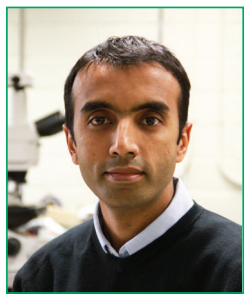
WHY SHOULD YOU SWITCH TO NON-INVASIVE TEMPERATURE MEASUREMENT?

Temperature measurement is the most common and arguably the most important measurement for efficiency and quality in the process industry. In our Q&A article Dr Guruprasad Sosale, Non-invasive and wireless product manager for ABB Measurement & Analytics globally, explains how non-invasive temperature sensing is transforming the way we measure temperature in the process industry



Dr Guruprasad Sosale

Describe non-invasive temperature sensing in 25 words or less

Guru: A simpler and safer way for plant operators to measure process temperature without compromising on performance - no shutdown, no holes, with dramatically simplified engineering.

Tell us more. What key benefits does it offer customers?

Guru: Non-invasive temperature is a revolution for plant operators both for existing plants and future new facilities. For existing plants, the primary benefit is in getting a reliable and responsive temperature measurement without having to shut down the process.

Every plant process engineer, maintenance engineer and plant manager knows the benefit of being able to measure temperature accurately without having to engineer and install a thermowell. Such a sensor could be used to optimise controls on heat exchangers, prevent pumps being destroyed by quickly detecting when a pump runs dry, detect pumps that could overheat and damage the quality of products, troubleshoot or even predict plugging of process lines and many other typical operational issues. For all these cases and more, a sensor is needed that rivals the performance of a thermowell, built on the same reliable hardware and that easily integrates into their existing control systems.

For future facilities, our non-invasive approach to temperature measurement simplifies engineering temperature points and dramatically reduces the capital expenditure costs. A typical project has hundreds of temperature measurement points that have to be individually engineered to satisfy a range of criteria, including ensuring the correct lengths of thermowells are used, the correct material is selected, the structures can withstand the process conditions, and that the flanges and connectors are correctly specified. This results in significant cost, engineering effort and increases the chance of error.

With our non-invasive approach, the majority of these measurement points can be covered by a single variant of the sensor.

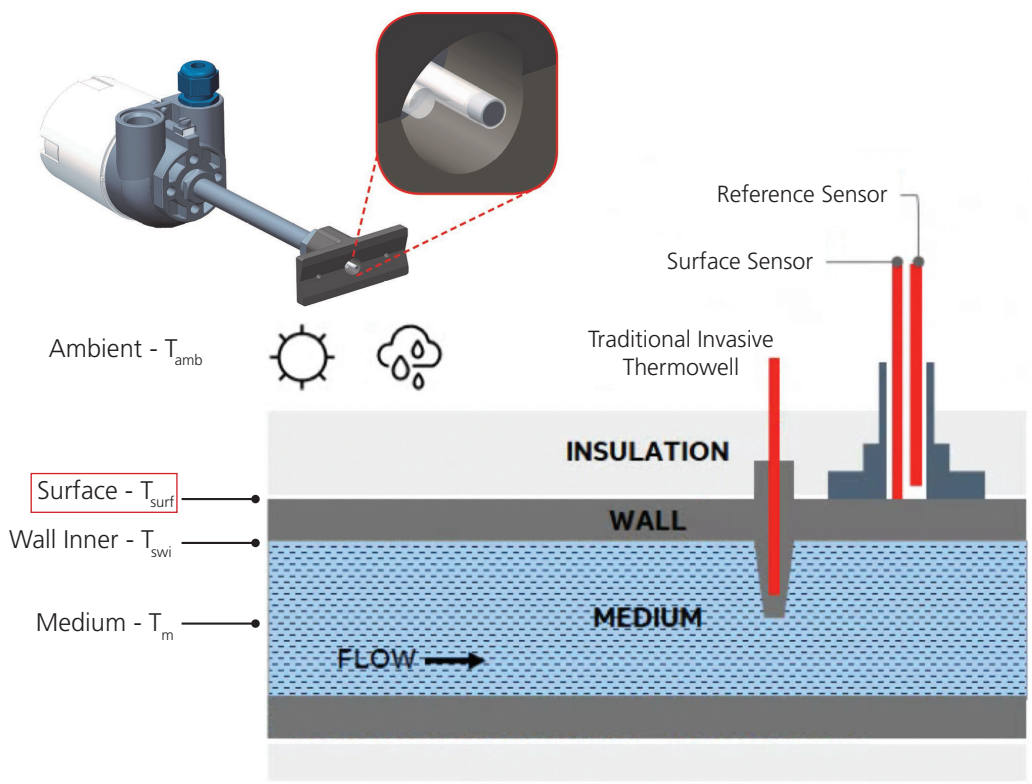
In essence, our customers' piping becomes the thermowell and temperature points can be added at the last stage of the project with little to no engineering requirement.

