PENTRONIC NEWS

PENTRONIC Scandinavia's leading manufacturer of industrial temperature

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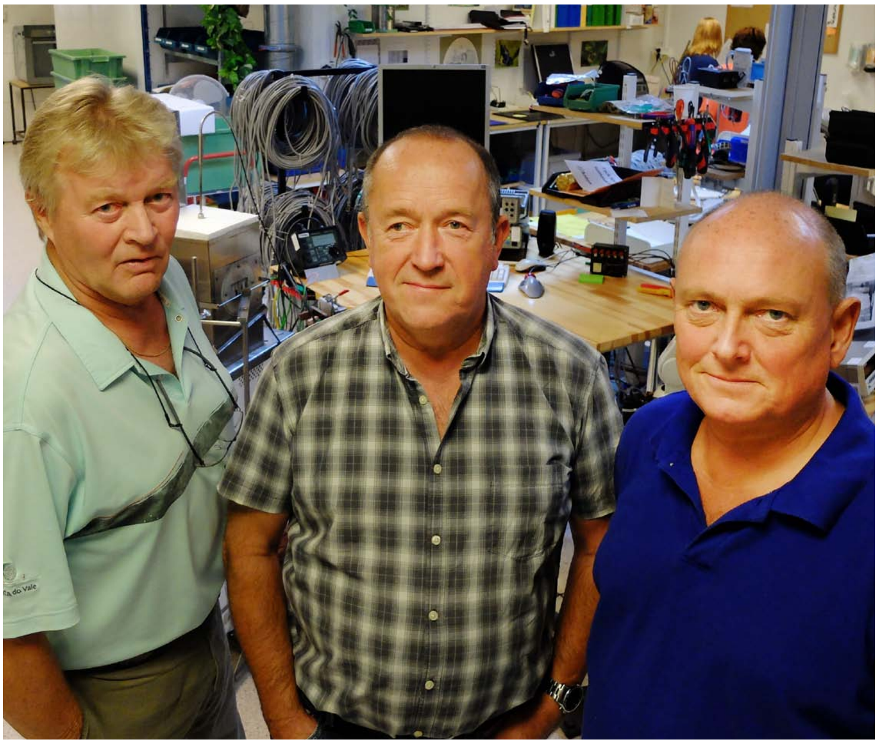
Gedevelop is now part of Pentronic



Gedevelop's team visit Pentronic. From left: Gerry ter Laak, Per Holmgren and Per Johansson.

Gedevelop has been acquired by one of Europe's leading manufacturers of industrial temperature sensors, the Swedish company Pentronic.

"Our new home will give us the resources to keep on developing our technology," comments Per Johansson, R & D Manager at Gedevelop.

Pentronic and Gedevelop were previously fellow subsidiaries of Indutrade, an industrial group of 180 companies listed on the Nasdaq OMS Stockholm. Gedevelop is now part of Pentronic under its own brand.

Pentronic is northern Europe's leading manufacturer of industrial temperature sensors. Customers include some of the world's leading equipment manufacturers in sectors such as food, steel, metal and heat treatment, medical technology, energy, automotive manufacturing and marine applications.

Resources for development

Pentronic's hallmark is close collaboration early on in the customer's product development process. Pentronic customises sensors in order to optimise performance, raise quality, lower energy consumption and reduce installation costs. The company also has its own accredited calibration laboratory for temperature sensors. The laboratory's performance is at the same level as that of many countries' national standards laboratories.

The company's latest major development project involves digital temperature sensors and a digital signal bus. The result is both improved measurement performance and simpler installation compared with traditional analogue systems.

Gedevelop is the world leader in glass flow measurement in the manufacture of fiberglass insulation. The GFM camera system has the corresponding effect on product quality and costs as Pentronic's temperature sensors do. Ninety-nine percent of the installations are outside Sweden.

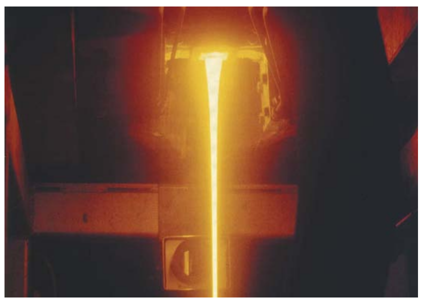
Similar camera system

The companies have other features in common. Pentronic has been working for many years with similar camera systems for the non-contact measurement of things like moisture and fat content. In addition, the GFM system is linked to temperature sensors in the nozzle, which directs the molten glass down into the spinning fiberizer. The GFM system measures and controls the flow from the nozzle.

