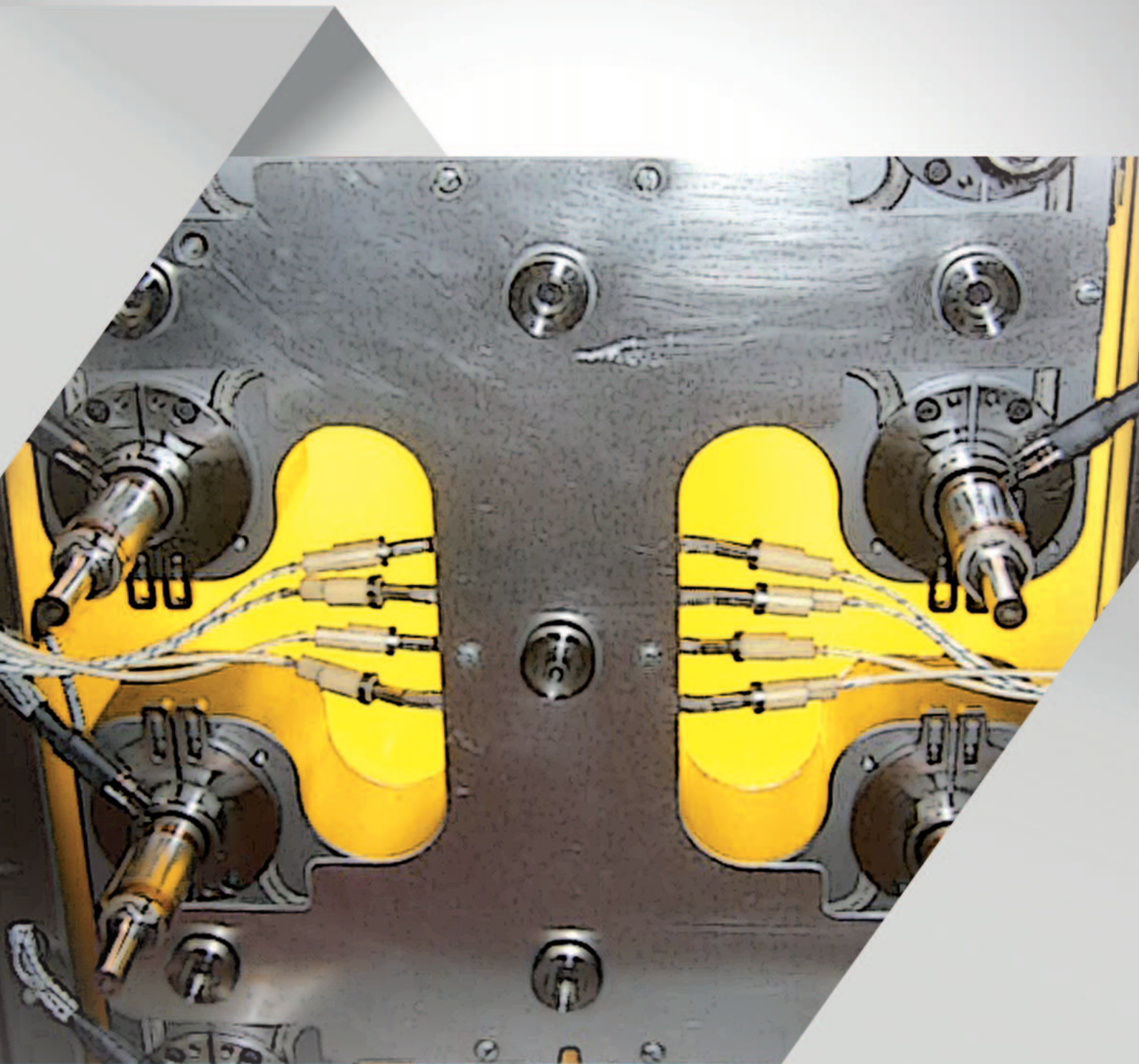


TEMPERATURE MEASUREMENT IN PLASTICS PROCESSING INDUSTRY



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FAMILY BUSINESS IN THE THIRD GENERATION

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.

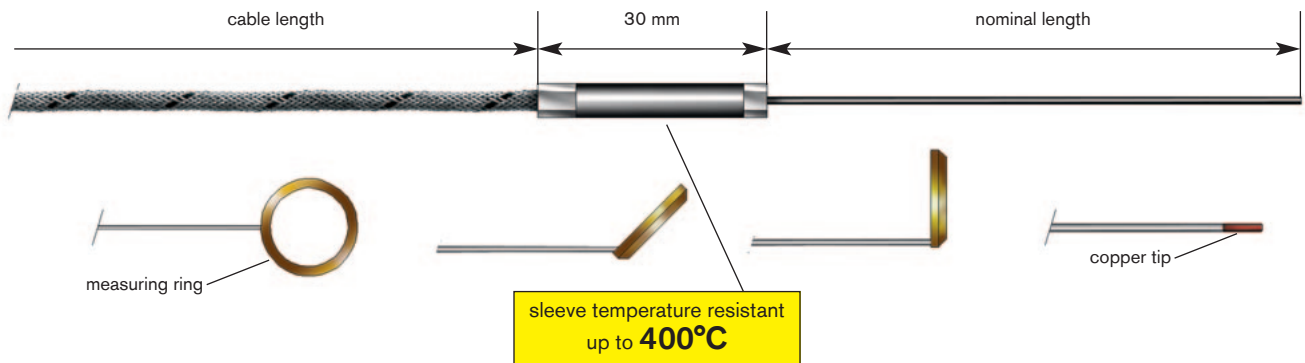
Today, the quality of our products is known and appreciated in more than 100 countries around the world. In all product ranges, we are certified according to DIN EN ISO 9001. Furthermore, we have implemented an environmental management system for our company according to DIN EN ISO 14001, an occupational health and safety management system according to NLF/ILO-OSH and DIN ISO 45001, and an energy management system according to DIN EN ISO 50001.

