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More than six decades of innovation as Emerson's Rosemount™ technologies continue to transform industrial temperature measurement

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Temperature measurement innovation advances process performance

Temperature is the most widely measured variable in industries ranging from oil & gas to chemical and food and beverage to pharma. Accurate measurements are vital to product quality as well as an operation's safety and efficiency. But ensuring that critical measurements are delivered in a timely, reliable and trustworthy fashion can present operators with a range of challenges. For more than 60 years, Emerson's Rosemount™ Temperature Measurement solutions have led the industry in combating such challenges through new and innovative technologies. *Control* recently caught up with Michael Olivier, Vice President of Temperature Measurement Instrumentation at Emerson, to learn more about how Emerson's innovative solutions continue to help processors tackle their biggest temperature measurement challenges.

Q: Why are temperature measurement solutions vital to the success of process industries?

A: Accurate temperature measurements help ensure product and process safety, quality, and efficiency in a variety of process industries. Temperature measurement serves as a key indicator of many processes such as complete reactions for chemical producers, distillates of desired purity for oil refiners, and thorough clean-in-place cycles for the food & beverage industry, just to name a few examples. In addition, the global push for increased sustainability means inaccurate temperature measurement can lead to not only inefficient processes, but also the discharge of unnecessary greenhouse gases into the atmosphere.

Q: What distinguishes Emerson as a leader in temperature instrumentation?

A: Emerson focuses on creating innovative and sustainable solutions, producing the highest quality outcomes, and ensuring our customers' needs are exceeded with our unmatched support and expertise. Our Rosemount Temperature Measurement solutions are no different. From transmitters to thermowells to sensors and more, we offer a complete breadth of temperature products and solutions available in fully integrated assemblies ready for out of the box installation. Our reliability, quality, expertise, and innovation set us apart from our competitors.

Q: What are the primary challenges associated with temperature measurement?

A: There are four phases in the lifecycle of temperature solutions: design, installation, operation, and maintenance. Challenges can occur in each phase. Most design challenges are associated with thermowell calculations to ensure they are designed appropriately for their application.

Temperature installations often need to be done when the process is not running and can require piping modifications to facilitate the installation of the thermowell. Unexpected shutdowns can occur when the

device is operational due to failing or degrading sensors or environmental factors. Failing, degrading, or malfunctioning sensors can also cause inaccurate measurements when maintaining the device throughout its lifecycle.

It is important to consider all phases and their potential challenges when specifying the temperature solution that best fits your application. Emerson considers these potential challenges in all phases when engineering our products and tools.

Q: What solutions does Emerson offer to help combat these challenges?

A: Emerson offers free thermowell design software that significantly decreases design time and eliminates manual trial-and-error calculations. We created a more robust thermowell with a unique design that can withstand harsh process conditions that are unsuitable for traditional thermowells. In addition, we were the first to design a technology to accurately measure process temperature without a thermowell.

Emerson also offers a full portfolio of temperature transmitters that have been recognized by our customers as the number one brand of transmitters for over 20 years in *Control's* Readers' Choice Awards. These transmitters have a full suite of advanced diagnostic capabilities to help customers do more with less by optimizing operations and simplifying maintenance.

Q: Finally, what future temperature measurement innovations can readers expect from Emerson?

A: Emerson continues to be at the forefront of temperature measurement innovation. With the next generation of temperature instrumentation, we aim to provide our customers with even higher quality devices with superior performance and usability to match. This includes improved user interfaces, advanced diagnostics, industry-leading accuracy specs and other features to make operation more intuitive for decades to come.

"Accurate temperature measurements help ensure product and process safety, quality, and efficiency in a variety of process industries."

