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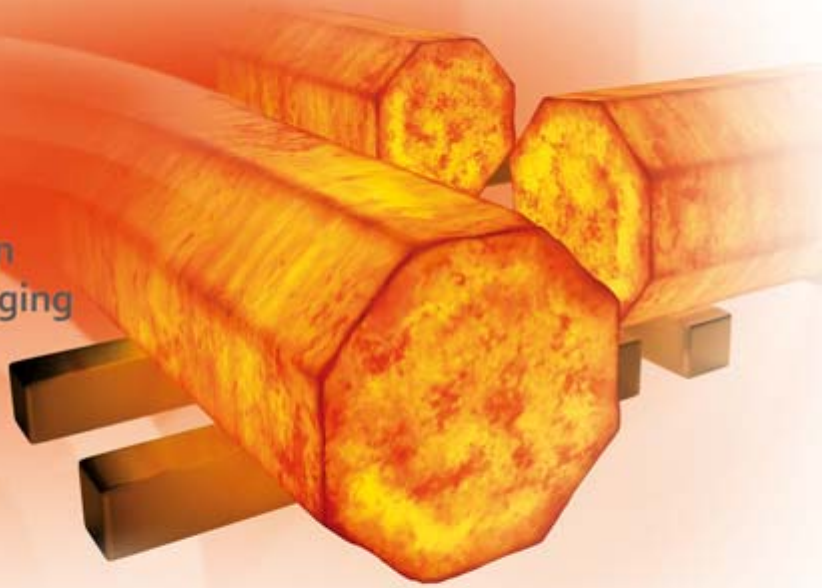

Extending the Life Span and the Application Range of Sensors using Thermo-Electric Cooling

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The Challenge

- Harsh conditions, particularly in the iron, steel, aluminum and metalworking industry due to:
  - Humidity
  - Dust
  - Extreme temperatures and radiating heat.
- Manufacturers of electronic components and devices offer only limited warranties with regard to system functionality.

The Result

- A failure-free operation of electronic components and devices cannot be guaranteed.
- Harsh environments significantly reduce the life span of sensors that are critical for production.
- Premature wear of sensor diodes and inaccurate measurements.
- Unexpected downtimes affect the day-to-day production.
- Uneconomical processes.

Processes can be optimized

Intelligent cooling:

» Reduces premature wear of electric sensors.

» Improves both performance and measurement accuracy of systems that are used in production.

» Ensures reliable operation and system uptime.

Unprecedented Possibilities

- Opens up unprecedented application possibilities in the steel industry.
- A wide range of processes can now be automated.
- Significantly reduces long-term repair and maintenance costs.
- Enables the use of more cost-efficient sensors that were not originally designed to withstand the extreme environmental temperatures in the industry.
- Profitability
- Sustainability

Automated Processes in the Steel Industry

The use of sensors is becoming increasingly important in the steel industry.

Advantages of automated processes:

» Enables measurement and inspection under unfavorable conditions

» Increased production line throughput

» Remote monitoring of processes

However, the extreme heat in steel production facilities negatively affects or prevents the use of sensors.

Use of Sensors in the Steel Industry

Creating surface profile pictures of aluminum bars:
With the profile picture created by the LMS400 laser distance meter system robots can unload aluminum bars from pallets and transport them to the furnace.

Geometric measurement:
The depth, the width, the length and the shapes of edges can be measured.

Positioning of slabs:
Roll conveyors transport the slabs to the heating furnace prior to the rolling process. This can result in the slabs being in a wrong position. Sensors that are used for slab positioning have to be protected from radiant heat.

Use of Sensors in the Steel Industry

Mold level monitoring
The increasing automation of casting processes requires even more precise mold level monitoring. For the most part, fill-level measurement is achieved by using different kinds of floating gauges. Since those gauges are in direct contact with the molten metal, this can lead to material deposit. Contact-free laser measurement systems are a convenient alternative.

