Electrical temperature measuring instruments
Ability to meet any challenge

As a family-run business acting globally, with over 8,500 highly qualified employees, the WIKA group of companies is a worldwide leader in pressure and temperature measurement. The company also sets the standard in the measurement of level and flow, and in calibration technology. Founded in 1946, WIKA is a strong and reliable partner for all the requirements of industrial measurement technology, thanks to a broad portfolio of high-precision instruments and comprehensive services.

With manufacturing locations around the globe, WIKA ensures flexibility and the highest delivery performance. Every year, over 50 million quality products, both standard and customer-specific solutions, are delivered in batches of 1 to over 10,000 units. With numerous wholly-owned subsidiaries and partners, WIKA competently and reliably supports its customers worldwide. Our experienced engineers and sales experts are available to support you locally.
WIKA product lines

The WIKA portfolio covers the following product lines for various fields of application.

**Electronic pressure measurement**
WIKA offers a complete range of electronic pressure measuring instruments: pressure sensors, pressure switches, pressure transmitters and process transmitters for the measurement of gauge, absolute and differential pressure. Our pressure measuring instruments are available in the measuring ranges 0.25 "WC to over 0 …200,000 psi. These instruments come supplied with standardized current or voltage output signals (also intrinsically safe or with flameproof enclosure), interfaces and protocols for various field busses. Whether ceramic thick film, metal thin film or piezo-resistive, WIKA is the leading manufacturer worldwide that develops and produces the full range of today's leading sensor technologies.

**Mechatronic pressure measurement**
As a result of the almost unlimited options for different combinations of mechanical and electrical connections, an extraordinary range of instrument variations are possible. Various digital and analogue output signals are also available for these measuring instruments.
For our measuring instruments we use the latest sensors, tested in automotive applications millions of times over. They work without any kind of mechanical contact, consequently they are wear-resistant, with absolutely no influence on the mechanics.

**Mechanical pressure measurement**
Indicating pressure gauges for gauge, absolute and differential pressure with Bourdon tube, diaphragm or capsule pressure elements have been tested millions of times over. These instruments cover scale ranges from 0 … 0.2 "WC to 0 … 100,000 psi and indication accuracies of up to 0.1 %.

**Diaphragm seals**
WIKA diaphragm seals, mounted with pressure gauges, pressure transducers, pressure transmitters etc., are recognized and valued internationally for the most difficult of measuring tasks. The measuring instruments can therefore be used at extreme temperatures (-130 … +400 °C, -202 … +752 °F), and with aggressive, corrosive, heterogeneous, abrasive, highly viscous or toxic media. The optimal diaphragm seal designs, materials and filling media are available for each application.

**Electrical temperature measurement**
Our range of products includes thermocouples, resistance temperature sensors (with optional on-site display), temperature switches as well as analogue and digital temperature transmitters for all industrial applications. Measuring ranges from -200 … +1,700 °C, -328 … +3,092 °F are covered.

**Mechatronic temperature measurement**
As a result of the integration of switch contacts and output signals into our mechanical temperature measuring instruments, we can offer a wide variety of combined instruments. With switch contacts the pointer position triggers a changeover. Electrical output signals are realized via an additional, independent sensor circuit (resistance temperature sensor or thermocouple).

**Mechanical temperature measurement**
The mechanical temperature measuring instruments work on the bimetal expansion, or gas actuation principle and cover scale ranges from -200 … +700 °C, -328 … +1292 °F. All temperature sensors are suited for operation in a thermowell if necessary.

**Level measurement**
WIKA has a comprehensive range of level measuring instruments available for temperatures up to 540 °C, 1,000 °F; specific gravity from 400 kg/m³ and pressure ranges up to 7,250 psi. This includes standard instruments and customized products.

**Flow measurement**
Orifice plates, meter runs, flow nozzles, Venturi tubes and pitot tubes are part of our portfolio of primary flow elements and restriction orifices. The wide range of our products is able to cover the majority of industrial applications. Customized solutions can be developed to meet your special needs.

**Calibration technology**
WIKA offers a broad product range of calibration instruments for the physical units of measurement for pressure and temperature, and for electrical measurands. Numerous patents ensure unmatched performance from many of our calibration instruments. The range of services covers the calibration of pressure and temperature measuring instruments in our accredited calibration laboratories and a mobile service to calibrate your instruments on site.
Resistance temperature sensors

Resistance temperature sensors (RTD’s) are equipped with platinum sensor elements which change their electrical resistance as a function of temperature. In our range of products you will find resistance temperature sensors with connected cable as well as versions with a connection head. A temperature transmitter can also be installed directly in the connection head.

RTD’s are suitable for applications between -200 ... +600 °C, -328 ... +1,112 °F, (dependent on instrument model, sensor element and materials coming into contact with the medium).

Accuracy classes AA, A and B apply to all RTD’s. They are available with a sensor limiting error to DIN EN 60751.
### TR15-2
Remote mount industrial RTD assembly

- **Sensor element:** 1 x Pt100, 2 x Pt100
- **Measuring range:** -200 ... +600 °C, -328 ... +1,112 °F
- **Connection method:** 2-, 3- and 4-wire

### TR40
Cable resistance temperature sensor

- **Sensor element:** 1 x Pt100, 2 x Pt100
- **Measuring range:** -200 ... +600 °C, -328 ... +1,112 °F
- **Connection method:** 2-, 3- and 4-wire
- **Cable:** PVC, silicone, PTFE
- **Data sheet:** TE 60.40

### TR45
Cut to length RTD sensor

- **Sensor element:** 1 x Pt100
- **Measuring range:** -50 ... +450 °C, -58 ... +842 °F
- **Connection method:** 2-, 3- and 4-wire

### TR50
Surface resistance temperature sensor

- **Sensor element:** 1 x Pt100, 2 x Pt100
- **Measuring range:** -50 ... +250 °C, -58 ... +482 °F
- **Connection method:** 2-, 3- and 4-wire
- **Process connection:** Surface mounting
- **Data sheet:** TE 60.50

### TR53
Bayonet resistance temperature sensor

- **Sensor element:** 1 x Pt100, 2 x Pt100
- **Measuring range:** -50 ... +400 °C, -58 ... +752 °F
- **Connection method:** 2-, 3- and 4-wire
- **Process connection:** Bayonet
- **Data sheet:** TE 60.53

