Temperature measurement

Thermometers and transmitters for the process industry

Endress+Hauser

People for Process Automation

Endress+Hauser – Your partner

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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 & Beverage, Oil & Gas, Water & Wastewater, Power & Energy, Life Science, Mining, Minerals and Metals, Renewable Energy, Pulp & Paper and Shipbuilding industries. Endress+Hauser helps customers to optimize their processes in terms of reliability, safety, economic efficiency and environmental impact.

To learn more about Endress+Hauser, visit:
www.endress.com

Information on the ISO certification:
Cybersecurity certification for Endress+Hauser

Temperature measurement by Endress+Hauser – Because we understand

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 the world's first self-calibrating thermometer iTHERM TrustSens and unique inserts such as the iTHERM QuickSens and iTHERM StrongSens, excellent temperature transmitters like the iTEMP TMT162 - with SIL 2 or SIL 3 and even multipoint 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.

Competence center for temperature measurement, Temperature Engineered Solutions and system products

Endress+Hauser Temperature+System Products is one of the leading producers of temperature measurement, Temperature Engineered Solutions and system products worldwide.

The company employs more than 700 associates worldwide. 400 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) and Aurangabad (India) guarantee customer proximity with products and services.

Oil & Gas

Fuel for thought

We reduce complexities to help you perform, comply and thrive in the Oil & Gas sector

Maximizing plant availability, safety and the efficiency of operations are the key challenges for today's Oil & Gas industry. Complexity increases in the face of volatile market forces, strict international regulations and your ever-tightening resources. Close, accurate monitoring of key process parameters is critical. Our broad, reliable portfolio of instrumentation, deep industry experience, and our services and solutions make Endress+Hauser the ideal partner for optimal plant performance.

Oil & Gas

Product highlights

iTHERM ProfileSens
- World's most robust insert for multipoint measurements
- Robust design for harsh process environments

More information: Page 20

iTHERM ModuLine
- Streamlined and innovative portfolio of modular thermometers
- With international approvals for hazardous areas, in compliance with international pressure regulations

More information: Page 30

TMT142B
- Smart 4 to 20 mA and HART 7 transmitter
- With Bluetooth and integrated overvoltage protection

More information: Page 24

iTHERM MultiSens
- Linear or flexible assemblies, with or without containment chamber
- Accurate temperature profiling, very low invasiveness, high density of measurement points

More information: Page 36

iTHERM ModuLine TM131
- RTD or TC insert, configurable for a wide range of applications
- Suitable for the most stringent safety requirements due to second process barrier

More information: Page 30

Temperature Engineered Solutions
- Fully customized surface thermometers
- High-precision multipoint thermometers

More information: Page 37

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 e.g. Dual Seal technology, iTHERM StrongSens sensor, iTHERM ProfileSens sensor

Chemicals

Competitive and safe

We help you boost your plant's safety and performance

Chemicals

Maximizing productivity and profitability whilst meeting toughening safety and sustainability standards is the greatest challenge facing the chemical industry today. Technological innovation brings opportunity, but reliability is vital. Plant modernization is expedient, yet project delivery complex. Our innovatory instrumentation with safety built-in, allied to expert safety and project consulting, enables Endress+Hauser to deliver solutions to safely and reliably attain peak plant performance.

Find a visual overview of the most relevant processes in the chemical industry and the suitable instruments in our portfolio brochure: SO01101

Product highlights

iTHERM ModuLine

- Suitable solutions from basic applications up to safety critical processes
- Including unique innovations like Dual Seal, iTHERM StrongSens and the 4-times faster thermowell

More information: Page 30

iTHERM TrustSens TM371 / TM372

- Intrinsically safe device with functions like self-calibration and self-diagnostics
- Perfect choice for white biotechnology processes

More information: Page 38

iTHERM MultiSens

- Pre-engineered, modular multipoint temperature assemblies
- E.g. for reactor and sitillation column measurement

More information: Page 36

iTHERM TMS21

- Right choice for chemical processes that require accurate temperature profiling
- Very low invasiveness, high density of measurement points and intrinsically safe versions

More information: Page 36

iTEMP TMT86

- Dual-channel Ethernet-APL head transmitter
- With FDI package for device integration, plug-on display support and integrated web server

More information: Page 40

iTEMP temperature transmitter

- Broad portfolio with head, field or DIN-rail and various field housing options.
- Explosion protection, SIL, 1 or 2-channel, HART 7, PROFIBUS PA, PROFINET, FOUNDATION Fieldbus, Ethernet-APL & Bluetooth

More information: Page 24

Advantages at a glance

- Meeting internationally recognized standards/recommendations: NAMUR, ASME, NACE, IEC 17025, MID, OIML
- Internationally accepted hazardous area approvals: ATEX, IECEx, FM/CSA, NEPSI, TIIS, INMETRO, KOSHA, EAC etc.
- 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
- Time savings for downtimes due to advanced diagnostic functions

Mining, Minerals & Metals

Extracting more from less

In a world of lower ore grades, skill gaps and excavation challenges we can help you hit your target

Never more so than today has the Mining, Minerals & Metals industry had to manage such tension between soaring demand, increased scarcity, lower ore grades, fluctuating prices, and toughening safety and sustainability criteria. Combining our innovative product portfolio with our deep application and industry knowledge enables Endress+Hauser customers to optimize processes, boost productivity, and ensure safety and environmental compliance.

Mining, Minerals & Metals

Product highlights

TAF11 / TAF12S/D/T / TAF16

- Modular high-temperature thermometers made from exclusive materials
- Applicable for ceramic baking ovens, brickworks, steel treatment, cement production etc.

More information: Page 34

TST310 / TSC310

- Cost efficient temperature cable probe for direct installation
- Designed for use in many process and laboratory applications

More information: Page 28

iTHERM ModuLine

- Suitable solutions from basic applications up to safety critical processes
- Including unique innovations like Dual Seal, iTHERM StrongSens and the 4 times faster thermowell

More information: Page 30

iTHERM ModuLine TM131

- Intrinsically safe temperature sensor (RTD or TC)
- Configurable for a wide range of applications

More information: Page 30

iTEMP TMT86

- Dual-channel Ethernet-APL head transmitter
- With FDI package for device integration, plug-on display support and integrated web server

More information: Page 40

iTEMP temperature transmitter

- Broad portfolio with head, field or DIN-rail and various field housing options.
- Explosion protection, SIL, 1 or 2-channel, HART 7, PROFIBUS PA, PROFINET, FOUNDATION Fieldbus, Ethernet-APL & Bluetooth

More information: Page 24

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
- High-temperature sensors with extended lifetime can help reduce costs significantly
- Vibration resistant, fast response time sensors and special materials result in increased process efficiency and product quality

Food & Beverages

Trust in quality

We help you to improve quality while reducing operational costs

Constant demand for consistency in product quality and taste makes Food & Beverage a demanding industry. Complexity increases as ever more stringent hygiene regulations for food safety add cost pressures. Endress+Hauser's industry leading portfolio of reliable instrumentation, expert global consulting and accredited calibration services all combine to enable greater plant availability, resource conservation and high repeatability in processing with traceable compliance.

Food & Beverages

Find a visual overview of the most relevant processes in Food & Beverage production and the suitable instruments in our portfolio brochure: SO01090

Product highlights

iTHERM TrustSens TM371 / TM372

- World's first self-calibrating thermometer
- Optimized elbow thermowells for clean operations

More information: Page 38

iTHERM ModuLine

- Suitable solutions from basic applications up to safety critical processes
- Including unique innovations like Dual Seal, iTHERM StrongSens and the 4-times faster thermowell

More information: Page 30

iTHERM TM401 / TM402

- Sanitary digital, modular thermometer with basic technology
- Developed specifically for use in hygienic / aseptic applications

More information: Page 32

iTEMP TMT31

- 4 to 20 mA basic head transmitter with RTD input and 4 to 20 mA output signal
- Easy to configure and quick to install thanks to push-in terminals

More information: Page 24

iTHERM CompactLine TM311 / TMR35

- Hygienic compact, fast and precise thermometers
- Ideal for short immersion depths in areas with small nominal pipe diameters

More information: Page 32

iTEMP TMT71 / TMT72

- 4 to 20 mA and HART temperature transmitters
- World's first Bluetooth transmitters for operation in Ex environment

More information: Page 24

Advantages at a glance

- The world's first self-calibrating thermometer reduces process risks and costs
- Best-in-class hygienic design
- Innovative thermowells with optimum hygienic properties

Life Sciences

The pulse of Life Sciences

Trust a reliable partner who helps you achieve operational excellence

Life Sciences

Today's thriving biopharmaceutical industry demands high productivity and efficiency balanced with meticulous alignment to GMP standards. From our innovatory ASME BPE compliant product portfolio enabling standardized production automation, reliable monitoring and predictive maintenance, to our expert consulting in process scale-up and operations optimization, Endress+Hauser offers the full solution. We speed time to market, sustain operational excellence, enhance productivity, and reduce risk.

