PENTRONIC Scandinavia's leading manufacturer of industrial temperature sensors

NO. 2018-3

PENTRONIC NEWS

It's all about temperature!

MEASUREMENT IS THE KEY TO FIRE-RESISTANT STRUCTURES

CONTINUED ON PAGES 2-3

We're now gearing up for the autumn!

After a record-hot summer with many enjoyable events in Västervik, such as the Visfestivalen music festival, which has been an annual event since 1966, the inauguration by Björn Ulveaus of the hotel, restaurant and apartment complex Slottsholmen, and the Swedish Floorball Open tournament, we are now gearing up for the autumn.

Part of our strategy is the introduction of digital solutions to improve our efficiency and customer benefit. One such initiative is our new LinkedIn profile, where you can read about what is happening here. Do follow us there!

We have a few new faces with whom you might come into contact: Josefin Knutsson, Quality and Environmental Systems Manager, Niklas Wiman, Key Accounts, and Jens Jupiter, Inside Sales.

We are also continuing to develop our business by expanding our accreditation. See the article in this issue.

After a fantastic 2017, in June I had the honour of receiving the award for Indutrade's best company, something we are incredibly proud of.

And now we're back up at full speed again!

Rikard Larsson
Managing Director

MEASUREMENT IS THE KEY TO FIRE-RESISTANT STRUCTURES

Christophe Zaninotti from Pentronic and Morgan Lehtinen from RISE Fire Research in front of a simulated engine compartment for doing fire testing.

In the centre of the large test hall of RISE Research Institutes of Sweden in the city of Borås stands part of a standardised bus. It simulates an engine compartment.

"Here we are testing systems for extinguishing engine fires," explains Morgan Lehtinen, who is in charge of measurements and a project manager at RISE Fire Research.

RISE RESEARCH INSTITUTES OF SWEDEN is the result of a merger of various research institutes in Sweden. They include the leading fire testing expertise at Sweden's former national testing institute SP. Testing how to put out fires in bus engines is a small part of the organisation's activities.

"We have four halls for testing, development and research," Morgan says.

During our visit a research project was underway. Unfortunately we are only able to describe it in general terms. In one of the halls, a miniature tunnel had been built. Over the years, a number of deadly fires have occurred in road tunnels. The project is led by Dr. Li Ying Zhen, a researcher at RISE.

"We are mapping how heat and smoke spread in tunnels," he says and gives an example of a problem that needs to be solved:

"We are mapping how heat and smoke spread in tunnels," he says and gives an example of a problem that needs to be solved:

"Why is it that people can be standing on one side of a tunnel fire and not be affected while at the same time the other side is filled with smoke?"

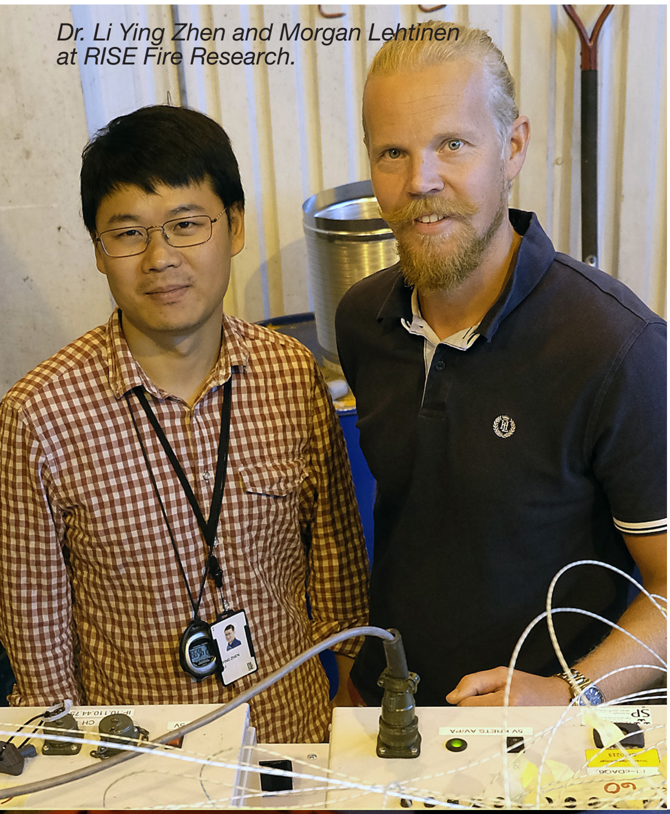
The knowledge gained will be used at the next stage to increase fire safety in tunnels and similar structures.

