

Surface Resistance Thermometers Model TR50

WIKA Data Sheet TE 60.50



Application

- To measure surface temperatures on flat surfaces or pipes in laboratories and industrial applications

Special Features

- Application ranges up to max. 250 °C (option: 600 °C)
- Easily interchanged, no thermowell necessary
- For screwing, welding or with worm drive hose clip
- Cable material PVC, silicon or Teflon®
- Explosion-protected version Ex-i, Ex-n and NAMUR NE24



Resistance Thermometers

Fig. top: Model TR50-O for surfaces

Fig. bottom: Model TR50-Q for pipes

Description

Probe

In the case of resistance thermometers for flat surfaces, the probe is installed into a contact block, which can be screwed or welded to the vessel surface. Thermometer designs for pipes will simply be fixed with a worm drive hose clip.

Cable

There are various insulating materials available to match different environmental conditions. The free end of the cable is made up ready for connection, or fitted with plugs and/or sockets as optional extras.

Sensor

Sensor method of connection

- 2-wire The lead resistance compounds the error.
- 3-wire With a cable length of approx. 30 m or longer measuring deviations can occur.
- 4-wire The inner lead resistance of the connecting wires is negligible.

Sensor limiting error

- Class B per DIN EN 60 751
- Class A per DIN EN 60 751
- 1/3 DIN B at 0 °C

It makes no sense to combine 2-wire connection with class A or 2-wire connection with 1/3 DIN B, because the lead resistance of the cable overrides the higher sensor accuracy.

Basic values and limiting errors

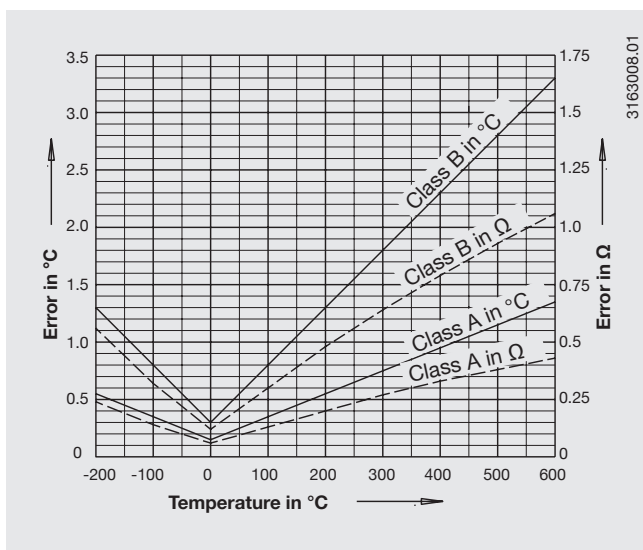
Basic values and limiting errors for the platinum measurement resistances are laid down in DIN EN 60 751. The nominal value of Pt100 sensors is 100 Ω at 0 °C. The temperature coefficient α can be stated simply to be between 0 °C and 100 °C with:

$$\alpha = 3.85 \cdot 10^{-3} \text{ }^{\circ}\text{C}^{-1}$$

The relationship between the temperature and the electrical resistance is characterised by polynomials which are defined in DIN EN 60 751. Furthermore, this standard lays down the basic values in °C stages.

| Class | Limiting error in °C |
|-------|--|
| A | $0.15 + 0.002 \cdot t $ ¹⁾ |
| B | $0.3 + 0.005 \cdot t $ |

1) |t| is the value of the temperature in °C without consideration of the sign



| Temperature (ITS 90) °C | Basic value Ω | Limiting error DIN EN 60 751 | | | |
|-------------------------|---------------|------------------------------|--------|---------|--------|
| | | Class A | | Class B | |
| °C | Ω | °C | Ω | °C | Ω |
| -200 | 18.52 | ± 0.55 | ± 0.24 | ± 1.3 | ± 0.56 |
| -100 | 60.26 | ± 0.35 | ± 0.14 | ± 0.8 | ± 0.32 |
| -50 | 80.31 | ± 0.25 | ± 0.10 | ± 0.55 | ± 0.22 |
| 0 | 100 | ± 0.15 | ± 0.06 | ± 0.3 | ± 0.12 |
| 50 | 119.40 | ± 0.25 | ± 0.10 | ± 0.55 | ± 0.21 |
| 100 | 138.51 | ± 0.35 | ± 0.13 | ± 0.8 | ± 0.30 |
| 200 | 175.86 | ± 0.55 | ± 0.2 | ± 1.3 | ± 0.48 |
| 300 | 212.05 | ± 0.75 | ± 0.27 | ± 1.8 | ± 0.64 |
| 400 | 247.09 | ± 0.95 | ± 0.33 | ± 2.3 | ± 0.79 |
| 500 | 280.98 | ± 1.15 | ± 0.38 | ± 2.8 | ± 0.93 |
| 600 | 313.71 | ± 1.35 | ± 0.43 | ± 3.3 | ± 1.06 |

