exacal

PRECISION THERMOMETERS HANDMADE IN GERMANY

Resistance thermometers and thermocouples

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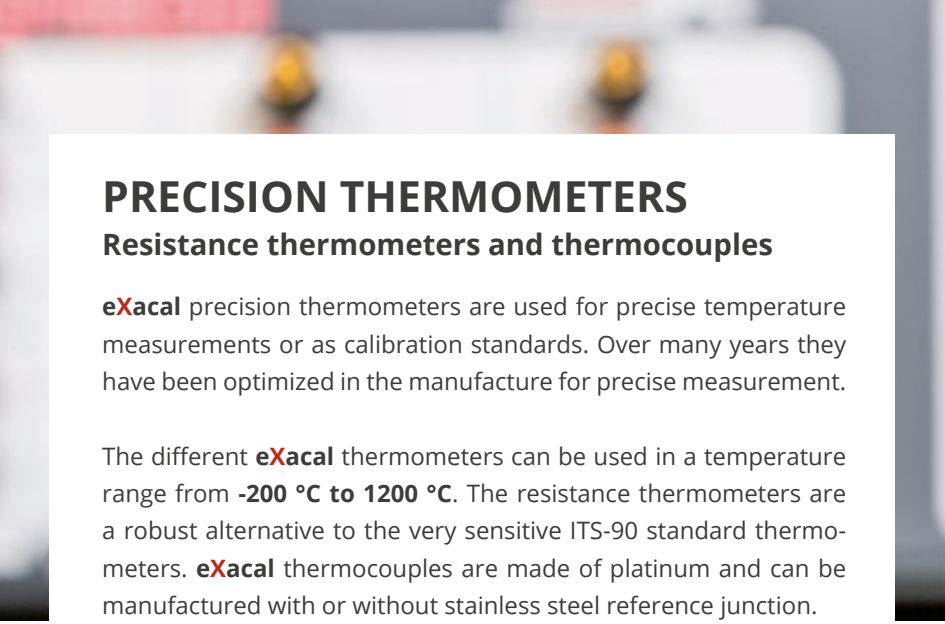


PRECISION THERMOMETERS

Resistance thermometers and thermocouples

eXacal precision thermometers are used for precise temperature measurements or as calibration standards. Over many years they have been optimized in the manufacture for precise measurement.

The different **eXacal** thermometers can be used in a temperature range from **-200 °C to 1200 °C**. The resistance thermometers are a robust alternative to the very sensitive ITS-90 standard thermometers. **eXacal** thermocouples are made of platinum and can be manufactured with or without stainless steel reference junction.

Type R / Type S Precision Thermocouple

Temperature range: **0 °C to 1200 °C**

Small measurement uncertainties with DAkkS calibration certificate.

Fixed point calibration	
0,01 °C	0,2 K
419,527 °C	0,5 K
660,323 °C	0,5 K
961.78 °C	0,6 K

Comparison calibration	
0 °C bis 962 °C	0,8 K
>962 °C bis 1200 °C	1,5 K

Pt100 model H
High Temperature Precision thermometer

Temperature range **-100 °C to 660 °C**

Small measurement uncertainties: 6 mK and 25 mK

Pt100 Model IH
Industrial reference thermometer

Temperature range **-100 °C to 600 °C**

The temperature sensor with a diameter of 4 mm and a small handle enables use in small spaces, e.g. for dry block calibrators.

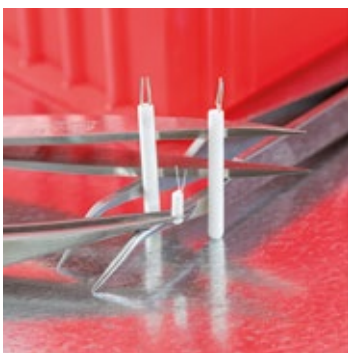
eXacal TECHNOLOGY

eXacal thermometers were designed from scratch. The development time took over four years. All components used have been carefully designed and coordinated. Of particular importance is the developed handle, which acts as a technology carrier. Due to its modular design, **eXacal** thermometers can be combined in almost any way.

The handle as technology carrier

Our **eXacal** thermometers can be assembled as a construction kit in almost any way. This is made possible by our aluminium handle, which is equipped with an individual 3d-printed insert for each thermometer.

Important components such as strain reliefs, inert gas fillings or different protective tubes can be freely combined.



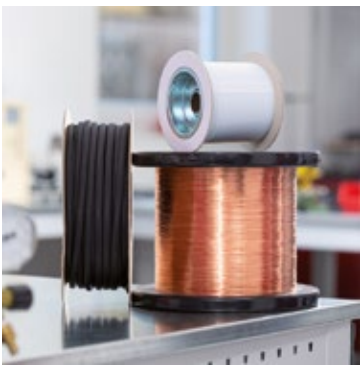
Temperature detectors

For the thermometers we use wire-wound Pt 100 ceramic detectors.
They are handmade and carefully stabilized. Three hand-picked types are used. They each represent the best compromise between design, stability, hysteresis and self-heating:

- 1/10 DIN detectors for precision thermometers up to 420 °C
- High temperature measuring resistor up to 850 °C
- 1/10 DIN extra small detectors for fast response times and improved heat connection

Thermometer wire

As thermometer wire at the measuring resistors and in the capillaries we use noble metals and no commercial coated wires. Depending on the temperature range, these are pure silver or platinum. In this way we reduce thermoelectric effects in the thermometer.



Connection cables

Connection cables for thermocouples and resistance thermometers are assembled by hand. We use copper strands made of a lowstress copper alloy which was cast especially for our thermometers.

