

## Cable resistance thermometer Model TR40

WIKA data sheet TE 60.40



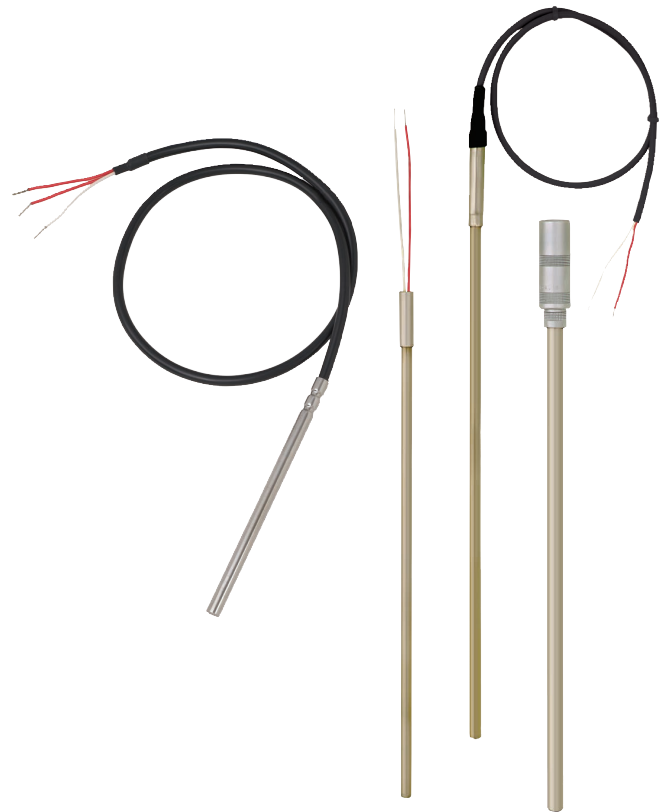
for further approvals  
see page 2

### Applications

- For direct installation into the process
- Machine building
- Motors
- Bearing
- Pipelines and vessels

### Special features

- Application ranges from -200 ... +600 °C  
(-328 ... +1,112 °F)
- For insertion, screw-in with optional process connection
- Cable from PVC, silicone, PTFE or glass fibre
- Explosion-protected versions



Cable resistance thermometer, model TR40

### Description

Cable resistance thermometers are particularly suited to those applications in which the metallic sensor tip is mounted directly into bored holes (e.g. in machine components) or directly into the process for any application with no chemically aggressive media or abrasion.

For mounting into a thermowell, a spring-loaded compression fitting should be provided, since only this can press the sensor tip into the bottom of the thermowell. Otherwise a potentially critical force could be exerted on the measuring tip.

In the standard version the cable sensors are manufactured without process connections. Fastening elements such as threaded fittings, union nuts, etc. can also be used.

## Explosion protection (option)





TR40 series cable resistance thermometers are available with an EC-type examination certificate for “intrinsically safe”, Ex i, ignition protection.







These instruments comply with the requirements of the ATEX directive for gases and dusts.

The permissible power  $P_{max}$  as well as the permissible ambient temperature for the respective category can be seen on the EC-type examination certificate and in the operating instructions.

The internal inductance ( $L_i$ ) and capacitance ( $C_i$ ) for cable probes are found on the product label and they should be taken into account when connecting to an intrinsically safe power supply.

## Approvals (explosion protection, further approvals)

Logo	Description	Country
	<b>EU declaration of conformity</b> ATEX directive (option) Hazardous areas - Ex i Zone 0 gas [II 1G Ex ia IIC T3 ... T6 Ga] Zone 1 mounting to zone 0 gas [II 1/2G Ex ia IIC T3 ... T6 Ga/Gb] Zone 1 gas [II 2G Ex ia IIC T3 ... T6 Gb] Zone 20 dust [II 1D Ex ia IIIC T125 ... T65 °C Da] Zone 21 mounting to zone 20 dust [II 1/2D Ex ia IIIC T125 ... T65 °C Da/Db] Zone 21 dust [II 2D Ex ia IIIC T125 ... T65 °C Db] - Ex n Zone 2 gas [II 3G Ex nA IIC T1 ... T6 Gc X] Zone 22 dust [II 3D Ex tc IIIC T440 ... T80 °C Dc X]	European Union
	<b>IECEx (option)</b> (in conjunction with ATEX) Hazardous areas - Ex i Zone 0 gas [Ex ia IIC T3 ... T6 Ga] Zone 1 mounting to zone 0 gas [Ex ia IIC T3 ... T6 Ga/Gb] Zone 1 gas [Ex ia IIC T3 ... T6 Gb] Zone 20 dust [Ex ia IIIC T125 ... T65 °C Da] Zone 21 mounting to zone 20 dust [Ex ia IIIC T125 ... T65 °C Da/Db] Zone 21 dust [Ex ia IIIC T125 ... T65 °C Db]	International
	<b>EAC (option)</b> Hazardous areas - Ex i Zone 0 gas [0 Ex ia IIC T3/T4/T5/T6] Zone 1 gas [1 Ex ib IIC T3/T4/T5/T6] Zone 20 dust [DIP A20 Ta 65 °C/Ta 95 °C/Ta 125 °C] Zone 21 dust [DIP A21 Ta 65 °C/Ta 95 °C/Ta 125 °C] - Ex n Zone 2 gas [Ex nA IIC T6 ... T1] Zone 22 dust [DIP A22 Ta 80 ... 440 °C]	Eurasian Economic Community
	<b>INMETRO (option)</b> Hazardous areas - Ex i Zone 0 gas [Ex ia IIC T3 ... T6 Ga] Zone 1 mounting to zone 0 gas [Ex ib IIC T3 ... T6 Ga/Gb] Zone 1 gas [Ex ib IIC T3 ... T6 Gb] Zone 20 dust [Ex ia IIIC T125 ... T65 °C Da] Zone 21 mounting to zone 20 dust [Ex ib IIIC T125 ... T65 °C Da/Db] Zone 21 dust [Ex ib IIIC T125 ... T65 °C Db]	Brazil

