PENTRONIC GROUP Europe's leading manufacturer of temperature sensors

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PENTRONIC NEWS

It's all about temperature!

HIGH TEMPERATURES IN HÖGANÄS

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TEMPERATURE SCHOOL – LESSON 8

An exciting end to the year!

The mist now lies thickly over the sea inlet in front of us and nature is preparing to survive the winter but here at Pentronic we are still working hard to serve our customers.

In my last editorial I said that one of our strategy goals is to digitalise some of our operations. Another goal is to continue to grow and to establish our presence in new markets and industries. In October we therefore acquired Thermo Electric Instrumentation (TEI) in the Netherlands. TEI is a significant player in its domestic market and has a strong product portfolio in oil & gas and chemicals as well as in semiconductor manufacturing and solar panels.

Thanks to our strong growth in recent years, we have decided to establish a dedicated service for HR issues. I welcome Cecilia Hedlund to Pentronic.

We thank you for a successful collaboration during 2018 and wish you a wonderful and relaxing Christmas and New Year's holiday!

Rikard Larsson
Managing Director

HIGH TEMPERATURES IN HÖGANÄS

In the small town of Höganäs in Sweden's southernmost province of Skåne, Cortus Energy is constructing a gas plant to reduce the carbon dioxide emissions of the Swedish multinational Höganäs AB, a major producer of powdered metals. Almost 200 temperature sensors from Pentronic have been installed in the plant's very extreme environment.

FROM A SKYLIFT WE GLIMPSE the far-off silhouette of Kullaberg peninsula but that is not what is attracting our attention right now. Because down on terra firma, a unique gas plant is taking shape. Its purpose is to ensure that in the longer term, Höganäs AB can replace natural gas with biogas and move from fossil energy to renewable energy.

"Höganäs is working methodically to reduce its carbon footprint and fossil dependency. It has also been a major driver of the Probiostål project, which this plant is part of, and which involves developing environmentally sound technology for the steel industry," explains Cortus Energy's Business Manager Magnus Nelsson Folkelid when we meet at the construction site hut.

Cortus Energy has developed a technology that transforms biomass, such as forest residue and bark, into a gas by completely using up and transforming the organic by-product. First, the gas and solid material are separated by heating the dried biomass in an oxygen-free environment, a process called pyrolysis. This itself is nothing new. The pioneering aspect is that instead of purifying and using mainly the pyrolysis gas, which is the conventional method, this new method exploits the radiation from burning the gas to extract a hydrogen-gas-rich and environmentally sound gas from the solid by-product.

"With this method, the efficiency – that is, the energy extracted from the biomass – is about 80 percent, compared with the 50 to 70 percent for traditional methods," explains Cortus Energy's CEO and founder Rolf Ljunggren, who has developed the technology under the name of WoodRoll®.

In order to keep track of all the flows, pressures and temperatures, almost 2,500 measuring sensors have been installed throughout the plant. Over 200 of these sensors measure temperature, and to do so, Cortus has chosen sensors from Pentronic.

"We have had a test facility in Köping since 2011, and there Pentronic has clearly shown that it is a supplier who measures up to

The gasification reactor has 14 infrared gas burners, each of which has its own piping and control systems.

expectations," Rolf says. "We haven't found anyone else who does the job better."

He explains that several circumstances make it necessary to have very high demands. Partly, extreme temperatures are involved – 1,100 degrees Celsius for the gasification process – and partly there are large variations in the work temperature, not least during the plant's start-up phase.

Pentronic's Sales Engineer Christophe Zaninotti, who is visiting Skåne on this day to discuss the project with Cortus, agrees:

"It is an extreme process. A lot is demanded from a sensor inside this type of environment. And that requires a lot of experience and knowledge to find the right things."

Out in the beautiful autumn weather, there is full activity and about a dozen people are working even though dusk is approaching. One of them is Fredrick Thyberg from the installation company Svizza.

"We began construction at the end of May and all the mechanical elements have to be connected and ready in November," he says.

The gas plant will be operationally tested next spring and the plan is for it to start supplying gas equivalent to 6 megawatts sometime next summer. Höganäs AB currently has a total energy requirement of 25 megawatts.

"If it goes well, they want to build a plant three times the size, which would supply three-quarters of their gas needs," says Cortus Energy's CEO Rolf Ljunggren.

