Temperature Measurement
Thermometers and transmitters for the process industry
Endress+Hauser – Your partner

Endress+Hauser is a global leader in measurement instrumentation, services and solutions for industrial process engineering

With dedicated sales centers and a strong network of partners, Endress+Hauser guarantees competent worldwide support. Our production centers in twelve countries meet your needs and requirements quickly and effectively. The Group is managed and coordinated by a holding company in Reinach, Switzerland. As a successful family-owned business, Endress+Hauser is set to remain independent and self-reliant.

Endress+Hauser provides sensors, instruments, systems and services for level, flow, pressure and temperature measurement as well as analytics and data acquisition. The company supports you with automation engineering, logistics and IT services and solutions. Our products set standards in quality and technology.

We work closely with the chemical, petrochemical, food and beverage, oil and gas, water and wastewater, power and energy, life science, primary and metal, renewable energy, pulp and paper and shipbuilding industries. Endress+Hauser helps customers to optimize their processes in terms of reliability, safety, economic efficiency and environmental impact.

Competence center for temperature measurement, temperature engineered solutions and system products

Endress+Hauser Wetzer is one of the leading producers of temperature measurement, temperature engineered solutions and system products worldwide. The company employs more than 630 associates worldwide. 360 of which are working in our headquarters Nesselwang (Germany), where our products are developed and produced. Associated Product Centers in Pessano (Italy), Greenwood (USA), Suzhou (China), Aurangabad (India) and Benoni (South Africa) guarantee customer proximity with products and services.

E-direct - Purchase preconfigured basic field instruments or system components easily.
www.e-direct.endress.com

To learn more about Endress+Hauser, visit:
www.endress.com
Temperature measurement – still leading the way

Its expansive, globally available portfolio of standard thermometers, temperature transmitters and engineered solutions makes Endress+Hauser one of the leading international complete providers of temperature measuring technology for process automation. The large vertical range of production and the high degree of in-house development, ranging from primary sensors and electronics to customized special solutions, make a crucial difference here.

As a reliable and close partner for our customers, we utilize our wealth of product and solution expertise to develop innovative products that produce excellent customer benefits. These products include unique inserts such as the iTHERM QuickSens and StrongSens, excellent temperature transmitters like the iTEMP TMT82 - SIL2/3 and even multi-point solutions for 2D/3D measurements in digesters. As your expert partner in all issues related to temperature measuring technology, we make a crucial contribution to making your processes more reliable and efficient and increasing the quality of the end products.

Temperature measurement by Endress+Hauser - BECAUSE WE UNDERSTAND!
Fuel for thought

With vast experience in the oil & gas sector, we help you to perform, comply and thrive

From exploration to refinery, from storage to distribution, from plant upgrades to new projects, we have the application expertise to help you succeed.

At a time when the sector faces skills shortages and regulations tightening, our organization is here across the full life cycle of your project always with your deadlines in mind.

While complexity of facilities and processes are ever increasing, and downtime must be reduced, your competitiveness is enhanced with reliable, accurate and traceable asset information.

In short, you need to do more with less, benefiting from a stable partner who is here for the long haul and ready across the globe, offering:

- Assured plant safety
- Optimized return on investment
- Best-fit products, solutions and services

Advantages at a glance

- Mitigating risks by using state of the art technology meeting highest demands with regard to Functional Safety (IEC 61508) and mechanical integrity (e.g. gastight feedthrough)
- Minimizing operational costs through efficient proof testing concepts, predictive maintenance and innovative data management
- Meeting internationally recognized standards and recommendations such as: API, OIML, ASME, NORSOK, NACE etc.
- Increasing plant availability with innovative technologies particularly designed for oil and gas industry applications
Product highlights

**Omnigrad S TMT162R/C, iTEMP TMT162**
Field transmitter in dual-compartment housing with flameproof encapsulation
- For use in potentially explosive atmospheres and in applications with functional safety up to SIL 2
- Large illuminated display
- Communication types: 4...20 mA, HART, PROFINET, FOUNDATION Fieldbus
- Special RTD thermometers or thermocouples for different applications

**TT511 VanStone thermowell**
Drilled barstock thermowell with slip-on flange
- Design specifically created for the oil & gas and petrochemical industries to meet the highest requirements
- Flexible application options in conjunction with RTD or TC thermometers
- Reliable plant operation due to load capacity calculations for the thermowell in accordance with DIN43772 or ASME PTC19.3 TW2010

**Omnigrad S TR66/TC66**
Resistance thermometers (RTD) or thermocouples for heavy-duty applications
- Barstock thermowell in line with the ASME standard for high process pressures, temperatures and flow velocities.
- Flexibility through optionally installed head transmitters with various communication types 4...20 mA, HART, PROFINET, FOUNDATION Fieldbus
- Special resistance thermometers (RTD) or thermocouples for various applications

**T13/T53**
Resistance thermometers (RTD) or thermocouples for heavy-duty applications
- Barstock thermowell in line with the ASME standard for high process pressures, temperatures and flow velocities.
- Flexibility through optionally installed head transmitters with various communication types
- Approvals for potentially explosive atmospheres in accordance with CSA and FM
- Vibration resistance of the measuring element up to 60g
- Suitable for use in areas in which there is risk of explosion

**iTHERM StrongSens**
Highly vibration-resistant RTD insert
- Available in Omnigrad series RTD thermometers
- Vibration resistance of the measuring element up to 60g
- Also suitable for use in areas in which there is risk of explosion

**iTEMP TMT82**
HART7 temperature transmitter
- Maximum reliability, availability and accuracy
- SIL 2/3-certified in accordance with IEC61508:2010
- Fast and tool-free wiring using spring terminal technology
- As a head transmitter, DIN rail device or in the field housing

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**Customer-specific temperature engineered solutions**

**Surface temperature measurement with SkinPoint thermometer**
- Surface sensor design optimized for the individual application
- Individual material selection for a long operating life
- Optimized contacting with the object of measurement for accurate measurement results

**Multipoint thermometers**
- Measuring systems designed for the individual application
- Rod or three-dimensional temperature profile measurement in digesters
- Design and material selection for high process temperatures and pressures as well as corrosive media
Global chemicals, competitive and safe

Get the extra project skill and know-how you need to boost your plant’s safe performance

You gain concrete benefits from a partner who has first-hand knowledge of your sector’s issues around the globe: on increased safety, on environmental protection, on over-supply leading to cost pressure and on finding engineering support and service when required. You can rely on our help to become more competitive in your line of business.

With a long history of industry firsts we have grown with the sector by listening, acting and innovating to better serve you with:

- Safety, built in
- The technology to lead
- Best-fit project management

Advantages at a glance

- Meeting internationally recognized standards/recommendations: NAMUR, WHG, ASME, NACE, IEC 17025, MID, OIML
- Internationally accepted hazardous area approvals: ATEX, IECEx, FM/CSA, NEPSI, TIIS, INMETRO
- Use of state of the art technology – functional safety according to IEC 61508 (up to SIL 3)
- Uniform operating safety by design concepts for simple and safe operations
- Optimized material availability and minimized stocks through inventory management solutions
Temperature measurement for critical applications

The most important parameter for ensuring safe operation of a turbine is to measure the temperature of the superheated steam at its inlet. An incorrect signal, triggered by a faulty temperature sensor, and the safety PLC can cause the complete system to switch over to emergency mode. This causes the boiler and turbine to restart, which wastes time and money. The iTEMP TMT82 temperature transmitter is certified by TÜV for SIL 2/3 applications in accordance with IEC61508:2010 and can solve this problem.

To ensure maximum availability and reliability, the device is equipped with two inputs for temperature sensors, enabling operation with redundant sensors. If one of the two temperature sensors returns a faulty signal, the system automatically switches to the backup sensor and a diagnostic message is sent via HART. This notifies the control room of the sensor failure. On the other hand, the 4...20 mA output continues to return a valid measured value, which ensures uninterrupted operation of the system.

Product highlights

Omnigrad TR10/TC10
Modular, universal thermometer
- Robust design, flexible configuration
- RTD or TC inserts
- Also suitable for use in areas in which there is risk of explosion
- Fast response times with reduced/tapered thermowell tip

Omnigrad TR15/TC15
Robust temperature measuring technology, ideal for steam or gas applications
- For high process pressures and temperatures in demanding applications
- Fast response times with reduced/tapered thermowell tip
- Head transmitter with simple communication type selection

Multipoint thermometers
Temperature engineered solutions
- Tube bundle reactors for the synthesis process or for further processing of basic chemicals.

TH13
Best-in-class temperature measuring technology in US design
- High flexibility through modular assembly
- Robust design for extremely harsh ambient conditions

iTEMP TMT85
Foundation Fieldbus Temperature head transmitter
- Fast and tool-free wiring using spring terminal technology
- Maximum accuracy due to sensor-transmitter matching

iTEMP TMT82
HART7 temperature transmitter
- Maximum reliability, availability and accuracy
- SIL 2/3-certified in accordance with IEC61508:2010
Extracting more from less

In a world of lower grades, skills gaps and excavation challenges - we can help you hit your targets

We’ve seen how lower grades are driving an acute need for ever-better automation and controls. You are also facing emerging skills gap, requiring better-informed industry partners. At the same time, energy costs are only going one way, and the legislative environment is becoming increasingly stringent.

