PENTRONIC NEWS

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IT´S ALL ABOUT TEMPERATURE!

PENTRONIC Scandinavia's leading manufacturer of industrial temperature sensors

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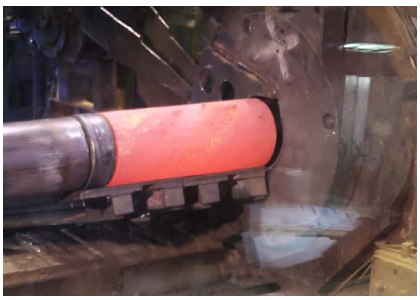
The right temperature transforms scrap metal into pure brass

"We must be sure that the temperature stays within specific margins," says Ronnie Emanuelsson. Behind him the contents of one of the furnaces are being poured into a holding furnace for the casting of brass blanks.

Nordic Brass is Scandinavia's only producer of brass. The process is a closed cycle in which the material is recycled almost endlessly. But many measurements must be taken to ensure the end product is correct.

Better known under the name of Gusums Bruk, the company is associated by many older people with metal zippers, a product that first came out in 1931 but which is now history. The company is still located in the hamlet of Gusum in the province of Östergötland and now specialises in the production of brass semi-manufactured products.

"We produce alloys and other products to customer specifications," explains Ronnie Emanuelsson, who is an instrument technician.



A heated brass blank before it is extruded to make profiles.

Brass is an alloy of copper, zinc and various additives used to create a range of properties. The material is used in everything from water taps to vehicle components. Brass is often hidden under chromed surfaces in products such as handles.

The raw material is mainly recycled brass, copper and zinc. One third is comprised of turnings from customers' processing and swarf from the company's own production.

"The closed cycle works well because we are located relatively close to our customers," Ronnie says.

Nordic Brass manufactures 25,000 tonnes of brass annually. Two thirds is in the form of rods and profiles and one third is in ingot form. Customers are in such industries as heating, plumbing and sanitation, electricity supply and the automotive sector. The company also makes 15 million brass nuts every year.

The first stage of the process is to melt the scrap at a temperature of 1050 °C. The molten metal is then analysed with a spectrometer and then blended to achieve the desired alloy. Temperature measurement is important, both to achieve the desired quality and to keep the furnaces functioning correctly.

"The furnaces have a limited lifespan and are regularly rebuilt," Ronnie explains. "We build the temperature sensors right into the furnaces to monitor their operations so they can be stopped before anything can go wrong. If that happened we would have 20 tonnes of brass in our basement."

The molten metal is shaped into round blanks by using water-cooled moulds in a continuous casting process. The correct temperature is even more important here. If it is too high there will be no casting and if it is too low the metal will stick in the mould.

The blanks then go on to the press line to be reheated and pressed into the customer's desired form. The most common forms are round and hexagonal rods but more complex profiles are also produced here. The ingots are cast on a separate production line.

Temperature is important

Then come several stages of cutting, extruding, pickling, heat treatment and polishing. Throughout the process, temperature is much more than just a measurement reading. It is a tool used to tailor-make the products' properties. The readings are taken mainly with type K thermocouples and IR pyrometers.

"The temperature sensors are regularly inspected using traceable reference equipment," Ronnie says. "We must be sure that the temperature stays within specific margins."

The semi-manufactured products are then finished by industries throughout the Nordic region. Sooner or later they return to Nordic Brass, either as turnings or as scrapped products. The tap in your bathroom could well once have been part of a copper roof that found its way to Gusum and was transformed into brass.

Round and hexagonal rods ready for shipment.

Here are the control functions for the highest delivery performance

There are several reasons for Pentronic's high delivery performance.

Three of them are Annelie Appelqvist, Kristin Nilsson and Camilla Gustafsson.

Everyone who has dialed Pentronic's switchboard has spoken with one or more of them. They guide customers to the right person in the company.

Ensuring reliable deliveries are the main task of Annelie Appelqvist (left), Kristin Nilsson and Camilla Gustafsson.

But their main task is to ensure deliveries.

"We handle the daily order administration and follow up to make sure that the deliveries are made on the right day as specified in the order acknowledgement," Annelie Appelqvist explains.

Reliable deliveries are one of Pentronic's specialities and customers expect their deliveries to arrive as promised.