A reinforced textile sheath made of heat-treated fibreglass protective tube, which is resistant to high temperatures, serves as an insulating sheath. This protects the individual strands from mechanical stress, high temperatures and organic solvents.

Protection tubes

Protection tubes are selected with regard to thermal stress and the nature of the atmosphere. In order to protect the temperature sensor optimally against mechanical and chemical influences, protection tubes made of pure ceramics, noble metals, hight-emperature alloys or sapphire are used, depending on the application.

High quality carrying case

All **eXacal** thermometers are delivered in a high-quality wooden carrying case. Due to the robust wooden case with the adapted foam inlay the sensitive thermometers are well protected during transport and storage.

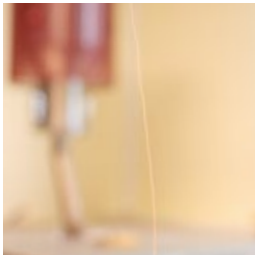
Alternatively and at a lower price, the thermometer can also be delivered without the case in a cardboard box.

PRECISION THERMOMETERS HANDMADE

In the **eXacal** manufacture of Klasmeier the precision thermometers are manufactured by careful manual work in Fulda/Germany. In addition to the construction of the actual thermometers, a further focus is the development of our own tools and production processes. For design, production and final DAkkS calibration, no external suppliers are required apart from the raw materials. This independence ensures the high quality of the thermometers.

Mechanical production

Required components, such as handles or prototypes for further development, are manufactured by machining.



Thermal treatment of thermal material

A core competence is the targeted thermal treatment of thermowires. Our aging processes ensure a metallurgically stable and thermoelectrically homogeneous condition of the **eXacal** thermocouples.

Noble metal welding process

Thermocouple wires and connecting cables are welded together precisely by hand. The required fuel gases hydrogen and oxygen are not stored in bottles, but are produced in a 2:1 mixture ratio of water by electrolysis. This guarantees the purity of the fuel gas.

Laser Welding

Particularly filigree connections, such as the connecting wires of the temperature detector, are welded under the microscope with precision lasers.

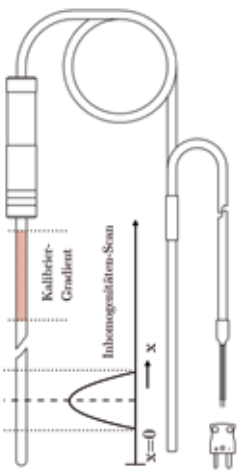
Annealing of resistance thermometers

Resistance thermometers are completely annealed according to our adapted annealing cycles in a specially designed annealing furnace with oxygen circulation.

3D printing

Insulation elements and complex plastic parts inside the handles, such as strain reliefs, are manufactured using a modern 3D printing process. This offers us many advantages. Complex designs are produced without manual detours and without expensive tools.

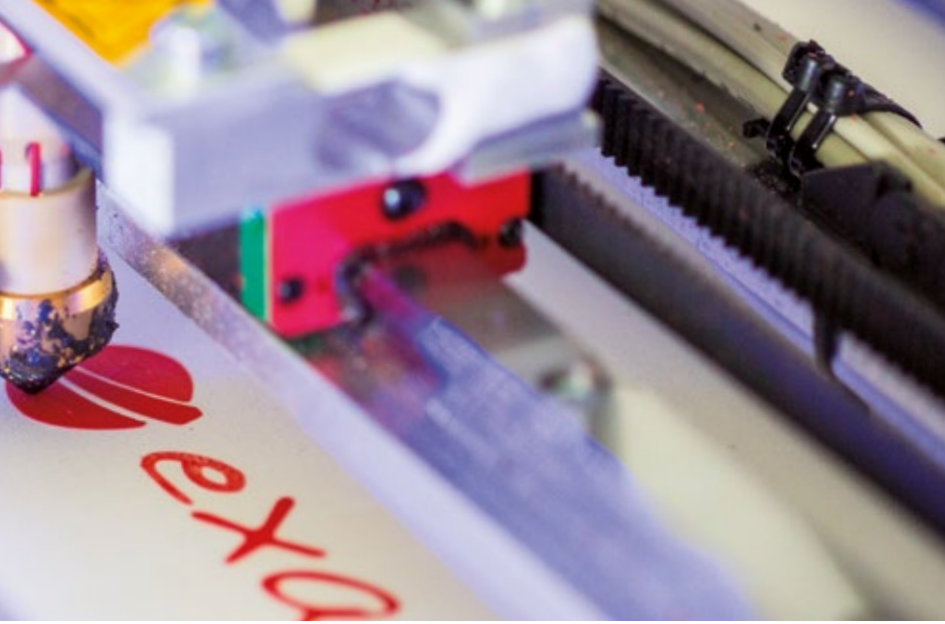
This saves a lot of time and money. By means of 3D printing, **eXacal** thermometers can be manufactured as a modular system according to customer specifications.



Inhomogeneity Scanner

Possible inhomogeneities of the **eXacal** thermocouples are examined with the help of an inhomogeneity scanner. A mobile heat source tests the entire thermal material of the measuring point for local inhomogeneities. The inhomogeneity scanner is a proprietary development of the **Klasmeier company**. With it the thermocouples of the **eXacal** manufacture can be improved substantially:

- **More realistic consideration of the measurement uncertainties**
- **Checking the thermal treatment**
- **Improvement of quality and manufacturing processes**



Questions about eXacal Manufacture?

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Questions about the technology?

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