Tough challenges call for experienced heads who can:
- Reduce your metal and mineral production costs
- Keep your plant safe
- Boost compliance and responsibility

Advantages at a glance
- Complete product basket for all applications, specifically in harsh environments
- Advanced diagnostic functionalities to make the process more safe and reliable
- Savings in raw material, water, energy and labor through accurate data of critical and quality relevant points in your process
Product highlights

**Omnigrad S TR15**
Modular RTD thermometer

**Robust temperature measurement technology**
- Highest reliability due to innovative and last state of art materials usage in terms of wear and corrosion resistance
- Advanced resistance temperature detection
- Fast response time thanks to high heat conduction performance materials
- Extension neck to protect the head transmitter from overheating
- Hazardous protections available:
  - Intrinsic Safety (Ex ia)
  - Non-sparking (Ex nA)

**Heat dissipation TAF16**

**Configurable heat neck design for onboard electronics protection**
- Even under extreme process conditions, such as very high temperatures, rotating connections and corrosive environments
- Temperature Engineered products can ensure reliable process monitoring and efficiency

**Omnigrad S TAF16**
High temperature TC thermometer

**Highest demands for continuous temperature measurement**
- Reliable measurement for cement production, steel treatment, incinerators, fluidized bed furnaces
- Very precise temperature detection thanks to noble thermocouples and high temperature thermowell materials, metallic or ceramic based
- Long lifetime by usage of innovative non-porous protection tube materials with increased wear and chemical resistance
- Flexible product selection by modular design and easy customer tailoring
- Optimized life cycle costs by means of replaceable spare parts

**Tile manufacturing in a rotary kiln**

The clay manufacturing application in the rotary kiln for tile production requires a specially adapted TAF16. A thermowell made of a nickel/cobalt alloy, which features high wear and corrosion resistance at high temperatures, is used to protect the sensor. A wireless HART module ensures reliable signal transmission from the rotary kiln to the control room. Special reflective discs are installed between the process connection and terminal head to protect the electronics from overheating due to strong heat emission. This allows the thermometer to be used optimally in various sections of the kiln, from the drying area at 300 °C to the combustion area with temperatures up to 1000 °C.

Your benefit: This method can be used to double the operating times of the sensors in this process.

- Easy data transfer using a wireless SWA70 module
- Reduced heat emission using suitable reflective discs
- Suitable thermowell materials for high resistance to erosion and corrosion
Nourishing your productivity

Your global partner for accurate measurements and expert support in food and beverages automation

From hygiene regulations and food safety to the basic demands of reliability and uptime, high quality food & beverage producers profit from our experience in more than 100 countries.

Get it right the first time and make your safe choice:
- Constant food quality & compliance
- Resources savings
- An expert partner

Advantages at a glance

- Complete basket of 3-A, FDA and EHEDG approved level measurement solutions
- Food safety and reliability due to instruments designed and manufactured specifically for all requirements in food & beverage industry
- Savings in raw material, water, energy and labor through accurate data of critical and quality relevant points in your process
- Optimized material availability and minimized stocks through inventory management solutions
Product highlights

iTHERM TM411
Forward-looking, hygienic thermometer with modular design
- Maximum possible variability for any demands
- Groundbreaking technologies for extremely easy handling, maximum process reliability and efficiency

iTHERM TM401 (E-direct)
Hygienic, modular thermometer - Basic technology
- Developed specifically for use in hygienic and aseptic applications
- Best cost/performance ratio and fast delivery time

Easytemp TMR35 (E-direct)
Hygienic compact thermometer
- Compact, fast and precise
- Best cost/performance ratio and fast delivery time

iTHERM QuickSens
Shortest response times worldwide:
- Fast, high-precision measurements
- Minimization of the needed insertion length
- Use of thermowells without affecting the measuring performance

iTHERM TM411

TH17
Hygienic, modular thermometer – in US design
- Developed specifically for use in hygienic and aseptic applications
- Best cost/performance ratio

iTEMP TMT180 / TMT181
4...20 mA temperature head transmitter
- Best cost/performance ratio
- High accuracy

Heating processes

A frequently used heating process for preserving milk is called (flash) pasteurization (high-temperature short-time HTST processing). Heating is used to neutralize any dangerous microorganisms that may be in raw milk. As a result, this is one of the most critical processes in terms of food safety.

Exact compliance with temperature specifications is mandatory in guaranteeing the effectiveness of this process. Excessive temperatures should be avoided due to their effects on taste and energy consumption. However, specialists must also ensure that the temperature in the holder tube never drops below the specified minimum temperature.

This can be ensured by implementing fast, tight temperature control which, in turn, is based on the fastest possible recording of temperature fluctuations. Endress+Hauser provides the critical advantage with iTHERM QuickSens technology sensors, which are the fastest in the world. Additionally, iTHERM QuickNeck – a divisible neck tube with a quick-release fastener – enables fast, tool-free calibration on site. These technologies are examples of product innovations from the iTHERM TM411 thermometer series, which sets new benchmarks for hygienic applications.
The pulse of life sciences

Trust a reliable partner who puts quality, compliance and cost control at the heart of life sciences

It is a daily task to meet stringent GxP regulations and productivity goals throughout your product lifecycle. You can count on our world-class instruments, designed to ASME-BPE standards, but also our highly qualified engineering input and experienced service teams. We partner with you to generate process optimization, higher plant availability and continuous improvement.

Our excellence, gained at the heart of the sector, will help you to:
- Streamline your projects
- Attain operational experience
- Make the right decisions

Advantages at a glance

- Measurement instruments that fully comply with the numerous requirements, codes and standards, such as FDA, ISPE, GAMP, ASME-BPE, EU1995/2004, etc.
- Advanced diagnostics guarantees highest process safety and efficiency
- Products designed for high temperatures and pressures during CIP and SIP processes
- Delivery of products with all required approvals (material certificates for the process wetted parts, certificates of compliance, calibration certificates, surface roughness finish certificates, test reports, etc.)
Product highlights

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Hygienic, modular thermometer - Basic technology
- Developed specifically for use in hygienic and aseptic applications
- Best cost/performance ratio and fast delivery time

**iTHERM QuickSens insert**
Extremely small pipe nominal diameters are sometimes used in machines in the pharmaceutical industry. This poses unique challenges for temperature measurement. Typical hygienic process adaptations can only be used if they meet a certain minimum nominal diameter. For this reason, Endress+Hauser provides welding solutions in the form of a T-piece or cornerpiece with an integrated thermowell for hygiene-compliant integration of temperature measuring points in small pipes. These small nominal diameters present the sensors with unique requirements. The position of the actual sensor element for standard measuring inserts is located 10...15 mm behind the tip. At very small immersion depths, this causes a crucial measurement error because the sensor here is located at the height of the pipe wall instead of in the center of the pipe. Endress+Hauser has developed a special solution for this problem – the iTHERM QuickSens insert. This involves a special sensor design in which the primary sensor is soldered directly onto the insert tip. This enables immersion lengths up to seven times shorter and the shortest response times in the world.

This allows Endress+Hauser to provide innovative, cutting-edge technology – the iTHERM TM411 thermometer. This product guarantees the user maximum accuracy, process control and reliability and quality without compromises.

**iTEMP TMT82**
HART 7 temperature transmitters
- Maximum reliability and availability
- Maximum accuracy due to sensor-transmitter matching

**Easytemp TMR35 (E-direct)**
Hygienic compact thermometer
- Compact, fast and precise
- Ideal for short insertion depths when installing in areas with small pipe nominal diameters

**iTEMP TMT180 / TMT181**
4...20 mA temperature head transmitter
- Best cost/performance ratio
- High accuracy

**TH27**
Hygienic, modular thermometer – in US design
- Developed specifically for use in hygienic and aseptic applications
- High reliability
Water is our life

Water quality, discharges, regulations, the environment... just rely on a trusted partner

As budgets shrink and legislative demands soar, we bring expertise for challenging needs. Safe potable water... discharges, environmental penalties... water infrastructure for developing countries... energy monitoring... the rising quantities of sludge from wastewater treatment and the opportunities they create for biogas. We make sense of it all, with experienced thinking supported by process technology solutions for your every need.

Through working with water in over 100 countries, Endress+Hauser offers a refreshing alternative.

- Improve plant safety and availability
- Optimize costs in your internal water processes
- Support your risk and failure management

Advantages at a glance

- Cost-effective product and service portfolio for any applications, e.g. for drinking water, wastewater and sewage, desalination
- Meeting internationally recognized standards/recommendations for drinking water applications
- Highest efficiency by easy commissioning, operation and maintenance of instruments
Operate your digester safely and reliably
Reduce operating costs and optimize the energy balance. In sewage management, a strong trend toward sludge treatment can be seen worldwide. This can primarily be ascribed to more stringent local requirements, which prohibit introducing sewage sludge into the environment (bodies of water, fields). As a result, sewage sludge has become a considerable cost factor for plant operators. In these scenarios, sludge decomposition can provide a cost advantage because it can be used to reduce the amount of sludge by around 50% and is also a valuable energy source for biogas.

Anaerobic bacteria require stable process conditions
The bacteria has to be protected from critical process conditions while processes take place in the digester. It is crucial to maintain a constant temperature. Endress+Hauser provides a reliable, robust thermometer for precisely this purpose – the Omnigrad M TR10. A thermowell with a reduced/tapered tip guarantees fast, immediate responses to changes in temperature. An optional head transmitter with all common communication protocols increases measuring accuracy and reliability compared to directly wired sensors.

Product highlights

**TR10**
Modular, universal thermometer
- Robust design, flexible configuration
- Fast response times with reduced/tapered thermowell tip
- Head transmitter with simple communication type selection

**Easytemp TMR31 (E-direct)**
Compact thermometer for industrial processes
- Compact, fast and precise
- Best cost/performance ratio and fast delivery time

**TST434**
Modular thermometer for inside/outside temperature measurement
- Robust terminal heads in accordance with DIN EN 50446 or stable plastic housings
- Easy and fast wall mounting
- Reliable temperature measurement with long-term stability

**iTEMP TMT180**
Compact thermometer for industrial processes
- Best in-class temperature measuring technology in US design
- High flexibility through modular assembly
- Robust design for extremely harsh ambient conditions

**iTEMP TMT112**
HART DIN rail temperature transmitter
- Universally programmable with HART protocol
- High reliability - breakdown information in case of sensor break/short-circuit

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Power up your plant

Power plants play a vital role. We help minimize downtime whilst delivering safety and productivity

Your plant needs a multi-skilled, versatile partner. You need reliable solutions that meet your application requirements and industry quality standards. And you may need to upgrade ageing plants with proven and state-of-the-art technologies, to keep the output consistently high. As the industry shifts towards natural gas, renewables and the new market dynamics driven by shale gas, our mission is to provide the all-round support and experience you need.

