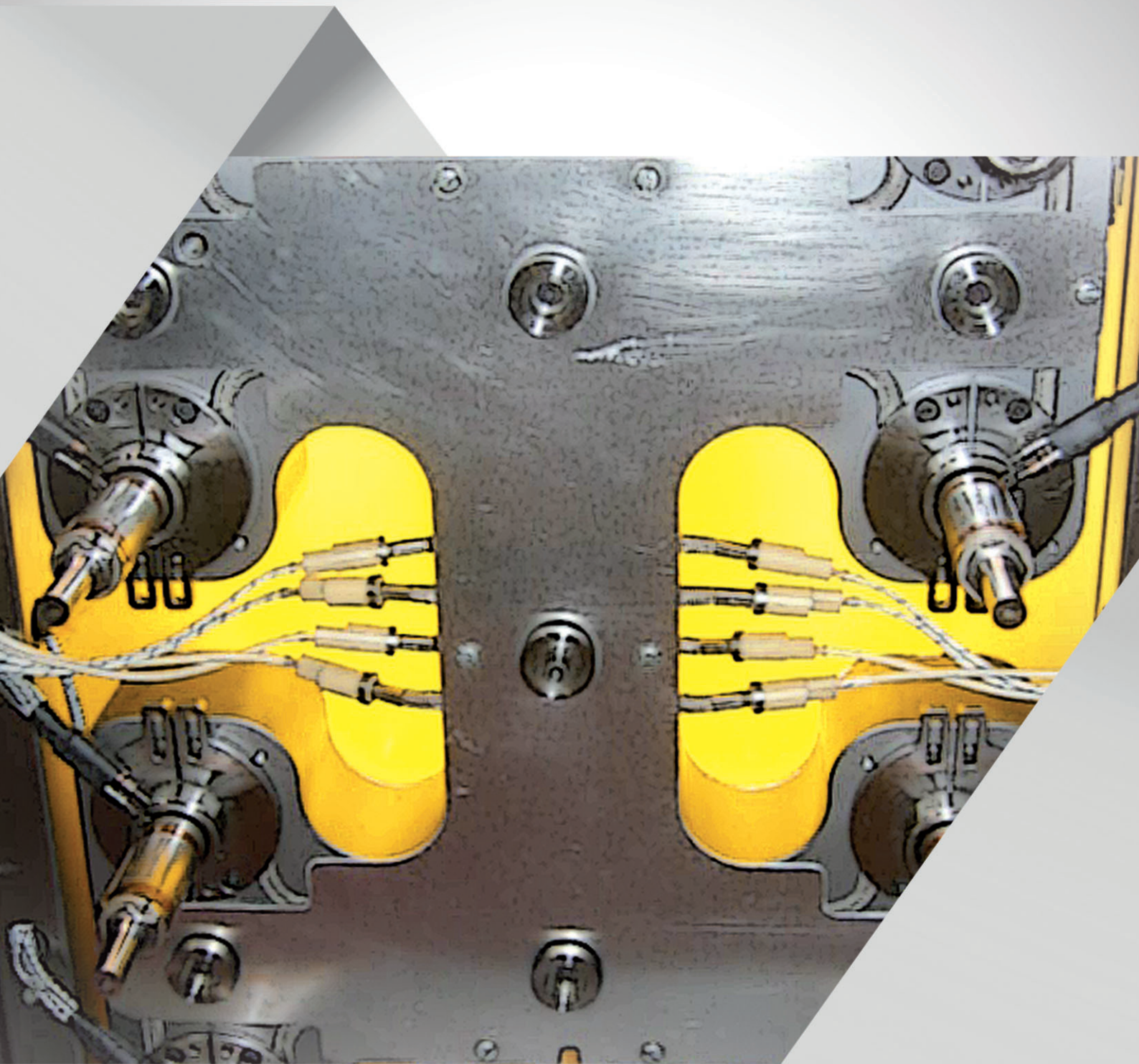


TEMPERATURE MEASUREMENT IN PLASTICS PROCESSING INDUSTRY



www.sab-worldwide.com



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WHO WE ARE

A SURVEY

75 years of experience in cable and wire manufacturing as well as in temperature measurement technology turned a one-man business into a company with more than 550 employees. We prove our strength every year with more than 1500 special products according to customers' requirements. Each product is a new challenge for our creative technical team. We at **SAB** see ourselves as a manufacturer and a service provider – in the sense of true partnership and the greatest possible customer orientation.

Today, the quality of our products is known and appreciated in more than 80 countries around the world. In all product ranges, we are certified according to DIN EN ISO 9001. Furthermore, we have implemented an environmental management system for our company according to DIN EN ISO 14001, an occupational health and safety management system according to DIN EN ISO 14001 and DIN ISO 45001, and an energy management system according to DIN EN ISO 50001.

And also for the future, our slogan is: **"WE CONTINUE!"**

FOUNDED:	1947 by Peter Bröckskes sen. an independent, medium-sized company.
CEO:	Peter Bröckskes and Sabine Bröckskes-Wetten
PLANT/LOCATION:	In Viersen (Lower Rhine) 110.000 m ² company site. Own manufacturing from copper conductor to outer sheath. VDE proved burnchamber and laboratory within the company.
EMPLOYEES/WORKERS:	Approx. 430 at the plant in Viersen, 550 worldwide
YEARLY SALES:	Approx. 95 Mio. € worldwide
PRODUCTS:	Special Cables Measurement Technology Cable Harnessing

CERTIFICATES AND APPROVALS:



Quality management system acc. to DIN EN ISO 9001
for every manufacturing field

Environmental management system acc. to DIN EN ISO 14001

Occupational health and safety management
acc. to NLF/ILO-OSH and DIN ISO 45001

Energy management system acc. to DIN EN ISO 50001

1. Temperature as measured variable

For nearly all procedures in research and production, temperature is a factor to be considered. It is of considerable importance as measured variable. For temperature measurements, temperature dependent characteristics of materials can be used, as for example the changing electrical resistance (resistance thermometer), the electromagnetic radiation of hot bodies (radiation pyrometer) and resulting thermoelectric voltage (thermocouple). The different electric contact thermometers are frequently used for the field temperature measurement.

2. Physical basis

2.1. Resistance thermometer

Temperature measurement with the help of resistance thermometers base on the special characteristic of conducting materials to change their resistance dependent on temperature. For metals the resistance increases with rising temperature. In case that the correlation between temperature and resistance is known, the temperature can be determined by resistance measurement. The suggestion to use the temperature dependent resistance of metal conductors for temperature measurement, was first made by Wilhelm von Siemens, the brother of Werner von Siemens in 1861 and was realized in the development of a thermometer for the measurement of deep sea temperatures. The works of H.L. Callendar made the resistance thermometer a precision device in 1886.

2.2. Thermocouples

The first basis of the thermovoltage effect was discovered by Seebeck in 1821. Thirty years later the exact correlations were found out by Thompson. The thermovoltage between 2 different metals depend on the thermal motion of electrons. It is not dependent on the absolute temperature values, but on temperature differences. The higher the temperature difference between "hot" and "cold", the higher the thermovoltage. The voltage at 1 degree Celsius is called the thermoelectric force of the thermocouple. It depends on the nature of the two materials whose connection point is heated.

3. The response time of contact thermometers

The temperature measurement with the help of contact thermometers is generally afflicted with a delayed indication. The result is that a changing temperature is not immediately indicated correctly but only after a certain time when the heat exchange between the measured medium and the temperature probe has been fully realized. This inertia of thermometers shall be as small as possible for certain measuring tasks. This is called the response time of a thermometer which means generally the time constant. Generally spoken: the time constant corresponds to the relation of the capacity of heat absorption and heat release of the thermometer. Both characteristics are mainly determined by:

- heat capacity
- transversal thermal conductivity of the thermometer
- relation of surface to volume of the thermometer
- coefficient of thermal conductivity between medium and surface of the thermometer as well as of the medium velocity, its thermal conductivity and its specific heat.

If a thermometer is suddenly exposed to another temperature, as for example by taking it out of water with a temperature of 20°C and putting it into water of 40°C, the indicated temperature rises almost according to the exponential function. The usual quantity for the changing velocity of such exponential procedures is the time constant. The time constant is equal to the time that passes until 63.2% of the temperature leap is indicated. In many cases, the temperature indication does not change according to the exponential function. For those cases the time constant is not sufficient to characterise the time response. Therefore it is useful to indicate the half-time $z\ 0.5$ and the 9/10 time value $z\ 0.9$. This is the definition of time from the sudden change of temperature to the reach of 50% either 90% of this temperature change. The exponential course shows $z\ 0.5 = 0.693$ (time constant) resp. $z\ 0.9 = 2.303$ (time constant) and the ratio $z\ 0.9/z\ 0.5$ has to be equal to 3.32.

Thermocouples

- can be applied in a much bigger temperature range than resistance thermometers.
- punctual measurement and thus a quicker response time.
- more robust and less sensitive against mechanical stress.
- often cheaper.