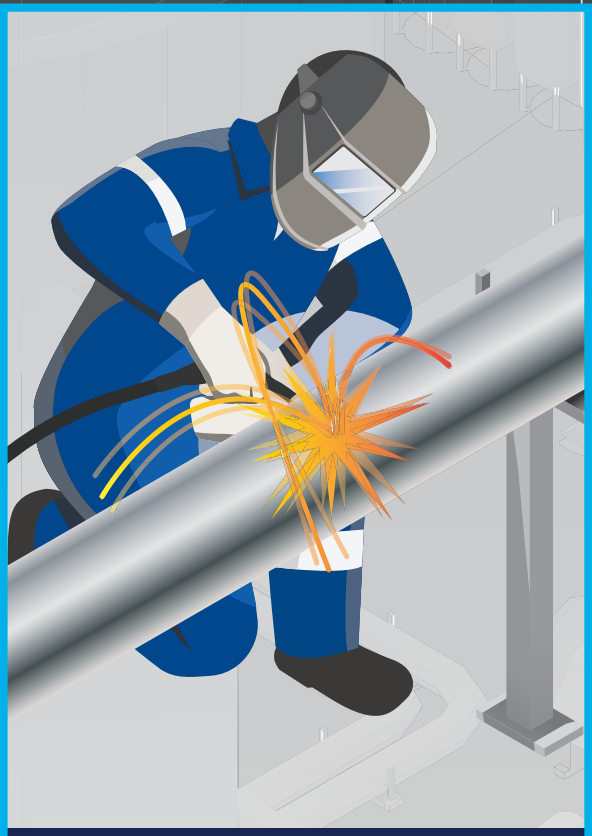
— Michael Olivier

COMMON CHALLENGES WITH PROCESS TEMPERATURE MEASUREMENT

Design

- Numerous hours performing manual calculations to properly design thermowells
- Unplanned process shutdowns and time-consuming rework for incorrectly designed thermowells

Installation



- Process shutdowns requiring pipe modifications for thermowell installation, causing potential leak points
- Complex and time-consuming installation process due to components sourced from multiple vendors

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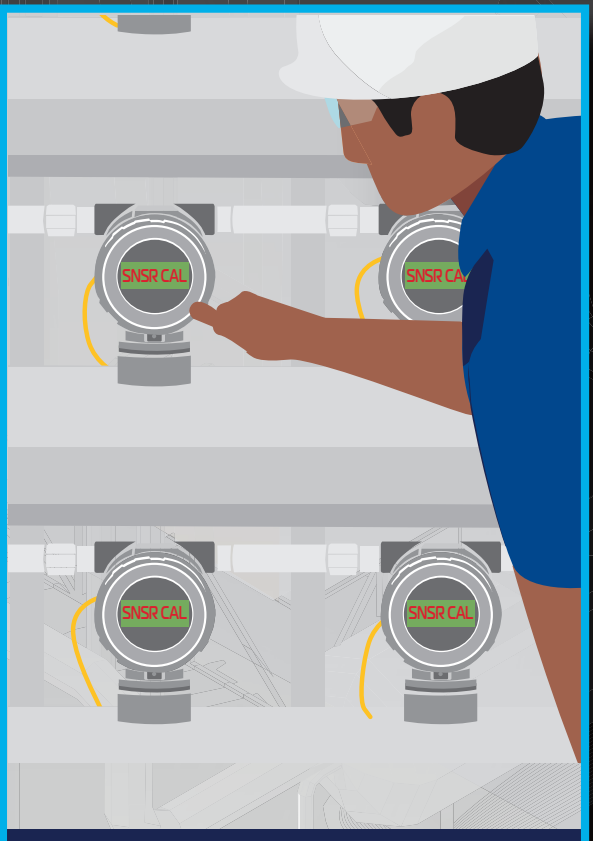
Operation

- Loss of a temperature measurement due to degrading or failing sensor elements
- Inaccurate readings caused by environmental factors, poor thermowell protrusion, and RTD impurities

Maintenance



- Possible on-scale failure resulting from sensor degradation
- Non-optimal calibration schedule can lead to inefficient use of maintenance personnel's time

Error-proof the design of your next temperature measurement point

New solutions offer the ability to ease the thermowell design process — or eliminate it altogether

In most cases, a complete process instrumentation solution for temperature measurement is comprised of three components: a transmitter, a sensor and a thermowell. Traditionally, its design comes with its share of complexity and a risk of failure if not done properly. Most of the challenge lies with the design of the thermowell, a metal alloy sheath that penetrates the process piping and protects the sensor from often harsh process conditions. Think about an oil refinery's catalytic cracker regenerator that runs in excess of 1,000° F. Add to such high temperatures turbulent flows and fluid velocities that can flirt with the speed of sound, and one quickly appreciates the need for a well-designed thermowell.

Industry best practice is to perform thermowell wake frequency calculations, which ensure that the thermowell design will withstand the process conditions to which it is exposed. These calculations account for 75% of the overall engineering work to design and specify a complete temperature measurement point. Most of the design time is spent on the thermowell because it is the component that comes into direct contact with the process. It is also a pressure-retaining component, so a poorly designed thermowell can lead to safety concerns as well as unplanned and costly shutdowns.

Emerson's Rosemount Twisted Square Thermowell is its most robust thermowell solution.

Designing a thermowell is a complex task, and there are several considerations that must be factored into both the overall design and the specifications for each application. Among those considerations are allowances for material compatibility with the process as well as the mounting types and style appropriate to the application. Other considerations may revolve around your measurement objective. Is your temperature measurement intended to be used for closed-loop control or monitoring purposes?

In addition, thermowell calculations must adhere to the most current ASME PTC-19.3 TW industry standard. Most individuals are not well-versed in the requirements of the standard and could potentially design a thermowell that fails to meet these requirements.

Historically, performing such calculations included the use of manual spreadsheets and numerous manual trial-and-error iterations. This process was tedious, time-consuming and prone to errors.

