

MACOR[®]

Machinable Glass Ceramic
For Industrial Applications



CORNING

A unique
material

MACOR[®] Machinable Glass Ceramic

MACOR[®] machinable glass ceramic is recognized worldwide to be a major technological innovation, as well as a technical solution for a wide range of industrial applications.

Opening a wide range of possibilities MACOR[®] gives the performance of a technical ceramic with the versatility of a high performance polymer, while providing the machinability of a soft metal.

As a result, MACOR[®] is an outstanding engineering material which can quickly be designed in to highly complex shapes, using conventional metalworking tools.

Unique composition

MACOR[®] can be considered unique as its composition comprises 55% fluorophlogopite mica and 45% borosilicate glass. Corning's unique production process results in Macor's microstructure that is a key to its versatile properties.

General properties

MACOR[®] offers a unique combination of properties, unlike any other technical material.

It is a white, nonwetting, odorless and non outgassing material that exhibits zero porosity.

Extremely machinable, MACOR[®] offers tight tolerances capabilities, allowing complicated shape design (optimal performances up to +/- 0.013 mm for dimensions, < 0.5 µm for finished surface and up to 0.013 µm for polished surface).

MACOR[®] remains continuously stable at 800 °C, with a maximum peak at 1000 °C under no load, and unlike ductile materials, doesn't creep or deform.

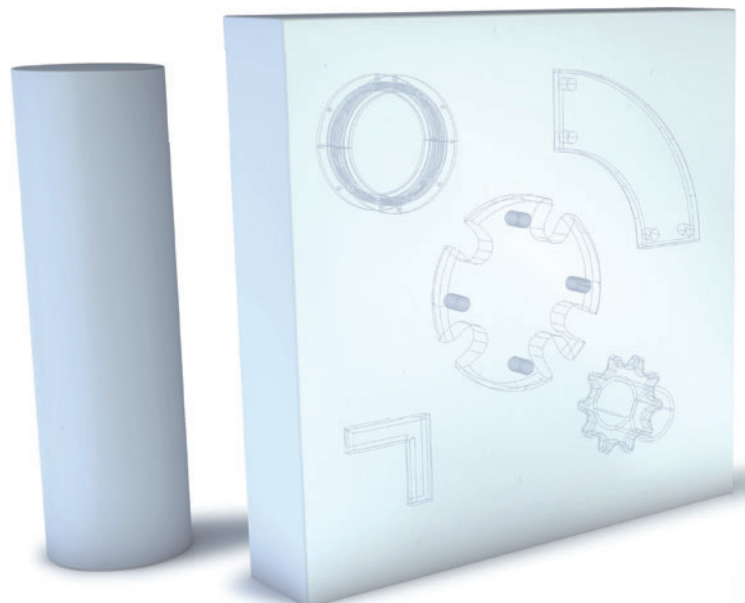
Its coefficient of thermal expansion readily matches most metals and sealing glasses.

As an electric insulator, particularly at high temperatures, it is excellent at high voltages and a broad spectrum of frequencies.

Material Forms

Corning supplies MACOR[®] as slab and rod.

High precision finished parts are manufactured by our specialist partners.



Key Benefits

Product

- Easily machinable
- Withstands high temperatures
- Low thermal conductivity
- Holds tight tolerances
- Electrical insulator
- Zero porosity and no outgassing
- Strong & rigid
- Highly polishable
- can be soldered to a wide range of material
- Radiation resistant
- Lead free

Process

Short production process



- Ordinary machining tools
- Complex design shapes
- No post firing required
- Fast turnaround and cost effective
- Quick end-user delivery time

Unrivalled properties combination - A wide range of possibilities
Quickly - Accurately - Economically

Industry Applications

MACOR[®] builds value in every field :

- Constant and ultra-high vacuum environments
- Laser technology
- Semiconductor / Electronic
- Aerospace / Space
- Medical/ Laboratory equipment
- Fixtures
- Chemical
- Automobile
- Military
- Nuclear...

Properties

I. Thermal

| | SI/Metric | Imperial |
|----------------------------------|---|--------------------------------------|
| Coefficient of Expansion | | |
| CTE -100°C → 25°C | $81 \times 10^{-7} / ^\circ\text{C}$ | $45 \times 10^{-7} / ^\circ\text{F}$ |
| CTE 25°C → 300°C | $90 \times 10^{-7} / ^\circ\text{C}$ | $50 \times 10^{-7} / ^\circ\text{F}$ |
| CTE 25°C → 600°C | $112 \times 10^{-7} / ^\circ\text{C}$ | $62 \times 10^{-7} / ^\circ\text{F}$ |
| CTE 25°C → 800°C | $123 \times 10^{-7} / ^\circ\text{C}$ | $68 \times 10^{-7} / ^\circ\text{F}$ |
| Specific Heat, 25°C | 0,79 kJ/kg°C | 0.19 Btu/lb°F |
| Thermal Conductivity, 25°C | 1,46 W/m°C | 10.16 Btu.in/hr.ft²°F |
| Thermal Diffusivity, 25°C | $7,3 \times 10^{-7} \text{ m}^2/\text{s}$ | 0.028 ft²/hr |
| Continuous Operating Temperature | 800°C | 1472°F |
| Maximum No Load Temperature | 1000°C | 1832°F |