Additional applications:

» Positioning of cranes and loading systems

» Position measurement of vessels and vehicles

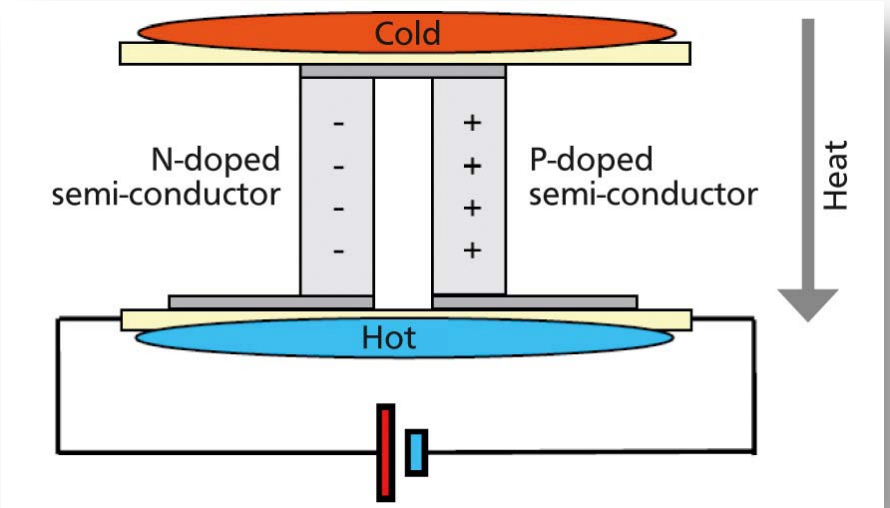
» Measurement of inaccessible points in hollows or cavities

Thermal Protection and Cooling of Sensors: The Concept of Thermoelectric Cooling

Possible solution: peltier technology

Peltier elements are thermoelectric components that can be used as heat pumps or as thermoelectric generators, respectively.

They are ideal for applications that require a temperature stabilization across wide temperature ranges.



A Peltier element...

... consists of two different electric conductors, which are electrically connected.
The conductors and their connecting joints are alternately arranged in a single layer.

Using Peltier Technology for Temperature Management

Process Optimization

- Highly flexible
- Immediate availability
- Time and cost savings thanks to
  - easy installation
  - reduced maintenance

Features and Benefits

- Failure-free, reliable technology (no mechanical components, minimum maintenance).
- Robust, vibration-free, not susceptible to interference, low noise.
- Can be used for heating and cooling applications alike by simply reversing the polarity.
- Application-specific, precise configuration, depending on temperature requirements.

The Thermo Protection Cooling Case (TPCC): Product Description / Technical Specifications

Technical Specifications

- Operating temperature range -20°C to +75°C, up to +80°C for short periods of time
- Dimensions (W x H x D): 0,349 x 0,305 x 0,239 m
- Cooling capacity approx. 70W
- 24V/15A power supply
- Solid-state relay
- Maximum sensor dimensions (W x H x D): 0,17 x 0,12 x 0,08 m

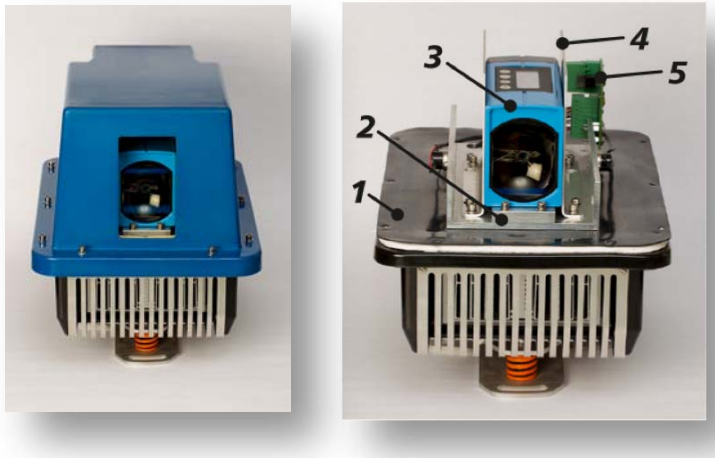
The Thermo Protection Cooling Case (TPCC): Product Description / Technical Specifications

The upper housing is made of a state-of-the-art heavy-duty synthetic fiber composite that provides excellent insulation properties.

The TPCC's lower housing includes the cooling unit.
The system operates on a thermoelectric basis.

To ensure direct heat dissipation and cooling, the sensor is securely bolted to an adapter plate, which is mounted to the TPCC.

Except for the installation of a power supply and the solid-state relay, no changes to the existing installation are required to install the TPCC.

