

# SensyTemp TSP311, TSP321, TSP331 Temperature Sensors

## Sturdy and versatile



### Heavy-duty design

#### Modular design

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

#### Extremely robust connection head

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

#### Transmitter in connection head

- Optional LCD indicator
- Optional display (type AS) or display with configuration function (type A)
- Transmitters available with SIL2

### Approvals

- Temperature Sensors available with SIL2
- ATEX
- GOST

### Applications

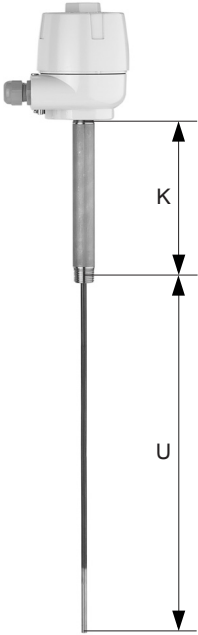
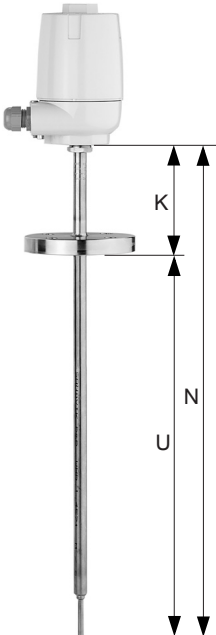
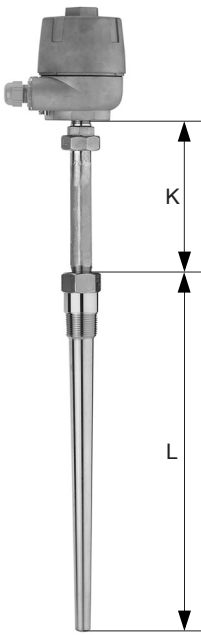
- Offshore and coastal areas
- Petroleum and natural gas production and transportation
- Petrochemical industry
- Chemical industry
- Energy industry

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## 1 General information

### 1.1 Overview of heavy-duty temperature sensors with exchangeable measuring inset

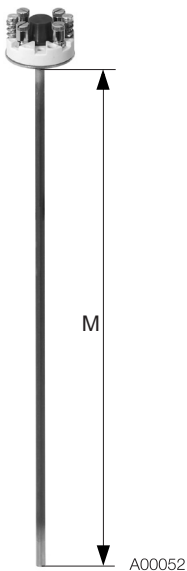
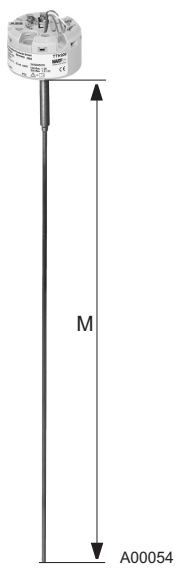
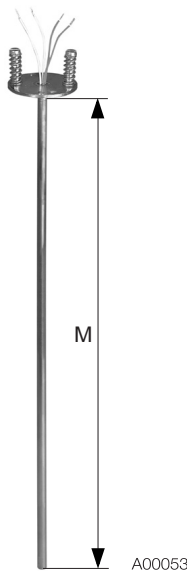
Type	TSP311	TSP321	TSP331	
<b>Legend</b>  K = Extension length U = Insertion length N = Nominal length L = Thermowell length				
Design	No thermowell	Welded protective fitting manufactured from pipe material	Drilled thermowell manufactured from bar stock material	
Process connection	Insertion in an existing 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 ... 70 °C (-4 ... 158 °F)			
Maximum temperature limits	(dependent upon the selected sensor and material, the prevailing lower temperature value counts)			
Sensor	Thin film measurement resistor: 500 °C (932 °F) Wire-wound measurement resistor: 600 °C (1,112 °F) Type K, N, J, and E thermocouples: 1250 °C (2,282 °F)			
Material	316L / 1.4404	≤ 600 °C (1,112 °F)		
	316Ti / 1.4571	≤ 800 °C (1,472 °F)		
	Hastelloy C276 / 2.4819	≤ 1,100 °C (2,012 °F)		
	Inconel 600 / 2.4816	-	≤ 1,100 °C (2,012 °F)	≤ 1,100 °C (2,012 °F)
	Monel 400 / 2.4360	-	-	550 °C (1,022 °F)
	1.7335 /	-	-	≤ 540 °C (1,004 °F)
	1.7380 /	-	-	≤ 570 °C (1,058 °F)
	1.5415 /	-	-	≤ 500 °C (932 °F)
	E-CTFE	-	≤ 120 °C (248 °F)	≤ 120 °C (248 °F)
Tantalum	-	≤ 200 °C (392 °F)	≤ 200 °C (392 °F)	
Pressure	-	Maximum 40 ... 100 bar (580.15 ... 1450.38 psi)	Maximum 700 bar (10,152.64 psi)	



#### Important

The maximum temperatures and pressures specified are maximum values and do not take into consideration process-related stress. Process-specific viscosity, flow rate, pressure, and temperature usually cause these values to drop.

## 1.2 Overview of measuring insets

Type	TSA101		
<b>Legend</b>  M = Measuring inset length U = Insertion length K = Ext. tube length N = Nominal length L = Thermowell length D = Outer diameter  TSP311 $M = U + K + 40 \text{ mm}$  TSP321 $M = N + 40 \text{ mm}$  TSP331 $M = L + K + 40 \text{ mm}$	 <p>A00052</p>	 <p>A00054</p>	 <p>A00053</p>
<b>Design</b>	Ceramic terminal block with connection terminals	Permanently mounted transmitter	Flying leads
	<ul style="list-style-type: none"> <li>• Bendable and vibration-resistant ABB mineral-insulated cable. The sheath for the resistance thermometer is manufactured from stainless steel (316Ti) or highly heat-resistant steel 2.4816 (alloy 600) for thermocouples.</li> <li>• Sensors conforming to IEC 60751 with measuring ranges from <math>-196 \dots 600 \text{ }^\circ\text{C}</math> (<math>-384.8 \dots 1,112 \text{ }^\circ\text{F}</math>) in three tolerance classes or thermocouples conforming to IEC 60584 and ANSI MC96.1 with measuring ranges from <math>-40 \dots 1,100 \text{ }^\circ\text{C}</math> (<math>-40 \dots 2,012 \text{ }^\circ\text{F}</math>), each in two tolerance classes.</li> <li>• Fitted with single or double sensors.</li> <li>• two spring design guarantees optimum contact between measuring inset and thermowell.</li> <li>• Measuring insets are available with outer diameters of 3.0 mm (0.12 inch), 6.0 mm (0.24 inch), 8.0 mm (0.318 inch), and 10.0 mm (0.39 inch).</li> </ul>		

## 1.3 Installation instructions

Ideally, in the case of pipes, the tip of the thermometer should be located in the center of the pipe. If this is not possible, both in the case of pipes and with containers, a minimum insertion depth of 10 to 15 times the thermowell diameter is assumed to be sufficient.

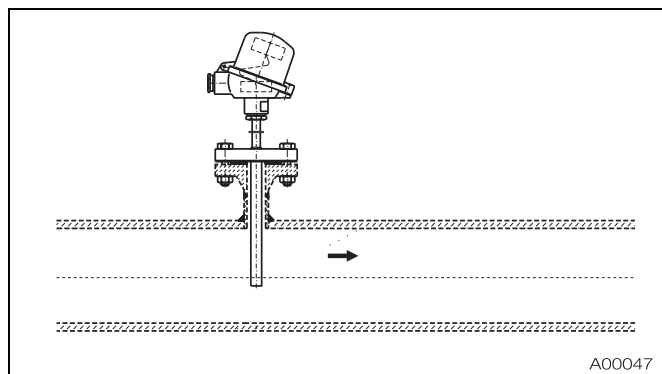


Fig. 1

### 1.3.1

### Insufficient nominal diameter

Pipes with very small nominal diameters, insertion inside an elbow pipe is recommended. The tip of the thermowell should be set in the opposite direction of the flow.. Inserting the thermowell with an adapter at an acute angle against the flow direction can also distort measurement results.

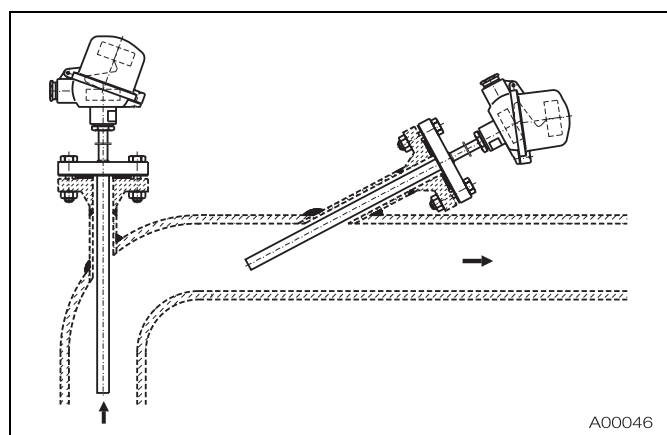


Fig. 2

## 2 Measuring inset specifications

### 2.1 Resistance thermometer design

The vibration resistance of ABB's uniquely designed inset is extraordinary.

The acceleration values of 3 g, defined in accordance with IEC 60751 for additional requirements, are exceeded by all measuring inset models in TSP temperature sensors.

The following table provides an overview of the vibration resistance of the measuring inset models at the measuring point.

Resistance thermometer to IEC 60751		
Basic design, thin film measurement resistor	10 g	-50 ... 400 °C (-58 ... 752 °F)
Increased vibration strength, thin film measurement resistor	60 g	-50 ... 400 °C (-58 ... 752 °F)
Extended measuring range, wire-wound measurement resistor, vibration strength to IEC 60751	3 g	-196 ... 600 °C (-320.8 ... 1112 °F)
Extended measuring range, wire-wound measurement resistor, increased vibration strength	10 g	-196 ... 600 °C (-320.8 ... 1112 °F)

The following table provides an overview of the temperature-sensitive section and the non-bendable section at the tip of the measuring inset.

