Surface thermocouple
Model TC50

Applications
To measure surface temperatures on flat surfaces or pipes, in both laboratory and industrial applications

Special features
- Sensor ranges -40 ... +1,200 °C (-40 ... +2,192 °F)
- Easily exchanged, no thermowell necessary
- For screw-fitting, welding or using a tightening strap
- Cable from PVC, silicone, PTFE or glass fibre
- Explosion-protected versions

Description
Probes
In the variants for flat surfaces, the probe is fitted within a contact block. This can be screwed or welded onto the vessel surface. Variants for pipes are secured using a tightening strap.

Cable
There are various insulating materials available to suit any particular environmental conditions. The cable end is made up, ready for connection, but can also be fitted with a connector or connected to a field case, as options.
**Explosion protection (option)**

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

The internal inductance ($L_i = 1 \, \mu\text{H/m}$) and capacitance ($C_i = 200 \, \text{pF/m}$) 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)

<table>
<thead>
<tr>
<th>Logo</th>
<th>Description</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU declaration of conformity</td>
<td>[II 1G Ex ia IIC T1 ... T6 Ga]</td>
<td>European Union</td>
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<tr>
<td>- Ex i</td>
<td>Zone 0 gas</td>
<td>[II 1/2G Ex ia IIC T1 ... T6 Ga/Gb]</td>
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<tr>
<td></td>
<td>Zone 1 gas mounting to zone 0 gas</td>
<td>[II 2G Ex ia IIC T1 ... T6 Gb]</td>
</tr>
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<td>Zone 1 gas</td>
<td>[II 1D Ex ia IIC T125 ... T65 °C Da]</td>
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<td>[II 3G Ex nA IIC T1 ... T6 Gc X]</td>
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<td>Zone 22 dust</td>
<td>[II 3D Ex tc IIC T440 ... T80 °C Dc X]</td>
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<td>[Ex ia IIC T125 ... T65 °C Db]</td>
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<td>Zone 21 dust</td>
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<td>Class I, Div 2</td>
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<tr>
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<td>Zone 20 dust</td>
<td>[DIP A22 Ta 80 ... 440 °C]</td>
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<td>[Ex ia IIC T3 ... T6 Ga]</td>
<td>Brazil</td>
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</tr>
<tr>
<td>- Ex i</td>
<td>Zone 0 gas</td>
<td>[Ex ib IIC T3 ... T6 Gb]</td>
</tr>
<tr>
<td></td>
<td>Zone 1 gas</td>
<td>[Ex ia IIC T125 ... T65 °C Da]</td>
</tr>
<tr>
<td></td>
<td>Zone 20 dust</td>
<td>[Ex ia IIC T125 ... T65 °C Da/Db]</td>
</tr>
<tr>
<td></td>
<td>Zone 21 dust mounting to zone 20 dust</td>
<td>[Ex ib IIC T125 ... T65 °C Db]</td>
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<td>Logo</td>
<td>Description</td>
<td>Country</td>
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<td>------</td>
<td>-------------</td>
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</tr>
</tbody>
</table>
| ![Logo](image1) | **NEPSI (option)**  
Hazardous areas  
- Ex i  
  Zone 0 gas  
  Zone 1 mounting to zone 0 gas  
  Zone 1 gas  
  [Ex ia IIC T3 – T6]  
  [Ex ia/ib IIC T3 – T6]  
  [Ex ib IIC T3 – T6] | China |
| ![Logo](image2) | **KC5s - KOSHA (option)**  
Hazardous areas  
- Ex i  
  Zone 0 gas  
  Zone 1 gas  
  [Ex ia IIC T4 ... T6]  
  [Ex ib IIC T4 ... T6] | South Korea |
| ![Logo](image3) | **PESO (option)**  
Hazardous areas  
- Ex i  
  Zone 0 gas  
  Zone 1 mounting to zone 0 gas  
  Zone 1 gas  
  [Ex ia IIC T1 ... T6 Ga]  
  [Ex ib IIC T3 ... T6 Ga/Gb]  
  [Ex ib IIC T3 ... T6 Gb] | India |
| ![Logo](image4) | **DNOP - MakNII (option)**  
Hazardous areas  
- Ex i  
  Zone 0 gas  
  Zone 1 gas  
  Zone 20 dust  
  Zone 21 dust  
  [II 1G Ex ia IIC T3, T4, T5, T6 Ga]  
  [II 2G Ex ia IIC T3, T4, T5, T6 Gb]  
  [II 1D Ex ia IIIC T65, T95, T125 °C Da]  
  [II 2D Ex ib IIIC T125 ... T65 °C Db] | Ukraine |
| ![Logo](image5) | **GOST (option)**  
Metrology, measurement technology | Russia |
| ![Logo](image6) | **KazInMetr (option)**  
Metrology, measurement technology | Kazakhstan |
| ![Logo](image7) | **MTSCHS (option)**  
Permission for commissioning | Kazakhstan |
| ![Logo](image8) | **BelGIM (option)**  
Metrology, measurement technology | Belarus |
| ![Logo](image9) | **UkrSEPRO (option)**  
Metrology, measurement technology | Ukraine |
| ![Logo](image10) | **Uzstandard (option)**  
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

