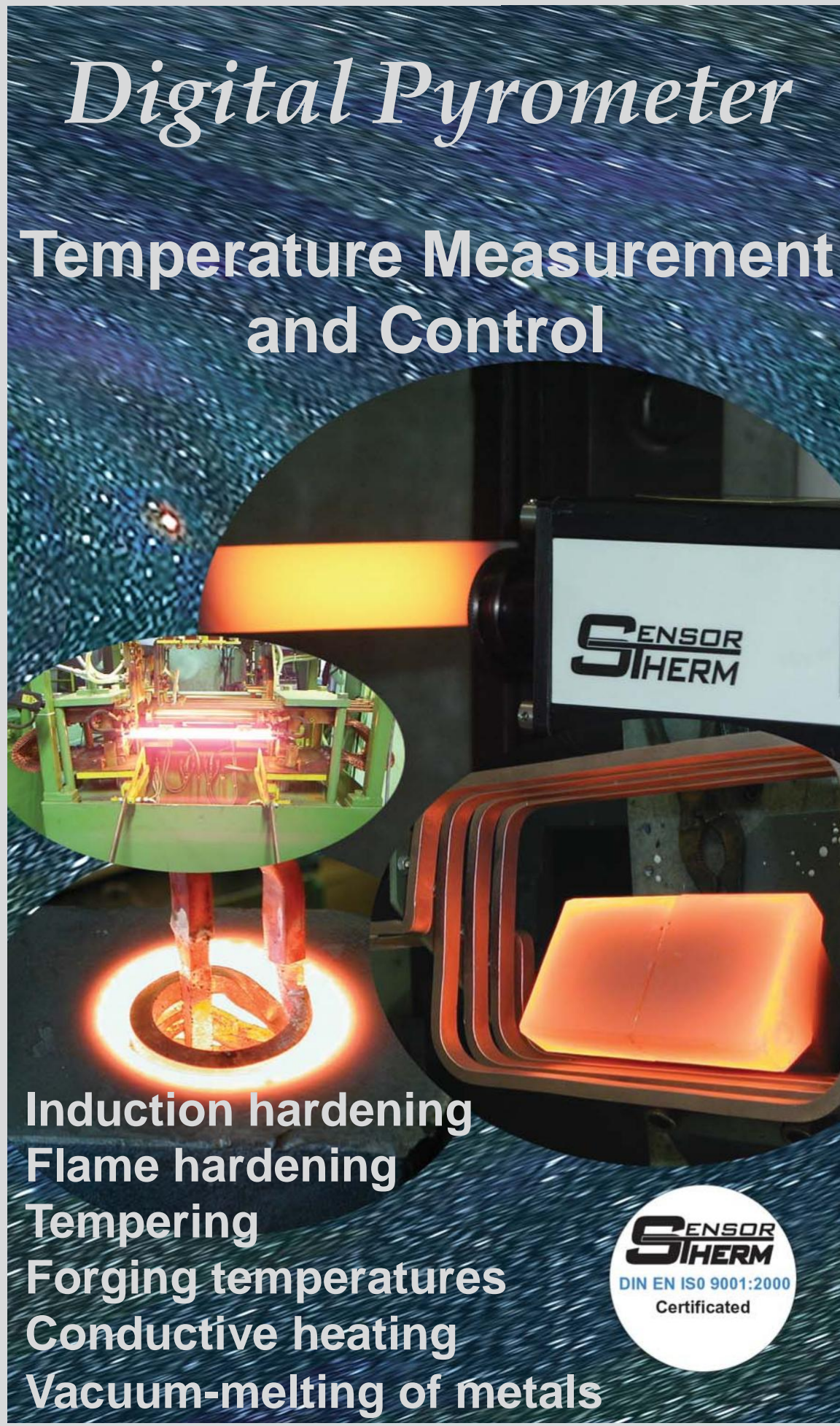


Digital Pyrometer

Temperature Measurement and Control



- Induction hardening
- Flame hardening
- Tempering
- Forging temperatures
- Conductive heating
- Vacuum-melting of metals



Non-Contact Temperature Measurement

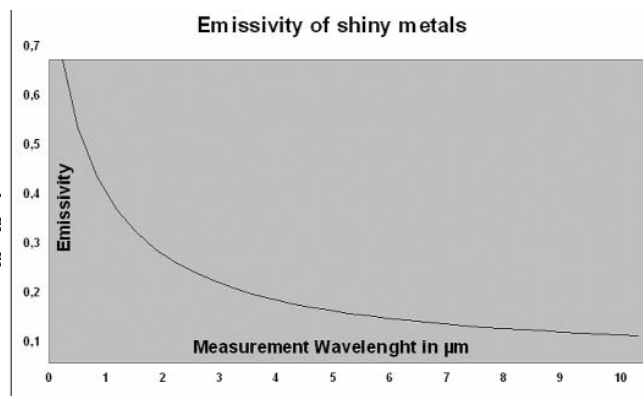
A non-contact temperature measurement with pyrometers is a passive measurement method and offers many advantages.

