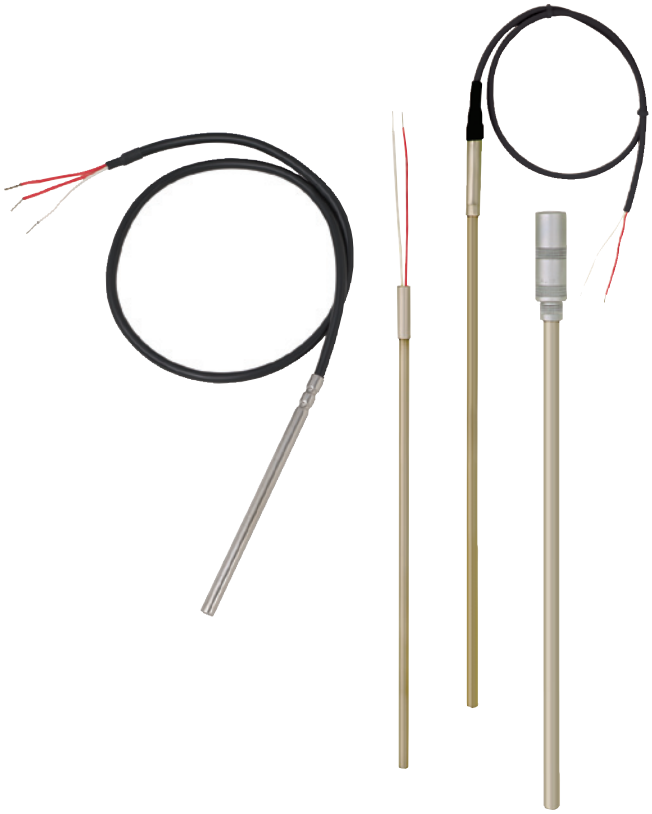
Cable resistance thermometer
Model TR40

Applications

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

Special features

- Application ranges from -200 ... +600 °C
- For insertion, screw-in with optional process connection
- Cable from PVC, silicone, PTFE or glass fibre
- Explosion-protected versions, Ex-i, Ex-n and NAMUR NE24



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.

Sensor

The sensor is located in the tip of the probe.

Sensor connection method

- 2-wire The lead resistance is recorded as an error in the measurement.
- 3-wire With a cable length of approx. 30 m or longer, measuring errors can occur.
- 4-wire The internal lead resistance of the connecting wires is negligible.

Sensor tolerance value per DIN EN 60751

- Class B
- Class A
- Class AA

The combinations of a 2-wire connection with Class A / 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.

Sensor tip design

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^2.
(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^2).
(test based on DIN EN 60751)

Metallic 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 in 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 cable thermocouples can only be used up to the temperature specified for the cable (see operating temperatures).

- **Sheathed designs**

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 resistance 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 be used in locations that are not easily accessible, since, with the exception of the sensor tip and the pot seal 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.

Transitions

The junction between the metal part of the resistance thermometer and the connecting cable or wire is either crimped, rolled or potted, depending on the design. This area should not be immersed within 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 denotes the length of the transition.

Criterion	Dimension T in mm	Ø transition in mm
Probe Ø = transition Ø	n/a	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 greater numbers of wires (e. g. 2 x 3-wire and shielding)

Connecting cable
There are various insulating materials available to match different 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 (strands)
- Wire cross-section: approx. 0.22 mm^2 (standard design)
- Number of wires: dependent on the connection method
- Insulation material PVC, silicone, PTFE or glass fibre
- Screen (option)

Maximum working temperatures

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

Sensor
The temperature range is limited by the sensor itself. Depending on the accuracy class and operating conditions the optimum can be chosen.

Outside of the defined measuring range the measurement is no longer accurate and the sensor can be damaged.

Possible measuring ranges:
-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 wires
At any point on the connection cable, the maximum temprature that may be attained is that for which the connection cable is specified. The sensor (see above) itself can potentially withdtand higher temperatures.

For the common connection wires the following temperature limits apply:

PVC	-20 … +100 °C
Silicone	-50 … +200 °C
PTFE	-50 … +250 °C
Glass fibre	-50 … +400 °C

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

Transitions
The temperature at the transition is further limited by the use of a potted sealing compound.
Maximum temperature of the potting compound: 150 °C.
Optionally: 250 °C
(other variants on request)

Plug
With the option of a connecting plug fitted the maximum permissible temperature at the plug is 85 °C.