II. Mechanical

| | SI/Metric | Imperial |
|--|---|---------------------------|
| Density | 2,52 g/cm³ | 157 lbs/ft³ |
| Porosity | 0% | 0% |
| Young's Modulus, 25°C (Modulus of Elasticity) | 66,9 GPa | 9.7×10^6 PSI |
| Poisson's Ratio | 0,29 | 0.29 |
| Shear Modulus, 25°C | 25,5 GPa | 3.7×10^6 PSI |
| Knoop Hardness, 100g | 250 kg/mm² | |
| Modulus of Rupture, 25°C (Flexural Strength) | 94 MPa (Minimum specified average value) | 13 600 PSI |
| Compressive Strength (After polishing) | 345 MPa up to 900 MPa | 49 900 PSI 130 000 PSI |

III. Electrical

| | SI/Metric | Imperial |
|---|------------------|------------------|
| Dielectric Constant, 25°C | | |
| 1 kHz | 6,01 | 6.01 |
| 8,5 GHz | 5,64 | 5.64 |
| Loss Tangent, 25°C | | |
| 1 kHz | 0,0040 | 0.0040 |
| 8,5 GHz | 0,0025 | 0.0025 |
| Dielectric Strength (AC) avg. 25°C, under 0,03 mm thickness. | 45 kV/mm | 1143 V/mil |
| Dielectric Strength (DC) avg. 25°C, under 0,03 mm thickness | 129 kV/mm | 3277 V/mil |
| DC Volume Resistivity, 25°C | 10^{17} Ohm.cm | 10^{17} Ohm.cm |

IV. Chemical

| Solution | pH | Time | Temp. | Weight Loss (mg/cm²) Gravimetric |
|--|------|--------|-------|--|
| 5% HCl (Hydrochloric Acid) | 0,1 | 24 hrs | 95°C | ~100 |
| 0,002 N HNO ₃ (Nitric Acid) | 2,8 | 24 hrs | 95°C | ~0,6 |
| 0,1 N NaHCO ₃ (Sodium Bicarbonate) | 8,4 | 24 hrs | 95°C | ~0,3 |
| 0,02 N Na ₂ CO ₃ (Sodium Carbonate) | 10,9 | 6 hrs | 95°C | ~0,1 |
| 5% NaOH (Sodium Hydroxide) | 13,2 | 6 hrs | 95°C | ~10 |

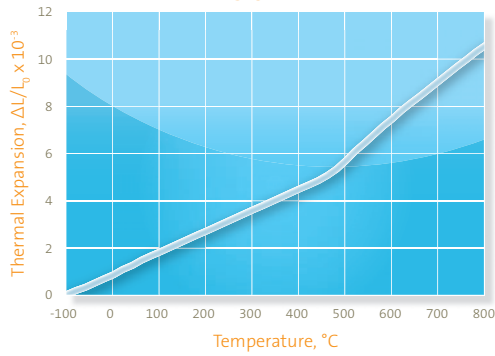
Chemical durability

| | | Class |
|------------------------|--------|-------|
| DIN 12111 / NF ISO 719 | Water | HGB2 |
| DIN 12116 | Acid | 4 |
| DIN 52322 / ISO 695 | Alkali | A3 |

