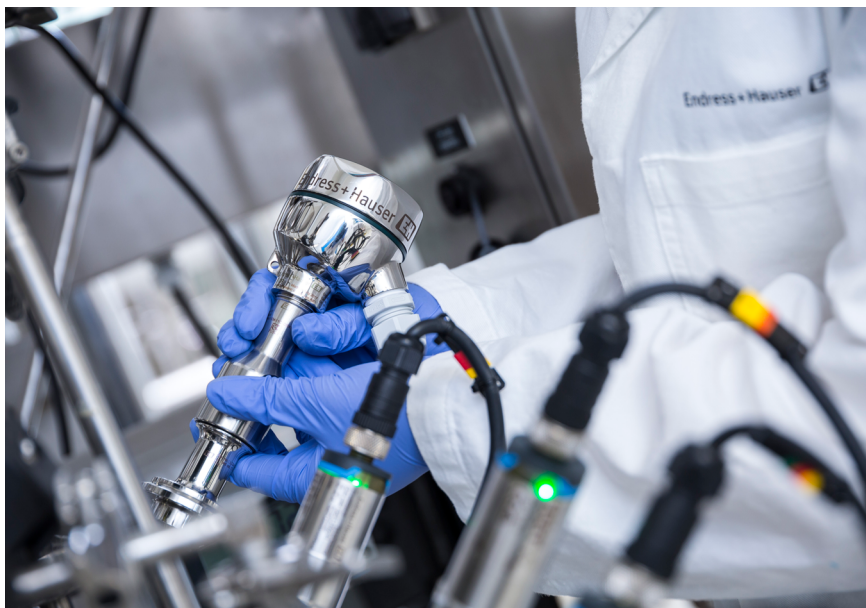


# Next-gen temperature solutions: Innovations for Life Sciences processes

## Key benefits

- Fully automated in-situ self-calibration
- Regulatory compliance
- Cost effective
- Production uptime
- Process safety



## Endress+Hauser's robust modular thermometers and hygienic RTD assemblies

**Summary** The continued expansion of the Life Sciences industry has created a demand for innovative solutions for temperature measurement. As the proliferation of advanced manufacturing processes in the industry has increased, modified instrumentation is needed to handle some harsher process conditions. Some examples are the mRNA vaccine process, oligonucleotide production and ADC (antibody-drug conjugates)

production, which have all become more prevalent.

mRNA stands for messenger ribonucleic acid, a single-stranded molecule that carries instructions to make proteins. The concept of mRNA technology is relatively straightforward: once inside cells, the mRNA instructs those cells to build proteins and that concept is utilized in vaccine production.

Oligonucleotides are short DNA or RNA molecules, oligomers, with various applications in genetic testing, research and forensics. Synthetic DNA or RNA strands are the starting point for many molecular and synthetic biology applications.

Antibody-drug conjugates (ADCs) are targeted medicines that deliver chemotherapy agents to cancer cells without damaging healthy cells like traditional chemotherapy treatment. This allows the ADCs to specifically target and destroy cancer cells with less impact to the patient.

In this ever-changing landscape, having a reliable partner becomes crucial, especially in solving the world's toughest challenges. Those in the Life Sciences industry understand there are potential challenges to overcome in their processes. Modern instrumentation is available to mitigate the risk of these process woes.

**Challenge** The Life Sciences industry faces several challenges regarding temperature measurement in advanced manufacturing processes.

**Aggressive chemicals:** Many biological compound production processes involve aggressive chemicals. These substances can corrode or damage conventional temperature sensors. For example, various chemical reagents can be highly corrosive and are used in mRNA vaccine production to synthesize the mRNA strands.

**High temperatures:** Some processes, such as oligonucleotide synthesis and ADC manufacturing, require elevated temperatures. Traditional temperature measurement devices may not withstand extreme heat, leading to inaccuracies or sensor failure.

**Challenging process environments:** Biologic processes occur in diverse environments, including reactors, bioreactors and purification systems.

These environments may have varying pressure levels, flow rates and physical constraints. Ensuring accurate temperature measurement under such conditions is crucial for process control and product quality.

**Process variability:** Biological processes are inherently dynamic. Reactants, intermediates and products continuously change. Temperature fluctuations can impact reaction rates, protein folding and overall process efficiency. Robust temperature sensors are essential to maintain consistent product quality.

**Solution** Endress+Hauser's temperature devices with additional materials, such as Hastelloy C-276, handle the harsh conditions of advanced biological compound production. This material is available as an option for Endress+Hauser's TM412 and TM372 hygienic RTD assemblies, enabling high-level application support required by mRNA, oligo and ADC spaces and other challenging biologic processes.

Endress+Hauser is committed to staying at the forefront of the instrumentation landscape. Endress+Hauser understands that customers continually improve their processes and invent new ones. As the world moves into an ever-changing future, offerings must evolve to ensure customers in every industry are well served and have a partner to help them solve the world's toughest challenges.

The Endress+Hauser TM412 modular thermometer is a robust, hygienic assembly that offers a variety of versions within a segmented standard product. This design saves time and cost through simple and fast product selection. It also features technical innovations such as iTHERM QuickSens, StrongSens and QuickNeck, significantly reducing maintenance costs and improving product quality, process efficiency and safety.