Cortus Energy's CEO Rolf Ljunggren in front of the company's WoodRoll® facility, which is being built in the Höganäs AB industrial park. The plant will be the first live test of the technology in an industrial setting.

Pentronic's Sales Engineer Christophe Zaninotti does an inspection tour together with Cortus Energy's CEO Rolf Ljunggren to get an update on the situation. In the drum behind them, the biomass is dried at 100 degrees before continuing on for pyrolysis.

CUSTOM EXTENSION CABLES FOR SPECIFIC APPLICATIONS

To connect its temperature sensors quickly and efficiently to installations and measuring rigs, Pentronic can make custom extension cables to facilitate your temperature sensor installation process.

Being able to quickly start measuring with the equipment and later to quickly dismantle it can be important when doing performance measurements and calibrations or taking readings in R&D contexts.

"In order to help our customers with this, we have ready-made extension cables in stock with various types of connector at each end and with both straight or coiled cords," explains sales engineer Per Bäckström.

Per Bäckström showing extension cables.

"But we are also making more and more cables to customer order, both for thermocouples and Pt100s."

Cable requirements vary – for example, a cable might have to withstand a specific demanding environment such as extra high temperatures in a furnace or ambient dampness or dust. It may also be necessary to convert from one type of connector to another.

"Just ask us and we'll offer suggestions that are suitable for different kinds of specific installations," Per concludes.

43 YEARS AT PENTRONIC

1 November 1975 was the first day at Pentronic for the newly employed Boije Fridell.

He strode through the door two minutes late but ever since then he has been among the first to arrive every morning, always with equally good humour and a fun story up his sleeve after a ten-kilometre bike ride or morning walk. Sports and club life have always been close to Boije's heart.

He began his "Pentronic journey" as warehouse manager and over the years he has worked in all departments and has both designed and built temperature sensors. He was also involved in doing the first in-house laboratory tests. After working as a holiday replacement for a few summers, Boije began as a sales engineer and since 1982 he has been Key Account Manager for two of Pentronic's key customers.

At New Year 2019 he will begin a new journey as a retiree after his 43 years with Pentronic.

"It's been fun to be involved and to follow the company for so many years," says Boije, who has also been a part-owner of Pentronic. "It's been full speed ahead and has just expanded. I was the tenth employee to join and now there are a hundred. I've always enjoyed it here and felt it was fun to go to work. That's because I've had such good colleagues and such interesting and varied work, with daily problem solving of sensor designs and various applications. Customer contact has also been an important aspect that I enjoy, and I would like to take this opportunity to thank all the people I've had contact with over the years."

Boije advocating a colour code chart for cables in Pentronic's customer magazine Stopextra from 1999.

PRODUCT INFORMATION www.pentronic.se

PORTABLE WELDING MACHINE FOR FIELD WORK

Pentronic has several models of thermocouple welding machines in its product portfolio.
They include a portable welding machine, model SR50, with a built-in rechargeable battery. The machine enables you to mount and build thermocouples out in the field. The built-in battery lasts for 500 weldings.

The machine's output voltage is adjustable and you can create your own measuring junctions by welding together wires with a thickness up to max. 0.9 mm (approx. 20AWG).

It is also possible to build a surface temperature sensor by welding the measuring junction onto the material whose temperature you want to measure, as long as the surface material is suitable for welding.

The manufactured thermocouple can be used for testing or measuring performance, induction etc.

The SR50 welding machine is built into a well-protected box with a handle, measures 270x250x120 mm, and has a comfortable weight of only 3 kilos. The charger for recharging the battery and operating the machine on mains electricity is included.

Article number 14-00250

WE SUPPORT SOS CHILDREN'S VILLAGES SWEDEN

This year Pentronic is supporting orphaned children by making a donation to the Swedish branch of SOS Children's Villages.
As our valued customer you are taking part in this gift.

STRAIGHT FROM THE LAB

ACCREDITED CALIBRATION IN THE FIELD

SWEDAC ACKREDITERING
Accred. no. 0076
Calibration
ISO/IEC 17025

On-site calibration at our customers' premises is a service that has been expanding for some time now. There are certainly multiple reasons for this but the most common one we encounter is increased requirements from industry for traceability and often accreditation in order to meet various standards such as AMS2750E and NORSOK.