Delivery performance is measured according to the day specified on the first order acknowledgement for when the shipment is to leave Pentronic.

Kristin Nilsson opens up a file on her computer containing the latest statistics.

"For the period January up to and including May, our delivery performance was 99 percent measured across all our customers," she says.

Other tasks include issuing out and sending the order acknowledgement, sending invoices, creating export documents and keeping the subscriber list updated for this publication, Pentronic News.

Annelie is also responsible for administering Pentronic's courses, a task that has increased recently.

"The latest courses have been fully subscribed," she says.

This article was written before the long summer holidays, because shortly afterwards Kristin Nilsson went on parental leave. Her replacement is Camilla Gustafsson, who together with Annelie Appelqvist continues the work to keep Pentronic's delivery performance at its very best.

Great news from Pentronic

CI Systems is a world-leading developer and manufacturer of electro-optical test systems for civilian and military applications.

Pentronic is now their Swedish representative.

"We already share a number of customers in Sweden," explains sales manager Dan Augustini.

There is a clear link between Pentronic and CI Systems. That link is temperature but the Israeli company approaches the field from the other direction.

"Their systems are based on blackbody radiation," Dan explains.

Blackbodies emit radiation within predetermined wavelength ranges and one of their uses is to calibrate pyrometers. CI Systems' versions of blackbodies have significantly greater surface areas than those used for temperature calibration.

CI Systems supplies both components and complete test systems including analysis software.

This test methodology is being used in more and more fields as various types of sensors are increasingly being used in vehicles, unmanned aircraft systems and production process monitoring.

CI Systems' test systems are used in the development and testing of many products and applications. The most important of these are: telescopic sights, night sights, laser rangefinders, observation systems, thermal imagers, electro-optical sensors, signature analysis and camouflage, systems for missile warning and the simulation of missile signatures.

Equipment is available for laboratories, for monitoring in-line production processes, and for field testing, from UV to far IR.

"CI Systems has had a representative in Sweden but there was no technical support or service in the country. That's what Pentronic adds," Dan says.

With Pentronic as CI Systems' representative, the company's Swedish customers will be closer to technical support and service," says Dan Augustini. (Left) An example of test equipment from CI Systems. The systems use blackbody emitters that range from UV to far IR.

How does a globe thermometer work?

QUESTION: To measure the temperature in our workshop the building services company uses both a radiation-shielded thermometer and a globe thermometer. Why? How does the globe thermometer work?

Åke J

ANSWER: The radiation-shielded thermometer only measures the air temperature. With a globe thermometer – see figure – you take into account both the air temperature and the radiation from hot or cold surfaces and objects in the workshop. In stationary conditions, the measured temperature is determined by the balance between the radiation from the globe to the surroundings and the convection from the air to the globe or vice versa. In a draught-free environment you are measuring a form of "operative temperature", which from a comfort perspective provides better information than the air temperature alone.

If, for example, we measure the temperature inside premises whose walls are colder than the air, the globe thermometer will display a temperature that is somewhat lower than the air temperature. If the readings are taken in premises containing hot furnaces, the globe thermometer will display a temperature that is higher than the air temperature.

A globe thermometer consists of a black, hollow, air-filled metal globe with an outer diameter of 50 –150 mm. The globe wall is thin and consists of a material, such as a copper alloy, with very high thermal conductivity. The globe is clamped to a stem which contains a temperature sensor that is positioned at the centre of the globe. See figure. Nowadays the sensor is either a thermocouple or a Pt100 sensor. If the temperatures of the air, walls, and objects in the globe's surroundings vary, the heat transfer via convection and radiation to various parts of the globe will also vary. In contrast, the temperature of the globe's surface will not vary very much because the globe wall's thermal conductivity is very high, which equalises the wall temperature. That is why we measure a mean temperature.

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

QUESTIONS ANSWERS

The heat transfer from the globe's inner wall to the sensor occurs mainly via convection and radiation. The heat transfer between the wall and the sensor is not very efficient, which results in a long response time. If the globe wall's temperature is constant, after a while the sensor will measure the wall's temperature – the globe temperature. If the air temperature and the temperature of the surroundings vary over time, the globe thermometer will measure a mean value over time.