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

Ingress protection

IP protection

Cable resistance thermometers can be delivered with up to IP 65 (dependent on cable sheath material and number of wires).
With a special design, IP 67 is also possible on request.
Connection leads with a glass-fibre sheath cannot be combined with an explosion-proof design.

Explosion protection (option)

TR40 series cable resistance thermometers are available with a EC type-examination certificate for "intrinsically safe", Ex-i, ignition protection.
These instruments comply with the requirements of 94/9/EC (ATEX) directive for gas and dust. Manufacturer's declarations in accordance with NAMUR NE24 are also available.

The classification/suitability of the instrument (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 (Li) and capacitance (Ci) for cable probes are found on the product label and they should be taken into account when connecting to an intrinsically-safe power supply.

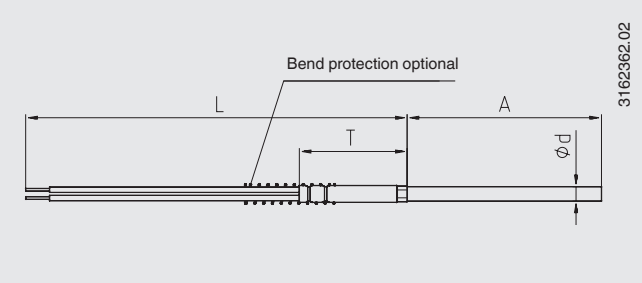
Design

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

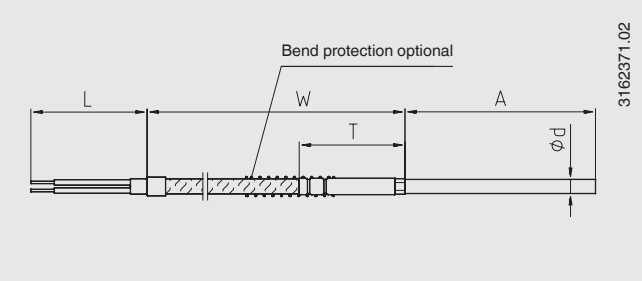
- With single wires
- With connection cable
- With connector
- Bare wire ends

The dimension A describes the insertion length within the process. The dimension W describes the length of the connecting wires. L stands for the length of the free single wires. The dimension T describes the transition (if present). T always makes up part of the length W or L (see table page 3).

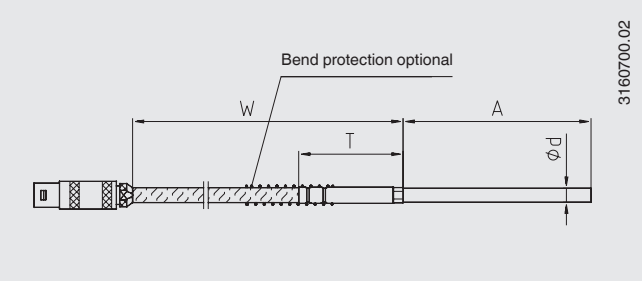
Connection with single wires
Cable length 150 mm, other lengths on request
Cu strands 0.22 mm², PTFE or glass fibre insulated, number of leads dependent on the number of sensors and the sensor connection method, bare wire ends, other designs on request



With connection cable
Cable and sensor are permanently connected to each other. Cable length and insulation materials to customer specification.
Cu strands 0.22 mm², number of leads dependent on the number of sensors and the sensor connection method, bare wire ends

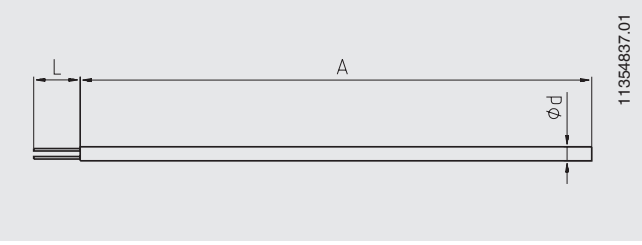


With connector fitted to connection cable
The optional connection plug is fitted to a flexible connection cable.

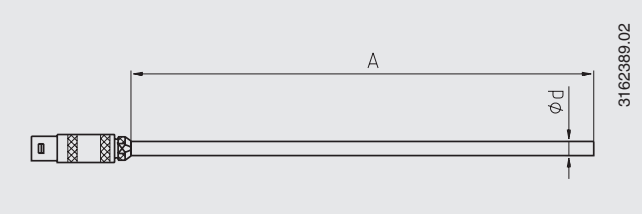


Designs with bare connecting wires
The internal leads of the mineral-insulated wire protrude.
L = 20 mm (standard)

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 metallic 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.