Accredited methods are, of course, the basis for us being able to do these calibrations, but working safely and independently at our customers' premises often requires not only work clothing and various types of protective gear but also various personal certificates. Our personnel have therefore completed a number of certification training programmes, for example:

SSG Entre safety training course is one of Sweden's most widely used courses for an improved work environment and increased awareness of risks at the workplace for industrial employees. SSG Entre includes information about current work environment legislation, general regulations, risks at the workplace and how to best work preventively, plus what should be done if an incident does occur.

Hot work can include welding, cutting, soldering or working with rapidly rotating tools. We call hot work that is a fire hazard and that is done at a temporary workplace Heta Arbeten®.

Mobile work platforms Swedish Work Environment Authority regulations specify that anyone using a lift must be well acquainted with the work and have the necessary theoretical and practical knowledge to ensure safe use.

Fall protection training covers the principles of personal fall protection equipment and the types of equipment required for various kinds of work. Swedish law specifies that personnel who work above a height of two metres where there is no guardrail must have this training.

We are prepared to be able to perform our services reliably and safely out in the field with the certifications required for access to various types of workplaces.

THE "PERFECT EGG" – A MEASUREMENT CHALLENGE

QUESTION: During a business trip to France, we were served a four-course dinner. The starter contained a fully peeled egg. When I cut into it, the white was firm and the yolk was liquid. Our French host told us this was the "perfect egg". How can I cook such an egg?

Martin M

ANSWER: Cooking the "perfect egg" is based on being able to measure the temperature with sufficient accuracy and on understanding the field of heat transfer. In a hen's egg, the egg white coagulates at a temperature of between 60 and 65 °C. For the yolk, the corresponding range is 65 to 70 °C. If you heat the egg to a temperature within the range of 60 till 65 °C, the white will set and become firm but the yolk will not. The heat problem is complicated by the fact that the white contains two different fractions with slightly different setting temperatures and phase transition heats. The relationship between the two fractions also depends on the egg's age.

The egg can be suitably cooked in a water bath that maintains a constant temperature within the range of 60 to 65 °C. A water temperature of 63 or 64 °C is commonly used. The heating process must be controlled with a control system that keeps the water temperature constant. With the aid of a stirrer, the temperature variations in the water bath can be kept very small. The control system requires that you measure the water temperature. It is relatively easy to measure temperature in flowing water. With a calibrated sensor that is correctly installed, the measurement error is very small.

Preparing the "perfect egg" takes considerably longer than the time it takes to boil an ordinary egg, which is usually about five minutes. It takes almost an hour to cook the "perfect egg". The time is determined by the difference between the water temperature and the egg white's setting temperature, the thermal resistance between the water and the area inside the egg where the egg white is setting, and the phase transition heat. In this case, the temperature difference is very small, which is one reason why it takes a long time to prepare a "perfect egg".

To cook the "perfect egg", you can use the same equipment that is used for the "sous vide" cooking method. The term "sous vide" is French and means "in a vacuum". The ingredients or food course are sealed in a vacuum, usually with plastic packaging. The method involves cooking the food at a specific temperature, and this is most easily done in a water bath. An advantage of this method is that the food can be prepared without using cooking fat and the aromas and nutrients are preserved. However, for safety's sake, you should use an external sensor to check that the equipment can maintain a constant water temperature.

If you have questions or comments, contact Professor Dan Loyd, LiU, dan.loyd@liu.se

QUESTION ? ANSWER

Questions should be of general interest and be about temperature measurement techniques and/or heat transfer.

A NEW COLLEAGUE IN A NEW JOB

Pentronic's growth has led us to establish a new position as HR Manager. Cecilia Hedlund began the new job in October.

Cecilia, who trained in human resources management, has extensive experience of HR issues, including from the staffing industry. She comes most recently from Västervik Municipality, where she worked as an HR specialist.

We welcome Cecilia to the Pentronic team!

This edition of Pentronic's temperature school now concludes with quality assurance and calibration. In eight issues over two years, we have reviewed fundamental aspects of temperature measurement, theory and methods. Back in Lesson 3 we discussed traceable temperature measurement, and we will now return to quality assurance with a focus on systemic calibration.