	Temperature-sensitive section	Non-bendable length
Basic design	7 mm (0.28 inch)	30 mm (1.18 inch)
Extended vibration resistance	10 mm (0.39 inch)	40 mm (1.57 inch)
Extended measuring range	50 mm (1.97 inch)	60 mm (2.36 inch)
Extended measuring range, increased vibration strength	50 mm (1.97 inch)	60 mm (2.36 inch)

### 2.1.1 Accuracy classes of measurement resistors to IEC 60751

Even with restricted accuracy F0,1 or F/W0,15, both layer and wire-wound multiplier resistors to IEC 60751 can be used throughout the entire application range. However, ultimately, only the accuracy class of the temperature range used can apply.

Example: A class F0,1 sensor is used at 290 °C (554 °F). After this albeit brief application, class F0,15 applies for this sensor.

#### Accuracy classes to IEC 60751

Thin film measurement resistor (SMW)	
Class F 0.3: $\Delta t = \pm (0.30 + 0.0050 t )$	-50 ... 400 °C (-122 ... 752 °F)
Class F 0.15: $\Delta t = \pm (0.15 + 0.0020 t )$	-30 ... 300 °C (-22 ... 572 °F)
Class F 0.1: $\Delta t = \pm (0.10 + 0.0017 t )$	0 ... 100 °C (32 ... 212 °F)
Wire-wound measurement resistor (DMW)	
Class W 0.3: $\Delta t = \pm (0.30 + 0.0050 t )$	-196 ... 600 °C (-320.8 ... 1112 °F)
Class W 0,15: $\Delta t = \pm (0.15 + 0.0020 t )$	-196 ... 500 °C (-320.8 ... 932 °F)

The resistance of the copper inner conductor of the measuring inset affects the measurement value of two-wire circuits and must be taken into consideration. It is determined by the diameter and length of the measuring inset.

If the error cannot be compensated mechanically, the following values apply:

- Measuring inset Ø 3 mm (0.12 inch): (0.281 Ω/m ⇒ +0.7 °C/m)
- Measuring inset Ø 6 mm (0.24 inch): (0.1 Ω/m ⇒ +0.25 °C/m)

For this reason ABB supplies three-wire or four-wire circuits as standard.

## 2.1.2 Versions

### Basic Version

Thin film measurement resistor (SMW)  
Measuring range -50 ... 400 °C (-122 ... 752 °F)  
Vibration-resistant up to 10 g

	Single sensor			Double sensor		
	2-w.	3-w.	4-w.	2-w.	3-w.	4-w.
3 mm, class B	●	●	●			
3 mm, class A		●	●			
6 mm, class B	●	●	●	●	●	●
6 mm, class A		●	●		●	●
6 mm, class AA		●	●		●	●

### Increased vibration resistance

Thin film measurement resistor (SMW)  
Measuring range -50 ... 400 °C (-122 ... 752 °F)  
Vibration-resistant up to 60 g

	Single sensor			Double sensor		
	2-w.	3-w.	4-w.	2-w.	3-w.	4-w.
3 mm, class B						
3 mm, class A						
6 mm, class B	●	●	●	●	●	●
6 mm, class A		●	●		●	●

### Extended measuring range

Wire-wound measurement resistor (DMW)  
Measuring range -196 ... 600 °C (-320.8 ... 1,112 °F)  
Vibration-resistant up to 3 g

	Single sensor			Double sensor		
	2-w.	3-w.	4-w.	2-w.	3-w.	4-w.
3 mm, class B	●	●	●	●	●	
3 mm, class A		●	●			
6 mm, class B	●	●	●	●	●	●
6 mm, class A		●	●			

### Extended measuring range, increased vibration strength

Wire-wound measurement resistor (DMW)  
Measuring range -196 ... 600 °C (-320.8 ... 1,112 °F)  
Vibration-resistant up to 10 g

	Single sensor			Double sensor		
	2-w.	3-w.	4-w.	2-w.	3-w.	4-w.
3 mm, class B	●	●	●	●	●	
3 mm, class A		●	●			
6 mm, class B	●	●	●	●	●	●
6 mm, class A		●	●			

## 2.2 Thermocouple design

The measuring accuracy of ABB's standard thermocouples complies with international standard IEC 60584. Thermocouples compliant with ANSI MC96.1 are also available on request. Since the values of both standards vary only marginally in the lower temperature range (up to approx. 300 °C (572 °F)), we recommend the use of thermocouples compliant with international standard IEC 60584. Tolerance data is listed in the "Tolerance classes" table.

The following table provides an overview of the temperature-sensitive section and the non-bendable section at the tip of the measuring inset.

Measuring inset	Temperature-sensitive section	Non-bendable length
Basic design	7 mm (0.28 inch)	30 mm (1.18 inch)

### 2.2.1 Accuracy classes to IEC 60584 and ANSI MC96.1

IEC 60584	Class	Temperature range	Maximum deviation
K (NiCr-Ni)	2	-40 ... 333 °C	±2.5 °C
		333 ... 1200 °C	±0.0075 x [t]
	1	-40 ... 375 °C	±1.5 °C
		375 ... 1000 °C	±0.0040 x [t]
J (Fe-CuNi)	2	-40 ... 333 °C	±2.5 °C
		333 ... 750 °C	±0.0075 x [t]
	1	-40 ... 375 °C	±1.5 °C
		375 ... 750 °C	±0.0040 x [t]
N (NiCrSi-NiSi)	2	-40 ... 333 °C	±2.5 °C
		333 ... 1200 °C	±0.0075 x [t]
	1	-40 ... 375 °C	±1.5 °C
		375 ... 1000 °C	±0.0040 x [t]

ANSI MC 96.1	Class	Temperature range	Maximum deviation
K (NiCr-Ni)	Standard	-0 ... 293 °C	±2.2 °C
		293 ... 1250 °C	±0.0075 x [t]
	Special	-0 ... 275 °C	±1.1 °C
		275 ... 1250 °C	±0.0040 x [t]
J (Fe-CuNi)	Standard	-0 ... 293 °C	±2.2 °C
		293 ... 750 °C	±0.0075 x [t]
	Special	-0 ... 275 °C	±1.1 °C
		275 ... 750 °C	±0.0040 x [t]
N (NiCrSiNiSi)	Standard	-0 ... 293 °C	±2.2 °C
		293 ... 1250 °C	±0.0075 x [t]
	Special	-0 ... 275 °C	±1.1 °C
		275 ... 1250 °C	±0.0040 x [t]

## 2.2.2 Versions

Basic versions  
Vibration-resistant up to 60 g

	1xK	2xK	1xJ	2xJ	1xN	2xN
3 mm, class 2	●	●	●	●		
3 mm, class 1	●	●	●	●		
6 mm, class 2	●	●	●	●	●	●
6 mm, class 1	●	●	●	●	●	●

## 2.3 Insulation resistance of measuring inset

IEC 60751 requires a measurement between fitting and measurement circuit with at least 100 V DC and an insulation resistance in excess of 100 MΩ. Test conditions at ABB are more stringent, requiring 500 V DC and  $R_{iso} \geq 500 \text{ M}\Omega$  at an ambient temperature of 15 ... 35 °C (59 ... 95 °F) and air humidity of less than 80 %.

## 2.4 Response times

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 TSP121 and TSP131 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).

### Resistance thermometer

Thermowell form	Diameter [mm]	t <sub>0.5</sub> [s]	t <sub>0.9</sub> [s]
2, 2G, 2F, 2G0	9 x 1	25	77
	11 x 2	23	64
3, 3G, 3F	9 mm tip	15	38
2S, 2GS, 2FS, 2GS0	6 mm tip	21	55

### Thermocouples

Thermowell form	Diameter [mm]	t <sub>0.5</sub> [s]	t <sub>0.9</sub> [s]
2, 2G, 2F, 2G0	9	10	24
	11	12	28
3, 3G, 3F	12	12	24
2S, 2GS, 2FS, 2GS0	12	6	14
	14	6	14

### 3 Thermowells

#### Thermowell functions

- Protection against aggressive media, high process pressures, and high flow rates
- Replacement or recalibration of the measuring unit 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 armatures manufactured from pipe material for TSP321
- Drilled thermowells manufactured from bar stock material for TSP 331

Available in accordance with DIN 43772 or ABB standard.

#### Use in highly aggressive media

- Stainless steel flange thermowells can have a special coating, e.g., with 0.5 mm (0.02 inch) E-CTFE.

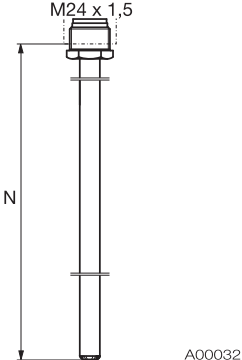
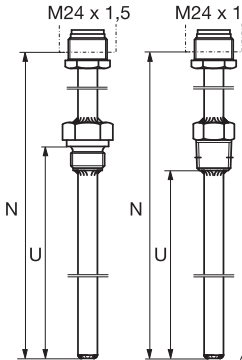
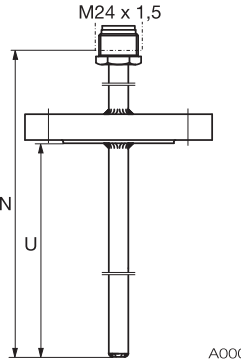
#### Use in highly corrosive applications

- Thermowells can also have a tantalum sheath consisting of a single-sided, closed tube with 13 mm (0.51 inch) diameter and flange disc. Requirements:
- TSP321 with flange thermowell (form 2F or 3F)
- Diameter 12 mm (0.47 inch)
- Material 1.4571 or 1.4404

#### Standard lengths for welded thermowells

N = 230 mm (9.06 inch)	U = 100 mm (3.94 inch)
N = 290 mm (11.42 inch)	U = 160 mm (6.3 inch)
N = 380 mm (14.96 inch)	U = 250 mm (9.84 inch)
N = 530 mm (20.87 inch)	U = 400 mm (15.75 inch)

#### 3.1 Tubular thermowells

Thermowell form / Thermowell type	DIN 43772 – Form 2		DIN 43772 – Form 2G		DIN 43772 – Form 2F	
U $\triangleq$ U <sub>1</sub> to DIN 43772						
Design	Straight shaft		Straight shaft		Straight shaft	
Material Thermowell diameter	1.4571 1.4404	12, 14 12, 14	1.4571 1.4404 2.4819 <sup>1)</sup>	12, 14 12, 14 13,7	1.4571 1.4404 2.4819 <sup>2)</sup>	12, 14 12, 14 13,7
Measuring inset diameter	SR-Ø 12: 6 SR-Ø 12: 6, tip 8		SR-Ø 12, 13,7: 6 SR-Ø 14: 6, tip 8		SR-Ø 12, 13,7: 6 SR-Ø 14: 6, tip 8	