"Through Pentronic we will get the resources and complementary know-how to develop future products and maintaining service for present customers," Johansson says.

The merger is happening now partly because since the beginning of 2014 Gedevelop has focused on the GFM system, after selling its business that included systems for the inspection of container glass. Gedevelop is also now undergoing a generational shift. Gerry ter Laak has been in charge of sales for many years and will soon retire. He will be succeeded by Per Bäckström, who has worked at Pentronic for many years with various types of non-contact measurement technology.

Per Johansson shows the camera that has made Gedevelop the world leader in the measurement of mass flow rates in the manufacture of fiberglass insulation.



Glass flow to be measured.

A question to the professor sets off a chain reaction

Some of the questions answered here in Pentronic News by Professor Dan Loyd of Linköping University may seem commonplace. But what appears to be a simple question from our readers can lead to both project work and changes in university engineering courses.

Pentronic has collaborated for many years with the division of Applied Thermodynamics and Fluid Mechanics at Linköping University. The university is highly advanced in measurement technology and another field of importance to temperature measurement: heat transfer. This expertise is of great value to Pentronic and its customers. But what use is the collaboration to the university?

"Most of our students will get jobs in industry and we need to introduce more industrial reality into our courses," explains Professor Loyd, who is now an emeritus professor but still active.

His successor as professor, Matts Karlsson, shares his predecessor's view that industrial practice is of decisive importance to both education and research.

"In some fields, academia has become too theoretical," Professor Karlsson says. "Not enough attention is being paid to rudimentary steps such as where a sensor should be placed in order to measure what you want to measure."

The answer is for academics to work together with the outside world. In the world of theory and software programs, it is often presumed that various parameters are stable, for instance that the ambient temperature is always constant. But reality is seldom like that.

University students will be working in a complex world that includes technology, economics and management.

"One of our goals is for our students to understand how technology is used within a business context," Karlsson says.

In this situation temperature sensors play a tiny role but it is one that is becoming increasingly important. The more computational power that is available to researchers and industries, the more sensors of various types are needed to provide the input data. A single wrongly placed sensor is enough to sabotage sophisticated algorithms.

In Linköping projects are constantly being done in which temperature measurement is of critical importance. Johan Renner is a university lecturer in the field of heat transfer. He gives examples of current projects:

"For Tekniska Verken in Linköping, a large local supplier of district heating, electricity etc., we're looking at how to best melt snow and ice on roads and pavements, and how to store the summer's excess energy for district heating in geological repositories."

These are sophisticated problems but even for them, a simple question in Pentronic News can be enough to set off a chain reaction that gives the students a nut to crack, the questioner an answer, and Sweden more engineers who are grounded in reality. In some cases the question can also lead to a research project.

"We need to introduce more reality into our educational courses," say Professor Emeritus Dan Loyd and his successor Matts Karlsson at Linköping University. That is why the university has been cooperating for many years with companies such as Pentronic.

You're holding a 25-year-old magazine

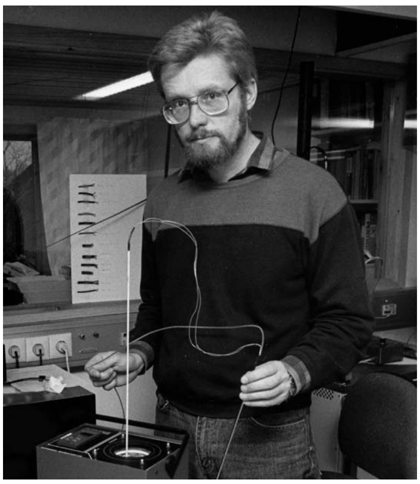
The magazine you're holding in your hand is celebrating its 25th anniversary.

The Swedish edition began in 1990 to give Pentronic's customers better knowledge in the field of temperature – not just about products but also about the technology and natural laws.

"Knowledgeable customers order the right products and understand the limitations, which makes life easier for both them and us," explains Hans Wenegård, who has been responsible for the magazine since the first issue.

A growing number of Pentronic's customers are outside Sweden so since 2008 the company has also published an English edition, Pentronic News.