The four test halls in Borås are used for different purposes. The two largest are used to test fire resistance and fire dynamics respectively in vehicles or buildings. To test fire resistance, the test products are placed on the top of or in front of a furnace. The fire has no direct contact with the test objects; it is the radiation from the flames that can set them alight.

"Fire dynamics involves mapping how much energy is developed when a product burns," Morgan explains.

Inside the large halls, not only vehicles but also structures such as building facades or entire buildings can be burned.

The two remaining halls are the medium-size hall and the materials hall. Inside the former, smaller products are tested, and the latter, as its name suggests, is used for materials testing. RISE also does testing in the field.


Dr. Li Ying Zhen and Morgan Lehtinen at RISE Fire Research.

Examples of projects include fire safety engineering design, testing firefighting systems, support in the development of standards and legislation, certification of products, and support for CE-marking.

At this level the tests and trials must be documented, traceable and repeatable. They are confirmed by measurements, including of temperature, which is why this article is being published in *Pentronic News*. Pentronic has been a supplier to a number of the RISE units for years. For example, it has been involved in developing sensors to improve measurements in fire-testing furnaces. These methods and sensors have been the European standard in fire research for the past 20 years.

Temperature is an important quantity in determining what effects are generated by fires.

"We can use more than a hundred thermocouples during a single test," Morgan says.

"We can use more than a hundred thermocouples during a single test," Morgan says.

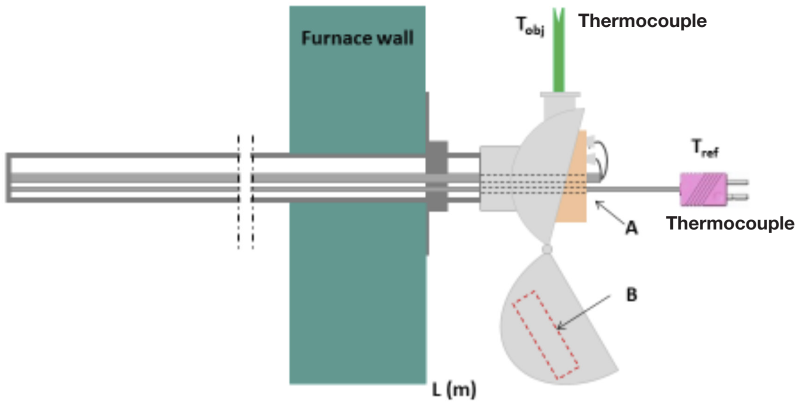
Depending on the importance of the tests, new temperature sensors are used every time to avoid the material changes that unavoidably occur in thermocouples at high temperatures.

In addition to heat and radiation, fires also produce large amounts of smoke. For this reason, RISE has a high-efficiency purification facility, which also recovers energy from the fires. As a result, the fires can burn fiercely inside the test halls without disturbing the neighbours or releasing dangerous substances into the surroundings.


Morgan Lehtinen, who is in charge of measurements and a project manager at RISE Fire Research inspects an on-going fire test.

CUSTOMISED SENSOR WITH IN-SITU TUBE MAKES CALIBRATION EASIER

In-situ calibration – practical installation



The reference sensor is inserted inside the extra tube that is inside the existing terminal block, see A.

To make life easier for customers who require continuous repeat calibrations, Pentronic manufactures thermocouples and Pt100s with an in-situ tube.