Thermowell form / Thermowell type	DIN 43772 – Form 3		DIN 43772 – Form 3G		DIN 43772 – Form 3F	
Design	Tapered tip		Tapered tip		Tapered tip	
Material	1.4571	12/9	1.4571	12/9	1.4571	12/9
Thermowell diameter (shaft / tip)	1.4404	12/9	1.4404	12/9	1.4404	12/9
Measuring inset diameter	6		6		6	

Thermowell form / Thermowell type	ABB – Form 2S		ABB – Form 2GS		ABB – Form 2FS	
Design	Stepped tip		Stepped tip		Stepped tip	
Material	1.4571	12/6, 14/6	1.4571	12/6, 14/6	1.4571	12/6, 14/6
Thermowell diameter (shaft / tip)	1.4404	12/6, 14/6	1.4404 2.4819 <sup>1)</sup>	12/6, 14/6 13,7/6	1.4404 2.4819 <sup>2)</sup>	12/6, 14/6 13,7/6
Measuring inset diameter	3		3		3	

Dimensions in mm

1) only with G1/2A, 1/2" NPT thread  
2) 1.4571 flange, 2.4819 flange disc



Thermowell form / Thermowell type	ABB - Form PS		
	<p style="text-align: right;">A00043</p>	<p style="text-align: right;">A00041</p>	<p style="text-align: right;">A00045</p>
Design	Screw-in thermowell, 1" NPT thread	Screw-in thermowell, 3/4" NPT thread	Screw-in thermowell, 1/2" NPT thread
Material Diameter (shaft / tip)	1.4404, 1.4571, 2.4819, 25/16 1.4876, 2.4360, 2.4816	1.4404, 1.4571, 2.4819, 20/13,5 1.4876, 2.4360, 2.4816	1.4404, 1.4571, 2.4819, 17/13,5 1.4876, 2.4360, 2.4816
Standard lengths	U = 100, 150, 200, 250, 300, 350 L = U + 65	U = 100, 150, 200, 250, 300, 350 L = U + 65	U = 100, 150, 200, 250, 300, 350 L = U + 65
Measuring inset diameter	6	6	6

Dimensions in mm

1) 1.4876, 2.4360, 2.4816, 2.4819 with 1.4571-material flange and flange disc

### 3.3 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)

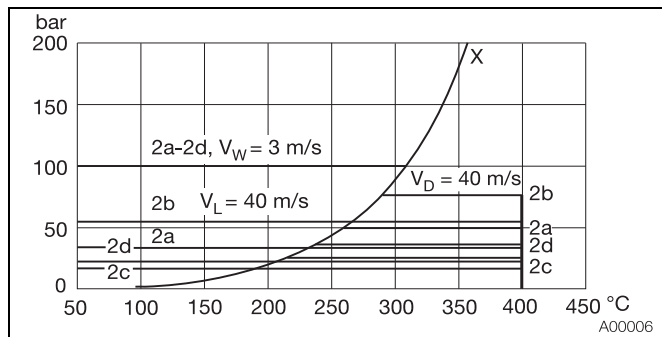


Fig. 1

X Vapor-pressure curve  
V<sub>L</sub> Flow rate in air  
V<sub>W</sub> Flow rate in water  
V<sub>D</sub> Flow rate in vapor

Curve	Insertion depth [mm]	Thermowell diameter [mm]
2a	250	11
2b	250	14
2c	400	11
2d	400	14

#### Thermowell form 3 (material 1.4571)

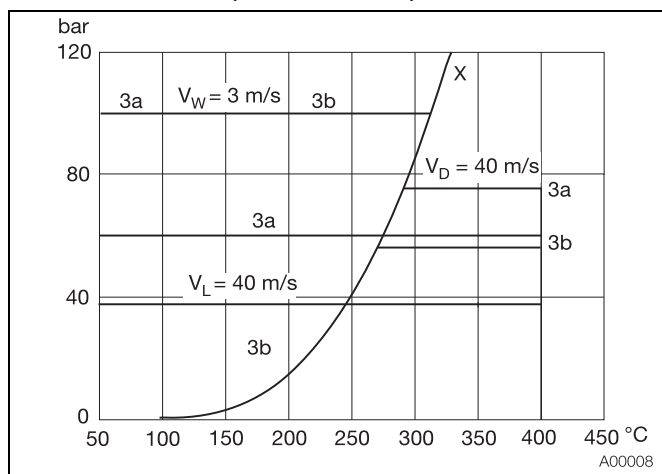


Fig. 2

X Vapor-pressure curve  
V<sub>L</sub> Flow rate in air  
V<sub>W</sub> Flow rate in water  
V<sub>D</sub> Flow rate in vapor

Curve	Insertion depth [mm]	Thermowell diameter [mm]
3a	225	12/9
3b	285	12/9

#### Thermowell form 4 (material 1.4571)

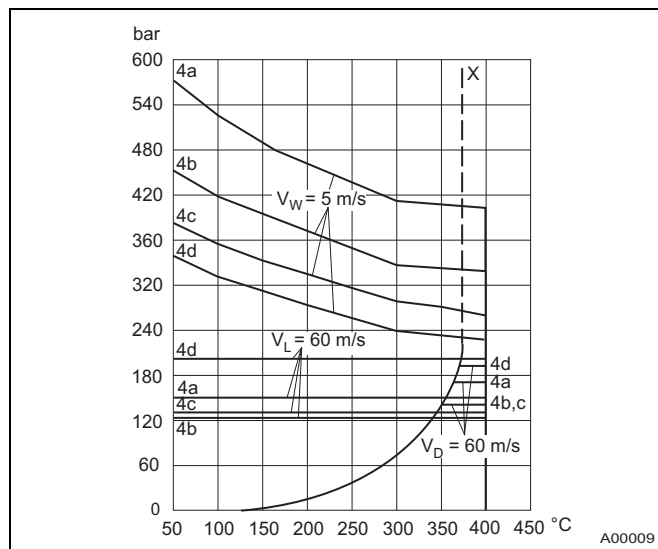


Fig. 3

X Vapor-pressure curve  
V<sub>L</sub> Flow rate in air  
V<sub>W</sub> Flow rate in water  
V<sub>D</sub> Flow rate in vapor

Curve	Insertion depth [mm]	Thermowell diameter [mm]
4a	65	18
4b	125	24
4c	125	26
4d	125	32



## 4 Process connections

### 4.1 SensyTemp TSP321 temperature sensor

#### 4.1.1 Weld-in / insertion thermowells

Type	Compression fitting
Straight tip (DIN 43772 – 2)	G 1/2A, 1/2" NPT
Tapered tip (DIN 43772 – 3)	
Stepped tip (ABB – 2S)	



**Important**

All ABB compression fittings are manufactured from stainless steel and are supplied without material confirmation with acceptance test certificate in accordance with EN 10204.

#### 4.1.2 Screw-in thermowells

Type	Screw-in thread
Straight tip (DIN 43772 – 2G)	G 1/2"A, G 3/4"A, G 1"A, 1/2" NPT, 3/4" NPT, 1" NPT, M20 x 1,5, M27 x 2, 1/2" BSPT, 3/4" BSPT, 1" BSPT.
Tapered tip (DIN 43772 – 3G)	
Stepped tip (ABB – 2GS)	

#### 4.1.3 Flange thermowells

Type	B1 flange, EN 1092-1	RF flange, ANSI / ASME B16.5
Straight tip (DIN 43772 – 2F)	DN25 PN40, DN40 PN40, DN50 PN40	1" 150 lbs., 1" 300 lbs., 1,5" 150 lbs., 1,5" 300 lbs., 1,5" 600 lbs., 2" 150 lbs., 2" 300 lbs., 2" 600 lbs.
Tapered tip (DIN 43772 – 3F)		
Stepped tip (ABB – 2FS)		

### 4.2 SensyTemp TSP331 temperature sensor

#### 4.2.1 Screw-in thermowells

Type	Screw-in thread
Thermowell manufactured from bar stock material (ABB - PS)	1/2" NPT, 3/4" NPT, 1" NPT

#### 4.2.2 Flange thermowells

Type	B1 flange, EN 1092-1	RF flange, ANSI / ASME B16.5
Thermowell manufactured from bar stock material (ABB - PF)	DN25 PN40, DN40 PN40, DN50 PN40	1" 150 lbs., 1" 300 lbs., 1,5" 150 lbs., 1,5" 300 lbs., 1,5" 600 lbs., 2" 150 lbs., 2" 300 lbs., 2" 600 lbs.
Thermowell manufactured from bar stock material (DIN 43772 – 4F, F2 = 24 mm)		
Thermowell manufactured from bar stock material, fast-acting (DIN 43772 – 4F, F2 = 18 mm, ABB – 4FS)		

## 5 Extension tubes

The extension tube is the component between thermowell and connection head. It is used to bridge existing insulation or serves as a cooling section between the transmitter's temperature-sensitive electronics (in the connection head) and the process. The relation illustrated in Fig. 3 led to the selection of the standard extension tube with a length  $K = 130$  mm (5.12 inch). If the two threads are manufactured in one part (known as a double nipple), a minimum length of  $K = 25$  mm (0.98 inch) is possible.