### TR55
With spring-loaded tip

- **Sensor element:** 1 x Pt100, 2 x Pt100
- **Measuring range:** -50 ... +450 °C, -58 ... +842 °F
- **Connection method:** 2-, 3- and 4-wire
- **Process connection:** Compression fitting
- **Data sheet:** TE 60.55

Further information at www.wika.com
### Resistance temperature sensors

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Sensor element</th>
<th>Measuring range</th>
<th>Output</th>
<th>CSA</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR33</td>
<td>Miniature design</td>
<td>1 x Pt100, 1 x Pt1000</td>
<td>-50 ... +250 °C, -58 ... +482 °F</td>
<td>Pt100, Pt1000, 4 ... 20 mA</td>
<td>Ordinary locations</td>
<td>TE 60.33</td>
</tr>
<tr>
<td>TR34</td>
<td>Miniature design, explosion-protected</td>
<td>1 x Pt100, 1 x Pt1000</td>
<td>-50 ... +250 °C, -58 ... +482 °F</td>
<td>Pt100, Pt1000, 4 ... 20 mA</td>
<td>Hazardous locations</td>
<td>TE 60.34</td>
</tr>
<tr>
<td>TR31</td>
<td>OEM miniature design</td>
<td>1 x Pt100</td>
<td>-50 ... +250 °C, -58 ... +482 °F</td>
<td>Pt100, 20mA</td>
<td></td>
<td>TE 60.31</td>
</tr>
<tr>
<td>TR30</td>
<td>Compact version</td>
<td>1 x Pt100</td>
<td>-50 ... +250 °C, -58 ... +482 °F</td>
<td>Pt100, 4 ... 20 mA, 0 ... 10 V</td>
<td></td>
<td>TE 60.30</td>
</tr>
</tbody>
</table>
Resistance temperature sensors for sanitary applications

**TR20**
Flush

Sensor element: Pt100
Measuring range: -50 ... +250 °C, -58 ... +482 °F
Connection method: 2-, 3- and 4-wire
Data sheet: TE 60.20

<table>
<thead>
<tr>
<th>Type</th>
<th>Design</th>
<th>Connection to thermowell</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TR21-A</strong></td>
<td>Miniature design with flange connection</td>
<td>Removable G ⅜”</td>
<td>TE 60.26</td>
</tr>
<tr>
<td><strong>TR21-B</strong></td>
<td>Miniature design for orbital welding</td>
<td>Removable G ⅜”</td>
<td>TE 60.27</td>
</tr>
<tr>
<td><strong>TR21-C</strong></td>
<td>Miniature design with welded flange connection</td>
<td>Welded</td>
<td>TE 60.28</td>
</tr>
<tr>
<td><strong>TR22-A</strong></td>
<td>With flange connection</td>
<td>Removable M24</td>
<td>TE 60.22</td>
</tr>
<tr>
<td><strong>TR22-B</strong></td>
<td>For orbital welding</td>
<td>Removable M24</td>
<td>TE 60.23</td>
</tr>
<tr>
<td><strong>TR25</strong></td>
<td>In-line resistance thermometer</td>
<td>Removable M24</td>
<td>TE 60.25</td>
</tr>
</tbody>
</table>

Further information at www.wika.com
Resistance temperature sensors, temperature switch

**TR75**
DiwiTherm® with digital indicator

- Measuring range: -40 ... +199.9 °C, -40 ... +392 °F
  +200 ... +450 °C, +392 ... +842 °F
- Power supply: Battery operation
- Data sheet: TE 60.75

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**TR60**
Indoor and outdoor resistance temperature sensor

- Sensor element: 1 x Pt100, 2 x Pt100
- Measuring range: -40 ... +80 °C, -40 ... +176 °F
- Connection method: 2-, 3- and 4-wire
- Process connection: Wall mounting
- Data sheet: TE 60.60

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**TSD-30**
Electronic temperature switch

- Sensor element: Pt1000
- Measuring range: -20 ... +80 °C, -4 ... +176 °F
- Switching output: 1 or 2 (PNP or NPN), analogue output (optional)
- Data sheet: TE 67.03

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**TF-LCD**
Longlife digital temperature sensor

- Measuring range: -40 ... +120 °C, -40 ... +248 °F
- Special feature: Dust and waterproof case, IP 68
  Battery or solar powered
  Extremely long service life
- Data sheet: TE 85.01
# Resistance temperature sensors

## TF40
Duct temperature sensor

- **Measuring range:** -50 ... +200 °C, -58 ... +392 °F
- **Measuring element:** Pt100, Pt1000, NTC
- **Special feature:**
  - Smallest housing design
  - High vibration resistance
  - Ingress protection IP 54 to IP 69K, depending on plug
- **Data sheet:** TE 67.16

## TF41
Ambient temperature sensor

- **Measuring range:** -40 ... +100 °C, -40 ... +212 °F
- **Measuring element:** Pt100, Pt1000, NTC
- **Special feature:**
  - Smallest housing design
  - Protected against dust and water jets
  - Clip-on sun protector
- **Data sheet:** TE 67.17

## TF43
OEM Insertion temperature sensor for refrigeration

- **Measuring range:** -50 ... +105 °C, -58 ... +221 °F
- **Measuring element:** Pt100, Pt1000, NTC
- **Special feature:**
  - Plastic moulded measuring element
  - Waterproof
  - Compatible with customary refrigeration controllers
- **Data sheet:** TE 67.13

## TF44
Strap-on temperature sensor with connecting cable

- **Measuring range:** -50 ... +200 °C, -58 ... +392 °F
- **Measuring element:** Pt100, Pt1000, NTC, KTY
- **Special feature:**
  - Connecting lead PVC, silicone
  - Aluminium sensor sleeve
  - Protected against dust and water jets, IP 65
- **Data sheet:** TE 67.14

## TF45
OEM insertion temperature sensor with connecting cable

- **Measuring range:** -50 ... +250 °C, -58 ... +482 °F
- **Measuring element:** Pt100, Pt1000, NTC, KTY, Ni1000
- **Special feature:**
  - Connecting lead PVC, silicone, PTFE
  - Stainless steel sensor sleeve
  - Protected against dust and water jets, IP 65
- **Data sheet:** TE 67.15

Further information at www.wika.com
Thermocouples

Thermocouples generate a voltage directly dependent on temperature. They are particularly suitable for high temperatures up to 1,700 °C, 3,092 °F and at very high oscillating stresses. Accuracy classes 1 and 2 and standard and special limits apply to all thermocouples.