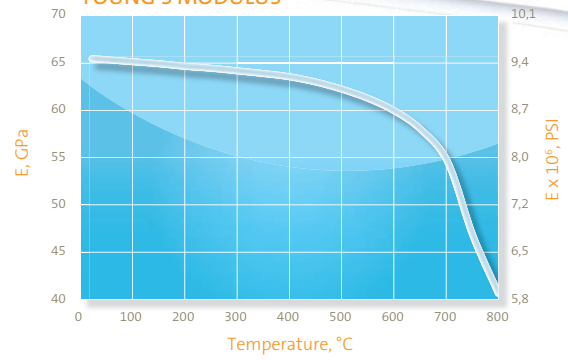


Technical Data

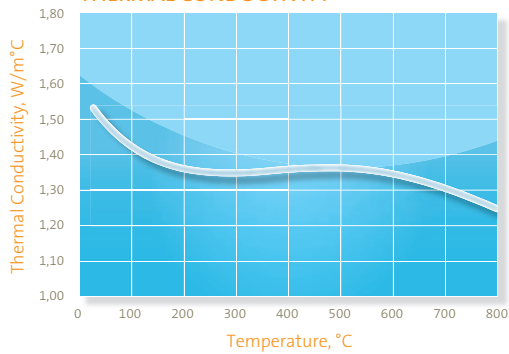
THERMAL EXPANSION



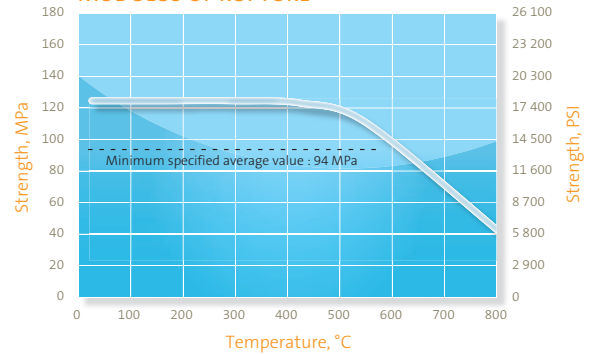
YOUNG'S MODULUS



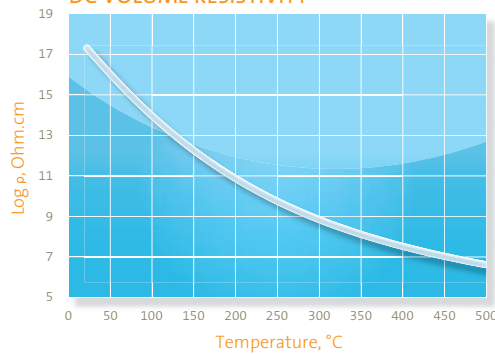
THERMAL CONDUCTIVITY



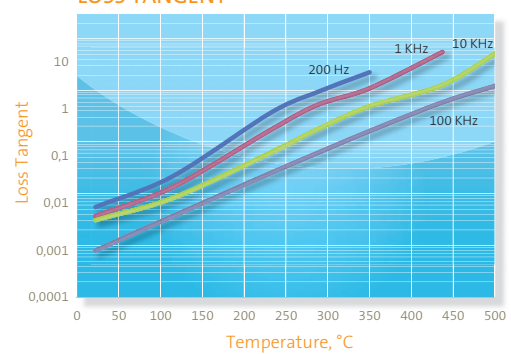
MODULUS OF RUPTURE



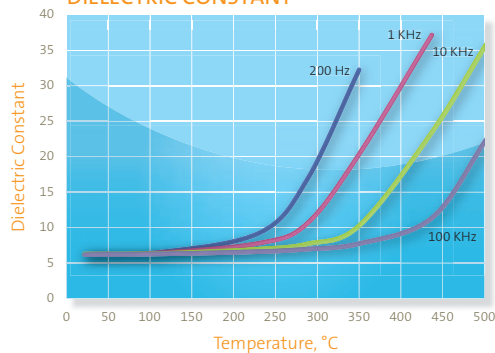
DC VOLUME RESISTIVITY



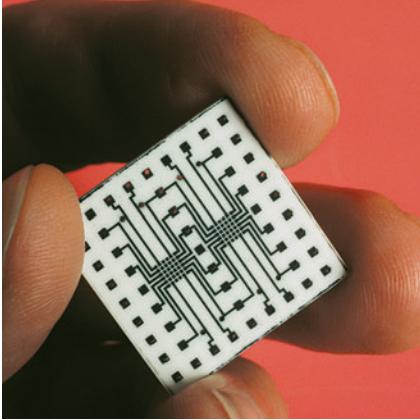
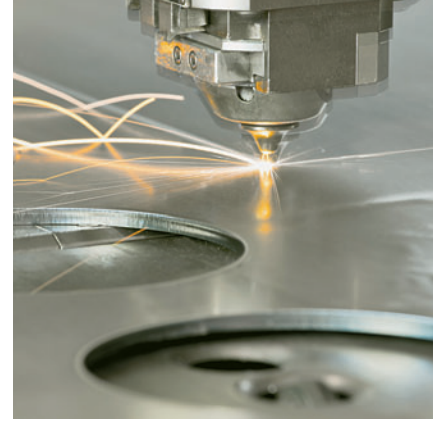
LOSS TANGENT



DIELECTRIC CONSTANT



Actual properties of specific production batches may vary. Stated general properties reflect results from regular tests on sample quantities in Corning labs.



Your
Application



ISO 9001
ISO 14001
OHSAS 18001

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MACOR® is a registered trademark of Corning Incorporated, Corning, NY

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