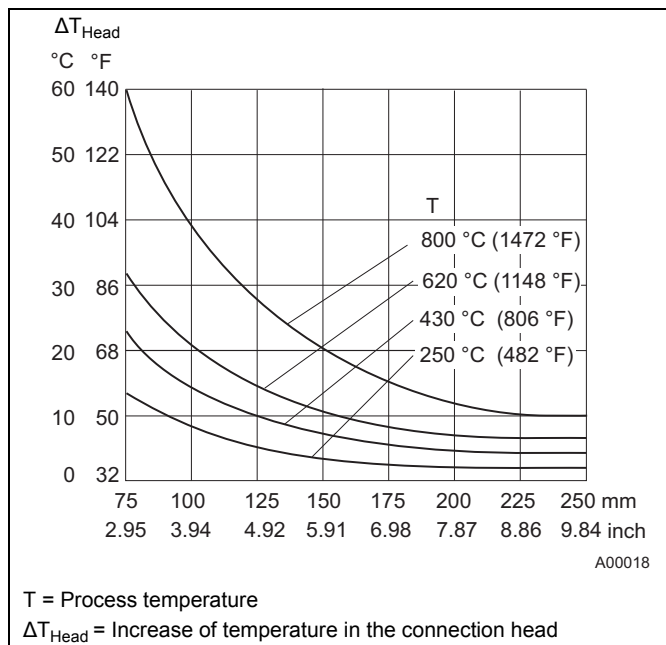


Fig. 3: Diagram illustrating extension tube length

### 5.1 Extension tube models

	Cylindrical screw-in thread	Conical screw-in thread	1/2" NPT - 1/2" NPT, not separable (nipple)
	<p>M24 x 1,5</p> <p>A00025</p> <p>G 1/2 / M14 x 1.5 / M18 x 1.5 / M20 x 1.5</p>	<p>M24 x 1,5</p> <p>A00024</p> <p>1/2" NPT</p>	<p>1/2" NPT</p> <p>A00022</p> <p>1/2" NPT</p>
	<p>1/2" NPT - 1/2" NPT, separable (nipple-union)</p> <p>A00021</p> <p>1/2" NPT</p>	<p>1/2" NPT - 1/2" NPT, separable (nipple-union-nipple)</p> <p>A00020</p> <p>1/2" NPT</p>	

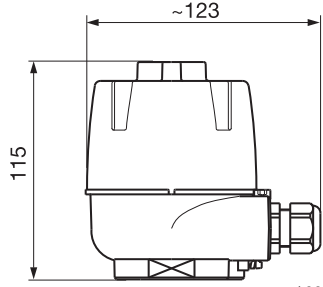
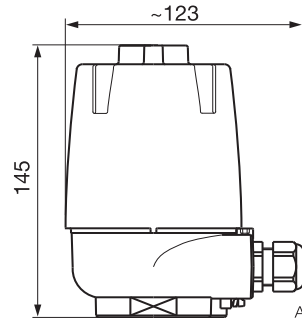
## 6 Connection heads

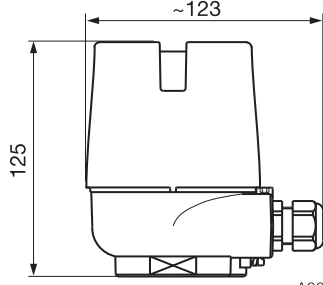
### Functions of the connection head

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

When the connection cable is fed into the connection head, a special cable guide automatically positions the cable 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.

The following connection heads belong to the SensyTemp TSP300 series of temperature sensors:

Head form	AGL / AGS		AGLH / AGSH	
Design without LCD indicator	 <p style="text-align: right;">A00061</p>		 <p style="text-align: right;">A00063</p>	
Material	AGL	Aluminum, epoxy-coated	AGLH	Aluminum, epoxy-coated
	AGS	Stainless steel	AGSH	Stainless steel
Cable gland	M20 x 1,5, optional cable entry 1/2 NPTF, without cable gland			
Ingress protection	IP 66 / IP 67			
Transmitter mounting	On the measuring inset		On the mounting bracket (optional on the measuring inset)	

Head form	AGLD / AGSD	
Design with LCD indicator	 <p style="text-align: right;">A00064</p>	
Material	AGLD	Aluminum, epoxy-coated
	AGSD	Stainless steel
Cable gland	M20 x 1,5, optional cable entry 1/2 NPTF, without cable gland	
Ingress protection	IP 66 / IP 67	
Transmitter mounting	On the measuring inset	

### 6.1 Ambient temperature at connection head

Connection head without transmitter	-40 ... 130 °C (-40 ... 266 °F)
Connection head with transmitter	-40 ... 85 °C (-40 ... 185 °F)
Connection head with LCD indicator	-20 ... 70 °C (-4 ... 158 °F)

The most commonly used cable gland is suited to temperatures between -20 and 100 °C (-4 ... 212 °F). For temperatures outside this range, an appropriate cable gland can be installed.






## 7 Transmitter

Installing a transmitter has the following advantages:

- Cost reduction due to less wiring expense
- Magnification of the sensor signal at the measuring point and conversion to standard signal format (thereby increasing the signal's interference immunity)
- Option to install an LCD indicator in the connection head
- SIL2 with appropriately classified transmitter

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

The following output signals are available:

Type	
TR04 4 ... 20 mA	
TTH200 HART 4 ... 20 mA, HART	
TTH300 HART 4 ... 20 mA, HART	
TTH300 PA PROFIBUS PA	
TTH300 FF FOUNDATION Fieldbus H1	

## 8 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.

We recommend using an LCD indicator with type AS display function if you are using an AGLD or AGSD connection head and a TTH200. If you choose an AGLD or AGSD in conjunction with a TTH300 transmitter, the transmitter can be configured with the type A LCD indicator as an additional option.

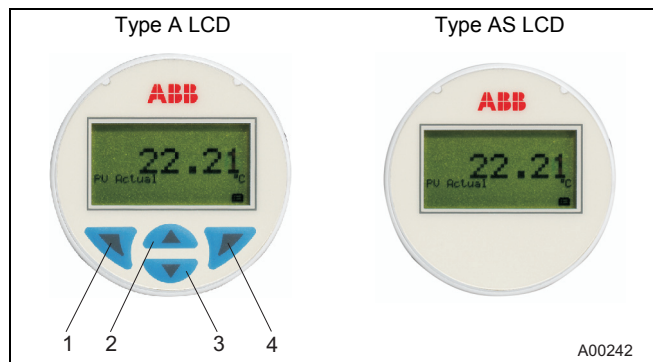


Fig. 4

- |                 |                  |
|-----------------|------------------|
| 1 Exit / Cancel | 3 Scroll forward |
| 2 Scroll back   | 4 Select         |

## 9 Functional safety (SIL)

SensyTemp TSP temperature sensors are available with a certificate of conformity for use in safety-relevant applications up to and including SIL Level 2.

This applies both for temperature sensors without transmitters and those with built-in SIL-certified transmitters.

Information regarding functional safety for SensyTemp TSP temperature sensors can be found in the SIL safety instructions.

## 10 Ex relevant specifications

### 10.1 Intrinsic safety ATEX "Ex i"

For use in thermowells, the surface temperature on the thermowell is correspondingly lower.

The operator assumes responsibility for correct and proper installation when replacing the measuring inset in a thermometer. ABB requires the manufacturing number marked on the old part so that the conformity of the ordered design can be checked with the initial delivery and the valid approvals.

Max. inner inductivity:  $L_i = 15 \text{ mH/m}$

Max. inner capacitance:  $C_i = 280 \text{ pF/m}$

#### 10.1.1 Electrical power limit "EEx i"

The following electrical values must not be exceeded:

U <sub>i</sub> (input voltage)	I <sub>i</sub> (input current)
30 V	101 mA
25 V	158 mA
20 V	309 mA

P<sub>i</sub> (inner power) = according to calculation using thermal resistance R<sub>th</sub>  
 L<sub>i</sub> (inner inductivity) = 15 μH per meter  
 C<sub>i</sub> (inner capacitance) = 280 pF per meter

#### 10.1.2 Thermal resistance

The following table lists thermal resistances for measuring insets with diameter 3.0 mm (0.12 inch) and 6.0 mm (0.24 inch). 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 <sub>th</sub>	Measuring inset Ø 3 mm (0.12 inch)	Measuring inset Ø 6 mm (0.24 inch)
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

#### 10.1.3 Output power P<sub>o</sub>

Transmitter type	P <sub>o</sub>
TTH200 HART	≤ 38 mW
TTH300 HART	≤ 38 mW
TTH300 PA	≤ 38 mW
TTH300 FF	≤ 38 mW
TR04	≤ 383 mW

All other information required to prove intrinsic safety (U<sub>o</sub>, I<sub>o</sub>, P<sub>o</sub>, L<sub>o</sub>, C<sub>o</sub> etc.) can be taken from the EC type-examination certificates for the relevant transmitter models.

#### 10.1.4 Special requirements (temperature rise)

In the event of a fault, the temperature sensors will exhibit a temperature rise Δt as appropriate for the applied power. This temperature rise Δt must be taken into account with regard to the difference between process temperature and temperature class.

#### **i** Important

In the event of a fault (short circuit), the dynamic short-circuit current which occurs in the measurement circuit for a matter of milliseconds not relevant with regard to temperature rise. The permissible outer capacitance is based on the dynamic short-circuit current.

The temperature rise Δt can be calculated as follows:

$$\Delta t = R_{th} \times P_o \text{ [K/W} \times \text{W]}$$

Δt = Temperature rise

R<sub>th</sub> = Thermal resistance

P<sub>o</sub> = Output power

#### Example:

Resistance thermometer diameter 3 mm (0.12 inch) without thermowell

R<sub>th</sub> = 200 K/W,

TTHXXX temperature transmitter P<sub>o</sub> = 38 mW.

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

Therefore, at a transmitter output power P<sub>o</sub> = 38 mW, the maximum temperature rise in the event of a fault is approximately 8 K.

This results in the following maximum process temperatures T<sub>medium</sub>:

#### Maximum process temperature T<sub>medium</sub> in Zone 0:

<b>T6 (85 °C)</b> 80 % = 68 °C	<b>T5 (100 °C)</b> 80 % = 80 °C	<b>T4 (135 °C)</b> 80 % = 108 °C
T <sub>medium</sub> = 60 °C	T <sub>medium</sub> = 72 °C	T <sub>medium</sub> = 100 °C
<b>T3 (200 °C)</b> 80 % = 160 °C	<b>T2 (300 °C)</b> 80 % = 240 °C	<b>T1 (450 °C)</b> 80 % = 360 °C
T <sub>medium</sub> = 152 °C	T <sub>medium</sub> = 232 °C	T <sub>medium</sub> = 352 °C

The surface temperature of Category 1 devices must not exceed 80 % of the ignition temperature of a flammable gas or liquid.