This includes elevated standards of safety for your staff. And the ability to meet even-higher environmental demands in flue gas cleaning processes such as SCR catalysts for nitrogen oxide reduction, electrostatic precipitators (ESPs) for particle separation, and limestone scrubbing processes for desulphurization.

When you choose us, you:
- Boost the efficiency of your plant
- Heighten safety
- Maintain expertise

Advantages at a glance

- Functional safety: IEC 61508 SIL 2/3 certified
- Intelligent instruments with continuous self-monitoring
- Minimized downtime and highest safety through modern instrumentation
Product highlights

**iTEMP TMT82**

**HART 7 temperature transmitters**
- Maximum reliability, availability and accuracy
- SIL 2/3-certified in accordance with IEC61508:2010
- Fast and tool-free wiring using spring terminal technology
- Maximum accuracy due to sensor-transmitter matching
- As a head transmitter, DIN rail device or in the field housing

**Omnigrad S TR15/TC15**

**Robust temperature measuring technology, ideal for steam or gas applications**
- For high process pressures and temperatures in demanding applications
- Fast response times with reduced/tapered thermowell tip
- Flexibility through optionally installed head transmitters with various communication types

**iTHERM StrongSens**

**Highly vibration-resistant RTD insert**
- Available in Omnigrad series RTD thermometers
- Vibration resistance of the measuring element >60g
- Also suitable for use in areas in which there is risk of explosion

**Omnigrad S TAF11, TAF12S/D/T; TAF16**

**Modular high-temperature thermometer**
- Robust design due to multiple ceramic thermowells or one metallic thermowell
- Selection of high-temperature thermocouples
- Selection of durable thermowell materials

**Omnigrad TR88/TC88**

**Modular, universal thermometer**
- Robust design, flexible configuration
- RTD or TC inserts
- For installation in an existing thermowell
- Also suitable for use in areas in which there is risk of explosion

**Omnigrad T TST310/TSC310**

**Cable thermometer for direct installation**
- Robust design, flexible configuration
- RTD or TC elements
- Mineral-insulated stainless steel or nickel-based sheathed cable
- Also suitable for use in areas in which there is risk of explosion

**Temperature measurement on the feed water pump**

At temperatures of approximately 170 °C and a pressure of approximately 220 bar, the temperature measurement on the feed water pump is not a particularly demanding measurement.

However, the temperature sensor is subjected to strong vibrations and often has a short operating life as a result. Using a Omnigrad S series thermometer with a barstock thermowell in conjunction with a vibration-resistant iTHERM StrongSens insert leads to a durable solution. The sensor’s fast response time and the excellent long-term stability contribute to reliable process control and short downtimes.
# Thermometer product overview

Endress+Hauser offers a complete assortment of compact thermometers, modular thermometers, thermowells, measurement inserts and accessories for all types of process industries.

<table>
<thead>
<tr>
<th>Product group</th>
<th>Cable probes and compact thermometers</th>
<th>Industrial modular</th>
<th>Hygienic modular &amp; compact</th>
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</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>[Image of cable probes]</td>
<td>[Image of modular thermometer]</td>
<td>[Image of hygienic compact thermometer]</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Cable probes, compact thermometers, temperature switches Simple design without thermowell</td>
<td>Modular thermometers for industrial general purposes</td>
<td>Compact thermometers, modular thermometers with hygienic process connections</td>
</tr>
<tr>
<td><strong>Application/Branches</strong></td>
<td>Universal</td>
<td>Universal, Chemical, Power</td>
<td>Food &amp; Beverage, Life Sciences</td>
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<tr>
<td><strong>Approvals</strong></td>
<td>ATEX Ex i, ATEX Ex nA, IECEx Ga Ex ia NEPSI Ex ia</td>
<td>ATEX Ex i, ATEX Ex nA FM/CSA IS IECEx Ga/Gb Ex ia NEPSI Ex ia</td>
<td>ATEX Ex ia, ATEX Ex ta/tb IECEx Ga/Gb Ex ia FM/CSA IS EHEDG, 3-A, FDA ASME BPE NEPSI Ex ia</td>
</tr>
<tr>
<td><strong>Measurement range</strong></td>
<td>RTD: -50 to +400 °C (-58 to +752 °F) TC: -40 to +1100 °C (-40 to +2012 °F)</td>
<td>RTD: -200 to +600 °C (-328 to +1112 °F) TC: -40 to +1100 °C (-40 to +2012 °F)</td>
<td>RTD: -200 to +600 °C (-328 to +1112 °F)</td>
</tr>
<tr>
<td><strong>Process connection</strong></td>
<td>Insertion, compression fitting, thread</td>
<td>Insertion, compression fitting, thread, flange, welded connection</td>
<td>Almost all common hygienic process connections, welded connections</td>
</tr>
<tr>
<td><strong>For detailed information see...</strong></td>
<td>pages 32 and 33</td>
<td>pages 34 and 35</td>
<td>pages 36 and 37</td>
</tr>
</tbody>
</table>
### Heavy duty (XP/Ex d)
- Pressure tight thermometers for Ex d applications
- Universal, Oil & Gas, Chemicals
- ATEX Ex i, Ex d; Ex nA; IECEx Ga/Gb Ex ia, Ex d; FM/CSA: IS, XP; NEPSI Ex ia, Ex d
- RTD: -200 to +600 °C (-328 to +1112 °F)
- TC: -40 to +1100 °C (-40 to +2012 °F)
- Thread, flange, welded connections

### High temperature
- High temperature thermometers with metal/ceramic thermowell and thermocouple
- Power, Primary industry, Metal preparation, Flue gas
- TC: 0 to +1800 °C (32 to +3272 °F)
- Flange, gas tight glands

### Temperature Engineered Solutions
- Furnace SkinPoint thermometers, Multipoint thermometers, application specific solutions
- Oil & Gas, Power, Chemical
- RTD: -200 to +600 °C (-328 to +1112 °F)
- TC: -200 to +1700 °C (-328 to +3092 °F)
- Customer specific solutions

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**Pages:**
- Heavy duty (XP/Ex d): pages 38 and 39
- High temperature: pages 40 and 41
- Temperature Engineered Solutions: pages 42 and 43
Construction of a thermometer

The mechanical construction of a thermometer used in process plants is the same for resistance thermometers and thermocouples and consists of the following components:

- Measurement insert with ceramic terminal block or head transmitter
- Thermowell
- Process connection
- Neck/lagging
- Terminal head with cable glands

**DIN-Style**

The **terminal head** is fitted to the thermowell or the neck of the thermometer.

**Benefits:**
- Protection and installation for terminal block or transmitter
- Cable entry and wiring
- Display (as option)

The **neck or lagging** is the connection between terminal head and process connection/thermowell.

**Benefits:**
- Protection of the head transmitter from overheating
- Guarantees access to the terminal head in the case of pipe insulation

The **process connection** is the connection between the process and the thermometer.

**Normally used are:**
- Threads
- Flanges
- Weld-in connections
- Compression fittings

The **thermowell** is the process wetted component of the thermometer.

**Benefits:**
- Increases the life cycle of the measurement insert through protection against process influence.
- Possible measurement insert exchange under process conditions.
- Mechanical stability against pressure and flow

**US-Style**
Measurement inserts

Basics and measurement principles

Temperature is the most frequently measured parameter in the process industry. In electrical, contact thermometers two measurement principles have asserted themselves as a standard.

**RTD - Resistance sensors**

In RTD resistance sensors the electrical resistance changes with a change in temperature. They are suitable for the measurement of temperatures between -200 °C and approx. 600 °C and stand out due to high measurement accuracy and long-term stability. The resistance sensor element most frequently used is a Pt100.

It is about a temperature-sensitive measuring resistance made of platinum with a resistance value of 100 Ω at 0 °C. The temperature coefficient is fixed with \( \alpha = 0.003851 \, ^\circ C^{-1} \).

Pt100 sensors are manufactured in different formats:

- **Wire wound ceramic sensors:** In a ceramic tube there is a double coil with capillary ultra-pure platinum wire. This tube is sealed at the top and bottom by a ceramic protective coating. These sensors ensure good long-term stability of their resistance/temperature characteristic in the temperature range of up to 600 °C.

- **Thin-layer sensors:** In a vacuum a very thin platinum coating of about 1 μm is sputtered onto a ceramic plate and is then photo-lithographically structured. The emerging platinum conductors form the sensor resistance. The advantages over the wire-wound versions are the smaller dimensions and the better vibration resistance. Thin-layer sensors are used for temperature measurements in temperature ranges of up to 500 °C.

As a standard, Endress+Hauser RTD resistance sensors fulfill the IEC 60751 accuracy class A.

**TC - Thermocouples**

A thermocouple is a component made of two different metals connected with each other at one end. An electrical potential (thermoelectric force) is caused due to the Seebeck effect at the open end if the connection and the free ends are exposed to different temperatures. With the help of the so-called thermocouples reference tables (see IEC 60584) the temperature at the connection (measuring junction) can be concluded.