Emerson developed the Rosemount™ Thermowell Design Accelerator to ease the complexities of the thermowell design process. This free, easy-to-use and intuitive online software tool can execute thermowell calculations up to 90% faster by eliminating many of the manual tasks of the past.

For example, if a user changes process specifics, they'll have to do another calculation to ensure the thermowell isn't affected. In the past, that required the use of trial and error and spreadsheets, resulting in a 50-tag project typically taking about 40 hours to calculate. The Rosemount Thermowell Design Accelerator can reduce that same project design time to about two hours. It is able to upload and calculate up to 1,000 thermowell tags at once and, uniquely, includes auto revision functionality, allowing the Accelerator to continue revising the thermowell dimensions after a failed calculation until it finds a passing solution.

Emerson's Rosemount Thermowell Design Accelerator can execute thermowell calculations up to 90% faster by eliminating many of the manual design tasks.

Another feature that makes the software unique is its ability to not only recalculate failed tags, but also automatically generate thermowell and sensor model numbers that are specific to the solution that meets the application's process conditions.

In addition, to ensure the most current standards are being used, all information from the software is based on the ASME PTC-19.3 TW standard.

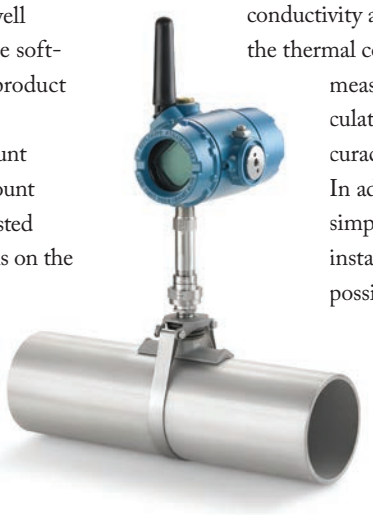
Analyzing the application

In situations where a traditional thermowell won't work for the specific application, the software can recommend a different type of product to meet the needs of the application.

Among those products are the Rosemount Twisted Square™ Thermowell and Rosemount X-well™ Technology. The Rosemount Twisted Square dampens the effects of the vibrations on the thermowell, thus making it a more robust solution. This is achieved by using a unique helical-shaped stem profile that is designed to eliminate more than 90% of the dynamic stresses that a conventional thermowell would experience. This design allows for operation at higher fluid velocities.

It is also designed to improve the reliability of a thermowell and to reduce the risk of thermowell failures with changing process conditions, including start-up, shutdown or unintended events. In addition, because of its ability to withstand harsher process conditions, the Rosemount Twisted Square allows for insertion lengths that reach the middle of the pipe for highest temperature measurement accuracy. The Rosemount Twisted Square Thermowell can easily be expanded to new applications and can reduce inventory since one thermowell fits a range of requirements.

Rosemount X-well Technology is Emerson's non-intrusive solution to accurately measure process temperatures without using a thermowell. It features a patented thermal conductivity algorithm and, with an understanding of the thermal conductive properties of the temperature measurement assembly and piping, can calculate internal process temperatures with accuracy on par with a traditional thermowell. In addition, Rosemount X-well Technology simplifies measurement point specification, installation and maintenance while reducing possible leak points.



To avoid the complexities of thermowells, or if a thermowell solution is not possible for an application, Emerson offers Rosemount X-well Technology which accurately measures process temperature without a thermowell.

The Rosemount Thermowell Design Accelerator can help turn a once time-consuming and tedious process into an efficient and accurate thermowell design solution. Whether it is recommending a traditional thermowell or an alternate approach, you can trust the Rosemount Thermowell Design Accelerator to give you the best possible temperature measurement solution for your application.

Faster and easier temperature measurement installation without a process shutdown

Turn to fully integrated assemblies and non-intrusive alternatives to streamline implementation without sacrificing performance

When it comes to accurately measuring the temperature of the flow inside a pipe, the thermowell has long played an essential role. It brings the sensor into close, conductive proximity with the process fluid while also protecting the sensor from often harsh conditions. But the thermowell also comes with several installation challenges.

First, installation of a thermowell into a pipe requires a shutdown of the process, directly affecting productivity. Pipe modifications, such as welding or cutting, are required to install a thermowell, and classified environments may need to be fully cleared of explosive hazards for the work to be performed.

In addition, small line sizes present a challenge. Stem conduction of ambient heat sources can impact measurement accuracy when the immersion depth is less than 10 times the thermowell tip diameter. It is often impossible to achieve this immersion depth in small line sizes without significant modifications to the pipe, such as adding a tee.

Finally, installation of a temperature measurement solution becomes more challenging when components are sourced from multiple vendors and made to fit properly. Assembling components from multiple vendors complicates and lengthens the overall installation process.