- the measurement does not effect the object on which the measurement is being performed
- very fast temperature acquisition - under 100 μ s
- very fast control of the heating process
- measurement and control of the smallest objects on which measurements can be performed
- wide measurement range
- long-term stable measurement thanks to digital technology
- induction RF fields have no effect on the measurement

Sensortherm Pyrometers offer optimal Conditions for reliable Measurements

Pyrometric measurements of metals depend upon the emittance of the work piece. With metals the emissivity decreases with increasing wavelength. This is particularly so since the shinier the surface is, the lower is the emissivity.

As a rule of thumb, measurements should be performed at the shortest possible wavelength. Shiny metal surfaces generally require the use of a system that measures wavelengths that are as short as possible.



The figure shows emissivity as a function of wavelength for shiny metals

Measurement Wavelengths	Temperature Range	Pyrometer Model
0,9 μ m	from 550 $^{\circ}$ C	Metis MS 09/ MQ 11 / Sirius SS
1,6 μ m	from 200 $^{\circ}$ C	Metis MI 16 / MQ 22 / Sirius SI16 (form 250 $^{\circ}$ C)
1,8 μ m	from 120 $^{\circ}$ C	Meits MI18
2,5 μ m	from 75 $^{\circ}$ C	Metis MP25

The extremely fast response time and high resolution, focusable optics with the smallest fields of view permit optimal adaptation to almost any measurement task.

The Metis MS and MI pyrometers with fiber optics are used for high ambient temperature environments and can be located in small areas due to their compact sizes. Temperatures starting at 120 $^{\circ}$ C can be detected.

Sensortherm pyrometers have also proven themselves under tough ambient conditions. An air purge attachment can be added to keep the optics free of dust, dirt and debris.

A wide range of accessories such as water cooled housings, protective housings and vacuum assemblies permit use in an industrial environment.

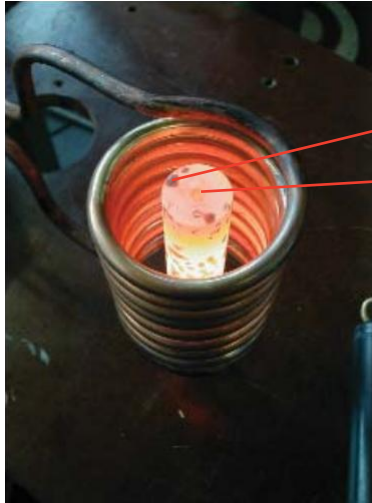
The requirements imposed on the device power supply concerning ripples are minimal.

Analog 0/4-20mA and digital RS232/485 or Profibus DP data interface.



All inputs and outputs are electrically insulated. This avoids interference and protects the pyrometer from serious damage. For long conductor lengths for data transmission, use an RS485 or Profibus DP interface.

Problem Case: Scale



Heating the steel to over 900°C in the presence of oxygen leads to the formation of scale.

Scale lifted off the surface of the metal.

Tightly adhering scale.

One can see more or less dark specks on the red-hot material visually. If the pyrometer is aimed at a scaly area, the measurement will show a temperature that is lower than that of the metal itself, a typical erroneous measurement. The use of a scanning mirror has proven valuable in avoiding erroneous measurements.