How does it work?

Guru: Our non-invasive sensing starts at the core of the need – process engineers want to be able to measure the true process temperature. To measure this, we use the pipe as our sensor and accurately measure its surface temperature and then predict the process temperature based on the process conditions. There are two primary challenges here:

1. How do you accurately measure the surface temperature? – We use a double sensor architecture which overcomes the drawbacks of traditional skin temperature sensors. Our double sensor has one sensor in contact with the surface of the pipe while the second measures the ambient temperature in the vicinity. A thermal model using these measurements compensates for contact resistances and ambient effects to measure the surface temperature at the tip.

2. How do you infer the process temperature? – We developed, tested and validated thermal models of typical fluids flowing in piping to predict the temperature fields under common process conditions. A simple engineer's rule of thumb that arises from these models is the following: "For a liquid or liquid-like medium (with a density of >50kg/m^3) flowing in a turbulent regime, in a metal pipe, there is little measurable difference between the surface temperature and medium temperature". This rule has



Device Model:
- Thermal model of device
- Dual sensor tip provides a simple and accurate measurement of surface temperature

Process Model:
- Predict process temperature from surface temperature
- Density, viscosity, flow rate, pipe marterial, pipe dimensions

powerful implications as most process conditions are liquid-like, turbulent flows in metal pipes, making our device a suitable alternative to using thermowells in the vast majority of applications.

I already have thermowells in my facility, why do I need your sensor?

For existing facilities, every thermowell measurement has three key drawbacks that operators live with today:

1. The thermowells in the process have the chance of failing. It may be due to changes in process flow conditions, corrosion, excess forces due to process excursions or just degradation over time. The impact and implications of such a failure can range from small break in welds to catastrophic damage. With a non-invasive approach, this risk is eliminated.

2. If a thermowell fails, the operator either must shut down until it is replaced or take the risk of running the process without the measurement until a suitable replacement is found. Unless it is on stock, a replacement thermowell can take weeks to be completed, tested and ready for installation. With our non-invasive sensor, the operator has a technology solution that has not existed before. They can continue to run with the temperature measurement that will perform like their invasive measurement allowing them to safely run to the next shutdown or, better yet, avoid replacing the existing thermowell assembly.

3. The inherent chance of error – there is an implicit assumption backed by experience that the measurement in the thermowell is correct and accurate. However, improper selection of insets, wrong insertion lengths and poor contact can all lead to an undetected error in measurement.

This error can remain undetected unless a similar thermowell is installed in the same location and the measurements are compared. In reality, this is rarely done, leaving many temperature measurement points that run on a belief of accuracy. With our non-invasive approach we examine the entire system. Not only can the invasive measurement be validated, but multiple measurements can be cost effectively installed, increasing the confidence in the measurement, and simplifying redundancy.

Why should I consider a non-invasive temperature sensor for my next project or facility?

There are multiple reasons to move towards a non-invasive approach:

1) Safety: not having a perforation and not having a structure facing the full force of your process fluid is inherently safe. At the start of your plant and over its entire lifespan

2) Cost effectiveness and flexibility: Aside from dramatic savings in engineering and hardware costs, a non-invasive approach eliminates the impact and cost of design changes late in the implementation stage. Changing piping size, flow velocities or nominal temperature ranges have little to no effect on the temperature measurement points

3) Performance: Built on fundamental physics principles, our process models can predict the performance of our sensor for your given process conditions. This approach provides an engineering basis to use our non-invasive sensor in your next project and reduces the risk of an excessive performance deviation

4) Simplicity: A typical plant has tens to hundreds of different dimensions of piping with an equivalent number of different thermowells, insets, inset lengths and material configurations. With non-invasive, a single variant can be used for piping from DN40 to DN2500 and can apply to over 70% of all the measurement points

What are typical applications for this device in existing facilities?

Having accurate and simple temperature measurements has numerous applications for existing facilities. Some of the common applications our customers are using these sensors for include:

1) Cost effective heat exchanger control and monitoring – a large number of heat exchangers have either inlet or outlet temperature sensing missing making optimization difficult

2) Validating existing temperature points – process engineers doubt the veracity of an existing measurement but installing a 2nd thermowell is prohibitively risky or expensive. Installing and getting a plausibility check with non-invasive can occur in minutes

3) Preventing overheating of pumps – our sensors are regularly used in the chemical industry in hazardous locations where the product should not exceed a specified temperature. Both for quality and safety reasons. There are process constellations where the pump can overheat the product. Installing a non-invasive sensor at each of the pumps is an easy and scalable approach to add this security in existing processes

4) Measurements in highly corrosive flows – Typical thermowells here are either coated with polymer coatings or of special materials that are reaching their end of life. For such flows that have some liquid content our non-invasive sensor has been shown to match or exceed the performance of invasive devices.