Temperature measurement without a thermowell

With these and other thermowell-related challenges in mind, Emerson developed Rosemount X-well Technology, which measures process temperature without the need for a thermowell. This technology is non-intrusive, as the instrumentation attaches around the outside of the pipe. When installing Rosemount X-well, users don't need to shut down the process because the instrumentation isn't going inside the pipe, in sharp contrast to thermowell installations. Instead, the sensor contacts only the outside surface of the pipe, resulting in a 75% reduction in overall installation time.

Rosemount X-well Technology accurately measures process temperature without the use of a thermowell or process penetration, thus avoiding process shutdowns to install a new temperature measurement point.

Rosemount X-well Technology is available with either the Rosemount 3144P Wired Temperature Transmitter or the Rosemount 648 Wireless Temperature Transmitter. Using the wireless transmitter option provides additional benefits of not having to run new wires to the device for power and communications. As a result, wireless instruments are routinely commissioned in less than an hour, leading to an even greater reduction in overall installation time.

Rosemount X-well Technology uses a built-in algorithm to extrapolate the internal process temperature based on surface temperature, plus the conductive properties of the pipe (composition and thickness). This delivers temperature measurement accuracy in line with that of a sensor in a traditional thermowell. Plus, Rosemount X-

well does not encounter the issues that often make thermowells inaccurate for line sizes smaller than 5 inches.

Rosemount X-well Technology is also suitable for any applications that have high-velocity, abrasive material within the process or corrosive processes that dictate an exotic material for the thermowell. It also makes sense for any application where a traditional thermowell path is too costly or too complicated.

One European chemical maker recently utilized Rosemount X-well Technology with Rosemount 648 Wireless Temperature Transmitters to further simplify the installation of 65 temperature measurement points to determine flowrates via energy balances for a heat exchanger that was particularly sensitive to erosion. The solution was commissioned in under an hour and seamlessly connected to the existing wireless infrastructure without process shutdown or production loss.

Universal Pipe Mount's cut-to-fit banding design brings new functionality to this technology. Standardized units can be stocked in inventory, installed, moved, and reinstalled on pipes of different line sizes. This provides value to operators, as they can rapidly deployment measurement solutions from their standardized inventory in emergency situations. They can also use a single device to validate several existing insertion measurement points over time.

Overall, for those looking to avoid installation and other thermowell challenges, but want to obtain accurate process temperature measurements, Rosemount X-well Technology is your go-to solution.

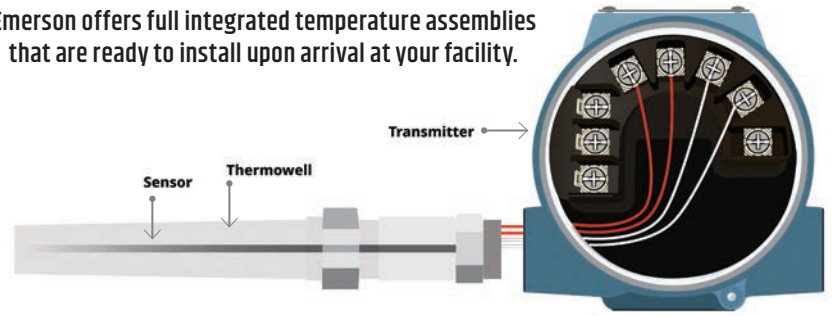
Three components in one integrated solution

For those applications where a thermowell still makes sense, another Emerson approach that significantly streamlines installation time and effort are fully integrated solutions that include sensor, transmitter and thermowell already fully assembled and ready to install.

This approach offers advantages from a procurement standpoint, eliminating the need for multiple quotes and purchase orders. In addition, it avoids the management of multiple shipments and lead times from separate vendors. Plus, different sources of each of those components can require time-consuming workarounds to accommodate unanticipated incompatibilities.

Sizing the thermowell and the sensor together is more complicated if you purchase them from different sources. It can increase the risk of a misfit—either the sensor's too long and it won't fit in the thermowell, or the sensor's too short, which could lead to measurement inaccuracies if the tip of the sensor is not making contact with the inner wall of the thermowell.

Emerson offers full integrated temperature assemblies that are ready to install upon arrival at your facility.



Meanwhile, each temperature transmitter must be configured to match the sensor type that's being wired. If the user buys them pre-assembled from the same vendor, this extra step is eliminated. Separate sourcing also creates extra work when it comes to wiring in the field. Separately purchased transmitters require the sensor to be physically wired to the terminal block.

Users can achieve a higher level of performance when the transmitter and sensor are ordered together by specifying Callendar-Van Dusen (CVD) constants. These are coefficients that characterize how a specific resistance temperature detector (RTD) operates at different temperatures. Sourcing components together makes it easier to achieve transmitter-sensor matching because Emerson can preconfigure the transmitter with CVD constants for that specific RTD at the factory. There's no manual entry of the constants into the transmitter as would be required to pair an RTD from one company with a transmitter from another.