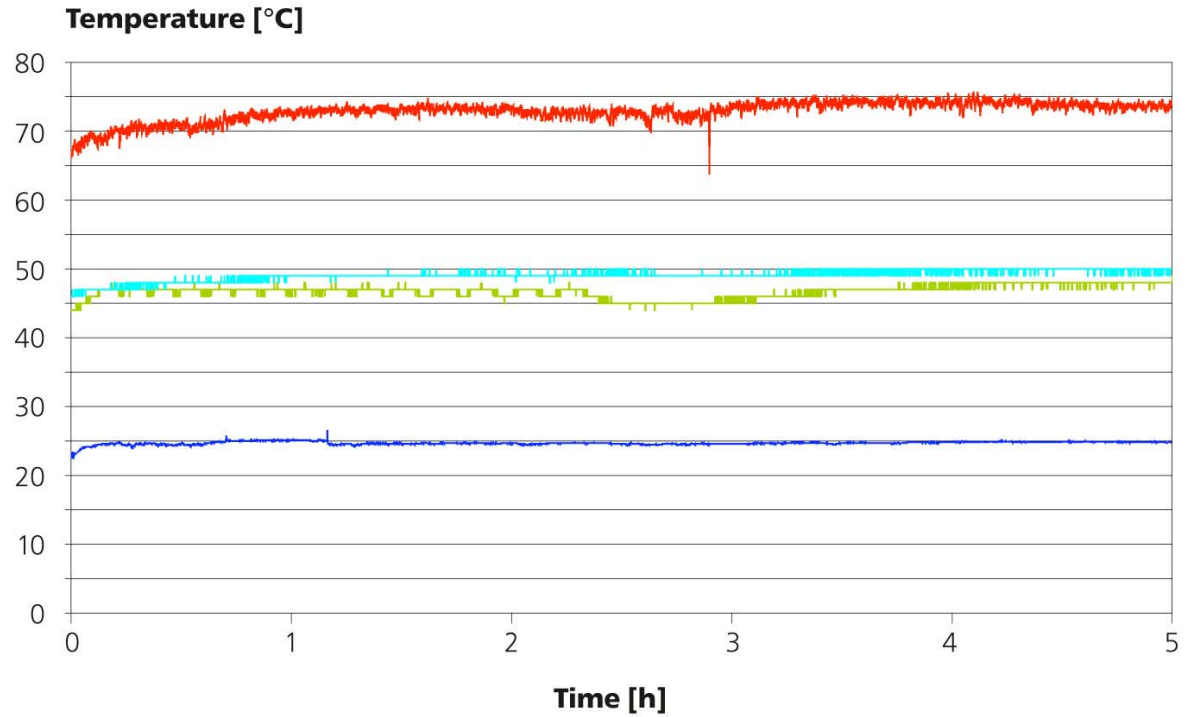


a: ***TPCC Thermo Protection Cooling Case***

b: ***TPCC lower housing with sensor assembly***

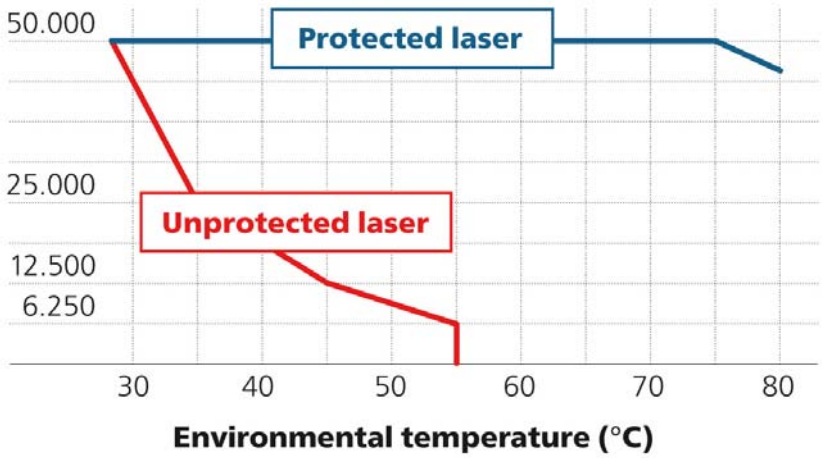
1 ***TPCC lower housing***
2 ***Adapter plate***
3 ***Laser distance meter***
4 ***Cooling plates***
5 ***TPCC terminal board***

