

PENTRONIC NEWS

It's about temperature!



**WHEN CUSTOMERS ASK ABOUT CURING CURVES
THEY FIND THE ANSWERS HERE**



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ISOTECH CELEBRATES 40 YEARS!

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UDDEHOLM QUALITY ASSURES

Dear reader!

None of us could have predicted how 2020 would develop when we toasted the arrival of a new decade just a few months ago. The pandemic now raging around the world is affecting daily life for us all, both on the job and also at home.

Something that strikes me when I read newspapers and watch news reports is how important it is to collect data (i.e. take measurements) and draw the correct conclusions. This is something we work with constantly in our business. Perhaps quite a number of us will look rather differently at the importance of measurement and analysis in future.

So, how can we at Pentronic get through this trying time? Every day we are working to ensure the safety of our employees and to maintain our capacity and supplies of materials with the aim of minimising any resulting delivery disruptions. All so that you as our customer can receive your products as promised.

In this issue you can explore some applications we have worked with plus a couple of new products that could make your own work a little easier.

Happy reading and have a wonderful summer, though certainly rather different from normal this year!

Rikard Larsson
Managing
Director



WHEN CUSTOMERS ASK ABOUT CURING CURVES THEY FIND THE ANSWERS HERE

Scania caused a sensation last year with its NXT concept.

The self-driving, electrically powered bus (shown on the cover of this issue) is also a delivery vehicle and a night-time refuse lorry.

The prototype was partly made with the aid of temperature sensors from Pentronic.

THE VEHICLE'S MAIN COMPONENTS ARE MADE OF CARBON FIBRE COMPOSITE and were manufactured by Marstrom Composite in Västervik. The company has long cooperated with Pentronic to ensure its products' quality and provide the documentation that customers require.

"A few years ago, hardly anyone was asking about curing curves. Nowadays almost all our customers do so," says the company's CEO, Per Wärn.

The aircraft manufacturer Saab was the first in Sweden to use the most advanced form of carbon

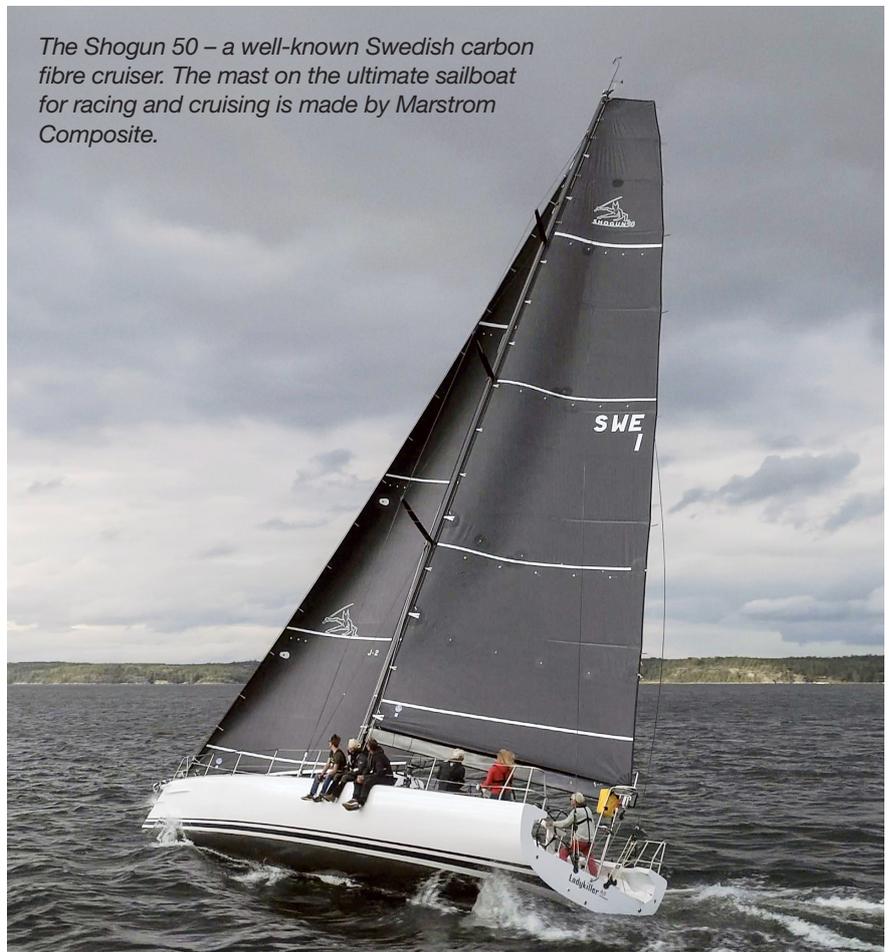
fibre, prepreg. That knowledge was absorbed by sailor Göran Marström, winner of an Olympic bronze medal in the Tornado class in 1980. He and his business partner Per Wärn began building catamarans out of fibreglass/carbon fibre, with attention-grabbing results. Other expertise was also acquired from Saab, including the autoclave with the biggest diameter.