Emerson's complete point solutions and Rosemount X-well Technology give process industry users streamlined and non-intrusive temperature measurement solutions that help reduce the time and effort spent during the installation process.

Temperature innovations boost measurement resiliency and accuracy during operation

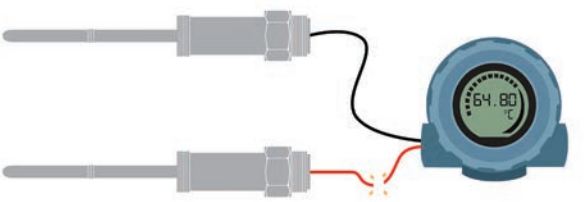
Innovations in electronic diagnostics, physical design and sensor redundancy head off process interruptions

In the list of sentences that operators and plant managers don't want to hear, "We need to shut down the plant" ranks near the top of the list. Unplanned shutdowns can have a significant impact on the profitability of a business. Furthermore, accurate process measurements throughout an operation are critical to the quality, safety and yield of the process. That's why continuous measurement in process control applications is essential. To operate continuously, users face two main challenges: performance optimization, ensuring sensors are working properly and electrical noise interference is minimized; and accuracy optimization, ensuring that the sensor physically accesses the most representative measurement point.

Temperature measurements can experience a multitude of issues that impact plant operation. Despite protective measures, sensors are prone to failure and degradation that can cause a loss of measurement integrity. Sensors can also have small voltages (known as thermal electromagnetic fields, or EMFs) build up in their wiring and can cause inaccuracies in temperature readings due to a resultant change in resistance.

In addition to issues with sensor failure and degradation, environmental factors can have a significant impact on the quality of a temperature reading received by the control system. Transmitter wiring can be susceptible to electrical noise and vibrations. Suboptimal conditions are commonly found in installations near blowers, pumps and compressors. Transient events such as lightning strikes or electrical discharges can cause inaccurate readings, which lead to false alarms. Such alarms can result in a shutdown of the process and require operations personnel to perform a check on the sensor.

Critical control or custody transfer applications, such as batch reactors, lease automatic custody transfer (LACT) skids, and safety loops require a high level of temperature measurement accuracy. Often, resistance temperature detector (RTD) sensors are used to take such measurements. These sensors work by measuring resistance changes in a temperature-sensitive alloy; and the accuracy of that correlation can be affected by errors and inconsistencies introduced during the sensor's manufacture.



Emerson's Hot Backup Capability will automatically switch to a secondary sensor if the primary sensor fails.

Accuracy of a temperature measurement can also be impacted by the immersion length of the thermowell used to protect the sensor. The highest level of accuracy and time response in a pipe application is obtained by inserting the tip of the thermowell (along with the tip of the sensing element) into the very center of the pipe. However, this goal is often not achieved, as thermowell length sometimes must be reduced to endure harsh process conditions and vibration stresses.

Emerson offers a range of solutions to help tackle these challenges and to better ensure continuous temperature measurement and operation. These include Transmitter-Sensor Matching, the Rosemount™ Twisted Square™ Thermowell, and a range of advanced diagnostic features included in Rosemount Temperature Transmitters.

Diagnostics for continuous temperature measurement

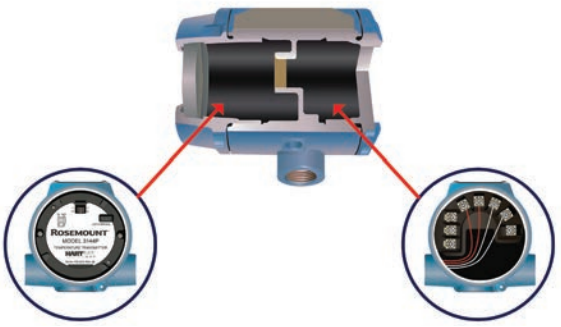
Temperature transmitters improve the performance and reliability of industrial temperature measurements. They are commonly used in the chemical, oil and gas, refining, food and beverage, life sciences and many other process industries. Rosemount Temperature Transmitters are available with a suite of sensor and environmental diagnostic features that help users proactively identify and address issues before they impact productivity or safety.

One of these features is Emerson's Hot Backup™ Capability. This capability features a redundant, dual-input sensor configuration designed to mitigate the effects of a failed sensor. If the primary sensor fails, the transmitter will automatically switch to the secondary sensor.

The Hot Backup feature also displays an alert indicating that the primary sensor has failed so that it can be replaced. This capability is especially beneficial for critical applications where a failed sensor and subsequent lost measurement could cause safety concerns.