Resistance thermometers

- platinum resistance thermometers are the most accurate sensors and have the best long-time stability.
Due to the chemical insensitiveness of the platinum, the risk of impurity by oxidation and other chemical influences is reduced.
- high reproducibility.



BASIC VALUES OF THERMOELECTRIC VOLTAGE IN MV

Temperature t 90/°C	type K	type L	type J	type U	type T	type E	type N	type S	type R	type B
	+NiCr -Ni	+Fe -CuNi	+Fe -CuNi	+ECu -CuNi	+ECu -CuNi	+NiCr -CuNi	+NiCrSi -NiSi	+PtRh 10 -Pt	+PtRh 13 -Pt	+PtRh 30 -PtRh 6
	DIN EN 60584	⁽¹⁾ DIN 43710	DIN EN 60584	⁽¹⁾ DIN 43710	DIN EN 60584	DIN EN 60584	DIN EN 60584	DIN EN 60584	DIN EN 60584	DIN EN 60584
-100	-3,554	-4,75	-4,633	-3,40	-3,379	-5,237	-2,407	-	-	-
0	0	0	0	0	0	0	0	0	0	0
100	4,096	5,37	5,269	4,25	4,279	6,319	2,774	0,646	0,647	0,033
200	8,138	10,95	10,779	9,20	9,288	13,421	5,913	1,441	1,469	0,178
300	12,209	16,56	16,327	14,90	14,862	21,036	9,341	2,323	2,401	0,431
400	16,397	22,16	21,848	21,00	20,872	28,946	12,974	3,259	3,408	0,787
500	20,644	27,85	27,393	27,41	-	37,005	16,748	4,233	4,471	1,242
600	24,905	33,67	33,102	34,31	-	45,093	20,613	5,239	5,583	1,972
700	29,129	39,72	39,132	-	-	53,112	24,527	6,275	6,743	2,431
800	33,275	46,22	-	-	-	61,017	28,455	7,345	7,950	3,154
900	37,326	53,14	-	-	-	68,787	32,371	8,449	9,205	3,957
1000	41,276	-	-	-	-	76,373	36,256	9,587	10,506	4,834
1100	45,119	-	-	-	-	-	40,087	10,757	11,850	5,780
1200	48,838	-	-	-	-	-	43,846	11,951	13,228	6,786
1250	50,644	-	-	-	-	-	45,694	12,554	13,926	7,311
1300	52,410	-	-	-	-	-	47,513	13,159	14,629	7,848
1400	-	-	-	-	-	-	-	14,373	16,040	8,956
1450	-	-	-	-	-	-	-	14,978	16,746	9,524
1500	-	-	-	-	-	-	-	-	-	10,099
1600	-	-	-	-	-	-	-	-	-	11,263
1700	-	-	-	-	-	-	-	-	-	12,433

TOLERANCES FOR THERMOCOUPLES

type	standard	material	class 1		class 2		class 3	
			temperature range	⁽²⁾ limit deviation	temperature range	⁽²⁾ limit deviation	temperature range	⁽²⁾ limit deviation
T	DIN EN 60584	Cu-CuNi	-40 up to +350°C	±0,5°C or 0,40%	-40 up to +350°C	±1,0°C or 0,75%	-200 up to +40°C	±1,0°C or 1,5%
⁽¹⁾ U	DIN 43710	Cu-CuNi	-	-	0 up to +600°C	±3°C or 0,75%	-	-
J	DIN EN 60584	Fe-CuNi	-40 up to +750°C	±1,5°C or 0,40%	-40 up to +750°C	±2,5°C or 0,75%	-	-
⁽¹⁾ L	DIN 43710	Fe-CuNi	-	-	0 up to +900°C	±3°C or 0,75%	-	-
K	DIN EN 60584	NiCr-Ni	-40 up to +1000°C	±1,5°C or 0,40%	-40 up to +1200°C	±2,5°C or 0,75%	-200 up to +40°C	±2,5°C or 1,5%
E	DIN EN 60584	NiCr-CuNi	-40 up to +800°C	±1,5°C or 0,40%	-40 up to +900°C	±2,5°C or 0,75%	-200 up to +40°C	±2,5°C or 1,5%
N	DIN EN 60584	NiCrSi-NiSi	-40 up to +1000°C	±1,5°C or 0,40%	-40 up to +1200°C	±2,5°C or 0,75%	-200 up to +40°C	±2,5°C or 1,5%
S	DIN EN 60584	PtRh 10-Pt	0 up to +1600°C	±1,0°C or ⁽³⁾	0 up to +1600°C	±1,5°C or 0,25%	-	-
R	DIN EN 60584	PtRh13-Pt	0 up to +1600°C	±1,0°C or ⁽³⁾	0 up to +1600°C	±1,5°C or 0,25%	-	-
B	DIN EN 60584	PtRh30-PtRh6	-	-	+600 up to +1700°C	±1,5°C or 0,25%	+600 up to +1700°C	±4,0°C or 0,5%

Classes 1, 2, and 3 are valid for thermocouples

⁽¹⁾ Since April 1994 the standard DIN 43710 is no longer valid

⁽²⁾ For the limit deviation, the higher value is valid

⁽³⁾ 1°C or $[1 + (t - 1100) \times 0,003]$ °C

■ Accuracy classes acc. to DIN EN 60751:2009-5

class	validity range °C		limit deviation °C
	leaded resistor	film resistor	
AA	-50 uo to +250	0 uo to +150	± (0,1 + 0,0017 [t])
A	-100 uo to +450	-30 uo to +300	± (0,15 + 0,002 [t])
B	-196 uo to +600	-50 uo to +500	± (0,3 + 0,005 [t])
C	-196 uo to +600	-50 uo to +600	± (0,6 + 0,01 [t])

^a [t] = Value of temperature in °C without considering the sign.

For resistance thermometers that belong to the above context, the temperature coefficient α is defined as:

$$\alpha = \frac{R_{100} - R_0}{100 \times R_0} = \text{and has the numerical value } 0,00385 \text{ } ^\circ\text{C}^{-1}$$

with: R_{100} is the resistance at 100°C and R_0 is the resistance at 0°C.
(for calculation purpose the exact value of 0,00385055°C⁻¹ is valid)

■ Limit deviations for PT 100 thermometers

abbreviation of RTD Pt 100 DIN EN 60751					
RTD material platinum					
application range -200 up to + 850 °C (class B)					
ITS 90 resistance and permitted deviation					
measuring temperature °C	basic value		allowed deviation		
	Ω	Ω	class A °C	class B Ω	class B °C
-200	18,52	±0,24	±0,55	±0,56	±1,30
-100	60,26	±0,14	±0,35	±0,32	±0,80
0	100,00	±0,06	±0,15	±0,12	±0,30
100	138,51	±0,13	±0,35	±0,30	±0,80
200	175,86	±0,20	±0,55	±0,48	±1,30
300	212,05	±0,27	±0,75	±0,64	±1,80
400	247,09	±0,33	±0,95	±0,79	±2,30
500	280,98	±0,38	±1,15	±0,93	±2,80
600	313,71	±0,43	±1,35	±1,06	±3,30
650	329,64	±0,46	±1,45	±1,13	±3,60
700	345,28	-	-	±1,17	±3,80
800	375,70	-	-	±1,28	±4,30
850	390,48	-	-	±1,34	±4,60

for the term "basic values" see DIN 16160 part 5.





































Resistance thermometers with different accuracy classes and validity ranges as for example acc. to DIN EN 60751: 2009-5 (class AA) are available on request.

INNER WIRES OF RESISTANCE THERMOMETERS

number of precision winding	circuit of inner wires			
	2-wire	3-wire	4-wire	2-wire with loop
Pt 100				
2 x Pt 100				
3 x Pt 100				

COLOUR CODE AND TEMPERATURE RANGE

for compensating and extension cables

THERMOCOUPLE						
Code	Material ⊕ ⊖	DIN IEC 584	DIN 43710*	ANSI MC 96.1	BS 4937	NF C 42-324
		Identification THL AGL	Identification THL AGL	Identification THL AGL	Identification THL AGL	Identification THL AGL
T	Cu - Cu Ni	 TX -25° to +100°C		 0° to +100°C	 0° to +100°C	 -25° to +200°C
U	Cu - Cu Ni		 UX 0° to +200°C			
J	Fe - Cu Ni	 JX -25° to +200°C		 0° to +200°C	 0° to +200°C	 -25° to +200°C
L	Fe - Cu Ni		 LX 0° to +200°C			
E	Ni Cr - Cu Ni	 EX -25° to +200°C		 0° to +200°C	 0° to +200°C	 -25° to +200°C
K	Ni Cr - Ni	 KX -25° to +200°C		 0° to +200°C	 0° to +200°C	 -25° to +200°C
K	Ni Cr - Ni	 KCA 0° to +150°C				 0° to +150°C
K	Ni Cr - Ni	 KCB 0° to +100°C			 0° to +100°C	 0° to +100°C
N	Ni Cr Si - Ni Si	 NX -25° to +200°C	 NC 0° to +150°C			
R S	Pt Rh 13 - Pt Pt Rh 10 - Pt	 RCB/ SCB 0° to +200°C		 0° to +200°C	 0° to +200°C	 0° to +200°C
B	Pt Rh 30 - Pt Rh 6			 0° to +100°C		 0° to +100°C

The application temperature range of the cable is limited by the highest application temperature of the insulating material or the application temperature range of the conductor material. In all cases the respective lower figure is valid. The compensating cable for the thermocouple type B can also be manufactured, deviating from the corresponding standards, for a temperature range from 0 to +200°C (SAB-Type BC-200). Variant colour codes can be manufactured for a minimum order quantity.