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

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 approved burnchamber and laboratory within the company.
EMPLOYEES/WORKERS:	Approx. 430 at the plant in Viersen, 550 worldwide
YEARLY SALES:	Approx. 134 Mio. € worldwide
PRODUCTS:	Special Cables Measurement Technology Cable Harnessing
CERTIFICATES AND APPROVALS:	<div style="display: flex; align-items: flex-start;"> <div style="flex: 1;">  </div> <div style="flex: 2;"> <p>Quality management system acc. to DIN EN ISO 9001 for every manufacturing field</p> <p>Environmental management system acc. to DIN EN ISO 14001</p> <p>Occupational health and safety management acc. to NLF/ILO-OSH and DIN ISO 45001</p> <p>Energy management system acc. to DIN EN ISO 50001</p> </div> </div>

THERMOCOUPLES

HOT RUNNER MINERAL INSULATED THERMOCOUPLE T219



■ 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. The 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.



The inner and outer-Ø as well as the angle to the mineral insulated thermocouple can be chosen on request.

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

* type L acc. to DIN 43710

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



The above mentioned technical data are standard data.

THERMOCOUPLES

THERMOCOUPLE WITH STAINLESS STEEL SLEEVE T221



■ 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 in type K, T or L*
and classes 1 or 2.

* type L acc. to DIN 43710

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 3,5 mm
- Ø 4,0 mm
- Ø 5,0 mm
- Ø 6,0 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 +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.

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

THERMOCOUPLES

RING THERMOCOUPLE T224



■ 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.



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

* type L acc. to DIN 43710

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 _____



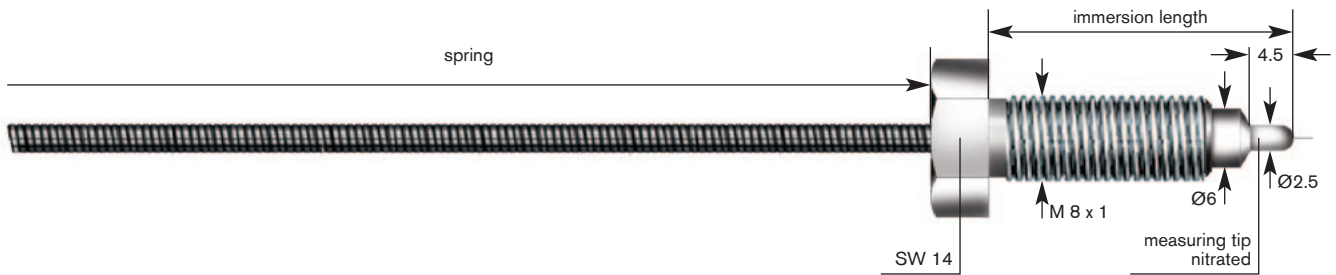
The above mentioned technical data are standard data.

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

Other ring diameters on request.

THERMOCOUPLES

MOLTEN MASS THERMOCOUPLE T229



■ 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.



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

* type L acc. to DIN 43710

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:

- M 8 x 1 VA
- _____

Immersion length:

- 31,5 mm

Diameter:

- Ø 6,0 mm / 2,5 mm

Connection cable:

(siehe auch Übersicht Anschlussleitungen für Thermoelemente)

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

Cable length: _____ m

Connection ends:

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



The above mentioned technical data are standard data.

Individual parameters, e. g. thread can be added or modified on request.

THERMOCOUPLES

ANGLE THERMOCOUPLE T231 / T233



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

* type L acc. to DIN 43710

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

Cable length: _____ m

Connection ends:

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

cable length

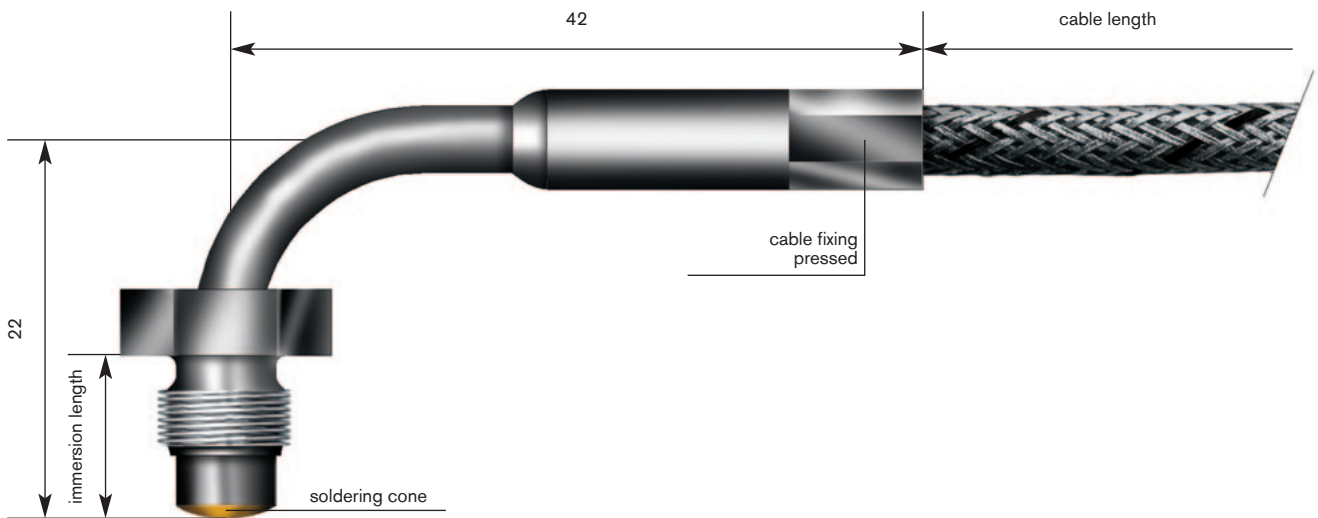


The above mentioned
technical data
are standard data.

Individual parameters,
e. g. connection cable,
double thermocouple,
cable end or higher
temperature resistance
can be added or modified
on request.

THERMOCOUPLES

ANGLE SCREWED THERMOCOUPLE T235



■ For the temperature collection at injection and die-casting 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.



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

* type L acc. to DIN 43710

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 _____



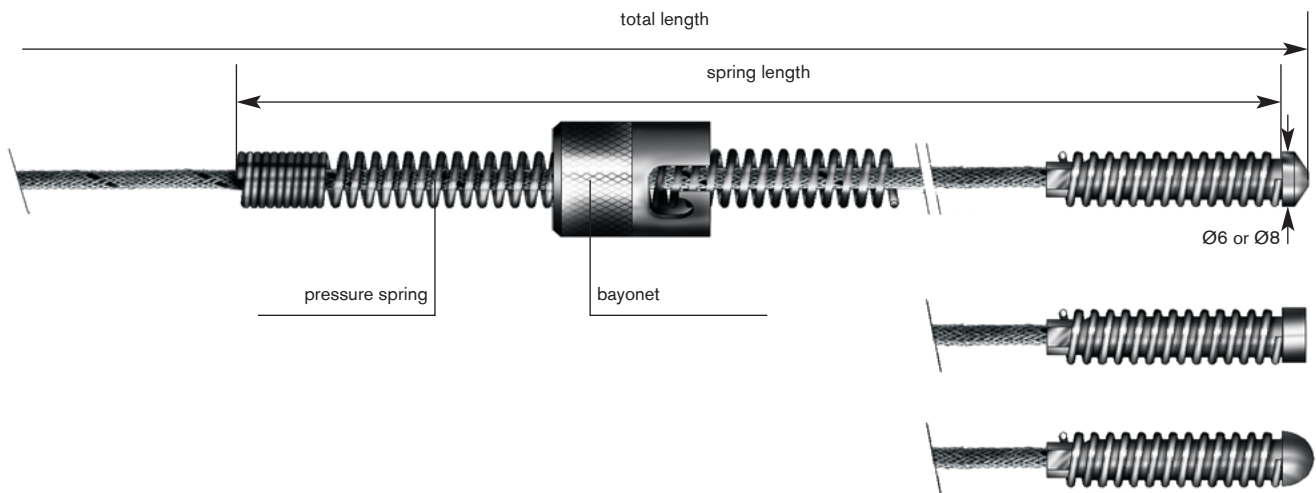
The above mentioned technical data are standard data.

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

Other ring diameters on request.

THERMOCOUPLES

BAYONET THERMOCOUPLE T242 / T245



■ 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.



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

* type L acc. to DIN 43710

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

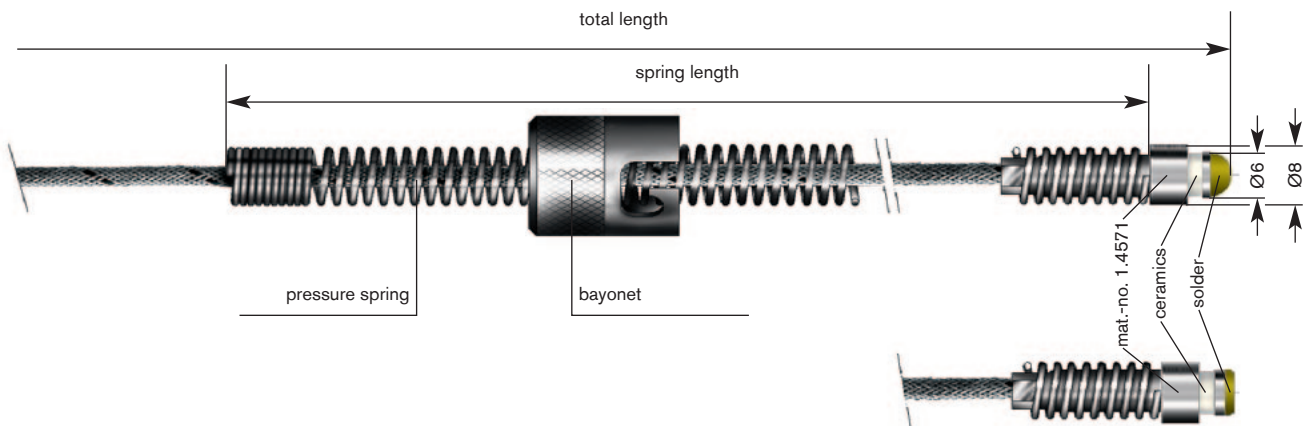


The above mentioned technical data are standard data.