Emerson's Rosemount Temperature Transmitters also offer several advanced diagnostic features to limit the impact of environmental conditions on the accuracy of a temperature measurement. One of those diagnostic features is transient filtering, which prevents intermittent transient signals (such as those resulting from an electrically noisy environment or high vibration) from affecting the measurement. By disregarding apparent temperature spikes, sensor signal interruption is prevented and the last known reliable temperature value continues to be transmitted, thus saving a potential process upset or trip condition.

Another useful diagnostic feature is Open Sensor Hold-Off. Based on calculations performed by the transmitter, this feature determines whether a high-voltage transient event (i.e., lightning or electrostatic discharge) or an actual open sensor event has occurred. Inaccurate open sensor conditions can cause unnecessary alarms. To avoid these alarms, the transmitter ignores the outlier and outputs the previously established value.



Emerson's field mount transmitters feature dual compartment housing to help prevent moisture affecting the transmitter electronics.

Additionally, Rosemount Temperature Transmitters are equipped with an electromagnetic field (EMF) compensation feature. This diagnostic analyzes sensor loops and compensates for the thermal EMFs, resulting in more accurate temperature readings.

Apart from their diagnostic features, Rosemount Temperature Transmitters are available in a variety of form factors and housing styles to optimize their performance based on the needs of the application. Of the available form factors, the field mount is the most robust design. This solution features a dual compartment housing, meaning that the device electronics are in a separate chamber from the terminal block. This helps prevent the presence of moisture (from humidity or other sources) and subsequent corrosion of the device electronics.

Precision-enhancing innovations for measurement accuracy

Thermowells that must be shortened from their optimal length to withstand an application's process conditions necessarily forfeit some degree of accuracy. Emerson's innovative solution, the Rosemount Twisted Square Thermowell, features a unique helical stem profile that reduces dynamic stresses by more than 90%. This reduction in vibrational effects allows for the tip of the thermowell to rest in the center region of the pipe, allowing for the most accurate measurement possible.

In some cases, users can live with the error associated with the actual resistance curve of an RTD. In critical control and custody transfer applications, however, this error can be detrimental to the plant's operation. Fortunately, Emerson's temperature transmitters have the option to be specified with a Transmitter-Sensor Matching option. Transmitter-Sensor Matching decreases the error associated with the total measurement by up to 75%.

'This reduction in error is achieved by programming the four constants from the sensor's Callendar-Van Dusen equation into the transmitter. When specified with the Transmitter-Sensor Matching option, Emerson programs the transmitter with the appropriate constants from the factory, allowing users to achieve highly accurate temperature measurements that reliably optimize operational performance.

Advanced temperature diagnostics steer effective maintenance practices

Built-in diagnostics provide value through improved confidence, prevention and response

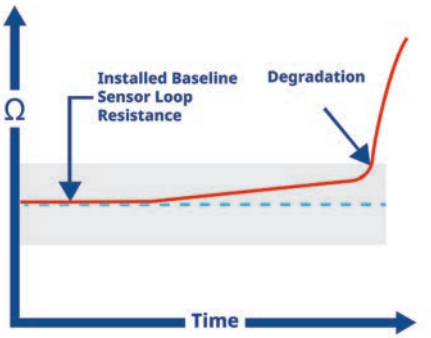
Once designed and installed correctly, maintaining temperature measurement accuracy and operational integrity over the long haul becomes the focus. Proper maintenance of a temperature measurement point can help reduce the risk of measurement failure as well as ensure ongoing accuracy. High-quality resistance temperature detectors (RTDs) can be extremely stable, but thermocouples can begin drifting as soon as they are put into operation. All temperature sensors, even high-quality ones, can degrade over time due to harsh process and environmental conditions.

Sensor degradation can lead to an abnormal measurement condition called on-scale failure. This is the indication of a valid measurement value that appears to be within process alarm limits, when the data is, in fact, inaccurate. If personnel cannot identify atypical temperature behavior such as on-scale failure, they might be unaware of problems occurring within the process. This lack of awareness can lead to unnecessary process shutdowns and safety issues, as well as negatively impact process efficiency and quality.

Diagnostic innovations have advanced the continuous maintenance capabilities for process instrumentation and sensor health monitoring, giving users confidence in both instrument performance and measurement accuracy. Emerson's Rosemount™ Temperature Transmitters feature advanced diagnostic capabilities that help proactively identify issues before they impact productivity and provide information to the right people at the right time, resulting in faster decision making.

Ensuring measurement accuracy

The Thermocouple Degradation Diagnostic monitors the resistance in a thermocouple sensor loop. This diagnostic notifies operators of an increase in sensor loop resistance, which can indicate that the sensor is deviating from the true temperature value and potentially failing.