Process connection

TR50-O: with metal contact block

Design: contact block for screwing or welding to flat surface
 Material: stainless steel
 Dimensions: see drawing
 other versions on request

TR50-P: with weld on sheet

Design: weld on sheet
 Material: stainless steel
 Dimensions: see drawing
 other versions on request

TR50-Q: with worm drive hose clip

Design: worm drive hose clip
 Material: stainless steel
 Dimensions: see drawing
 other versions on request

TR50-T: with washer

Design: centric drilled washer
 Material: stainless steel
 Dimensions: see drawing
 other versions on request

TR50-U: with magnet

Versions on request

Metallic sensor

Material: stainless steel

Diameter: 3 mm or 6 mm

Length: selectable

Regardless of the design, the sensor tip must not be bent over the first 60 mm of its length.

Surface resistance thermometers can be constructed in two different ways:

■ Tubular design

The tubular design is characterised by a rigid construction of the metal sensor tip, therefore tubular designs must not be bent.

Inside, the measuring resistor is connected directly to an insulated lead, therefore TR50 in tubular design can only be used up to the temperatures specified for the cable (see operating temperatures).

■ Sheathed design

In sheathed resistance thermometers the flexible part of the sensor is a mineral-insulated cable (MI-cable).

This consists of a stainless steel outer sheath with a lead forced into it, insulated with a highly-compressed ceramic powder.

The measuring resistor is directly connected to the inner leads of the sheathed cable and is, therefore, suitable for use with higher temperatures.

Owing to their flexibility and smaller possible diameters, sheathed resistance thermometers can be used for difficult to access locations. With the exception of the sensor tip and the transition to the connecting cable the sheath can be bent to a radius of 3 times the diameter.

Transitions

The junction between the metal part of the resistance thermometer and the connecting cable or wire is either crimped, rolled or cast, depending on the design. This area should not be submerged into the process and must not be bent. Compression fittings should not be attached to the transition. The type and dimensions of the transition depend largely on the combination between input leads and metal sensor and the sealing requirements.

Dimension T denominates the length of the transition.

| Criterion | Dimensions T in mm | Ø transition in mm |
|--|--------------------|--------------------|
| Probe Ø = transition Ø | not applicable | identical to probe |
| Ø 2 ... 4.5 mm with crimped transition | 45 | 6 |
| Ø 6 mm with crimped transition | 45 | 7 |
| Ø 6 mm with crimped transition ¹⁾ | 45 | 8 |
| Ø 8 mm with crimped transition | 45 | 10 |

¹⁾ With a large number of wires (e. g. 2 x 3-wire and shielding)

Connection cable

Numerous insulating materials are available to adapt to different prevailing conditions.

The cable end can be supplied ready for connection, fitted with a plug as an option, also with connected fieldcase.

Connection cable (standard)

- Wire material: Cu (strands)
- Wire cross-section: approx. 0.22 mm² (standard version)
- Number of wire: according to method of connection
- Insulation material: PVC, silicon, Teflon[®] or fibreglass
- Shielding (option)

Operating Temperatures maximum

The maximum temperatures of these thermometers are limited by different parameters.

■ Sensor

The temperature measuring range is limited by the sensor itself. An optimum choice is made according to the accuracy class and operating conditions.

Outside the defined measuring range the measurement loses its accuracy and the sensor can be damaged.