"It's a former LPG tank from Saab that we rebuilt," Per says.

The company also has a 35-metre-long autoclave for manufacturing boat masts.

Alongside Saab, Marstrom is a carbon fibre pioneer in Sweden.

The Shogun 50 – a well-known Swedish carbon fibre cruiser. The mast on the ultimate sailboat for racing and cruising is made by Marstrom Composite.





Mounting temperature sensors inside the 35-metre-long autoclave for making boat masts.

Its customers are found among the defence industry, vehicle manufacturers, windpower developers and the aviation industry. The company's marine operation consists of masts for large sailboats plus RIB boats and super yacht-type vessels.

The material's big advantage is the combination of low weight and high strength. The NXT bus concept from Scania is one example of this. Marstrom manufactured the sides and roof and mounted the body (see the cover of this issue) on a chassis from Scania.

"Our components weigh 75 percent less than metal plate," Per says.

The concept was presented at a trade fair in 2019 and the prototype is currently undergoing extensive tests at Scania. The idea is a modular system that enables the vehicle to serve as a self-driving bus in the mornings and evenings, distribute packages in between, and be transformed into a refuse lorry at night.

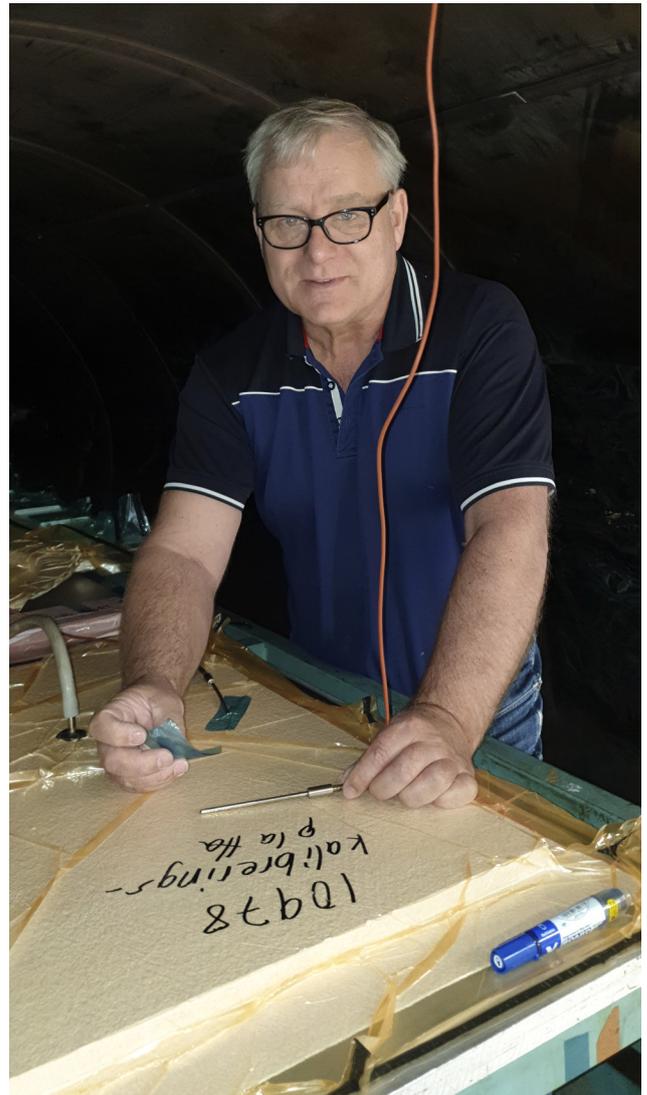
Everything made by Marstrom is characterised by extreme quality demands, whether the products are components for aircraft or masts for sailboats. The components are baked in autoclaves, with critical parameters being vacuum, pressure and temperature.