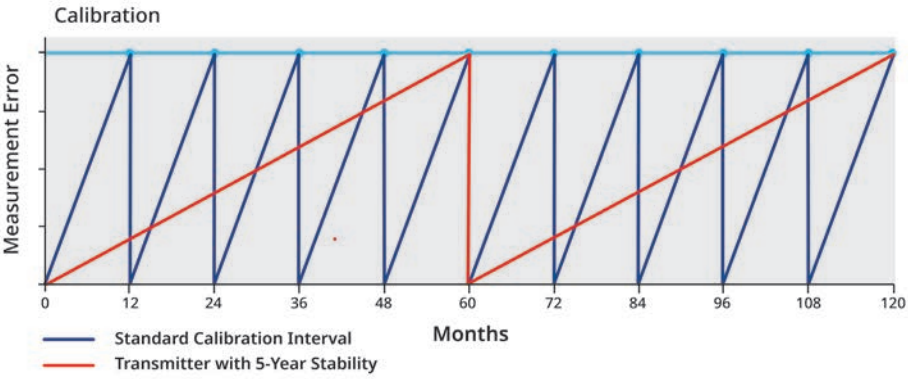


T/C Degradation alerts users of a degrading sensor by detecting loop resistance.

It lets users set a resistance limit for each unique installation. For example, if a plant's standard installation is running at 30 ohms, the transmitter can be set to alert technicians if it hits a threshold of twice the baseline, or in this case, 60 ohms. Once it hits the threshold, the transmitter will keep the process operating but send an alert.

Another diagnostic available in Rosemount Temperature Transmitters is Measurement Validation. It works by evaluating sensor noise. Before a sensor fails, it will exhibit signs of degradation such as increased signal noise, which will often result in inaccurate but transient on-scale readings. Measurement Validation monitors the signal noise and uses it to calculate a deviation value, indicating the magnitude of the noise, which is compared to a user-selected alert limit. If this limit is exceeded, the user is notified, allowing action to be taken.

Measurement Validation can detect increases in signal noise due to loose or corroded connections, high vibration levels or electronic interference. In addition to detecting on-scale failures as a result of these conditions, Measurement Validation also performs a rate of change calculation



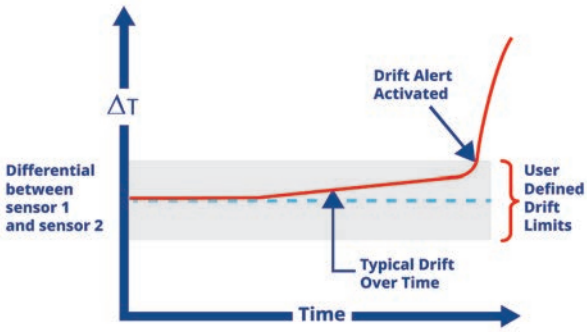
Transmitters with longer stability require less frequent calibrations.

to differentiate abnormally fast temperature changes due to sensor failure from actual temperature swings.

Solving sensor drift

Sensors are sometimes prone to drift, especially when exposed to extreme process conditions. Sensor drift is a common issue found in the chemical, refining and power industries and in applications such as coker heaters, crude vacuum distillation units, furnaces and hydrocrackers. Drift can have a significant impact on the accuracy and reliability of sensor data. Gradual, subtle changes in the sensor happen over time, causing discrepancies between the true process temperature and the output of the sensor.

For transmitters with dual sensor input capability, Sensor Drift Alert is another diagnostic tool that provides insight into sensor health. Sensor Drift Alert works by measuring two sensors simultaneously and monitoring the temperature difference between them. If one starts to drift, the other can be relied upon to continue to provide accurate data until the failing sensor is replaced. Because there are two readings for the same measurement point, technicians are quickly alerted if the readings diverge.



Sensor Drift Alert gives insight to potential failure by monitoring the temperature differential between two sensors.

Reducing recalibration tasks

Another important component of maintenance of a temperature measurement point is calibration frequency. When using Rosemount Temperature Transmitters, it is possible to calculate the frequency needed for calibration, as the stability specification plays a large role in how often they must be recalibrated.

For example, the Rosemount 3144P Temperature Transmitter has a five-year stability specification. Users should take into account a transmitter's stability and accuracy specifications in conjunction with their own onsite requirements to calculate how often units should be inspected. This approach can often extend the calibration interval, freeing maintenance personnel to do other important tasks.

Maintaining accurate instrumentation is a vital element in the productivity of a process. Temperature sensors will degrade over time, and the inability to monitor this behavior can lead to false alarms, lower product quality, energy inefficiencies or process shutdown. Emerson's Rosemount Temperature Measurement Solutions are designed to help maintain accurate instrumentation and keep your process up and running over the long term. Advanced diagnostic capabilities also help users do more with less by enhancing overall operations, augmenting the capabilities of their front-line teams, and empowering them to direct their efforts towards the highest value-added tasks.