Logo	Description	Country
	<b>NEPSI (option)</b> Hazardous areas - Ex i Zone 0 gas [Ex ia IIC T3 ~ T6] Zone 1 mounting to zone 0 gas [Ex ia/ib IIC T3 ~ T6] Zone 1 gas [Ex ib IIC T3 ~ T6] Zone 20 dust [Ex iaD 20 T65 ~ T125] Zone 21 mounting to zone 20 dust [Ex ibD 20/21 T65 ~ T125] Zone 21 dust [Ex ibD 21 T65 ~ T125] - Ex n Zone 2 gas [Ex nA IIC T1 ~ T6 Gc]	China
	<b>KCs - KOSHA (option)</b> Hazardous areas - Ex i Zone 0 gas [Ex ia IIC T4 ... T6] Zone 1 gas [Ex ib IIC T4 ... T6]	South Korea
-	<b>PESO (option)</b> Hazardous areas - Ex i Zone 0 gas [Ex ia IIC T1 ... T6 Ga] Zone 1 mounting to zone 0 gas [Ex ib IIC T3 ... T6 Ga/Gb] Zone 1 gas [Ex ib IIC T3 ... T6 Gb]	India
	<b>GOST (option)</b> Metrology, measurement technology	Russia
	<b>KazInMetr (option)</b> Metrology, measurement technology	Kazakhstan
-	<b>MTSCHS (option)</b> Permission for commissioning	Kazakhstan
	<b>BelGIM (option)</b> Metrology, measurement technology	Belarus
	<b>Uzstandard (option)</b> Metrology, measurement technology	Uzbekistan

Instruments marked with "ia" may also be used in areas only requiring instruments marked with "ib" or "ic".  
 If an instrument with "ia" marking has been used in an area with requirements in accordance with "ib" or "ic", it can no longer be operated in areas with requirements in accordance with "ia" afterwards.

Approvals and certificates, see website

## Sensor

The sensor is located in the tip of the probe.

### Sensor connection method

- 2-wire
- 3-wire
- 4-wire

### Sensor tolerance value per DIN EN 60751

- Class B
- Class A
- Class AA

The combinations of a 2-wire connection with class A or class AA are not permissible, since the lead resistance of the measuring insert negates the higher sensor accuracy.

For detailed specifications for Pt100 sensors, see Technical information IN 00.17 at [www.wika.com](http://www.wika.com).

## Sensor tip designs

### Standard version

In the standard version a sensor is fitted which is appropriate for the selected measuring range.

This sensor can be operated with acceleration loads of up to 30 m/s<sup>2</sup>.

(test in accordance with DIN EN 60751)

### Peak response (thin-film sensor)

A special measuring resistor is connected directly to the sensor tip. Due to direct contact to the tip this version cannot be used as an intrinsically safe thermometer.

### Vibration resistant sensor tip (max. 10 g)

Special resistors are used for this extremely robust version. In addition special internal design is chosen which durably resists these high loads (100 m/s<sup>2</sup>).

(test based on DIN EN 60751)

## Metal sensor

Material: stainless steel

Diameter: 2 mm, 3 mm, 6 mm or 8 mm

Length: selectable

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

For temperature measurement in a solid body, the diameter of the bore into which the sensor should be inserted, should be no more than 1 mm larger than the sensor diameter.

### Cable resistance thermometers can be designed in two different ways:

#### ■ Tubular design

The tubular design features a rigid construction to the metal sensor tip; therefore tubular designs must not be bent.

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

#### ■ Sheathed design

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

It consists of a stainless steel outer sheath, which contains the insulated internal leads, embedded within a high-density ceramic compound.

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

Due to their flexibility and the small possible diameters, sheathed resistance thermometers can also be used in locations that are not easily accessible, since, with the exception of the sensor tip and the transition sleeve of the connection cable, the sheath can be bent to a radius of three times the diameter of the cable.

#### Please note:

The flexibility of the sheathed resistance thermometer must be considered, especially when the flow rates are relatively high.

## Maximum working temperatures

The maximum temperatures for this thermometer are limited by different parameters:

### ■ Sensor

#### Measuring element

Pt100, Pt1000 <sup>1)</sup> (measuring current: 0.1 ... 1.0 mA) <sup>2)</sup>

Connection method	
Single elements	1 x 2-wire 1 x 3-wire 1 x 4-wire
Dual elements	2 x 2-wire 2 x 3-wire 2 x 4-wire <sup>3)</sup>

Tolerance value of the measuring insert per EN 60751		
Class	Sensor construction	
	Wire-wound	Thin-film
Class B	-200 ... +600 °C	-50 ... +500 °C
Class A <sup>4)</sup>	-100 ... +450 °C	-30 ... +300 °C
Class AA <sup>4)</sup>	-50 ... +250 °C	0 ... 150 °C

1) Pt1000 only available as a thin-film measuring resistor

2) For detailed specifications for Pt100 sensors, see Technical information IN 00.17 at [www.wika.com](http://www.wika.com).