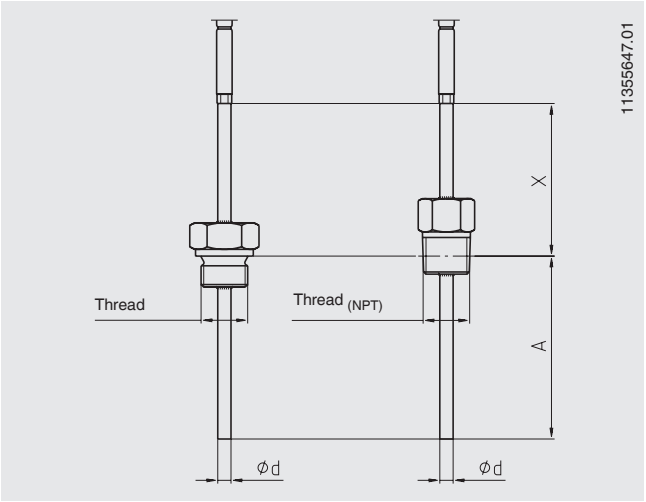
To minimise heat dissipation errors via the threaded connection, the insertion length, A, should be at least 25 mm long. The position of the threaded connection is specified by the dimension X and is not dependent on the connection type.

Please note:
- For parallel threads (e.g. G ½) the dimensioning always refers to the sealing collar of the threaded connector nearest the process
- For tapered threads 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.

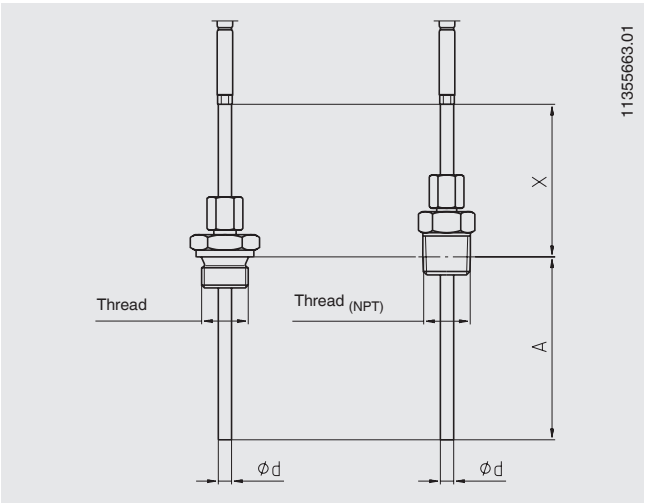
Since the compression fitting is adjustable on the thermowell, the dimensions A and X are stated as the values for the delivered item. The length of the compression fitting determines the smallest possible neck length, X, of approx. 40 mm.

Material: stainless steel
Sealing ring material: stainless steel or PTFE

Stainless steel sealing rings 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 sealing rings 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 Ø of 2 mm, only PTFE sealing rings are approved.



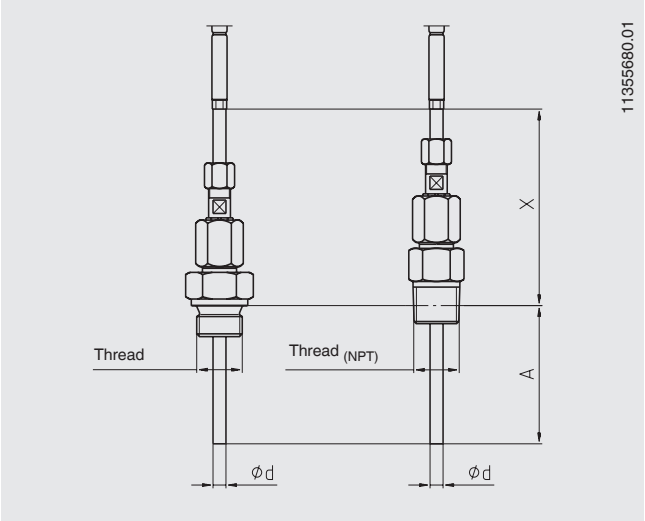
Spring-loaded compression fitting
allows easy adjustment to the desired insertion length at the mounting point, while at the same time maintaining the spring pre-tension

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

Material: stainless steel
Sealing ring material: stainless steel

Stainless steel sealing rings 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 compression fitting is not intended.