Possible measuring ranges are:

- 50 ... +250 °C
- 50 ... +450 °C
- 200 ... +250 °C
- 50 ... +400 °C (only Class A)
- 200 ... +450 °C
- 200 ... +600 °C (from 450°C Class B)
- 200 ... +400 °C
- 50 ... +600 °C (only Class B)

■ Connection cable and single lead wires

The maximum temperature permissible at each point of the connecting cable is that specified for the connecting cable. The sensor itself could, possibly, be subjected to higher temperatures.

The following temperature limits apply to conventional connecting cables:

| | |
|------------|--------------------|
| PVC | -20 °C ... +100 °C |
| Silicon | -50 °C ... +200 °C |
| Teflon® | -50 °C ... +250 °C |
| Fibreglass | -50 °C ... +400 °C |

Since an isolated cable is also fitted inside the metallic probe of the tubular design, the operating limits of the connection wire apply.

■ Transition

The temperature at the transition is further limited by the use of potted sealing compound.

Maximum temperature of the compound: 150 °C

Option: 250 °C

(Other versions on request).

■ Plugs

For optionally-fitted connecting plugs the maximum permissible temperature at the plug is 85 °C.

■ Operating temperature

If the temperature to be measured is higher than the permissible temperatures at the cable, plug or transition, the metal part of the sensor must be long enough to protrude from the hot zone. Care must be taken that the lowest of the maximum operating temperatures of cable, transition or plug are not exceeded.

Ingress protections

■ IP protection

Surface resistance thermometer can be delivered up to an ingress protection of IP 65 (depending on the surface sheath material and the number of wires).

In a special design, IP 67 is also possible on request.

For connectors with sheathed glass fibre the combination with an explosion-protected design is excluded.

■ Explosion protection (option)

Surface resistance thermometers of the TR50 product range are available with a type-examination certificate for protection classes Ex-i and Ex-n (Directive 94/9/EG).

The devices comply with the requirements of the directive 94/9/EG (ATEX), EEx-i, for gases and dust. The classification or suitability of the device (approved power P_{max} , minimum clearances from hot surfaces as well as the permissible ambient temperature) for the appropriate category should be taken from the type-examination certificate or operating instructions.

Note:

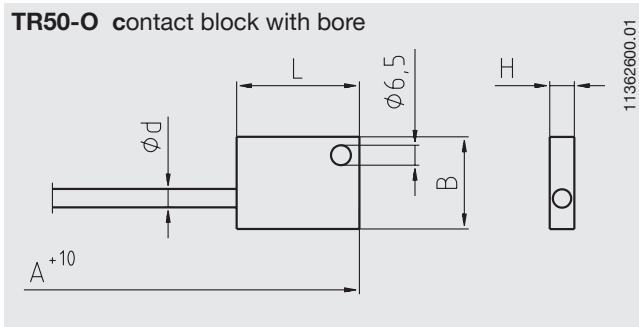
When mounting thermometers with flying leads, the personnel fitting them must ensure that the connection is carried out properly and in compliance with the appropriate regulations. When the thermometer cables are terminated within the hazardous area, suitable adapters / connectors should be used.

Flying leads must be connected outside of the hazardous area or, when operated in dust explosive atmospheres, within an enclosure which is certified according to the 94/9/EC and EN 50 281-1-1 directives, and provides an ingress protection of at least IP 65.

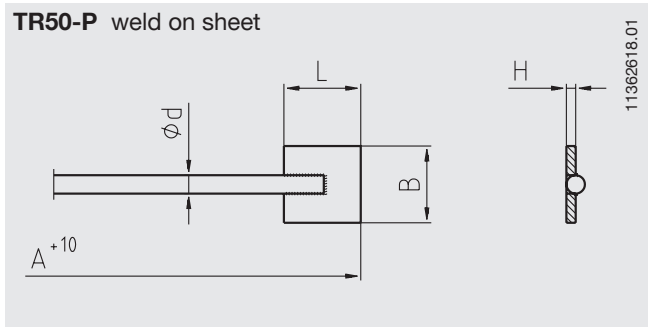
A minimum air and creepage distance of 2 mm must be ensured.