3) Not with 3 mm diameter

4) Not for 2-wire connection method

### ■ Connection cable and single wires

At any point on the connection cable, the maximum temperature that may be attained is that for which the connection cable is specified. The sensor (see above) itself can potentially withstand higher temperatures.

For the common connection wires the following temperature limits apply:

PVC	-20 ... +100 °C
Silicone	-50 ... +200 °C
PTFE	-50 ... +250 °C
Fibreglass	-50 ... +400 °C

Since, in the tubular design variant, an isolated lead is also fitted within the metal probe, the operating limits of the connecting cable apply.

### ■ Transition

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

Temperature range of the potting compound: -40 ... +150 °C  
Option: 250 °C

(other variants on request)

Temperature range of the special low-temperature version: -60 ... +120 °C <sup>5)</sup>

5) only available with selected approvals

### ■ Connector

With the option of a coupler connector fitted the maximum permissible temperature range is:

Lemos: -55 ... +250 °C

Binder, Amphenol: -40 ... +85 °C

### ■ Working temperature

If the temperature to be measured is higher than the permissible temperature at the cable, connector or transition, the metal part of the sensor must be long enough to be outside of the hot zone. It should be noted that the lowest of the maximum working temperatures for the cable, transition or connector must not be exceeded.

## Transition

The junction between the metal part of the sensor and the connecting cable or bare wire should not be immersed within the process and must not be bent. Compression fittings should not be attached to the transition sleeve.

The dimension T describes the length of the transition sleeve.

Criterion	Dimension T <sup>6)</sup> in mm	Ø transition sleeve in mm
Probe Ø = transition sleeve Ø	40	Identical to probe
Ø 2 ... 4.5 mm with crimped transition sleeve	45	6
Ø 6 mm with crimped transition sleeve	45	7
Ø 6 mm with crimped transition sleeve <sup>7)</sup>	45	8
Ø 8 mm with crimped transition sleeve	45	10

For operating temperatures < -40 °C the transition sleeve is designed as follows:

Criterion	Dimension T in mm	Ø transition sleeve in mm
Probe Ø = transition sleeve Ø	60	Identical to probe
Ø 2 ... 4.5 mm with crimped transition sleeve	60	8
Ø 6 mm with crimped transition sleeve	60	8
Ø 8 mm with crimped transition sleeve	60	10

6) The transition sleeve is generally 60 mm long for 2 x 4-wire sensor connection method.

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

## Connecting cable

There are various insulating materials available to suit any particular environmental conditions.

The cable ends can be prepared ready for connection, or as an option, can be fitted with connectors.

### Connection cable (standard)

- Wire material: Copper (wire)
- Wire cross-section: Approx.  $0.22 \text{ mm}^2$  (standard version)
- Number of wires: Dependent on the connection method
- Insulation material: PVC, silicone, PTFE or glass fibre
- Screen (option):  
Recommendation for connection to transmitter

## IP ingress protection

Cable resistance thermometers can be delivered with up to IP65 (dependent on cable sheath material and number of wires).

With a special design, IP67 is also possible on request.

Connection leads with a glass-fibre sheath cannot be combined with an explosion-proof design.

## Designs

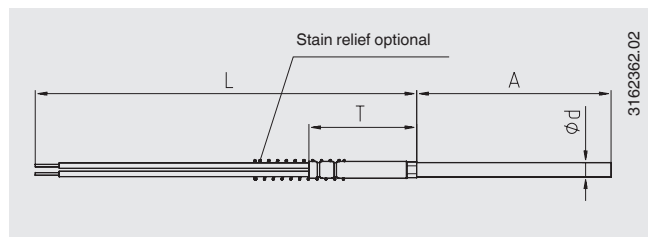
Cable resistance thermometers are classified into the following variants, depending on the nature of their electrical connections:

- With single wires
- With connection cable
- With connector
- Bare ends

### Connection with single wires

Cable length 150 mm, other lengths on request

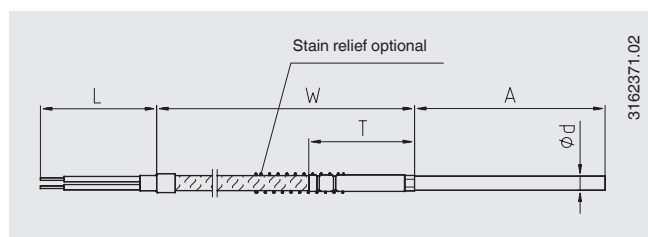
Cu strands  $0.22 \text{ mm}^2$ , PTFE or glass-fibre insulated, number of leads dependent on the number of sensors and the sensor connection method, bare wire ends, other designs on request



### With connection cable

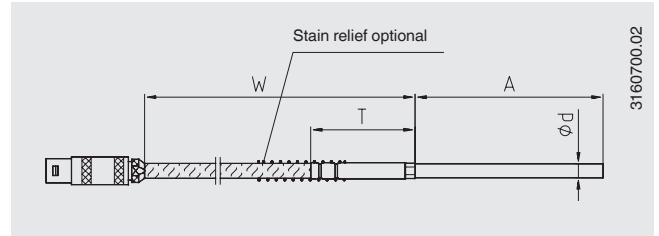
Cable and sensor are permanently connected to each other. Cable length and insulation materials to customer specification.

Cu strands  $0.22 \text{ mm}^2$ , number of leads dependent on the number of sensors and the sensor connection method, bare wire ends



### With connector fitted to connection cable

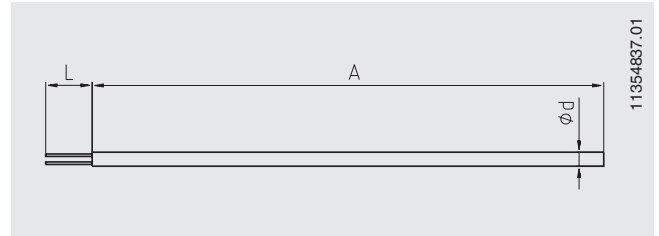
The optional connection plug is fitted to a flexible connection cable.



