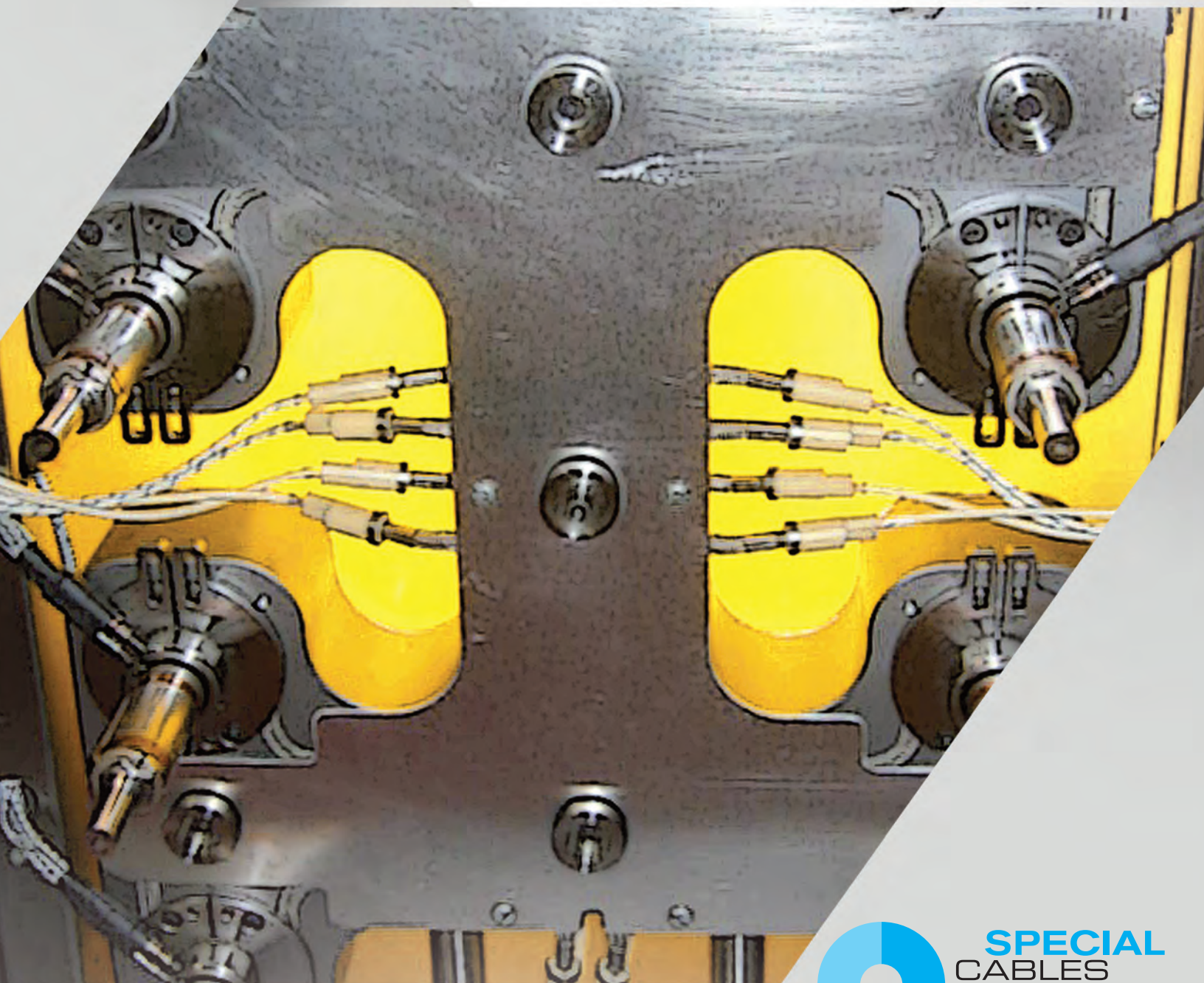
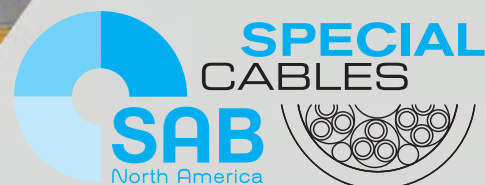


# TEMPERATURE MEASUREMENT IN PLASTICS PROCESSING



[www.sabcable.com](http://www.sabcable.com)  
866-722-2974 ■ [info@sabcable.com](mailto:info@sabcable.com)



## About Us



SAB North America is a focused supplier for the automation, aerospace, medical, high temperature, and robotics industries, providing cable and thermocouple solutions that meet, exceed, and set new standards in the flexible cable market. In addition to flexible cable products, we offer an extensive inventory of high-quality cable accessories, including cord grips, grounding glands and other accessories that complement our flexible control and automation cables.

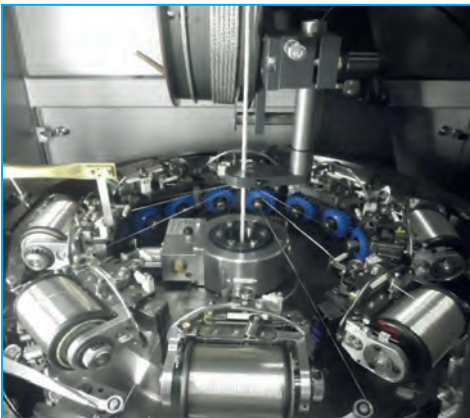
Whatever the need may be, look to SAB North America for Special Cables that can, for example, help minimize maintenance costs and increase productivity, reduce downtime, and solve specific problems. Here is a small sample of some of the challenges that Special Cables from SAB North America can help address:

- Hybrid designs for multiple functions
- Harsh environments
- Difficult applications
- Industry-specific requirements



In plastics processing, the processing temperature is a key variable. Fast temperature detection as well as reliable temperature monitoring must therefore be ensured during the entire production process. Thermocouples from SAB have been monitoring the different stages of plastics processing applications for more than 75 years. Typical applications of our temperature sensors include temperature measurement on surfaces, monitoring of temperature in injection and die casting molds, or for measuring the melting temperature in injection nozzles. SAB will help you choose a suitable thermocouple for your specific application. We design and manufacture thermocouples according to your individual measurement requirements and technical specifications.

SAB's level of speed and service as a supplier is unmatched. SAB lives up to its name in not only flexible cable but also flexible manufacturing.