Dimensions in mm

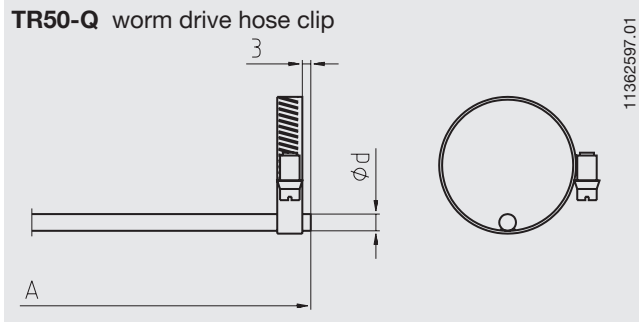
TR50-O contact block with bore



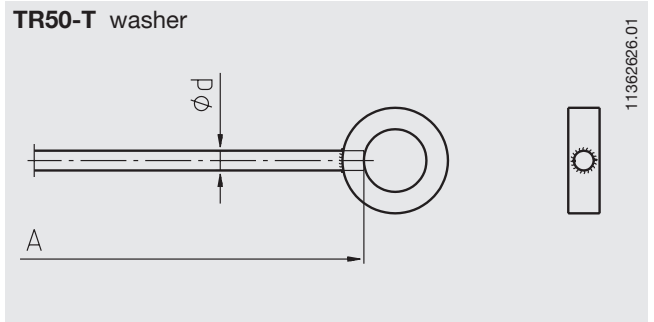
TR50-P weld on sheet



TR50-Q worm drive hose clip



TR50-T washer



Please note:

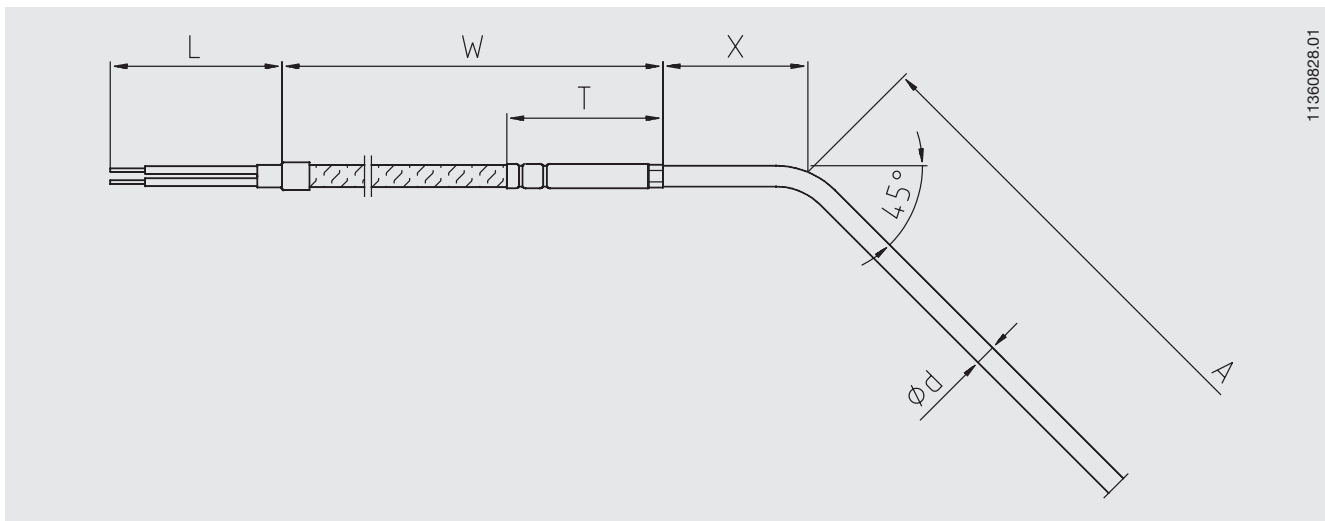
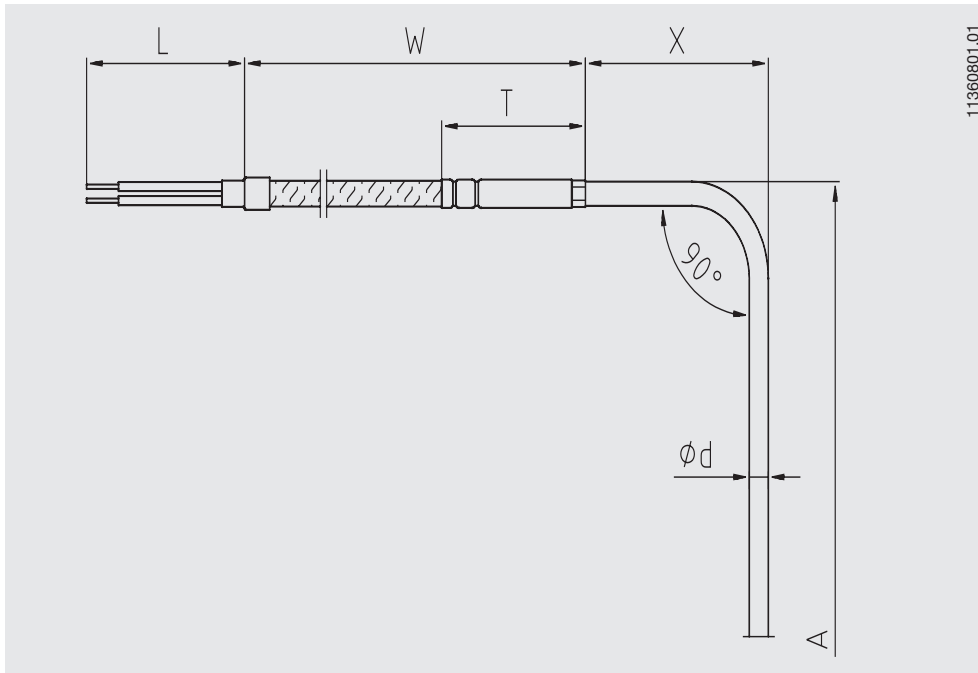
The complete A length must always be seen in connection with the drawings on page 6 and 7.

