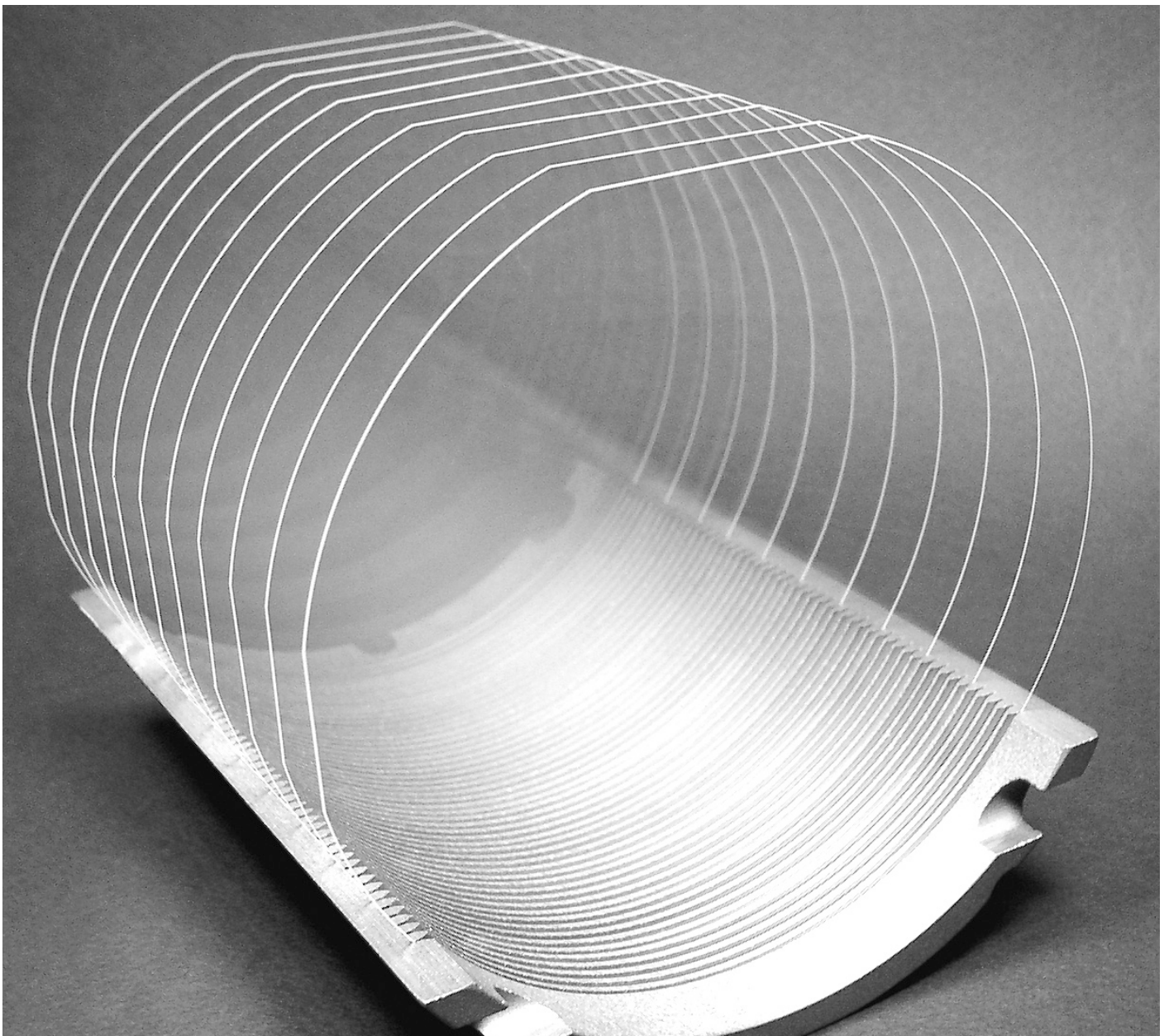


MATERIAL DATASHEET

# Borofloat 33



# Borofloat 33

## **Floated borosilicate glass made in germany**

high chemical stability  
outstanding thermal resistivity  
excellent mechanical resilience

low cte adapted to Si

used for wafer level packaging  
material for MEMS applications  
anodic bonding with Silicon  
carrier for wafer handling of thin Silicon wafers

