

PTCR KEEPING AN EYE ON THE PROCESS

Process Temperature Control Rings from 560 °C (1040 °F) up to 1750 °C (3182 °F)

With this data sheet we provide a general overview about PTCR. For further technical information, useful hints and application advice for the use of Process Temperature Control Rings PTCR please refer to our PTCR Manual "Technique & Application".



Take control of your firing process

The accurate control of the firing/sintering process is of highest importance. After all, the results have a direct effect on the quality and the costs of the final product.

Optimal process control requires both, accurate measurement of the quantity of heat and the ability to control the temperature and its uniform distribution throughout the kiln/furnace. Efficient process temperature measurement is a key to high product quality.

By approximation, the temperature can be measured at different places in the kiln/furnace. However, most conventional temperature measurement techniques are limited in their applicability. For example, the thermocouples, which are often used in the ceramic industry, do not measure the temperature of the product itself, but that of its vicinity. They are also limited to measuring of radiated heat and take no account of heat transferred from kiln furniture.

Much better measurement for the quantity of absorbed heat by the product, is the shrinkage of a ceramic ring made of defined material and optimised for the desired application.

The Process Temperature Control Ring PTCR has been developed to give a better representation of the firing/sintering processes to allow a tight control of the real amount of heat transferred, taking into account the above-described influences.

YOUR BENEFITS WITH PTCR AT A GLANCE

- ✓ Fast and simple analysis of your firing/sintering processes
- ✓ Comparison of several processes possible
- ✓ Reduction of inspection time and costs
- ✓ Decrease of possible error sources
- ✓ Improvement of product quality
- ✓ Trouble shooting and problem handling in the furnace
- ✓ Easy handling
- ✓ Yield improvement
- ✓ Cost-effective process control and optimisation
- ✓ Process control, as formulated in ISO 9001:2015



How does a PTCR work?

The PTCR is a ceramic ring which shrinks if it is exposed to heat. The degree of shrinkage depends on the actual temperature in the kiln/furnace, the ability of the kiln/furnace to transfer the heat and the time it is exposed to the heat treatment. The amount of contraction - the amount by which the ring diameter has shrunk - is measured with a numerical or digital micrometer.

For ease and for comparison, the shrinkage of PTCR – and therefore the total absorbed heat quantity – is converted by means of a chart into a single, fictitious conversion parameter the so-called "ring temperature" (RT). Basically, this is not a "temperature", but a parameter that depends on time and temperature.

The RT does not reflect the maximum temperature of the firing process and does not correspond to the real kiln/furnace temperature, because the PTCR accumulates the absorbed heat quantity over time.

The PTCR temperature reading is further influenced by the top temperature hold time (soak time) at maximum temperature. At a constant temperature the PTCR will continue to shrink, leading to a higher RT reading. Selecting the most appropriate ring type depends on the process temperature compared to the temperature range of the ring and the maximum hold time, which is typically between 0.5 and 10 hours. Using the PTCR beyond this maximum hold time may lead to erroneous results, because the PTCR ceases to shrink further on a certain moment.

Which types of PTCR are available?

A total of eight different ring types are available. The standard rings have a thickness of 7 mm (named H). Alternatively, thinner rings with a thickness of 3.5 mm (named L) are also available on request. All PTCRs have an outer diameter of 20 mm. They cover a temperature range from 560 °C (1040 °F) to 1750 °C (3182 °F). The ring types are coloured, with batch number and type embossed on the surface.

PTCR type	Colour	Temperature range
ZTH	light gray	560 °C – 660 °C (1040 °F – 1220 °F)
ATH	greyish white	600 °C – 850 °C (1112 °F – 1562 °F)
UTH	yellow	660 °C – 900 °C (1220 °F – 1652 °F)
ETH	pale green	850 °C – 1100 °C (1562 °F – 2012 °F)
LTH	pink	970 °C – 1250 °C (1778 °F – 2282 °F)
STH	green	1130 °C – 1340 °C (2066 °F – 2444 °F)
MTH	cream	1340 °C – 1520 °C (2444 °F – 2768 °F)
HTH	white	1450 °C – 1750 °C (2642 °F – 3182 °F)

Select a PTCR type whose central temperature spread is nearest to the kiln's peak firing temperature. PTCR are most accurate in the central temperature range rather than at the extreme ends. If the maximum kiln/furnace temperature is within the limit range of two ring types, the selection falls according to the hold time and atmosphere, since both factors also strongly influence the shrinkage of the ring.