Thermocouples are suitable for temperature measurement in the range of 0 °C to +1800 °C. They stand out due to the fast response time and high vibration resistance.
Sensor types

### Resistance sensors (RTD)

<table>
<thead>
<tr>
<th>Model</th>
<th>iTHERM QuickSens</th>
<th>iTHERM StrongSens</th>
<th>Standard thin film</th>
<th>Wire wound (WW)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Measurement range</strong></td>
<td>-50 to +200 °C</td>
<td>-50 to +500 °C</td>
<td>-50 to +400 °C</td>
<td>-200 to +600 °C</td>
</tr>
<tr>
<td><strong>Number of sensors</strong></td>
<td>1x Pt100</td>
<td></td>
<td>1x/2x Pt100</td>
<td></td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
<td>3-/4-wires</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Insert diameter</strong></td>
<td>3 mm / 6 mm</td>
<td>6 mm</td>
<td>3 mm / 6 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>Class A / AA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vibration resistance</strong></td>
<td>3 mm: 3g</td>
<td>&gt; 60g</td>
<td>3g</td>
<td></td>
</tr>
<tr>
<td>6 mm: &gt; 60g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Response times t₉₀ (for 1x Pt100)</strong></td>
<td>3 mm: 0.75 s</td>
<td>6 mm: 9.5 s</td>
<td>3 mm: 5.5 s</td>
<td>3 mm: 5 s</td>
</tr>
<tr>
<td>6 mm: 1.5 s</td>
<td>6 mm: 13 s</td>
<td>6 mm: 13.5 s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Design**

Measurement inserts consist of a SS316L stainless steel, Alloy 600 or Pyrosil tube inside. The internal leads (RTD) or thermal leads (TC) are placed and insulated from each other by magnesium oxide (MgO) powder.

The sensor is located at the tip of the measurement insert. The electrical contact at the top end of the measurement insert is made, in the simplest case, by the use of flying leads, a terminal block or a head transmitter. Measurement inserts are available with a single sensor or, for redundant measurement, with two sensors.

In order to guarantee thermal contact to the process the measurement inserts are pushed onto the base of the thermowell by means of two springs on the fixing screws or one spring on the collar (U.S. style: ‘spring loaded’).
Thermowells

The thermowell is the process wetted part of the thermometer. Basically, thermowells are divided into protection tubes constructed from welded tubes and thermowells made of drilled barstock material.

Thermowell construction In many cases thermometers cannot be placed directly into the medium but need protection from rough process conditions. Furthermore the thermowell makes sure that an exchange of the measurement insert is possible without interrupting the process.

Correct construction and design of a thermowell requires exact calculations. The load capacity of thermowells in individual processes is calculated at Endress+Hauser according to the Dittrich/Kohler method which represents the basis of the DIN 43772.

The calculation can alternatively be carried out according to ASME / ANSI PTC 19.3, i.e. the Murdock method.

Thermowell calculation tool

The "Sizing Thermowell Tool" can be found on the Endress+Hauser website for online calculation and engineering of all Endress+Hauser thermometer thermowells.

Interested? Have a look:
www.endress.com/applicator
Select and size product →
Sizing & documentation →
Sizing thermowell

Fabricated thermowells

<table>
<thead>
<tr>
<th>Model</th>
<th>TA414</th>
<th>TW10</th>
<th>TW11</th>
<th>TW12</th>
<th>TW13</th>
<th>TT411</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermometer connection</td>
<td>Matched adapter for TST414</td>
<td></td>
<td></td>
<td>M24 x 1.5, ½&quot; NPT</td>
<td></td>
<td>M24 x 1.5, G3/8&quot;, iThERM QuickNeck</td>
</tr>
<tr>
<td>Process connection</td>
<td>G ½&quot;</td>
<td>G ¼&quot;, G ½&quot;, G ¼&quot;, G 1&quot;, ½&quot; NPT, ¾&quot; NPT</td>
<td></td>
<td>Without, TA50 with Ø9 mm or Ø11 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck/extension</td>
<td>Without</td>
<td>As per DIN 43772</td>
<td>Double nipple</td>
<td>Without</td>
<td></td>
<td>According to DIN 43772</td>
</tr>
<tr>
<td>Material</td>
<td>1.4571</td>
<td>1.4435, 1.4571, 2.4819, 2.4816</td>
<td>1.4435, 1.4571, 2.4816</td>
<td>1.4435, 1.4571, 2.4816</td>
<td>1.4435, 1.4571, 2.4816</td>
<td>1.4404, 1.4435; 1.4435+316L, delta-ferrite &lt; 1%</td>
</tr>
<tr>
<td>Suitable for</td>
<td>Only TST414</td>
<td>Replacement thermowell for Tx10 and TST90</td>
<td>Replacement thermowell for TR11</td>
<td>Replacement thermowell for Tx12</td>
<td>Replacement thermowell for Tx13</td>
<td>Replacement thermowell Ø6 mm or Ø9 mm for TM411</td>
</tr>
<tr>
<td>Order number for detailed technical information</td>
<td>TI22BT/02</td>
<td>TI261T/02</td>
<td>TI262T/02</td>
<td>TI263T/02</td>
<td>TI264T/02</td>
<td>TI01099T/09</td>
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### Fabricated thermowells

<table>
<thead>
<tr>
<th>Model</th>
<th>TW251</th>
<th>TA535</th>
<th>TA540</th>
<th>TA541</th>
</tr>
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<tbody>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermometer</strong> connection</td>
<td>Compression fitting Ø9 mm</td>
<td>G ½&quot;, ⅛&quot; NPT</td>
<td>⅝&quot; NPT, ⅛&quot; NPT</td>
<td>½&quot; NPT male</td>
</tr>
<tr>
<td><strong>Process connection</strong></td>
<td>G ½&quot;, G ¼&quot;, ⅛&quot; NPT, ½&quot; NPT, ⅛&quot; NPT</td>
<td>G ½&quot;, G ⅛&quot;, ⅛&quot; NPT, ¼&quot; NPT</td>
<td>Flange according to EN 1092 or ASME, thread ½&quot; NPT, ⅛&quot; NPT, ⅛&quot; NPT, ⅛&quot; NPT</td>
<td>Flange according to EN 1092 or ASME, thread ¾&quot; NPT, ⅛&quot; NPT, ⅛&quot; NPT</td>
</tr>
<tr>
<td><strong>Neck/extension</strong></td>
<td>Without</td>
<td>50 to 500 mm</td>
<td>100 to 300 mm</td>
<td>80 to 300 mm</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>1.4435</td>
<td>1.4401, 1.4749</td>
<td>1.4401</td>
<td></td>
</tr>
<tr>
<td><strong>Suitable for</strong></td>
<td>Thermowell for TST410, TEC410, TST310 or TSC310</td>
<td>TR88, TC88, TR24, TR25</td>
<td>TR88, TMT162R, TC88, TMT162C</td>
<td>-</td>
</tr>
<tr>
<td><strong>Order number for detailed technical information</strong></td>
<td>TI245T/02</td>
<td>TI00250T/09</td>
<td>TI01158T/09</td>
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</table>

### Barstock thermowells

<table>
<thead>
<tr>
<th>Model</th>
<th>TA565/TA566</th>
<th>TA570</th>
<th>TA571</th>
<th>TA572</th>
<th>TA575</th>
<th>TA576</th>
<th>TT511</th>
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</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermometer</strong> connection</td>
<td>½&quot; NPT</td>
<td>½&quot; NPT, ⅛&quot; BSP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Process connection</strong></td>
<td>1&quot; NPT</td>
<td>Weld-in</td>
<td></td>
<td>Flange according to EN 1092 or ASME</td>
<td>Collar flange according to EN 1092 or ASME</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Neck/extension</strong></td>
<td>30 to 300 mm</td>
<td>30 to 400 mm</td>
<td>50 to 300 mm</td>
<td>50 to 400 mm</td>
<td>25 mm (type 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>1.4401, 1.4435, 1.4571</td>
<td>1.4401, 1.4435</td>
<td>1.4571</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Suitable for</strong></td>
<td>TR88 / TC88, TMT162R / TMT162C, TR62 / TC62, TR65 / TC65, TST90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Order number for detailed technical information</strong></td>
<td>TA565:TI160T/02 TA566: TI177T/02</td>
<td>TI01162T/09</td>
<td>TI01128T/09</td>
<td>TI01135T/09</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Temperature Measurement**
## Barstock thermowells

<table>
<thead>
<tr>
<th>Model</th>
<th>TW15</th>
<th>TT411*</th>
<th>TA550/TA555</th>
<th>TA556</th>
<th>TA557</th>
<th>TA560</th>
<th>TA562</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td><img src="image1.png" alt="Design TW15" /></td>
<td><img src="image2.png" alt="Design TT411*" /></td>
<td><img src="image3.png" alt="Design TA550/TA555" /></td>
<td><img src="image4.png" alt="Design TA556" /></td>
<td><img src="image5.png" alt="Design TA557" /></td>
<td><img src="image6.png" alt="Design TA560" /></td>
<td><img src="image7.png" alt="Design TA562" /></td>
</tr>
<tr>
<td>Thermometer connection</td>
<td>M24 x 1.5, ½&quot; NPT male</td>
<td>G3/8&quot; male</td>
<td>½&quot; NPT</td>
<td>¾&quot; NPT</td>
<td>½&quot; NPT</td>
<td>½&quot; NPT, ½&quot; BSP</td>
<td></td>
</tr>
<tr>
<td>Process connection</td>
<td>Flange according to EN 1092/ASME, or weld-in</td>
<td>Clamp according to ISO 2852, DIN 11851, VariVent, weld-in adapter, thread</td>
<td>Flange according to ASME, thread ¾&quot; NPT (TA550), 1&quot; NPT (TA555)</td>
<td>Flange according to ASME, thread 1&quot; NPT</td>
<td>Thread ¾&quot; NPT, ½&quot; NPT, G1/4&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck/ extension</td>
<td>40 to 400 mm</td>
<td>65 mm</td>
<td>50 to 300 mm</td>
<td>45 to 300 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>1.4404, 1.4435; 1.4435+316L, delta-ferrite &lt; 1%</td>
<td>1.4404, 1.4435; 1.4435+316L, delta-ferrite &lt; 1%</td>
<td>1.4401, 1.4435, 1.4571</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suitable for</td>
<td>TR15 / TC15</td>
<td>Replacement thermowell Ø12.7 mm for TM411</td>
<td>TR88 / TC88, TMT162R / TMT162C, TR62 / TC62, TR65 / TC65, TST90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order number for detailed technical information</td>
<td>TI00265T/02</td>
<td>TI01099T/09</td>
<td>TA550: TI153T/02 TA555: TI154T/02</td>
<td>TI155T/02</td>
<td>TI156T/02</td>
<td>TI159T/02</td>
<td>TI00230 T/02</td>
</tr>
</tbody>
</table>