They are available with a sensor limiting error to DIN EN 60584 or ASTM E230.

In our range of products you will find resistance temperature sensors with connected cable as well as versions with a connection head. A temperature transmitter can be installed in the connection head.

**TC10-2**
**Industrial TC assembly spring loaded, head internal**

- Sensor element: Type K, J, E, N or T
- Measuring range: 0 … +1,260 °C, +32 … +2,300 °F
- Measuring point: Ungrounded or grounded

**TC10-3**
**Industrial TC assembly fixed, direct mount into process**

- Sensor element: Type K, J, E, N or T
- Measuring range: 0 … +1,260 °C, +32 … +2,300 °F
- Measuring point: Ungrounded or grounded

**TC10-4**
**Industrial TC assembly spring assembly, neck extension external**

- Sensor element: Type K, J, E, N or T
- Measuring range: 0 … +1,260 °C, +32 … +2,300 °F
- Measuring point: Ungrounded or grounded

**TC10-9**
**Ceramic beaded industrial thermocouple assembly**

- Sensor element: Type K, J, E, N or T
- Measuring range: 0 … +1,260 °C, +32 … +2,300 °F
- Measuring point: Recessed or exposed

**TC15-2**
**Remote mount industrial thermocouple assembly**

- Sensor element: Type K, J, E, N or T
- Measuring range: 0 … +1,260 °C, +32 … +2,300 °F
- Measuring point: Ungrounded or grounded

**TC45**
**Cut to length thermocouple sensor**

- Sensor element: Type K, J, E, N or T
- Measuring range: 0 … +450 °C, +32 … +842 °F
- Measuring point: Ungrounded or grounded
<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Sensor element</th>
<th>Measuring range</th>
<th>Measuring point</th>
<th>Option</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC12-B</td>
<td>Process thermocouple, for additional thermowell</td>
<td>Type K, J, E, N or T</td>
<td>-200 ... +1,200 °C, -328 ... +2,192 °F</td>
<td>Ungrounded or grounded</td>
<td>Ex i, Ex d</td>
<td>TE 65.17</td>
</tr>
<tr>
<td>TC12-M</td>
<td>Process thermocouple, basic module</td>
<td>Type K, J, E, N or T</td>
<td>-200 ... +1,200 °C, -328 ... +2,192 °F</td>
<td>Ungrounded or grounded</td>
<td></td>
<td>TE 65.17</td>
</tr>
<tr>
<td>TC12-A</td>
<td>Measuring insert for process thermocouple</td>
<td>Type K, J, N or T</td>
<td>-200 ... +1,200 °C, -328 ... +2,192 °F</td>
<td>Ungrounded or grounded</td>
<td></td>
<td>TE 65.16</td>
</tr>
<tr>
<td>TC46</td>
<td>Hot runner thermocouple</td>
<td>Type J or K</td>
<td>-25 ... +400 °C, -13 ... +752 °F</td>
<td>Ungrounded or grounded</td>
<td></td>
<td>TE 65.46</td>
</tr>
<tr>
<td>TC47</td>
<td>Plastics machinery thermocouple</td>
<td>Type J or K</td>
<td>-25 ... +400 °C, -13 ... +752 °F</td>
<td>Ungrounded or grounded</td>
<td></td>
<td>TE 67.20</td>
</tr>
<tr>
<td>TC40</td>
<td>Cable thermocouple</td>
<td>Type K, J, E, N or T</td>
<td>-200 ... +1,260 °C, -328 ... +2,300 °F</td>
<td>Ungrounded or grounded</td>
<td></td>
<td>TE 65.40</td>
</tr>
<tr>
<td>TC80</td>
<td>High-temperature thermocouple</td>
<td>Type S, R, B, K, N, E or J</td>
<td>-200 ... +1,700 °C, -328 ... +3,092 °F</td>
<td>Recessed (exposed optional)</td>
<td></td>
<td>TE 65.40</td>
</tr>
<tr>
<td>TC85</td>
<td>Measuring insert for high temperature thermocouple</td>
<td>Type S, R or B</td>
<td>0 ... +1,700 °C, +32 ... +3,092 °F</td>
<td>Exposed or recessed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Thermocouples

**TC50**
*Surface thermocouple*

- **Sensor element:** Type K, J, E, N or T
- **Measuring range:** -200 ... +400 °C, -328 ... +752 °F
- **Measuring point:** Ungrounded or grounded
- **Process connection:** Surface mounting
- **Data sheet:** TE 65.50

**TC53**
*Bayonet thermocouple*

- **Sensor element:** Type K, J, E, N or T
- **Measuring range:** -200 ... +1,200 °C, -328 ... +2,300 °F
- **Measuring point:** Ungrounded or grounded
- **Special feature:** Single and dual thermocouples, Explosion-protected versions

**TC59-W**
*Weld pad thermocouple*

- **Sensor element:** Type K, J, E, N or T
- **Measuring range:** 0 ... +1,260 °C, +32 ... +2,300 °F
- **Measuring point:** Welded
- **Process connection:** Surface mounting
- **Data sheet:** TE 65.58

**TC59-V**
*Tubeskin thermocouple V-Pad®*

- **Sensor element:** Type K, J, E or N
- **Measuring range:** 0 ... +1,260 °C, +32 ... +2,300 °F
- **Measuring point:** Welded
- **Process connection:** Surface mounting
- **Data sheet:** TE 65.59

**TC59-X**
*Tubeskin thermocouple assembly Xtracto-Pad™*

- **Sensor element:** Type K, J, E or N
- **Measuring range:** 0 ... +1,260 °C, +32 ... +2,300 °F
- **Measuring point:** Removable
- **Process connection:** Surface mounting
- **Data sheet:** TE 65.57

**TC59-R**
*Tubeskin thermocouple assembly Refracto-Pad™*

- **Sensor element:** Type K, J, E or N
- **Measuring range:** 0 ... +1,260 °C, +32 ... +2,300 °F
- **Measuring point:** Welded
- **Process connection:** Surface mounting
- **Data sheet:** TE 65.56
## Temperature transmitters

### T32
**HART® transmitter**
- **Input:** Resistance temperature sensors, thermocouples, potentiometers
- **Accuracy:** < 0.1 %
- **Output:** 4 … 20 mA, HART® protocol
- **Special feature:** TÜV certified SIL version (full Assessment)
- **Data sheet:** TE 32.04