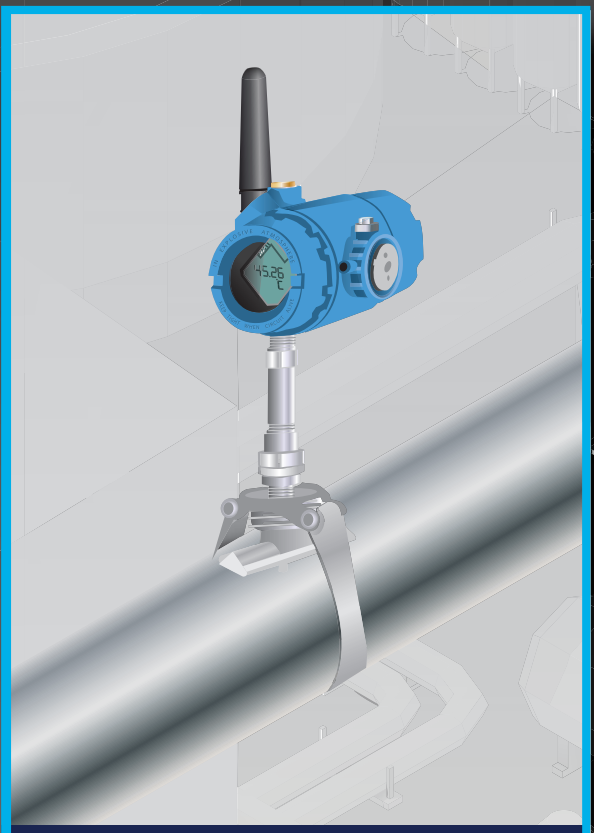
As people around the world demand a more sustainable way of life, process industries need innovative solutions that are proven safe, reliable, and efficient. Emerson's Rosemount Temperature Measurement Solutions are designed to tackle the most challenging process design, installation, operation and maintenance challenges to ensure industry can meet its safety and sustainability goals. In addition, the MyEmerson portal serves as go-to source for the necessary service, education and training to make this vision a reality.

EMERSON'S ROSEMOUNT™ TEMPERATURE MEASUREMENT SOLUTIONS

Design

- Reduce thermowell design time by up to 90% with The Rosemount Thermowell Design Accelerator's Auto Revision feature
- Receive alternative technology recommendations for process conditions unsuitable for traditional thermowells

Installation



- Avoid a process shutdown associated with thermowell installations by utilizing Rosemount X-well™ Technology
- Decrease installation time and complexity by purchasing Emerson's fully integrated temperature assemblies

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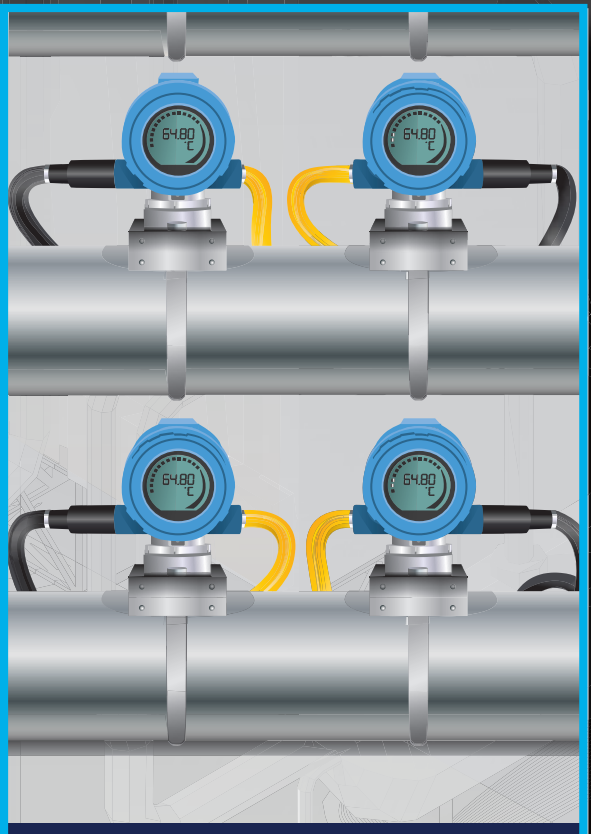
Operation

- Detect sensor degradation and protect against environmental interference with Rosemount Temperature Transmitters' various diagnostic features and form factors
- Optimize accuracy with the Rosemount Twisted Square™ Thermowell and the Transmitter-Sensor Matching option

Maintenance



- Gain insights into sensor health with Sensor Drift Alert and other diagnostic capabilities available on Rosemount Temperature Transmitters
- Reduce the frequency of calibrations with the multi-year stability on Rosemount Temperature Transmitters

Go Simplify.
Go Boldly™

Emerson's Rosemount™ X-well™ Technology delivers accurate and reliable process temperature measurements without a thermowell. Simplify design, installation, and maintenance, and save up to 30% on lifetime costs per temperature measurement point.

Learn more at
www.Emerson.com/Rosemount-X-well

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