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

THERMOCOUPLES

PLUG-IN THERMOCOUPLE T247



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



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

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

* type L acc. to DIN 43710

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 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 _____

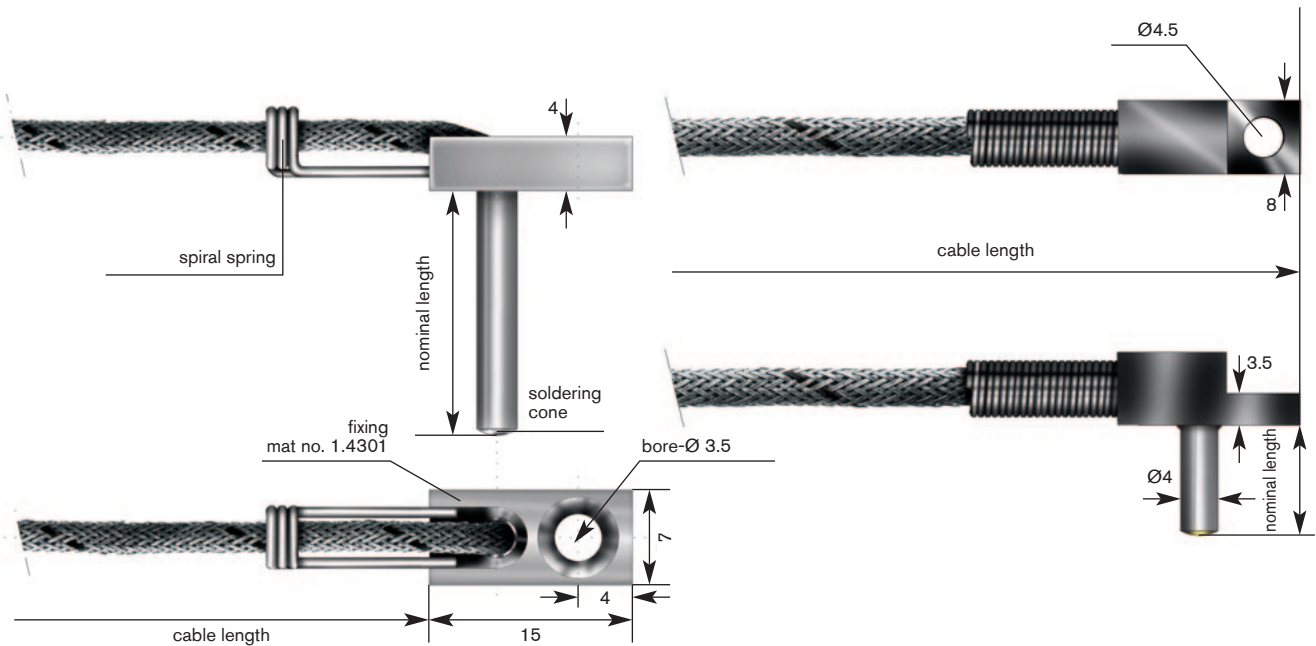


The above mentioned technical data are standard data.

Individual parameters, e. g. connection cable, insulated type, spring length, bayonet or cable end can be added or modified on request.

THERMOCOUPLES

ANGLE THERMOCOUPLE T277



■ 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 armouring of the connection cable is used as mechanical protection.