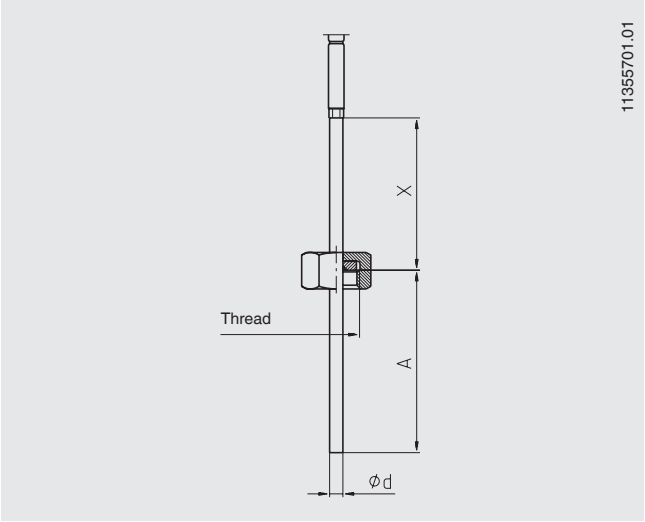


Union nut (female)
used to mount the probe into a threaded coupling with a male thread.

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

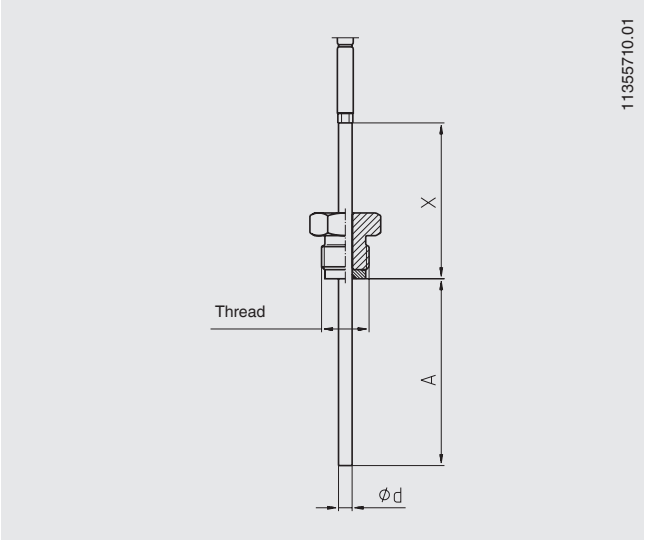


Male nut
used to mount the probe into a threaded coupling with a female thread.

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



Angled probes

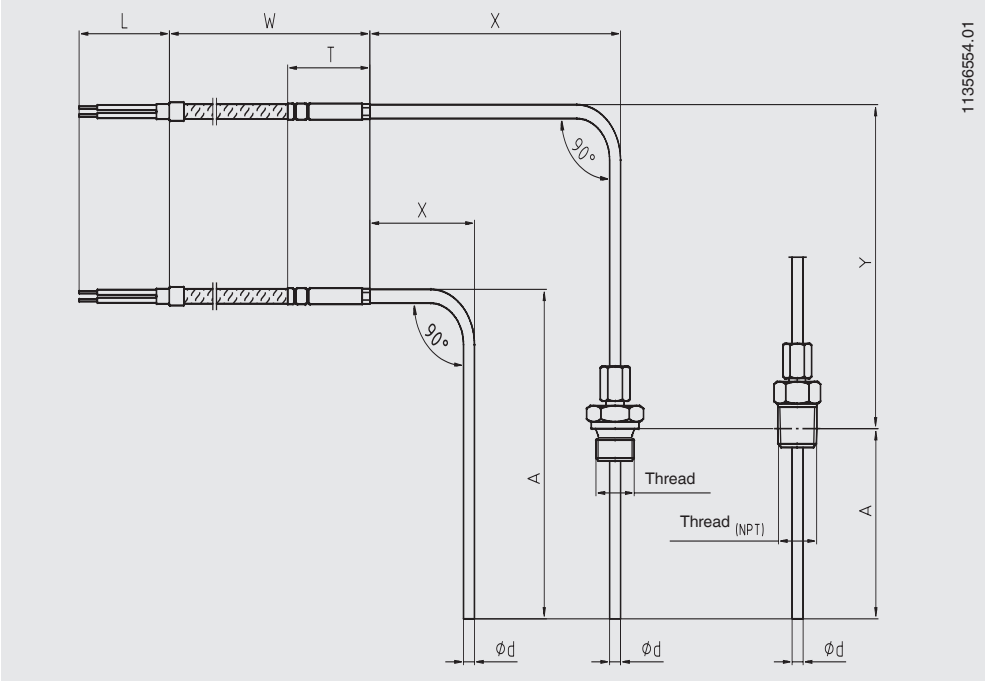
Cable resistance thermometers made from sheathed cable can be delievered in a pre-formed shape. In this case, the position of the bend is defined by a further dimension.