#### iTHERM QuickNeck

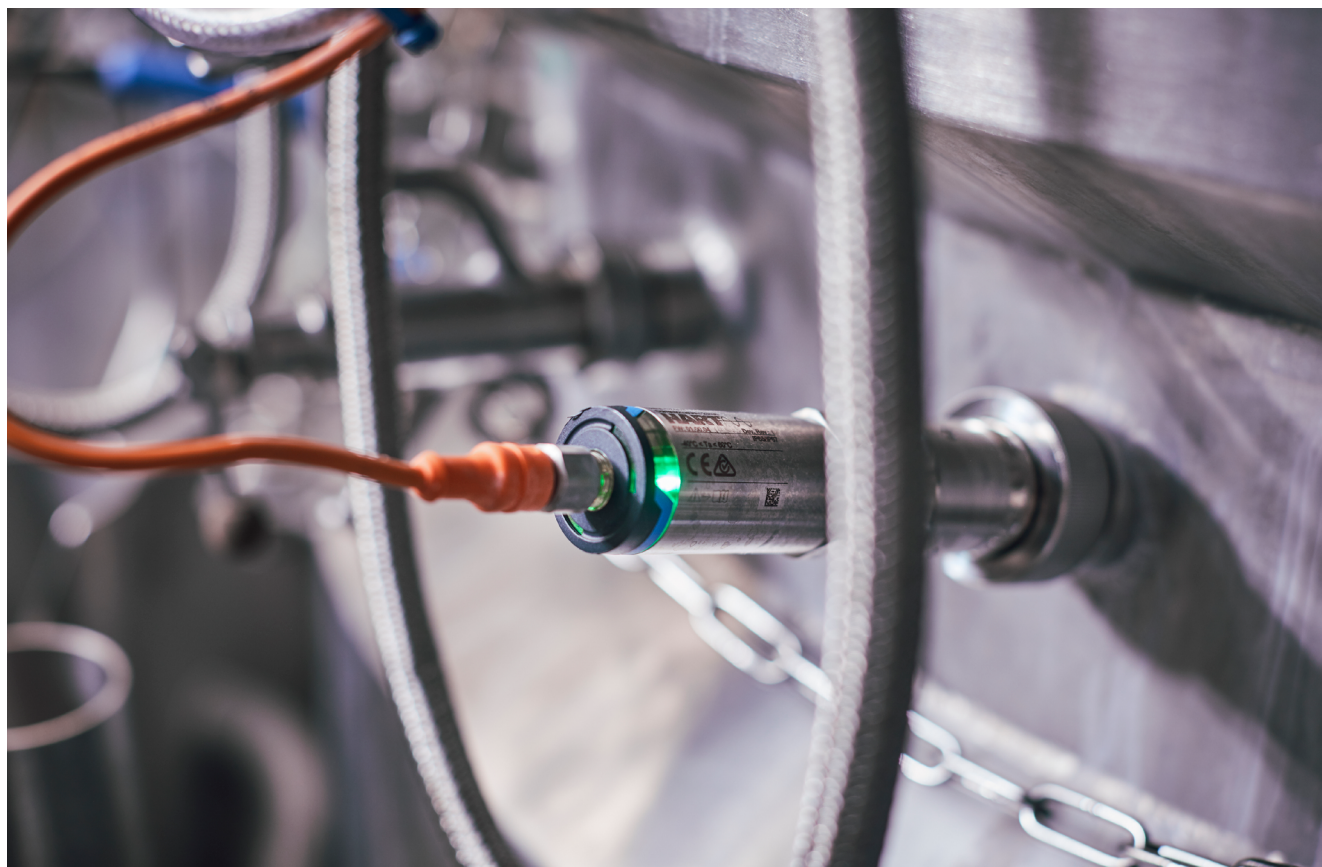
- A patented thermometer extension neck with a quick-release mechanism
- Enables tool-free and easy access to the thermometer insert for recalibration
- Up to three times faster recalibration procedures without rewiring
- Prevents errors and reduces the risk of mechanical damage to the sensor
- Hygienic design with an IP69K-rated neck mount for clean and safe operations

#### iTHERM StrongSens

- Ensures high sensor availability under rough conditions
- Utilizes vibration-resistant RTD technology (resists > 60 g of vibration)
- Ideal for demanding industrial environments



iTHERM TM412



iTHERM TrustSens TM372 self-calibrating temperature sensor

#### iTHERM QuickSens

- Offers fast sensor response times (t90: 1.5 s) for optimum process control
- Up to 75% faster and safer recalibrations with the iTHERM QuickNeck
- Tool-free quick-release allows instant insert removal
- Enhances reliability and efficiency in temperature measurement

The award-winning smart temperature probe TM372 with integrated HART® transmitter and Heartbeat Technology, technology that provides in-depth insights into sensor performance and process conditions, features the world's first RTD sensor unit capable of fully automated in-situ self-calibration. It eliminates the risk of undetected non-conformities, reduces production

downtime and increases product safety and process efficiency in applications in the Food & Beverage and Life Sciences industries. The device complies with FDA 21 CFR Part 11 regulations and GMP rules.

**Results** TM412 and TM372 hygienic RTD assemblies with Hastelloy C-276 materials can help enhance process reliability in advanced biological compound production. By withstanding aggressive chemicals, elevated temperatures and challenging process environments, these sensors help ensure accurate temperature measurement throughout the production cycle.

Since temperature fluctuations can directly impact reaction rates, protein folding and overall process efficiency, temperature sensors help minimize

variability, maintaining consistent product quality even in dynamic biological processes.

Whether in mRNA vaccine production, oligonucleotide synthesis or ADC manufacturing, the TM412 and TM372 sensors may accommodate diverse biologic processes.

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