Find a visual overview of the most relevant processes in Life Sciences and the suitable instruments in our portfolio brochure: SO01099

Product highlights

iTHERM TrustSens TM371 /TM372

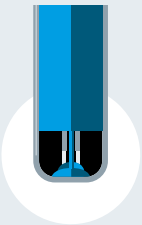
- World's first self-calibrating thermometer
- Optimized elbow thermowells for clean operations

More information: Page 38

iTHERM TM401 / TM402

- Hygienic, modular thermometer with basic technology
- Developed specifically for use in hygienic / aseptic applications

More information: Page 32



iTHERM QuickSens

- RTD insert with shortest response times worldwide
- High-precision, fast response times even in combination with thermowells

More information: Page 20

iTEMP TMT86

- Dual-channel Ethernet-APL head transmitter
- With FDI package for device integration, plug-on display support and integrated web server

More information: Page 40

iTHERM CompactLine TM311 / TMR35

- Hygienic compact, fast and precise thermometers
- Ideal for short immersion depths in areas with small nominal pipe diameters

More information: Page 32

iTEMP TMT31

- 4 to 20 mA basic head transmitter with RTD input and 4 to 20 mA output signal
- Easy to configure and and quick to install thanks to push-in terminal

More information: Page 24

Advantages at a glance

- The world's first self-calibrating thermometer reduces process risks and costs
- Other modular, accurate, safe and reliable hygienic thermometers which enable quick and easy recalibration thanks to iTHERM QuickNeck technology
- Best-in-class hygienic design
- Innovative thermowells with optimum hygienic properties

Water & Wastewater

Water is our life

Increase your efficiency and ensure compliance with an experienced and trusted partner

Today more than ever the Water & Wastewater industry must balance the opposing pressures of improving water safety and shrinking budgets. Whether treating for consumption or discharge, process complexity is rising. Endress+Hauser combines a wide portfolio of smart measuring instruments with industry-experienced consulting and expert services to flexibly and efficiently ensure water safety with verifiable regulatory compliance.

Water & Wastewater

Find a visual overview of the most relevant processes in the water / wastewater industry and the suitable instruments in our portfolio brochure: SO01094

Product highlights

iTHERM CompactLine TMR31
- Small design made entirely of stainless steel
- Extremely short response times and highly accurate

More information: Page 28

iTEMP TMT31
- 4 to 20 mA basic head transmitter with RTD input and 4 to 20 mA output signal
- Easy to configure and and quick to install thanks to push-in terminal

More information: Page 24

iTHERM CompactLine TM311
- Compact, accurate and fast RTD sensor
- With 4 to 20 mA, IO-Link (auto-detect) or switch output

More information: Page 28

iTEMP TMT72
- 4 to 20 mA and HART temperature transmitter
- World's first Bluetooth transmitter for operation in Ex environment

More information: Page 24

iTHERM ModuLine
- Streamlined and innovative portfolio of modular thermometers
- With international approvals for hazardous areas, in compliance with international pressure regulations

More information: Page 30

iTEMP TMT71
- 4 to 20 mA temperature transmitter
- World's first Bluetooth transmitter for operation in Ex environment

More information: Page 24

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/ recomendations for drinking water applications
- Highest efficiency by easy commissioning, operation and maintenance of instruments
- Worldwide accepted Ex approvals and SIL certified transmitters and assemblies
- Unique technologies like Dual Seal and iTHERM StrongSens

Power & Energy

Power up your plant

Power plants play a vital role, we help maximize uptime while delivering safety and productivity

Power & Energy

Today's Power & Energy industry must strike a complex balance: meeting spiraling demand for affordable and reliable energy while increasing cleaner and renewable sources in the energy mix. As cost and regulatory pressures grow, modernization is essential for efficient, safe resource use. As renewables advance, so does the need for energy storage. With best-fit instrumentation, deep power application expertise, services and solutions, Endress+Hauser brings efficient, reliable productivity.

Product highlights

TAF11 / TAF12S/D/T / TAF16

- Modular high-temperature thermometers in robust design
- Selection of durable thermowell materials

More information: Page 34

iTEMP TMT71 / TMT72

- 4 to 20 mA and HART temperature transmitters
- World's first Bluetooth transmitters for operation in Ex environment

More information: Page 24

iTHERM ModuLine

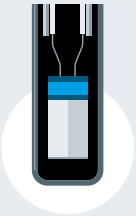
- Assorted thermometers with RTD or TC insert
- Flexible configuration for e.g. straightforward monitoring tasks or complex, safety-related measuring points

More information: Page 30

iTEMP TMT82

- Dual channel, SIL compliant, incl. HART 7
- Field mount housing with separate terminal compartment for comfortable wiring

More information: Page 24



iTHERM StrongSens

- Highly robust and vibration-resistant RTD insert
- Also suitable for applications in hazardous areas

More information: Page 20

iTEMP TMT142B

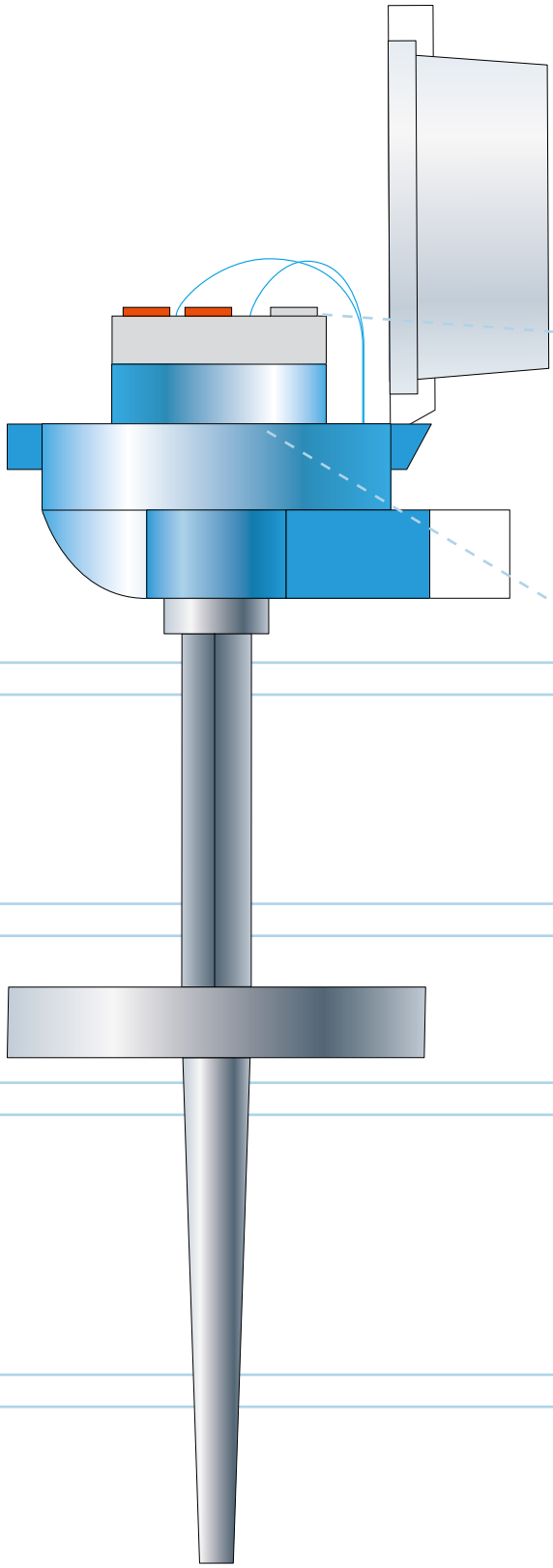
- Smart 4 to 20 mA and HART 7 transmitter
- With Bluetooth and integrated overvoltage protection

More information: Page 24

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

Thermometer design



Terminal head

... is fitted to the thermowell or the neck of the thermometer.

Head transmitter

... transfers the sensor signal into a stable and standardized output signal.

Extension neck

... is the connection between terminal head and process connection/thermowell.

Process connection

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

Thermowell

... is the process wetted component of the thermometer.