* The standard 43710 was withdrawn in April 1994.
Therefore, the element types "U" and "L" are not standardized anymore.

THL = extension cable · AGL = compensating cable

Also available in type K, T or L* and classes 1 or 2!



The high temperature resistance of the connection sleeve is highly suitable for the application in hot runner technique. Three standard construction types of the measuring tip are available. This sensor type can be obtained with copper tip, measuring ring or without fix accessories. Without fix accessories the mineral insulated thermocouple is suitable for the placing into a groove considering the diameter. After being deformed, the copper tip is suitable to be cramped under a pipe clamp. Types with measuring ring are especially suitable to be mounted in the hot runner nozzle. The measuring rings are manufactured with a special inner diameter adapted to the nozzle diameter, so that an optimal temperature collection is guaranteed due to the achieved positive locking.

THERMOCOUPLE - CLASS 2:

- 1 x type J
- 1 x type K
- other thermocouples: _____

MEASURING POINT:

- form A, insulated
- form B, grounded

MATERIAL:

- 1.4541
- 2.4816

NOMINAL LENGTH: _____ mm

DIAMETER:

- Ø 0,5 mm
- Ø 0,64 mm
- Ø 1,0 mm
- Ø 1,5 mm

TEMPERATURE RESISTANCE OF THE SLEEVE:

- +200 °C
- +300 °C
- +400 °C

OPTIONAL WITH RING OR COPPER TIP:

- dimension: _____

TYPE:

- with kink protection
- without kink protection

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring +400°C
- extension cable strand/PFA/fiber glass/
stainless steel wire armouring +250°C
- extension cable strand/fiber glass/fiber glass/Pi-foil +300°C
- _____

CABLE LENGTH: _____ m

CONNECTION ENDS:

- miniature thermoplug
- miniature socket
- standard plug
- Lemo plug type _____
- clips
- Lemo socket type _____
- bare ends
- other cable ends _____



The above mentioned technical data are standard data.

Also available in
type K, T or L* and
classes 1 or 2!

For the temperature collection at plastics processing machines or similar. The stainless steel wire armouring of the connection cable is used as mechanical protection.



THERMOCOUPLE - CLASS 2:

- 1 x type J 1 x type K other thermocouples: _____

MEASURING POINT:

- form A, insulated form B, grounded

MATERIAL:

- 1.4541

NOMINAL LENGTH: _____ mm

DIAMETER:

- Ø 3,0 mm Ø 4,0 mm Ø 6,0 mm
 Ø 3,5 mm Ø 5,0 mm Ø 8,0 mm

BOTTOM SHAPE:

- flat 118°C spherical

OPTIONAL WITH SHEET:

- 8 x 15 mm / hole Ø 5 mm dimension: _____

TYPE:

- with kink protection with fiberglass sleeve

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring +400°C
 extension cable strand/PFA/fiber glass/
stainless steel wire armouring +250°C
 extension cable strand/PFA/PFA +250°C

CABLE LENGTH: _____ m

CONNECTION ENDS:

- miniature thermoplug miniature socket
 standard plug Lemo plug type _____
 clips Lemo socket type _____
 bare ends other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, double thermocouple or cable end can be added or modified on request.

Also available in type K, T or L* and classes 1 or 2!

For the temperature collection at surfaces. Easy mounting with the help of a screw and appropriate for numerous application fields. The stainless steel wire armouring of the connection cable is used as mechanical protection.



THERMOCOUPLE - CLASS 2, FORM B:

- 1 x type J 1 x type K other thermocouples: _____

RING TYPE:

- Ø 14 / 4,5 mm CuSn 6

NOMINAL LENGTH: _____ mm

TYPE:

- with kink protection (shrinkable sleeve)
 with fiberglass sleeve (shrinkable sleeve)

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
 stainless steel wire armouring +400°C
- extension cable strand/PFA/fiber glass/
 stainless steel wire armouring +250°C
- _____

CABLE LENGTH: _____ m

CONNECTION ENDS:

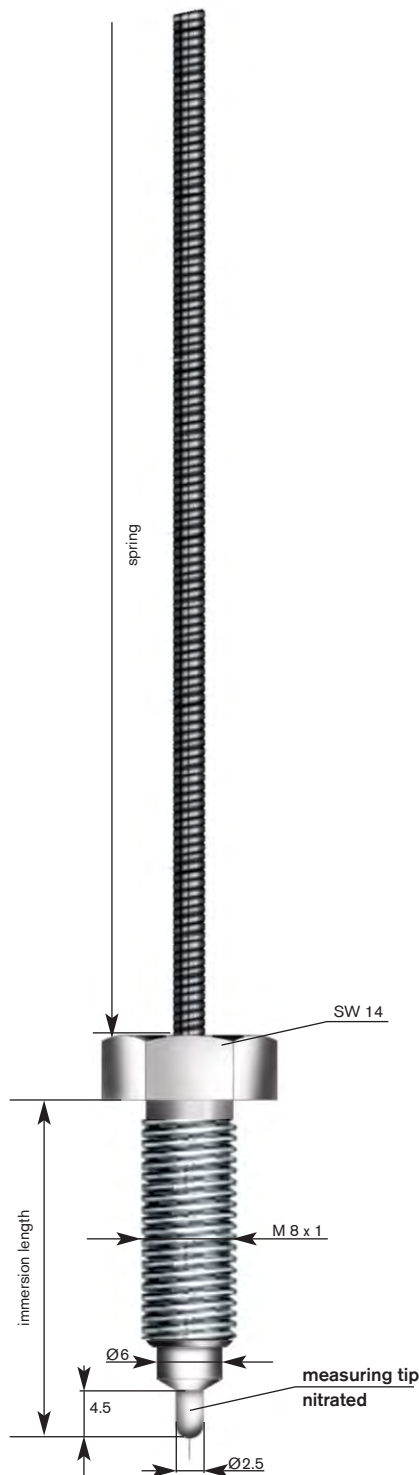
- | | |
|---|---|
| <input type="checkbox"/> miniature thermoplug | <input type="checkbox"/> miniature socket |
| <input type="checkbox"/> standard plug | <input type="checkbox"/> Lemo plug type _____ |
| <input type="checkbox"/> clips | <input type="checkbox"/> Lemo socket type _____ |
| <input type="checkbox"/> bare ends | <input type="checkbox"/> other cable ends _____ |



- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, double thermocouple or cable end can be added or modified on request.
- Other ring diameters on request!

Also available in
type K, T or L* and
classes 1 or 2!

With the help of this special construction, the molten mass temperature in injection nozzles is measured. The surface treated measuring tip is also suitable for application in reinforced plastics. In case of adequate mounting only the nitrated measuring tip is in contact with the molten mass stream. Thus the temperature collection takes place directly in the mass without additional protecting sleeve.



THERMOCOUPLE:

- 1 x type J 1 x type K other thermocouples: _____

MEASURING POINT:

- form B, grounded

LIMITING DEVIATION:

- class 1
 class 2

TEMPERATURE RANGE:

- 0°C ... +400°C

THREAD:

- M8 x 1 VA

IMMERSION LENGTH:

- 31,5 mm

DIAMETER:

- Ø 6,0 mm / 2,5 mm

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable wire/fiber glass/fiber glass +250°C

CABLE LENGTH: _____ m

CONNECTION ENDS:

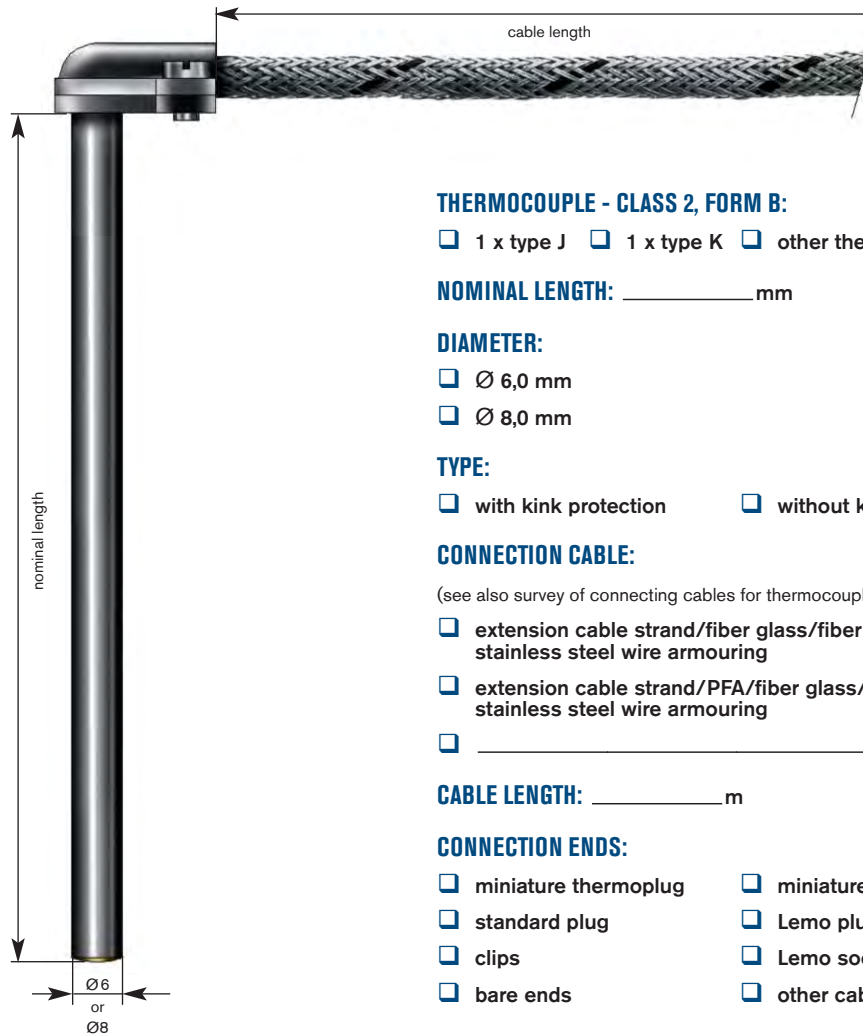
- | | |
|---|---|
| <input type="checkbox"/> miniature thermoplug | <input type="checkbox"/> miniature socket |
| <input type="checkbox"/> standard plug | <input type="checkbox"/> Lemo plug type _____ |
| <input type="checkbox"/> clips | <input type="checkbox"/> Lemo socket type _____ |
| <input type="checkbox"/> bare ends | <input type="checkbox"/> other cable ends _____ |



- The above mentioned technical data are standard data.
- Individual parameters, e. g. thread can be added or modified on request.

Also available in
type K, T or L* and
classes 1 or 2!

For the temperature collection at plastics processing machines. It is especially appropriate, whenever a straight cable lead for example due to space reasons is not possible or wanted. The steel wire armouring of the connection cable is used as mechanical protection. Fixing by a clamping screw connection.



THERMOCOUPLE - CLASS 2, FORM B:

- 1 x type J 1 x type K other thermocouples: _____

NOMINAL LENGTH: _____ mm

DIAMETER:

- Ø 6,0 mm
 Ø 8,0 mm

TYPE:

- with kink protection without kink protection

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring **+400°C**
- extension cable strand/PFA/fiber glass/
stainless steel wire armouring **+250°C**
- _____

CABLE LENGTH: _____ m

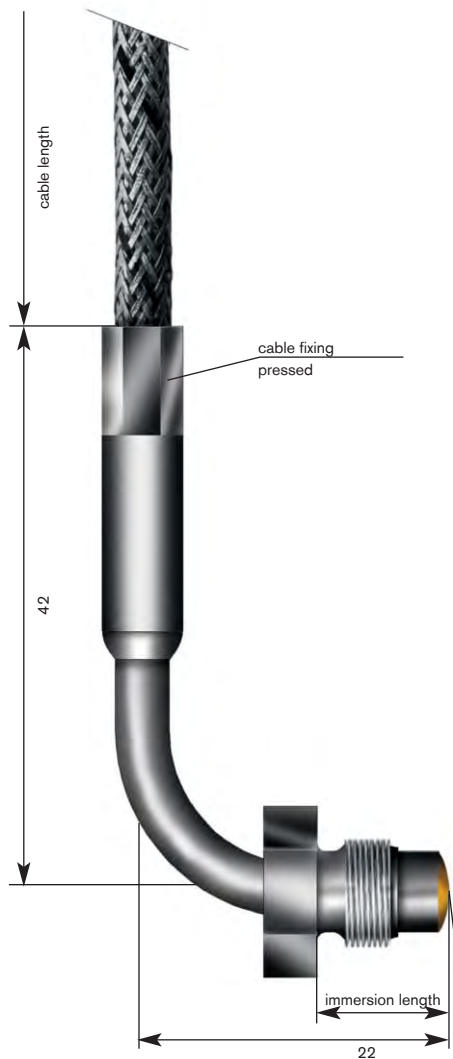
CONNECTION ENDS:

- miniature thermoplug miniature socket
- standard plug Lemo plug type _____
- clips Lemo socket type _____
- bare ends other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, double thermocouple, cable end or higher temperature resistance can be added or modified on request.

Also available in
type K, T or L* and
classes 1 or 2!



For the temperature collection at injection and diecasting moulds as well as at plastics processing machines. It is especially appropriate, whenever a straight cable lead for example due to space reasons is not possible or wanted. The steel wire armouring of the connection cable is used as mechanical protection. Fixing by a screwed thread.

THERMOCOUPLE - CLASS 2:

- 1 x type J 1 x type K other thermocouples: _____

MEASURING POINT:

- form A, insulated form B, grounded

MATERIAL:

- 1.4305

IMMERSION LENGTH: _____ mm

DIAMETER:

- Ø 6,0 mm

BOTTOM SHAPE:

- soldering cone

SCREWING:

- M8 x 1 VA dimension: _____

TYPE:

- with kink protection with fiberglass sleeve

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring **+400°C**
- extension cable strand/PFA/fiber glass/
stainless steel wire armouring **+250°C**
- _____

CABLE LENGTH: _____ m

CONNECTION ENDS:

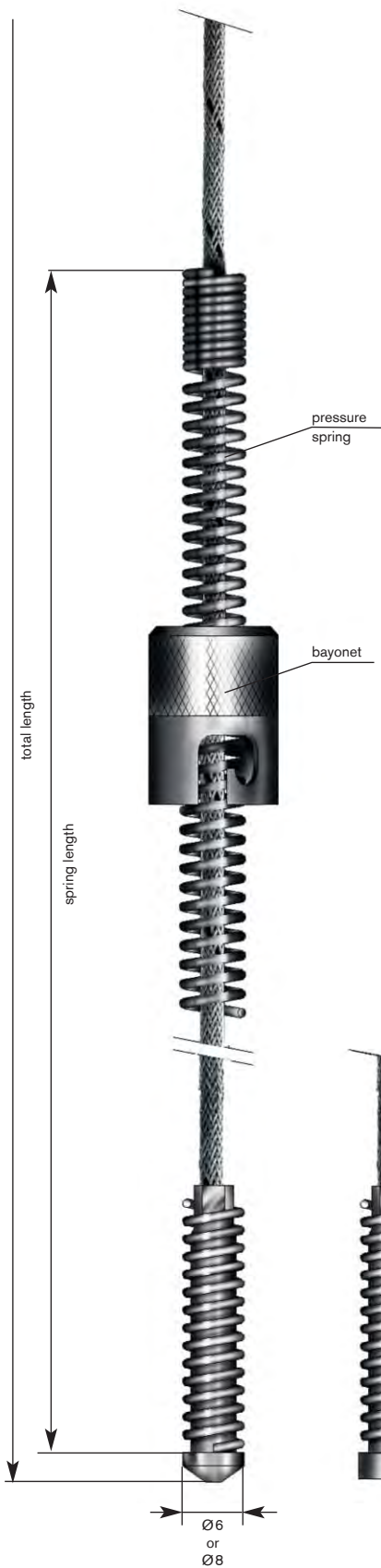
- miniature thermoplug miniature socket
- standard plug Lemo plug type _____
- clips Lemo socket type _____
- bare ends other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. nominal length, connection cable, double thermocouple or cable end can be added or modified on request.
- Other screwed threads as well as immersion length on request!

Also available in type K, T or L* and classes 1 or 2!

For the temperature collection at plastics processing machines. Fixing by bayonet joint. Bayonet freely adjustable on spring. Also available with plain measuring tip. The stainless steel wire armouring of the connection cable is used as mechanical protection.