The main benefit of having a tube installed especially for the reference sensor is the time saved, because the process sensor does not have to be removed to be calibrated. Another benefit is that the calibration can be performed without using a calibration furnace, as long as the required production temperature can be maintained.

It is worth noting that with this system, the limited space inside the installed in-situ tube often makes it necessary to use a thin reference sensor during the calibration process. This can affect the reference sensor's accuracy and lifespan.

The design of sensors with an in-situ tube can vary and depends on several factors, such as the sensor model involved, the process temperature, the type of furnace etc. The final design of an appropriate sensor is therefore often the result of a discussion with Pentronic's sales team, who are very willing to answer questions and make suitable suggestions.

A SUCCESSFUL RELAUNCH OF THE COURSE "TRACEABLE TEMPERATURE MEASUREMENT 2"

Course instructors Jonas Bertilsson and Michael Steiner agree that the relaunch of the course "Traceable Temperature Measurement 2" was a success.

After an interval of several years for the course "Traceable Temperature Measurement 2", it was time for a relaunch in May. The sought-after three-day course with its emphasis on calibration and measurement uncertainty was given in Västervik and included a full day at Pentronic's laboratory.

The course is a follow-up to the popular basic course in traceable temperature measurement, which Pentronic offers several times each year, and has done so ever continuously since 1991, both at our Västervik location and at customers' premises on request.

The satisfied course instructors agree that the relaunch was a success, with hardworking and engaged participants who all already work with temperature measurement in one way or another. In this way, the course also functions a forum, where participants can compare experiences and discuss and get solutions to measurement problems that they have already encountered or might encounter in future.

The course participants also appeared to be satisfied, based on a summary of comments they made on the course evaluation. They described the course as well-composed with professional and skilled instructors, relevant lab exercises in a "live" environment, and well-received uncertainty calculations. A new "Traceable Temperature Measurement 2" course is now planned for May 2019. More information and a downloadable course folder are available at www.pentronic.se.

PRODUCT INFORMATION www.pentronic.se

WIRELESS TEMPERATURE LOGGER WITH BLUETOOTH COMMUNICATION

Pentronic can offer the Bluetooth logger ThermaQ Blue, which has dual channels and miniature female connectors, and measures temperature with the aid of a type K thermo-couple.

The instrument has the measuring range of -100 to 1370 °C and can be used with most of our own thermocouples. The unit has a display with built-in lighting, which alternates between the two channels and has indicating LEDs that show if any of the installed alarms has been activated and whether logging is occurring.

By using the ThermaQ app (downloadable free from the App Store or Google Play), you can manage your measurements and share your results.

The software can show the readings in table format or as temperature curves, and can be copied or emailed.

The wireless range between the data logger and the unit containing the installed app is up to 50 metres.

Article number 13-40300-BT.

The unit operates on ordinary alkaline AA batteries, which are easy to change and last for 4,000 hours of normal operation. The instrument is well protected and has the protection rating IP 67 (splashproof). For further information contact Pentronic.

WE CONTINUE TO REINFORCE THE PENTRONIC TEAM

Niklas Wiman, Jens Jupiter and Josefin Knutsson.

Pentronic welcomes two new colleagues who joined the company after the summer plus a well-known face in a new position within the company.

From left: Niklas Wiman, who previous-ly worked as Team Leader and Account Manager with Akzo Nobel, is now a new member of Pentronic's sales team. Jens Jupiter has worked at the company for 23 years, the past 15 as Production Manager, and is a well-known face at Pentronic. He now brings his product expertise to the Inside Sales team. Josefin Knutsson has extensive experience from various types of industry, most recently as Quality Manager at 3M. She replaces Kristina as the new Quality and Environmental Systems Manager.

STRAIGHT FROM THE LAB

EXPANSION TO THE SCOPE OF OUR ACCREDITATION

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

During the autumn of 2018 we will be expanding the scope of our ac-creditation. This change is totally in line with our ambition to develop and improve our methods while at the same time satisfying our customers' wishes and requests.