## SAB Advantage...We make it Easy

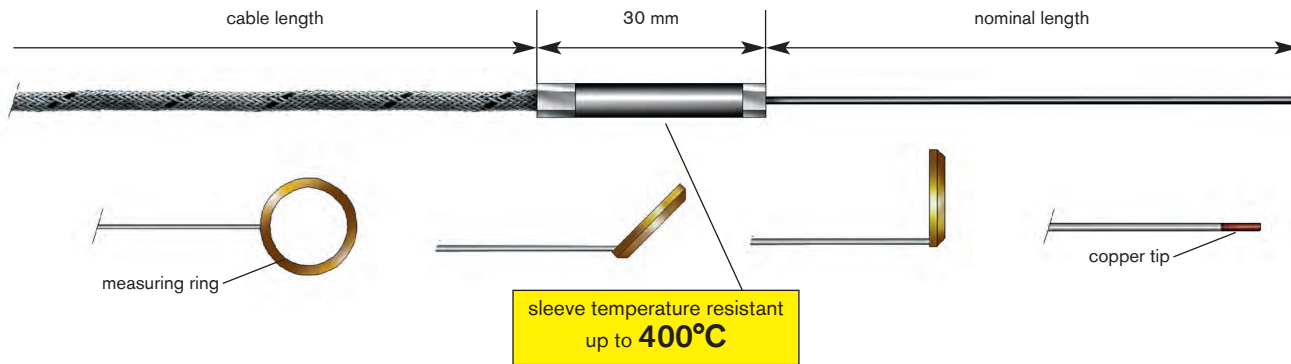
- Engineering & technical assistance
- Cut to length with no cut charges
- Prepaid freight within US for orders over \$2,500
- Specialty cable designs (1500 ft minimum)
- No minimum on orders from stock
- Free drop shipments (no surcharges)
- 24-hour shipments from stock
- Cord Grips for securing and grounding cables

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# THERMOCOUPLES

## HOT RUNNER MINERAL INSULATED THERMOCOUPLE T219



■ The high temperature resistance of the connection sleeve is highly suitable for use in hot runner systems. Three standard construction types of the measuring tip are available. The sensor type can be completed with a copper tip, measuring ring, or without fixed accessories. Without fixed accessories, the mineral insulated thermocouple is suitable for placing into a groove considering the diameter. After being deformed, the copper tip is suitable to be cramped under a pipe clamp. The measuring rings are 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 locking.



The inner and outer-Ø as well as the angle to the mineral insulated thermo-couple 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 armoring +400°C
- extension cable strand/PFA/fiber glass/  
stainless steel wire armoring +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 is standard technical data.

# THERMOCOUPLES

## THERMOCOUPLE WITH STAINLESS STEEL SLEEVE T221



■ Used for temperature collection in plastics processing machines or similar applications. The stainless steel wire armoring of the connection cable is used for 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 armoring +400°C
- extension cable strand/PFA/fiber glass/  
stainless steel wire armoring +250°C
- extension cable strand/PFA/PFA +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 is standard technical data.

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

# THERMOCOUPLES

## RING THERMOCOUPLE T224



■ Used for temperature collection on surfaces. Easy mounting with the help of a screw and appropriate for numerous application fields. The stainless steel wire armoring of the connection cable is used for 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)



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

\* type L acc. to DIN 43710

### 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 \_\_\_\_\_



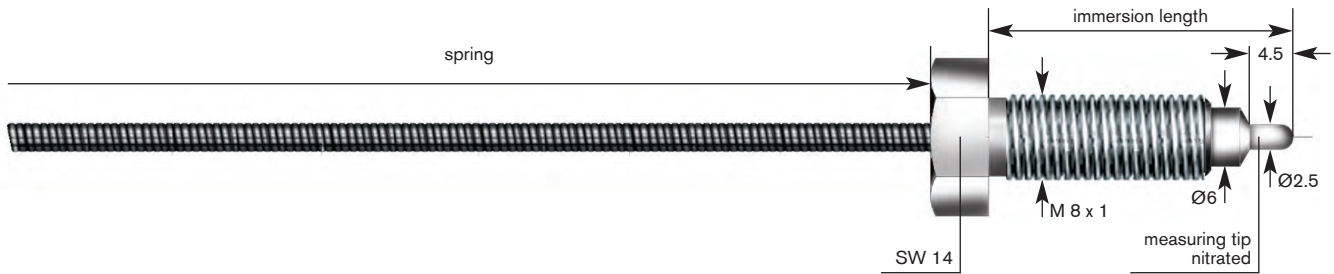
The above mentioned is standard technical data..

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



■ The special construction allows measurement of the molten mass temperature in injection nozzles. 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 an 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:

- M8 x 1 VA
- \_\_\_\_\_

### Immersion length:

- 31.5 mm

### Diameter:

- Ø 6.0 mm / 2.5 mm

### Connection cable:

(see also overview 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 _____ |

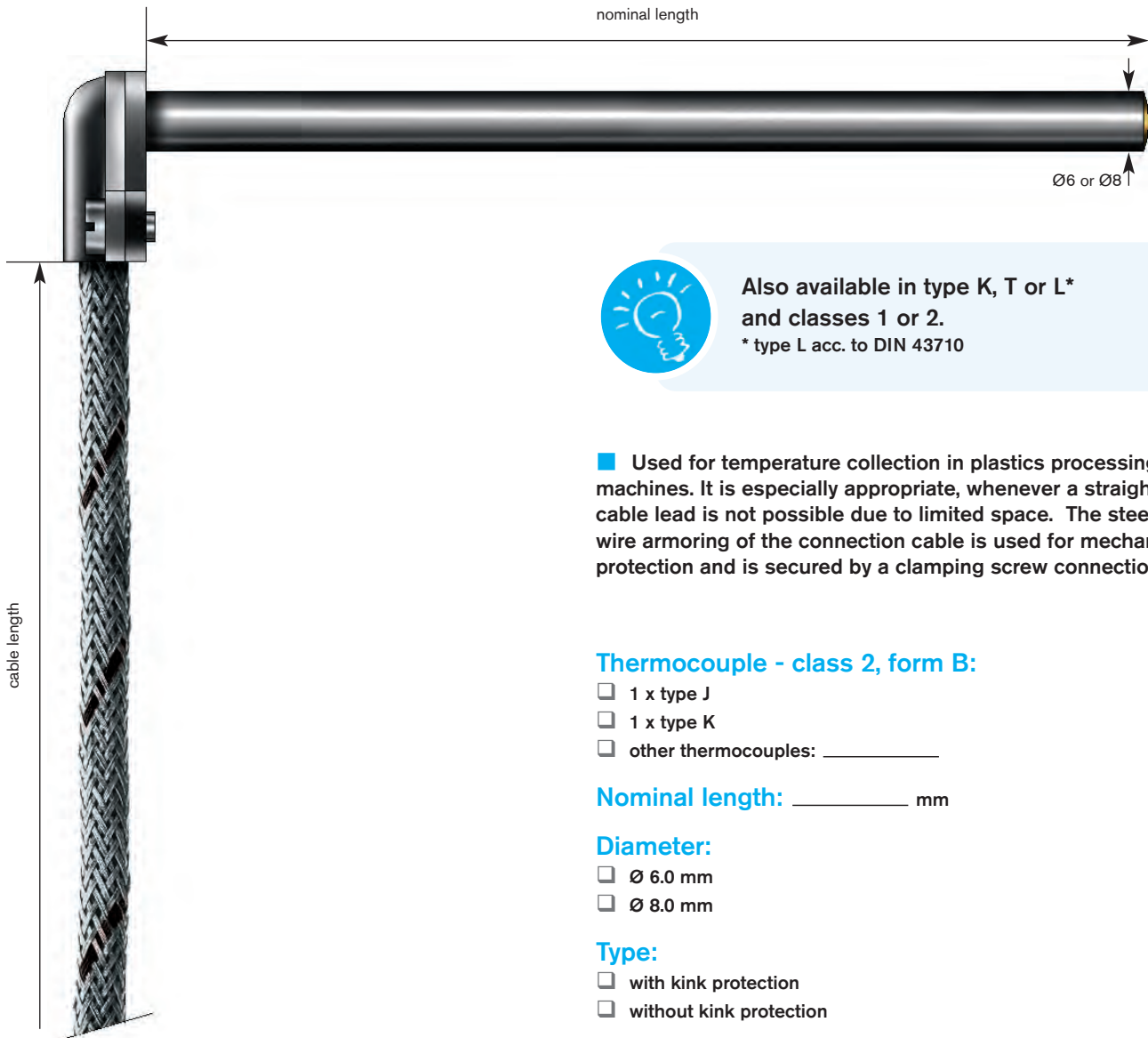


The above mentioned is standard technical data.

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

■ Used for temperature collection in plastics processing machines. It is especially appropriate, whenever a straight cable lead is not possible due to limited space. The steel wire armoring of the connection cable is used for mechanical protection and is secured 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:

- |   |   |
|---|---|
| <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 _____ |



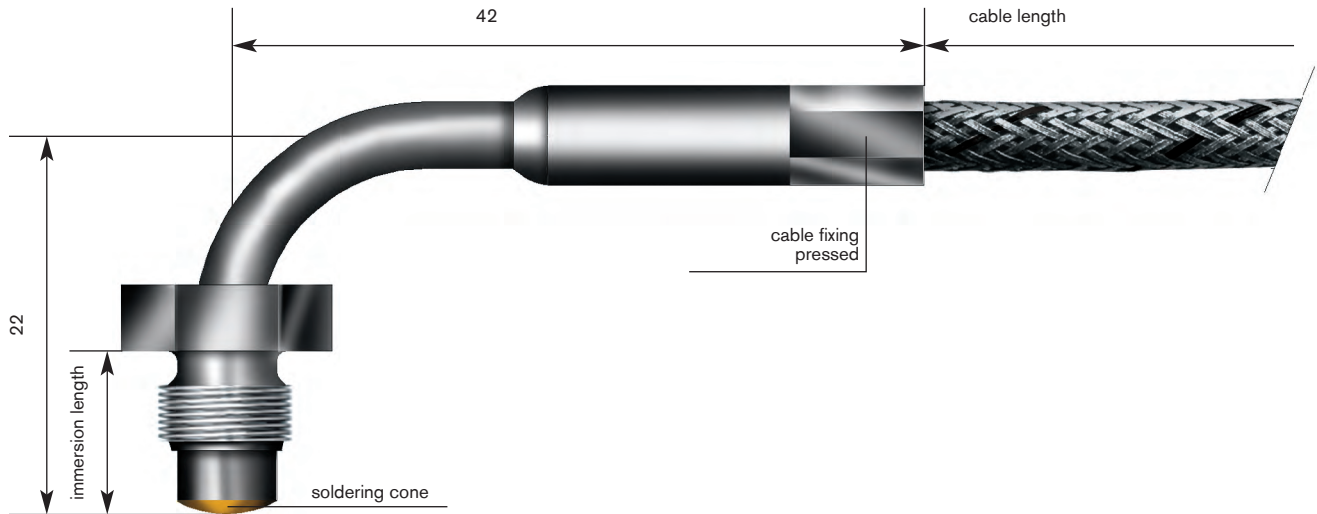
The above mentioned is standard technical data.

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



■ Used for temperature collection in injection and die casting molds as well as in plastics processing machines. It is especially appropriate, whenever a straight cable lead is not possible or wanted due to limited space. The steel wire armoring of the connection cable is used for mechanical protection and is secured by a clamping screw connection.



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 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 \_\_\_\_\_



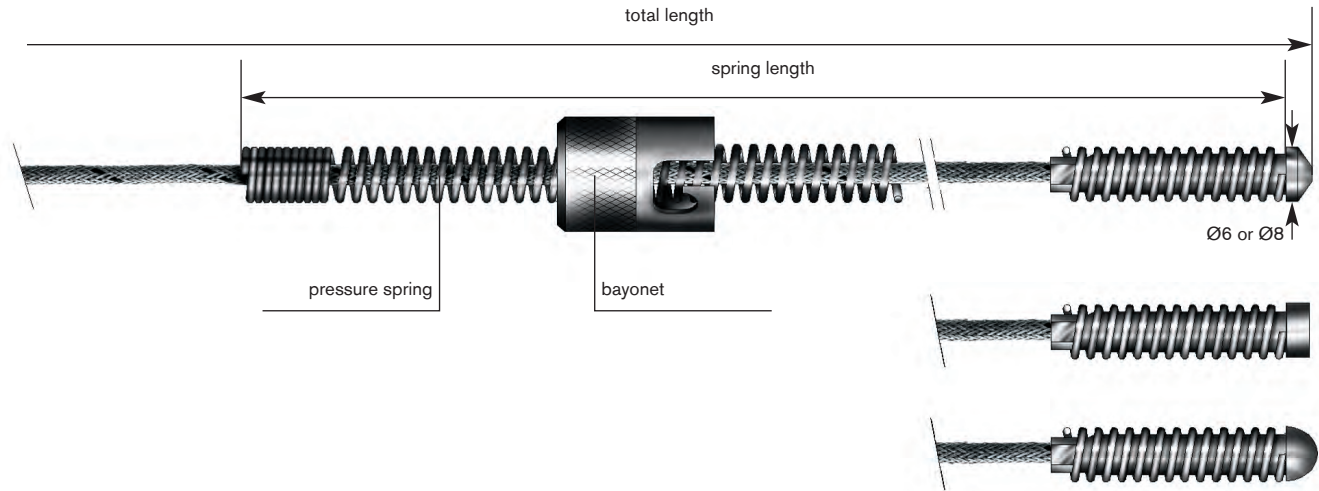
The above mentioned is standard technical data.