LESSON 8 QUALITY ASSURANCE AND CALIBRATION

ALL THE LESSONS ARE NOW available at our website: www.pentronic.se All the lessons are based on Pentronic's popular courses Traceable Temperature Measurement 1 and 2, which are offered regularly in Västervik and which can also be tailored for a specific industry or technology. The courses give a deeper theoretical insight into temperature measurement but also include practical lab work and guides for calculations as well as for documenting your own measurements.

You are welcome to contact us for more information about our courses.

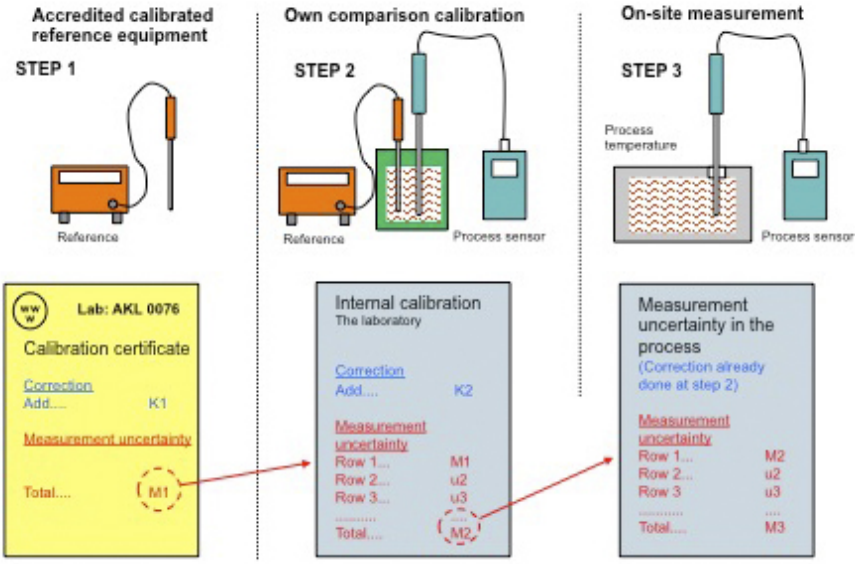
TAKE STOCK OF THE NEED FOR CALIBRATION

If you lack routines for calibration, your first action should be to carefully take stock of your needs. Often there will be many temperature measuring points at varying temperature intervals and requiring different measurement equipment, both new and old. One way to do such an assessment is to use the headings in the table below.

When doing the survey, you need to be extremely careful to document the the measurement uncertainties required by each specifier from the temperature measurement process (based on e.g. standards, quality or regulations).

MEASUREMENT UNCERTAINTY

Often the permitted measurement uncertainties are large enough that you can personally make comparisons to calibrated reference equipment.



However, remember that the measurement uncertainty increases quickly with every comparison. The images above illustrate how measurement uncertainty is added to the chain at each step you take away from the accredited reference calibration.

The measurement uncertainty increases with the number of calibration steps away from the accredited laboratory. Normally, the increase amounts to a factor of 3 to 5 in controlled environments. In industrial environments, it is easy to multiply the measurement uncertainty by a factor of 10. Once again, the choice of type and quality of sensors and equipment has a major effect on the measurement uncertainty along the chain.

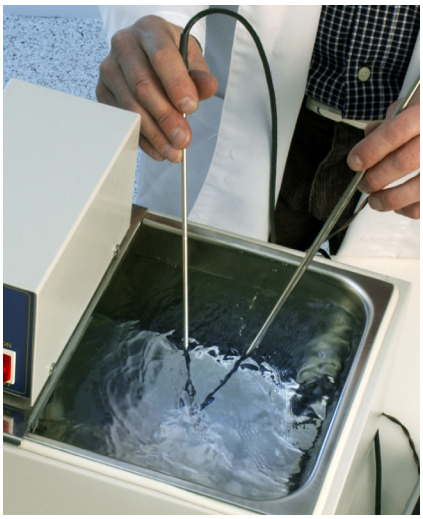
CALCULATING TOTAL MEASUREMENT UNCERTAINTY

The total measurement uncertainty must be calculated based on the values stipulated for your equipment and on your calibration certificates, as well as based on assumptions about error sources. To do this correctly, it is often necessary to have experience of temperature measurement, statistics and calculation tools, experience that suppliers of sensors and instruments can provide.