| Process connection | Dimensions in mm | | |
|--|--|-------------------|--|
| | width x length x height (B x L x H) | for pipe diameter | outer \emptyset x inner \emptyset x thickness (AD x ID x d) |
| Metal contact block with bore d = 6.5 mm | 30 x 40 x 8 | - | - |
| Weld on sheet | 25 x 25 x 3.0 | - | - |
| Worm drive hose clip | - | 7 ... 17 | - |
| Worm drive hose clip | - | 14 ... 34 | - |
| Worm drive hose clip | - | 17 ... 57 | - |
| Worm drive hose clip | - | 60 ... 75 | - |
| Worm drive hose clip | - | 78 ... 93 | - |
| Worm drive hose clip | - | 97 ... 112 | - |
| Washer | - | - | 38.1 x 19.1 x 9.5 |

Angled probes

Sheathed surface resistance thermometers can be supplied in pre-bent shapes. In this case the position of the bend is indicated by a further dimension.

Dimension X denominates the distance of the bend from the lower edge of the transition.



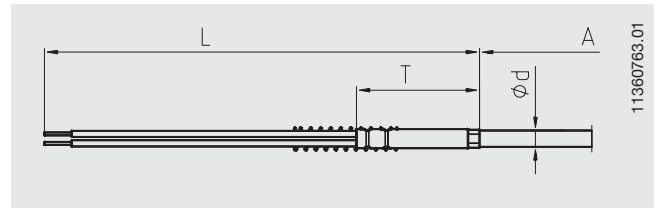
Cable end design

Dimension A defines the probe length, dimension W the length of the connection lead, L the length of the free single strands and dimension T the transition (if present).

T is always a part of lengths W and L respectively. (see table on page 3).

Connection with single lead wires

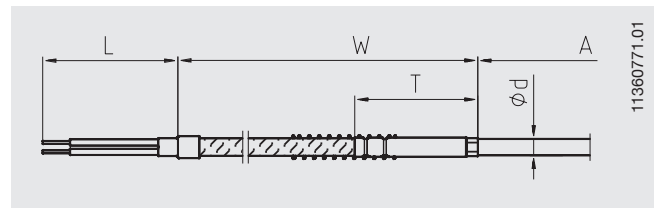
Lead length 150 mm, other length on request
Cu braid 0.22 mm², Teflon® or fibreglass insulated, number of leads dependant on the number of sensors and the method of sensor connection, stripped lead wires, other versions on request



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With connection cable

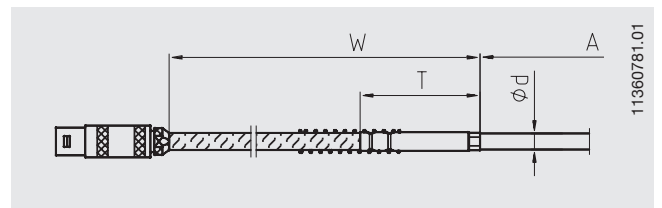
Cable and probe are firmly connected to each other. Cable length and insulating materials to customer specifications.
Cu leads 0.22 mm², number of wire according to number of sensor and sensor method of connection, stripped lead wires



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With connector fitted on connection cable

The optional connection plug is fitted to the flexible connecting cable.

