# ZERODUR® K20
# White Glass Ceramic Material with High Temperature Stability and Low Thermal Expansion

For over 30 years the zero expansion glass ceramic ZERODUR® has been used worldwide in very different and challenging applications. Now Schott can announce a promising modification called "ZERODUR® K20".

The new K20 glass ceramic material contains a crystal phase of over 90 % Keatite, produced by thermal transformation from the semi transparent ZERODUR® material. With an expansion coefficient of $2.0 \cdot 10^{-6}\ K^{-1}$ between 20° - 700° C, the new material has an even lower value of $1.5 \cdot 10^{-6}\ K^{-1}$ at room temperature. The material has high temperature stability and does not change during multiple temperature cycles.

Material samples before and after transformation to the high temperature stability glass ceramic ZERODUR® K20

## Innovative Properties:

The new glass ceramic ZERODUR® K20 is characterized by the following properties:

- A low coefficient of thermal expansion together with high long-term temperature stability up to 850°C.
- ZERODUR® K20 can be matched with low thermal expansion metal alloys, e.g. Invar®.
- The excellent homogeneity and internal quality can be inspected optically in the semi transparent base material before transformation.
- After transformation the material has a radiance factor of more than 90% with a matt brilliant white finish.
- The glass ceramic is free of pores and can be polished to very low surface roughness levels.
- Large-scale parts can be produced with dimensions of several meters.

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glass made of ideas

| Properties | ZERODUR® K20 | ZERODUR® |
|---|---|---|
| Density [g/cm$^3$] | 2.53 | 2.53 |
| Young's modulus E [GPa] | 83 | 90 |
| Poisson's ratio μ | 0.25 | 0.24 |
| Knoop hardness [HK 0.1/20] | 620 | 620 |
| Expansion coefficient (20°-700°C) [10$^{-6}$/K]) | 2.0 | 0.2 |
| Expansion coefficient (0°-50°C) [10$^{-6}$/K] | 1.5 | 0 ± 0.1 |
| Thermal capacity $c_p$ (20°C) [J/(gK)] | 0.90 (extrapolated) | 0.80 |
| Thermal conductivity (90 °C) [W/(mK)] | 1.6 | 1.46 |
| Max. application temperature [°C] | 850 | 600 |
| Upper annealing (μ=10$^{13}$ dPas) [°C] | 970 | --- |

## Innovative Properties:

The new glass ceramic ZERODUR® K20 is now the material of choice for many different optical and engineering applications:

- High temperature usage
- High precision manufactured components
- Low expansion coefficient
- High thermal load resistance
- Pore-free surfaces that can be polished to high precision standards

ZERODUR® K20 used as a mould material for the production of X-Ray telescope mirror segments in astronomy applications

## Possible Applications:

- Mechanical and optical components within high energy laser systems
- Mould material in hot forming processes (glass, plastic, etc.)
- Ceramic engine components
- Calibration standards for optical and mechanical probes
- Serial production or prototype manufacture

Optics for Devices
**SCHOTT AG**
Hattenbergstraße 10
55122 Mainz
Germany
Phone: + 49 (0)6131/66-3835
Fax: + 49 (0)6131/66-1998
E-mail: info.optics@schott.com
www.schott.com/optics_devices

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