In summary, our non-invasive sensor is suitable for all temperature measurements in piping in the process industry. We believe it to

be the first step towards eliminating the need for a thermowell in future plants. However, as with any new approach, its performance will need to be carefully validated by operators and engineers the world over. At present, there are over 80 global players in the chemical, oil and gas, pulp and paper, power, food and beverage and wastewater industries that are validating the performance of our technology against existing thermowells.

Since being launched our sensor has also been recognised publicly and has been shortlisted for and won prestigious awards, like the German Innovation Award.

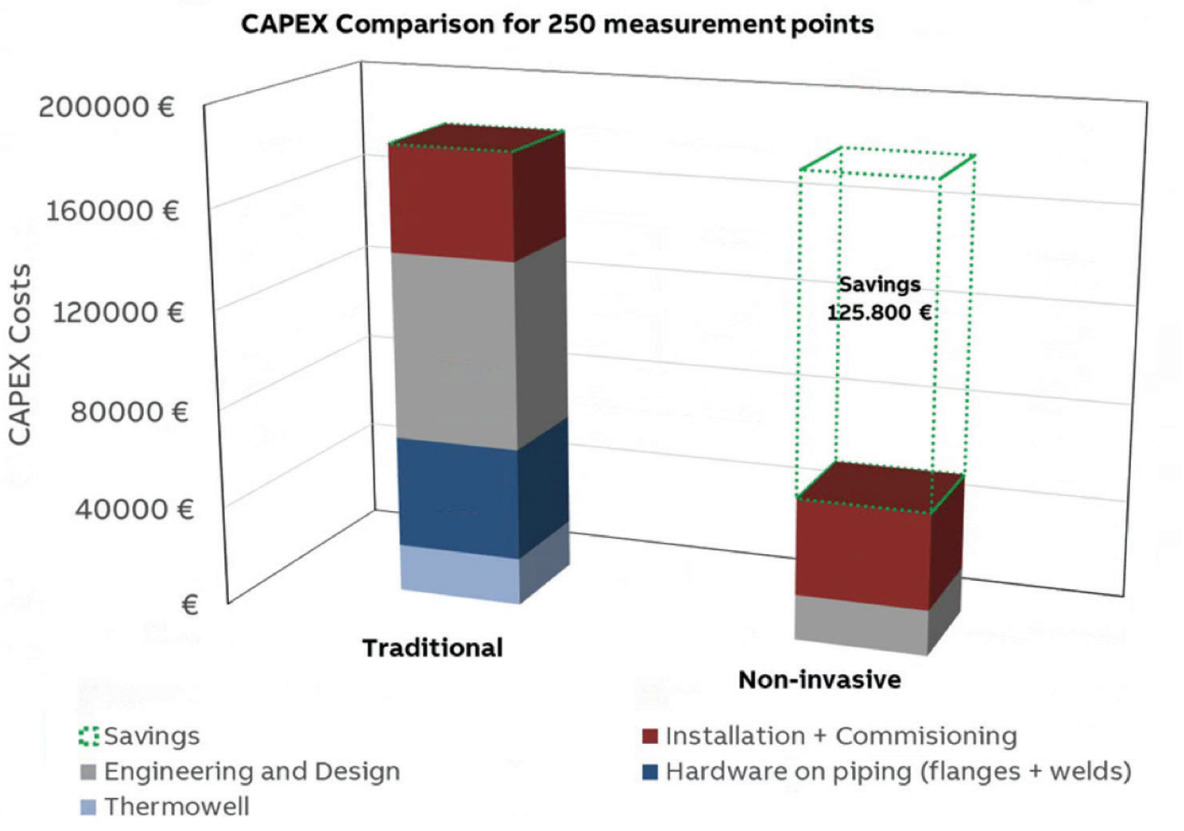
How do CAPEX costs compare with conventional invasive methods?

In a running plant, the cost of a non-invasive sensor is orders of magnitude less than the cost of shutting down or the risks of installing a new thermowell.

For greenfield projects, the potential reduction in engineering, installation and material costs can be up to 75 percent. Even including the cost of instrumentation, the savings are substantial compared to the traditional approach.

How can I find out more?

Guru: Contact ABB to check if you can use a non-invasive temperature approach for your process. For more information, please visit our website.



CAPEX comparison between invasive and non-invasive temperature measuring techniques

Contact Details

ABB • ABB Howard Rd, Eaton Socon, Saint Neots PE19 8EU • Tel: 0870 600 6122 • Email: enquiries.mp.uk@gb.abb.com • **Web: www.abb.com/measurement**