Insert

... is located in the thermowell. The tip of the measurement insert contains the **temperature sensor** element itself.

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

Benefits:
- Enhanced accuracy and stability
- Reduced wiring costs
- Lower maintenance time and expense
- Advanced diagnostics

Learn more on pages 22-25.

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

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
- Ensures long-term stable temperature measurements

Benefits:
Enables electrical connection of the sensor element to the terminal block / transmitter

Learn more on pages 20-21.

Visit our Youtube playlist on temperature know-how series to learn more about:

- Measurement inserts (RTD Resistance sensors / TC Thermocouples)
- Golden rules of temperature measurements
- Technical insights on thermometers

Link to YouTube Playlist

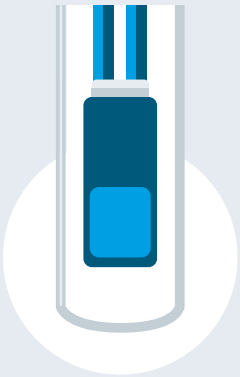
Endress+Hauser offers a complete assortment of thermometers and their components such as thermowells, terminal heads, temperature transmitters, process connections, neck / lagging, measurement inserts and further accessories for all types of process industries.

Using the configurator on **endress.com** helps you create a thermometer suitable for your process, deciding on the version of every single component. Of course it is possible to order these different components separately, e.g. as spare parts.

Find all products on the endress.com:
Products for temperature measurement

Sensor technology

Exclusive

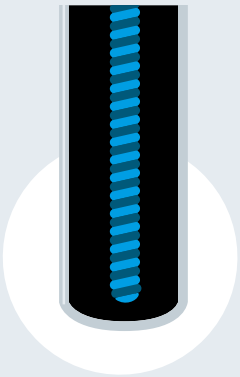


Basic thinfilm
Pt100 (RTD)

- Thinfilm sensor consisting of ceramic substrate with vapor-deposited platinum
- Sensing element and wiring in stainless steel sheath

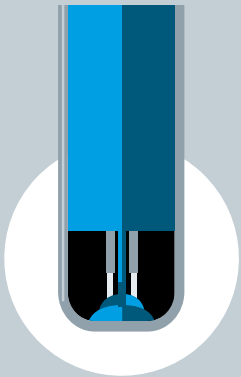
Standard thinfilm
Pt100 (RTD)

- Small sensor consisting of ceramic substrate with vapor-deposited platinum
- Embedded in mineral isolated stainless steel sheath



Wirewound
Pt100 (RTD)

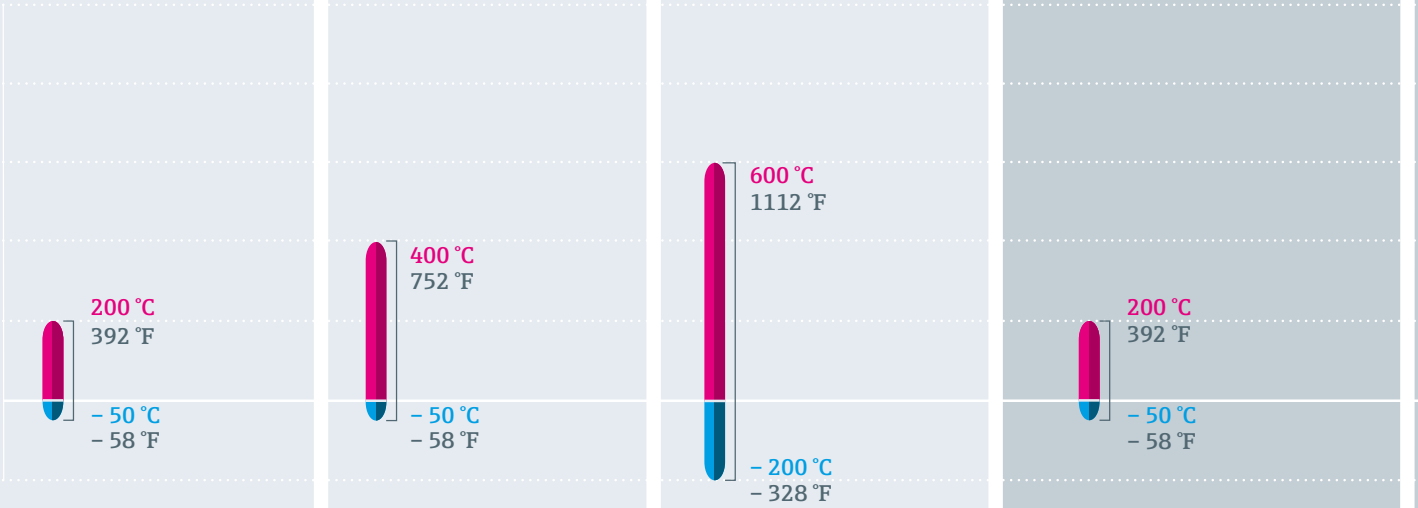
- Ultrapure platinum wire wound around a ceramic core
- Embedded in mineral isolated stainless steel sheath



iTHERM QuickSens
Pt100 (RTD)

- Pt100 thinfilm sensor with the world's fastest response time
- Sensor-on-tip technology for short immersion length
- Better process control and product quality, optimized efficiency
- Highest accuracy

Measurement range



Properties

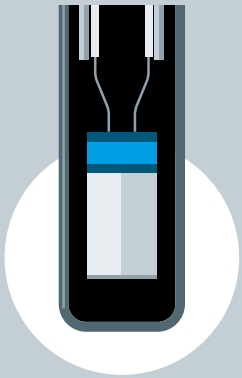
- \+ Measurement performance sufficient for most support processes
- – Limited measurement range

- \+ Long-term stability
- \+ Vibration resistance
- – Limited measurement range

- \+ Long-term stability
- \+ High measurement repeatability
- – Relative cost
- – Susceptible to mechanical stress

- \+ World's fastest response time
- \+ Maximum process safety
- – Limited measurement range

Endress+Hauser technology



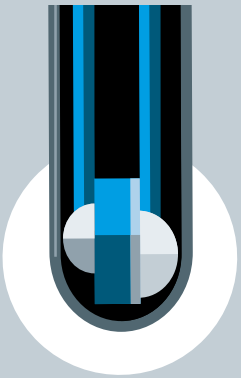
iTHERM StrongSens
Pt100 (RTD)

- Ceramic-encapsulated Pt100 thinfilm RTD with unmatched robustness
- Vibration resistance up to 60g (2,116 oz) for lower life cycle cost
- High long-term stability, high plant availability

500 °C
932 °F

– 50 °C
– 58 °F

- \+ World's highest vibration resistance
- \+ Robust
- \+ Long lifetime and plant availability
- – Limited measurement range



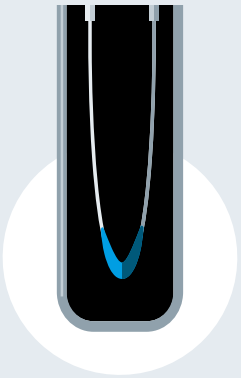
iTHERM TrustSens
Pt100 (RTD)

- Self-calibrating sensor unit
- Pt100 sensor and integrated fixed point reference
- Higher product quality and safety
- Lower risk, cost and effort

190 °C
374 °F

– 40 °C
– 40 °F

- \+ Self-calibrating
- \+ High accuracy
- \+ Reliability
- \+ High degree of automation
- \+ Risk reduction
- – Limited measurement range



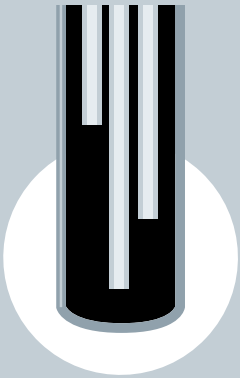
Thermocouple (TC)

- Two dissimilar metals spot welded (hot junction)
- Ideal for high temperatures

up to 1800 °C
3272 °F

– 270 °C
– 454 °F

- \+ Measurement range
- \+ Ideal for high temperatures
- – Long-term stability
- – Limited accuracy



iTHERM ProfileSens
Thermocouple (TC)

- Minimally invasive multipoint cable sensor profiling system
- Up to six individual thermocouple sensors per probe
- MI cable mineral insulated (MgO powder)
- Robust design with double metal sheathing technology

1100 °C
2012 °F

– 40 °C
– 40 °F

- \+ Robust and reliable
- \+ For high temperatures, pressure, agressive media
- \+ Increased plant safety
- – Limited accuracy (compared to RTD)

Transmitters

The task of a temperature transmitter is the transformation of the sensor signal into a stable and standardized signal. To interpret this signal correctly, an exact configuration with respect to sensor and process conditions is required. Different technologies can be used to adapt this configuration and display the process value and further information.