Thermocouple per IEC 60584-1 or ASTM E230
Types K, J, E, N, T (single or dual thermocouple)

Sensor types

<table>
<thead>
<tr>
<th>Type</th>
<th>Operating temperatures of the thermocouple</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
</tr>
<tr>
<td>K</td>
<td>-40 ... +1,200 °C</td>
</tr>
<tr>
<td>J</td>
<td>-40 ... +750 °C</td>
</tr>
<tr>
<td>E</td>
<td>-40 ... +900 °C</td>
</tr>
<tr>
<td>N</td>
<td>-40 ... +1,200 °C</td>
</tr>
<tr>
<td>T</td>
<td>-40 ... +350 °C</td>
</tr>
</tbody>
</table>

The table shows the temperature ranges listed in the respective standards, in which the tolerance values (class accuracies) are valid.

The actual operating temperature of the thermometers is limited both by the maximum permissible working temperature and the diameter of the thermocouple and the MI cable, as well as by the maximum permissible working temperature of the thermowell material.

If the temperature to be measured is higher than the permissible temperature at the cable transition, the distance between the cable transition and the critical temperature must be adjusted accordingly by an increased probe length (MI cable).

Listed models are available both as single or dual thermocouples. The thermocouple will be delivered with an ungrounded measuring point, unless explicitly specified otherwise.

For detailed specifications for thermocouples, see IEC 60584-1, IEC 60584-3 or ASTM E230 and Technical information IN 00.23 at www.wika.com.

Tolerance value
For the tolerance value of thermocouples, a cold junction temperature of 0 °C has been taken as the basis.

Metallic probe

Material: Stainless steel
Diameter: 3 or 6 mm
Length: selectable

Surface thermocouples can be designed in two different ways:

■ Tubular design
The tubular design features a rigid construction to the metal probe tip; therefore, tubular designs must not be bent. Within the pipe, the connection cable extends almost to the probe tip. Therefore tubular cable thermocouples can only be used up to the temperature specified for the cables (see operating temperature).

■ Sheathed design
In sheathed thermocouples the flexible part of the probe 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.

Sheath material
■ Ni-alloy: alloy 600
■ Stainless steel
■ Others on request

Sheathed thermocouples, with the exception of the transition, may be bent to a radius of 3-times the sheath diameter. Due to this flexibility, the probe can be used in areas that are difficult to access.
Maximum working temperatures

The maximum working temperature for these thermometers is limited by different parameters.
If the temperature to be measured inside the sensor measuring range is higher than the permissible temperature at the connection cable, the connector or the transition point, the metallic part of the sensor (mineral-insulated cable) must be long enough to place the critical components outside of the hot zone. The lowest of the maximum working temperatures of process connection, connection line, cable transition or connector must be observed here.

■ Sensor (thermocouple)
The temperature ranges indicated on page 4 refer to the operating range of the thermocouple. These measuring ranges depend on the selected thermocouple and the selected accuracy class.

Operation outside the measuring range defined for the given thermocouple type and class can result in a damage to the thermocouple.