### Designs with bare connecting wires

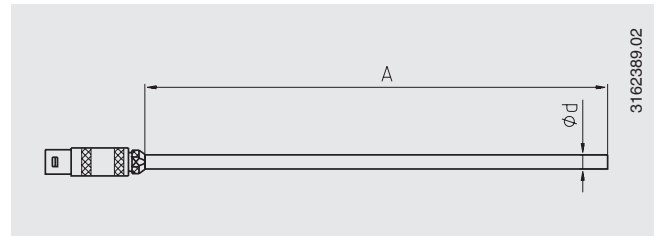
The internal leads of the mineral-insulated wire protrude.  
 $L = 20$  mm (standard)

The length of the bare connection wires can be matched to customer requirements. These bare internal leads are made from solid wire, and so are not suitable to be run over long distances.



### Design with connector fitted directly to the probe

These designs are based on the design with bare connection wires. The connector is fitted directly to the metal probe.



## Process connections for straight probes

The cable resistance thermometers can be fitted with an optional process connection. The dimension A describes the insertion length into the process.

To minimise heat dissipation errors via the threaded connection, the insertion length, A, should be at least 25 mm long. The position of the threaded connection is specified by the dimension X and is not dependent on the connection type.

### Please note:

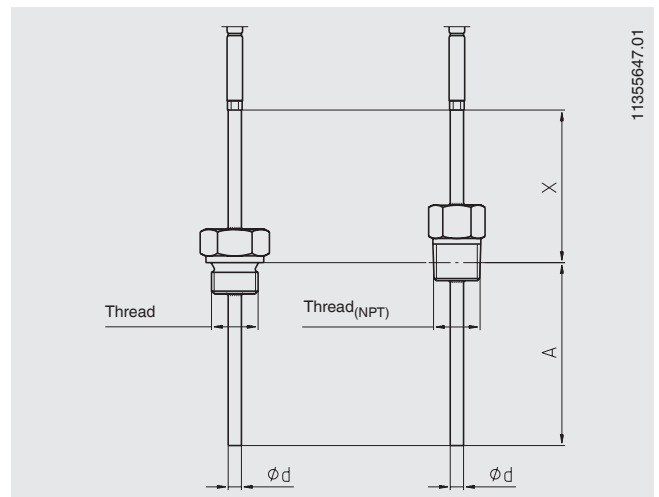
- For parallel threads (e.g. G 1/2) the dimensioning always refers to the sealing collar of the threaded connector nearest the process.
- For tapered threads (e.g. NPT) the measurement plane is located approx. in the centre of the thread

### Fixed threaded connections/threads

used to mount the probe into a threaded coupling with a female thread.

Insertion length A: in accordance with customer specification  
Material: stainless steel, others on request

The sensor must be rotated in order to screw it into the process. Therefore, this design must first be mounted mechanically and it can then be electrically connected.



### Compression fitting

allows simple adjustment to the required insertion length at the installation point.

Since the compression fitting is adjustable on the probe, the dimensions A and X are stated as the values for the delivered item. The length of the compression fitting determines the smallest possible length, X, of approx. 40 mm.

Material: stainless steel

Ferrule material: stainless steel or PTFE

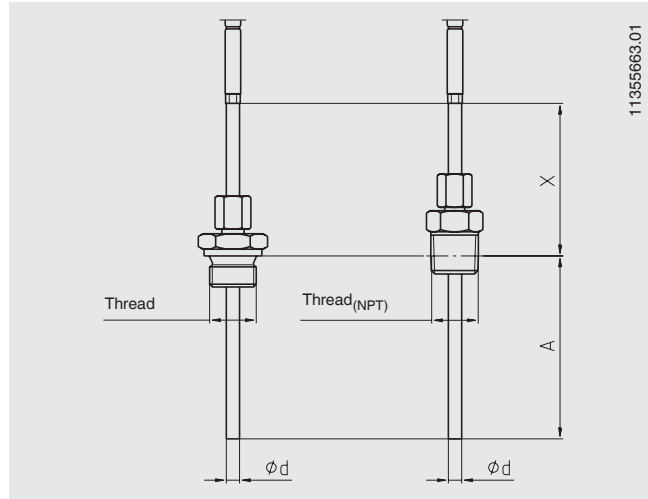
Stainless steel ferrules can be adjusted once; once they have been unscrewed, sliding along the sheath is no longer possible.

- Max. temperature at process connection 500 °C
- Max. pressure load 40 bar

PTFE ferrules can be adjusted several times, after unscrewing, repeated sliding along the sheath is still possible.

- Max. temperature at process connection 150 °C
- For use without pressure

For sheathed resistance thermometers with a  $\varnothing$  of 2 mm, only PTFE ferrules are permitted.



### Spring-loaded compression fitting

allows easy adjustment to the desired insertion length at the mounting point, while at the same time maintaining the spring pre-tension.

Since the compression fitting is adjustable on the probe, the dimensions A and X are stated as the values for the delivered item. The length of the compression fitting determines the smallest possible length, X, of approx. 80 mm.