The velocity of the air in the room influences the heat transfer coefficient and thereby both the globe temperature and the response time. If the air velocity increases, both the response time and the difference between the air temperature and the globe temperature will decrease. The air velocity also influences how a person experiences the comfort level inside the premises, because the heat transfer from his/her body to the surroundings increases with the air velocity. [Ref 1]

The globe temperature only reveals the interaction between convection and radiation inside the premises. To make an even better assessment of the comfort level there, we can use the concept of "equivalent temperature". This takes into account such factors as how a person experiences the influence of the air temperature, radiation and air velocity. Additional influencing parameters are the air humidity plus the individual's activity and clothing.

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

An example of a globe thermometer (50 mm) here with a thermocouple inserted into the centre of the globe. The globe thermometer should be freely installed in the air.

[Ref 1] See further www.pentronic.se > News > Technical info > Examples of heat transfer > "Does a table fan reduce the room temperature?" (2010-4 p. 3)

Investing for greater capacity

A five-axled CNC-operated lathe for small components.

That's Pentronic's latest investment to increase its capacity and thereby handle the greater demand from its customers.

"The investment opens up capacity on our larger lathes and thereby gives us better utilisation of our machinery," explains Managing Director Rikard Larsson.

Pentronic differs from most manufacturers of temperature sensors because it manufactures its own subcomponents in house. This enables greater flexibility and the ability to quickly manufacture special products.

Many of the subcomponents are small and their manufacture currently also involves the bigger lathes, which are needed for large and more complex products. Having yet another lathe for smaller components means the company can produce more products while maintaining its high delivery reliability.

Jonas Waldenstål is unpacking the new lathe.

PRODUCT-INFO

All-new 20-channel temperature logger

The new DATAPAQ TP3 data logger for heat-treatment, paint-curing, and ceramics processes provides more measurement channels and connectivity options than previous instruments. It is easy to use for measuring temperatures and temperature profiles in high-temperature furnaces. With an accuracy of ± 0.3 °C the logger surpasses the most stringent requirements of the AMS 2750E and CQI-9 standards. The new features are:

- New, stronger thermal barriers
- Full data connectivity including Bluetooth
- Fully certified TUS (Temperature Uniformity Survey) capability for AMS 2750E and CQI-9
- Integrated correction and calibration functions
- Inputs for the most common thermocouple types

The new DataPaq TP3 with multiple battery options.

Standards for temperature sensors and wake analysis

Many standards exist for temperature measurement. Some of them govern the sensors' electrical data, others their construction. There are also standardised methods for industry-specific phenomena such as taking high-temperature measurements in steel production or wake analysis plus many other standards. We discuss some of them in this article.

The electrical data for Pt100s are standardised in IEC 60751 (2008), where IEC stands for International Electrotechnical Commission, which means this is an international standard. It refers to temperature as a function of resistance, specifying the tolerance limits for deviations in resistors and assembled temperature sensors respectively, taking into account the type of resistor (wirewound or film). See the table in Figure 1. The standard also prescribes the identification of single and double resistor circuits by means of the colours of the wires inside the connection cable. See Figure 2. The standard also gives advice on test methods to verify that the temperature sensor meets its specifications.

For thermocouples the relevant standard is IEC 60584 (2013), which also contains electrical data about the relationship of temperature as a function of thermovoltage and vice versa. The relevant tolerances are presented, as are the relevant intervals for each thermocouple type, which are currently 10. The thermocouple types are identified in terms of their thermocouple wire, extension cable, and compensation cables (where they exist). See Figure 3.

Build sensors for their measurement task

Standardisation in terms of sensors' outer form is not considered necessary in EU member states. The exception is Germany with its extensive chemical industry, where almost identical pipes and vessels make it desirable

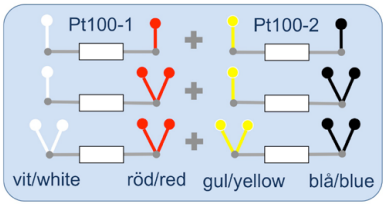


Figure 2. IEC 60751 (2008) prescribes the colour coding of Pt100 sensors' cable wires as shown here. The left column shows the colours for a single Pt100 with red and white on each side of the resistor. If the same sheathing contains a double Pt100, resistor circuit 2 should then be surrounded by yellow and black (grey) colours on the wires.

to standardise the forms and measurements of sensors and protection tubes. This is why Germany has the DIN 43772 (2000) standard, even though sensors and protection tubes should as much as possible be dimensioned to suit their measurement task. Measurement accuracy is frequently in opposition to such properties as durability. Companies that make sensors for the German market are, of course, instructed to follow the DIN standard.