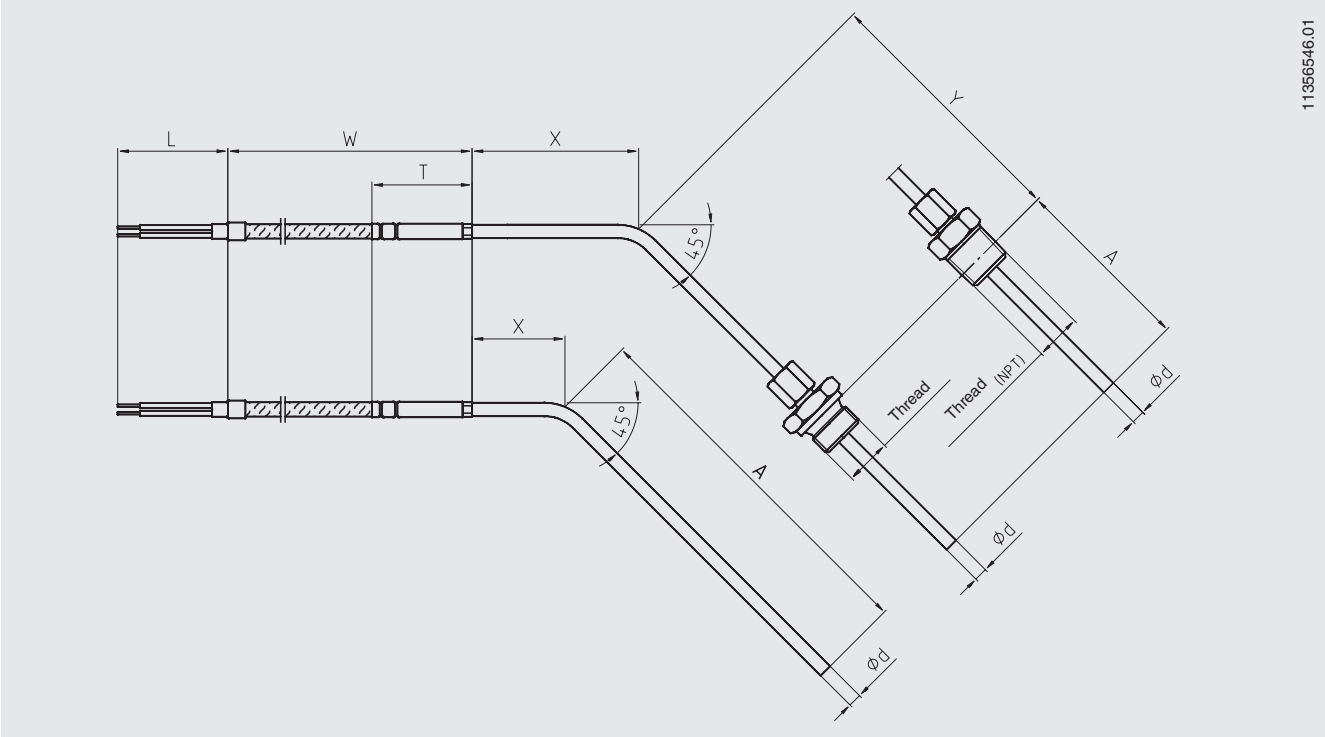
The dimension X describes the distance of the bend from the lower edge of the transition sleeve.

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.