*Made from solid bar stock for L ≤ 200 mm

---

## US Barstock thermowells

<table>
<thead>
<tr>
<th>Model</th>
<th>TU51</th>
<th>TU52</th>
<th>TU53</th>
<th>TU54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td><img src="image8.png" alt="Design TU51" /></td>
<td><img src="image9.png" alt="Design TU52" /></td>
<td><img src="image10.png" alt="Design TU53" /></td>
<td><img src="image11.png" alt="Design TU54" /></td>
</tr>
<tr>
<td>Thermometer connection</td>
<td>½&quot; NPT</td>
<td>½&quot; NPT</td>
<td>½&quot; NPT</td>
<td>½&quot; NPT</td>
</tr>
<tr>
<td>Process connection</td>
<td>Weld-in Ø ¾&quot;, Ø1&quot;</td>
<td>Socket weld process connections</td>
<td>Thread ½&quot; NPT, ¾&quot; NPT, 1&quot; NPT</td>
<td>Flange according to ASME</td>
</tr>
<tr>
<td>Neck/ extension</td>
<td>1&quot;-6&quot; cylindrical</td>
<td>1&quot;-6&quot; cylindrical</td>
<td>1&quot;-6&quot; hexagonal</td>
<td>1&quot;-6&quot; cylindrical</td>
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<tr>
<td>Material</td>
<td>SS316</td>
<td>SS316</td>
<td>SS316</td>
<td>SS316</td>
</tr>
<tr>
<td>Suitable for</td>
<td>T15, T55</td>
<td>T15, T55</td>
<td>T15, T55</td>
<td>T15, T55</td>
</tr>
</tbody>
</table>
Process connections

The process connection is the connection between the process and the thermometer. The following process connections are those most commonly used in the process industries:

**Thread:** The most commonly used thread types are NPT-, G- and M-threads:
- The ANSI B 1.20.1 NPT thread is a U.S. thread norm for self-sealing pipe threads. Sealing is achieved through conical threads.
- G threads are cylindrical pipe threads and seal using the sealing area above the thread.
- M threads are metric threads which are used at low process pressures. M threads are frequently used on thermometers that are to be screwed into already existing thermowells on site.

**Welded joint:** The thermowell is directly welded into the container or pipe wall via a welding sleeve or a welding adapter.

**Flange:** Flanges are subject to the DIN or ANSI / ASME standards. They are classified according to material, diameter and pressure rating.

To fulfill the strongly varying process conditions a variety of sealing geometries are available.

**Process connections for hygienic and aseptic application**

Seals in hygienic process connections must be replaced at fixed intervals. Fast and simple exchange of the complete thermometer as well as simple cleaning in the process have led to special hygienic process connections for the Food & Life Sciences industry.

<table>
<thead>
<tr>
<th>Connection</th>
<th>Clamp according to ISO 2B52</th>
<th>DIN 11851</th>
<th>DIN 11864</th>
<th>SMS</th>
<th>Weld-in adapter</th>
<th>Screw-in adapter</th>
<th>Varivent</th>
<th>Ingold</th>
<th>Metallic sealing connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>DNB/18</td>
<td>DN 25</td>
<td>DN 25</td>
<td>DN 25</td>
<td>Cylindrical or spheric cylinder 30 x 40 mm</td>
<td>G 1&quot;, as for Liquiphant</td>
<td>DN32/125, D = 68 mm</td>
<td>DN25, D = 50 mm</td>
<td>DN10/15, D = 31 mm</td>
</tr>
<tr>
<td></td>
<td>DN12/21,3</td>
<td>DN 32</td>
<td>DN 40</td>
<td></td>
<td></td>
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<td>DN25/38</td>
<td>DN 40</td>
<td>DN 50</td>
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<td></td>
<td>DN40/51</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tri-Clamp ½&quot;, ¾&quot;, 1½&quot;, 2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Available for metric design:</td>
<td>TM401, TM411, TMR35, TTR35</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Available for imperial design:</td>
<td>TM402, TM412</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Terminal heads

The terminal heads, in which the terminal block or transmitter is installed, differ in shape and material depending on the application. Materials used are: Plastic, varnished aluminum or stainless steel. All terminal heads have an internal form according to DIN 43729 (form B). Various threads for thermometer connection (M24, NPT½") or cable connection (M20, NPT½", NPT¾", G½") are available. Moreover, a large selection of cable glands and connectors is available.

### Terminal heads offering maximum comfort

- With high or low hinged cover.
- With screw-on cover even in explosion-proof version (XP).
- Cover with display window for process value and diagnostic messaging display.
- Internal and external grounding screws.
- Simple connection cable feed by means of a spiral cable guide well.
- Easy access to mounting platform for head transmitter or terminal block installation.
- Simple identification due to explicit nameplate positioning.
- Double cable entry
- Optional with wall or pipe mounting
- Connectors

### iTHERM TA30R - Stainless steel terminal head for hygienic applications

**Benefits at a glance:**

- Improved handling, reduced installation and maintenance costs by optimal access to the terminals
- Optional display - safety due to on-site process display
- Protection class IP69K - optimal protection even when using high-pressure cleaners
Transmitter

The task of transmitters is the transformation of the sensor signal into a stable and standardized signal. In the past, transmitters were built using analog technology. In the meantime digital technology has gained acceptance, however, because it offers better measurement accuracy at simultaneously higher flexibility.

Transmitters are typically offered in three distinctive types of housing:

- As DIN rail mounted devices suitable for panel installation.
- As head transmitters for direct installation in thermometer terminal heads.
- As field transmitters for direct connection in the process areas.

Transmitters are configurable and support both numerous resistance sensor types and thermocouples. In order to obtain the highest measurement precision, linearization characteristics for every type of sensor are stored in the transmitter.

In addition, the measurement accuracy in modern transmitters can be improved by use of a specific ‘sensor-transmitter-matching’ software. The complete measuring chain consisting of transmitter and sensor is then matched with each other.

On the one hand, the standardized output signal in the process measurement is a 4...20 mA signal, but also the internationally standardized field buses, such as HART®, PROFIBUS® and FOUNDATION™ Fieldbus are used. The HART® protocol serves mainly for a more convenient operation in combination with the 4 to 20 mA analog measured signal. PROFIBUS® and FOUNDATION™ Fieldbus, however, transfer the real measured value digitally and therefore offer cost savings by simplifying the wiring.

The plug-on display TID10 can be used in connection with a TMT82, TMT84 or TMT85 head transmitter. Simply plug it onto the head transmitter and the display will be switched on. It displays information regarding the actual measured value, the measurement point identification and events of fault in the measurement chain. DIP-switches can be found on the rear of the display. This enables the hardware set-up such as the PROFIBUS® device address. With the optional field housing TA30x the device is suitable for use in the field, even a use for Ex d applications is possible without problems.
Device configuration

**HART®**

HART® signal for on-site or centralized device set-up using a hand-held terminal or PC. Operation, visualization and maintenance at the PC using FieldCare, AMS, PDM or ReadWin 2000 software.

**PC programmable (PCP)**

Online configuration with SETUP connector, socket and ReadWin 2000 operating software.

**Fieldbus**

Temperature transmitter for PROFIBUS® PA and FOUNDATION™ Fieldbus enables data exchange and operation using standardized fieldbus protocols.

Endress+Hauser is one of the pioneers in fieldbus technology and plays a worldwide leading role in the application of the HART®, PROFIBUS® DP/PA and FOUNDATION™ fieldbus technology.

- Accredited PROFIBUS® competence center
- Engineering of field bus networks
- System integration checks
- Training courses, seminars
- Customer service
- Endress+Hauser’s own fieldbus laboratory
# iTEMP and DIN rail transmitters at a glance

## Head and DIN rail transmitters

<table>
<thead>
<tr>
<th>Typ</th>
<th>Model</th>
<th>Design</th>
<th>DIN rail</th>
<th>Special features</th>
<th>RTD input</th>
<th>TC input</th>
<th>Ω input</th>
<th>mV input</th>
<th>Accuracy (Pt100)</th>
<th>Approvals</th>
<th>Order number for Technical Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TMT111</td>
<td>DIN rail</td>
<td>±</td>
<td>PC- interface, universal</td>
<td>Pt50/100/500/1000, Ni100/500/1000, Cu50/100, GOST: Pt50/100, Cu50/100, Polynom RTD</td>
<td>B, C, D, R, S, E, J, K, L, N, T, U (additionally type A for TMTB2)</td>
<td>10...2000 Ω</td>
<td>-10...100 mV</td>
<td>≤ 0.2 K</td>
<td>ATEX: Ex ia, FM/CSA: IS, UL to 3111-1, Dust-Ex Zone 22, GL ship building approval, GOST, NEPSI</td>
<td>TI00070R/09 TI00087R/09 TI00135R/09</td>
</tr>
<tr>
<td></td>
<td>TMT112</td>
<td>DIN rail</td>
<td>±</td>
<td>HART®, interface, SIL2, universal</td>
<td>Pt100/500/1000, Ni100/500/1000, Polynom RTD</td>
<td>-</td>
<td>-</td>
<td>-10...75 mV</td>
<td>-</td>
<td>ATEX: Ex ia, FM/CSA: IS, Dust-Ex Zone 22, NEPSI, IEC Ex</td>
<td>TI00078R/09 TI00090R/09 TI00114R/09</td>
</tr>
<tr>
<td></td>
<td>TMTB2</td>
<td>DIN rail</td>
<td>±</td>
<td>HART®, 2-channel, back-up, drift, SIL2/3, universal</td>
<td>Pt100/200/500/1000, Ni100/120/1000, Cu10/50/100 (Cu50 for TMTB2) GOST: Pt50/100, Cu50/100 (Cu50 for TMTB2) Polynom RTD, Callendar/Van Dusen</td>
<td>-</td>
<td>-</td>
<td>-20...100 mV</td>
<td>-</td>
<td>ATEX: Ex ia, FM/CSA: IS, Staub-Ex Zone 22; NEPSI, IEC Ex</td>
<td>TI01010T/09 TI00138R/09 TI00134R/09</td>
</tr>
<tr>
<td></td>
<td>TMTB4</td>
<td>DIN rail</td>
<td>±</td>
<td>PROFIBUS® PA, 2-channel, back-up, drift, universal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>TMTB5</td>
<td>DIN rail</td>
<td>±</td>
<td>FOUNDATION™ Fieldbus, 2-channel, back-up, drift, universal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Field transmitters