At this time we will implement the following changes/improvements to the scope of our accreditation:

1. Change to the measuring range for resistance thermo-meters at our accredited cali-bration laboratory in Karlstad

This change means that our calibration laboratory in Karlstad will be able to perform within accreditation comparison calibrations of resistance thermo-meters within the measuring range -80 °C up to 425 °C. Previously the upper limit was 250 °C.

2. Calibration of pyrometers on site at the customer's

With this addition to our already extensive scope of accreditation for field calibrations, we will now be able to offer our customers an even greater possibility of having basi-cally all their temperature measuring equipment calibrated on site.

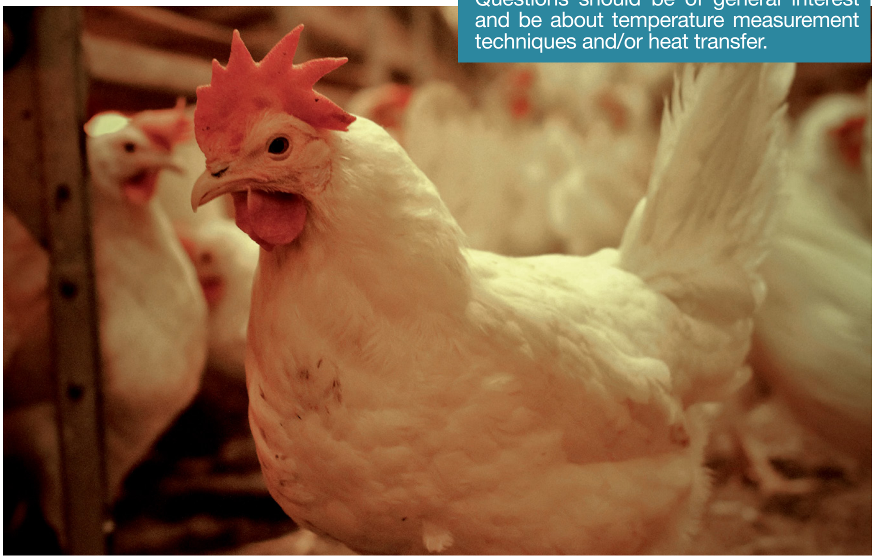
AIR TEMPERATURE INSIDE A HEN SHED

QUESTION ? ANSWER

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

QUESTION: We measure the indoor temperature in a large shed that houses laying hens on one of our experimental farms. To take the measurements, someone has previously installed a type K sheathed thermocouple with a 3 mm diameter. The thermocouple is mounted on an inner wall of the shed and the tip is very close to the wall. Unfortunately the wall sometimes gets extremely dirty and the thermocouple disappears inside the dirt. Is it possible to estimate how the dirt affects the measurement error?

Malin A



ANSWER: If we start by assuming that the air temperature inside the shed is constant, then both the inner wall and the thermocouple will adopt the air temperature. We then assume that we can disregard any possible effect of radiation from warm or cold surfaces inside the shed. If the thermocouple is calibrated and correctly installed, it will measure the air temperature under stationary conditions. If the thermocouple gets dirty, nothing really happens to the temperature measurement process as long as the temperature inside the shed is constant. The inner wall, the thermocouple, and the dirt will have the same temperature. The measurement error will be the same as for the clean thermocouple.

In contrast, if the air temperature inside the shed is altered, then the response time will be extended when the thermocouple is dirty compared with when it is clean. The dirt acts as insulation, and the heat transfer between the air and the thermocouple is reduced compared with when a clean thermocouple is involved. The reduced heat flow affects the temperature of both the thermocouple and the inner wall, which makes the response time longer. Whether or not the longer response time is acceptable must be determined from case to case. The air temperature inside large sheds normally varies by up to a few degrees, and you should therefore use several temperature sensors so you can determine the average temperature.