THERMOCOUPLE - CLASS 2:

- 1 x type J 1 x type K other thermocouples: _____

MEASURING POINT:

- form A, insulated form B, grounded

MATERIAL:

- 1.4305

SPRING LENGTH:

- 200 mm _____ mm

DIAMETER:

- Ø 6,0 mm Ø 8,0 mm

BOTTOM SHAPE:

- flat 118° spherical

OPTIONS:

- with ceramic as thermal insulation

BAYONET:

- Ø i = 12,2 mm / 1 bayonet Ø i = 12,2 mm / 2 bayonet
 Ø i = 15,0 mm / 1 bayonet Ø i = 15,0 mm / 2 bayonet
 dimension: _____

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/
fiber glass/stainless steel wire armouring +400°C
 extension cable strand/PFA/
fiber glass/stainless steel wire armouring +250°C

CABLE LENGTH: _____ m

CONNECTION ENDS:

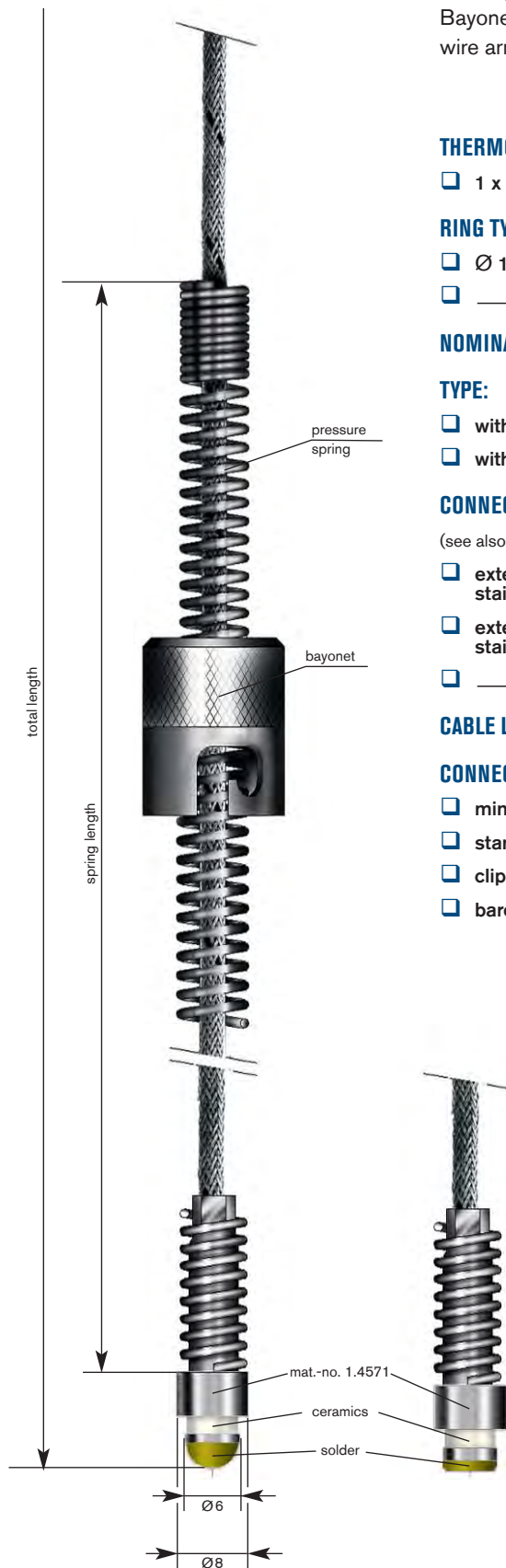
- miniature thermoplug miniature socket
 standard plug Lemo plug type _____
 clips Lemo socket type _____
 bare ends other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, double thermocouple, insulated type, spring length, bayonet or cable end can be added or modified on request.

Also available in type K, T or L* and classes 1 or 2!

For the temperature collection at plastics processing machines. Fixing by bayonet joint. Bayonet freely adjustable on spring. The steel wire armouring of the connection cable is used as mechanical protection.



THERMOCOUPLE - CLASS 2, FORM B:

- 1 x type J
- 1 x type K
- other thermocouples: _____

RING TYPE:

- Ø 14 / 4,5 mm CuSn 6
- _____

NOMINAL LENGTH: _____mm

TYPE:

- with kink protection (shrinkable sleeve)
- with fiberglass sleeve (shrinkable sleeve)

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/stainless steel wire armouring +400°C
- extension cable strand/PFA/fiber glass/stainless steel wire armouring +250°C
- _____

CABLE LENGTH: _____m

CONNECTION ENDS:

- miniature thermoplug
- miniature socket
- standard plug
- Lemo plug type _____
- clips
- Lemo socket type _____
- bare ends
- other cable ends _____

Due to the integrated ceramic as thermal insulation, an excellent response time is guaranteed.

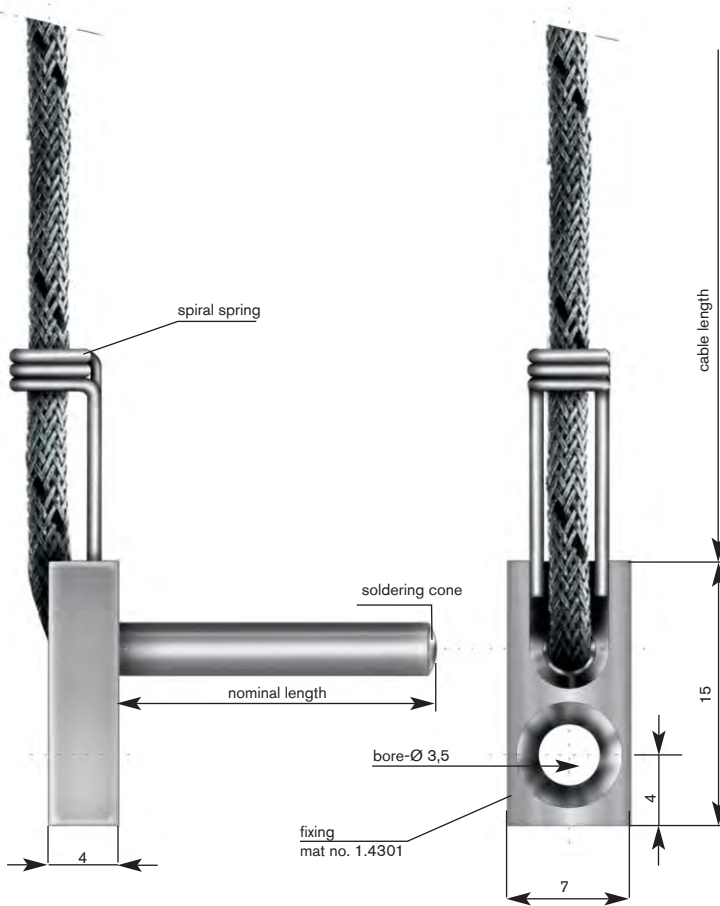


- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, insulated type, spring length, bayonet or cable end can be added or modified on request.

Also available in type K, T or L* and classes 1 or 2!

For the temperature collection at tools.

Simple fixing by a screw with initial tension (guarantees the contact between probe and plain to be measured). The stainless steel wire armoring of the connection cable is used as mechanical protection.



THERMOCOUPLE - CLASS 2:

- 1 x type J 1 x type K
- other thermocouples: _____

MEASURING POINT:

- form A, insulated
- form B, grounded

MATERIAL:

- 1.4571

DIAMETER:

- Ø 3,0 mm
- Ø 4,0 mm
- Ø 5,0 mm

FIXING AND SPIRAL SPRING:

- with without

NOMINAL LENGTH: _____ mm

CONNECTION CABLE:

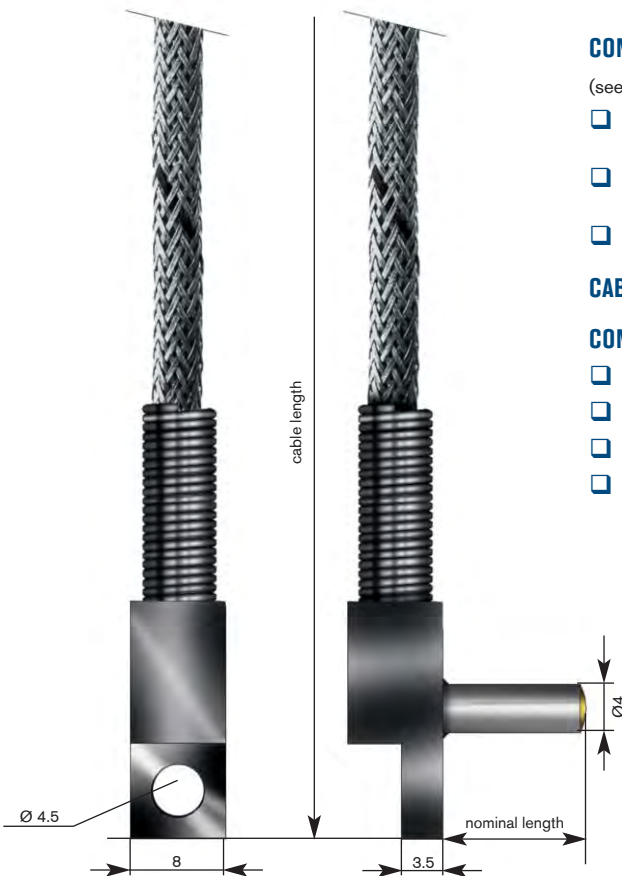
(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/ stainless steel wire armoring +400°C
- extension cable strand/PFA/fiber glass/ stainless steel wire armoring +250°C
- _____

CABLE LENGTH: _____ m

CONNECTION ENDS:

- miniature thermoplug miniature socket
- standard plug Lemo plug type _____
- clips Lemo socket type _____
- bare ends other cable ends _____