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Design</th>
<th>DIN rail</th>
<th>Special features</th>
<th>RTD input</th>
<th>TC input</th>
<th>Ω input</th>
<th>mV input</th>
<th>Accuracy (Pt100)</th>
<th>Approvals</th>
<th>Order number for Technical Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TMT162</td>
<td>DIN rail</td>
<td>Illustrated display, 2-chamber device, 2-channel, back-up, drift, (SIL2, NE89 for HART®), universal</td>
<td>Pt100/200/500/1000 Ni100/120/1000 Cu50/50/100 GOST: Pt50/100, Cu50/100 (not for TMT142) Polynorm RTD, Callendar/Van Dusen</td>
<td>B, C, D, R, S, E, J, K, L, N, T, U</td>
<td>0 to 2000 Ω</td>
<td>-20 to 100 mV</td>
<td>≤ 0.2 K analog: 0.02% of the set span</td>
<td>ATEX: Ex ia, Ex d, FM/CSA: IS, XP, DIP, Dust-Ex Zone 21, GL ship building approval, GOST (for HART®), NEPSI, IEC Ex</td>
<td>TI00086R/09</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TMT142</td>
<td>DIN rail</td>
<td>Illustrated display, rotatable, universal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≤ 0.2 K (≤ 0.15 K)</td>
<td></td>
<td>ATEX: Ex ia</td>
<td>TI00107R/09</td>
</tr>
<tr>
<td></td>
<td>TMT125</td>
<td>DIN rail</td>
<td>For up to 8 input channels, universal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≤ 0.2 K</td>
<td></td>
<td>ATEX: Ex ia, Ex nA, FM: IS Ni, NEPSI, IEC Ex</td>
<td>TI00131R/09</td>
</tr>
</tbody>
</table>

### E-direct transmitters

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Design + DIN rail</th>
<th>Input</th>
<th>Accuracy</th>
<th>Order number for Technical Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TMT180</td>
<td>+ DIN rail</td>
<td>RTD: Pt100</td>
<td>≤ 0.2 K or 0.08%</td>
<td>TI00088R/09</td>
</tr>
<tr>
<td></td>
<td>TMT80</td>
<td>DIN rail</td>
<td>RTD: Pt100, 1000 TC: B, K, N, R, S</td>
<td></td>
<td>TI00153R/09</td>
</tr>
<tr>
<td></td>
<td>TMT187/127</td>
<td>DIN rail</td>
<td>RTD: Pt100</td>
<td>0.2 K or 0.08%</td>
<td>TI00076R/09</td>
</tr>
<tr>
<td></td>
<td>TMT188/128</td>
<td>DIN rail</td>
<td>TC: B, C, D, E, J, K, L, N, R, S, T, U, MoRe5-MoRe41</td>
<td>0.2 K or 0.08%</td>
<td>TI00077R/09</td>
</tr>
</tbody>
</table>

### Approvals

- ATEX: Ex ia, Ex d, FM/CSA: IS, XP, DIP, Dust-Ex Zone 21, GL ship building approval, GOST (for HART®), NEPSI, IEC Ex
- FM/CSA: IS, XP, DIP, NEPSI, IEC Ex
- ATEX: Ex ia, Ex nA, FM: IS Ni, NEPSI, IEC Ex
Compact thermometers

**Simple, fast and economical** Cost efficiency and optimal use of space indicate modern process measuring technology. Particularly OEM applications require fast delivery times, reliable operation as well as simple assembly and calibration of the measurement technology used.

The compact families completely fulfill these requirements. They are easily commissioned, measure reliably, and when required convert into standard signals and alert at alarm limit violation.

- Precise primary sensors, long-term stable electronics.
- Robust construction in stainless steel, compatible connection technology.
- Versatile process adapters, flexible sensor lengths.
- Simplest assembly as well as on-site and PC parameter set-up.
- Patented sensor concept

**Output signals** Direct access to the primary signal using high grade cables in 3- or 4-wire connection or 4...20 mA access at the standard connection socket – all selectable.

**The electronics** The dimensions of the freely programmable measurement PCB in the Easytemp TMR31 are only 40 x 18 mm. The Thermophant TTR31 can be set up using push buttons and switches in the case of an alarm limit violation.

**The process connections** Stainless steel compression fittings, inch and metric threads ensure complete compatibility. Hygienic process adapters and thermowells fulfill the EHEDG-, 3A- and FDA requirements.

**The sensors** Vibration-proof integrated thin-film Pt100 sensors guarantee the highest operational security at the fastest response times.
### Cable probes and compact thermometers overview

<table>
<thead>
<tr>
<th>Type</th>
<th>Metric style</th>
<th>US-style</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>TST310</td>
<td>TSC310</td>
</tr>
<tr>
<td>Design</td>
<td>Special</td>
<td>Special</td>
</tr>
<tr>
<td></td>
<td>features</td>
<td>features</td>
</tr>
<tr>
<td></td>
<td>Compact thermometer with non-detachable cable for plug-in or screw-in connection</td>
<td>Temperature switch with 1/2 PNP switching outputs, 4 to 20 mA</td>
</tr>
<tr>
<td>Approvals</td>
<td>ATEX Ex ia, ATEX Ex nA, IECEx Ga Ex ia, NEPSI Ex ia</td>
<td>UL 61010B-1 and CSA C22.2 No. 1010.1-92</td>
</tr>
<tr>
<td>Principle</td>
<td>RTD</td>
<td>TC</td>
</tr>
<tr>
<td>Measurement range</td>
<td>-50 to +400 °C</td>
<td>-50 to +150 °C</td>
</tr>
<tr>
<td>Process pressure</td>
<td>≤ 100 bar (dependent on process connection)</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>1.4404</td>
<td>1.4404, 2.4816</td>
</tr>
<tr>
<td>Order number for Technical Information</td>
<td>TI00085T/09</td>
<td>TI00255T/09</td>
</tr>
</tbody>
</table>

Monitoring of a supply pipework using compact thermometers and temperature switches
Endress+Hauser offers a broad portfolio of temperature measurement technology for comprehensive solutions for almost all branches of industry. The measurement principles used are RTD resistance sensors and thermocouples. Important points for the inclusion of the measurement point into the process are the protection of the thermometers through thermowells and the process connection.

These thermometers are mainly used in the chemical industry, but they also find their use in other areas of the process industry, both in core as well as peripheral processes.

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Design</th>
<th>Thermowell armature</th>
<th>Measurement insert</th>
<th>Sensor measurement range</th>
<th>Ex approvals</th>
<th>Process connection</th>
<th>Thermowell</th>
<th>Thermowell material</th>
<th>Order number for Technical Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RTD: -200 to +600 °C</td>
<td></td>
<td>Thread</td>
<td>Fabricated thermowell out of tubing with welded tip</td>
<td>1.4435, 1.4571, 2.4819, 1.4816</td>
<td>TI00256 T/09, TI257 T/02, TI01118 T/09, TI01097 T/09, TI01100 T/09, TI01098 T/09, TI274 T/02, TI01118 T/09, TI01097 T/09</td>
</tr>
</tbody>
</table>
## Modular thermometers for industrial applications

<table>
<thead>
<tr>
<th>Metric design</th>
<th>Imperial design</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC15</td>
<td>TH11</td>
</tr>
<tr>
<td>Weld-in thermowell, flange with neck</td>
<td>Without thermowell, thread with neck</td>
</tr>
</tbody>
</table>

- **MgO-sheathing, exchangeable; diameter: 6 mm, 3 mm**

<table>
<thead>
<tr>
<th>TC: Type J, Type K</th>
<th>RTD: -328 to 1112 °F (-200 to +600 °C)</th>
<th>TC: Type J, Type K, Type E, Type N, Type T</th>
<th>RTD: -330 to +1600 °F (-200 to +870 °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATEX I GD Ex ia</td>
<td>-</td>
<td>CSA (IS, NI)</td>
<td>CSA (IS, NI)</td>
</tr>
<tr>
<td>ATEX 1/2 GD Ex ia, Ex nA</td>
<td>Thread or compression fitting, fixed or movable</td>
<td>Thread according to ANSI</td>
<td>Thread or compression fitting, fixed or movable</td>
</tr>
<tr>
<td>IECEx Ga/Gb Ex ia</td>
<td>Threaded connection to existing thermowell</td>
<td>Flange according to ANSI</td>
<td>Threaded connection to existing thermowell</td>
</tr>
<tr>
<td>IECEx Ga/Gb Ex ia</td>
<td>Thread or for welding</td>
<td>Flange according to ANSI</td>
<td>Thread or for welding</td>
</tr>
<tr>
<td>NEPSI Ex ia</td>
<td>Thread or for welding</td>
<td>Flange according to ANSI</td>
<td>Threaded connection to existing thermowell</td>
</tr>
<tr>
<td></td>
<td>Thread or compression fitting, fixed or movable</td>
<td>Threaded connection to existing thermowell</td>
<td></td>
</tr>
<tr>
<td>Drilled barstock thermowell</td>
<td>Drilled barstock thermowell</td>
<td>Drilled barstock thermowell</td>
<td>Drilled barstock thermowell</td>
</tr>
<tr>
<td>1.4435, 1.4571, 2.4819, 1.4816</td>
<td>5S316 or Alloy 600</td>
<td>SS316L, Alloy 600, Alloy C276, Titan, Alloy 400</td>
<td>-</td>
</tr>
</tbody>
</table>
Temperature measurement in the Food & Life Sciences industry

The innovative iTHERM thermometers of the new, modular hygienic line have been designed to meet the requirements of the Food & Life Sciences industries and comply with highest quality standards. For the first time a comprehensive, global product portfolio with a large selection of process connections, transmitters and further constructive variants is offered. All products - both metric and imperial - are available with the relevant international approvals.