### T12
**Universally programmable digital transmitter**
- **Input:** Resistance temperature sensors, thermocouples
- **Accuracy:** < 0.2 %
- **Output:** 4 … 20 mA
- **Special feature:** PC configurable
- **Data sheet:** TE 12.03

### T15
**Digital temperature transmitter**
- **Input:** Resistance temperature sensors, potentiometers
- **Accuracy:** < 0.1 %
- **Output:** 4 … 20 mA
- **Special feature:** Extremely easy and fast configuration
- **Data sheet:** TE 15.01

### T53
**FOUNDATION™ Fieldbus and PROFIBUS® PA transmitter**
- **Input:** Resistance temperature sensors, thermocouples, potentiometers
- **Accuracy:** < 0.1 %
- **Output:** Foundation Fieldbus™, Profibus® PA
- **Special feature:** PC configurable
- **Data sheet:** TE 53.01

### T91
**Analogue transmitter 3-wire, 0 … 10 V**
- **Input:** Resistance temperature sensors, thermocouples
- **Accuracy:** < 0.5 or < 1 %
- **Output:** 0 … 10 V, 0 … 5 V
- **Special feature:** Fixed measuring range
- **Data sheet:** TE 91.01, TE 91.02

### TIF50, TIF52
**HART® field temperature transmitter**
- **Input:** Resistance temperature sensors, thermocouples, potentiometers
- **Accuracy:** < 0.1 %
- **Output:** 4 … 20 mA, HART® protocol
- **Special feature:** PC configurable
- **Data sheet:** TE 62.01

Further information at www.wika.com
### Digital Indicators

#### DI32-1
For panel mounting, 48 x 24 mm

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Multi-function input for resistance temperature sensors, thermocouples and standard signals</td>
</tr>
<tr>
<td>Alarm output</td>
<td>2 electronic contacts</td>
</tr>
<tr>
<td>Power supply</td>
<td>DC 9 ... 28 V</td>
</tr>
<tr>
<td>Data sheet</td>
<td>AC 80.13</td>
</tr>
</tbody>
</table>

#### DI25
For panel mounting, 96 x 48 mm

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Multi-function input for resistance temperature sensors, thermocouples and standard signals</td>
</tr>
<tr>
<td>Alarm output</td>
<td>3 relays, 2 relays for instruments with integrated transmitter power supply DC 24 V</td>
</tr>
<tr>
<td>Power supply</td>
<td>AC 100 ... 240 V, AC/DC 24 V</td>
</tr>
<tr>
<td>Special feature</td>
<td>Analogue output signal</td>
</tr>
<tr>
<td>Data sheet</td>
<td>AC 08.02</td>
</tr>
</tbody>
</table>

#### DI35
For panel mounting, 96 x 48 mm

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Multi-function input for resistance temperature sensors, thermocouples and standard signals</td>
</tr>
<tr>
<td>Alarm output</td>
<td>Alternatively double input for standard signals with calculation function (+ - x /) for two transmitters</td>
</tr>
<tr>
<td>Power supply</td>
<td>AC/DC 24 V, AC 115 V or DC 24 V</td>
</tr>
<tr>
<td>Alarm output (optional)</td>
<td>2 relays, 4 relays</td>
</tr>
<tr>
<td>Power supply</td>
<td>AC 230 V</td>
</tr>
<tr>
<td>Data sheet</td>
<td>AC 80.03</td>
</tr>
</tbody>
</table>

#### DIH10
Connection head with digital indicator

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>4 ... 20 mA</td>
</tr>
<tr>
<td>Power supply</td>
<td>From the 4 ... 20 mA current loop</td>
</tr>
<tr>
<td>Data sheet</td>
<td>AC 80.11</td>
</tr>
</tbody>
</table>

#### DIH50, DIH52
For current loops with HART® communication

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>163 x 127 x 127 mm</td>
</tr>
<tr>
<td>Case</td>
<td>Aluminium, stainless steel</td>
</tr>
<tr>
<td>Special feature</td>
<td>Adjustment of indication range and unit via HART® communication</td>
</tr>
<tr>
<td></td>
<td>Additionally, model DIH52 is suitable for multistrip operation and with local master function</td>
</tr>
<tr>
<td>Approval</td>
<td>Intrinsically safe per ATEX</td>
</tr>
<tr>
<td></td>
<td>Flameproof enclosure</td>
</tr>
<tr>
<td>Data sheet</td>
<td>AC 80.10</td>
</tr>
</tbody>
</table>
Temperature controllers

**CS4M, CS4S**
For panel mounting, 48 x 24 mm, 48 x 48 mm
- **Input:** Multi-function input for resistance temperature sensors, thermocouples and standard signals
- **Control characteristic:** PID, PI, PD, P, ON/OFF (configurable)
- **Control output:** Relay or logic level DC 0/12 V for 3-point control to control an electronic switch relay (SSR) or analogue current signal 4 … 20 mA
- **Power supply:**
  - AC 100 … 240 V
  - AC/DC 24 V
- **Data sheet:** AC 85.06, AC 85.02

**CS4H, CS4L**
For panel mounting, 48 x 96 mm, 96 x 96 mm
- **Input:** Multi-function input for resistance temperature sensors, thermocouples and standard signals
- **Control characteristic:** PID, PI, PD, P, ON/OFF (configurable)
- **Control output:** Relay or logic level DC 0/12 V for 3-point control to control an electronic switch relay (SSR) or analogue current signal 4 … 20 mA
- **Power supply:**
  - AC 100 … 240 V
  - AC/DC 24 V
- **Data sheet:** AC 85.03, AC 85.04

**CS58**
For panel mounting, 62 x 28 mm
- **Input:** Pt100 or PTC
- **Control characteristic:** Simple 2-point controller
- **Control output:** Relay switching output 12 A, 250 V
- **Power supply:**
  - AC 230 V
  - AC 12 … 24 V or DC 16 … 32 V
- **Data sheet:** AC 85.24

**SC64**
For panel mounting, 64 mm, round
- **Input:** Pt100 or PTC
- **Control characteristic:** Simple 2-point controller
- **Control output:** Relay switching output 16 A, 250 V
- **Power supply:**
  - AC 230 V
  - AC 12 … 24 V or DC 16 … 32 V
- **Data sheet:** AC 85.25