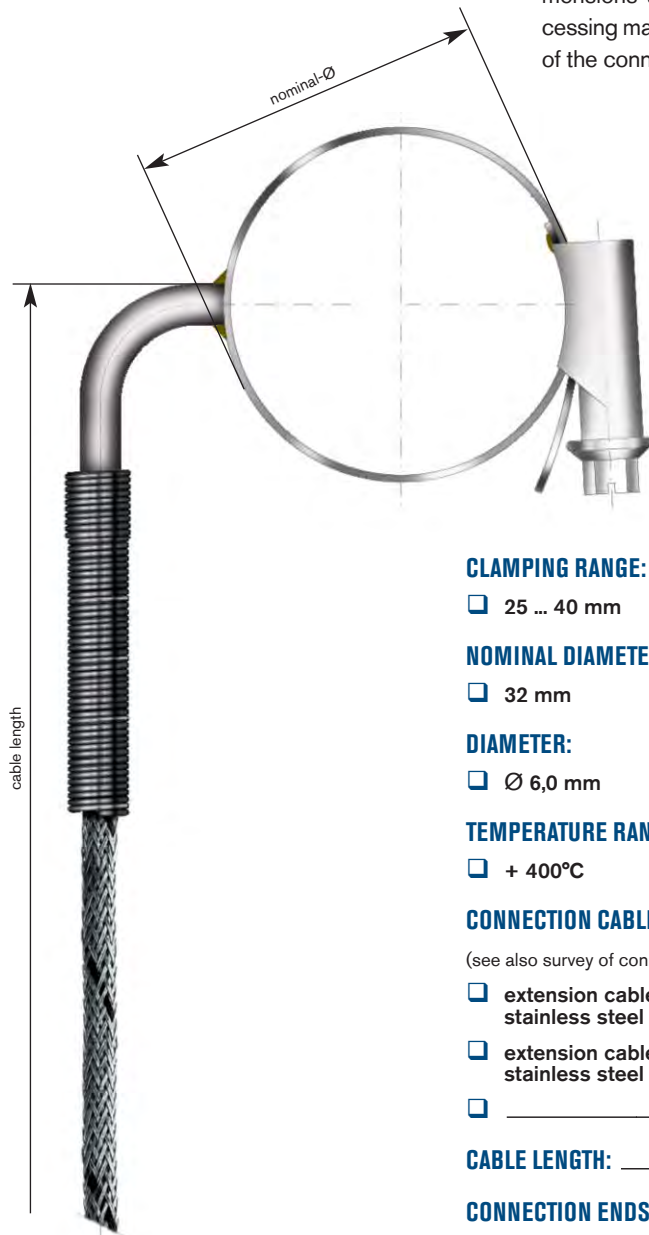


■ The above mentioned technical data are standard data.

■ Individual parameters, e. g. connection cable, double thermocouple, nominal length, bayonet or cable end can be added or modified on request.

Also available in
type K, T or L* and
classes 1 or 2!

For the temperature collection at conduits, generally spoken at all cylindric dimensions as well as at plastics processing machines. Fixing by pipe clamp. The stainless steel wire armouring of the connection cable is used as mechanical protection.



THERMOCOUPLE - CLASS 2:

- 1 x type J 1 x type K
- other thermocouples: _____

MEASURING POINT:

- soldered with pipe clamp

MATERIAL:

- 1.4571

MATERIAL PIPE CLAMP:

- 1.4016

CLAMPING RANGE:

- 25 ... 40 mm
- _____ mm

NOMINAL DIAMETER:

- 32 mm
- _____ mm

DIAMETER:

- Ø 6,0 mm

TEMPERATURE RANGE:

- + 400°C

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring +400°C
- extension cable strand/PFA/fiber glass/
stainless steel wire armouring +250°C
- _____

CABLE LENGTH: _____m

CONNECTION ENDS:

- miniature thermoplug
- miniature socket
- standard plug
- Lemo plug type _____
- clips
- Lemo socket type _____
- bare ends
- other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, double thermocouple, pipe-clamp-Ø or cable end can be added or modified on request.

Also available in
type K, T or L* and
classes 1 or 2!

For the temperature collection at conduits, generally spoken at all cylindric dimensions as well as at plastics processing machines. Fixing by pipe clamp. The stainless steel wire armouring of the connection cable is used as mechanical protection.



THERMOCOUPLE - CLASS 2:

- 1 x type J 1 x type K
- other thermocouples: _____

MEASURING POINT:

- form B, grounded measuring point

MATERIAL:

- 1.4571

NOMINAL LENGTH:

- 38 mm
- _____ mm

DIAMETER:

- Ø 6,0 mm

FIX ACCESSORIES:

- sheet 15 x 30 mm, radius: 28 mm
- _____

TEMPERATURE RANGE:

- + 400°C

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring +400°C
- extension cable strand/PFA/fiber glass/
stainless steel wire armouring +250°C
- _____

CABLE LENGTH: _____ m

CONNECTION ENDS:

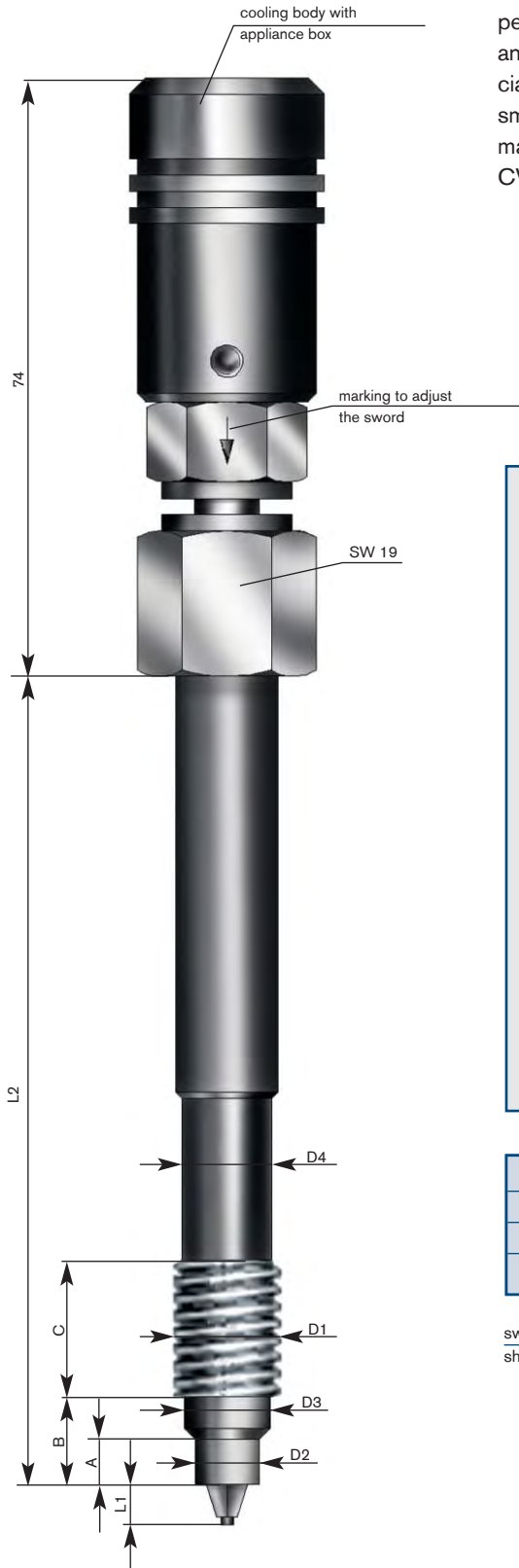
- miniature thermoplug miniature socket
- standard plug Lemo plug type _____
- clips Lemo socket type _____
- bare ends other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, double thermocouple, radius or cable end can be added or modified on request.

Also available in
type K, T or L* and
classes 1 or 2!

For the temperature collection of fictile plastics in extruders, injection moulders and injection tools. Our molten mass temperature probes with swordshaped measuring tip have a quick response time and avoid any waviness in the mass due to its flow-favouring shape. The special mounting of the measuring tip keeps the fault due to heat dissipation as small as possible. Our standard measuring tips are made of stainless steel, material no. 1.4571. For especially abrasive plastics measuring tips with CVD-coating made of titanium carbide / titanium nitride are available.



The dimensions of the mass temperature probe enable the installation in already existing pressure absorption mounting bores. The standard threads are 1/2"-20UNF and M 18 x 1.5.

With a swordshaped measuring tip a marking makes possible the exact fixing of the sword in flow direction.

The molten mass temperature probes are available as straight or angle construction type with:

- fixed cable connection
- integrated plug-in connection at the end of the protecting tube plus extension cable with counter-plug available.

Immersion depth and shank length see illustration.