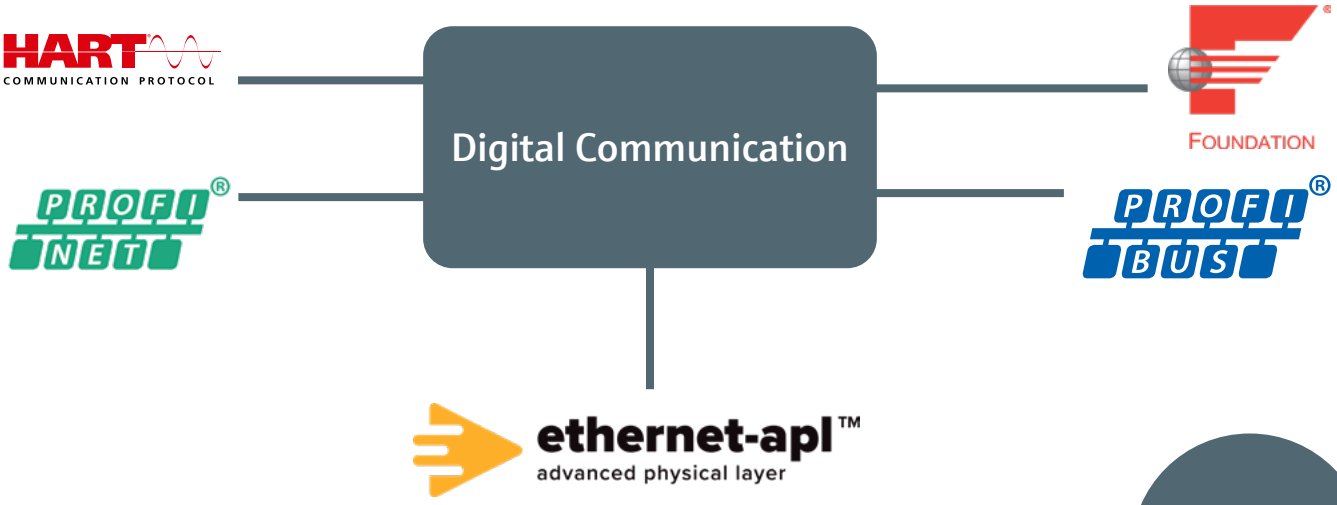
Transmitter type	Display	Configuration
DIN rail Panel installation 	-	**Bluetooth** Mobile device with SmartBlue App 
Head transmitter Installation in thermometer terminal heads 	TID10 - plug on display 	FieldXpert SMT70 / SMT77 
Field transmitter Direct connection in the process area 	Integrated backlit display 	FieldCare SFE500 Software 
		PLS / PLC 

Learn more in our Youtube videos:

- Push-in vs. screw terminals — tool-free transmitter commissioning
- Remote parametrization of temperature transmitter with the SmartBlue App

Communication standards

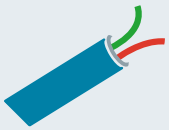
In the past, transmitters mainly using analog technology were built. In the meantime, digital technology has gained more and more acceptance, because it offers better measurement accuracy at simultaneously higher flexibility.



NEW

Ethernet-APL
Smart, fast, digital

The 2-wire data highway for endless possibilities
Ethernet-APL combines the benefits of simple and robust 2-wire technology with the benefits of Ethernet, enabling top-performance and seamless data access in the field of process plants.



2-wire cable with 10 Mbit/s full duplex communication

Explosion protection for all zones and divisions

Power supply via APL switches

Advantages
- Ethernet technology in combination with well-established Industrial Ethernet Protocols like PROFINET
- High-speed communication and remote access to the field shorten commissioning time
- Seamless access to the data and algorithms of smart instruments (e.g. Heartbeat Technology) exploits the full potential of instrumentation

Benefits
- High plant availability and increased production output with less plant shutdowns
- Increased efficiency in maintenance
- Plant downtimes can be minimized

iTEMP temperature transmitters

Communication standard	**4 to 20 mA**				
Field housings	-				
	-				TMT71 
Top hat / DIN rail	TMT127 	TMT128 	-		TMT71 
Head mount	TMT31 	TMT188 	TMT80 	TMT31 	TMT71 
Sensor input(s)	RTD	thermocouple	1-ch universal	RTD	1-ch universal
Approvals	Ex Zone 2	Ex	-	Ex Zone 2	Ex
Additional information	fixed configuration		-		Bluetooth
	-				plug-in display unit (TID10) available for head transmitters

HART		Foundation Fieldbus	ProfiBus	ProfiNet
TMT142B 	TMT162 	TMT162 	TMT162 	-
TMT72 	TMT82 	TMT85 	TMT84 	TMT86 
TMT72 	TMT82 	-	-	-
TMT72 	TMT82 	TMT85 	TMT84 	TMT86 
1-ch universal	2-ch universal	2-ch universal	2-ch universal	2-ch universal
Ex		Ex	Ex	Ex
Bluetooth	SIL 2 SC 3	-	-	Ethernet-APL
plug-in display unit (TID10) available for head transmitters				

Overview thermometers

Product group	**Compact thermometers**	**iTHERM ModuLine**
Design (examples)		
Description	With integrated electronics	Modular design for a wide range of industrial applications
Process connections	Hygienic process connections, weld-in connections	For insertion, compression fittings, thread, flanges, weld-in connections
Industry	Food & Beverages Life Sciences	Chemicals Oil & Gas Power & Energy
Approvals / certificates	EHEDG, 3-A, FDA, ASME BPE	Ex
Temperature range	**RTD:** -50 to +200 °C (-58 to +392 °F)	**RTD:** -200 to +600 °C (-328 to +1112 °F) **TC:** -40 to +1100 °C (-40 to +2012 °F)
Detailed information	Page 28 to 29	Page 30 to 31

Modular, hygienic thermometers	High temperature thermometers	Temperature Engineered Solutions
		
Sanitary thermometers for sterile process applications	With metallic /ceramic thermowell and thermocouples	Multipoint thermometers
Partically all common hygienic process connections and weld-in connections	Flanges, gas thight threaded couplings	Application specific solutions
Food & Beverages Life Sciences	Mining, Minerals & Metals Oil & Gas Power & Energy	Oil & Gas Chemicals
Ex, FM, EHEDG, 3-A, FDA, ASME BPE	-	Ex, FM, CSA
RTD: -200 to +600 °C (-328 to +1112 °F)	**TC:** 0 to +1800 °C (+32 to +3272 °F)	**RTD:** -200 to +600 °C (-328 to + 1112 °F) **TC:** -200 to +1700 °C (-328 to +3092 °F)
Page 32 to 33	Page 34 to 35	Page 36 to 37

Compact thermometers

Type	**Cable sensor, metric and imperial**					**Compact thermometer, metric and imperial**		
Model	TST310	TSC310	TH12	TH52	TH56	TTR31/ TTR35	TMR31/ TM311/ TMR35	TM371/ TM372
Design								
Description	With permanently affixed plug-in or screw-in cable			With permanently affixed plug-in or screw-in cable (TH52) or connector (TH56)		Temperature switch with 1/2 PNP switch outputs	With integrated transmitter, short insertion length, extremely fast response times	For hygienic and aseptic applications, exceptional sensor technology with self-calibration function
Communication standards	-					4 to 20 mA	IO-Link	HART
Approvals / certificates	Ex		-			UL, CSA	UL	EHEDG, ASME, FDA, 3-A, CSA, Ex
Temperature range	**RTD:** -50 to +400 °C (-58 to +752 °F)	**TC:** -40 to +1100 °C (-40 to +2012 °F)	**RTD:** -50 to +200 °C (-58 to +392 °F)	**TC:** -270 to +1150 °C (-454 to +2100 °F)		**RTD:** -50 to +150 °C (-58 to + 302 °F)	**RTD:** -50 to +200 °C (-58 to +392 °F)	**RTD:** -40 to +160 °C (-40 to +320 °F)