In conclusion, under stationary conditions the measurement process is not affected by the presence of dirt. When time-dependent processes are involved, the presence of dirt will extend the response time. If the temperature sensor were to be located on an outer wall of the shed, both the stationary and the non-stationary measurement process can be affected by the presence of dirt. The reason is that the heat transfer through the outer wall lessens when the wall is dirty. This affects the temperature field and thereby the measured temperature – increasing the measurement error.

In the case discussed here, the sensor was a thermocouple inside a hen shed but the conclusions also apply to other types of sensors in totally different environments.

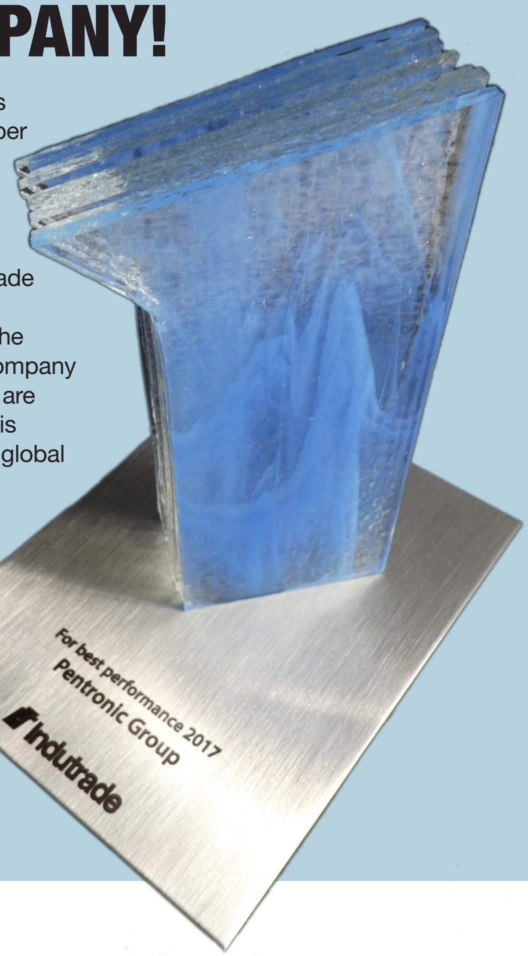
If you have questions or comments, contact Professor Dan Loyd, LiU, dan.loyd@liu.se

PENTRONIC IS INDUTRADE'S BEST COMPANY!

Each year Indutrade ranks its companies based on a number of key figures. In 2017 Pentronic was number 1 on the list, which includes over 200 companies in the total of 28 countries where Indutrade has operations.

We have previously won the award as the group's best company six times. It is something we are incredibly proud of, as there is challenging competition in a global marketplace.

The award, which proves our strategy continues to be successful, was received by our Managing Director at a group-wide meeting in June.



Following a brief presentation of the construction and applications of the thermocouple in Lesson 6, in this issue the temperature school will discuss the resistance thermometer with a focus on the Pt100. In the next issue of *Pentronic News* we will conclude the current series of the temperature school with a lesson on quality assurance and calibration.

LESSON 7 THE PT100 – ITS CONSTRUCTION AND APPLICATIONS

THE PLATINUM RESISTANCE THERMOMETER

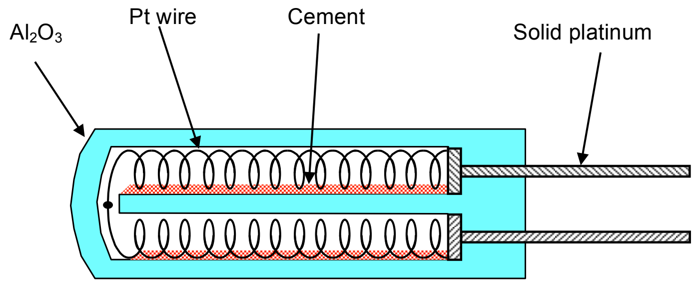
The first theories about resistance thermometers were proposed as early as 1891 by H C Callendar. The basis is that all metals change their resistance according to the temperature. The noble metal platinum is one of the most stable materials known, and is therefore suitable for temperature measurement.