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



■ Used for temperature collection in plastics processing machines. Securing by bayonet joint and bayonet is freely adjustable on spring. Also available with plain measuring tip. The stainless steel wire armoring of the connection cable is used for 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



The above mentioned is standard technical 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.  
\* type L acc. to DIN 43710

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

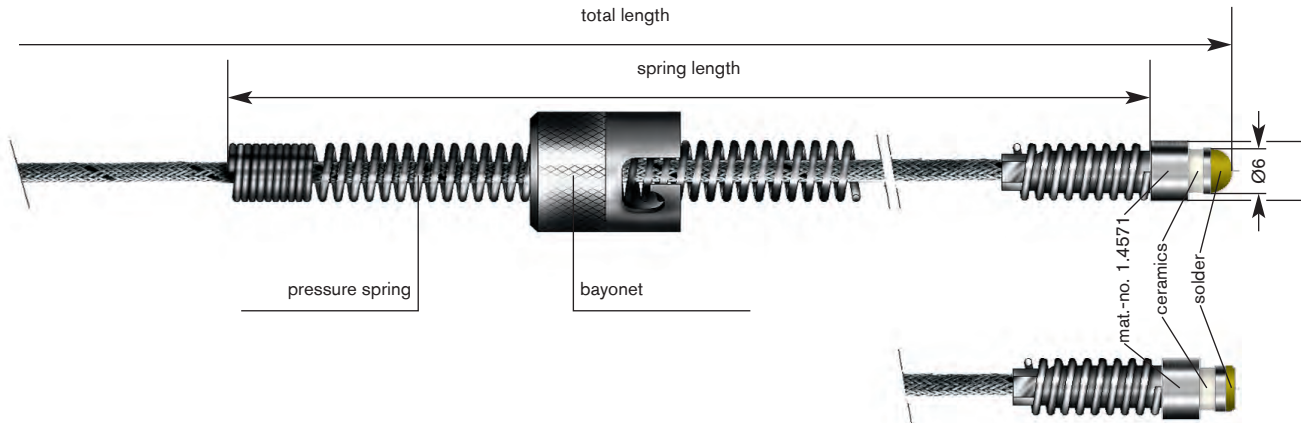
Cable length: \_\_\_\_\_ m

### Connection ends:

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

# THERMOCOUPLES

## PLUG-IN THERMOCOUPLE T247



■ Used for temperature collection in plastics processing machines. Secured by bayonet joint and bayonet is freely adjustable on spring. The steel wire armoring of the connection cable is used for 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
- standard plug
- clips
- bare ends
- miniature socket
- Lemo plug type \_\_\_\_\_
- Lemo socket type \_\_\_\_\_
- other cable ends \_\_\_\_\_

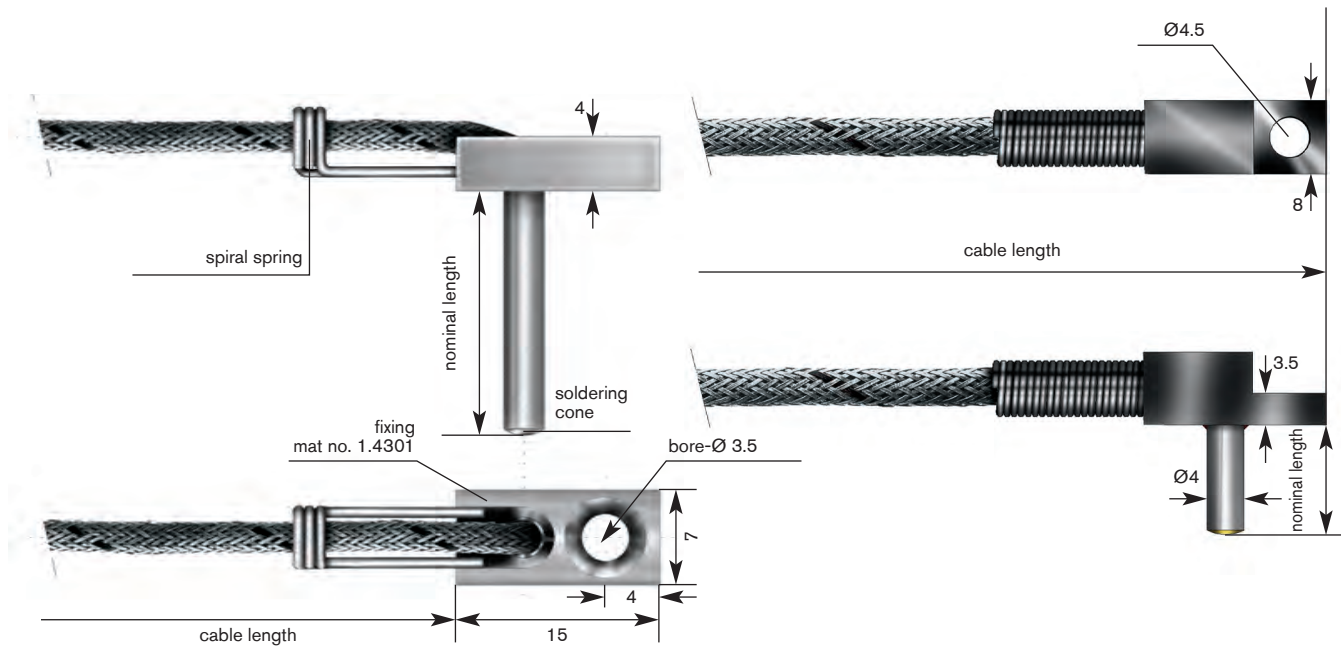


The above mentioned is standard technical data..

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



■ Used for temperature collection of tools. Simple securing by a screw with initial tension guarantees the contact between probe and area to be measured. The stainless steel wire armoring of the connection cable is used for 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