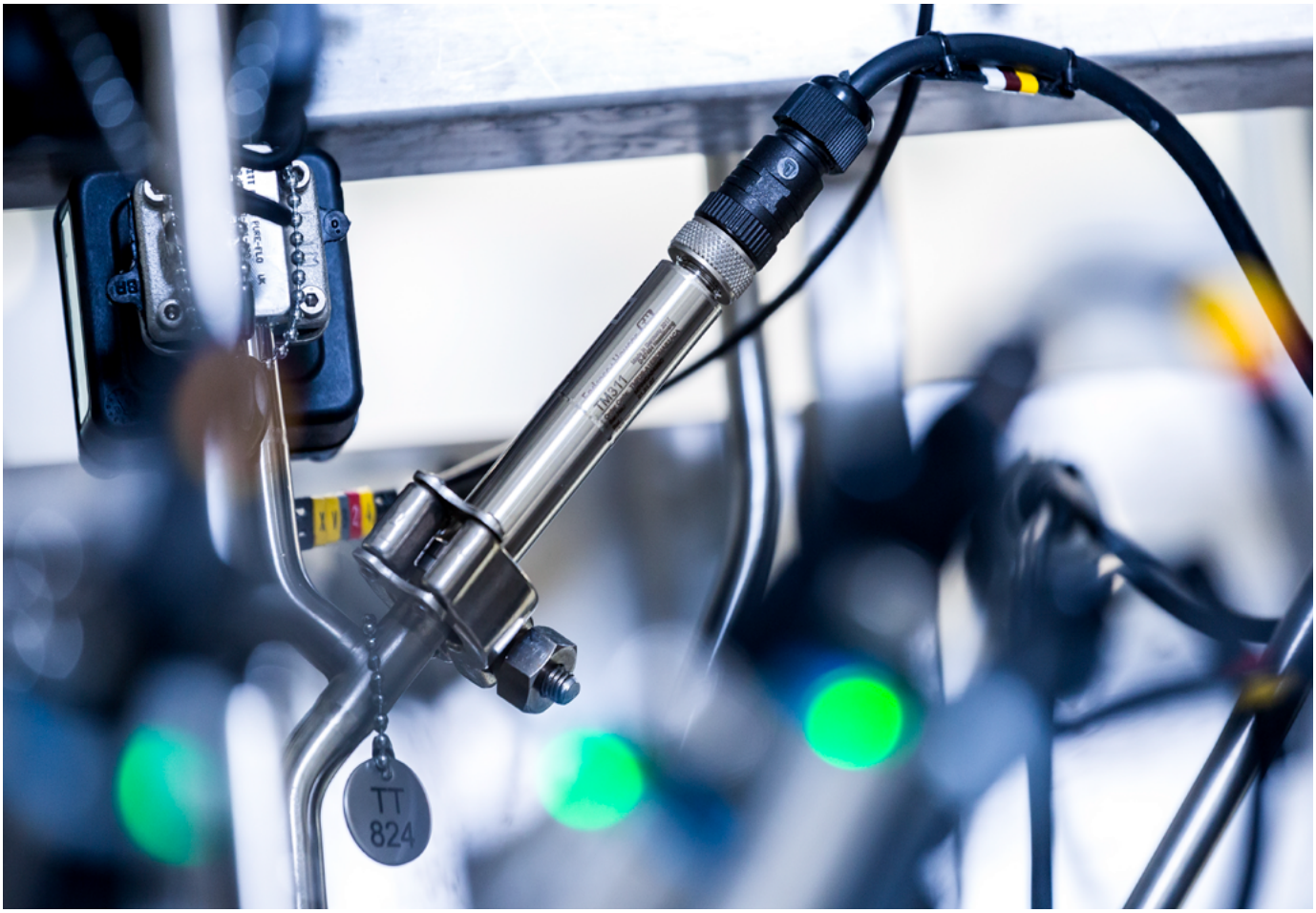
Simple, fast and economical!

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 thermometers are easily commissioned, measure reliably, and when required convert into standard signals and alert at alarm limit violation.

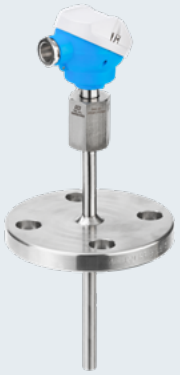
Benefits at a glance

- Small, robust design made entirely of stainless steel
- Extremely short response times
- Vibration-resistant, thin-film Pt100 sensors
- Highly accurate even with short insertion lengths
- Simplest assembly as well as on-site and PC parameter set-up
- Long-term stable electronics
- Versatile process adapters, flexible sensor lengths
- Compression fittings, imperial and metric threads guarantee compatibility worldwide
- Hygienic process adapters and thermowells satisfy EHEDG, 3-A, FDA, ASME BPE requirements



iTHERM ModuLine

Thermowell	**Direct contact - without thermowell**		
Design	Metric		Imperial
Model	TM101	TM111	TM112
Design			
Communication standards	4 to 20 mA, HART	4 to 20 mA, HART, ProfiNet, Foundation FieldBus	
Segment	F L E X	F L E X	
Features	Excellent price performance	iTHERM StrongSens iTHERM QuickSens	
Approvals / certificates	-	Ex	
Temperature range	**TC:** -270 to 650 °C (-454 to 1202 °F) **RTD:** -50 to 200 °C (-58 to 392 °F)	**TC:** -270 to 1100 °C (-454 to 2012 °F) **RTD:** -200 to 600 °C (-328 to 1112 °F)	

Welded thermowell		**Barstock thermowell**	
Metric		Metric	Imperial
TM121	TM131	TM151	TM152
			
4 to 20 mA, HART	4 to 20 mA, HART, ProfiNet, Foundation FieldBus		
F L E X	F L E X		
Excellent price performance with thermowell	iTHERM StrongSens iTHERM QuickSens iTHERM QuickNeck - Fast responding - Dual Seal technology - Dual compartment housing	iTHERM StrongSens iTHERM QuickSens iTHERM QuickNeck iTHERM TwistWell - Fast responding - Dual Seal technology - Dual compartment housing	
-	Ex		
TC: -270 to 650 °C (-454 to 1202 °F) **RTD:** -50 to 200 °C (-58 to 392 °F)	**TC:** -270 to 1100 °C (-454 to 2012 °F) **RTD:** -200 to 600 °C (-328 to 1112 °F)		

Modular, hygienic thermometers

Type	Modular thermometers metric design		Modular thermometers imperial design
Model	TM401	TM411	TM402
Design			
Segment	F L E X	F L E X	F L E X
Communication standard	4 to 20 mA, HART	4 to 20 mA, HART Foundation Fieldbus, ProfiBus	4 to 20 mA, HART
Highlights	-	iTHERM - QuickNeck - QuickSens - StrongSens	-
Approvals / certificates	EHEDG, ASME, 3-A, FDA		
Temperature range	**RTD:** -50 to +200 °C (-58 to +392 °F)	**RTD:** -200 to +600 °C (-328 to +1112 °F)	**RTD:** -50 to +200 °C (-58 to +392 °F)

Modular thermometers imperial design	Compact thermometers		
TM412	TM371/TM372	TMR35	TM311
			
F L **E** X	F L E **X**	**F** L E X	
4 to 20 mA, HART, Foundation Fieldbus, ProfiBus	4 to 20 mA, HART	4 to 20 mA	4 to 20 mA, HART, IO-Link
-	Self-calibration, Heartbeat Technology	-	
	EHEDG, ASME, 3-A, FDA, Ex, CSA	EHEDG, ASME, 3-A, FDA	
RTD: -200 to +600 °C (-328 to +1112 °F)	**RTD:** –40 to +190 °C (–40 to +374 °F)	**RTD:** -50 to +200 °C (-58 to +392 °F)	

High-temperature thermometers

Model	TAF11	TAF12S	TAF12D	TAF12T	TAF16
Design					
Max. immersion length	1700 mm	1500 mm			2200 mm
Material thermowell	Ceramic C610, sinterized silicon carbide (SiC), special silicon nitride ceramic (SiN)	Ceramic C610, C799		Ceramic C530, C610, C799	AISI: 316L, 310, 304, 446, Alloy 600, Alloy 601; Alloy 800HT, Alloy C276, Kanthal AF and Kanthal Super, special nickel/ cobalt alloy (NiCo), special silicon nitride ceramic (SiN)
Material intermediate sheath	-			Ceramic C610, C799	-
Material intermediate sheath	Ceramic C610	-	Ceramic C610, C799		
Temperature range	**TC:** -270 to +1820 °C (-454 to + 3308 °F)	**TC:** -50 to +1820 °C (-58 to + 3308 °F)			**TC:** -270 to +1768 °C (-454 to + 3214,4 °F)

Benefits at a glance

- Exclusive materials increase the life span of the sensors
- Cost savings for maintenance of the measuring point
- Quality improvements of the products
- Increased plant safety
- Long term stable measurement due to sensor protection with non-porous materials
- Optimized life cycle costs by means of replaceable spare parts

Exclusive materials

In glass smelters, flue gas applications and in the brick and ceramics industries temperatures up to 1700 °C (3092 °F) can occur. That's why among a various number of industry standard materials, we offer special materials with increased wear and chemical resistance for high temperature measurement, such as platinum and rhodium. For further information please contact your Endress+Hauser sales representative.