Ever since the first issue, the customer magazine has had a clear structure with the emphasis on knowledge transfer. The contents include customer descriptions of their measurement problems and solutions, an in-depth technical article about measurement problems and methods, a report from the accredited laboratory, and the Q&A column hosted by Professor Dan Loyd of Linköping University.



Hans Wenegård explains the concept of traceability in the customer magazine's first issue of 1990.

There are also news of products and other developments at Pentronic.

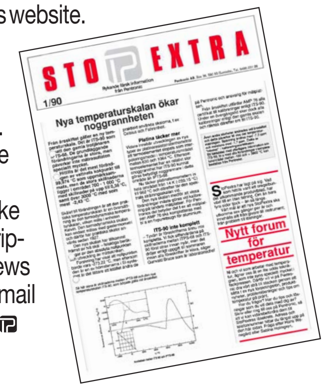
The large amount of knowledge in the magazine means that issues can also be saved.

"That is gratifying and proof that our customers want to acquire knowledge not just product information," Wenegård adds.

Faithful readers will have noticed that the number of issues per year has fallen from six to four. This is due to the Internet and the fact that much of the content has been moved to Pentronic's website.

Of course you can download Pentronic News from the website: go to www.pentronic.se and the heading "News".

If you would like your own free subscription to Pentronic News in paper format, email info@pentronic.se.



The temperatures of refrigerant in a geothermal heat pump

QUESTIONS ANSWERS

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

QUESTION: In my home's geothermal heat pump, with a heat exchanger installed inside a borehole, I want to measure the temperatures of the incoming and outgoing refrigerant. Can I use a surface-mounted sensor or must I use thermowells? The tubing for the refrigerant has an outer diameter of 30 mm and is surrounded by thin metal netting. The insulation is 30 mm thick. The air temperature inside the room where the two sets of tubing enter the house is fairly high – about 25 °C.

Lasse S

ANSWER: The refrigerant's incoming temperature normally lies in the range of +5 °C down to a few degrees below 0. The return temperature is 2 –5 °C lower. The time of year and the installation's construction and operation determine what the temperatures will be. The difference between the fluid's incoming and outgoing temperatures is needed to calculate the installation's efficiency and energy supply. Under normal operation the refrigerant's temperature varies very slowly over time, and the measurement problem can therefore be regarded as stationary.

We can use an insulated sheathed thermocouple as a temperature sensor, lay the thermocouple on the outside of the metal netting and attach it with a cable tie or hose clamp. A thermocouple with an external diameter of 1.5 – 2 mm is easy to handle. The thermocouple should run about 25 mm in the axial direction on the outside of the metal netting before you let the thermocouple exit radially through the insulation. It is important that the thermocouple is calibrated and that the insulation is as good as possible when it is restored after the thermocouple installation, see the diagram. It is also important that the thermocouple installation is the same on both sets of tubing to reduce the error in the temperature difference.

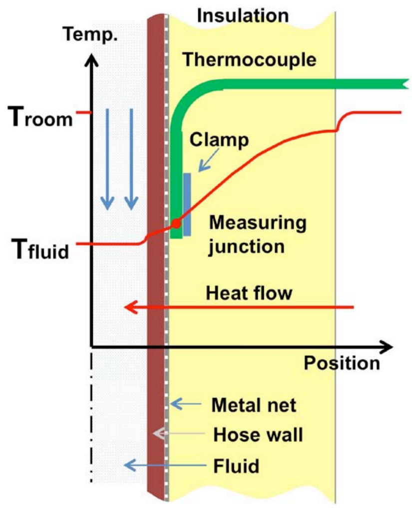
Heat from the warm room will be added to the fluid and the temperature sensor will therefore measure a higher temperature than the temperature of the fluid. The heat transfer from the room to the outside of the insulation occurs via natural convection and radiation. Inside the insulation, the metal netting and the tubing wall, heat transfer occurs via thermal conduction. The heat transfer from the tubing wall to the fluid occurs via forced convection; see the diagram.

Estimate the measurement error

Based on the information given in the question plus some supplementary assumptions it is possible to estimate the measurement error. The total heat transfer coefficient on the outside of the insulation is 8 to 10 W/(m²K) and this value includes both natural convection and radiation. The thermal conductivity for the insulation and tubing is assumed to be 0.04 W/(m²K) and 0.4 W/(m² K) respectively. The thickness of the tubing wall is assumed to be 3 mm. The velocity of the fluid is estimated at 1 m/s, which gives a heat transfer coefficient of 1300 - 1700 W/(m²K). The effect of the metal netting on the heat flux is neglected and the heat transfer is assumed to be one dimensional.