### 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 \_\_\_\_\_

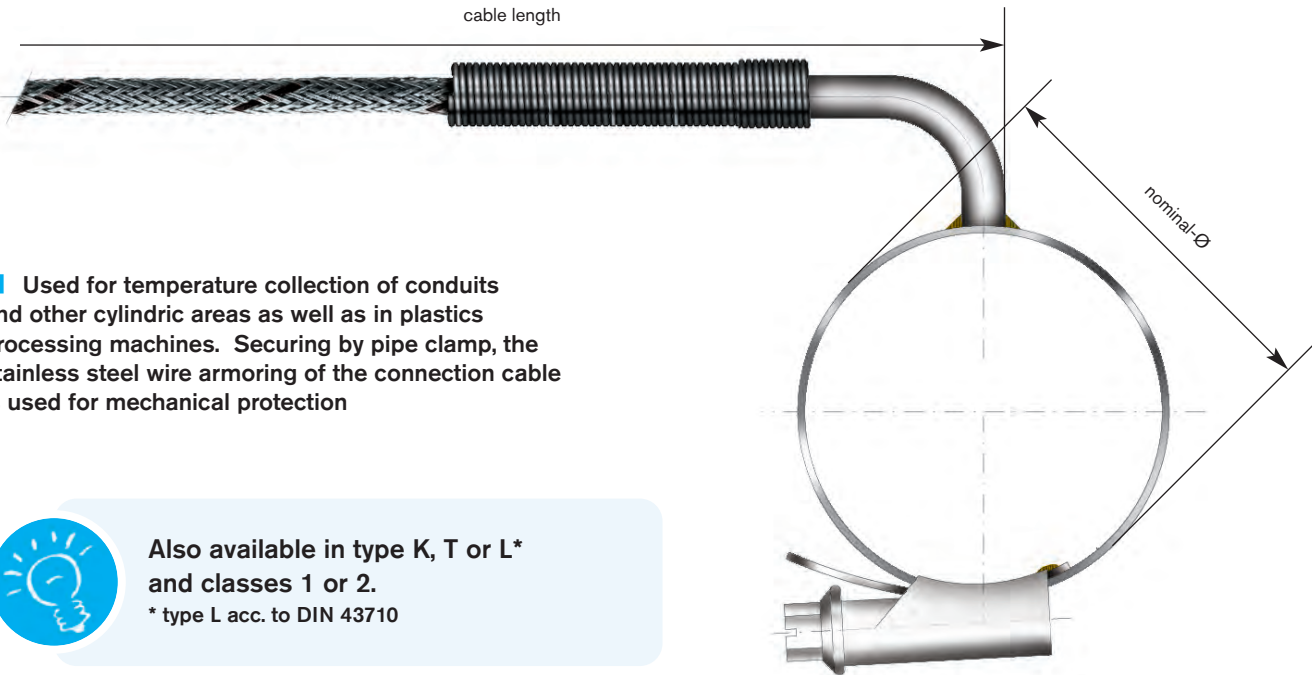


The above mentioned is standard technical data.

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



■ Used for temperature collection of conduits and other cylindric areas as well as in plastics processing machines. Securing by pipe clamp, the stainless steel wire armoring of the connection cable is used for 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 armoring +400°C
- extension cable strand/PFA/fiber glass/  
stainless steel wire armoring +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 _____ |

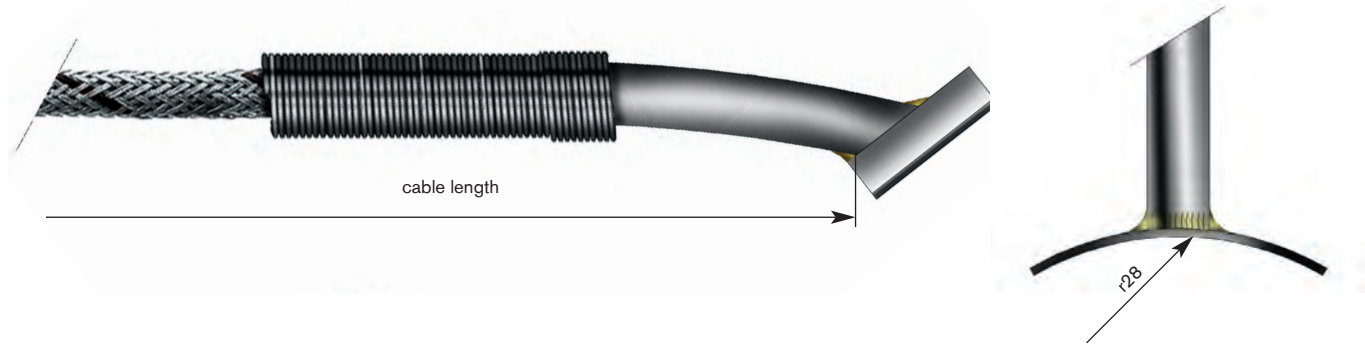


The above mentioned is standard technical data.

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



■ Used for temperature collection of conduits and other cylindric areas as well as in plastics processing machines. Secured by pipe clamp, the stainless steel wire armoring of the connection cable is used for 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



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

### Fix accessories:

- sheet 15 x 30 mm, radius: 28 mm
- \_\_\_\_\_

### Temperature range:

- +400°C

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

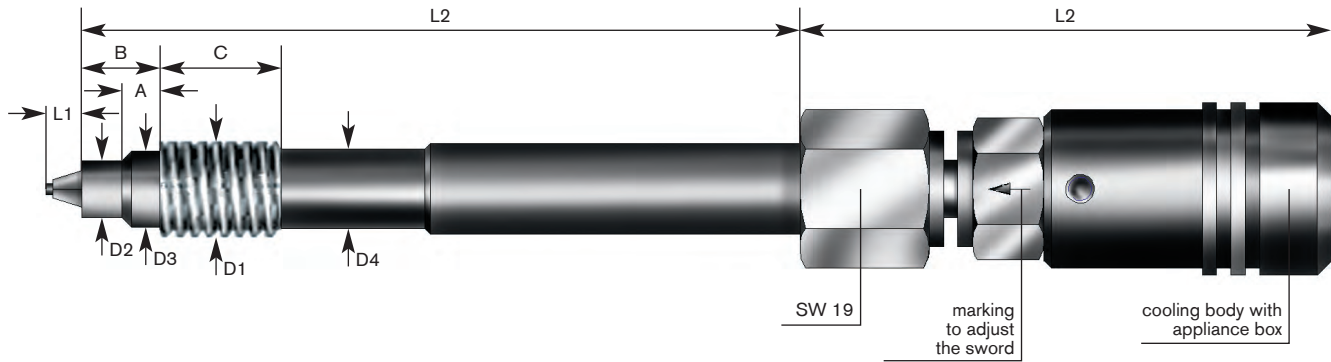


The above mentioned is standard technical data.

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



■ Used for temperature collection of molded plastics in extruders, injection molders, and injection tools. Our molten mass temperature probes with sword shaped measuring tips have a quick response time and avoid any waviness in the mass due to its flow-favoring shape. The special mounting of the measuring tip limits the fault due to heat dissipation. Our standard measuring tips are made of stainless steel, material no. 1.4571. Measuring tips with CVD-coating made of titanium carbide / titanium nitride are available for especially abrasive plastics.