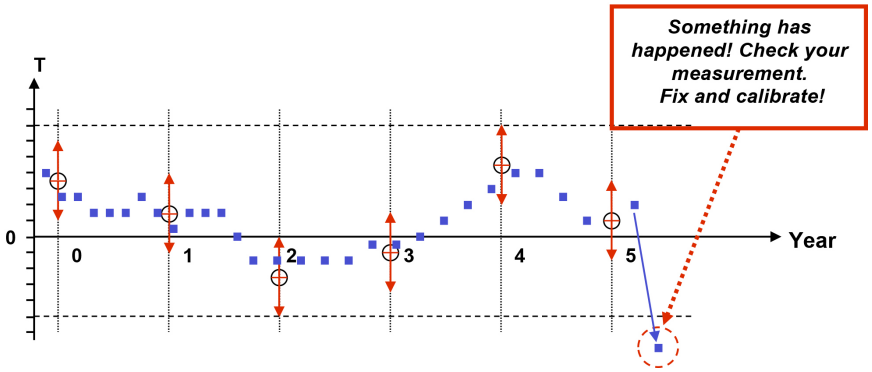
On the next page is an example of what a table of calculated total measurement uncertainty might look like.

	Survey table	Examples of tasks
1	Measuring point	Furnace 1, position A, hanging through the roof
2	Sensor type	Type K thermocouple in an outer protection tube
3	Temperature range	0 – 1000 °C
4	Measurement chain	Directly connected to the temperature indicator, model…
5	Critical temperatures	630 and 870 °C
6	Stipulated maximum measurement uncertainty	+/- 10 and +/- 5 °C respectively
7	Representative measuring point	In the air near the goods in process. Yes until further notice.
8	Special control methods	Temperature consistency at nine points at 630 and 870 °C
9	Suspected error sources	Radiant heat from a radiator?

An example of what may need to be done when calibration routines are introduced.



Calculated measurement uncertainty			
ui	**Uncertainty description, sources**	**Size (C)**	**Distribution**
	Basic uncertainties		
1	Reference equipment, from the calibration certificate k=2	0.2	Normal
2	Operation with the time after the calibration occasion	0.1	Rectangle
3	Resolution & reading errors, reference indicator	0.1	Rectangle
4	Stability in the reference indicator's measurement series	0.1	Range
5	Gradients in the bath or furnace	0.15	Rectangle
6	Resolution & reading errors, the measurement object	0.1	Rectangle
7	Stability in the measurement object's measurement series	0.1	Range
	Other uncertainties		
8a	Temperature operation, reference system, ± x °C	0.01	Rectangle
8b	Temperature operation, measurement object ± x °C	0.014	Rectangle
8c	Gradients over contact	0.01	Rectangle
	± Total measurement uncertainty: 0.3374	**± Rounded off: 0.4**	



Calibration deviation ± measurement uncertainty (the circles with a red cross ± red arrows). The short-term stability is made clear on the calibration occasion. The long-term stability, the operational stability, only becomes apparent after the passage of some time and several calibrations. The blue squares indicate the self-inspection values, which can be offset from the calibrations. However, the trend line of the series of self-inspections should follow that of the calibrations. Major deviation is a warning signal that something has happened.

The procedure for calculating the total measurement uncertainty can be demanding, but remember it is only done once, as long as nothing in your process is dramatically altered. For cases that involve many measuring points, one calculation of total measurement uncertainty can apply to a number of points.

HOW OFTEN DO YOU NEED TO CALIBRATE?

Once a year is a simple rule if nothing else is stipulated. This annual interval presumably has no other reason than that it is easy to remember. Otherwise, the stipulated measurement uncertainty requirements plus the operation experienced between the calibrations should form the basis for the length of the calibration interval. ISO 9001-9002 permits such variations in procedure.

By documenting "experiences", for example by doing regular self-inspections, you acquire a good knowledge basis for making any changes to the calibration interval. The short-term stability is made clear on the calibration occasion. The long-term stability, the operational stability, only becomes apparent after the passage of some time and several calibrations. The self-inspection values can be offset from the calibrations. However, the trend line of the series of self-inspections should follow that of the calibrations fairly closely. Major deviation is a warning signal that something has happened and a spur to start investigating. See the figure on the left.

If you would like to discover even more about temperature measurement, Pentronic offers courses in traceable temperature measurement in Västervik or at your own premises if required. For more information visit www.pentronic.se

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