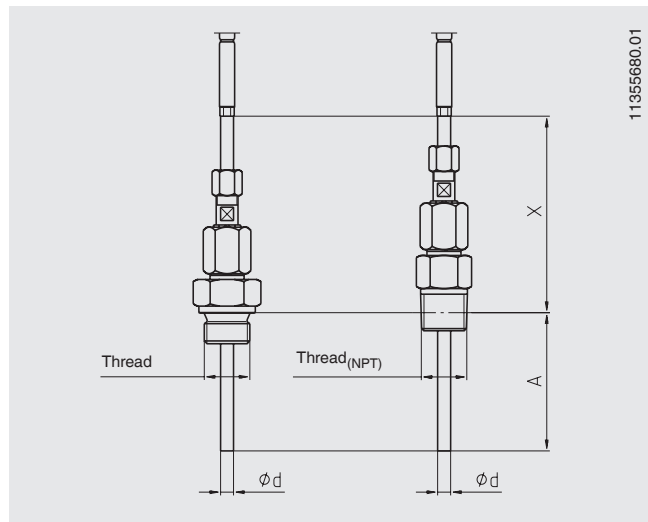
Material: stainless steel

Ferrule material: stainless steel

Stainless steel ferrules can be adjusted once; once they have been unscrewed, sliding along the sheath is no longer possible.

- Max. temperature at process connection 500 °C

A pressure load on the spring-loaded compression fitting is not intended.





**Spring-loaded compression fitting, can work with pressures up to max. 8 bar**

allows easy adjustment to the desired insertion length at the mounting point, while at the same time maintaining the spring pre-tension, intended for use with hydraulic oil

Since the compression fitting is adjustable on the probe, the dimensions A and X are stated as the values for the delivered item. The length of the compression fitting determines the smallest possible length, X, of approx. 80 mm.

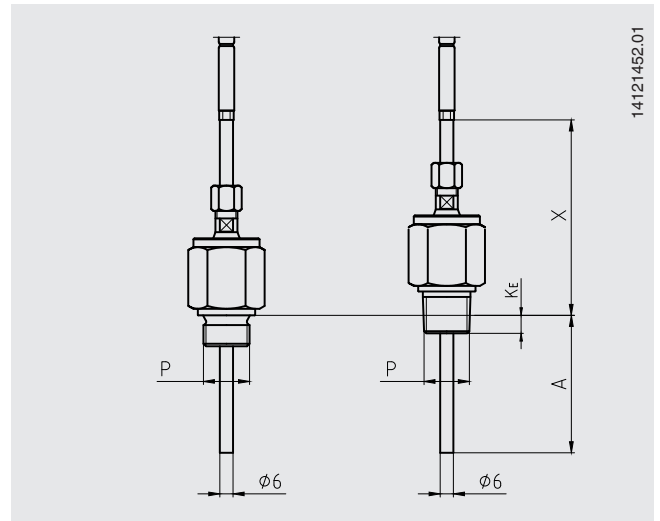
Material: stainless steel

Ferrule material: stainless steel

Stainless steel ferrules can be adjusted once; once they have been unscrewed, sliding along the sheath is no longer possible.

- Permissible temperature at process connection  
-30 ... +100 °C

A pressure load on the spring-loaded compression fitting is permissible up to a max. 8 bar.



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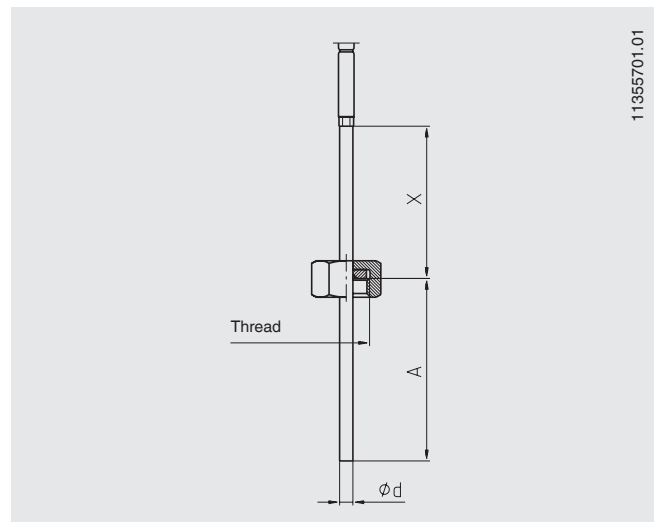
**Union nut**

used to mount the probe into a threaded coupling with a male thread.

The probe and threads rotate against each other, so the order in which the mechanical and electrical installation is made is not important.

This option is not advisable for NPT threads.

Insertion length A: in accordance with customer specification  
Material: stainless steel, others on request



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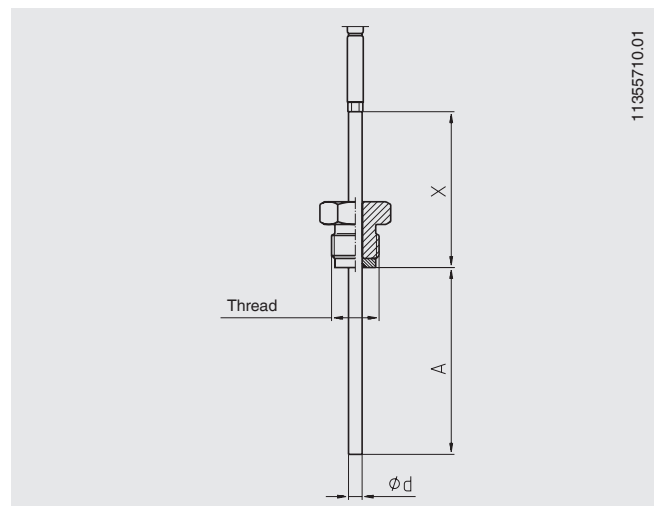
**Male nut**

used to mount the probe into a threaded coupling with a female thread.