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 sword shaped measuring tip, a marking allows the securing 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

# 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 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 \_\_\_\_\_



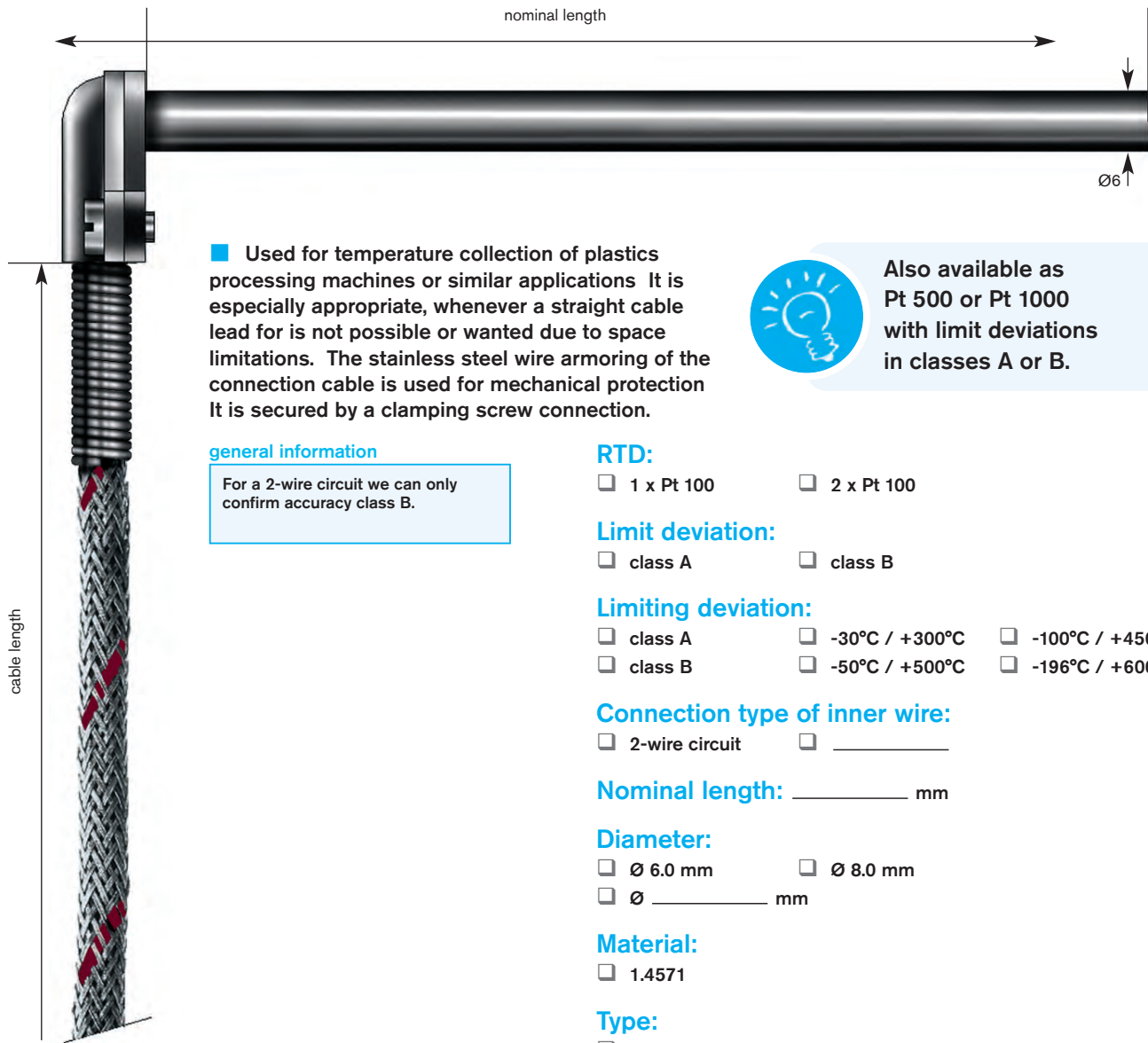
The above mentioned is standard technical data.

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



■ Used for temperature collection of plastics processing machines or similar applications. It is especially appropriate, whenever a straight cable lead for is not possible or wanted due to space limitations. The stainless steel wire armoring of the connection cable is used for mechanical protection. It is secured by a clamping screw connection.

### 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

### 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 \_\_\_\_\_



The above mentioned is standard technical 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



■ Used for temperature collection in plastics processing machines or similar applications. The stainless steel wire armoring of the connection cable is used for 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

### 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
- \_\_\_\_\_

### 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 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 \_\_\_\_\_

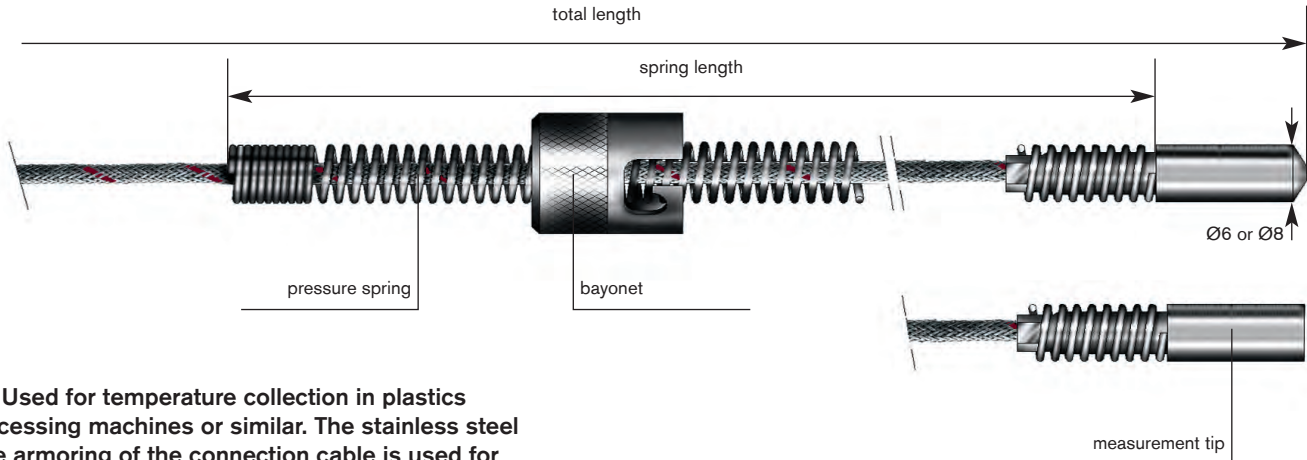


The above mentioned is standard technical data.