The measurement error can now be estimated at about 0.5 °C and the error becomes somewhat larger on the return tubing than on the incoming tubing even if you have the same type of installation. Based on the measurement and the added assumptions we can also calculate the actual temperatures of the fluid. The error with respect to the temperature difference will be very small but the temperature difference is also small. As usual, whether or not the measurement is acceptable must be decided from case to case.

The advantages of surface-mounted sensors are that they are fairly easy to install in an existing installation, they do not disrupt the fluid flow and they do not cause any pressure drop. One prerequisite is that there is good close contact between the sensor and the metal netting. It is therefore necessary to inspect the installation regularly.



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

New design of dry block calibrators

Pentronic is presenting a new series of dry block calibrators from Isotech. The temperature range is -45 to 1200 °C with furnaces that can be used as dry block or stirred baths to calibrate Pt100/Pt1000s, thermocouples and thermostats. Optionally the furnaces can be used to calibrate IR pyrometers and surface temperature sensors.

The series has a built-in three-channel temperature indicator that permits the simultaneous measurement of reference and calibration sensors with resolution down to 0.001 °C.

The furnaces can automatically ramp and log data between several pre-programmed temperatures. The measurement data can be further transmitted via USB and Ethernet connections. The software is included.

STRAIGHT FROM THE LAB

SWEDAC ACKREDITERING 0076 ISO/IEC 17025

Tolerance indications are a perishable commodity so calibrate to know about the uncertainty

The current standard for thermocouples is IEC 60584:2013. [Ref 1].

"It's important to know that the tolerances given in the standard only apply to unused thermocouples," says Lars Grönlund, manager of Pentronic's accredited calibration laboratory. Thermocouples are thus a perishable product in the sense that they alter more or less rapidly depending on their type and measurement environment. For example, in only five minutes at 450 °C the sensitivity of type K thermocouples can change so that the deviation becomes almost +3.5 °C [Ref 2].

IEC 60584 gives tolerances for various thermocouple types. For non-calibrated sensors, these tolerances apply for calculating measurement uncertainty etc. For calibrated sensors, the actual result together with the associated measurement uncertainty calculation is what applies. Lars Grönlund gives an example for the common thermocouple types, K and N:

"If the IEC standard promises that the tolerance is ± 4 °C at 1 000 °C then we can use calibration to achieve a measurement uncertainty of less than ± 1 °C. Under favourable conditions it is possible to go even lower."

Further examples are available in [Ref 3]. These examples prove the value of having critical temperature sensors calibrated often instead of relying on tolerances in accordance

See: www.pentronic.se:
[Ref 1] See: To download > Useful links > Thermocouples: IEC 60584:2013
See: News > Pentronic News > Archive
[Ref 2] Pentronic News 2010-1 page 4.
[Ref 3] Pentronic News 2011-5 page 4.

The economic advantages of noble metal thermocouples

The term 'noble metal' often makes people think of expensive materials. This also applies to noble metal thermocouples such as the most common models of types S, R and B. It is easy to become fixated on the purchase price but instead it is important to weigh in the life cycle cost. Then the economics of noble metal thermocouples are much better.

Types S, R and B thermocouples all contain noble metal. The highest stated operating temperature for a reasonably long operating time is usually 1350 °C for types R and S, whilst type B can be used up to 1750 °C. It is impossible to give an exact number of hours for the operating time within a specific tolerance interval. The local environmental conditions at the sensor's position are very important, as are the installation conditions. For example, the operating time for type B increases dramatically if you restrict the operating temperature down to around 1350 °C. There are almost no alternative standardised thermocouples for oxidising environments for operation at over 1200 °C. Since 2013, types C and A thermocouples (tungsten-rhenium compositions [Ref 1] are indeed included in the IEC standard for temperatures about and above 2000 °C, but primarily for use in vacuum environments.

Scrap value of the wires

As the name suggests, noble metals have a significant economic value. However, even used platinum wire, both with and without added doping materials (e.g. rhodium) can be refined and then reused, and is therefore repurchased by the manufacturers. This can significantly reduce the cost of the wire.