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

* type L acc. to DIN 43710

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

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

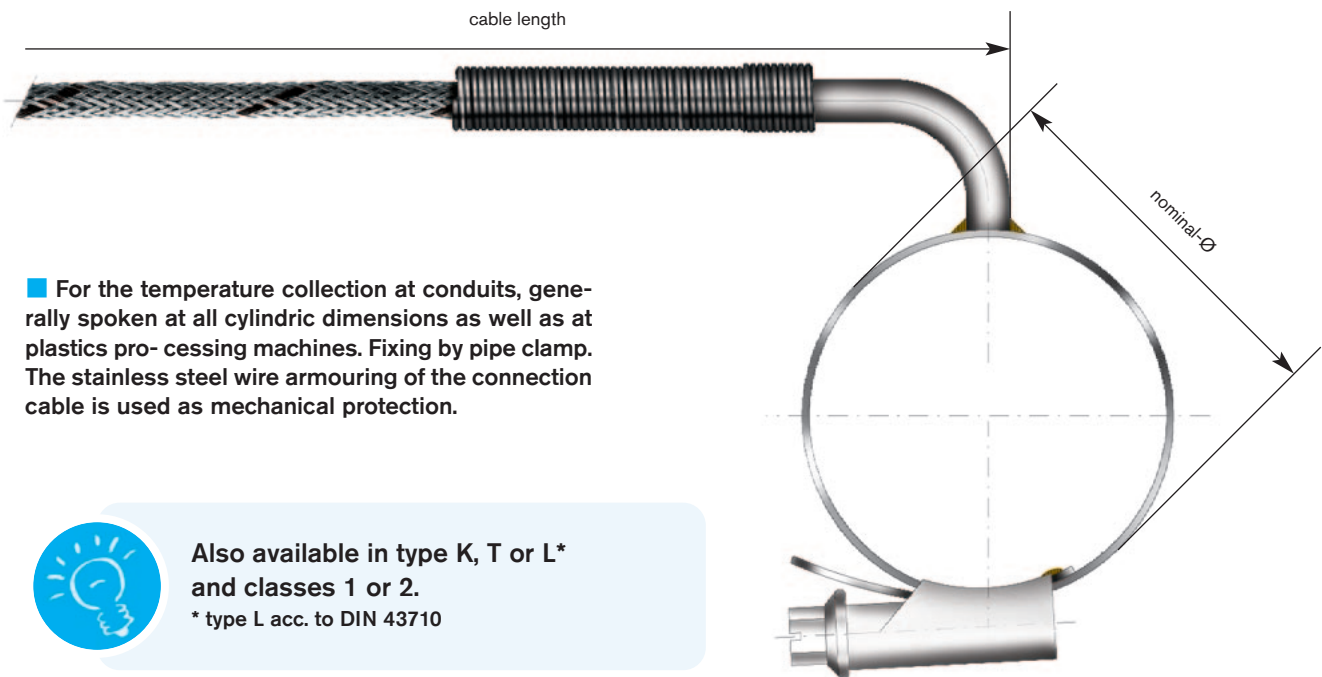


The above mentioned technical data are standard data.

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

THERMOCOUPLES

PIPE-CLAMP THERMOCOUPLE T286



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



Also available in type K, T or L* and classes 1 or 2.
* type L acc. to DIN 43710

Thermocouple - class 2:

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

Measuring point:

- soldered with pipe clamp

Material:

- 1.4541

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

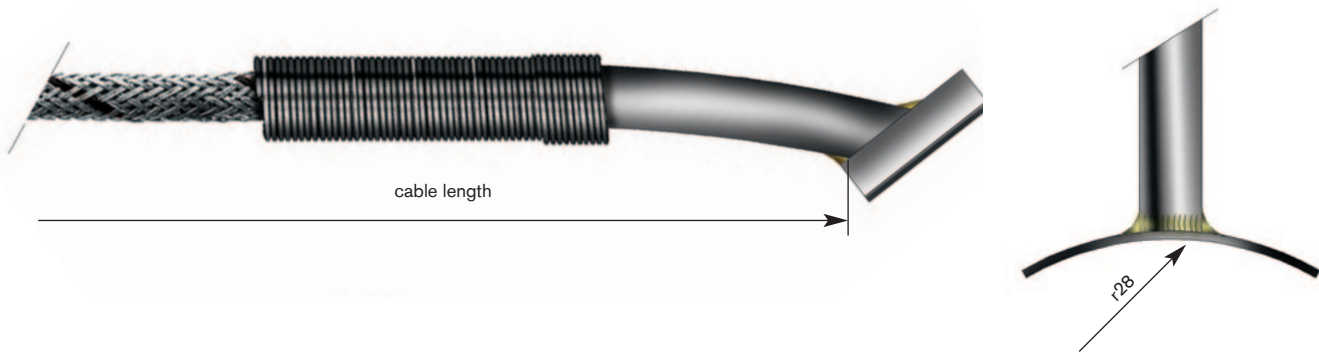


The above mentioned technical data are standard data.

Individual parameters, e. g. connection cable, double thermocouple, pipe-clamp-Ø or cable end can be added or modified on request.

THERMOCOUPLES

SURFACE THERMOCOUPLE T999



■ 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.



Also available in type K, T or L*
and classes 1 or 2.
* type L acc. to DIN 43710

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

Nominal length: _____ mm

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

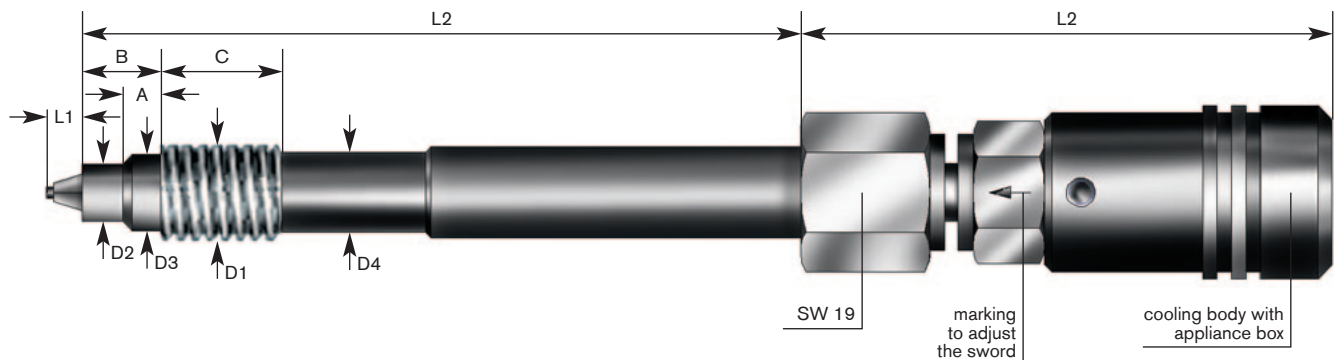


The above mentioned technical data are standard data.