Unique construction

The external and sandwich coatings of the ceramic thermowell 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 inner sheath of the ceramic thermowell is the ceramic capillary. It has the purpose of feeding and insulating the thermo wires. A higher number of ceramic protection coatings increases the lifetime of the measurement point.

Modular design

For the thermometer lines TAF11 and TAF16 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 and due to optimized stock keeping.

iTHERM MultiSens

Pre-engineered, modular multipoint temperature assemblies

Model	**Flex TMS01**		**Flex TMS02**		**Linear TMS11**	**Linear TMS12**	**Slim TMS21**		**Bundle TMS31**
Design									
Type	direct contact	individual thermo-wells	direct contact	individual thermo-wells	multiple, primary thermowell		annealed tube	annealed tube with flexible part	stainless steel flexible rope
Response time	▪▪▪▪▪	▪▪▪▫▫	▪▪▪▪▪	▪▪▪▫▫	▪▪▫▫▫		▪▪▪▪▫	▪▪▪▪▫	▪▪▪▪▪
Layout / bendability	▪▪▪▪▪	▪▪▪▪▫	▪▪▪▪▪	▪▪▪▪▫	-		▪▪▪▫▫	▪▪▪▪▫	▪▪▪▫▫
Diagnostic capabilities	-		Advanced		Basic	Advanced	-		
Individually replaceable sensors	✔	✔	✔	✔	✔	✔	-		
Max. number of points	48 (linear or 3D) 80 (Profile-Sens)	48 (linear or 3D)	52 (linear or 3D) 80 (Profile-Sens)	48 (linear or 3D)	16 (linear)	12 (linear)	59 (linear)		20 (linear)
Max. pressure in bar (psi)	100 (1,450)		200 (2,900)		240 (3,481)		90 (1,305)		100 (1,450)

Benefits at a glance

- Measurement and recording of a temperature profile for control of the process in the reactor
- Shortest response time enabled by high number of temperature probes
- Easily configurable and globally available
- Coverage of all key applications in the Oil & Gas, Chemical, Petrochemical industries
- Defective thermocouples can be replaced during shutdown
- Increased safety thanks to a diagnostic chamber able to contain the process in the event of leakages through the primary seals (PED certified chamber)

Temperature Engineered Solutions - TES

Endress+Hauser bundles vast industry knowledge and application know-how from worldwide, complex projects to deliver innovative and fully customized Temperature Engineered Solutions.

Customized engineered temperature solutions – excellence in instrumentation, services and project support

Our solutions including tests, accessories and service – are planned and executed specifically with the aim of satisfying challenging customer requirements. Engineering and production expert design, selected materials and highest production standards guarantee instrument longetivity in all types of process media, pressure and temperature ranges.

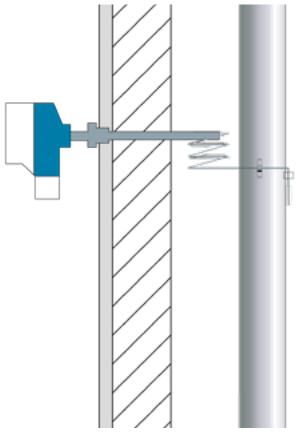
Expertise from project start to finish

- Active support during turn-around planning
- Design studies
- Installation and supervision
- Field tests, complete in-house validation test packages
- Immediate on-site or remote service and consultation
- Maintenance, training
- Comprehensive documentation package

Customized SkinPoint thermometers – for surface temperature measurement

Benefits at a glance

- Continuous temperature detection and heat exchange monitoring
- No affection of the stream's steadiness or invasion into the pipe
- Engineered for maximum reliability – wide range of high-grade materials
- Compensation for thermal distortion with optimized expansion coils
- Quick & easy commissioning
- Compatibility with existing process connections



To configure and order a customized multipoint thermometer, surface thermometer or other Temperature Engineered Solutions and for further information please contact your Endress+Hauser sales representative.

Highlight: iTHERM TrustSens TM371/TM372

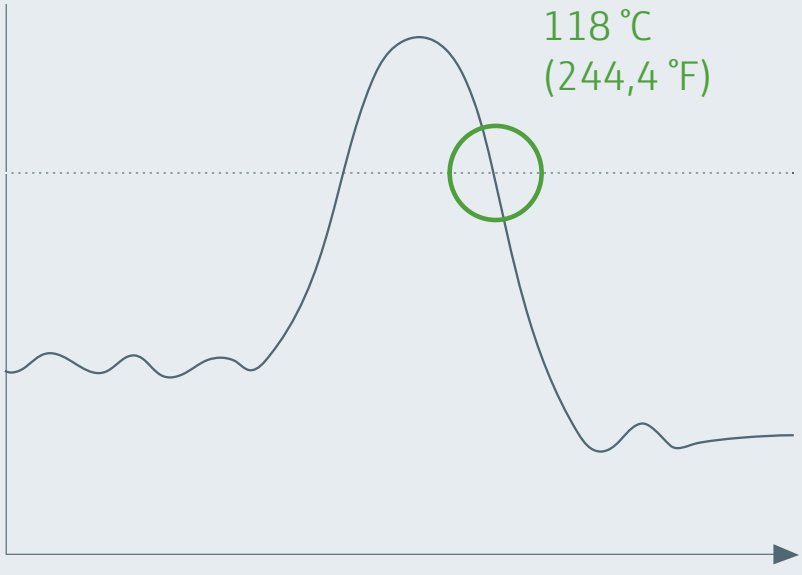
Self-calibrating RTD temperature sensor

Industry 4.0 ready: Unlock your full asset potential

Netilion cloud-based IIoT ecosystem
for secure decentralized process & asset monitoring around the clock

Legally compliant documentation & reporting, including audit- and inspection-proof calibration certificates

Fully automated self-calibration at 118 °C (244,4 °F) e.g. for SIP, UHT, ...



HERMES AWARD 2018 · FDA · Ex · IP69K · Heartbeat Technology · HART COMMUNICATION PROTOCOL

Designed for hygienic applications

4 to 20 mA and HART (multi-variable)

Transmitter & diagnostic electronics

Safety built-in:
- memory for 350 calibration events
- automated 4 to 20 mA loop check
- self-diagnostics

Extension neck

Process connection

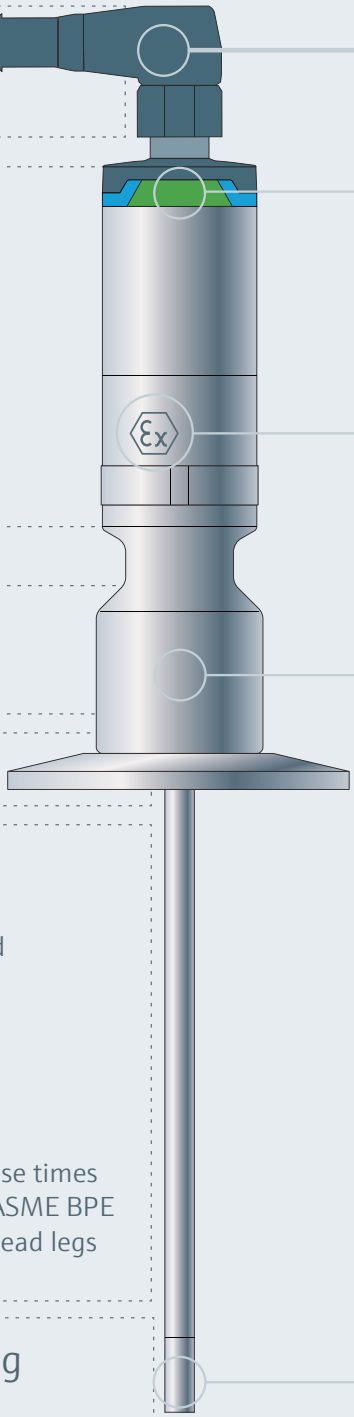
Thermowell

- 6 mm / 9 mm / 12.7 mm as standard

- Straight or reduced tip for fast response times
- Special hygienic thermowells acc. to ASME BPE with elbow shape, without welds or dead legs

World's only self-calibrating thermometer

-40 to 190 °C (-40 to 374 °F)