## Chemical Composition

SiO <sub>2</sub>	B <sub>2</sub> O <sub>3</sub>	Na <sub>2</sub> O	Al <sub>2</sub> O <sub>3</sub>	K <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	ZrO <sub>2</sub>
80 %	12,75 %	3,55 %	2,4 %	0,55 %	<230 ppm	< 15 ppm

## Chemical Properties

Durability:

Durability is measured via weight-loss per surface area after immersion. Values are highly dependent upon actual testing conditions. Unless otherwise noted, concentrations refer to weight percent.

Reagent	Time	Temp	Weight Loss [mg/cm <sup>2</sup> ]
HCl – 5%	24 hrs	95°C	<0.01
0.02 n H <sub>2</sub> SO <sub>4</sub>	24 hrs	95°C	<0.01
H <sub>2</sub> O	24 hrs	95°C	<0.01
NaOH – 5%	6 hrs	95°C	1.1
0.02 n NaOH	6 hrs	95°C	0.16
0.02 n Na <sub>2</sub> CO <sub>3</sub>	6 hrs	95°C	0.16
HF – 10%	20 min	23°C	1.1
NH <sub>4</sub> F x HF – 10%	20 min	23°C	0.14

Hydrolytic resistance acc. to DIN ISO 719	Class HGB 1
Acid Resistance acc. to DIN 12116	Class 1
Alkali resistance acc. to DIN ISO 695	Class A 2