Laboratory tests prove: measurably extended life span of laser sensors



Life span of optical sensor in high-temperature environments

The cooling system increases the life span of your laser



Environmental temperature (°C)	Hours (h)
25	50.000
35	25.000
45	12.500

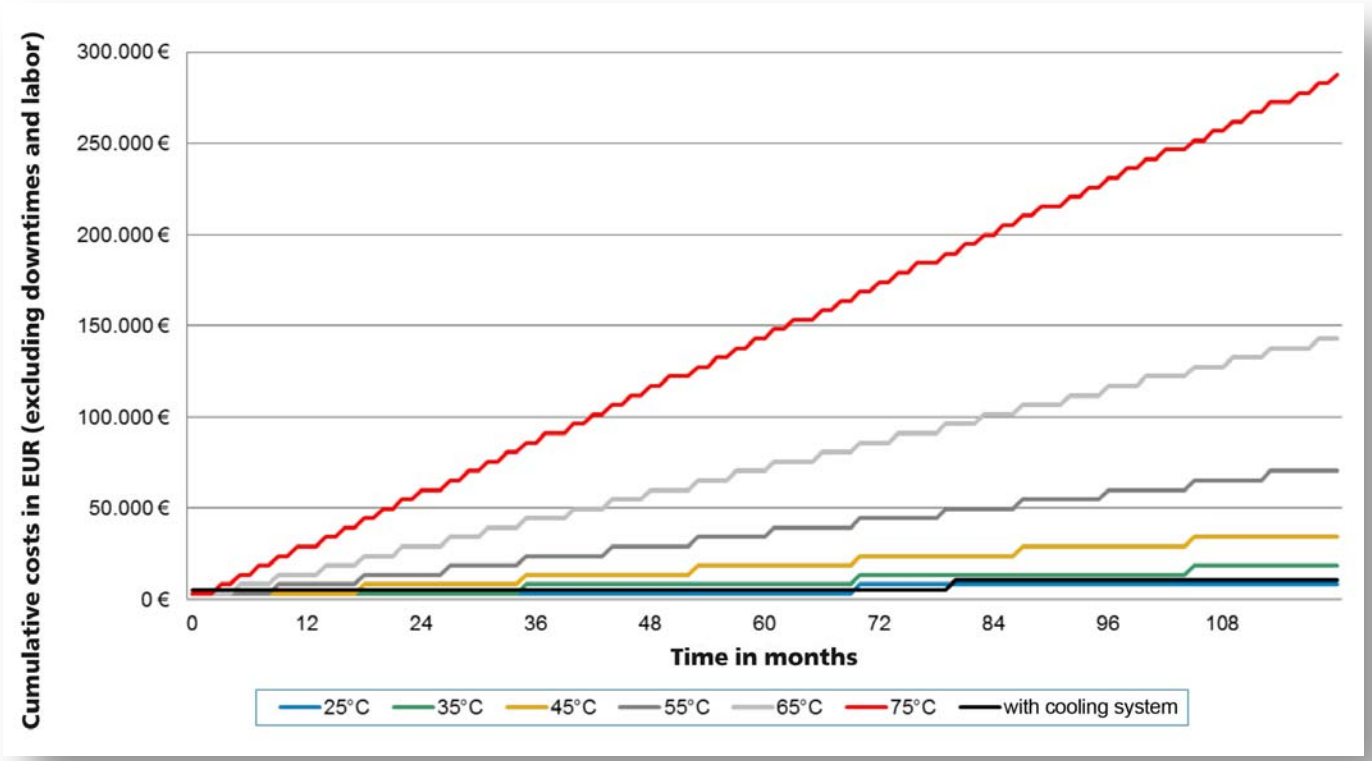
Reduced sensor life span at rising environmental temperatures (SICK DME5000 laser distance meter) (Source: SICK DME5000 Technical Documentation.)

Laboratory tests prove: measurably extended life span of laser sensors

Increased safety and reduced costs

- The cooling system increases the life span of laser sensors by 15% compared to the manufacturer's MTTF of 50,000 hours at +25°C.
- At environmental temperatures of +45°C it increases the life span of laser sensor diodes by up to 440%.
- Average extended sensor life span of 6.6 years (as compared to only 1.5 years without the cooling system).
- The cooling system pays for itself on average after only 2.5 years.