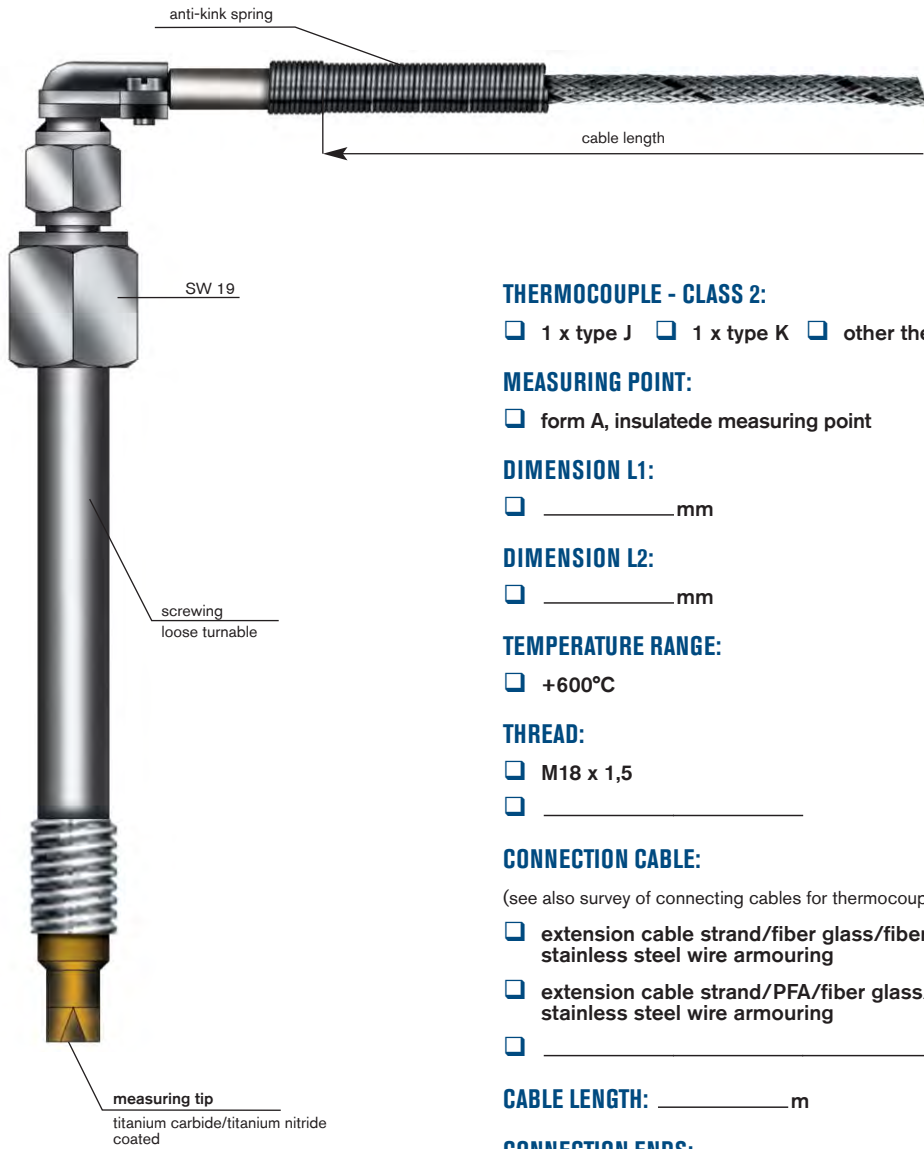
Response time:

Time	SAB T-393
T50	4,4 s
T90	8,1 s

1/2-20UNF-2A	7.8 -0.05	10.5 -0.05	12.5 -0.5	5.6 -0.1	10.8	17
M18 x1.5	10.0 -0.5	16.0 -0.1	16.0 -0.5	6.0 -0.25	14.0	20
M14x1.5	8.0 -0.5	12.0 -0.1	12.0 -0.5	6.0 -0.25	12.0	20
D1	ØD2	ØD3	ØD4	A	B	C

sword length L1 min. 5, max. 30 mm
shank length L2 standard length 152 mm

Also available in type K, T or L* and classes 1 or 2!



THERMOCOUPLE - CLASS 2:

- 1 x type J 1 x type K other thermocouples:_____

MEASURING POINT:

- form A, insulatede measuring point

DIMENSION L1:

- _____ mm

DIMENSION L2:

- _____ mm

TEMPERATURE RANGE:

- +600°C

THREAD:

- M18 x 1,5
- _____

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/ stainless steel wire armouring +400°C
- extension cable strand/PFA/fiber glass/ stainless steel wire armouring +250°C
- _____

CABLE LENGTH: _____ m

CONNECTION ENDS:

- | | |
|---|---|
| <input type="checkbox"/> miniature thermoplug | <input type="checkbox"/> miniature socket |
| <input type="checkbox"/> standard plug | <input type="checkbox"/> Lemo plug type _____ |
| <input type="checkbox"/> clips | <input type="checkbox"/> Lemo socket type _____ |
| <input type="checkbox"/> bare ends | <input type="checkbox"/> other cable ends _____ |

Hardness of the measuring tip acc. to Vickers (HV)

TiC/TiN	=	HV 2400
Wolfram - Carbit	=	HV 2080



- The above mentioned technical data are standard data.
- Individual parameters, e. g. immersion depth, connection cable, double thermocouple, Pt 100 in 2-, 3- or 4-wire circuit, or cable end can be added or modified on request.

ANGLE RESISTANCE THERMOMETER T531

General Information

With a 2-wire circuit only one class accuracy class B accuracy can be confirmed.

Also available as Pt 500 or Pt 1000 with limit deviations in classes A or B!

For the temperature collection at plastics processing machines or similar. It is especially appropriate, whenever a straight cable lead for example due to space reasons is not possible or wanted. The stainless steel wire armouring of the connection cable is used as mechanical protection. Fixing by a clamping screw connection.



RTD:

- 1 x Pt 100 2 x Pt 100

LIMIT DEVIATION:

- class A class B

LIMITING DEVIATION:

- class A -30°C / +300°C -100°C / +450°C
 class B -50°C / +500°C -196°C / +600°C

CONNECTION TYPE OF INNER WIRE:

- 2-wire circuit _____

NOMINAL LENGTH: _____ mm

DIAMETER:

- Ø 6,0 mm Ø 8,0 mm Ø _____ mm

MATERIAL:

- 1.4571

TYPE:

- with kink protection without kink protection

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring +400°C
 extension cable strand/PFA/fiber glass/
stainless steel wire armouring +250°C

CABLE LENGTH: _____ m

CONNECTION ENDS:

- miniature thermoplug miniature socket
 standard plug Lemo plug type _____
 clips Lemo socket type _____
 bare ends other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. nominal length, connection cable, double resistance thermometer in 3-or 4- wire circuit, cable end or higher temperature resistance can be added or modified on request.

PLUG-IN RESISTANCE THERMOMETER T521

General Information

With a 2-wire circuit only one class accuracy class B accuracy can be confirmed.

Also available as Pt 500 or Pt 1000 with limit deviations in classes A or B!

For the temperature collection at plastics processing machines or similar. The stainless steel wire armouring of the connection cable is used as mechanical protection.



RTD:

- 1 x Pt 100

LIMIT DEVIATION:

- class A class B

LIMITING DEVIATION:

- class A -30°C / +300°C -100°C / +450°C
 class B -50°C / +500°C -196°C / +600°C

CONNECTION TYPE OF INNER WIRE:

- 2-wire circuit _____

NOMINAL LENGTH:

- 29 mm 31 mm

DIAMETER:

- Ø 3,5 mm

MATERIAL:

- 1.4571

TYPE:

- with kink protection without kink protection

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/
stainless steel wire armouring +400°C
 extension cable strand/PFA/fiber glass/
stainless steel wire armouring +250°C

CABLE LENGTH: _____m

CONNECTION ENDS:

- miniature thermoplug miniature socket
 standard plug Lemo plug type _____
 clips Lemo socket type _____
 bare ends other cable ends _____



- The above mentioned technical data are standard data.
- Individual parameters, e. g. nominal length, connection cable, double resistance thermometer in 3-or 4- wire circuit, cable end or higher temperature resistance can be added or modified on request.