"The temperature is important for the polymerisation of the epoxy," Per explains.

Temperature measurement is particularly important because the components are manufactured in moulds made of different materials depending on size and other requirements. A mould made of metal heats up quickly whereas a wooden one takes far longer to reach the correct temperature. The moulds are therefore equipped with the most precise type of temperature sensors, Pt 100s, partly to ensure the curing and partly to control the process.

Marstrom has its own reference equipment to check the temperature sensors. Once a year Pentronic does an accredited calibration of the equipment on site.

"We've been collaborating with Pentronic since our company was founded. It works really well and I have a hard time imagining anyone who could do it better. It's also convenient for us that they're close by," says Per Wärm of Marstrom Composite.



Per Wärm, CEO of Marstrom Composite. Here with one of the Pt100 sensors from Pentronic that will be mounted inside the autoclave.

ISOTECH CELEBRATES 40 YEARS!

The UK manufacturer of measurement and calibration systems, Isothermal Technology Limited, or Isotech as it's generally called, is marking its fortieth anniversary in the industry.

Isotech was founded in 1980 by John Tavener with the main aim of supplying reference thermocouples to the power and energy industry.

Quite soon after the market launch, John discovered a lack of efficient temperature calibration equipment. He immediately began designing and building his own solutions in a specially built laboratory.

Since then, thanks to its good reputation, high-quality products and leading performance, Isotech has successfully supplied and installed many fully equipped calibration laboratories all over the world. A large proportion of the company's equipment is in use at national laboratories and in various types of industrial laboratories.

The drive to manufacture high-quality products that satisfy customers' constantly changing needs has resulted in a number of award-winning and innovative products. It was a proud moment for Isotech when its microK precision thermometry bridge won a Queen's Award for Enterprise 2017.

Isotech supplies solutions for all calibration requirements in a variety of industries and environments, from primary laboratories that work to maintain national standards to field engineers who calibrate industrial

sensors in situ. Isotech exports to more than 126 countries via a network of some 90 sales agents.

Pentronic supplies the Swedish market with Isotech's product portfolio. We have been Isotech's Swedish partner since the company was founded in 1980 and are therefore celebrating 40 years of cooperation.

"All that time we've worked closely with Isotech and its founder John Tavener," comments Jonas Bertilsson, who is in charge of Isotech's product range at Pentronic. "Our shared interest has been to increase knowledge about temperature and to develop products so that temperature measurement can be done as precisely and correctly as possible. As just one example, the products that have been developed and the expertise that has been built up over the years were of great help when the major certification period in Swedish industry culminated in the 1990s."

Pentronic would like to congratulate Isotech on its many years of success and we look forward to continuing our excellent collaboration!

Celebrating...

40 years
1980-2020



...world leading temperature calibration solutions

STRAIGHT FROM THE LAB

NEW MANAGER OF THE LABORATORY

Andreas Holm is the new manager of Pentronic's accredited laboratory. Although this is a new role for him, he is not new to the company. Andreas has a number of years' experience as a laboratory engineer in charge of technology. He has acquired a lot of knowledge over the years, so if you have any questions about accredited calibration, just ask him.

"I've always been interested in both technology and mathematics, and I think it's super interesting to work with temperature – it suits me perfectly. When I'm not at work, my big passion is cars, and the annual highlight is the sportscar days in Västervik, when car enthusiasts from all over Sweden gather in our beautiful summer town. I've always liked to challenge myself, so when I was offered the chance to continue developing Pentronic's accredited laboratory I never hesitated," Andreas says.



LABORATORY APPROVED IN ACCORDANCE WITH THE NEW EDITION OF ISO/IEC 17025

The edition is entitled ISO/IEC 17025:2018 and has the same structure as other modern accreditation standards. The standard's structure has also been harmonised with ISO-9001 and ISO-14001, which Pentronic is certified in accordance with.

What it means for you as our customer that Pentronic has been audited and approved against the new standard:

- The new edition places additional requirements on the laboratory's impartiality in relation to other parts of the

organisation

- Risk-based thinking, which ensures that we introduce measures aimed at achieving better results and eliminating negative consequences
- The concept of "decision rule" has been added. It means that according to the general requirements, the laboratory has a special rule for how to handle measurement uncertainty when making statements about agreement with specifications or limit values.