**CS4R**
For rail mounting, 22.5 x 75 mm
- **Input:** Multi-function input for resistance temperature sensors, thermocouples and standard signals
- **Control characteristic:** PID, PI, PD, P, ON/OFF (configurable)
- **Control output:** Relay or logic level DC 0/12 V to control an electronic switch relay (SSR) or analogue current signal 4 … 20 mA
- **Power supply:**
  - AC 100 … 240 V
  - AC/DC 24 V
- **Data sheet:** AC 85.06
Thermowells

Whether in aggressive or abrasive process media, whether in high or low temperature ranges: For electrical or mechanical temperature sensors, to prevent direct exposure of the sensor to the medium, thermowells that suit each application are available. Thermowells can be machined from solid barstock or assembled from tube sections and can either be screw-, weld- or flange-fitted. They are offered in standard and special materials such as stainless steel 316L, 316 Ti, Hastelloy® or titanium. Each version, depending on its construction type and its mounting to the process, has certain advantages and drawbacks with respect to its load limits and the special materials that can be used. In order to manufacture thermowells for flange mounting at low cost from special materials, the designs used differ from standard thermowells in accordance with ASME B40.9. Thus, only the wetted parts of the thermowell are manufactured from special materials, whereas the non-wetted flange is made of a lower cost material and is welded to the special material.

This design is used both for fabricated and solid-machined thermowells. With tantalum as special material a removable sheath is used, which is slid over the supporting thermowell from stainless steel.

**TW10**
**Flanged (solid machined)**
Thermowell form: Tapered, straight or stepped
Nominal size: ASME 1 … 4 inch DIN/EN DN 25 … 100
Pressure rating: ASME to 2,500# (DIN/EN to PN 100)

**TW15**
**Threaded (solid machined)**
Thermowell form: Tapered, straight or stepped
Head version: Hexagon, round with hexagon, or round with spanner flats
Process connection: ½, ¾ or 1 NPT
Pressure rating: ASME to 2,500# (DIN/EN to PN 100)

**TW20**
**Socket weld (solid-machined)**
Thermowell form: Tapered, straight or stepped
Welding diameter: 1.050, 1.315 or 1.900 inch (26.7, 33.4 or 48.3 mm)
Class: 3,000 or 6,000

**TW25**
**Weld-in (solid-machined)**
Thermowell form: Tapered, straight or stepped
Head diameter: Up to 2 inch (50.8 mm)
Nominal size: ASME 1, 1½ or 2 inch
Pressure rating: ASME up to 2,500#

**TW30**
**Vanstone (solid-machined) for lap flanges**
Thermowell form: Tapered, straight or stepped
Nominal size: ASME 1, 1½ or 2 inch
Pressure rating: ASME up to 2,500#

**TW70**
**Flanged/threaded/weld-in protection tube**
Thermowell form: Flanged, threaded or weld-in
Pipe size: 1/4, 1/2, 3/4, or 1 NPS
Pipe schedule: 40, 80, 160 or XXH

VARIVENT® is a registered trademark of the company GEA Tuchenhagen
BioControl® is a registered trademark of the company NEUMO
Thermowells for sanitary applications

**TW60**
- Socket weld, for sanitary connection
- Process connection: Tri-clamp, bevel seat
- Nominal width: 1 ... 3 inch

**TW22**
- Fabricated with flange connection for sanitary applications
- Aseptic connection: Tri-clamp, DIN 32676, DIN 11851, VARIVEN®, BioControl®
- Thermowell material: Stainless steel 316L, 1.4435
- Data sheet: TW 95.22

**TW61**
- For orbital welding for sanitary applications
- Tube standard: DIN 11866 series A, B, C
- Material: Stainless steel 316L, 1.4435
- Data sheet: TW 95.61

Further information at www.wika.com
**Custom engineered solutions**

**Multipoints**
- Free-hanging and spring-loaded multipoint thermocouples with or without fabricated thermowell for use in catalytic reactors, reformers and heat exchangers.
- Downhole thermocouples for temperature monitoring in various zones in oil and gas wells. These mineral-insulated, metal-sheathed thermocouples can exceed 3,000 metres (10,000 ft) in length.
- Resistance temperature sensors with multipoint sensors, for applications requiring high precision for monitoring vessels and for level control.

**Proper installation by field service**
A correct installation is essential for industrial temperature measurement. WIKA/Gayesco services also provide installation support up to and including full turnkey installations for those clients who want to be sure that multipoints or tubeskin thermocouples are installed properly.

Our field service team has created installation animations to help those clients who want to install the product themselves. On request, installation support (supervising) is provided for these activities.
Accessories

- Temperature calibrators
- Hand-held measuring instruments
- magWIK magnetic quick connector

- Plug & jack connector
- Fittings
- Wires & cables

Further information at www.wika.com
Technical information

Resistance temperature sensors

Measuring resistors

- Industrial resistance thermometers are equipped with platinum temperature sensors which change their electrical resistance as a function of temperature.

In accordance with IEC 60751, resistance thermometers and measuring resistors are divided into accuracy classes. For wire-wound resistors and film resistors, these accuracy classes are assigned to the corresponding temperature ranges.

<table>
<thead>
<tr>
<th>Class</th>
<th>Temperature range Wire-wound (W)</th>
<th>Thin-film (F)</th>
<th>Tolerance value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>-196 °C ... +600 °C (-320.8 °C ... +1,112 °F)</td>
<td>-50 °C ... +500 °C (-58 °C ... +932 °F)</td>
<td>±(0.30 + 0.0050</td>
</tr>
<tr>
<td>A</td>
<td>-100 °C ... +450 °C (-148 °C ... +842 °F)</td>
<td>-30 °C ... +300 °C (+22 °C ... 572 °F)</td>
<td>±(0.15 + 0.0020</td>
</tr>
<tr>
<td>AA</td>
<td>-50 °C ... +250 °C (-58 °C ... +482 °F)</td>
<td>0 °C ... 150 °C (+32 °C ... 302 °F)</td>
<td>±(0.10 + 0.0017</td>
</tr>
</tbody>
</table>

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

The electrical resistance of a resistance thermometer's sensor changes with the temperature. The resistance increases when temperature is raised. This is known as PTC (Positive Temperature Coefficient).