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



■ Used for temperature collection in plastics processing machines or similar. The stainless steel wire armoring of the connection cable is used for mechanical protection

### general information

For a 2-wire circuit we can only confirm accuracy class 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
- \_\_\_\_\_



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

### 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 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 \_\_\_\_\_



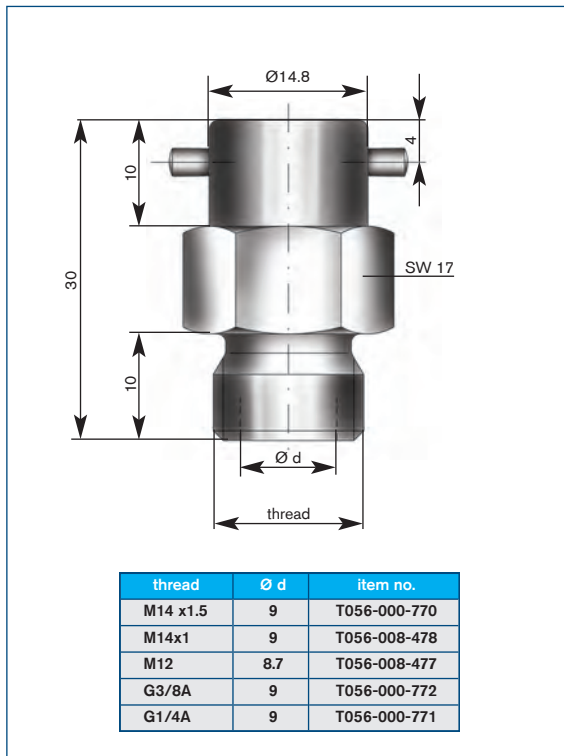
The above mentioned is standard technical data.

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.

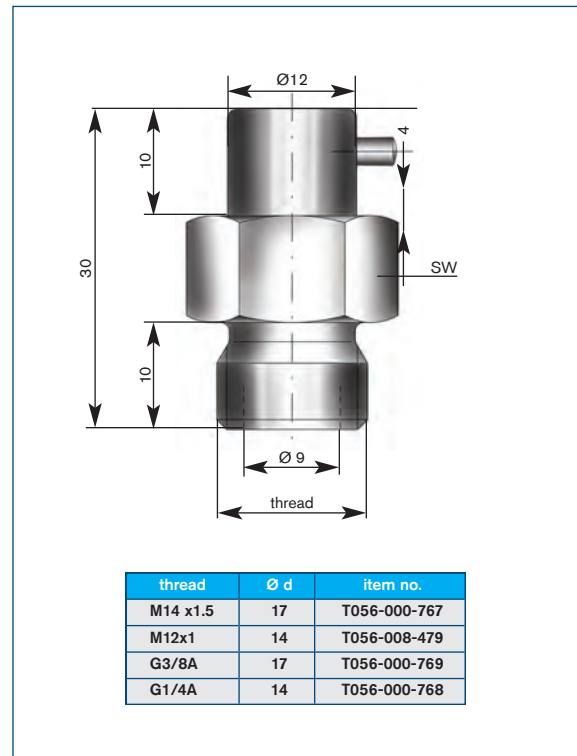
# ACCESSORIES

## NIPPLES

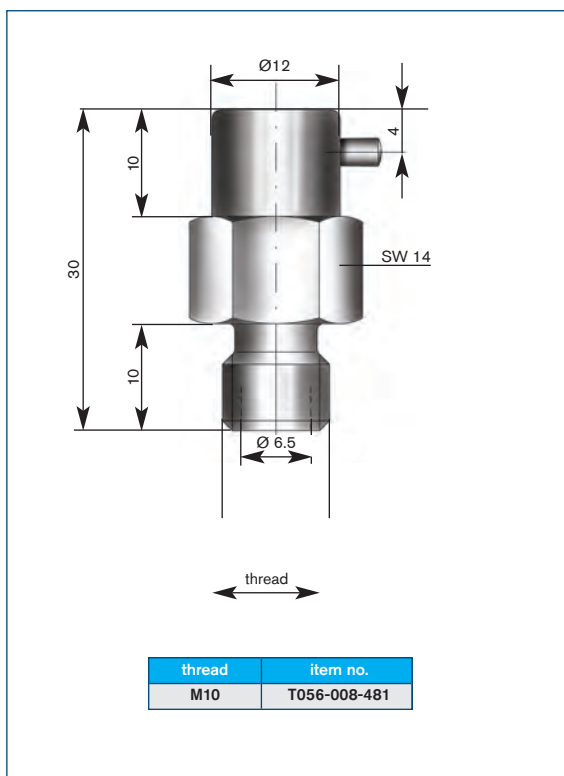
form A · probe-Ø max. 8 mm



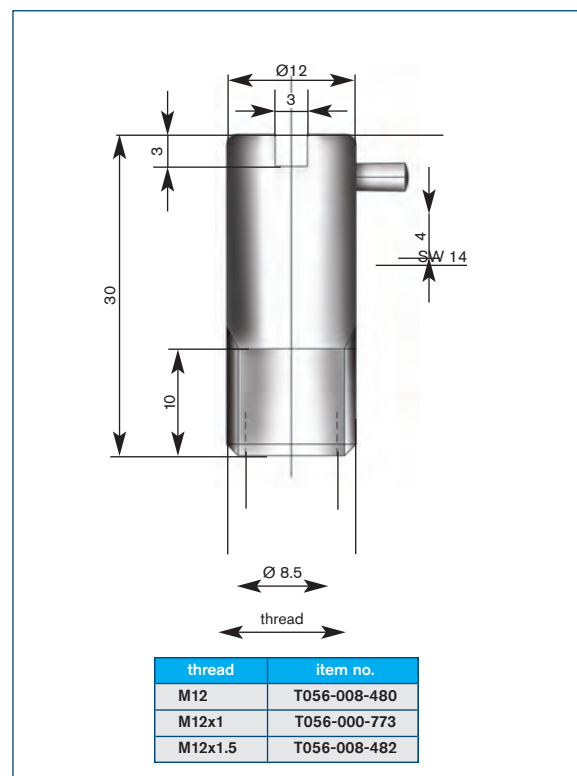
form B · probe-Ø max. 8 mm



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 a measured variable. For temperature measurements, temperature dependent characteristics of materials can be used, 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 field temperature measurement.

## 2. Physical basis

### 2.1. Resistance thermometer

Temperature measurement with the help of resistance thermometers based on the special characteristics of conducting materials to change their resistance dependent on temperature. For metals, the resistance increases with rising temperature. In cases where 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 amount of 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 characterize 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.