PRODUCT INFORMATION

TRANSMIT PROCESS DATA TO YOUR MOBILE DEVICE

It is now possible to add Bluetooth communication and data logging to PR's 4000 and 9000 units. Just mount PR electronics' new PR 4512 display on the front of your existing 4000 or 9000 device and install the PPS app on your smart device (iOS and Android).

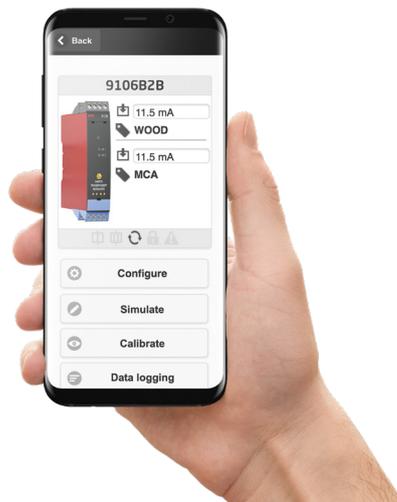
This enables live monitoring of your process data, data- and event logging and easy programming of your device. You can easily analyse both historical and real-time process data on your smart device

while on site.

With its 100 MB onboard memory, the PR 4512 display can log up to 5.50 million data points depending on which PR device is connected.

The PR 4512 display also captures device-specific measurement, status or relay errors. The device's built-in real-time clock logs the exact time of error events, including relay status. Both logs can be monitored directly in the PPS app or exported in CSV format. This provides incredible insight into loop performance and optimisation.

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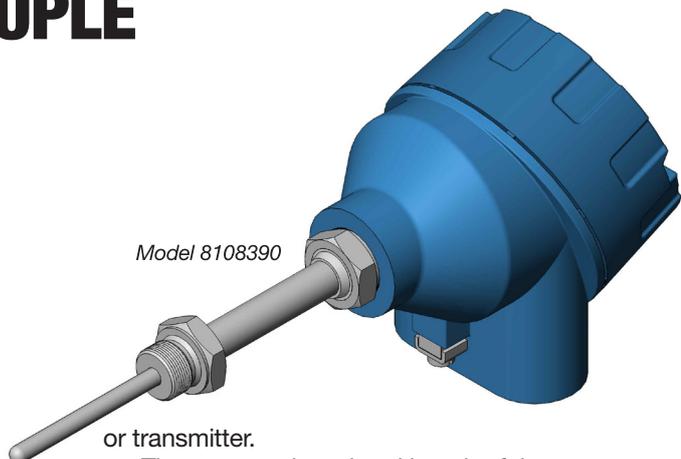
ATEX/IECEX-APPROVED PROCESS SENSOR WITH A THERMOCOUPLE

To complete the portfolio of Pentronic's own Ex d-classified sensors for potentially explosive atmospheres we now also launch an ATEX/IECEX-approved process sensor with a thermocouple. The sensor suits various types of thermowells.

The thermocouple's robust construction and large measuring range makes the product suitable for use in demanding environments, such as those with vibrations or other mechanical action. The thermocouple's wide measuring range enables you to measure temperatures up to 1000 °C.

The thermocouple insert's diameter is 6 mm and it can be supplied together with a cable connector

Model 8108390



or transmitter.

The process thread and length of the sensor can be customised for the thermowell it will be mounted in.

You are welcome to contact us for more information!

CONTACT RESISTANCE

QUESTION



ANSWER

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

QUESTION: Several technical articles in *Pentronic News* have discussed if and when it is appropriate to use a surface sensor and how the contact resistance between the sensor and the measurement object influences the measurement error. One conclusion seems to be that the greater the contact resistance between the sensor and the measurement object, the greater the possible resulting measurement error. How can I determine whether the contact resistance is significant and what should I do to reduce the contact resistance so that the measurement error is as small as possible?

Hossein N

ANSWER: These are very valid questions and they refer to a topic where it is unfortunately hard to give simple and clear-cut answers. A large contact resistance can cause a large measurement error but this does not have to be the case. Surface sensors have many advantages but it is important to minimise the influence of the contact resistance in order to avoid large measurement errors. I will start by reviewing the reasons why contact resistance occurs between two surfaces and I will discuss some of the factors influencing this contact resistance. I will then discuss how you can assess the influence of the contact resistance on the measurement error.