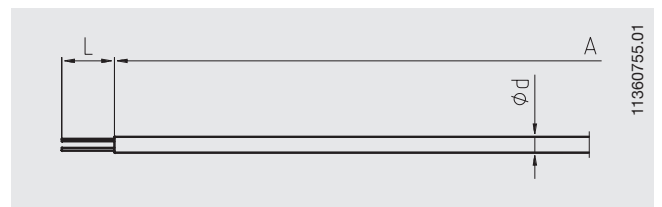


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Designs with bare connecting wires

The inner leads of the mineral-insulated cable protrude.
L = 20 mm (standard).

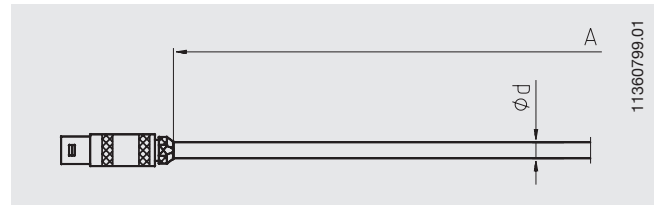
The length of the flying leads can be adapted to customer requirements. These blank internal leads are made of solid wire and thus are not suitable for longer distances.



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Version with plug fitted directly to the sensor

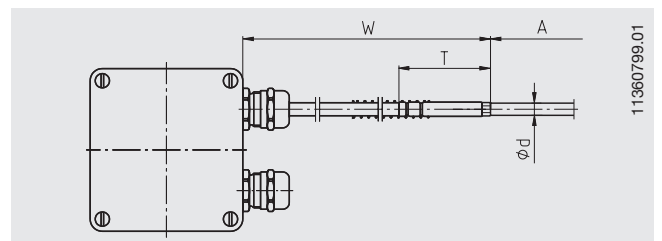
These versions are based on the design with bare connecting wires. The plug is fitted directly to the metal sensor.



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Version with connected fieldcase

The cable gland (plastic) connects the connection cable with the fieldcase (plastic, ABS).
A second cable gland is mounted for the flying lead.
An aluminium case is available as an option.



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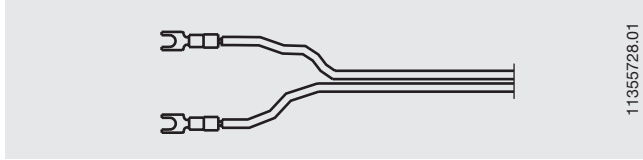
Plug (option)

Cable thermocouples can be supplied with plugs fitted.

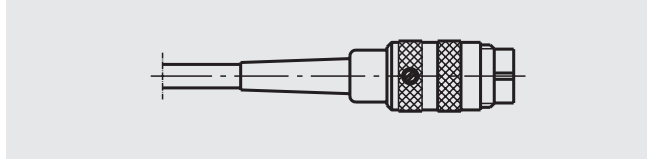
The following options are available:

■ Spade lugs

(not suitable for versions with bare connecting wires)

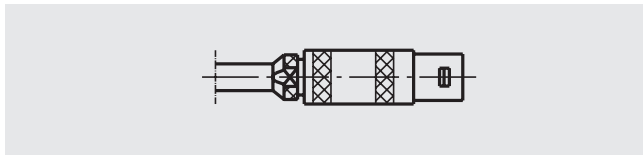


■ Screw-in-plug, Binder (male)

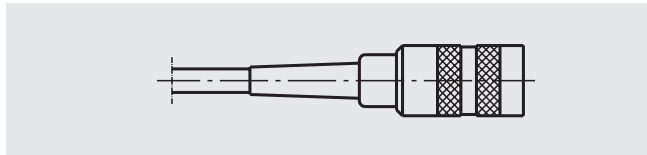


■ Lemosa plug size 1 S (male)

■ Lemosa plug size 2 S (male)

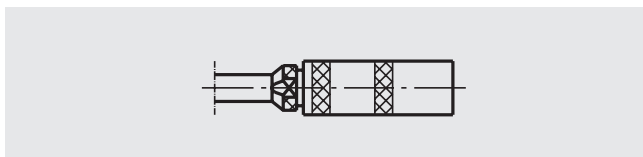


■ Screw-in-plug, Binder (female)



■ Lemosa plug size 1 S (female)

■ Lemosa plug size 2 S (female)



Other plug versions (sizes) on request.