Individual parameters, e. g. connection cable, double thermocouple, radius or cable end can be added or modified on request.

TEMPERATURE PROBE

MOLTEN MASS TEMPERATURE PROBE T393



■ 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.



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

* type L acc. to DIN 43710

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 -0.05	16.0 -0.1	16.0 -0.5	6.0 -0.25	14.0	20
M14x1.5	8.0 -0.05	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

TEMPERATURE PROBE

MOLTEN MASS TEMPERATURE PROBE T393



Hardness of the measuring tip acc. to Vickers (HV)	
TiC/TiN	= HV 2400
Wolfram - Carbit	= HV 2080



Also available in type K, T or L*
and classes 1 or 2.
* type L acc. to DIN 43710

Thermocouple - class 2:

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

Measuring point:

- form A, insulated 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:

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

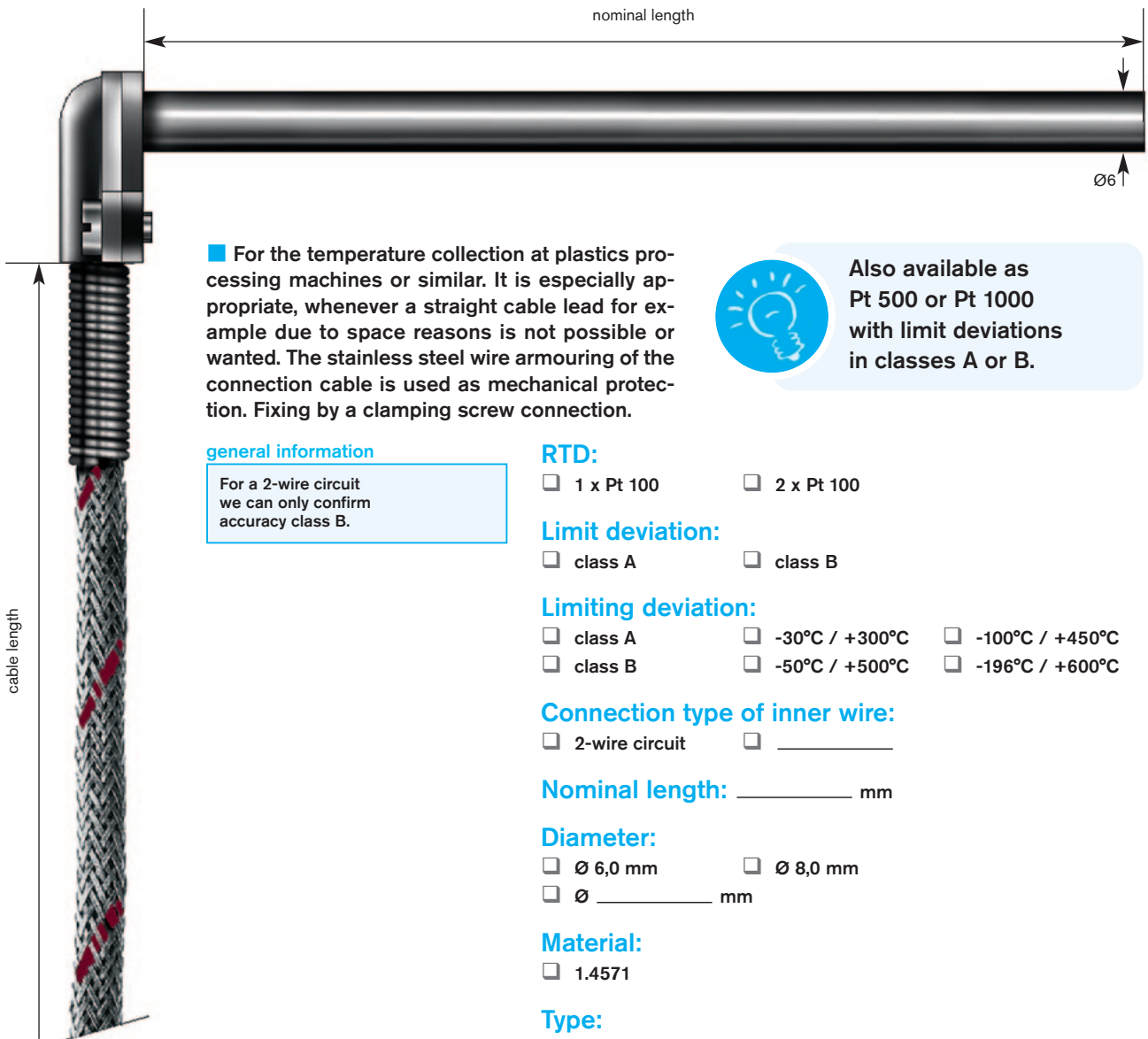


The above mentioned technical data are standard data.

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.

RESISTANCE THERMOMETER

ANGLE RESISTANCE THERMOMETER T531



■ 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 armoring of the connection cable is used as mechanical protection. Fixing by a clamping screw connection.



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

general information

For a 2-wire circuit we can only confirm accuracy class B.

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 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 _____

cable length



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.

RESISTANCE THERMOMETER

PLUG-IN RESISTANCE THERMOMETER T521



■ 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.

general information

For a 2-wire circuit we can only confirm accuracy class B.