Figure 1a shows the temperature

distribution in the case of a perfect thermal contact between two large plates, 1 and 2, with the surface temperatures T_1 and T_2 . Unfortunately, no perfect contact exists in reality, because no perfectly smooth surfaces exist. All surfaces have some surface roughness. A cold-rolled metal plate has a surface roughness of approximately $1 - 3 \mu\text{m}$ ($1 \mu\text{m} = 0.001 \text{ mm}$) and a lathed surface can have the surface roughness $0.5 - 12 \mu\text{m}$. There are therefore a limited number of contact points where the two plates are in direct contact with each other – see *Figure 1b*.

The heat transfer in the contact points occurs by thermal conduction. There are also small cavities between the plates. If these spaces contain air or another gas, the heat transfer between the two plates occurs partly by thermal conduction in the contact points and partly by thermal conduction in the gas. The heat transfer can also occur by radiation between the surfaces inside the cavities. If the plates exist in a vacuum, the heat transfer occurs only by thermal conduction in the contact points and by radiation between the surfaces inside the cavities. Both thermal conduction and radiation are temperature dependent. When there is a contact resistance between the plates, we get the temperature distribution shown in *Figure 1b*.

Alloy steel has the thermal conductivity $40 - 50 \text{ W/(m K)}$, stainless steel approximately 15 W/(m K) and air at room condition 0.03 W/(m K) . In general, the heat transfer inside the cavities is small compared with the heat transfer in the contact points. To improve the heat transfer, you can fill the cavities with a suitable material – heat sink compound – with a thermal conductivity which is higher than that of gas. If the heat sink compound has the thermal conductivity $1 - 2 \text{ W/(m K)}$ you get a considerably better heat transfer than in air.

The heat transfer is influenced by both plates' thermal conductivity and surface roughness. In addition, the heat transfer is influenced by the thermal conductivity of the contents of the cavities. The pressure between the two plates also influences the contact resistance, because the number of contact points increases with greater pressure. This means that the higher the pressure, the lower the contact resistance. If corrosion occurs between the surfaces, the contact resistance increases.

The hardness of the materials influences the number and geometry of the contact points, which in turn influence the heat transfer and thereby the contact resistance. Two plates made of stainless steel therefore have higher contact resistance than two plates made of a softer material such as aluminium, if the other conditions are the same. In this case, to increase the heat transfer and reduce the contact resistance, the stainless steel material could be coated with some softer material such as an aluminium alloy.

Don't miss the **READ MORE** version of this article at <https://www.pentronic.se/en/about-temperature/technical-information/> If you use a surface sensor we recommend that you read the expanded article. In it you will find practical tips on how to reduce the measurement error and how to determine if the contact resistance is significant. The article also gives a comparison between contact resistances.

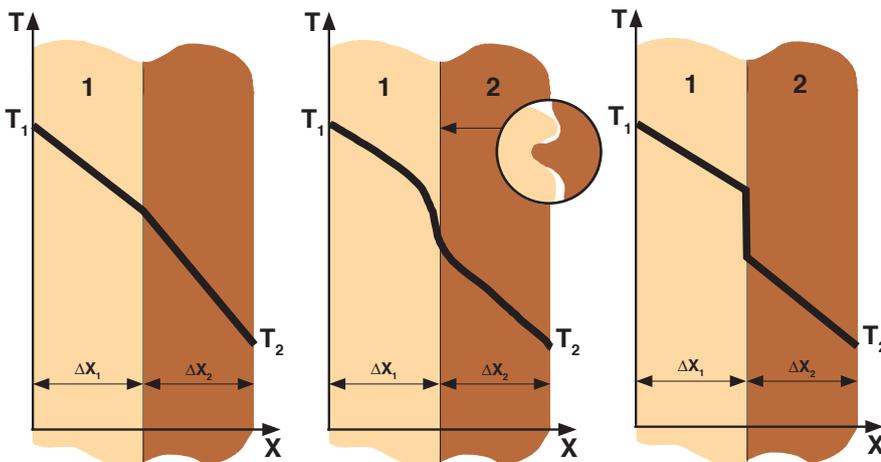


Figure 1a

Figure 1b

Figure 1c

PENTRONIC HELPS UDDEHOLM QUALITY ASSURE ITS HEAT TREATMENT PROCESS

Today's steel industry is facing big challenges when it comes to measuring temperature. Companies must both follow internal demands to ensure the right product quality and meet external requirements set by such standards as CQI9, AMS2750 and NORSOK.