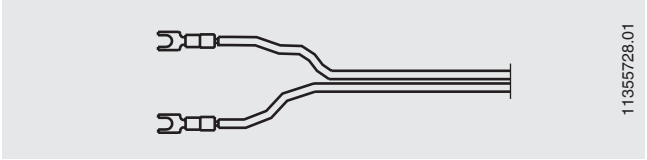


Plug (option)

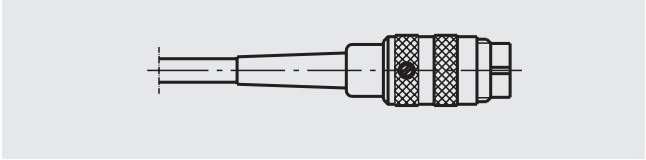
Cable resistance thermometers can be supplied with plugs fitted.

The following options are available:

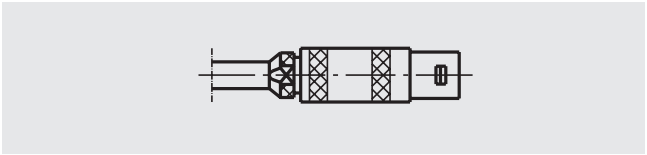
■ **Terminal ends**
(not suitable for versions with bare connecting wires)



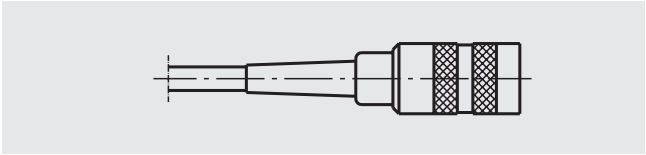
■ **Screw-in-plug, Binder (male)**



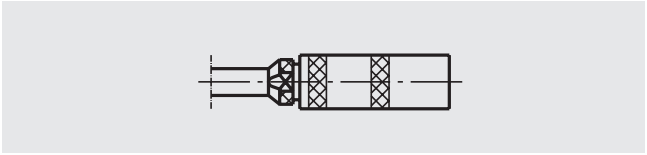
■ **Lemosa plug size, 1 S (male)**
■ **Lemosa plug, size 2 S (male)**



■ **Screw-in-plug, Binder (female)**



■ **Lemosa plug, size 1 S (female)**
■ **Lemosa plug, size 2 S (female)**



Further options

Bend protector
A cable protector (spring or shrink sleeving) is used to protect the transition point from rigid probe to flexible connection cable. This should always be used when a relative movement between the cable and the thermometer mounting is expected.

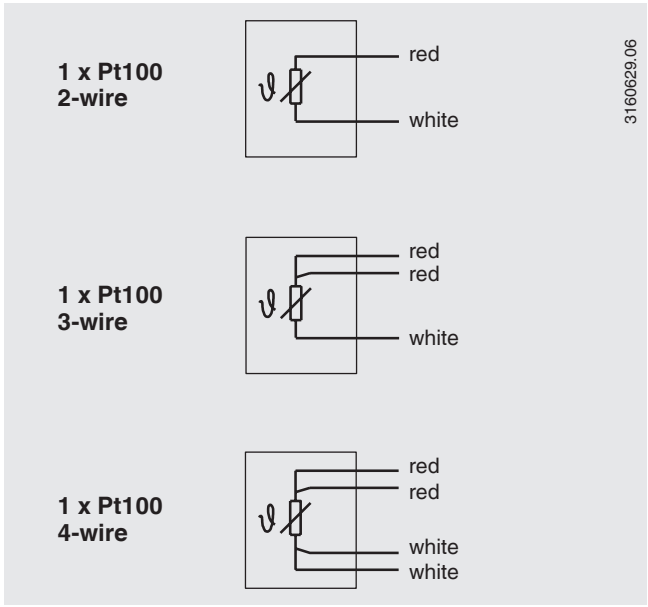
For designs to Ex-n the use of bend protection is obligatory.

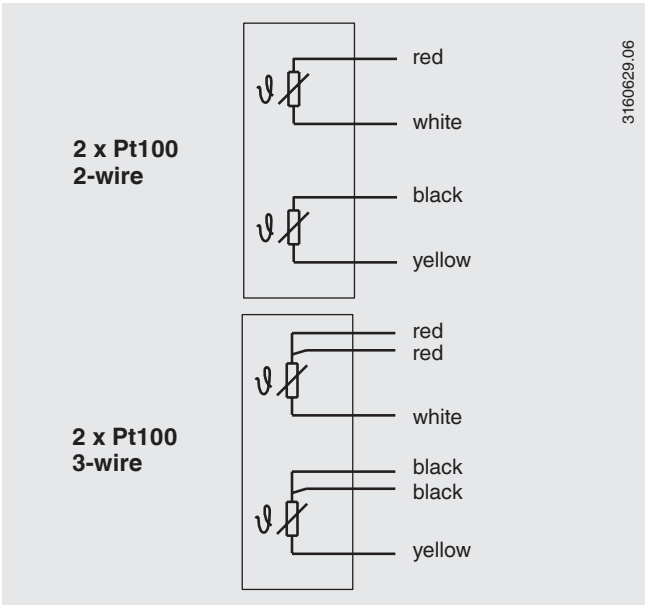
The standard length of the bend protection spring is 60 mm.