Further options

Bend protection

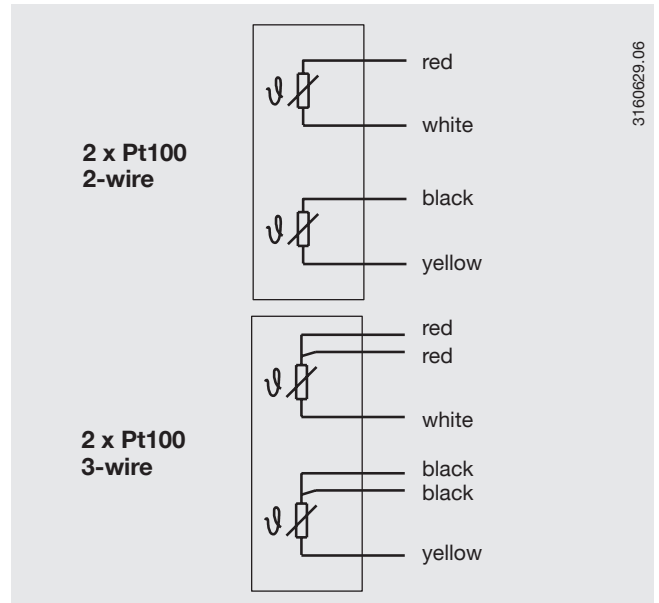
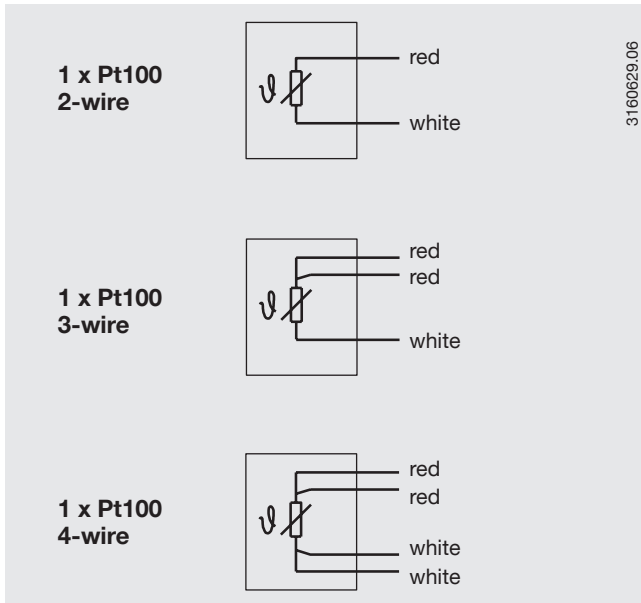
Bend protection (strain relief spring or shrink tubing) serves to protect the transition where the rigid probe and the flexible connection cable join. This should always be used when any movement of the connection cable relative to the thermometer mounting point is expected.

For installation in accordance with Ex-n, bend protection is obligatory.