COMPLYING WITH THESE STANDARDS can be both tough and challenging: performing a correct TUS (Temperature Uniformity Survey) and SAT (System Accuracy Test) requires resources in the form of personnel, equipment and know-how.

"Earlier this year we were commissioned by Uddeholm to develop an data collection system for their heat treatment process. The requirement was that the system as a whole had to cope with temperatures up to 1300 °C and have a process time of at least 24 hours. That gave us something to sink our teeth into!" says Pentronic's Morgan Norring, Key Account Manager specialising in steel, metal and heat treatment.

Uddeholm is the world's leading manufacturer of tool steel for industrial tools, with over 350 years of innovation experience. It has 3,000 employees around the world and is represented in more than 90 countries. It possesses in-depth



A steel ingot with measurement equipment heading into the furnace for heat treatment.



This is what it looks like when several tonnes of steel exit the furnace after having been heat treated at over 1200 °C for more than 24 hours. What's incredible is that electronic equipment for logging and wirelessly transmitting temperature readings followed along on the journey inside this furnace – and survived to tell the story!

knowledge and tradition, including an understanding of the material and how important it is to heat treat the steel in order to give it the right properties. The company recently faced a measurement problem and turned to Pentronic.

“We often function as a sounding board in such discussions, and in many cases we’re also commissioned to perform or participate in the measurement processes,” explains Jonas Bertilsson, Sales Engineer at Pentronic specialising in temperature measurement in conjunction with heat treatment.

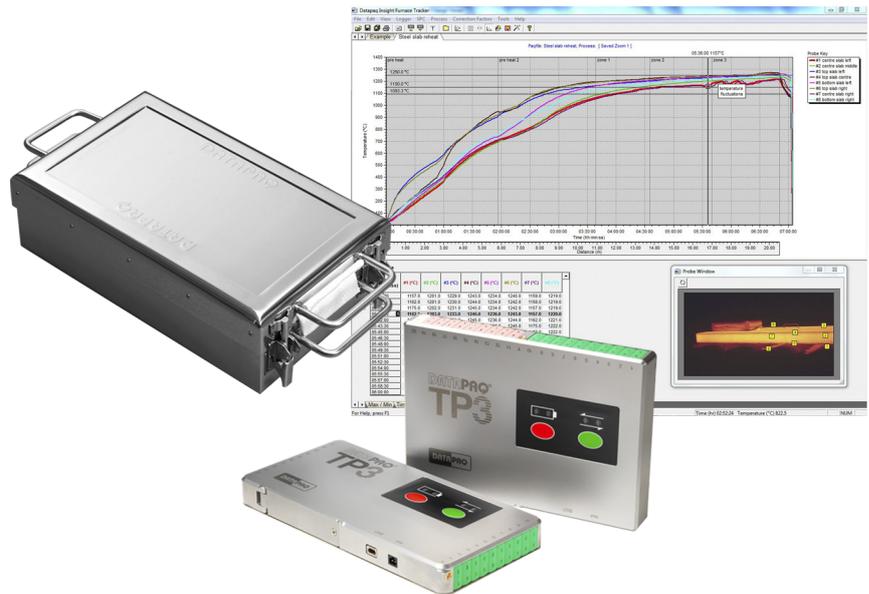
The solution to the problem was to use a 10-channel TP3 temperature profiling logger from Datapaq with type S thermocouples. The logger was protected by a barrier, which in this application weighed 150 kg and had a total volume of almost 1 m³.

The system is also equipped with telemetry, so that the entire process inside the furnace can be followed in real time and thereby ensure that the temperature transfer to the material occurs as expected. The temperature profile is clearly presented by the powerful software that comes with the system.

“This gives Uddeholm the ability to track the readings and make any necessary adjustments. Quality assuring the process and at the same time being able to optimise the dwell time improves product quality and production capacity while also reducing energy consumption,” Jonas concludes.



Here the heat-treated steel together with its accompanying measurement equipment is being retrieved from the furnace by a forklift truck. The load of about seven tonnes is still at a temperature of over 1000 °C.



An example of a Datapaq measurement system used in heat treatment processes.

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