The market is dominated by two wire diameters, Ø 0.5 and Ø 0.35 mm, although other dimensions also exist. Ø 0.5 mm wire contains twice as much material as the thinner version per unit of length because the volume is double. A thicker wire will give greater lifespan at the higher end of each respective temperature interval because there is more material for the surrounding environment to attack and "use up" and thereby to gradually transform the pure platinum into other products, which can have a different sensitivity, or merely to deplete part of the area of the wire. When none of the electrically conductive original material remains, the instrumentation perceives this as a break in the wire.

Defects in crystal structures and impurities that are unavoidably present from the start in newly manufactured wire both affect the sensitivity, which is also called the Seebeck coefficient. When the wires are drawn down to thinner and thinner dimensions, the affected material is "smeared" farther out along the wire. This will probably lead to a larger proportion of the temperature gradient [Ref 2] encompassing the affected material, which increases the measurement error. This applies even more to sheathed base metal thermocouples. See Figure 1.

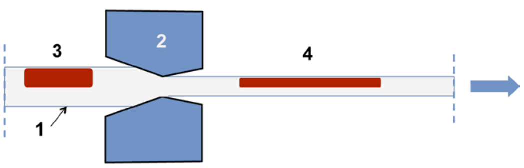


Figure 1. To suit the diameter to commercially used measurements, a thermocouple wire or a metal-sheathed thermocouple (1) is drawn through draw plates (2) equipped with smaller and smaller holes. An unavoidable impurity (3) from the alloy melt will also therefore in principle be reduced radially according to the draw plate hole. This thereby increases the length of both the impurity and the wire. See (4).

K and N the most robust

Ordinary types K and N thermocouples become more and more unreliable when used at very high temperatures. The limit for the base metal thermocouples is usually set at 1000 – 1200 °C. The term 'base metal' already indicates that the alloys used in the wires are much more likely to react to their surroundings than is the case with noble metals, which first start to react at higher temperatures than those just mentioned. This predisposition to react is one of the factors that determine the temperature limits.

In the cases when priority is placed on rapid response time and robustness, and when the operating temperature is not too high, types K and N metal-sheathed thermocouples can still be preferable over the "slower" types S, R and B thermocouples, all of which must be sheathed in very pure ceramic, Al_2O_3, which makes them more susceptible to mechanical damage and heat stresses when they are replaced during operation. See Figure 3. According to the standard, types R/S have a tolerance of ±3 °C at 1200 °C whilst types K and N are at ±9 °C. However, types K and N degenerate quickly at this temperature with a resulting high maintenance cost. See Figure 2.

Thermocouple type	Tolerance before use, °C	
R and S	T < 1100: 1100 < T < 1600:	±1 [±1 + 0,003 • (T-1100)]
B	600 < T < 1700:	± 1,5 or 0,0025 • T
K and N	1000 < T < 1200:	± 2,5 or 0,0075 • T

Figure 2. A comparison of tolerances in accordance with IEC 60584:2013 for the relevant thermocouple types and temperature intervals. Note that the tolerances only apply to unused thermocouples.

To summarise, noble metal thermocouples are not necessarily very expensive when their scrap value, lifespan and maintenance costs are included in the total calculation. In addition, noble metal thermocouples have much better measurement performance than types K and N.

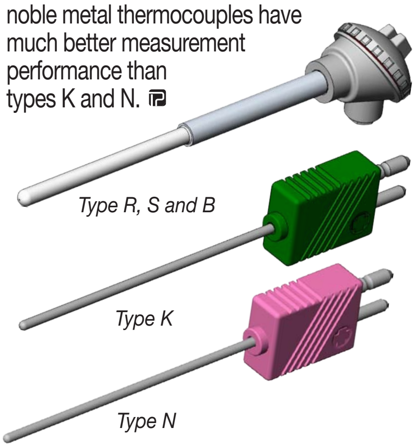


Figure 3: The noble metal wires for types S, R and B thermocouples must be sheathed in very pure ceramic to protect them from the measuring environment. The insulation consists of, for example, a two-bore rod surrounded by a closed protection tube. In metal-sheathed thermocouples like types K and N, the wires are integrated in densely packed magnesium oxide acting as electrical isolation, which in its turn is enclosed in the metal sheath. This compact construction gives excellent heat transfer with a short response time compared with the ceramic construction.

References see www.pentronic.se > News > Pentronic News > Pentronic News Archive
[Ref 1] Pentronic News 2014-2 p 4
[Ref 2] Pentronic News 2012-1 p 4

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