Resistance values and tolerance values with selected temperatures (Pt100)

<table>
<thead>
<tr>
<th>Temperature (ITS 90)</th>
<th>Resistance value in Ω</th>
<th>Tolerance class B</th>
<th>Tolerance class A</th>
<th>Tolerance class AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>-196 °C (-320.8 °F)</td>
<td>19.69 ... 20.80</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-100 °C (-148 °F)</td>
<td>59.93 ... 60.58</td>
<td>60.11 ... 60.40</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-50 °C (-58 °F)</td>
<td>80.09 ... 80.52</td>
<td>80.21 ... 80.41</td>
<td>80.23 ... 80.38</td>
<td>-</td>
</tr>
<tr>
<td>-30 °C (-22 °F)</td>
<td>88.04 ... 88.40</td>
<td>88.14 ... 88.30</td>
<td>88.16 ... 88.28</td>
<td>-</td>
</tr>
<tr>
<td>0 °C (32 °F)</td>
<td>99.88 ... 100.12</td>
<td>99.94 ... 100.06</td>
<td>99.96 ... 100.04</td>
<td>-</td>
</tr>
<tr>
<td>20 °C (68 °F)</td>
<td>107.64 ... 107.95</td>
<td>107.72 ... 107.87</td>
<td>107.74 ... 107.85</td>
<td>-</td>
</tr>
<tr>
<td>100 °C (212 °F)</td>
<td>138.20 ... 138.81</td>
<td>138.37 ... 138.64</td>
<td>138.40 ... 138.61</td>
<td>-</td>
</tr>
<tr>
<td>150 °C (302 °F)</td>
<td>156.93 ... 157.72</td>
<td>157.16 ... 157.49</td>
<td>157.91 ... 157.64</td>
<td>-</td>
</tr>
<tr>
<td>250 °C (482 °F)</td>
<td>193.54 ... 194.66</td>
<td>193.86 ... 194.33</td>
<td>193.91 ... 194.29</td>
<td>-</td>
</tr>
<tr>
<td>300 °C (572 °F)</td>
<td>211.41 ... 212.69</td>
<td>211.78 ... 212.32</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>450 °C (842 °F)</td>
<td>263.31 ... 265.04</td>
<td>263.82 ... 264.53</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>500 °C (932 °F)</td>
<td>280.04 ... 281.91</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>600 °C (1,112 °F)</td>
<td>312.65 ... 314.77</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Sensor connection methods

2-wire connection
The lead resistance to the sensor is recorded as an error in the measurement. For this reason, this connection type is not recommended when using Pt100 measuring resistors for accuracy classes A and AA, since the electrical resistance of the connection lines and their own temperature dependence are fully included in the measurement result and thus falsify it.

Applications
- Connecting cables up to 250 mm
- Standard when using Pt1000 measuring resistors
- Class B

3-wire connection (standard version)
The influence of the lead resistance is compensated using a second red wire. The maximum length of the connecting cable depends on the conductor cross-section and the compensation options of the electronic evaluation system (transmitter, display, controller or process control system).

Applications
- Connecting cables up to approx. 30 m
- Class B, A, AA

4-wire connection
The influence of the connecting cable on the result of measurement is completely eliminated since any possible asymmetries in the connecting cable’s lead resistance are compensated. The maximum length of the connecting cable depends on the conductor cross-section and the compensation options of the electronic evaluation system (transmitter, display, controller or process control system). A 4-wire connection can also be used as a 2-wire or 3-wire connection by disconnecting the unnecessary conductors.

Applications
- Laboratory technology
- Calibration technology
- Tolerance class A or AA
- Connecting cables up to approx. 1,000 m

Dual sensors
In the standard version a single sensor is fitted. The combination of black and yellow is reserved for an optional second measuring resistor. For certain combinations (e.g. small diameter) dual sensors are not possible for technical reasons.

Further data see Technical Information IN.00.17
Thermocouples

- Thermocouples generate a voltage directly dependent on temperature. Suited to the corresponding measurement temperature, you can choose from a variety of thermocouple models.

- Thermocouples are particularly suited for high temperatures (up to 1,700 °C or 3,092 °F). Instrument designs from mineral-insulated sheathed cable are very resistant against extremely high vibration loads (depending on instrument model, sensor element and wetted materials).

Information on the application of thermocouples

Base-metal thermocouples

- **Type K**
  
<table>
<thead>
<tr>
<th>+ leg</th>
<th>- leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>NiCr</td>
<td>NiAl</td>
</tr>
<tr>
<td>Nickel-Chromium</td>
<td>Nickel-Aluminum (ferromagnetic)</td>
</tr>
</tbody>
</table>

NiCr-NiAl thermocouples are suitable for use in oxidizing or inert gas atmospheres up to 1,200 °C, 2,192 °F (ASTM E230: 1,260 °C, 2,300 °F) with the largest wire size. Protect thermocouples from sulphurous atmospheres. Since they are less susceptible to oxidation than thermocouples made of other materials, they are mostly used for applications at temperatures above 550 °C, 1,022 °F up to the maximum working pressure of the thermocouple.

- **Type J**
  
<table>
<thead>
<tr>
<th>+ leg</th>
<th>- leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>CuNi</td>
</tr>
<tr>
<td>Iron (ferromagnetic)</td>
<td>Copper-Nickel</td>
</tr>
</tbody>
</table>

Fe-CuNi thermocouples are suitable for use in vacuum, in oxidising and reducing atmospheres or inert gas atmospheres. They are used for temperature measurements up to 750 °C, 1,382 °F (ASTM E230: 760 °C, 1,400 °F) with the largest wire size.

Thermoelectric voltage curves

- **ASTM E230**

- **IEC 60584-2**

The charts illustrate the curves corresponding to the relevant temperature ranges of ASTM E230 / IEC 60584-2. Outside these temperature ranges, the permissible tolerance value is not standardized.
# Operating limits and accuracies of thermocouples

(IEC 60584, ASTM E230)

The following table contains permissible tolerance values of IEC 60584-2 incl. the tolerance values of ASTM E230 standard which is common in North America:

## Tolerance values of the thermocouples per IEC 60584-2 / ASTM E230 (Reference temperature 0 °C)

<table>
<thead>
<tr>
<th>Model</th>
<th>Thermocouple</th>
<th>Tolerance value per</th>
<th>Class</th>
<th>Temperature range</th>
<th>Tolerance value</th>
</tr>
</thead>
<tbody>
<tr>
<td>K N</td>
<td>NiCr-NiAl (NiCr-Ni)</td>
<td>IEC 60584 part 2</td>
<td>1</td>
<td>-40 ... +1,000 °C (-40 ... +1,832 °F)</td>
<td>±1.5 °C or 0.0040</td>
</tr>
<tr>
<td></td>
<td>NiCrSi-NiSi</td>
<td>IEC 60584 part 2</td>
<td>2</td>
<td>-40 ... +1,200 °C (-40 ... +2,192 °F)</td>
<td>±2.5 °C or 0.0075</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Special</td>
<td>0 ... +1,260 °C (+32 ... +2,300 °F)</td>
<td>±1.1 °C or 0.04 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Standard</td>
<td>0 ... +1,260 °C (+32 ... +2,300 °F)</td>
<td>±2.2 °C or 0.075 %</td>
</tr>
<tr>
<td>J</td>
<td>Fe-CuNi</td>
<td>IEC 60584 part 2</td>
<td>1</td>
<td>-40 ... +750 °C (-40 ... +1,382 °F)</td>
<td>±1.5 °C or 0.0040</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 60584 part 2</td>
<td>2</td>
<td>-40 ... +750 °C (-40 ... +1,382 °F)</td>
<td>±2.5 °C or 0.0075</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Special</td>
<td>0 ... +760 °C (+32 ... +1,400 °F)</td>
<td>±1.1 °C or 0.04 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Standard</td>
<td>0 ... +760 °C (+32 ... +1,400 °F)</td>
<td>±2.2 °C or 0.075 %</td>
</tr>
<tr>
<td>E</td>
<td>NiCr-CuNi</td>
<td>IEC 60584 part 2</td>
<td>1</td>
<td>-40 ... +800 °C (-40 ... +1,472 °F)</td>
<td>±1.5 °C or 0.0040</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 60584 part 2</td>
<td>2</td>
<td>-40 ... +900 °C (-40 ... +1,652 °F)</td>
<td>±2.5 °C or 0.0075</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Special</td>
<td>0 ... +870 °C (+32 ... +1,600 °F)</td>
<td>±1.0 °C or 0.04 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Standard</td>
<td>0 ... +870 °C (+32 ... +1,600 °F)</td>
<td>±1.7 °C or 0.05 %</td>
</tr>
<tr>
<td>T</td>
<td>Cu-CuNi</td>
<td>IEC 60584 part 2</td>
<td>1</td>
<td>-40 ... +350 °C (-40 ... +662 °F)</td>
<td>±0.5 °C or 0.0040</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 60584 part 2</td>
<td>2</td>
<td>-40 ... +350 °C (-40 ... +662 °F)</td>
<td>±1.0 °C or 0.0075</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 60584 part 2</td>
<td>3</td>
<td>-200 ... +40 °C (-328 ... -40 °F)</td>
<td>±1.0 °C or 0.015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Special</td>
<td>0 ... +370 °C (+32 ... +700 °F)</td>
<td>±0.5 °C or 0.04 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Standard</td>
<td>-200 ... 0 °C (-328 ... -32 °F)</td>
<td>±1.0 °C or 0.015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Standard</td>
<td>0 ... +370 °C (+32 ... +700 °F)</td>
<td>±1.0 °C or 0.075</td>
</tr>
<tr>
<td>R S</td>
<td>Pt13%Rh-Pt / Pt10%Rh-Pt</td>
<td>IEC 60584 part 2</td>
<td>1</td>
<td>0 ... +1,600 °C (+32 ... +2,912 °F)</td>
<td>±1.0 °C or 0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 60584 part 2</td>
<td>2</td>
<td>0 ... +1,600 °C (+32 ... +2,912 °F)</td>
<td>±1.5 °C or 0.0025</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Special</td>
<td>0 ... +1,480 °C (+32 ... +2,700 °F)</td>
<td>±0.6 °C or 0.1 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Standard</td>
<td>0 ... +1,480 °C (+32 ... +2,700 °F)</td>
<td>±1.5 °C or 0.25 %</td>
</tr>
<tr>
<td>B</td>
<td>Pt33%Rh-Pt6%Rh</td>
<td>IEC 60584 part 2</td>
<td>2</td>
<td>+600 ... +1,700 °C (+1,112 ... +3,092 °F)</td>
<td>±0.0025</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 60584 part 2</td>
<td>3</td>
<td>+600 ... +1,700 °C (+1,112 ... +3,092 °F)</td>
<td>±0.5 °C or 0.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Special</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM E230</td>
<td>Standard</td>
<td>+870 ... +1,700 °C (+1,100 ... +3,100 °F)</td>
<td>±0.5 %</td>
</tr>
</tbody>
</table>

1) $T_I$ is the value of the temperature in °C without consideration of the sign
2) The greater value applies

There are different notations of type K thermocouples in Europe and North America:

- Europe: NiCr-NiAl or NiCr-Ni
- North America: Ni-Cr / Ni-Al

There is no physical difference, it is just the naming caused by historical reasons.

## Thermocouple and extension wire colour codes

![Thermocouple and extension wire colour codes](image-url)
**Thermowells**

**Welded joints**

Internationally, the most common welded joint between flanges and thermowells is the full penetration weld of the flange (full penetration welding, FPW). As well as fulfilling the highest requirements of stability this welding method also meets all requirements of the American flange standard ASME B16.5 for the use of blind flanges. WIKA manufactures thermowells to the widest range of welding procedure tests in accordance with ASME Sec. IX for full and partial penetration. Furthermore, for all common welded joints on fabricated or solid-machined standard thermowells, welding procedure tests are available according to ASME B31.3 or B31.1.

**Welding options**

- **Full penetration weld design**
- **Fillet weld, double-sided**
- **Screwed and welded design**

**Calculation of the thermowell strength to ASME PTC 19.3 TW-2016**

Calculations for establishing the stability of thermowells make it possible to minimise or eliminate the possibility of damage to the thermowells even before the plants where they are used are commissioned. The calculations can be made in accordance with ASME PTC 19.3/TW-2016 or Dittrich/Klotter. The following process parameters are required to complete the calculations:

- Flow rate in m/s or ft/s
- Medium density in kg/m³ or lb/ft³
- Temperature in °C or °F
- Pressure in bar or PSI

In case of a calculation with negative results, the only constructive solution so far was to shorten the thermowell stem or to increase the root and tip diameter, accepting a longer response time of the thermometer. As alternatives, thermowells in ScrutonWell® or support collar design can be used.