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 _____

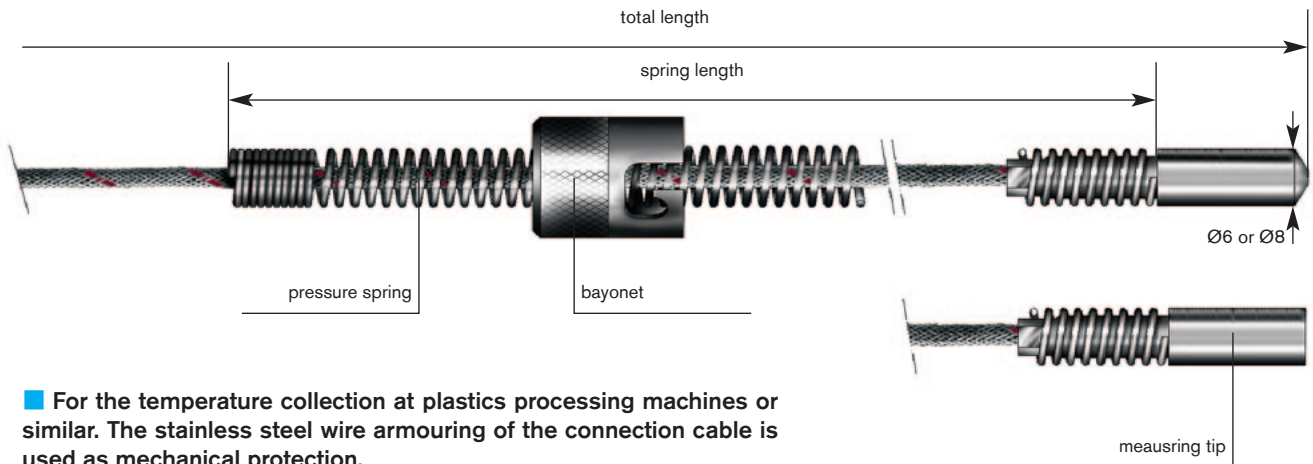


The above mentioned technical data are standard data.

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.

RESISTANCE THERMOMETER

BAYONET RESISTANCE THERMOMETER T542



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

general information

For a 2-wire circuit we can only confirm accuracy class B.



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 class B
- 30°C / +300°C -50°C / +500°C
- 100°C / +450°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 _____

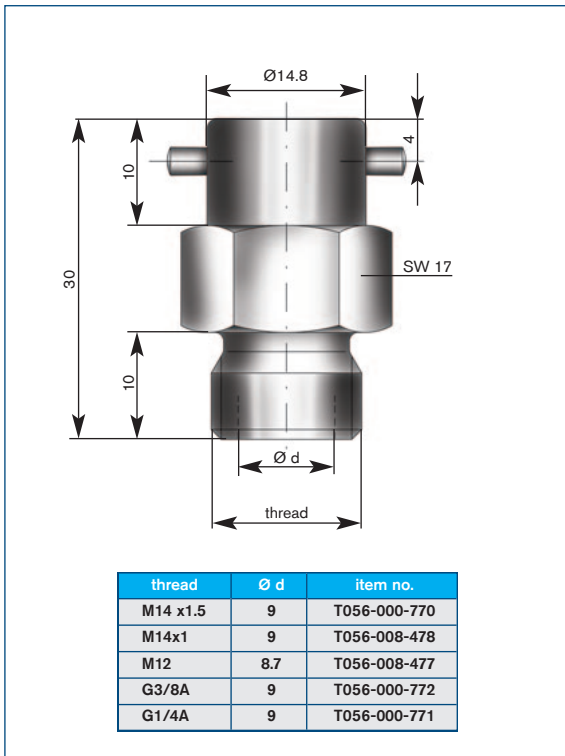


The above mentioned technical data are standard data.

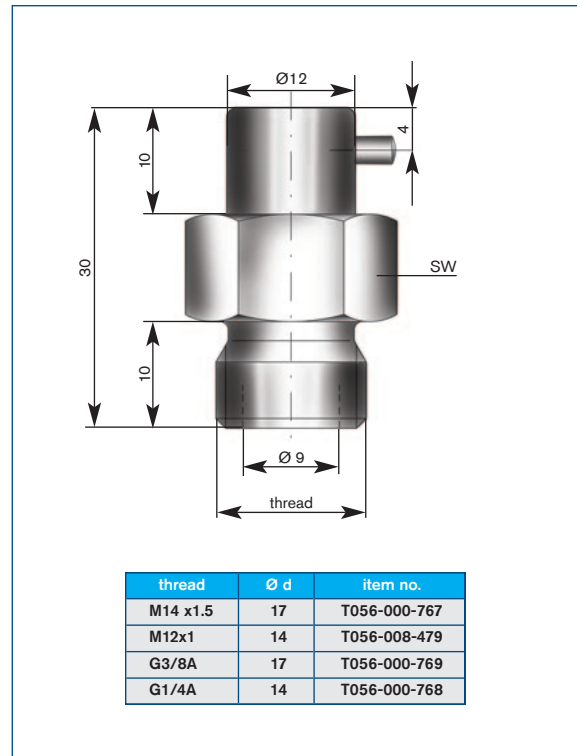
Individual parameters, e. g. nominal length, connection cable, spring length, double resistance thermometer in 3-or 4- wire circuit, cable end or higher temperature resistance can be added or modified on request.

