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ZERODUR®

Product Information

ZERODUR® is a glass ceramic with an extremely low thermal expansion coefficient. The most important properties of ZERODUR® are:

- Nearly zero thermal expansion with outstanding 3D homogeneity
- High internal quality
- Good processing behaviour
- Can be polished to a very high accuracy
- Can be coated easily
- Low Helium permeability
- Non-porous
- Good chemical stability

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Applications

Astronomy:

For more than 30 years, ZERODUR® has been the favored material for mirror substrates of earthbound and orbital telescopes. ZERODUR® can be made in large batches with reproducible quality and is therefore suited for future extremely large telescopes (ELTs) in the 20 m to 100 m class.

Modern fabrication technologies enable the production of structures with more than 65% weight reduction. ZERODUR® is the ideal mandrel material for the shaping of mirror shells in future x-ray telescope projects due to the excellent homogeneity of its coefficient of thermal expansion.

Lithography:

ZERODUR® is used as a movable mechanical part in wafer stepper and scanner machines, to achieve precise and reproducible wafer positioning. ZERODUR® is an ideal substrate material for reflective optics in the forthcoming EUV lithography due to its almost zero thermal expansion, outstanding homogeneity and good processing behavior.

Measurement Technology:

The extremely low thermal expansion and proven long-term dimensional stability of ZERODUR® make it an ideal reference standard for measurement instruments.

Forms of Supply

ZERODUR® can be supplied in the form of discs, rectangular blocks, prisms, rods and cut pieces measuring from a few cm up to approximately 4m in length. Modern CNC processing equipment and a variety of grinding technologies allow the generation of complex geometries and filigree structures on request.

Specifications

Individual pieces of ZERODUR® (discs, plates, rods) can be supplied with a mean coefficient of linear thermal expansion in the temperature range 0° to 50°C in three expansion classes as follows:

Expansion class 2 0 ± 0.10*10-6 K-1

Expansion class 1 0 ± 0.05*10-6 K-1

Expansion class 0 0 ± 0.02*10-6 K-1

ZERODUR® exhibits excellent homogeneity of the linear thermal expansion coefficient. Typical values are between 0.01 and 0.02*10-6 K-1.

On request homogeneities < 0.01*10-6 are possible.

ZERODUR® may be used as a mechanical component as well as a window at temperatures up to 600 °C. For applications up to 850°C ZERODUR® K20 was developed as a new material modification. The material has an expansion coefficient of 2.0*10-6 K-1 between 20° - 700° C and 1.5*10-6 K-1 at room temperature.

Internal Quality:

The following applies for the internal quality of “standard” ZERODUR® with typical dimensions < 500 mm:

Average number of inclusions 5 / 100 cm3

Maximum diameter of single inclusions 3.0 (1.4 within the critical volume)

Striae (birefringence) < 60 nm / striae

Bulk stress (birefringence) < 6 nm / cm

Further Properties:

Density 2.53 g/cm3

Thermal conductivity at 20°C 1.46 W/(m*K)

Thermal diffusivity at 20°C 0.72*10-6 m2/s

Thermal capacity 0.8 J/(g*K)

Young’s modulus at 20°C 90.3 GPa

Poisson’s ratio 0.243

Knoop hardness 0.1/20 620

Information on tolerances for larger pieces or tighter tolerances are available to download.

Quality Assurance

ZERODUR® parts are inspected during all stages of fabrication. Additionally an intensive final inspection is carried out. Modern measurement equipment is used for the inspection.

For more information please contact the technical team at Skan.

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