The product choice is very simple:

- A consistent segmentation into 2 product structures for basic (TM40x) and advanced technology (TM41x) supports the preselection of the suitable thermometer
- Support from a cost-free, graphical product configurator with integrated knowledge database

All this saves time and costs and increases the planning security – misorders are practically impossible.

<table>
<thead>
<tr>
<th>Device configuration</th>
<th>Basic technology</th>
<th>Advanced technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insert</td>
<td>TM401 metric</td>
<td>TM411 metric</td>
</tr>
<tr>
<td>Transmitter</td>
<td>Not replaceable</td>
<td>Replaceable</td>
</tr>
<tr>
<td>Ex-certificate</td>
<td>1-channel; no display</td>
<td>1- or 2-channel; plug-on display (optional)</td>
</tr>
<tr>
<td>Sensor</td>
<td>1x Pt100 standard thin film sensor</td>
<td>1x Pt100 standard thin film sensor, 1x Pt100 iTHERM QuickSens or StrongSens, 1x or 2x Pt100 wire wound</td>
</tr>
<tr>
<td>Extension neck</td>
<td>Standard</td>
<td>Standard, optional iTHERM QuickNeck</td>
</tr>
</tbody>
</table>

iTEMP Transmitter
Accurate and reliable measured value transmission

iTEMP QuickSens
Shortest response times worldwide:
- Fast, high-precision measurements
- Minimization of the needed insertion length
- Use of thermowells without affecting the measuring performance

iTHERM TA30R
Stainless steel terminal head:
- Optimal access to the terminals due to a low housing edge
- Optional display
- Protection class IP69K

iTHERM QuickNeck
Divisible neck with quick release:
- Removal of the insert without tools
- Protection class IP69K

iTHERM StrongSens
Unmatched robustness:
- Vibration resistance > 60g
- Automated, traceable production
## Food & Life Sciences Product Overview

<table>
<thead>
<tr>
<th>Type</th>
<th>Metric design</th>
<th>Imperial design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>TTR35 (E-direct)</td>
<td>TMR35 (E-direct)</td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special features</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificates, Conformity</td>
<td>3-A, UL</td>
<td>3-A, FDA, ASME BPE</td>
</tr>
<tr>
<td>Measurement principle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring range</td>
<td>316L, Ra &lt; 0.8 µm or &lt; 0.4 µm; optionally electro-polished</td>
<td>316L, Ra &lt; 0.8 µm or &lt; 0.4 µm; optionally electro-polished</td>
</tr>
<tr>
<td>Process pressure</td>
<td>≤ 40 bar, dependent on the process connection</td>
<td></td>
</tr>
<tr>
<td>Material and surface finish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response time</td>
<td>2.0 s</td>
<td>7 s</td>
</tr>
<tr>
<td>Process connection</td>
<td>Clamp according to ISO 2852, DIN 11851, DIN 11864-1, metallic sealing system</td>
<td>Tri-Clamp / Micro-Clamp</td>
</tr>
<tr>
<td>Output signal</td>
<td>1/2 PNP; 100 4-wire, 4 to 20 mA</td>
<td>100 3/4-wire, 1-channel iTEMP transmitter (4 to 20 mA; HART®, FF, PA)</td>
</tr>
<tr>
<td>Order number for Technical Information</td>
<td>TI00105R/09</td>
<td>TI0123R/09</td>
</tr>
</tbody>
</table>

* with thermowell and thermoconductive paste

---

**E+H = °C  Innovative Temperature Measurement**

**Benefits at a glance**

- Global portfolio (metric/imperial) with international certificates
- User friendliness and security from product choice to maintenance
- iTEMP® inserts: automated production - worldwide unique. Complete traceability and constantly high product quality for reliable measurement values
- iTEMP® QuickSens: shortest response times (t₉₀: 1.5 s) for optimal process control
- iTEMP® StrongSens: unmatched vibration resistance (> 60G) for highest plant safety
- iTEMP® QuickNeck: cost and time savings through toolfree, easy recalibration
- iTEMP® TA30R: terminal head from 316L with improved handling for reduced installation and maintenance costs and highest protection class IP69K
- More than 50 hygienic process connections
Temperature measurement in Oil & Gas

The Oil & Gas industry is divided into the areas, “Up-stream – exploration and support”, “Mid-stream – transportation” and “Downstream – processing”. Different, very high requirements are made in these areas on the measurement technology used.

Requirements at a glance

- **Terminal head/Communication**
  - Field transmitter with display in 316L stainless steel for off-shore applications
  - Terminal head with screw cap
  - PC-programmable, with HART® protocol, PROFIBUS® PA or FOUNDATION™ Fieldbus

- **Neck/Extension**
  - Coupling piece with integrated flame path barrier, Nipple-Union-Nipple (NUN)

- **Process connection**
  - Flange according to ASME/ANSI, “full penetration welding”, ‘Greylock’ connections, weld-in connections

- **Process wetted parts/thermowell**
  - Process wetted parts in stainless steel: 316L / 1.4404, 316Ti / 1.4571 or Alloy C276 / 2.4819; barstock material for highest process pressures
**Heavy Duty Product Overview**

<table>
<thead>
<tr>
<th>Type</th>
<th>Metric design</th>
<th>Imperial design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>TR61/TC61</td>
<td>T13/T53</td>
</tr>
<tr>
<td></td>
<td>TR62/TC62</td>
<td>T14/T54</td>
</tr>
<tr>
<td></td>
<td>TR63/TC63</td>
<td>T15/T55</td>
</tr>
<tr>
<td></td>
<td>TR65/TC65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TR66/TC66</td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special features</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approvals</td>
<td>ATEX Ex d, ATEX Ex ia, IECEx</td>
<td>FM/CSA XP Class 1, Div. 1</td>
</tr>
<tr>
<td>Measurement principle</td>
<td>RTD, TC: Type J or K</td>
<td>RTD, TC: Type J, Type K, Type E, Type N, Type T</td>
</tr>
<tr>
<td>Measurement range</td>
<td>RTD: -328 to 1112 °F [-200 to +600 °C] TC: -40 to 2012 °F [-40 to +1100 °C]</td>
<td>RTD: -58 to +392 °F [-50 to +200 °C] TC: -328 to +1600 °F [-200 to +870 °C]</td>
</tr>
<tr>
<td>Process pressure</td>
<td>≤ 100 bar</td>
<td>≤ 80 bar</td>
</tr>
<tr>
<td>Material</td>
<td>1.4404/SS316L; 1.4571/SS316Ti; 2.4819/Alloy C276</td>
<td>1.4404/SS316L; 1.4749/SS446; 2.4816/Alloy 600</td>
</tr>
<tr>
<td>Process connection</td>
<td>Thread, compression fitting, flange</td>
<td>Thread, compression fitting, flange</td>
</tr>
<tr>
<td>Output signal</td>
<td>4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus</td>
<td>4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus</td>
</tr>
</tbody>
</table>

**Approvals/certificates/tests**

- **NACE (MR0175)**: Suitability test of materials for acid gas surroundings by approval test EN 10204, 3.1 listed in the NACE standard MR0175.
- **Dye penetrant testing**: Dye penetrant testing according to the ASME V and ASME VIII guidelines.
- **X-ray test certificate**: X-ray test certificate for thermowell welding seams in accordance with ASME V – ASME VIII.
- **Thermowell calculation**: Thermowell calculation according to ASME PTC 19.3 using customer specific pressure, temperature and flow rate values.
- **Helium leakage test**: Sealing tightness test.
- **Pressure test**: Thermowell internal and external pressure test according to PED (Pressure Equipment Directive) in Europe or CRN (Canadian Registration Number) in North- and Central America.

Temperature measurement in Oil & Gas
High temperature applications

In glass smelters, flue gas applications and in the brick and ceramics industries temperatures up to 1700 °C can occur. This requires special thermometers with ceramic thermowells and thermocouples made from special metals, such as platinum and rhodium. The ceramic thermowell external and sandwich coatings act as diffusion barriers. They serve as protection of the measurement point from mechanical and chemical damages in the process, e.g. from abrasive gases. The ceramic thermowell inner sheath is the ceramic capillary.

It has the purpose of feeding and insulating the thermo wires. A higher number of ceramic protection coatings increases the life time of the measurement point.

**Influences on the life time are:**
- Ceramic thermowell material and temperature limit values
- Temperature shocks in the process
- Gases and vapors
- Reducing and neutral atmospheres

The diameter of the thermo wires for thermometers in the TAF series must be defined for high temperatures. The higher the process temperature is, the larger the thermo wire diameter has to be chosen.