NIPPELS

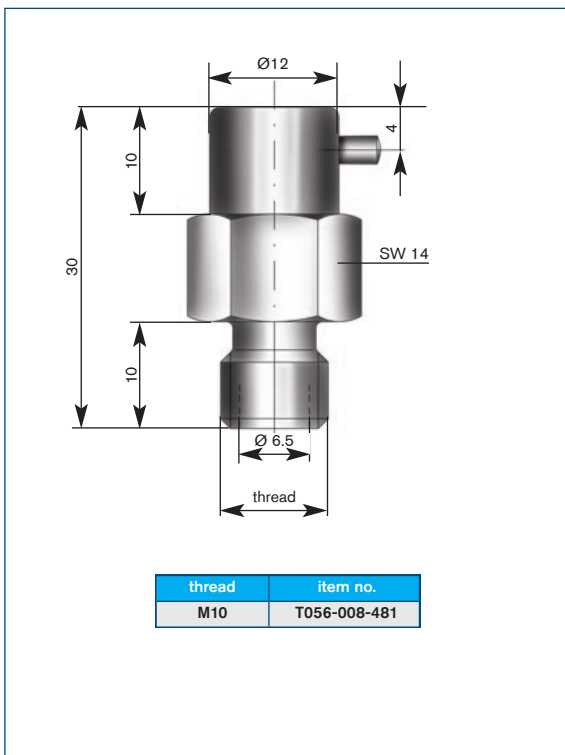
form A · probe-Ø max. 8 mm



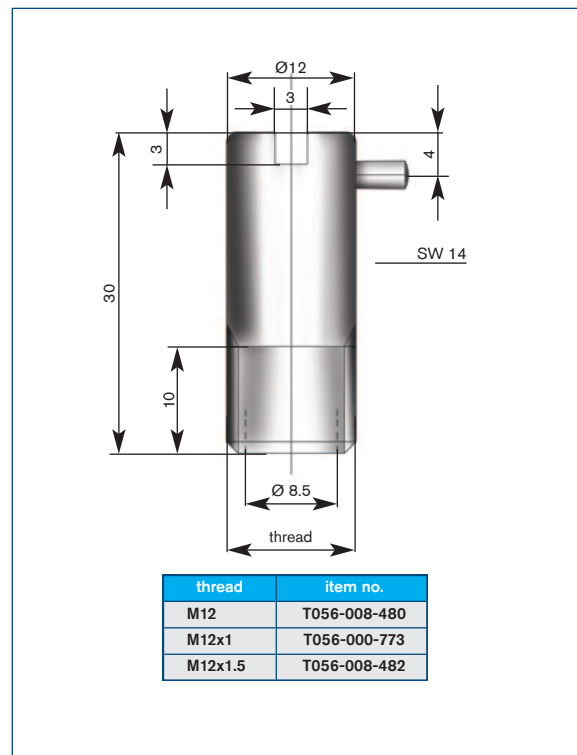
form B · probe-Ø max. 8 mm



form C · probe-Ø max. 6 mm



form C · probe-Ø max. 8 mm



GENERAL INFORMATION ON TEMPERATURE MEASUREMENT WITH CONTACT THERMOMETERS

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.

ADVANTAGES OF THERMOCOUPLES AND RESISTANCE THERMOMETERS

thermocouples

- ▶ larger temperature range than resistance thermometers.
- ▶ small hot junction enables short response time.
- ▶ more robust and resistant against mechanical stress.
- ▶ cheaper.

resistance thermometers

- ▶ Platinum resistance thermometers are the most accurate sensors and have the best long-time stability.
due to the chemical resistance of Platinum, the risk of impurity by oxidation and other chemical influences is reduced.
- ▶ high consistency.



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 OF 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	±3,0°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	±3,0°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

BASIC VALUES OF RTDS

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

class	validity range °C		limit deviation ^a °C
	leaded resistor	film resistor	
AA	-50 bis +250	0 bis +150	± (0,1 + 0,0017 [t])
A	-100 bis +450	-30 bis +300	± (0,15 + 0,002 [t])
B	-196 bis +600	-50 bis +500	± (0,3 + 0,005 [t])
C	196 bis +600	-50 bis +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 Ω	allowed deviation			
		class A		class B	
		Ω	°C	Ω	°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 RANGES

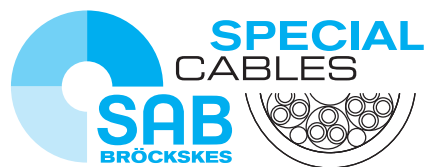
for compensating and extension cables

THERMOCOUPLE							
		DIN IEC 584	DIN 43710*	ANSI MC 96.1	BS 4937	NF C 42-324	
Material ⊕ ⊖	Identification	THL	AGL	THL	AGL	THL	AGL
		T	Cu - Cu Ni	 TX -25° to +100°C		 0° to +100°C	 0° to +100°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



SAB Bröckskes GmbH & Co. KG

Grefrather Str. 204 - 212 b

41749 Viersen · GERMANY

Tel.: +49/2162/898-0

Fax: +49/2162/898-101

www.sab-cable.com

info@sab-cable.com