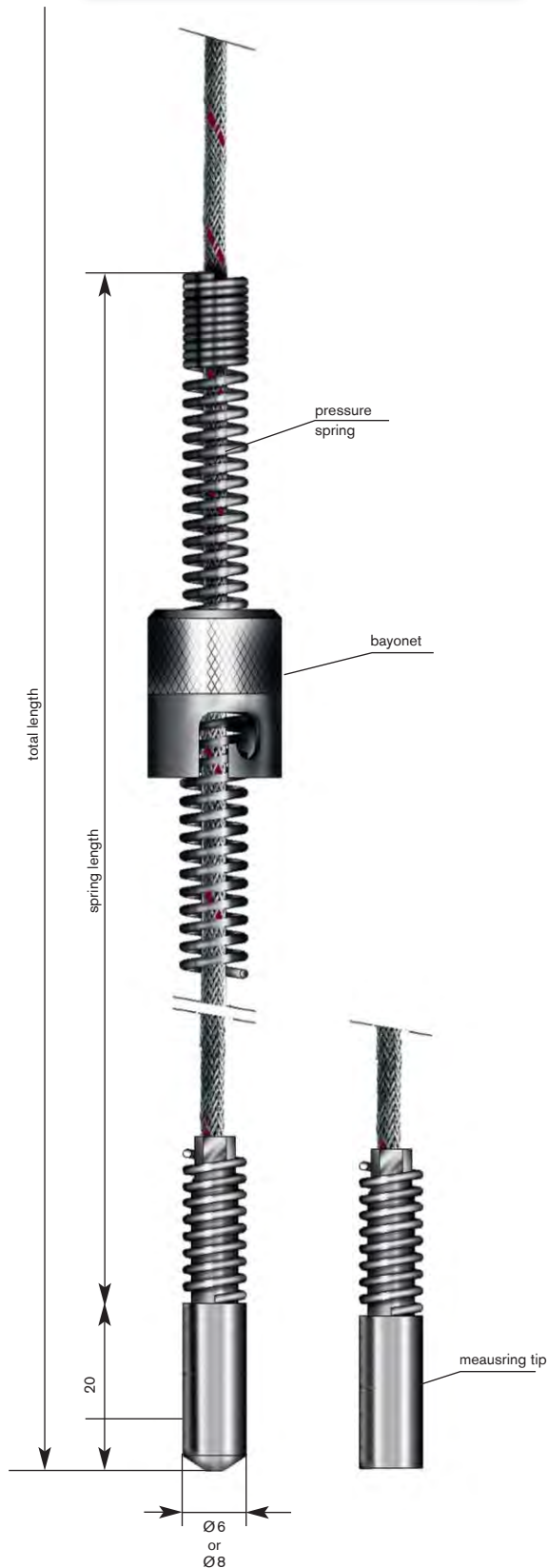
BAYONET RESISTANCE THERMOMETER T542

General Information

With a 2-wire circuit only one class accuracy class B accuracy can be confirmed.

For the temperature collection at plastics processing machines or similar. The stainless steel wire armouring of the connection cable is used as mechanical protection.

Also available as Pt 500 or Pt 1000 with limit deviations in classes A or B!



RTD:

- 1 x Pt 100 2 x Pt 100
- other thermocouples: _____

LIMIT DEVIATION:

- class A class B

LIMITING DEVIATION:

- class A -30°C / +300°C -100°C / +450°C
- class B -50°C / +500°C -196°C / +600°C

CONNECTION TYPE OF INNER WIRE:

- 2-wire circuit _____

MATERIAL:

- 1.4305

SPRING LENGTH:

- 200 mm _____ mm

DIAMETER:

- Ø 6,0 mm Ø 8,0 mm

BOTTOM SHAPE:

- flat 118° spherical

BAYONET:

- Ø i = 12,2 mm / 1 bayonet Ø i = 12,2 mm / 2 bayonet
- Ø i = 15,0 mm / 1 bayonet Ø i = 15,0 mm / 2 bayonet
- dimension: _____

CONNECTION CABLE:

(see also survey of connecting cables for thermocouples)

- extension cable strand/fiber glass/fiber glass/stainless steel wire armouring +400°C
- extension cable strand/PFA/fiber glass/stainless steel wire armouring +250°C
- _____

CABLE LENGTH: _____ m

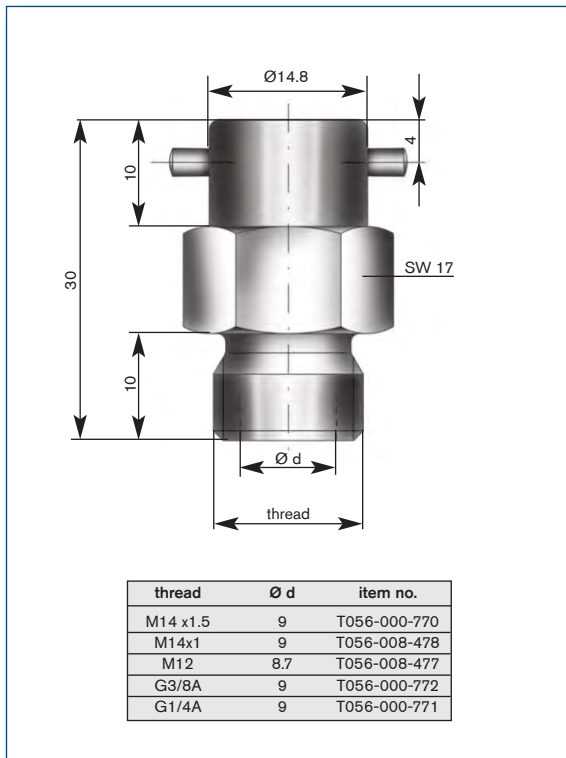
CONNECTION ENDS:

- miniature thermoplug miniature socket
- standard plug Lemo plug type _____
- clips Lemo socket type _____
- bare ends other cable ends _____

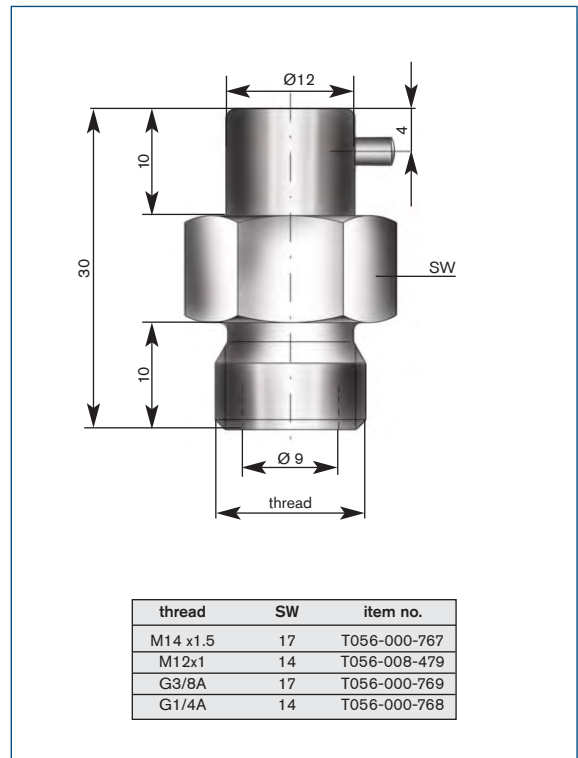


- The above mentioned technical data are standard data.
- Individual parameters, e. g. connection cable, spring length, double resistance thermometer in 3- or 4- wire circuit, cable end or higher temperature resistance can be added or modified on request.

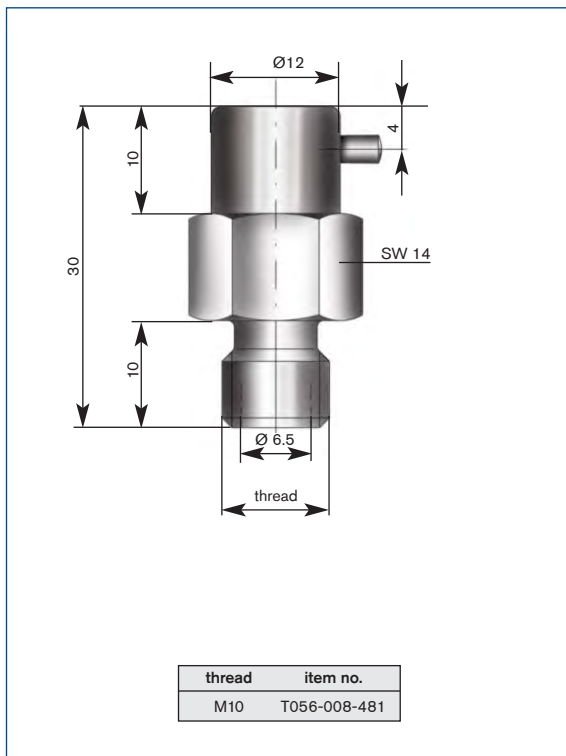
form A · probe-Ø max. 8 mm



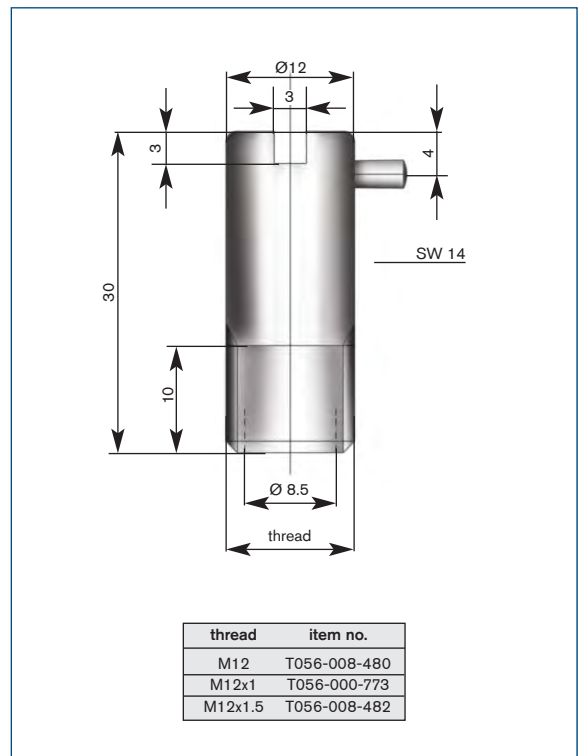
form B · probe-Ø max. 8 mm



form C · probe-Ø max. 6 mm



form C · probe-Ø max. 8 mm





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