#### Possible process temperature T<sub>med</sub> in Zone 1:

<b>T6 (85 °C)</b> - 5 °C = 80 °C	<b>T5 (100 °C)</b> - 5 °C = 95 °C	<b>T4 (135 °C)</b> - 5 °C = 130 °C
T <sub>medium</sub> = 72 °C	T <sub>medium</sub> = 87 °C	T <sub>medium</sub> = 122 °C
<b>T3 (200 °C)</b> - 5 °C = 195 °C	<b>T2 (300 °C)</b> - 10 °C = 290 °C	<b>T1 (450 °C)</b> - 10 °C = 440 °C
T <sub>medium</sub> = 187 °C	T <sub>medium</sub> = 282 °C	T <sub>medium</sub> = 432 °C

To calculate the temperature classes for T6, T5, T4, and T3 deduct 5 K each; for T2 and T1, deduct 10 K each.

## 10.2 Flameproof enclosure "Ex d"

The enclosures for thermometers of this design are flameproof. An explosion inside the thermometer will not ignite the explosive atmosphere in the area in which the device is located. Alongside the use of a flameproof enclosure, this is achieved by compliance with specified ignition gap lengths and widths (between enclosure and measuring inset) and "Ex d"-certified cable entries. SensyTemp TSP300 temperature sensors can be used as "Ex d" versions in the following zones provided that the corresponding requirements are met:

- With suitable thermowell and connection head in Zone 1 / 0 (separation of zones, so measuring inset in Zone 0)
- With connection head but without thermowell in Zone 1

These thermometers hold EC type-examination certificate PTB 99 ATEX 1144 with Ex designation II 1/2 G Ex d IIC T1 ... T6.

### Temperature ranges:

Maximum permissible ambient temperature: -40 ... 60 °C

Maximum permissible temperature in connection head:

Temperature class	Without transmitter	With transmitter
T1 ... T4	125 °C	85 °C
T5	90 °C	82 °C
T6	75 °C	67 °C

### 10.3.1 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 1/2 with intrinsically-safe transmitter installed	-40 ... 85 °C (-40 ... 185 °F)	-40 ... 85 °C -40 ... 200 °C <sup>1)</sup> -40 ... 300 °C <sup>1)</sup> -40 ... 400 °C <sup>1)</sup>	85 °C	120 °C	133 °C
			164 °C		200 °C
			251 °C		300 °C
			346 °C		400 °C
Category 1D or Category 1/2 with fuse protection of installed transmitter by means of external IEC fuse	-40 ... 85 °C (-40 ... 185 °F)	-40 ... 85 °C -40 ... 200 °C <sup>1)</sup> -40 ... 300 °C <sup>1)</sup> -40 ... 400 °C*	85 °C	133 °C <sup>2)</sup> 150 °C <sup>3)</sup>	133 °C
			164 °C		200 °C
			251 °C		300 °C
			346 °C		400 °C
Category 1D or Category 1/2D Measurement circuit intrinsically-safe transmitter external or non-intrinsically-safe via external IEC fuse in the power feed circuit of the external transmitter	-40 ... 85 °C -40 ... 120 °C -40 ... 120 °C -40 ... 120 °C	-40 ... 85 °C -40 ... 200 °C -40 ... 300 °C -40 ... 400 °C	85 °C	85 °C 200 °C 200 °C 200 °C	133 °C
			200 °C		200 °C
			251 °C		300 °C
			346 °C		400 °C

1) The user must take suitable measures to ensure that the maximum permissible ambient temperature of 85 °C (185 °F) at the connection head is not exceeded.

2) Fitted with a transmitter with and without display.

3) Fitted with two transmitters.

Maximum permissible media temperature:

Temperature class	Use in Zone 0	Use in Zone 1
T1	358 °C	438 °C
T2	238 °C	288 °C
T3	158 °C	193 °C
T4	106 °C	128 °C
T5	78 °C	93 °C
T6	66 °C	78 °C

## 10.3 Dust ignition protection (enclosure)

The power feed can come from a power supply with intrinsically-safe output circuit of protection type "EEx ia IIB" or "EEx ia IIC", or can be non intrinsically safe. In the case of a non-intrinsically-safe power feed, the current is limited by an upstream fuse conforming to IEC 127 with a fuse nominal current of 32 mA.

Highest value for connection to an intrinsically-safe power supply unit of protection type "Ex ia IIB / IIC":



### Important

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

## 11 Approvals

TSP3X1 temperature sensors hold numerous approvals.

These range from metrological approvals to explosion-protection certification for individual countries as well as EC-wide ATEX certificates.

They include:

- ATEX EEx i PTB 01 ATEX 2200 X
- ATEX dust ignition protection BVS 06 ATEX E 029
- ATEX EEx d: PTB 99 ATEX 1144
- Ex n - Zone 2 and 22 Manufacturer declaration  
no. 22 – 2006 X
  
- GOST Russia
- GOST Kazakhstan
- GOST Ukraine

ABB temperature sensors conforming to ATEX EEx i also meet requirements for the NAMUR NE 24 recommendation.

## 12 Tests and certificates

To increase the safety and accuracy of your process, ABB provides a number of mechanical and electrical tests. The results of these tests are certified in accordance with EN 10204.

The following EN 10204 certificates are issued:

- Certificate of compliance 2.1 for order conformity
- Acceptance test certificate 3.1 for the following tests:
  - Material confirmation for wetted parts
  - Visual, dimensional, and functional checks for temperature sensor
  - Helium leak test for thermowell
  - X-ray inspection of thermowell for bore hole concentricity on request
  - Dye penetration test at the weld seams of the thermowell
  - Compression test of thermowell
  - Reference measurement for calibration of measuring inset
- Acceptance test certificate 3.2 is available on request

For measurements requiring extremely high accuracy, ABB can calibrate the temperature sensor in its own DKD calibration lab.

When DKD calibration is performed, a separate certificate is provided for each temperature sensor.

Reference measurements and DKD calibrations are performed on the measuring inset or, if applicable, on the transmitter.

To obtain accurate measurements, observe the minimum depth for the measuring inset.

- For low to medium temperatures: 100 ... 150 mm
- For temperatures above 500 °C (932 °F): 300 ... 350 mm

These are recommended values. If in doubt, your ABB partner is available for on-site assistance.

For reference measurements and DKD calibration, the individual characteristics of the temperature sensor can be calculated and a separate transmitter can be programmed based on freestyle characteristics.

Adjusting the transmitter to the sensor characteristic can considerably improve the measuring accuracy of the temperature sensor. This requires that measurements are taken at a minimum of three different temperatures.

## 13 Additional information

### 13.1 Supplementary documents

Device		Data sheet
<b>Temperature transmitter for sensor head mounting</b>		
TR04	4 ... 20 mA, fixed measuring range	10/11-8.14
TTH200 HART	4 ... 20 mA, HART	DS/TTH200
TTH300 HART	4 ... 20 mA, HART	DS/TTH300
TTH300 PA	PROFIBUS PA	DS/TTH300
TTH300 FF	FOUNDATION Fieldbus H1	DS/TTH300
<b>Interchangeable measuring insets</b>		
SensyTemp TSA101	measuring insets	DS/TSA101

### 13.2 Information about ordering information.

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.

## 14 Ordering information

### 14.1 SensyTemp TSP311

Main order number																Add. order no.							
Version number	1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	XX	
<b>SensyTemp temperature sensor TSP311</b>		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX	
<b>Explosion protection / Approvals</b>																							
None		Y	0																				
Intrinsic safety: ATEX II 1 G Ex ia IIC T6 ... T1 – Zone 0, 1, 2		A	1																				
Dust ignition protection: ATEX II 1 D IP6X T133 ... T400 - Zone 20, 21, 22		A	3																				
Dust ignition protection and intrinsic safety: ATEX II 1 D IP6X T133 ... T400 and ATEX II 1 G Ex ia IIC T6 ... T1 - Zone 0, 1, 2, 20, 21, 22		1) A	4																				
Flameproof enclosure: ATEX II 1/2 G Ex d IIC T6 ... T4 - Zone 1		A	5																				
ATEX II 3 G Ex nA II T6 ... T1 and ATEX II 3 D IP6X T133 ... T300 - Zone 2 and 22		1) B	1																				
Others		Z	9																				
<b>Extension length K</b>																							
150 mm		K	1																				
Variable extension length		Z	9																				
<b>Thermowell connection</b>																							
Parallel screw-in thread G 1/2 A		G	1																				
Parallel screw-in thread M14 x 1.5		M	1																				
Parallel screw-in thread M18 x 1.5		M	2																				
Parallel screw-in thread M20 x 1.5		M	3																				
Tapered screw-in thread 1/2 NPT		N	1																				
1/2 NPT - 1/2 NPT, not separable		N	2																				
1/2 NPT - 1/2 NPT, separable		N	3																				
Others		Z	9																				
<b>Insertion depth U</b>																							
U = 140 mm		U	2																				
U = 200 mm		U	4																				
U = 260 mm		U	6																				
Acc. to customer specifications		Z	9																				
<b>Measuring inset type</b>																							
Basic version, thin film measurement resistor, measuring range -50 ... 400 °C, vibration resistance 10 g		S	1																				
Increased vibration resistance, thin film measurement resistor, measuring range -50 ... 400 °C, vibration resistance 60 g		S	2																				
Extended measuring range -196 ... 600 °C, wire-wound measurement resistor, vibration resistance 10 g		D	1																				
Extended measuring range -196 ... 600 °C, wire-wound measurement resistor, vibration resistance 3 g		D	2																				
Thermocouple		T	1																				
Others		Z	9																				

1) 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 61241-0.