■ 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 itself (see page 4) can potentially withstand higher temperatures.

For the common connection lines the following maximum operating temperatures apply:
- PVC: -20 °C ... +100 °C
- Silicone: -50 °C ... +200 °C
- PTFE: -50 °C ... +250 °C
- Fiberglass: -50 °C ... +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.

■ Transition from the metal part of the thermometer to the connection cable
The temperature at the transition may be further limited by the use of a potted sealing compound.

Temperature range of the potting compound: -40 °C ... +150 °C
Option: 250 °C (other variants on request)

Temperature range of the special low-temperature version: -60 °C ... +120 °C 1)

1) only available with selected approvals

Transition

The junction between the metal part of the probe and the connecting cable or wire is either 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 probe and the sealing requirements.

The dimension T describes the length of the transition.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Dimensions</th>
<th>Ø transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe Ø = transition sleeve Ø</td>
<td>40</td>
<td>identical to probe</td>
</tr>
<tr>
<td>Ø 2 ... 4.5 mm with crimped transition sleeve</td>
<td>45</td>
<td>6</td>
</tr>
<tr>
<td>Ø 6 mm with crimped transition sleeve</td>
<td>45</td>
<td>7</td>
</tr>
<tr>
<td>Ø 8 mm with crimped transition sleeve</td>
<td>45</td>
<td>10</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Dimension</th>
<th>Ø transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe Ø = transition sleeve Ø</td>
<td>60</td>
<td>identical to probe</td>
</tr>
<tr>
<td>Ø 2 ... 4.5 mm with crimped transition sleeve</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>Ø 6 mm with crimped transition sleeve</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>Ø 8 mm with crimped transition sleeve</td>
<td>60</td>
<td>10</td>
</tr>
</tbody>
</table>

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

Connection lead

There are various insulating materials available to suit any particular environmental conditions.
The cable end is made up, ready for connection, but can also be fitted with a connector or connected to a field case, as options.

Connection cable (standard)

■ Wire material adapted to the sensor
■ Wire cross-section: approx. 0.22 mm² (standard design)
■ Number of wires: depending on the number of thermocouples
■ Insulation material: PVC, silicone, PTFE or glass fibre
■ Screen (option)
IP ingress protection

Surface thermocouples 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 version.

Process connection

**Metal contact block**
Design: Contact block for screwing or welding to a flat surface
Material: Stainless steel
Dimensions: see drawing
other versions on request

**Washer**
Design: Centrally-drilled washer
Material: Stainless steel
Dimensions: see drawing
other versions on request

**Tightening strap**
Design: Tightening strap
Material: Stainless steel
Dimensions: see drawing
other versions on request

**Weld-on sheet**
Design: Weld-on sheet
Material: Stainless steel
Dimensions: see drawing
other versions on request
### Dimensions in mm

**Metal contact block with bore**

<table>
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<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ 6.5</td>
<td>L</td>
<td>A</td>
<td>B</td>
<td>H</td>
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</table>

**Washer**

<table>
<thead>
<tr>
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<th>3</th>
<th>4</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>φ 6.5</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Tightening strap**

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<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ 6.5</td>
<td>4.5</td>
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<td></td>
<td></td>
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</table>

**Weld-on sheet**

<table>
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<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>φ 6.5</td>
<td>L</td>
<td>B</td>
<td>H</td>
<td></td>
</tr>
</tbody>
</table>

**Bending direction** (MI cable)

1. Standard version straight
2. Standard version 90° bent
3. Standard version 45° bent
4. Option (ask for delivery time)
5. Option (ask for delivery time)

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**Please note:**
The complete length, A, must always be viewed in relation to the drawings on pages 8 and 9.