The probe and threads rotate against each other, so the order in which the mechanical and electrical installation is made is not important.

This option is not advisable for NPT threads.

Insertion length A: in accordance with customer specification  
Material: stainless steel, others on request



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## Angled probes

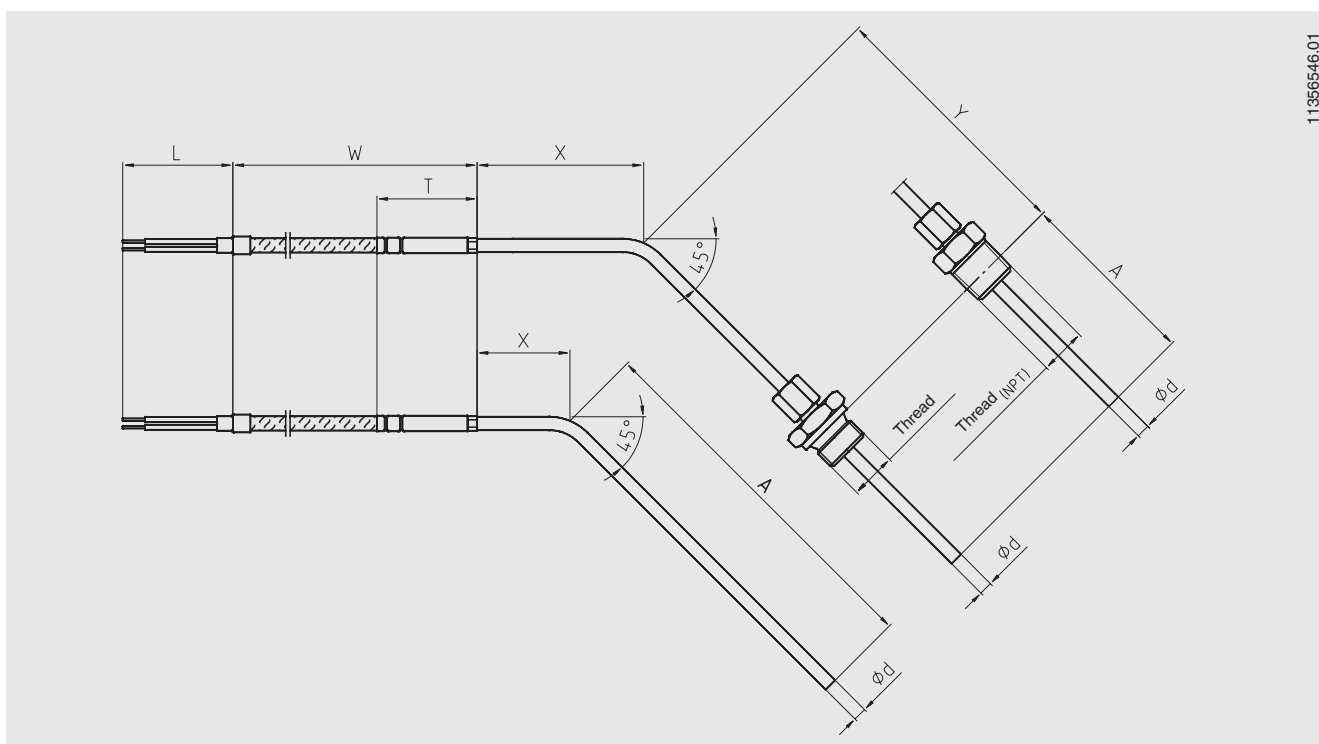
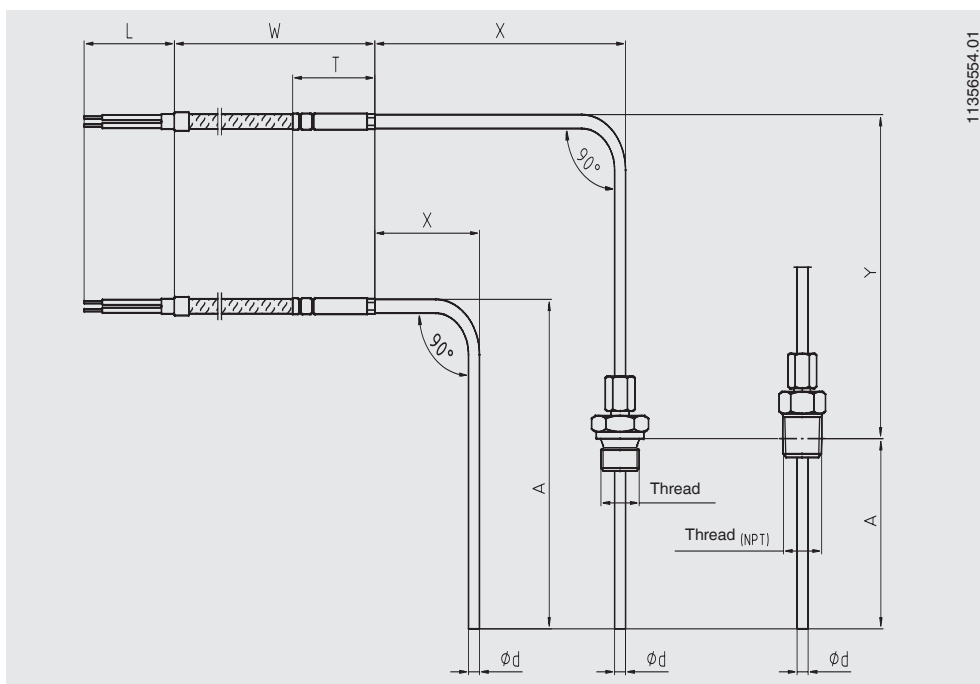
Cable resistance thermometers made from sheathed cable can be delivered in a pre-formed shape. In this case, the position of the bend is defined by a further dimension.