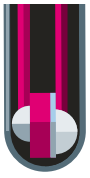


Bluetooth® WirelessHART
optional, requires FieldPort SWA50 adapter

LED 'state of health'

Explosion proof

iTHERM QuickNeck



Pt100 (RTD)
Fix-point reference

Highlight: iTEMP TMT86

Reliable, intelligent and future proof temperature head transmitter

Function & features

NEW

ethernet-apl™ advanced physical layer

The first temperature transmitter with Ethernet-APL in the market

2-wire Ethernet for use in hazardous areas

High measurement accuracy up to 0.1 K and long-term stability

Sensor-transmitter matching using Calendar van Dusen linearization for critical measurement points

Categorized and uniform diagnostic information according to NAMUR

Benefits

Digital communication down to the field level, even in explosion hazardous areas

- Ethernet-APL with PROFINET
- Simple Ex planning and validation by 2-WISE (2-wire Intrinsically Safe Ethernet)

Long-term stability, accurate and precise temperature measurements

- Long-term stability of the electronics
- Highly accurate sensor input

Robust technology which ensures high availability of the process plant

- Condensed status according to NE107
- PROFINET PA Profile 4
- Advanced diagnostic functions like corrosion monitoring

Save time and effort on commissioning, configuration and maintenance

- Easy access to the device in the network - Web server
- Local device interface for fast maintenance access – CDI interface
- Easy and state-of-the-art device integration – FDI package

Form B head transmitter

Push-in terminals

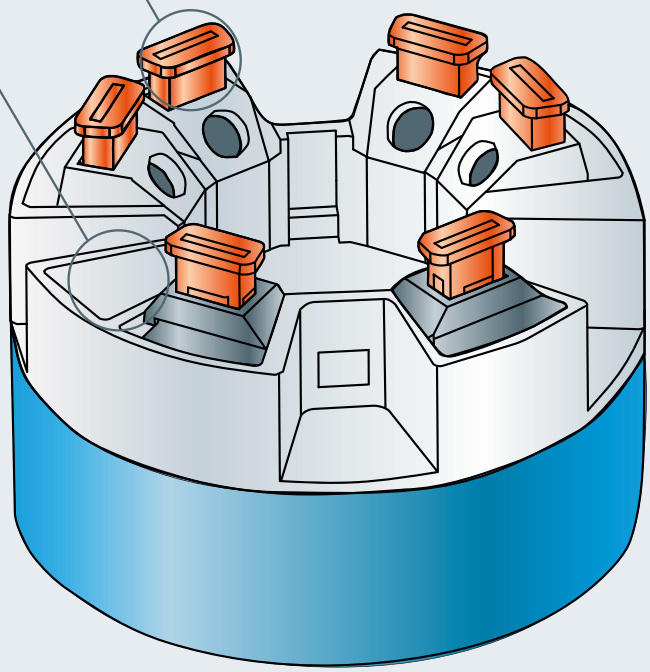
CDI interface

PROFINET® output

ethernet-apl™ advanced physical layer NEW

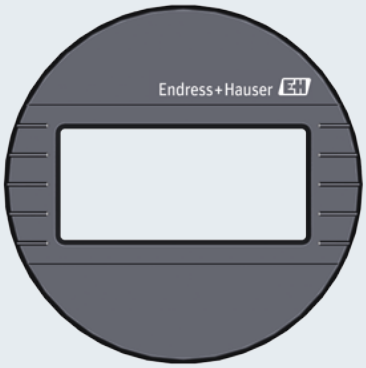
2x RTD / TC
Ohm /mV input

Ex 2-wire



Upgrade with:

Local display TID10
- Clear information at the measuring point and process
- Inverse display in case of diagnostic messages
- Permanent process monitoring or temporary application for service and maintenance work
- Device configuration via DIP-switches



Highlight: Patented technologies

Innovation by Endress+Hauser

Today and into the future, we use our instrumentation and application know-how to develop cutting edge, trend-setting technologies for most precise temperature control.
Our patented innovations not only help our customers to exploit the great potential for conserving energy, avoiding critical plant conditions and maintaining product quality. We have the goal to facilitate daily work, ensure process safety and furthermore increase efficiency.

Learn more in our videos:

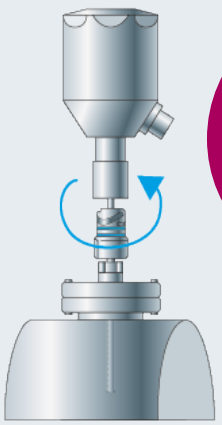
Take the right turn with iTHERM QuickNeck

iTHERM ModuLine TM131 with Dual Seal technology

iTHERM ModuLine TM131 with fast responding thermowell

iTHERM QuickNeck

Divisible neck with tool-free quick release

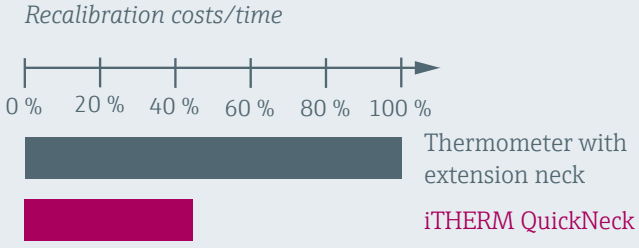


more than **50 %** cost + time saving

Technical features
- Removal of insert without tools
- Terminal head can remain closed
- Connection cables can remain connected

Benefits
- Simple, easy and fast (dis-)mounting of the insert for recalibration
- No risk of water ingress
- No risk of mechanical damage
- No risk of wiring errors

Added value
- Cost / time savings
- Less downtime
- Higher system safety and availability



Dual Seal technology

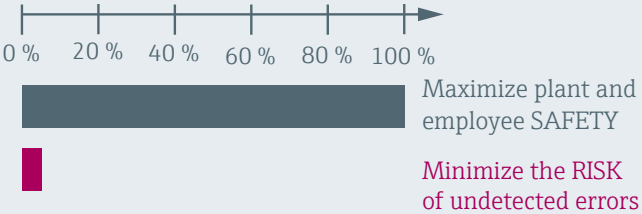
The pressure-triggered safety valve for critical applications

Technical features
- Second process barrier for the case of thermowell failure / rupture
- Signal to PLC if pressure in neck is reaching 3 bar
- Immediate sealing of the sensor insert for containment of hazardous media

Benefits
- Additional health information from measurement device
- Temperature signal stays alive
- Significant risk reduction of leakage of hazardous substances

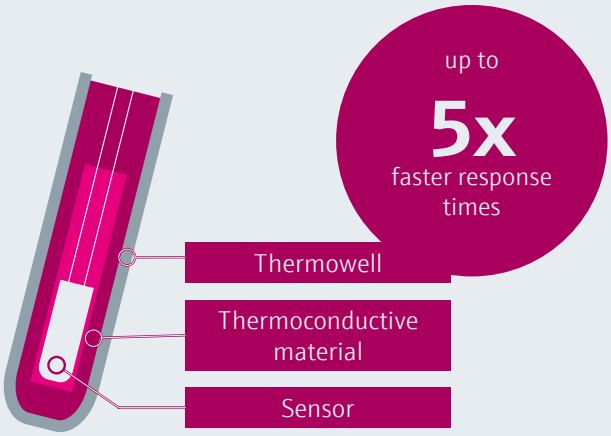
Added value
- Increased process safety
- Reduced unplanned shutdown times
- Health status information

Use of Dual Seal technology



Thermowell with fast response time

Enables to control the process at peak efficiency and performance

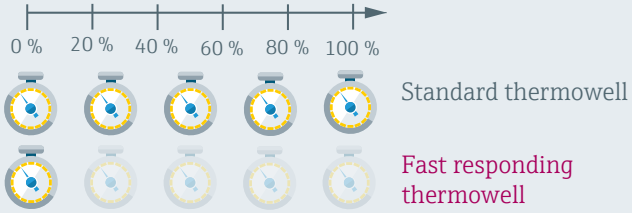


Technical features
- Heat transfer material elimination air gap
- Replaceable standard insert Ø 6 mm (0.24 inch)
- Durable effective for temperatures up to 400 °C (752 °F)

Benefits
- Variety of sensor types available
- Fastest response time in combination with thermowell

Added value
- Real time process information
- Improved process control
- Increased process safety and efficiency