The platinum sensor remains stable over a long period of time and is characterised by high accuracy. Its limitations compared with a thermocouple are a closer temperature range and a mechanically more sensitive construction with a longer response time.

WIREWOUND RESISTORS AND THINFILM RESISTORS

A wirewound Pt100 resistor can be illustrated by the adjacent diagram. In this construction, the platinum wires have the highest possible freedom of movement and thereby have reliable electrical properties. However, this construction is sensitive to mechanical influence and also requires a complex production process that affects its cost.

Nowadays thinfilm resistors are fabricated in slightly different ways but the main principle is that the platinum



resistance loop is instead patterned onto or etched out from a substrate consisting of a ceramic plate. This technique gives the resistor considerably worse stability but the simplified production process also comes with a lower cost.

PROTECTION TUBE AND PROBE TIP

A Pt100 sensor in a process always consists of a resistor encased in some sort of protection tube. The design of this tube has a great influence on the sensor's properties and is basically customised to whatever resistor is required. The resistor's dimensions can be fitted into a length ranging from 2 to 30 mm and a diameter of 0.5 to 3 mm. The resistor can be cylindrical or "box" shaped.

It is sometimes possible to find cylindrical resistors that fit precisely into a protection tube without troublesome air pockets being created. This is an ideal situation. Normally, the respective measurements are not a good match, and steps must be taken so that the measurement performance is not worsened. One method is to place the resistor inside a metal casing that is customised to the protection tube's inner diameter (Figure 2). Another way is to use a heat-conductive paste that does not damage the resistor and its platinum resistance (Figure 6).

An alternative recommended by standards is to use a reduced probe tip. (Figure 5).

FIGURE 1

Normal

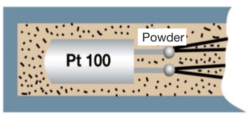
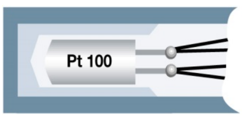


FIGURE 2



For better heat transfer

FIGURE 3

Normal

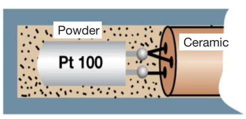
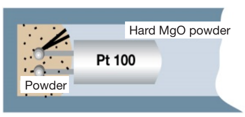


FIGURE 4



For vibrations at high temperatures

FIGURE 5

For better heat transfer

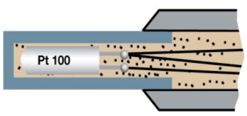
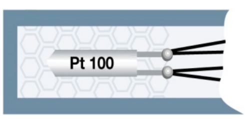


FIGURE 6



For strong vibrations at limited temperatures

At left are three common probe tip constructions available on the market. At right are three improved versions, which can be used for more reliable measuring or when more difficult environments are involved.

Example of a DIN standardised industrial Pt100 model.

AREAS OF APPLICATION AND STANDARDS

The most common industrial resistor has a resistance of 100 ohms at 0 °C - R(0) – and is called the Pt100. There are resistors with other R(0) values. R(0) = resistance value at zero degrees. The Pt1000 is common, especially in the plumbing and white goods industries. Other R(0) values also occur but to a lesser extent. The sensitivity and tolerances of these versions are the same as for the Pt100.

In Europe we use the standard IEC 60751 (2008). The USA and Japan set their own standards for Pt100s after there had been sufficient time to improve the production of platinum, so that their demands for the purity of the platinum could be set higher.

The practical consequence is that sensors from Japan or the USA will show higher values used with a European instrument.

However, nowadays the IEC standard, which has a strong position in Europe, has for competitive reasons also gained ground in the USA and Japan.