The dimension  $X$  describes the distance of the bend from the lower edge of the transition sleeve.

The dimension  $A$  is always the insertion length of the sensor, and thus the area which is built in to the process.

If a threaded connection is used on the bent probe, then the dimension  $Y$  describes the distance from the centre of the bend to the measurement plane of the threaded connection.

Using a fixed threaded connection is not recommended, as the bent sensor would need to be screwed into the process with a wide sweeping movement.



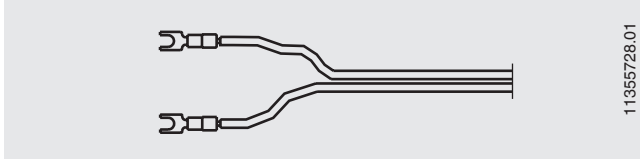
## Plug (option)

Cable resistance thermometers can be supplied with plugs fitted.

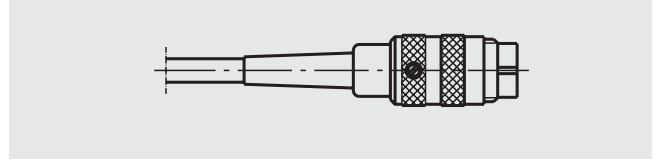
The following options are available:

### ■ Spade lugs

(not suitable for versions with bare connecting wires)

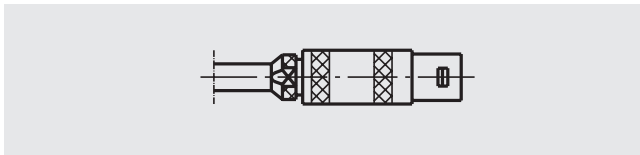


### ■ Screw-in-plug, Binder (male)

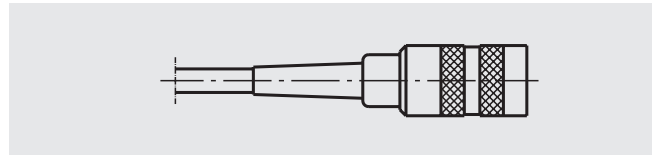


### ■ Lemosa connector size 1 S (male)

### ■ Lemosa connector size 2 S (male)

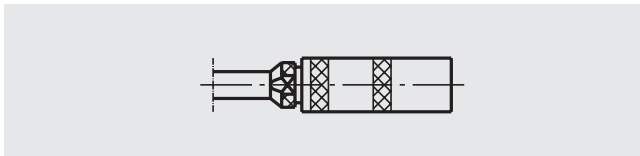


### ■ Screw-in-plug, Binder (female)



### ■ Lemosa free socket size 1 S (female)

### ■ Lemosa free socket size 2 S (female)



## Further options

### Stain relief

A stain relief (spring or shrink hose) is used to protect the transition point from rigid probe to flexible connecting cable. This should always be used when a relative movement between the cable and the installation site of the thermometer is expected.

For designs to Ex n the use of a stain relief is obligatory.

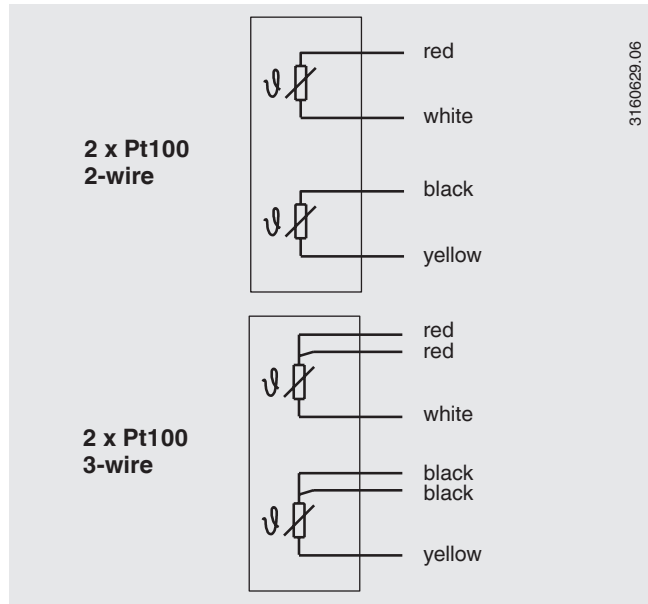
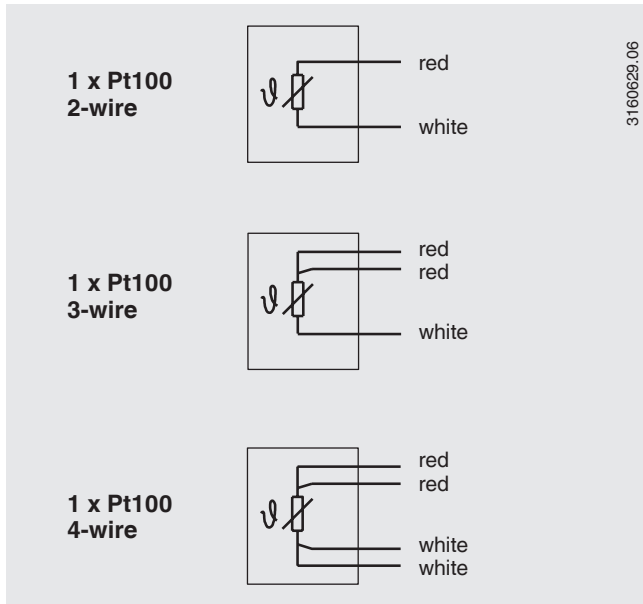
The standard length of the stain relief spring is 60 mm.