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<table>
<thead>
<tr>
<th>Process connection</th>
<th>Dimensions in mm</th>
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<tbody>
<tr>
<td><strong>Width x length x height</strong></td>
<td><strong>Outer diameter x inner diameter x thickness</strong></td>
</tr>
<tr>
<td>(B x L x H)</td>
<td>(AD x ID x d)</td>
</tr>
<tr>
<td>Metal contact block with bore d = 6.5 mm</td>
<td>30 x 40 x 8</td>
</tr>
<tr>
<td>Washer</td>
<td>-</td>
</tr>
<tr>
<td>Weld-on sheet</td>
<td>25 x 25 x 3.0</td>
</tr>
<tr>
<td>Tightening strap</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>-</td>
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<td></td>
<td>-</td>
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<td>-</td>
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</tbody>
</table>
Cable end design
The dimension A defines the probe length. The dimension W describes the length of the connecting wire. L is the length of the free cable ends. The dimension T describes the transition (if present). T is always a constituent of the length W or L (see table on page 5).

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 probe 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 connector 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.

Version with connected field case
The connection cable is connected to the field case (plastic, ABS) via a cable gland. A second cable gland is mounted for the cable outlet. An aluminium case is available as an option.
Ambient temperature at case:
-40 ... +80 °C
Cable gland material:
- Plastic (standard)
- Metal (option)
Angled probes

Surface thermocouples 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.

Other bend angles on request.
Strain relief loops are also possible on request.
Connector (option)

Surface thermocouples can be supplied with connectors fitted. The following options are available:

- **Screw-in-connector, Binder** (male)
- **Screw-in-connector, Binder** (female)
- **Lemosa connector size 1 S** (male)
- **Lemosa connector size 2 S** (male)
- **Lemosa coupling size 1 S** (female)
- **Lemosa coupling size 2 S** (female)
- **Standard thermo connector 2-pin** (male)
- **Standard thermo connector 2-pin** (female)
- **Miniature thermo connector 2-pin** (male)
- **Miniature thermo connector 2-pin** (female)
- **Lemosa connector size 1 S** (male)
- **Lemosa connector size 2 S** (male)
- **Lemosa coupling size 1 S** (female)
- **Lemosa coupling size 2 S** (female)
- **Spade lugs**
  (not suitable for versions with bare connecting wires)

Other connector variants (sizes) on request.

Further options

Bend protector

A cable protector (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 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.
**Electrical connection**

**Cable**
Marking of wire ends see table

**Lemosa connector, male at the cable**
max. permissible temperature range: -55 ... +250 °C

**Binder connector**
Series 680, Series 423 (shielded), male at the cable (screw-in-connector)
max. permissible temperature range: -40 ... +85 °C

**Single thermocouple**

**Dual thermocouple**

**Thermo connector**
Positive and negative terminal are marked. Two thermo connectors are used with dual thermocouples.

Other coupler connectors and pin assignments on request.

**Colour code of cable**

<table>
<thead>
<tr>
<th>Sensor type</th>
<th>Standard</th>
<th>Positive</th>
<th>Negative</th>
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<tbody>
<tr>
<td>K</td>
<td>IEC 60584</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>J</td>
<td>IEC 60584</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>E</td>
<td>IEC 60584</td>
<td>Violet</td>
<td>White</td>
</tr>
<tr>
<td>T</td>
<td>IEC 60584</td>
<td>Brown</td>
<td>White</td>
</tr>
<tr>
<td>N</td>
<td>IEC 60584</td>
<td>Pink</td>
<td>White</td>
</tr>
</tbody>
</table>

For further information on colour codes see Technical information IN 00.23 at www.wika.com.
Mounting instructions

The basic requirements to ensure a perfect measurement result is to retain good thermal contact between the probe and the outside wall of the vessel or pipe. Minimal heat loss to the environment from both the probe and the measuring point is imperative.

The probe should have direct, metallic contact with the measuring point and sit firmly on the surface of the measuring point.

Insulation must be applied at the installation site to avoid error due to heat loss. This insulation must have sufficient temperature resistance and is not included in the scope of delivery.

Certificates (option)

<table>
<thead>
<tr>
<th>Certification type</th>
<th>Measuring accuracy</th>
<th>Material certificate</th>
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</thead>
<tbody>
<tr>
<td>2.2 Test report</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Other certificates on request.

Ordering information

Model / Process connection / Probe version / Explosion protection / Material of the process mounting / Probe diameter / Connection cable, sheath / Cable end version / Cable connection accessories / Measuring element / Number of measuring points / Sensor tolerance value / Temperature range / Certificates / Options

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