Wake analysis

The American standard ASME PTC 19.3 TW (2010) describes a method of calculating Kármán vortex streets, which can influence fixed thermowells in pipe flows. What can happen is that the wake effect's oscillation frequency can approach the thermowell's natural frequency and thereby cause the thermowell to oscillate violently, with the result that it can break apart or break free from its mounting. Wake-effect oscillations can also be beneficial. A vortex-flow meter uses the flow's oscillation effect as the basis for its flow measurements.

ASME PTC 19.3 TW provides calculation software for various basic types of thermowells made of lathed rod materials. This includes thermowells that are welded in, screwed in, or attached by a flange to a vessel wall, plus straight, conical, and two-step diameter-reducing shapes. A customer need only input data on the measurements, material and shape of the thermowell plus data on the relevant measurement environment. The software will then calculate the disruptive oscillation frequencies and state whether or not they are at safe levels in relation to the thermowell's natural frequency.

Pentronic offers wake analysis as an optional service.

*Figure 3. IEC 60584 (2013) contains 10 different thermocouple types, which are identified by colour where possible. *) Types C (WRe5-WRe26) and A (WRe5-WRe20) have been included in the standard but (to the best of our knowledge) their colour codes have not yet been assigned. The code for type C in the figure is that given in the de facto standard.*

Tolerance classes for Pt resistors				Tolerance classes for complete Pt sensors			Tolerance for temperature T
Wirewound (W)		Film type (F)			Temperature range [°C]		[°C]
Tolerance class	Temperature range [°C]	Tolerance class	Temperature range [°C]	Tolerance class	Wirewound (W)	Film type (F)	
W 0.1	-100 – 350	F 0.1	0 – 150	AA	-50 – 250	0 – 150	± (0.1 + 0.0017·|T|)
W 0.15	-100 – 450	F 0.15	-30 – 300	A	-100 – 450	-30 – 300	± (0.15 + 0.002·|T|)
W 0.3	-196 – 660	F 0.3	-50 – 500	B	-196 – 600	-50 – 500	± (0.3 + 0.005·|T|)
W 0.6	-196 – 660	F 0.6	-50 – 600	C	-196 – 600	-50 – 600	± (0.6 + 0.01·|T|)

Figure 1. IEC 60751 (2008) has adapted its standard to suit today's Pt100 resistors and assembled Pt100 sensors.

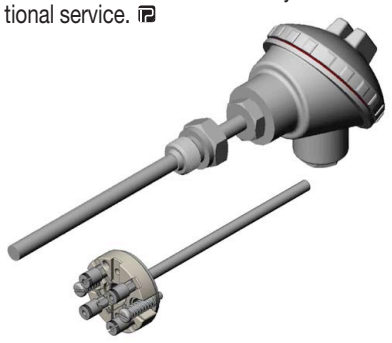


Figure 4. DIN 43772 (2000) describes various types of construction of sensors designed to operate in pipes and vessels. Shown here is a modified "form 2" (previously "form B") with a short neck and replaceable Ø 6 mm measurement insert. The air gap between insert and protection tube is eliminated by a metal bushing to improve heat transfer to the Pt100 resistor.

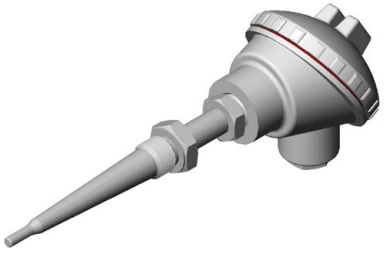


Figure 5. A thermowell's protruding section up to the probe tip has a resonance frequency, in this case two. The wake frequency of the flow influences the sensor with oscillations, which are governed by the construction, material and measurement environment. The ASME PTC 19.3 TW (2010) standard presents a method for determining if the wake frequency is limited enough not to initiate destructive resonance effects.

If you have questions or comments, contact Hans Wenegård: hans.wenegard@pentronic.se