Continued on next page

		Main order number																				XX	
Version number		1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	XX
<b>SensyTemp temperature sensor</b>		<b>TSP311</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX
<b>Measuring inset diameter</b>																						XX	
3 mm														D	3								
6 mm														D	6								
8 mm, with 80 mm long sleeve, to DIN 43735														H	8								
10 mm, with 80 mm long sleeve														H	1								
Others														Z	9								
<b>Sensor type and circuit type</b>																							
1 x Pt100, two-wire														P	1								
1 x Pt100, three-wire														P	2								
1 x Pt100, four-wire														P	3								
2 x Pt100, two-wire														P	4								
2 x Pt100, three-wire														P	5								
2 x Pt100, four-wire														P	6								
1 x type K (NiCr-Ni)														K	1								
2 x type K (NiCr-Ni)														K	2								
1 x type J (Fe-CuNi)														J	1								
2 x type J (Fe-CuNi)														J	2								
1 x type N (NiCrSi-NiSi)														N	1								
2 x type N (NiCrSi-NiSi)														N	2								
Others														Z	9								
<b>Sensor accuracy</b>																							
Class B to IEC 60751														B	2								
Class A to IEC 60751, measuring range -30 ... 300 °C														S	1								
Class A to IEC 60751, measuring range -196 ... 500 °C														D	1								
Class 2 to IEC 60584														T	2								
Class 1 to IEC 60584														T	1								
Class AA to IEC 60751, measuring range 0 ... 100 °C														S	3								
Others														Z	9								
<b>Connection head</b>																							
AGL / aluminum, with screw-on cover														L	1								
AGLH / aluminum, with high screw-on cover														L	2								
AGLD / aluminum, with screw-on cover and display														L	4								
AGS / stainless steel, with screw-on cover														S	1								
AGSH / stainless steel, with high screw-on cover														S	2								
AGSD / stainless steel, with screw-on cover and display														S	4								
Others														Z	9								

Continued on next page

Main order number																										Add. order no.
Version number	1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	XX				
<b>SensyTemp temperature sensor TSP311</b>																										<b>XX</b>
<b>Transmitter</b>																										
Without transmitter, measuring inset with ceramic terminal bloc																									Y	1
Without transmitter, measuring inset with flying leads																									Y	2
TR04, fixed measuring range, 4 ... 20 mA																									R	1
TR04-Ex, fixed measuring range, 4 ... 20 mA																									R	2
TTH200 HART, adjustable, 4 ... 20 mA																									H	6
TTH200 HART-Ex, adjustable, 4 ... 20 mA																									H	7
TTH300 HART, adjustable, 4 ... 20 mA																									H	4
TTH300 HART-Ex, adjustable, 4 ... 20 mA																									H	5
TTH300 PA, adjustable, PROFIBUS PA																									P	6
TTH300 PA-Ex, adjustable, PROFIBUS PA																									P	7
TTH300 FF, adjustable, FOUNDATION Fieldbus H1																									F	6
TTH300 FF-Ex, adjustable, FOUNDATION Fieldbus H1																									F	7
Others																									Z	9
<b>Inscription plate</b>																										
Stainless steel plate with TAG no.																									T1	
<b>Certificates</b>																										
TÜV certificate for functional safety SIL2 to IEC61508																									CS	
Declaration of compliance 2.1 to EN 10204 with order																									C4	
Inspection test certificate 3.1 to EN 10204 for visual, dimensional, and functional checks																									C6	
Inspection test certificate 3.1 to EN 10204 for sensor calibration 1 x Pt100																									CD	
Inspection test certificate 3.1 to EN 10204 for sensor calibration 2 x Pt100																									CE	
Inspection test certificate 3.1 to EN 10204 for sensor calibration 1 x thermocouple																									CF	
Inspection test certificate 3.1 to EN 10204 for sensor calibration 2 x thermocouple																									CG	
DKD calibration 1 x Pt100 with calibration certificate for each thermometer																									CH	
DKD calibration 2 x Pt100 with calibration certificate for each thermometer																									CJ	
DKD calibration 1 x thermocouple with calibration certificate for each thermometer																									CK	
DKD calibration 2 x thermocouple with calibration certificate for each thermometer																									CL	
Others																									CZ	
<b>Temperatures for sensor calibration</b>																										
0 °C / 32 °F																									V1	
100 °C / 212 °F																									V2	
400 °C / 752 °F																									V3	
0 °C and 100 °C / 32 °F and 212 °F																									V4	
0 °C and 400 °C / 32 °F and 752 °F																									V5	
0 °C, 100 °C, and 200 °C / 32 °F, 212 °F, and 392 °F																									V7	
0 °C, 200 °C, and 400 °C / 32 °F, 392 °F, and 752 °F																									V8	
Acc. to customer specifications																									V6	

Continued on next page

Main order number																					XX	XX	
1-6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			
TSP311	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		XX	
<b>Test temperatures for DKD calibration</b>																							
0 °C / 32 °F																							D1
100 °C / 212 °F																							D2
400 °C / 752 °F																							D3
0 °C and 100 °C / 32 °F and 212 °F																							D4
0 °C and 400 °C / 32 °F and 752 °F																							D5
0 °C, 100 °C, and 200 °C / 32 °F, 212 °F, and 392 °F																							D7
0 °C, 200 °C, and 400 °C / 32 °F, 392 °F, and 752 °F																							D8
Acc. to customer specifications																							D6
<b>Cable entry options</b>																							
1 x 1/2 NPT, without cable gland																							U2
2 x 1/2 NPT, without cable gland																							U5
2 x M20 x 1.5, with plastic cable gland, cable diameter 5 ... 12 mm																							U7
2 x M20 x 1.5, with EEx-d cable gland, cable diameter 6.0 ... 7.5 mm																							UC
Others																							UZ
<b>Measuring range of the transmitter</b>																							
-30 ... 60 °C																							A1
-20 ... 40 °C																							A2
0 ... 40 °C																							A3
0 ... 60 °C																							A4
0 ... 100 °C																							A5
0 ... 120 °C																							A6
0 ... 150 °C																							A7
0 ... 200 °C																							A8
0 ... 250 °C																							AF
0 ... 300 °C																							AG
0 ... 400 °C																							AH
0 ... 600 °C																							AJ
0 ... 800 °C																							AK
0 ... 1000 °C																							AL
Others																							AZ

14.2 SensyTemp TSP321

		Main order number																														Add. order no.		
Version number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
<b>SensyTemp temperature sensor TSP321</b>		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX
<b>Explosion protection / Approvals</b>																																		XX
None								Y	0																									
Intrinsic safety: ATEX II 1 G								A	1																									
Ex ia IIC T6 ... T1 - Zone 0, 1, 2																																		
Dust ignition protection: ATEX II 1 D IP6X T133 ... T400 - Zone 20, 21, 22								A	3																									
Dust ignition protection and intrinsic safety: ATEX II 1 D IP6X T133 ... T400 and ATEX II 1 G Ex ia IIC T6 ... T1 - Zone 0, 1, 2, 20, 21, 22								1)	A	4																								
Flameproof enclosure: ATEX II 1/2 G Ex d IIC T6 ... T4 - Zone 1										A	5																							
ATEX II 3 G Ex nA II T6 ... T1 and ATEX II 3 D IP6X T133 ... T300 - Zone 2 and 22								1)	B	1																								
Others								Z	9																									
<b>Material for wetted parts</b>																																		
Stainless steel 1.4404 / 316 L										S	1																							
Stainless steel 1.4571 / 316 Ti										S	2																							
2.4819 / Hastelloy C-276 (stainless steel flange with flange disc manufactured from Hastelloy C-276)										N	1																							
Others										Z	9																							
<b>Thermowell type</b>																																		
Straight thermowell (form 2 to DIN 43772)										A	1																							
Straight flange thermowell (form 2F to DIN 43772)										A	2																							
Straight screw-in thermowell (form 2G to DIN 43772)										A	3																							
Tapered thermowell (form 3 to DIN 43772)										C	1																							
Tapered flange thermowell (form 3F to DIN 43772)										C	2																							
Tapered screw-in thermowell (form 3G to DIN 43772)										C	3																							
Thermowell with stepped tip (ABB form 2S)										B	1																							
Flange thermowell with stepped tip (ABB form 2FS)										B	2																							
Screw-in thermowell with stepped tip (ABB form 2GS)										B	3																							
Others										Z	9																							

1) 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 61241-0.

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Main order number																	Add.															order no.			
Version number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31				
<b>SensyTemp temperature sensor</b>	<b>TSP321</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX		
<b>Process connection</b>																																			
Without process connection																	Y	0	0																
Adjustable compression fitting G 1/2 A																	A	0	1																
Adjustable compression fitting 1/2 NPT																	A	0	2																
Cylindrical screw-in thread G 1/2 A																	S	0	1																
Cylindrical screw-in thread G 3/4 A																	S	0	2																
Cylindrical screw-in thread G 1 A																	S	0	3																
Conical screw-in thread 1/2 NPT																	S	0	4																
Conical screw-in thread 3/4 NPT																	S	0	5																
Conical screw-in thread 1 NPT																	S	0	6																
Cylindrical screw-in thread M20 x 1.5																	S	0	7																
Cylindrical screw-in thread M27 x 2																	S	0	8																
Conical screw-in thread 1/2 BSPT																	S	0	9																
Conical screw-in thread 3/4 BSPT																	S	1	0																
Conical screw-in thread 1 BSPT																	S	1	1																
Flange DN25 PN10 ... PN40, to EN 1092-1																	F	0	3																
Flange DN40 PN10 ... PN40, to EN 1092-1																	F	0	4																
Flange DN50 PN10 ... PN40, to EN 1092-1																	F	0	5																
Flange 1 inch 150 lbs, to ASME B16.5																	F	0	7																
Flange 1 inch 300 lbs, to ASME B16.5																	F	0	8																
Flange 1.5 inch 150 lbs, to ASME B16.5																	F	1	1																
Flange 1.5 inch 300 lbs, to ASME B16.5																	F	1	2																
Flange 1.5 inch 600 lbs, to ASME B16.5																	F	1	3																
Flange 2 inch 150 lbs, to ASME B16.5																	F	1	5																
Flange 2 inch 300 lbs, to ASME B16.5																	F	1	6																
Flange 2 inch 600 lbs, to ASME B16.5																	F	1	7																
Others																	Z	9	9																
<b>Thermowell diameter</b>																																			
12 mm																	A	3																	
14 mm																	A	4																	
13,7 mm																	B	2																	
Others																	Z	9																	