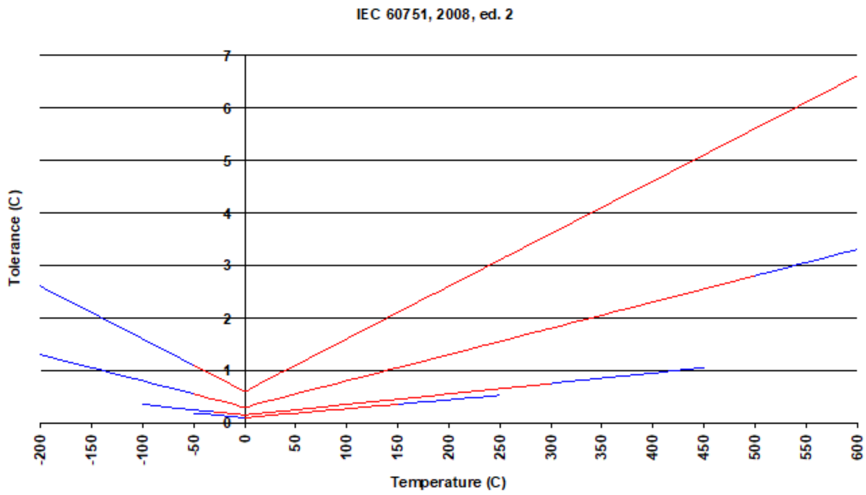
TOLERANCES AND CLASS DIVISIONS

Pt100 sensors are classified according to IEC 60751 (2008) in four classes: AA, A, B and C. See the table below, which gives the tolerances in °C. The different tolerance classes vary because the IEC permits varying degrees of purity in the platinum alloy. The European national standards, such as DIN 43760, follow the IEC.

The above table shows the tolerance classes with their associated ranges for wirewound and thinfilm resistors respectively. The tolerance level as a function of the temperature is shown in the column "Tolerance values", where the permitted deviation in 0 °C is also given by the expression's first term. |t| represents the temperature value regardless of the sign, i.e. the tolerances are symmetrical around 0 °C within the permitted temperature range. The slope of the tolerance curve is expressed by the coefficient before the temperature |t| which is expressed in °C/°C. The temperature of -196 °C has been used instead of the previous -200 because the end point should be easy to calibrate and this is normally done in boiling nitrogen, whose boiling point is very close to -196 °C.

IEC 60751 (2008) tolerance classes	The relevant temperature ranges (°C) for complete temperature sensors		Tolerance values °C
	Wirewound resistor	Thinfilm resistor	
AA	-50 to 250	0 to 150	± (0,1 + 0.0017 I t I)
A	-100 to 450	-30 to 300	± (0,15 + 0.002 I t I)
B	-196 to 600	-50 to 500	± (0,3 + 0.005 I t I)
C	-196 to 600	-50 to 600	± (0,6 + 0.01 I t I)

The IEC 60751 tolerance classes for integrated temperature sensors with Pt100 resistors in wirewound and thinfilm formats respectively. Note that other tolerances and temperature ranges can be used as long as you clearly state the situation that applies between the manufacturer and the user.



The tolerances of Pt100s according to IEC 60751 (2008) shown in graphic form. As a comparison, the positive tolerance limits according to Class 1 for types K and N thermocouples have been added as a dashed line. However, the platinum resistance thermometer is much more stable than the corresponding thermocouple.

PENTRONIC'S PRODUCTS AND SERVICES

- Temperature sensors
- Temperature transmitters
- Temperature indicators
- Dataloggers
- Temperature calibration services
- Moisture and thickness monitors
- GFM Glass flow meters
- Connectors and cables
- IR pyrometers
- Temperature controllers
- Temperature calibration equipment
- Training courses in temperature
- Flow meters
- Electro-optical test systems

PENTRONIC
Bergsliden 1, SE-593 96 Västervik
Tel. +46 490-25 85 00, Fax. +46 490-237 66
www.pentronic.se

Follow us: in

Subscribe to Pentronic News at our website www.pentronic.se