**Requirements at a glance**

- **Terminal head**
  - Form A terminal head
  - Form B terminal head

- **Process connection**
  - Gas tight compression fitting, adjustable flange or flat face flange according to DIN 43734

- **Process wetted parts/thermowell**
  - Ceramic thermowell – external and dividing coating as diffusion barrier,
  - Ceramic thermowell – internal coating as thermo wire feeder and insulation

- **Sensor/measurement insert**
  - Thermocouples type J, K or type B, S, R for application at high temperatures, with ceramic or mineral coating

High temperature measurement in cement production - with remote mounted head transmitter
Materials
Among a various number of industry standard materials, e.g. ceramics as C530, C610 and C799 or metals like AISI 316L, 310, 304, 446, Alloy 600, Alloy 601, Alloy 800HT or Alloy C276, Kanthal AF and Kanthal Super Endress+Hauser offers exclusive special materials for high temperature measurement.

For further information concerning special materials please contact your Endress+Hauser sales representative.

<table>
<thead>
<tr>
<th>Product overview high temperature thermometers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>Design</td>
</tr>
<tr>
<td>Special features</td>
</tr>
<tr>
<td></td>
</tr>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Max. immersion length/diameter (mm)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
| Benefits at a glance

These exclusive special materials increase the life span of the sensors. This leads to:
- Cost savings for maintenance of the measuring point
- Quality improvements of the products
- Increased plant safety

The thermometer lines TAF11 and TAF16 have a modular design. The measurement inserts and thermowells can be ordered as spare parts via a standard order structure. This saves costs,
- as only actually defective parts need to be exchanged
- due to optimized stock keeping
Temperature Engineered Solutions

Temperature Engineered Solutions comprise custom-designed equipment which is conceived for special applications. The solution (product+services) is engineered and executed special for individual customer requirements including services and accessories. The solution is defined by customer specifications (e.g. process data) and approved Endress+Hauser documentation, e.g. drawings, calculations, etc. Examples of TES products are Multipoints assemblies, SkinPoint and High temperature thermometers, together with the necessary accessories like brackets or thermowells.

The combination of process conditions which bring about high temperatures as well as high flow velocities in aggressive and corrosive media requires special design and engineering of custom-made thermowells and sensors. With these components temperature measurement can be handled in applications such as hydro desulfurization, hydro crackers, reactors, storage tanks, process containers and boilers with the required reliability and precision.

Temperature measurement in process reactors

**Engineering services** Endress+Hauser is a provider of technical solutions - therefore it is a matter of course that not only complete thermometers are provided but also the necessary engineering is implemented. “State-of-the-art” methods are used for engineering the solution e.g. the Finite Elements method, 3D-CAD models, etc.

Moreover, Endress+Hauser offers support in the internal reactor design e.g. the engineering of the support options within the reactor. When engineering these support structures it is important that no channeling occurs which would lead to deterioration in the reactor performance. The necessary engineering information is obtained through onsite customer visits where the best solution is developed in cooperation with the process engineers.

The Endress+Hauser specialists also offer on-site support during installation in order to manage teams and lead to a correct installation. This ensures that experts are available from the beginning of the project up to start-up.

**Diagnostic chamber concept**

The diagnostic chamber is a very important module of some TES products which allows to monitor continuously, through pressure and/or gas analysis, the complete product life cycle, having proactive maintenance strategies and safety monitoring.

- **Advantages at a glance**
  - Defective thermocouples can be replaced without switching off the process
  - The process can be contained in the case of any leakage (PED certified chamber)
Multipoint thermocouples

Multipoint assemblies are custom made products for several applications from low to high pressure process reactors. In these applications a temperature profile for control of the process in the reactor is measured and recorded. The challenge is to be less invasive as possible and to have an high number of temperature probes, enabling the shortest response time. Material selection, mechanical design, heat treatments and construction technics are the latest state-of-the-art in terms of product optimization, positioning Endress+Hauser as a global supplier continuously focused on reliable innovation.

SkinPoint thermocouples

Surface temperature measurement may be requested by industrial processes when hot surfaces of reactors or pipes have to be monitored and invasion into the pipe or reactor must be avoided.

Coil furnaces and reactors are the typical chemical and petrochemical plant equipment where SkinPoints are installed. Continuous temperature detection and heat exchange monitoring of the process medium flowing through pipe bundles, without affecting the stream’s steadiness, is fundamental to guarantee the whole process efficiency and to check for deposit rates within the pipes that affect the quality of the products. High temperatures, the existence of aggressive burning gases and differential expansions of the heat exchanger pipe bundles are very demanding conditions.

Approvals and certificates

High standards at the engineering, design stages and different tests during the production as well as final tests and controls counteract an early wear and tear failure of the equipment.
Test center

Extensive measurement and test equipment are available for safeguarding the quality and continuous optimization of the thermometer, thermowell and transmitters.

Here, for example, the quality of welding and soldered connections are visually tested with micro- and endoscope and by X-ray examination.

Using dye penetration tests, ultrasound test, helium leakage test, pressure endurance test, insulation and vibration checks as well as various, non-destructive material tests the quality of materials and processing is proven.

The response time of measurement insert with and without thermowell is measured and tested in a water velocity test installation according to VDI/VDE 3522 or IEC EN 60751.

Smallest details up to 1 μm in thermometers can be recognized with precise X-ray equipment without having to open it or to destroy it.
Calibration and approvals

With their know-how and excellent equipment (high stable temperature baths and furnaces, fixed point cells, precision thermometers) the accredited calibration laboratories realize calibration of thermometers to the lowest possible measurement uncertainty and traceable to national standards and the ITS90 international temperature scale:

- Fixed point calibration at the water triple point cell (0.01 °C) and the ice point (0.0 °C) with a measurement uncertainty of < 5 mK and at the nitrogen fixed point of -196 °C.
- Comparison calibration of resistance thermometers and thermocouples with precision thermometers from -80 to +400 °C in very homogenous and stable calibration baths (measurement uncertainty 20 to 100 mK) and up to 1500 °C in calibration furnaces with a measurement uncertainty of ≤ 500 mK.
- High precision resistance measurements (1 ppm accuracy) and thermo voltage measurements (sub-µV accuracy).
- Sensor-transmitter-matching for additional reduction of the thermometer measurement uncertainty.

Certificates issued:
- Detailed works or Accredia-/DAkkS calibration certificates with measurement results according to ISO 17025, calibrating uncertainties according to GUM or DIN V ENV 13005 and identification curve approximations like Callendar/Van Dusen coefficients.
- Testimonials in accordance with paragraph 3.1 EN 10204 regarding material compositions (if necessary with smelt composition), surface roughness and ferrite content.
Planning, commissioning and maintenance tools

Temperature measurement technology is the oldest measuring principle with an correspondingly long history. Over the years more than 50 important standards to be observed by process industries have established themselves worldwide. Through these standards the individual components of a temperature measurement point such as the measurement insert, thermowell, terminal head, transmitter etc. are easily defined. With modern software tools it is possible today to manage the complexity and easily design the suitable thermometer for the right application.

Applicator selection
During the planning of measurement points the course is set right at the beginning, in the basic engineering phase. An optimally designed thermometer has many advantages:

- Reliable and accurate measured values
- Low risk of later device failures
- Constant process quality

For the choice of the suitable thermometer the most important parameters such as medium, pressure and temperature are requested in the Applicator Selection. With these details the tool makes an initial suggestion which can then be filtered further. The suggested device type technical data can be compared in a table. The result is a thermometer type which, on the one hand, meets all requirements but, on the other hand, is also not technically over dimensioned.

The efficient choice of a suitable thermometer saves engineering time and cost.

Further information can be found under:
www.endress.com/applicator
Common Equipment Record
When ordering a thermometer the result of the engineering is submitted to Endress+Hauser in form of an order structure. The associated data is not lost but is saved electronically as a birth certificate at the production of the thermometer. This database is called the “Common Equipment Record” and in turn is available to the customer for the complete life cycle of the thermometer.

This function is part of the Web supported Asset Management (W@M) software from Endress+Hauser. The customer can load all data to the device from the Internet and therefore optimize his own asset management. This is becoming more and more important in the process industries because, by optimizing supplies, considerable cost savings can be made in the life cycle of a production plant.

Therefore, in addition to the order details, the thermometer serial number and, if required, a measurement point identifier (TAG), calibration details and test certificates can be placed into the “Common Equipment Record”. Since the customer can access all this data during operation:
- Access to information on the measurement point is easy.
- Spare parts are quickly found during the operation phase.
- Down time is minimized.

Fieldcare
For the operation and maintenance of field devices completely new prospects open up for the use of globally standardized “Field Device Technology” (FDT). With the assistance of “Device Type Managers” (DTM):
- all commonly used field devices,
- independent from manufacturer,
- can be set up using an operating software.

The software Fieldcare is used for these worldwide FDT/DTM standards and therefore simplifies the parameter setting of thermometers and other field devices.

Basis functions of Fieldcare are:
- Maintenance of the connection to the field devices (point to point or per fieldbus systems)
- Easily read display of all device parameters
- Configuration of measurement devices (online and offline)
- Documentation of configuration and measurement point data (also in PDF format)
- Archiving and storage of device data as files (up-/download)
- Device status display for fast fault diagnosis

Furthermore Fieldcare offers extended functions which support the asset management of the customer. There is an automatic interface to W@M and the birth certificate of the field device. All data from the engineering phase is therefore passed on electronically via “Common Equipment Record” up to the device commissioning. This not only saves time but also avoids faults caused by mix-up.
Further Information

- Calibration of Thermometers CP00004R
- Temperature Engineered Solutions CP00003R
- System Components and Data Managers - FA00016K/09
- Tailor-made field instrumentation, solutions and services FI00001Z

See as download under:
www.endress.com/download

Further documentation and order code for detailed information on thermometers, transmitters and thermowells see last lines of the tables inside.

www.addresses.endress.com