Independently of the thermowells' method of manufacture, the results of the thermowell strength calculation are always divided into two parts: Firstly, the dynamic view on vibration failures through operation at resonance and secondly, the static load through external pressure and bending.

Further data see Technical Information IN 00.15
**ScrubonWell®**

The ScrubonWell® design reduces the amplitude of oscillation by more than 90% \(^1\) and allows an easy and fast installation of the thermowell.

The WIKA ScrubonWell® design was proven with laboratory tests by the Institute of Mechanics and Fluid Dynamics of the University of Freiberg.

The ScrubonWell® design can be used for all kinds of solid-machined thermowells with flange connection, in Vanstone design or for weld-in or screwed process connections.

This helical design has been used successfully for decades in a wide variety of industrial applications to effectively suppress vortex-induced shrinkage excitation.

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**Support collar**

For the stabilisation of the stem in the flange nozzle a support collar is used. This variant requires an on-site machining of the collar to assure an interference fit in flange nozzles.

For further data see Technical Information IN 00.26.

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Further technical data see data sheet SP 05.16
Coated thermowells for special applications

Special metallic coatings can be applied to the surface of a thermowell so it can be used in a process where there is a high risk of abrasion, due to a high flow of suspended solids. Polymer coatings, on the other hand, are used for highly corrosive processes in which, for example, sulphuric acid is involved.

Flange sealing faces on thermowells

For flanges in accordance with the standards ASME B16.5, EN 1092-1 and DIN 2527 there are different sealing face forms and surface finishes in use. The most commonly-used sealing face of all the standards is the version with offset raised face with spiral phonographic grooves in the sealing face. The form and depth of the grooves is defined in the corresponding flange standards.

<table>
<thead>
<tr>
<th>Flange form</th>
<th>AARH (µinch)</th>
<th>Ra (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard flange sealing faces to ASME B16.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock finish</td>
<td>125 ... 250</td>
<td>3.2 ... 6.3</td>
</tr>
<tr>
<td>Smooth finish</td>
<td>&lt; 125</td>
<td>&lt; 3.2</td>
</tr>
<tr>
<td>RTJ (Ring joint groove)</td>
<td>&lt; 63</td>
<td>&lt; 1.6</td>
</tr>
<tr>
<td>Tongue/groove</td>
<td>&lt; 125</td>
<td>&lt; 3.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard flange sealing faces to DIN 2527</th>
<th>Ra (µm)</th>
<th>Rz (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form C</td>
<td>-</td>
<td>40 ... 180</td>
</tr>
<tr>
<td>Form E</td>
<td>-</td>
<td>&lt; 16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard flange sealing faces to EN 1092-1</th>
<th>Ra (µm)</th>
<th>Rz (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form B1</td>
<td>3.2 ... 12.5</td>
<td>12.5 ... 50</td>
</tr>
<tr>
<td>Form B2</td>
<td>0.8 ... 3.2</td>
<td>3.2 ... 12.5</td>
</tr>
</tbody>
</table>

Less common in thermowells are flanges with smooth sealing faces without detectable grooves or designs with concentric, continuous grooves.

Further data see Technical Information IN 00.15.
Non-destructive evaluation/test

NDE or NDT
NDE/NDT are abbreviations for “Non-Destructive Examination”/“Non-Destructive Testing”. The abbreviations NDE or NDT stand for “Non-Destructive Examination” or “Non-Destructive Testing”, respectively. This is used to refer to non-destructive inspections or tests of components, in general.

Liquid penetrant inspection
With the penetrant test in accordance with DIN EN 571-1 or SNT-TC-1A, fine surface cracks and porosities in weld seams can be made visible. After cleaning the surface to be inspected, a contrast agent (red or fluorescent) is sprayed on. Through the capillary effect, this agent penetrates any surface defects there might be. After re-cleaning the surface, a developer (white) is then sprayed on, which extracts the contrast agent (from any hairline cracks, etc.) and through colour contrast, enables an easy evaluation of the defects.

X-ray testing
Through an X-ray test to EN 1435 or ASME Section V, Article 2, Edition 2004, for example, full penetration welds on thermowells can be investigated with respect to irregularities (cracks, voids, insufficient bonding). Here, depending on the dimensions of the thermowell, up to five X-ray images may be necessary to determine irregularities with sizes < .020” in the full-penetration weld. An X-ray examination can also be used to record the bore centrality in solid body material thermowells. For this purpose, two images of the thermowell tip at 90° to each other are required.

Pressure and stability tests
The hydrostatic pressure test is a pressure and stability test of the components of a thermowell following AD 2000 code of practice HP30. For the test, the thermowell is clamped into a testing device and subjected to a defined test pressure at room temperature for a certain period of time (e.g. three minutes). In general, a distinction is made between the outside and inside pressure test. A typical pressure is 1.5 times the nominal pressure of the flange as outside pressure or 7500 psig (500 bar) as inside pressure.

Helium leak test
For leak testing in accordance with DIN EN 1779 (1999)/EN 13185, helium 4.6 is used as a test gas. The test is able to detect minimal leakage rates and is considered the most sensitive test method for leak testing. In general, one should distinguish between an integral and local test method. In the integral test, leak rates (e.g. 1x10^-7 mbar * l / s) can be determined, while the local testing enables the location of the leak to be determined using a spray probe.

Ultrasonic test
Through an ultrasonic test in accordance with DIN EN ISO 17640, for example, full penetration weld seams on thermowells can be investigated with respect to irregularities (cracks, voids, insufficient bonding). For this, the reflections of a radiated ultrasound signal are measured at the interfaces of irregularities. To determine the position of the irregularities, the ultrasonic device is adjusted beforehand by means of a reference body. The ultrasonic test can also be used to measure the wall thicknesses of a thermowell from solid body material to determine the bore centrality.

Positive material identification test (PMI)
The PMI (positive material identification) test proves which alloy constituents exist in the material. There are various common test procedures. With optical emission spectroscopy (OES) in accordance with DIN 51008-1 and -2, an arc is generated between the thermowell surface and the test equipment, and the spectrum of this arc enables the alloy’s elements to be identified – both qualitatively and quantitatively. This process does leave a characteristic burn mark on the workpiece. A test procedure which doesn’t damage the surface is the X-ray analysis in accordance with DIN 51001; during the X-ray the atoms of the thermowell material are energised until they radiate themselves. The wavelength and intensity of the emitted radiation is again a measure of the alloy’s constituent elements and their concentrations.