Transition with the same diameter as the probe
Optionally, a transition 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.

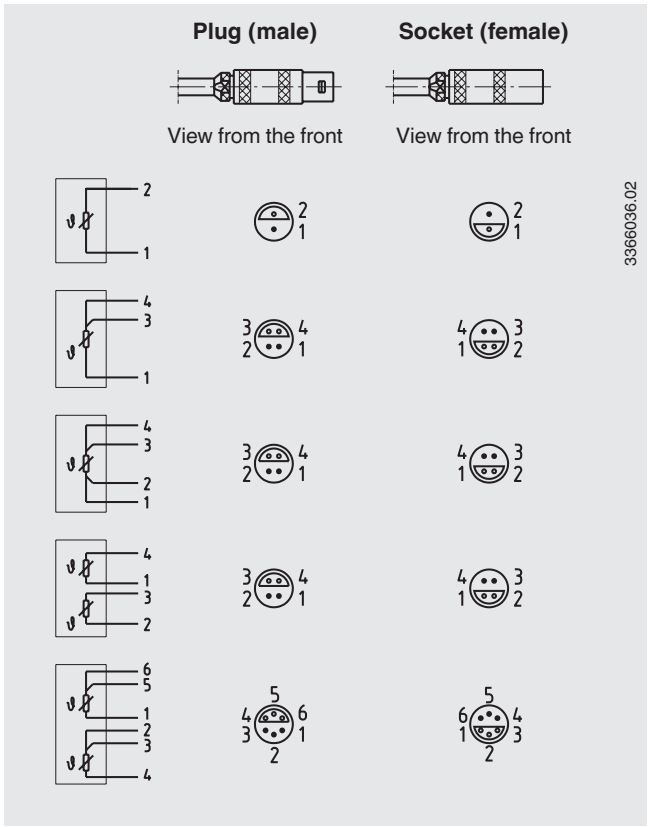
Electrical connection

Without connector

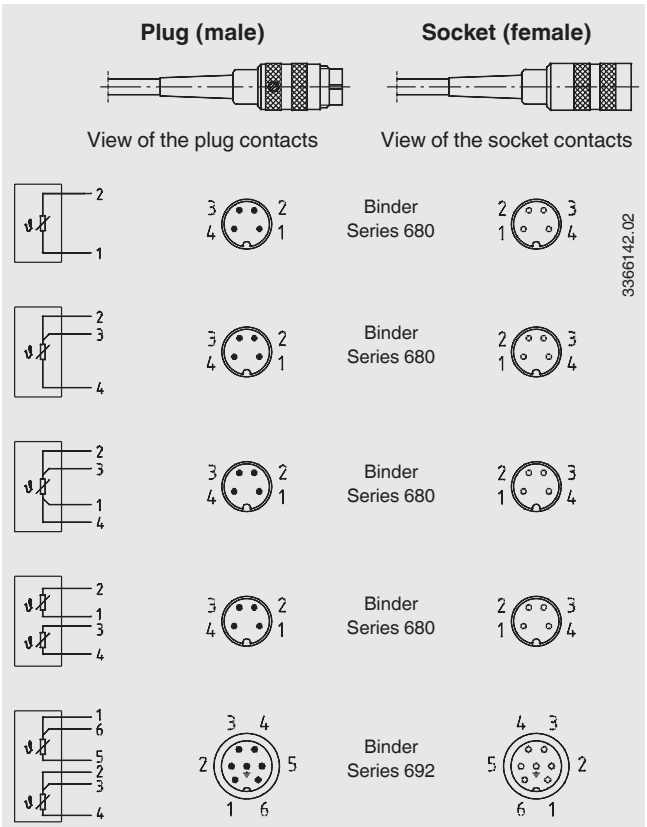




Lemosa plug



Binder screw/plug-in connector



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