Continued on next page

		Main order number																														XX		
Version number		1	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	XX					
<b>SensyTemp temperature sensor</b>		<b>TSP321</b>																														XX		
<b>Insertion depth U</b>																																XX		
No fixed insertion depth																				Y	0													
U = 100 mm																				U	1													
U = 160 mm																				U	3													
U = 250 mm																				U	5													
U = 400 mm																				U	7													
Acc. to customer requirements																				Z	9													
<b>Nominal length N</b>																																		
N = 230 mm																				N	1													
N = 290 mm																				N	3													
N = 380 mm																				N	5													
N = 530 mm																				N	7													
Acc. to customer requirements																				Z	9													
<b>Measuring inset type</b>																																		
Basic design, thin film measurement resistor, measuring range -50 ... 400 °C, vibration resistance 10 g																				S	1													
Increased vibration resistance, thin film measurement resistor, measuring range -50 ... 400 °C, vibration resistance 60 g																				S	2													
Extended measuring range -196 ... 600 °C, wire-wound measurement resistor, increased vibration resistance 10 g																				D	1													
Extended measuring range -196 ... 600 °C, wire-wound measurement resistor, vibration resistance 3 g to IEC 60751																				D	2													
Thermocouple																				T	1													
Others																				Z	9													
<b>Sensor type and circuit type</b>																																		
1 x Pt100, two-wire																				P	1													
1 x Pt100, three-wire																				P	2													
1 x Pt100, four-wire																				P	3													
2 x Pt100, two-wire																				P	4													
2 x Pt100, three-wire																				P	5													
2 x Pt100, four-wire																				P	6													
1 x type K (NiCr-Ni)																				K	1													
2 x type K (NiCr-Ni)																				K	2													
1 x type J (Fe-CuNi)																				J	1													
2 x type J (Fe-CuNi)																				J	2													
1 x type N (NiCrSi-NiSi)																				N	1													
2 x type N (NiCrSi-NiSi)																				N	2													
Others																				Z	9													

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		Main order number																														Add. order no.			
Version number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			
<b>SensyTemp temperature sensor TSP321</b>		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX	XX
<b>Sensor accuracy</b>																												B	2						
Class B to IEC 60751																												S	1						
Class A to IEC 60751, measuring range -30 ... 300 °C																												D	1						
Class A to IEC 60751, measuring range -196 ... 500 °C																												T	2						
Class 2 to IEC 60584																												T	1						
Class 1 to IEC 60584																												S	3						
Class AA to IEC 60751, measuring range 0 ... 100 °C																												Z	9						
Others																																			
<b>Connection head</b>																												L	1						
AGL / aluminum, with screw-on cover																												L	2						
AGLH / aluminum, with high screw-on cover																												L	4						
AGLD / aluminum, with screw-on cover and display																												S	1						
AGS / stainless steel, with screw-on cover																												S	2						
AGSH / stainless steel, with high screw-on cover																												S	4						
AGSD / stainless steel, with screw-on cover and display																												Z	9						
Others																																			
<b>Transmitter</b>																												Y	1						
Without transmitter, measuring inset with ceramic base																												Y	2						
Without transmitter, measuring inset with free leads																												R	1						
TR04, fixed measuring range, 4 ... 20 mA output																												R	2						
TR04-Ex, fixed measuring range, 4 ... 20 mA output																												H	6						
TTH200 HART, adjustable, 4 ... 20 mA output																												H	7						
TTH200 HART-Ex, adjustable, 4 ... 20 mA output																												H	4						
TTH300 HART, adjustable, 4 ... 20 mA output																												H	5						
TTH300 HART-Ex, adjustable, 4 ... 20 mA output																												P	6						
TTH300 PA, adjustable, PROFIBUS PA output																												P	7						
TTH300 PA-Ex, adjustable, PROFIBUS PA output																												F	6						
TTH300 FF, adjustable, FOUNDATION Fieldbus output																												F	7						
TTH300 FF-Ex, adjustable, FOUNDATION Fieldbus output																												Z	9						
Others																																			

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Main order number																															Add. order no.
1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	XX					
TSP321	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX				
<b>Inscription plate</b>																															
Stainless steel plate with TAG no.																															T1
<b>Certificates</b>																															
TÜV certificate for functional safety SIL2 to IEC61508																															CS
Acceptance test certificate 3.1 to EN 10204 material confirmation for wetted parts																															C2
Certificate of compliance 2.1 to EN 10204 for order conformity																															C4
Acceptance test certificate 3.1 to EN 10204 for visual, dimensional, and functional checks																															C6
Acceptance test certificate 3.1 to EN 10204 for helium leak test																															C7
Acceptance test certificate 3.1 to EN 10204 for x-ray inspection																															C8
Acceptance test certificate 3.1 to EN 10204 for dye penetration test																															C9
Acceptance test certificate 3.1 to EN 10204 for compression test of thermowell																															CB
Acceptance test certificate 3.1 to EN 10204 for reference measurement 1 x Pt100																															CD
Acceptance test certificate 3.1 to EN 10204 for reference measurement 2 x Pt100																															CE
Acceptance test certificate 3.1 to EN 10204 for reference measurement 1 x thermocouple																															CF
Acceptance test certificate 3.1 to EN 10204 for reference measurement 2 x thermocouple																															CG
DKD calibration 1 x Pt100 with calibration certificate for each thermometer																															CH
DKD calibration 2 x Pt100 with calibration certificate for each thermometer																															CJ
DKD calibration 1 x thermocouple with calibration certificate for each thermometer																															CK
DKD calibration 2 x thermocouple with calibration certificate for each thermometer																															CL
Others																															CZ
<b>Test temperatures for reference measurement</b>																															
0 °C / 32 °F																															V1
100 °C / 212 °F																															V2
400 °C / 752 °F																															V3
0 °C and 100 °C / 32 °F and 212 °F																															V4
0 °C and 400 °C / 32 °F and 752 °F																															V5
0 °C, 100 °C, and 200 °C / 32 °F, 212 °F, and 392 °F																															V7
0 °C, 200 °C, and 400 °C / 32 °F, 392 °F, and 752 °F																															V8
Customer-specific																															V6
<b>Test temperatures for DKD calibration</b>																															
0 °C / 32 °F																															D1
100 °C / 212 °F																															D2
400 °C / 752 °F																															D3
0 °C and 100 °C / 32 °F and 212 °F																															D4
0 °C and 400 °C / 32 °F and 752 °F																															D5
0 °C, 100 °C, and 200 °C / 32 °F, 212 °F, and 392 °F																															D7
0 °C, 200 °C, and 400 °C / 32 °F, 392 °F, and 752 °F																															D8
Customer-specific																															D6

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Main order number																															Add. order no.
1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	XX					
TSP321	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX				
<b>Thermowell options</b>																															
Stainless steel with additional tantalum sheath																										S1					
Thermowell with 0.5 mm E-CTFE / Halar coating, wetted parts incl. flange sealing surface																										S2					
Special cleaning of the thermowell for oxygen applications																										S9					
Others																										SZ					
<b>Flange connection options</b>																															
Flange sealing surface with form C spring to EN 1092																										F1					
Flange sealing surface with form D groove to EN 1092																										F2					
Flange sealing surface form RTJ to ASME B16.5v																										F3					
Others																										FZ					
<b>Cable entry options</b>																															
1 x 1/2 NPT, without cable gland																										U2					
2 x 1/2 NPT, without cable gland																										U5					
2 x M20 x 1.5, with plastic cable gland, clamping area 5 ... 12 mm																										U7					
2 x M20 x 1.5, with EEx-d cable gland, cable diameter 6.0 ... 7.5 mm																										UC					
Others																										UZ					
<b>Measuring range of the transmitter</b>																															
-30 ... 60 °C																										A1					
-20 ... 40 °C																										A2					
0 ... 40 °C																										A3					
0 ... 60 °C																										A4					
0 ... 100 °C																										A5					
0 ... 120 °C																										A6					
0 ... 150 °C																										A7					
0 ... 200 °C																										A8					
0 ... 250 °C																										AF					
0 ... 300 °C																										AG					
0 ... 400 °C																										AH					
0 ... 600 °C																										AJ					
0 ... 800 °C																										AK					
0 ... 1000 °C																										AL					
Others																										AZ					

14.3 SensyTemp TSP331

		Main order number																												Add. order no.
Version number	1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	XX	
<b>SensyTemp temp. sensor</b>	<b>TSP331</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX	
<b>Explosion protection / Approvals</b>																														
None		Y	0																											
Intrinsic safety: ATEX II 1 G																														
Ex ia IIC T6 ... T1 - Zone 0, 1, 2		A	1																											
Dust ignition protection: ATEX II 1 D																														
IP6X T133 ... T400 - Zone 20, 21, 22		A	3																											
Dust ignition protection and intrinsic safety: ATEX II 1 D IP6X T133 ... T400 and ATEX II 1 G Ex ia IIC T6 ... T1 - Zone 0, 1, 2, 20, 21, 22		1)	A	4																										
Flameproof enclosure: ATEX II 1/2 G Ex d IIC T6 ... T4 - Zone 1		A	5																											
ATEX II 3 G Ex nA II T6 ... T1 and ATEX II 3 D IP6X T133 ... T300 - Zone 2 and 22		1)	B	1																										
Others		Z	9																											
<b>Material for wetted parts</b>																														
Stainless steel 1.4404 / 316 L				S	1																									
Stainless steel 1.4571 / 316 Ti				S	2																									
Heat-resistant steel 1.7335 (13CrMo4-5)				W	1																									
Heat-resistant steel 1.5415 (15Mo3)				W	3																									
2.4819 / Hastelloy C-276 (stainless steel flange with flange disc manufactured from Hastelloy C-276)				N	1																									
2.4360 / Monel 400 alloy (stainless steel flange with flange disc manufactured from Monel 400)				N	4																									
1.4876 / Incoloy 800 alloy (stainless steel flange with flange disc manufactured from Incoloy 800)				H	4																									
2.4816 / Incoloy 600 (stainless steel flange with flange disc manufactured from Incoloy 600)				N	5																									
Others				Z	9																									
<b>Thermowell type</b>																														
Weld-in thermowell manufactured from bar stock material to DIN 43772, form 4, F2 = 24 mm				D	1																									
Weld-in thermowell manufactured from bar stock material to DIN 43772, form 4, fast-acting, F2 = 18 mm (ABB form 4S)				D	2																									
Flange thermowell manufactured from bar stock material to DIN 43772, form 4F, F2 = 24 mm				D	3																									
Flange thermowell manufactured from bar stock material to DIN 43772, form 4F, fast-acting, F2 = 18 mm (ABB form 4FS)				D	4																									
Weld-in thermowell manufactured from bar stock material to ABB standard, form PW, F2 = 32 mm				P	1																									
Flange thermowell manufactured from bar stock material to ABB standard, form PF				P	2																									
Screw-in thermowell manufactured from bar stock material to ABB standard, form PS				P	3																									
Others				Z	9																									

1) 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 61241-0.