Positioning



PTCR can be placed at almost any location in the kiln/furnace, on kiln furniture, trolleys etc. The use of multi-location and multi-level positioning is recommended, as this provides the most insight into the temperature distribution within the kiln/furnace. Rings do not have to be measured before they are put into the kiln/ furnace, because differences are statistically corrected and integrated in the conversion chart. Sticking of the rings is prevented e.g. by placing a small amount of aluminum oxide powder (Al_2O_3) underneath the ring.

Measurement

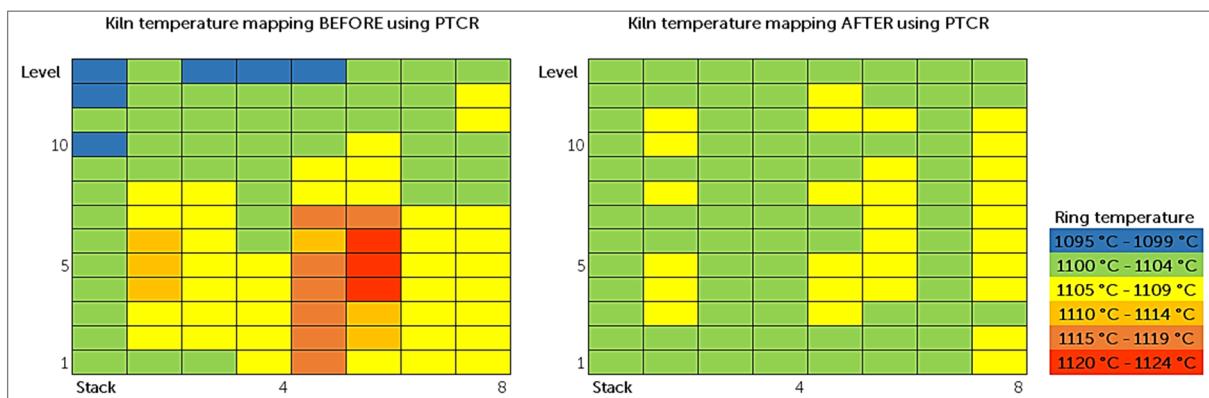
After the firing/sintering cycle has been terminated, the ring diameters have to be measured. The contraction of the ring reflects the absorbed quantity of heat at the place in the kiln/furnace where the ring was located. The diameter is easily measured, using the special PTCR micrometer. Only a single measurement is necessary (see the 2 pictures on the left side).



Correct positioning of the ring in the micrometer is required for accurate measurement. The "T" is impressed in the ring should be placed exactly on the indentation of the micrometer. The numerical and the digital micrometer both have ergonomically designed solid base with a ring positioning chuck, which ensures the ring is always correctly positioned in the micrometer. This design simplifies the measuring process and improves the reproducibility of the measurement.

Process control and optimisation

In the process of establishing a standard, the firing/sintering process is characterized by mapping the ring temperatures of PTCR distributed throughout the kiln/furnace. This allows the "hot" and "cold spots" to be detected and defined. Using the heat treatment mapping, the firing process can then be optimized by offsetting heat sources or thermocouples as indicated by the variations in ring temperatures. As a rule of thumb, one degree of ring temperature (RT) corresponds to one degree Celsius. The exact relationship between ring temperature (RT) and degrees Celsius is of course dependent upon the specific firing/sintering cycle of the kiln/furnace. The illustration below shows two heat treatment mappings of the same 15 m³ kiln. The first was generated before using the PTCR, the second after firing process optimisation using PTCR, resulting in substantial yield improvement.



The most frequent use of PTCR is by optimising and managing the firing/sintering processes to achieve the optimal product quality and to assess the thermal performance and characteristics of a kiln/furnace. The way of working is to make a number of runs with different settings of the parameters temperature and time. These runs are characterised by the ring temperature (RT) values as determined from the rings. Product quality analysis determines the optimal run and accompanying RT values.

In this way the estimated ring temperature (RT) is related to a specific firing/sintering process. Once the optimal setting of the process parameters is found, the PTCR is used to control the process and to recognize deviations in time and temperature. In future runs the same RT reading will guarantee the best reproducibility of the firing process.

This method is followed whenever a new product or process has to be introduced, to determine differences in the thermal characteristics of new kilns/furnaces, or after maintenance of kilns/furnaces. The PTCR's accuracy and convenience free you from the concerns of process quality and control, allowing you to fully concentrate on your product, not on temperature control.

In case of technical questions related to our products and their application, please do not hesitate to contact us.

Packaging

15 pcs. / small paper boxes

600 rings in a solid shipping box (standard packing unit)

2,400 rings in a solid shipping carton