### Transition sleeve with the same diameter as the probe

Optionally, a transition sleeve can also be selected that has the same diameter as the metal probe. This makes it possible to slide on cable glands or compression fittings from both ends of the sensor. The transition is hardly visible. The operating limits of the transition do not change, however, i.e. they must still remain outside the process and should not be loaded with a compression fitting.

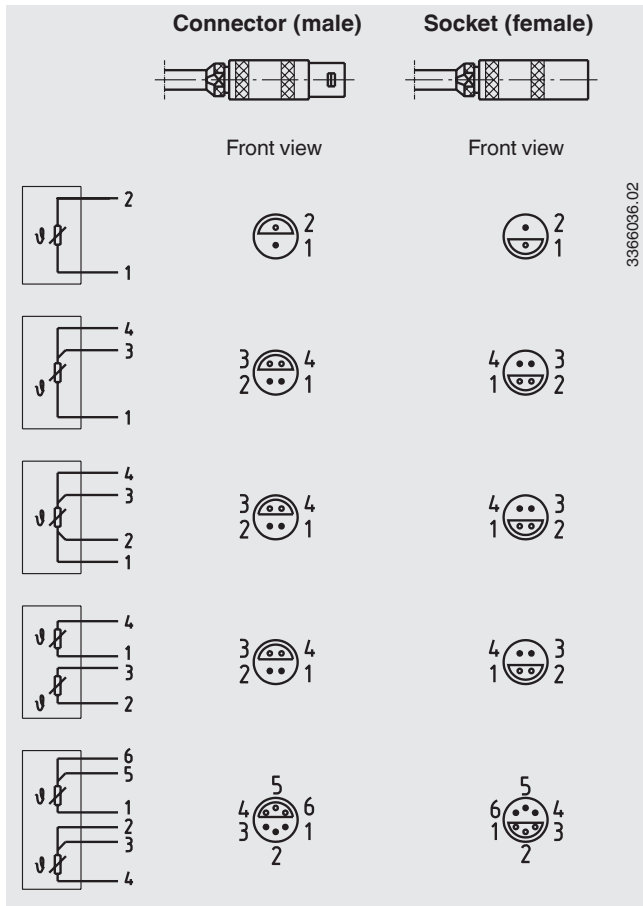
# Electrical connection

## Without connector



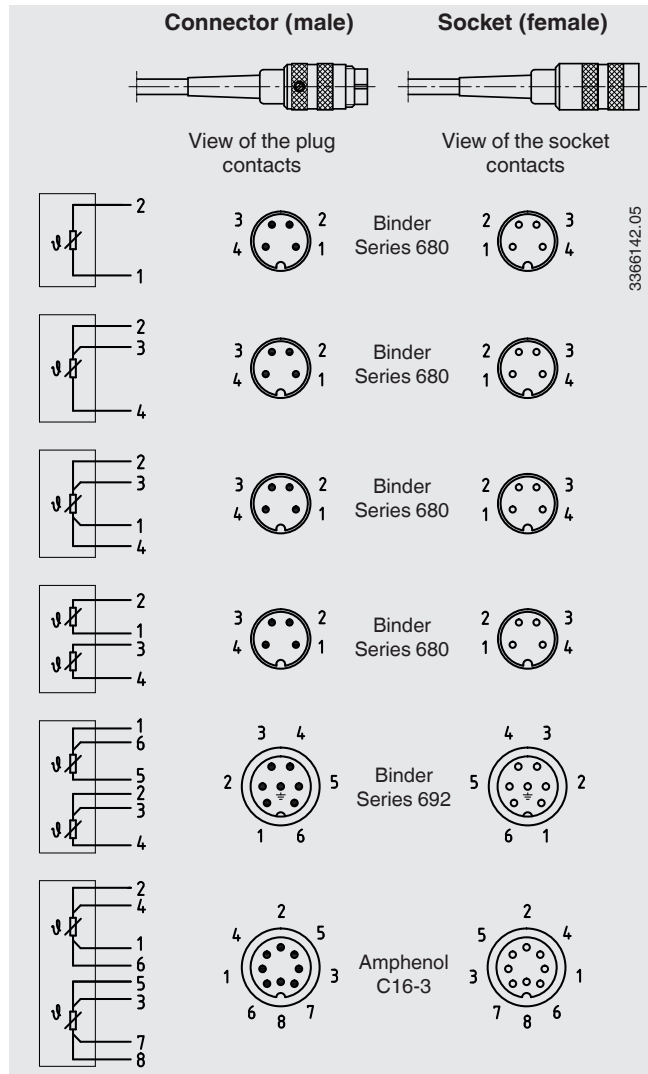
## Lemosa connector

max. permissible temperature range: -55 ... +250 °C



## Screw-in-plug, (Amphenol, Binder)

max. permissible temperature range: -40 ... +85 °C



## Certificates

- 2.2 test report
- 3.1 inspection certificate
- DKD/DakS calibration certificate

## Ordering information

Model / Explosion protection / Sensor version / Threaded connection version / Thread size / Materials / Sensor diameter / Measuring element / Connection method / Temperature range / Connection cable, jacket / Lead ends version / Certificates / Options

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