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		Main order number																																Add. order no.					
Version number	1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	XX										
<b>SensyTemp temp. sensor</b>	<b>TSP331</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX									
<b>Process connection</b>																																							
Without process connection								Y	0	0																													
Conical screw-in thread 1/2 NPT								S	0	4																													
Conical screw-in thread 3/4 NPT								S	0	5																													
Conical screw-in thread 1 NPT								S	0	6																													
Flange DN25 PN10 ... PN40, to EN 1092								F	0	3																													
Flange DN40 PN10 ... PN40, to EN 1092								F	0	4																													
Flange DN50 PN10 ... PN40, to EN 1092								F	0	5																													
Flange 1 inch 150 lbs, to ASME B16.5								F	0	7																													
Flange 1 inch 300 lbs, to ASME B16.5								F	0	8																													
Flange 1.5 inch 150 lbs, to ASME B16.5								F	1	1																													
Flange 1.5 inch 300 lbs, to ASME B16.5								F	1	2																													
Flange 1.5 inch 600 lbs, to ASME B16.5								F	1	3																													
Flange 2 inch 150 lbs, to ASME B16.5								F	1	5																													
Flange 2 inch 300 lbs, to ASME B16.5								F	1	6																													
Flange 2 inch 600 lbs, to ASME B16.5								F	1	7																													
Others								Z	9	9																													
<b>Ext. tube length K</b>																																							
150 mm											K	1																											
Variable ext. tube length											Z	9																											
<b>Thermowell connection</b>																																							
Cylindrical screw-in thread M14 x 1.5													M	1																									
Cylindrical screw-in thread M18 x 1.5													M	2																									
Conical screw-in thread 1/2 NPT													N	1																									
1/2 NPT - 1/2 NPT, not separable													N	2																									
1/2 NPT - 1/2 NPT, separable													N	3																									
Others													Z	9																									

Continued on next page

		Main order number																																Add. order no.	
Version number	1 - 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	XX						
<b>SensyTemp temp. sensor</b>	<b>TSP331</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX						
<b>Insertion depth U</b>																																			
No fixed insertion depth																Y	0																		
U = 130 mm																D	1																		
U = 190 mm																D	2																		
U = 340 mm																D	3																		
U = 100 mm																P	1																		
U = 150 mm																P	2																		
U = 200 mm																P	3																		
U = 250 mm																P	4																		
U = 300 mm																P	5																		
U = 350 mm																P	6																		
Acc. to customer requirements																Z	9																		
<b>Thermowell length L</b>																																			
L = 110 mm, C = 65 mm																D	1																		
L = 140 mm, C = 65 mm																D	3																		
L = 200 mm, C = 65 mm																D	4																		
L = 200 mm, C = 125 mm																D	5																		
L = 260 mm, C = 125 mm																D	6																		
L = 410 mm, C = 275 mm																D	7																		
To ABB standard (insertion depth + 65 mm)																P	1																		
Acc. to customer requirements																Z	9																		
<b>Measuring inset type</b>																																			
Basic design, thin film measurement resistor, measuring range -50 ... 400 °C, vibration resistance 10 g																S	1																		
Increased vibration resistance, thin film measurement resistor, measuring range -50 ... 400 °C, vibration resistance 60 g																S	2																		
Extended measuring range -196 ... 600 °C, wire-wound measurement resistor, vibration resistance 10 g																D	1																		
Extended measuring range -196 ... 600 °C, wire-wound measurement resistor, vibration resistance 3 g																D	2																		
Thermocouple																T	1																		
Others																Z	9																		
<b>Sensor type and circuit type</b>																																			
1 x Pt100, two-wire																P	1																		
1 x Pt100, three-wire																P	2																		
1 x Pt100, four-wire																P	3																		
2 x Pt100, two-wire																P	4																		
2 x Pt100, three-wire																P	5																		
2 x Pt100, four-wire																P	6																		
1 x type K (NiCr-Ni)																K	1																		
2 x type K (NiCr-Ni)																K	2																		
1 x type J (Fe-CuNi)																J	1																		
2 x type J (Fe-CuNi)																J	2																		
1 x type N (NiCrSi-NiSi)																N	1																		
2 x type N (NiCrSi-NiSi)																N	2																		
Others																Z	9																		

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		Main order number																												Add. order no.					
Version number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	XX
<b>SensyTemp temp. sensor</b>		<b>TSP331</b>																												XX					
<b>Sensor accuracy</b>																														XX					
Class B to IEC 60751																														B 2					
Class A to IEC 60751, measuring range -30 ... 300 °C																														S 1					
Class A to IEC 60751, measuring range -196 ... 500 °C																														D 1					
Class 2 to IEC 60584																														T 2					
Class 1 to IEC 60584																														T 1					
Class AA to IEC 60751, measuring range 0 ... 100 °C																														S 3					
Others																														Z 9					
<b>Connection head</b>																																			
AGL / aluminum, with screw-on cover																														L 1					
AGLH / aluminum, with high screw-on cover																														L 2					
AGLD / aluminum, with screw-on cover and display																														L 4					
AGS / stainless steel, with screw-on cover																														S 1					
AGSH / stainless steel, with high screw-on cover																														S 2					
AGSD / stainless steel, with screw-on cover and display																														S 4					
Others																														Z 9					
<b>Transmitter</b>																																			
Without transmitter, measuring inset with ceramic base																														Y 1					
Without transmitter, measuring inset with free leads																														Y 2					
TR04, fixed measuring range, 4 ... 20 mA output																														R 1					
TR04-Ex, fixed measuring range, 4 ... 20 mA output																														R 2					
TTH200 HART, adjustable, 4 ... 20 mA output																														H 6					
TTH200 HART-Ex, adjustable, 4 ... 20 mA output																														H 7					
TTH300 HART, adjustable, 4 ... 20 mA output																														H 4					
TTH300 HART-Ex, adjustable, 4 ... 20 mA output																														H 5					
TTH300 PA, adjustable, PROFIBUS PA output																														P 6					
TTH300 PA-Ex, adjustable, PROFIBUS PA output																														P 7					
TTH300 FF, adjustable, FOUNDATION Fieldbus H1 output																														F 6					
TTH300 FF-Ex, adjustable, FOUNDATION Fieldbus H1 output																														F 7					
Others																														Z 9					

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<b>TSP331</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	<b>XX</b>				
<b>Inscription plate</b>																																	
Stainless steel plate with TAG no.																																	T1
<b>Certificates</b>																																	
TÜV certificate for functional safety SIL2 to IEC 61508																																	CS
Acceptance test certificate to EN 10204 material confirmation for wetted parts																																	C2
Certificate of compliance 2.1 to EN 10204 for order conformity																																	C4
Acceptance test certificate 3.1 to EN 10204 for visual, dimensional, and functional checks																																	C6
Acceptance test certificate 3.1 to EN 10204 for helium leak test																																	C7
Acceptance test certificate 3.1 to EN 10204 for x-ray inspection																																	C8
Acceptance test certificate 3.1 to EN 10204 for dye penetration test																																	C9
Acceptance test certificate 3.1 to EN 10204 for compression test of thermowell																																	CB
Acceptance test certificate 3.1 to EN 10204 for reference measurement 1 x Pt100																																	CD
Acceptance test certificate 3.1 to EN 10204 for reference measurement 2 x Pt100																																	CE
Acceptance test certificate 3.1 to EN 10204 for reference measurement 1 x thermocouple																																	CF
Acceptance test certificate 3.1 to EN 10204 for reference measurement 2 x thermocouple																																	CG
DKD calibration 1 x Pt100 with calibration certificate for each thermometer																																	CH
DKD calibration 2 x Pt100 with calibration certificate for each thermometer																																	CJ
DKD calibration 1 x thermocouple with calibration certificate for each thermometer																																	CK
DKD calibration 2 x thermocouple with calibration certificate for each thermometer																																	CL
Others																																	CZ
<b>Test temperatures for reference measurement</b>																																	
0 °C / 32 °F																																	V1
100 °C / 212 °F																																	V2
400 °C / 752 °F																																	V3
0 °C and 100 °C / 32 °F and 212 °F																																	V4
0 °C and 400 °C / 32 °F and 752 °F																																	V5
0 °C, 100 °C, and 200 °C / 32 °F, 212 °F, and 392 °F																																	V7
0 °C, 200 °C, and 400 °C / 32 °F, 392 °F, and 752 °F																																	V8
Customer-specific																																	V6
<b>Test temperatures for DKD calibration</b>																																	
0 °C / 32 °F																																	D1
100 °C / 212 °F																																	D2
400 °C / 752 °F																																	D3
0 °C and 100 °C / 32 °F and 212 °F																																	D4
0 °C and 400 °C / 32 °F and 752 °F																																	D5
0 °C, 100 °C, and 200 °C / 32 °F, 212 °F, and 392 °F																																	D7
0 °C, 200 °C, and 400 °C / 32 °F, 392 °F, and 752 °F																																	D8
Customer-specific																																	D6

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<b>TSP331</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	<b>XX</b>				
<b>Thermowell options</b>																																	
Thermowell design with tests and certificates to NACE MR 0175																																	S8
Special cleaning of the thermowell for oxygen applications																																	S9
Others																																	SZ
<b>Flange connection options</b>																																	
Flange sealing surface with form C spring to EN 1092																																	F1
Flange sealing surface with form D groove to EN 1092																																	F2
Flange sealing surface form RTJ to ANSI / ASME B16.5																																	F3
Flange full penetration welded																																	F4
Others																																	FZ
<b>Cable entry options</b>																																	
1 x 1/2 NPT, without cable gland																																	U2
2 x 1/2 NPT, without cable gland																																	U5
2 x M20 x 1.5, with plastic cable gland, clamping area 5 ... 12 mm																																	U7
2 x M20 x 1.5, with EEx-d cable gland, cable diameter 6.0 ... 7.5 mm																																	UC
Others																																	UZ
<b>Measuring range of the transmitter</b>																																	
-30 ... 60 °C																																	A1
-20 ... 40 °C																																	A2
0 ... 40 °C																																	A3
0 ... 60 °C																																	A4
0 ... 100 °C																																	A5
0 ... 120 °C																																	A6
0 ... 150 °C																																	A7
0 ... 200 °C																																	A8
0 ... 250 °C																																	AF
0 ... 300 °C																																	AG
0 ... 400 °C																																	AH
0 ... 600 °C																																	AJ
0 ... 800 °C																																	AK
0 ... 1000 °C																																	AL
Others																																	AZ





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