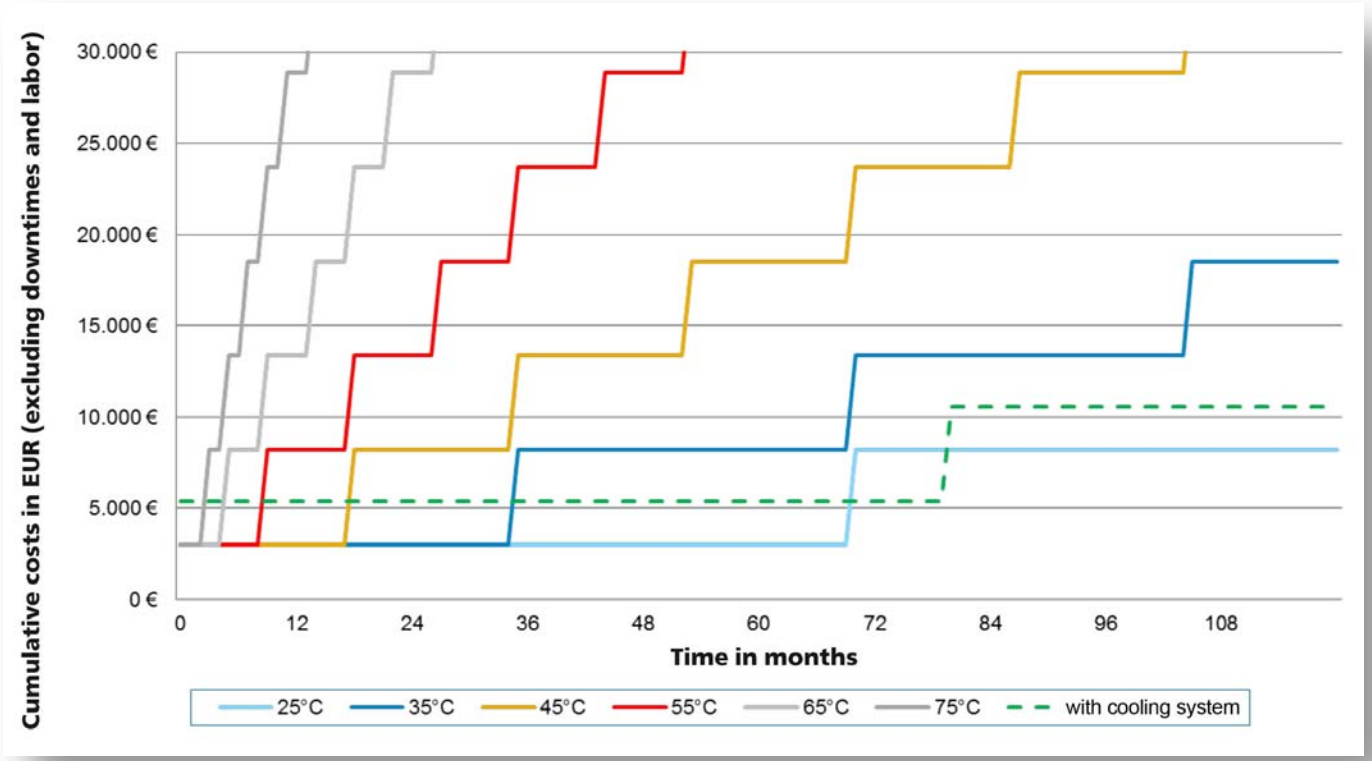
Return on investment



Cumulative costs for sensors used without the use of a cooling system in relation to ambient temperature (24/7 timeline)

Depending on the environmental temperature, the cooling system pays for itself within months.

Return on investment



Cumulative costs for sensors used without the use of a cooling system in relation to ambient temperature (24/7 timeline)

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Conclusion:
Unprecedented application possibilities

Thermoelectric cooling offers a wide range of unprecedented application possibilities for **electric sensors**, **optical data light barriers** and other sensitive devices used in high-temperature environments of up to +80°C in the steel industry such as:

- » Fill-level and molten metal monitoring.
- » Automated measuring and positioning of metal slabs in furnaces.
- » Controlling the lengths, widths and heights in strand casting.
- » Permanent use of sensors for the control of rolling stock in hot-rolling mills.
- » Automated positioning of bridge cranes, for example, for the storage of coils in warehouses.

Long-term benefits of thermoelectric cooling systems

- Significantly increases diode performance of optical laser systems.
- Guarantees precise measurements.
- Optimum protection for sensitive sensors, up to +80°C.
- Compatible with sensor systems of most major brands.
- Maintenance-free cooling systems (thermoelectric effect).
- Easy integration into existing measuring systems.
- Sensors are automatically disabled when the temperature inside the protective enclosure exceeds the permissible limit.
- Efficient cooling system.
  No additional components are required; only a 24V power supply is needed.
- Dramatically reduces downtimes and repair costs.

Thank you very much for your attention.

I'd be happy to answer any questions you may have.

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