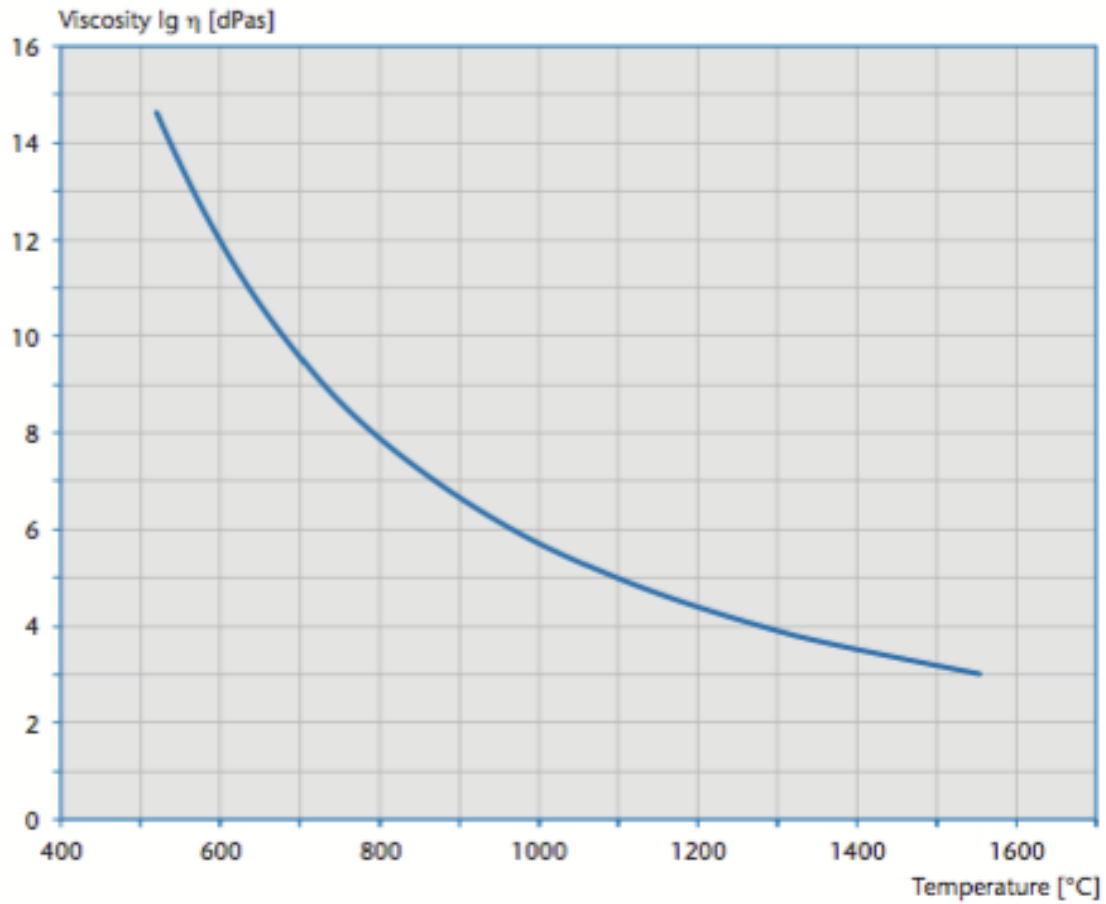
## Mechanical Properties

Density [g/cm <sup>3</sup> ]	2.2
Young's Modulus [MPa]	64,000
Poisson's Ratio	0.20
Knoop Hardness HK <sub>0.1/20</sub>	480
Bending strength [MPa]	25

## Thermal Properties

<b>Viscosity</b>	
Working Point (10 <sup>4</sup> dPas) [°C]	1270
Softening Point (10 <sup>7.6</sup> dPas) [°C]	815
Annealing Point (10 <sup>13</sup> dPas) [°C]	560
Strain Point (10 <sup>14.5</sup> dPas) [°C]	518
Transformation Temperature [°C]	525

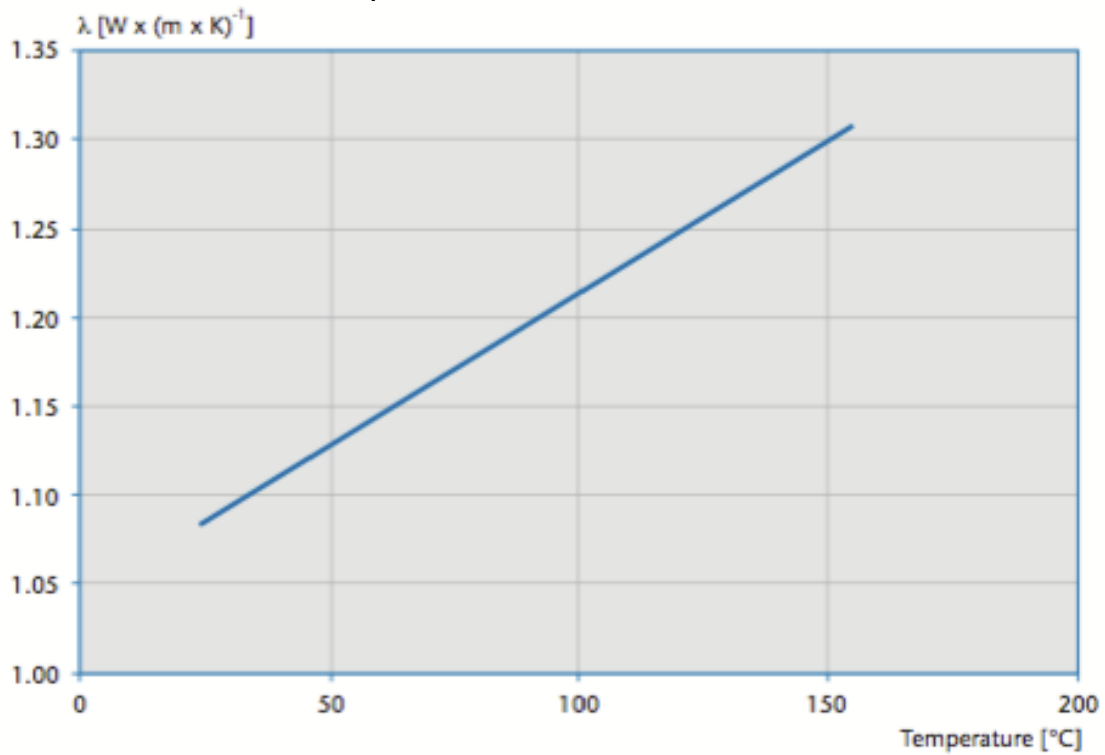
□ Temperature Dependency of the Viscosity:



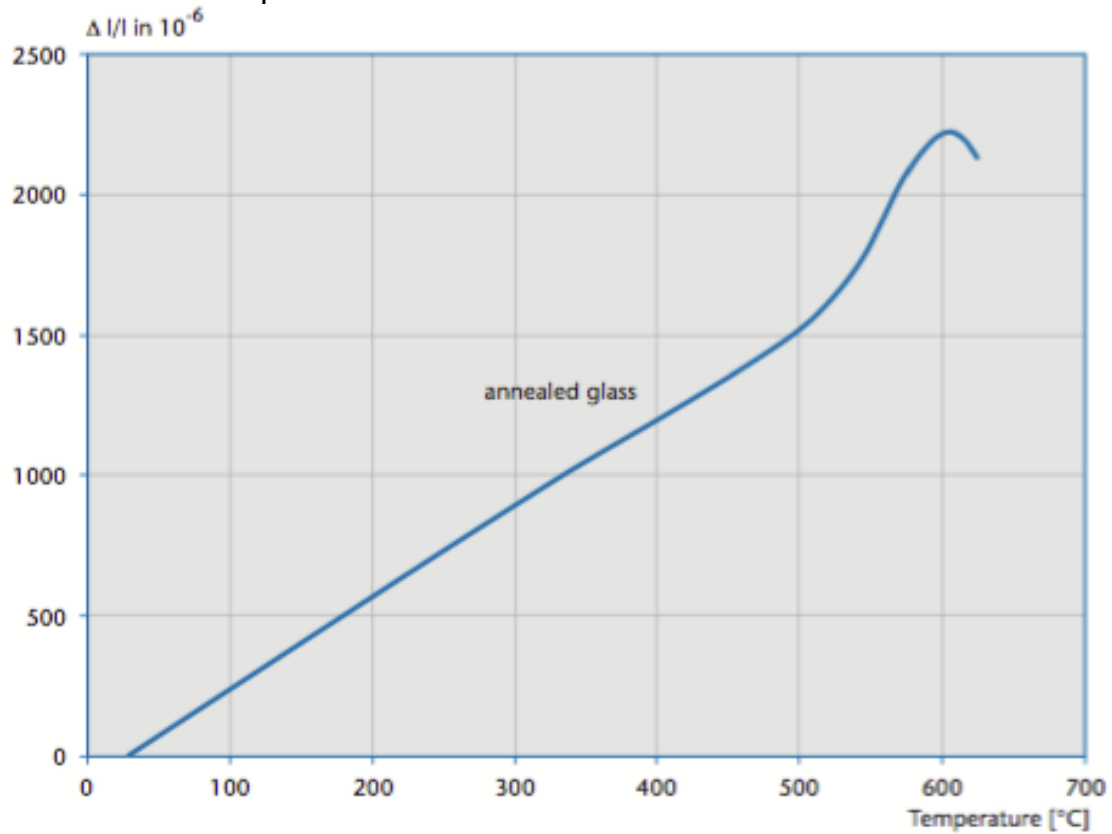
Maximum operating Temperature (short-term < 10h) [°C]	500
Maximum operating Temperature (long-term ≥ 10h) [°C]	450

Thermal Conductivity $\lambda$ (90 °C) [W/(m*K)]	1.2
Specific Heat Capacity $C_p$ (20 °C; 100 °C) [J/(kg*K)]	900
Coefficient of Linear Thermal Expansion (cte) $\alpha$ (20 °C; 300 °C) [K <sup>-1</sup> ]	$3.25 \times 10^{-6}$