Recalibration costs/time



Quality assurance

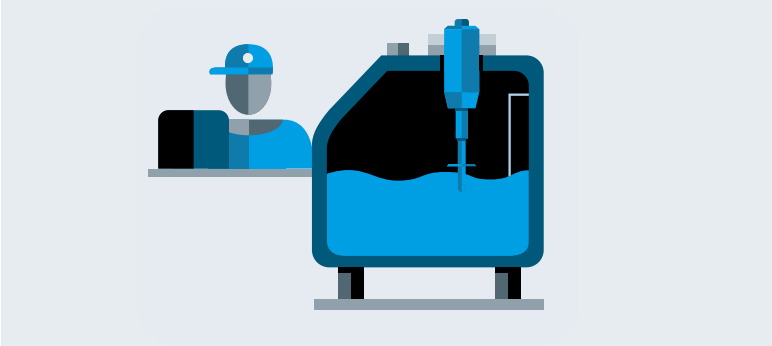
Extensive range of measurement and test equipment

- Microscopy, endoscopy and X-ray are used for **optical testing of the quality of welded and soldered joints.**
- **Material and machining quality** is verified by means of dye penetration testing, ultrasonic testing, helium leak testing, pressure endurance testing, insulation and vibration testing, along with a range of material testing techniques that are also non-destructive.
- **Determination of response times** of the inserts with and without a thermowell in flowing water in an appropriate test facility in accordance with VDI/VDE 3522 or IEC EN 60751.
- Using high-precision **x-ray equipment**, the tiniest details measuring up to 1 µm can be detected in thermometers without having to open or destroy them.

Certificates

- **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:** for thermowell welding seams in accordance with ASME V – ASME VIII.
- **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.
- **Testimonials in accordance with paragraph 3.1 EN 10204** regarding material compositions (if necessary with smelt composition), surface roughness and ferrite content.

Calibration services



Calibration competence at a glance

- Worldwide calibration facilities, partially accredited to ISO / IEC 17025
- Calibration of thermometers to the lowest possible measurement uncertainty and traceable to national standards and the ITS90 international temperature scale

Certificates

- **Detailed works calibration certificates** oriented to ISO 17025
- **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

Calibration methods

- **Fixed point calibration** at the water triple point cell (0.01 °C) and the ice point (0.0 °C / 32 °F) with a measurement uncertainty of < 5 mK and at the nitrogen fixed point of 196 °C (384.8 °F).
- **Comparison calibration** of resistance thermometers and thermocouples with precision thermometers from -80 to +400 °C (-112 to +752 °F) in very homogenous and stable calibration baths (measurement uncertainty 20 to 100 mK) and up to 1500 °C (2732 °F) 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.

Netilion – the multi-brand ecosystem

Netilion is a cloud-based IIoT ecosystem, designed for industrial processes. It connects the physical and digital worlds to send valuable information from the field straight to your phone, tablet or other devices. Netilion empowers you to improve efficiency and drive innovation.

Multi-brand ecosystem

You have equipment from various vendors in your installation. An IIoT solution should provide data from as many assets as possible, and Netilion can do that. This multi-brand ecosystem brings transparency into a plant regardless of device type or manufacturer.

Security and privacy

Your facility's information is valuable and needs protection. Netilion allows users to access data digitally because it meets internationally recognized standards of cloud-platform security. It's a safe harbor for your data.

Decentralized processes monitored efficiently

- Reduction of routine checkup tours through comprehensive visualization of essential process variables, e.g. flow quantities, limit values, levels, temperature, pressure or physicochemical quality parameters
- Low operating costs through fast reaction in case of failure

Legal compliance thanks to automation

- Continuous measurement of quantitative and qualitative parameters
- Generation of legally compliant documentation thanks to integrated reporting systems

Data access around the clock

- Complete data access independent of time and place
- Numerous options to analyze and visualize ratios, amounts, thresholds, time series and trends, as well as balances
- Everything at a glance thanks to the web-based visualization of networks with optimized depiction for highly diverse terminal devices

More about Netilion:
www.netilion.endress.com

5. Data fusion and analysis

Algorithms for leakage detection, verification, forecasts, etc.

4. Data management and visualization

Monitoring of networks and decentralized infrastructures

3. Data collection and transmission

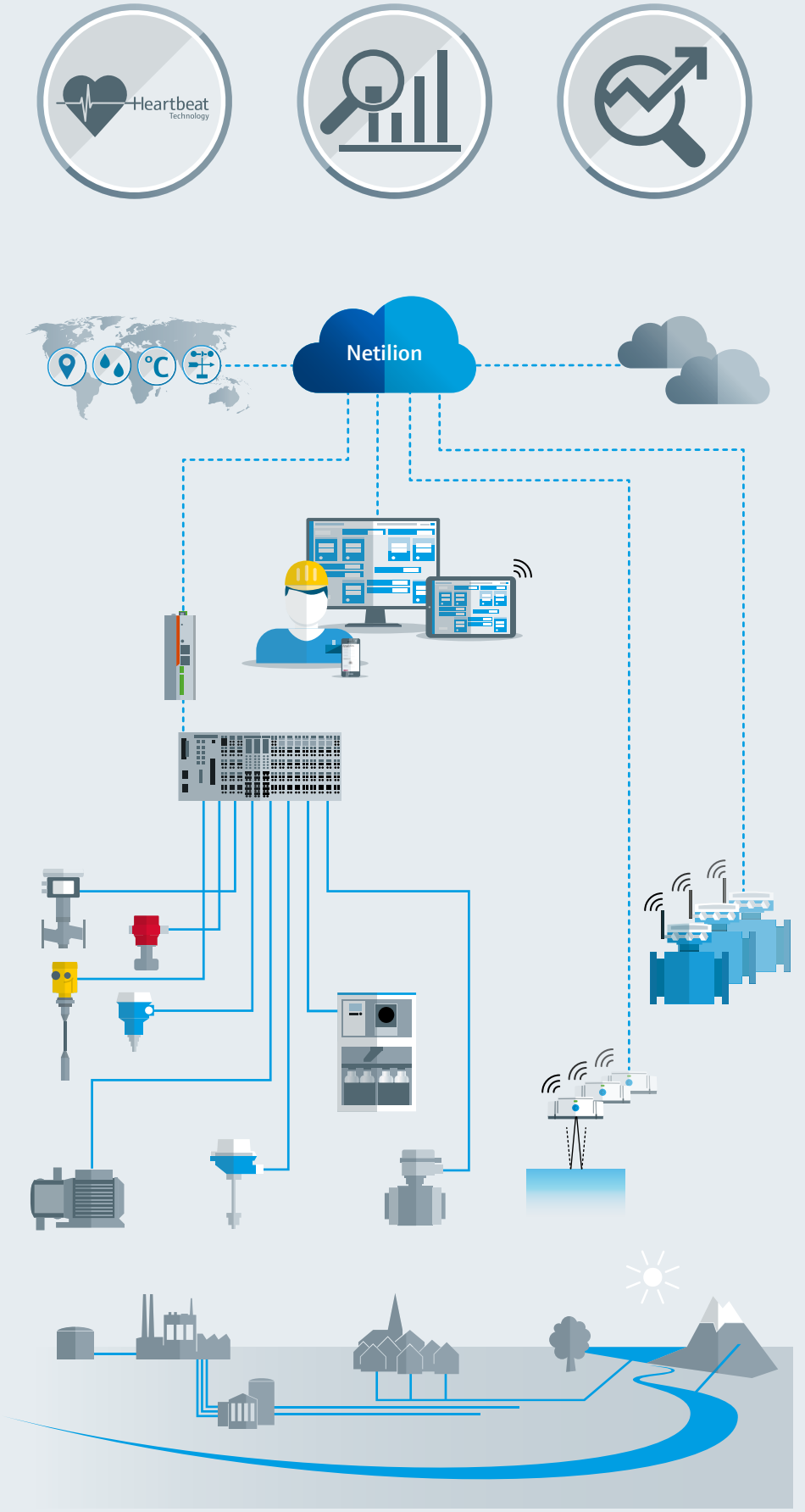
Flexible edge connectivity solutions

2. Data collection and control

Smart field devices and sensors (flow, analysis, pressure, level, temperature, etc.)

1. Physical world

Infrastructure (pipes, pumps, valves, etc.)



Further information

- Calibration of thermometers CP00004R
- Temperature Engineered Solutions CP00003
- System products and data managers FA00016K/09
- Tailor-made field instrumentation, solutions and services FI00001Z
- Next Level Hygienic PU01305T

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

Have you found "your" device? We would be pleased to send you further detailed technical information.

www.addresses.endress.com

FA00006T/09/EN/22.23

Endress+Hauser
People for Process Automation