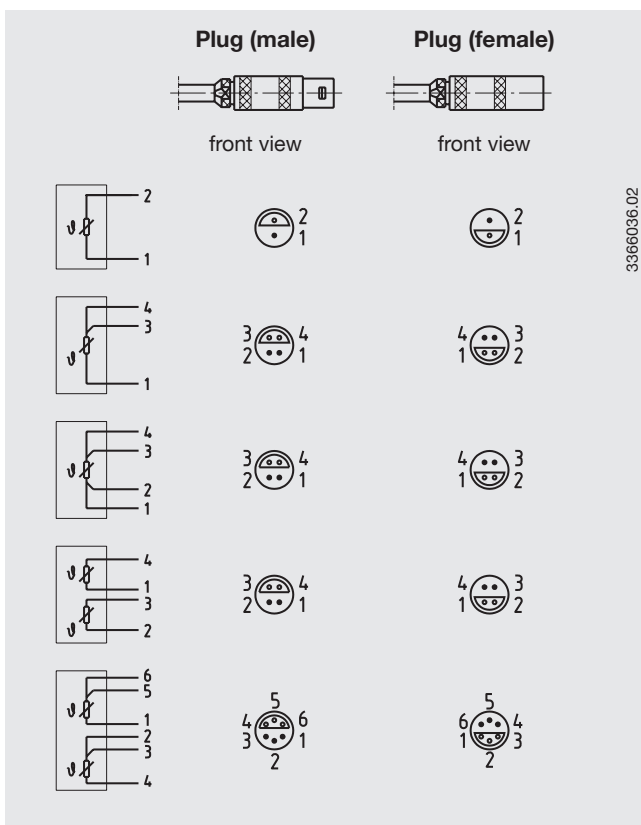
The standard length of the strain relief spring is 60 mm.

Electrical connection

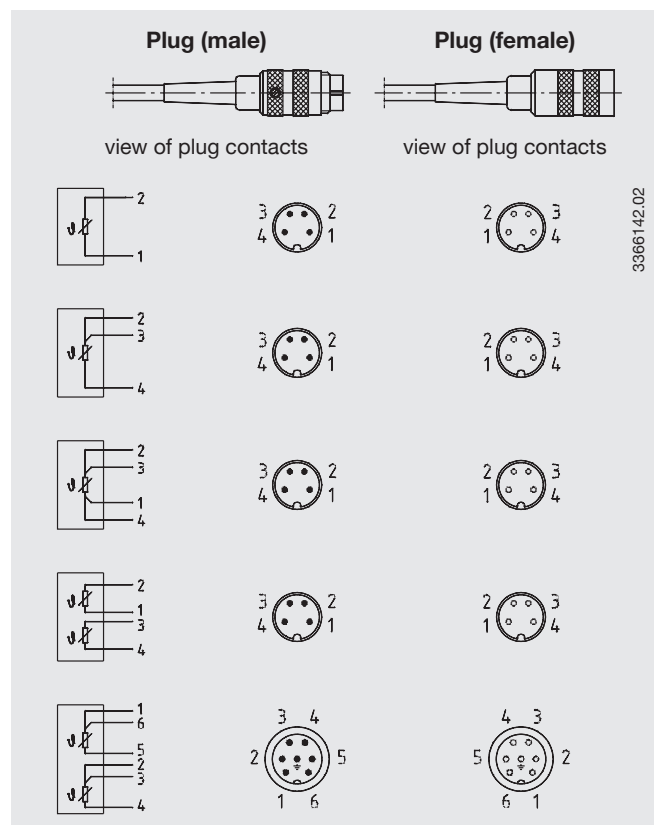
Without plug



Lemosa plug



Screw-in-plug, Binder

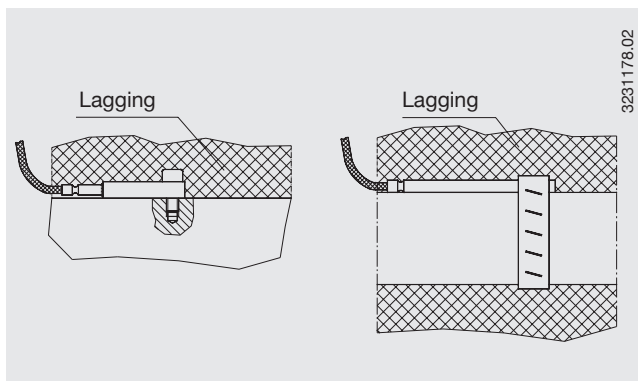


Mounting instructions

The basic requirements to ensure perfect measurement results is to retain good thermal contact between the probe and the outside wall of the tank or pipe. Minimal heat loss to the ambient from the probe and measuring point is imperative.

The probe should have direct metallic contact with the measuring point and have firm contact with the measuring point.

Lagging must be applied where the probe has been mounted to avoid error due to heat loss. This lagging must have sufficient temperature resistance and is not provided with the probe.



Modifications may take place and materials specified may be replaced by others without prior notice. Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing.