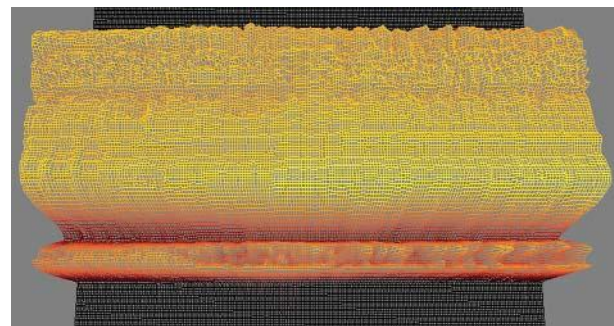
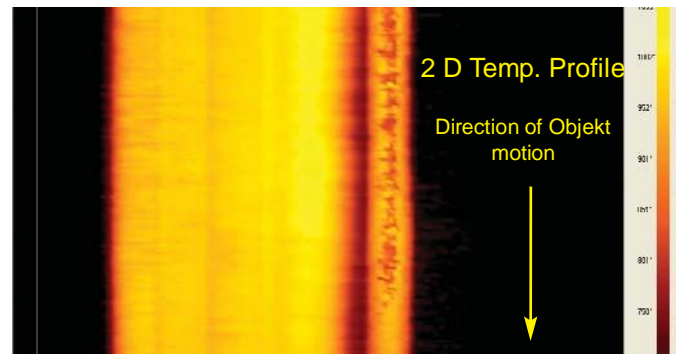
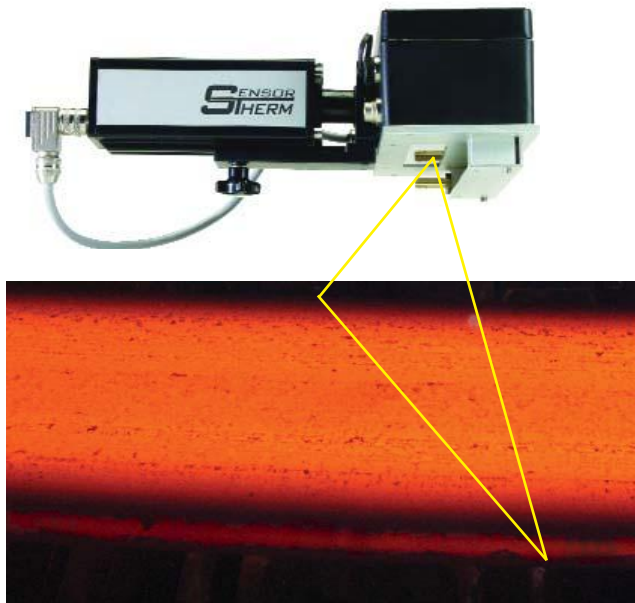
Adding an SC10 scanning mirror allows the pyrometer optical path to be continually diverted. In this way the extremely small field of view of the Metis pyrometer can locate even the slightest occurrence of scale and is able to display the true temperature by means of the integrated maximum-value storage. The SC10 scanning mirror is also excellent for measurements on small diameter wires.

Column and Line Measurements

It is often necessary to measure temperature along a line instead of at a single point. The Galaxy Scanner steers the pyrometer optical path precisely and provides an 0/4-20mA analog temperature output signal for each scanner position. A simultaneous readout query can naturally also be made via the digital interface. If the object moves in the optical path during the scan, the line measurement can be displayed as a 2-D or 3-D temperature profile.

Example:

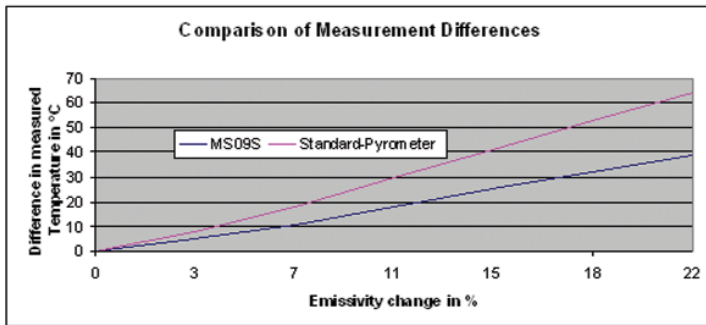
Continuous Casting; measuring a steel slab



Forge Pyrometer

Induction heating is one of the most commonly used heating process in forging. It offers several advantages over other heating methods in this application. Pyrometers for temperature measurement at the exit from the induction furnace are vital instrumentation for quality assurance. Ever more highly alloyed steels and the demand for high durability tools require very tightly and precisely controlled temperature windows.

Sensortherm developed the Metis MS09S as a specialized forge pyrometer in order to meet these requirements. The surface and therefore the emittance of the work pieces depends upon the pretreatment of the pieces. Different surfaces result depending on whether the piece is freshly sandblasted, oxidized, or preheated before passing through the induction furnace.



The Metis MS09S provides clear advantages over conventional pyrometers in this case. Changes in surface emittance affect the measurement significantly less.

Temperature Control

In many heating processes such as induction hardening, flame hardening, soldering and tempering, it is necessary to heat to a prescribed temperature and to hold this temperature for a certain time. Often a precisely prescribed temperature ramp must be followed and then the material must undergo controlled cooling. The Regulus PID controller meets these requirements precisely.