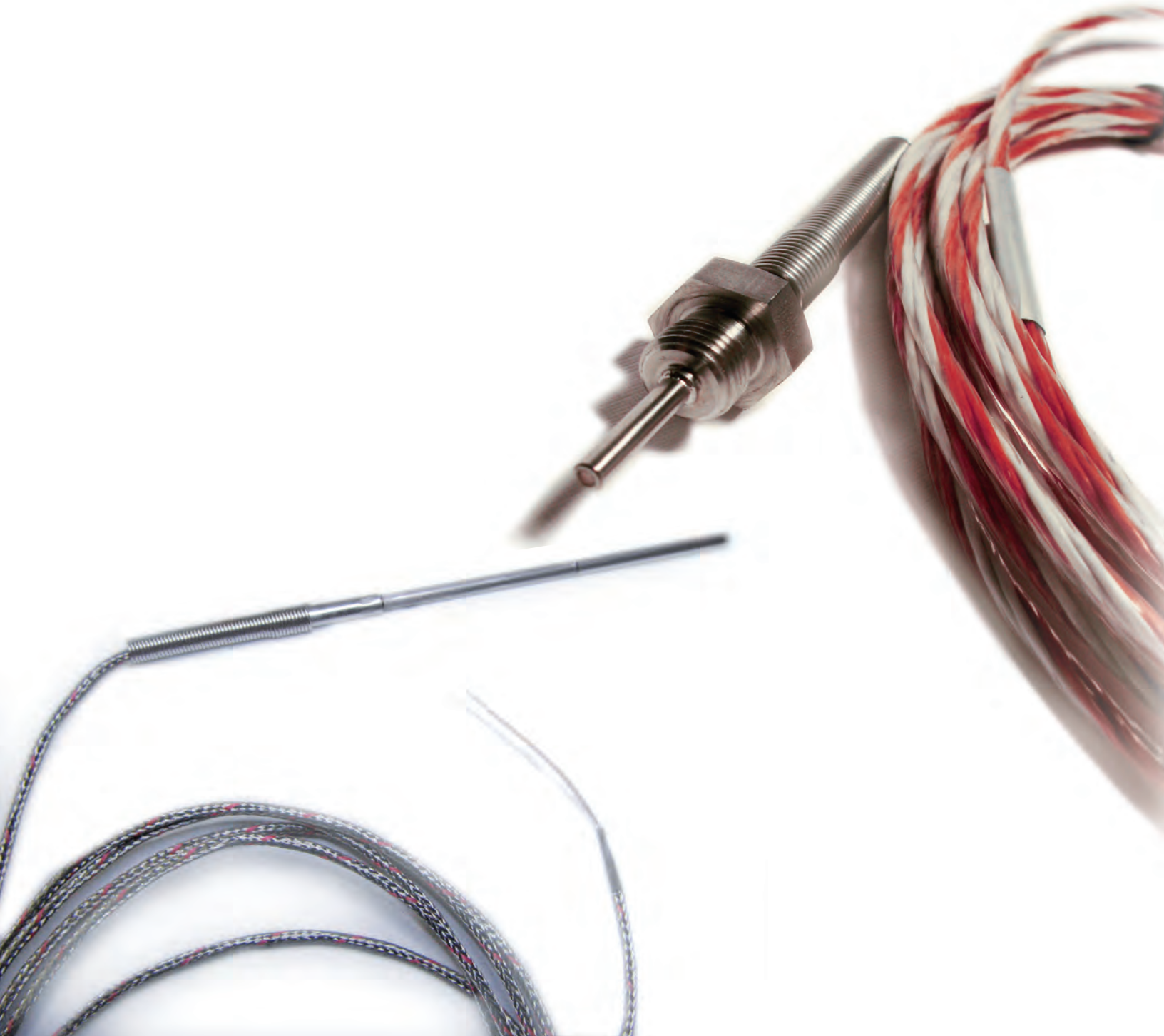
# ADVANTAGES OF THERMOCOUPLES AND RESISTANCE THERMOMETERS

## 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	<sup>(1)</sup> DIN 43710	DIN EN 60584	<sup>(1)</sup> 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

# TOLERANCE OF THERMOCOUPLES

## 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%
<sup>(1)</sup> 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%	–	–
<sup>(1)</sup> 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 <sup>(3)</sup>	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 <sup>(3)</sup>	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.

<sup>(1)</sup> Since April 1994 the standard DIN 43710 is no longer valid.

<sup>(2)</sup> For the limit deviation, the higher value is valid.

<sup>(3)</sup> 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 <sup>a</sup> °C
	leaded resistor	film resistor	
AA	-50 up to +250	0 up to +150	± (0.1 + 0.0017 [t])
A	-100 up to +450	-30 up to +300	± (0.15 + 0.002 [t])
B	-196 up to +600	-50 up to +500	± (0.3 + 0.005 [t])
C	196 up to +600	-50 up to +600	± (0.6 + 0.01 [t])

<sup>a</sup> [t] = Value of temperature in °C without considering the sign

For resistance thermometers that belong to the above context.  
the temperature coefficient  $\alpha$  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<sup>-1</sup> is valid)

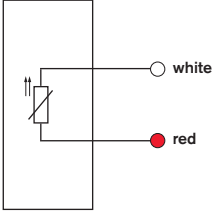
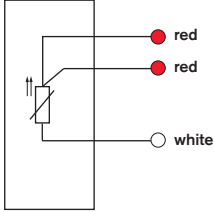
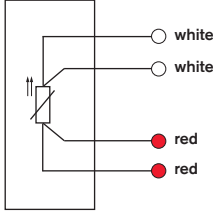
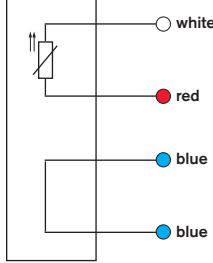
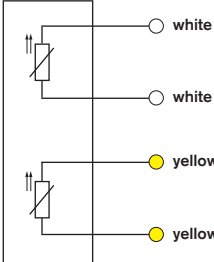
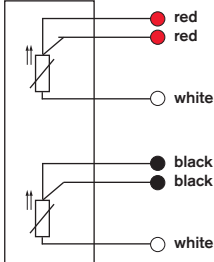
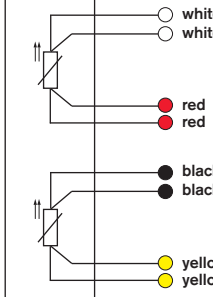
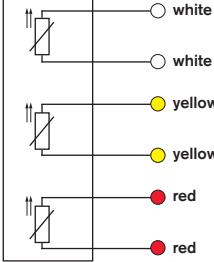
## Limit deviations for PT 100 thermometers

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				

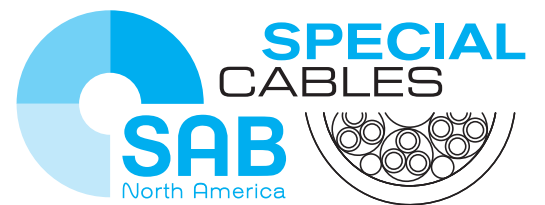
# COLOR CODE AND TEMPERATURE RANGES

THERMOCOUPLE						
Material ⊕ ⊖		DIN IEC 584	DIN 43710*	ANSI MC 96.1	BS 4937	NF C 42-324
	THL	AGL	THL	AGL	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 color 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



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