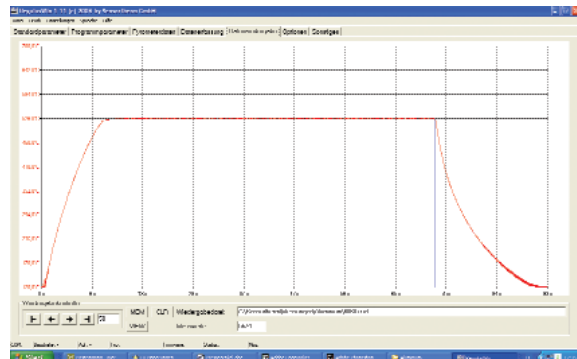
It is specially designed for this purpose and its cycle time of only 200µs allows it to handle the fastest controlled applications. The ability to combine the PID with all Sensortherm pyrometers provides a broad spectrum of applications.

Regulus,

the programmable controller



- 9 program steps
- ramp functions
- limit switches
- self-optimization
- includes software



Example: Induction hardening of aluminum at 525°C, Regulus in combination with a Metis MI18 pyrometer

Ratio or Two-Colour Pyrometers

The Metis MQ11 and MQ22 pyrometers measure the intensity simultaneously at two adjacent wavelengths with two detectors. The temperature is calculated from the ratio of the two radiated powers.

Advantages:

- the object to be measured can be smaller than the field of measurement
- measurements that are largely independent of the emittance
- no effect due to smoke and dust in the optical path
- measurements can be checked for plausibility

Contamination monitoring of the optics and the optical path: Pyrometric measurement is an optical process and assumes that the thermal energy to be measured arrives at the pyrometer unhindered. Often there is a sight glass upon which contaminants settle in the optical path.

Sensortherm has developed a monitoring function for the Metis MQ series ratio pyrometers that makes it possible to recognize the degree of contamination of the optics or to detect perturbations in the optical path and to trigger an alarm if needed. The intensity of the radiation arriving at the pyrometer is measured and analyzed in various spectral regions. Even selective interferences at only one wavelength that would be fatal to a ratio pyrometer are thus recognized. The false measurement result can then be filtered out by means of a plausibility check before it is displayed. The cutoff threshold can be selected freely and adjusted to suit the measurement task.



Fiber Optic model of the Metis MQ

The high resolution focusable optics in both models permit optimal focusing of the field of view.

Metis MQ with zoom optics

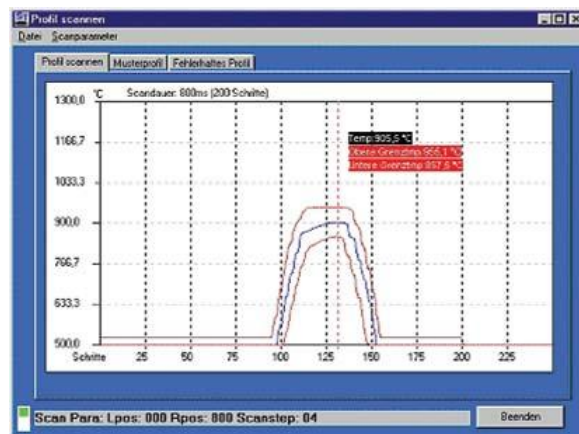


Individual custom-made Systems Solutions

Sensortherm's in-house software and hardware development services can furnish a complete solution custom-made to the customer's specification. We'll be happy to be at your service.

Example Profile Scan:

The temperature profile of an object is recorded during heating and is fitted with an envelope. All other objects in the same batch must have the same temperature profile during heating. In the event of a violation, automatic rejection can be activated.



Functions integrated into the Pyrometer

Extra functions can be integrated in the pyrometer if desired.

Control Function:

A controller integrated into the pyrometer will meet even the fastest control requirements. Adaptation to the control task occurs via self-optimization.

Limit Switches:

Two limit switches with adjustable hysteresis and selectable zero-potential N/O and N/C operation can take over additional switching functions.

Profibus-DP

(Process Field Bus-Decentral Peripherals):

The Metis series pyrometers are naturally also available as Profibus DP models.



Example of meeting a special customer requirement:
Highly legible display in piggy-back format.

Sensortherm shows Competence

All Sensortherm pyrometers operate digitally. Our proprietary process for digital signal processing with direct digitization of the sensor signal sets the current standard. This process is now being developed further and offers new dimensions in pyrometry. Even faster response times while retaining the smallest measurement fields provide access to the range below 50µs.

For the first time, all of the advantages of digital pyrometry such as range selection, easy integration into existing facilities, long-term stability, highest accuracy, digital interfaces and much more are thus now available with these short measurement times. More than 25 years experience in the development and manufacture of pyrometers and more than a decade in the digital pyrometer field guarantee reliability and quality.

Worldwide references

Highly qualified on-site service for complete on-the-spot Consultation

Customer-specific Development

After-sales support

Repair and calibration service

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