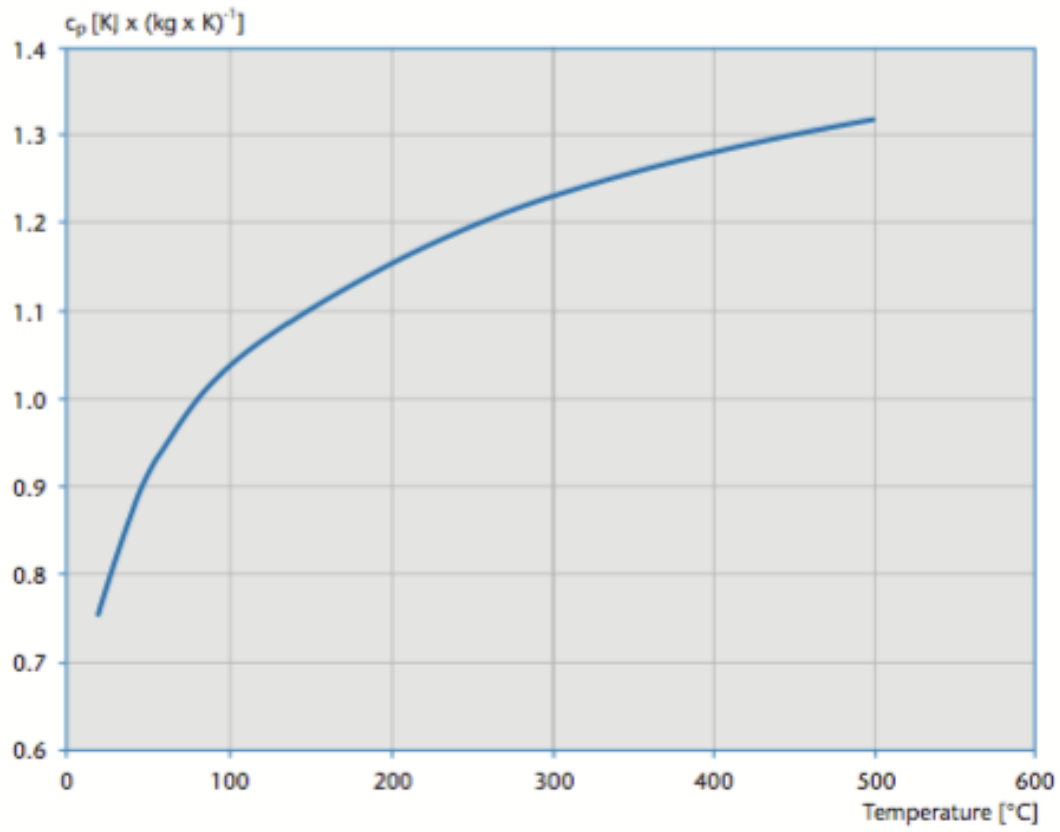
□ Thermal Conductivity:



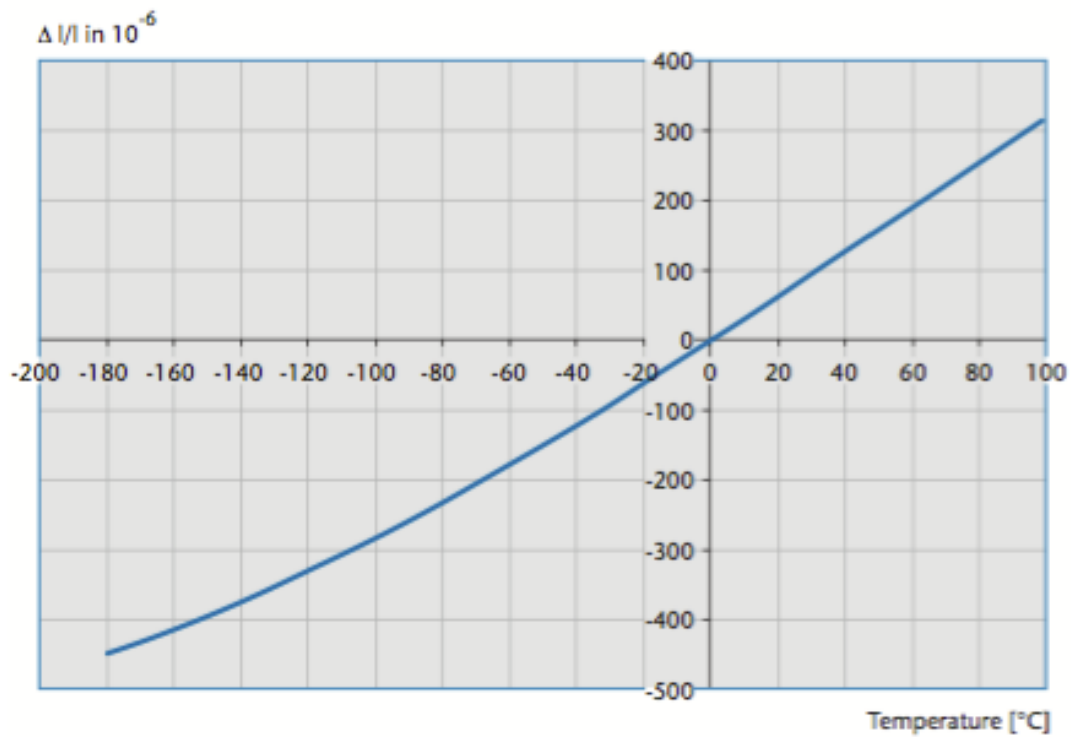
□ Thermal Expansion:



□ Specific Heat Capacity:



□ Behavior in the Cryogenic Temperature Range:

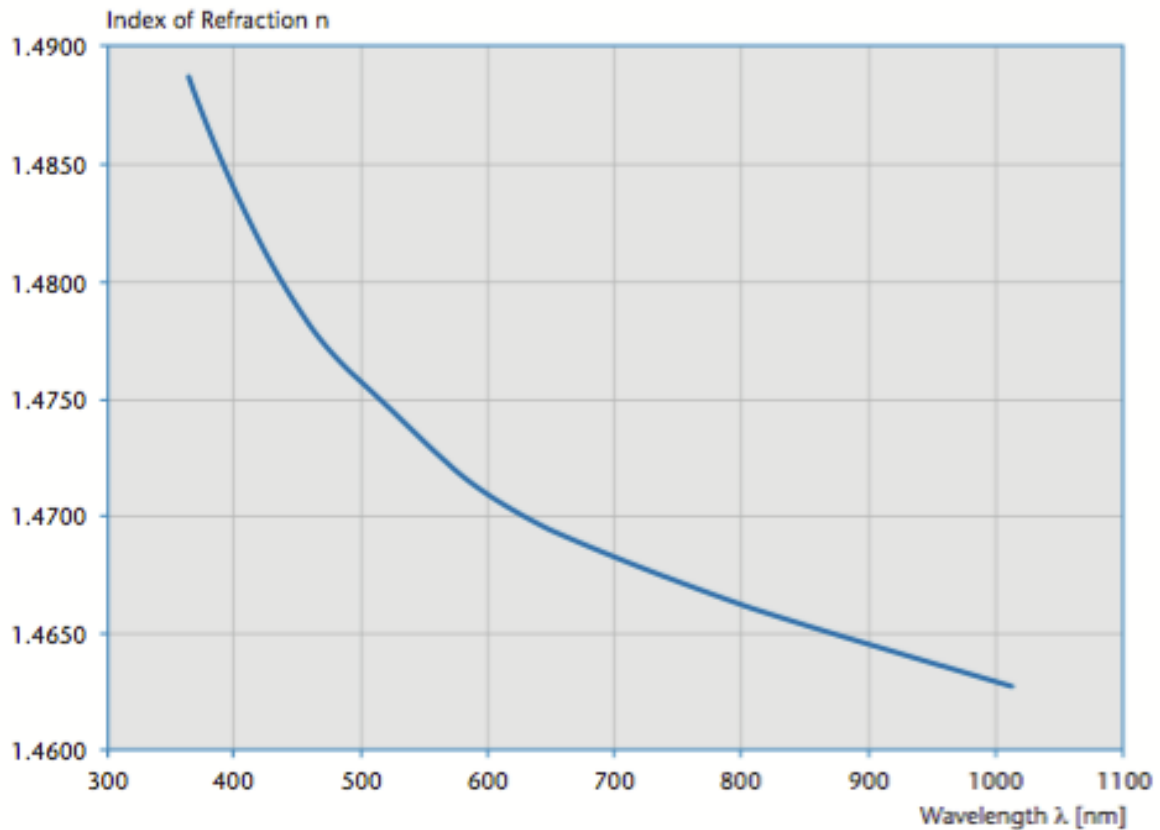


## Optical Properties

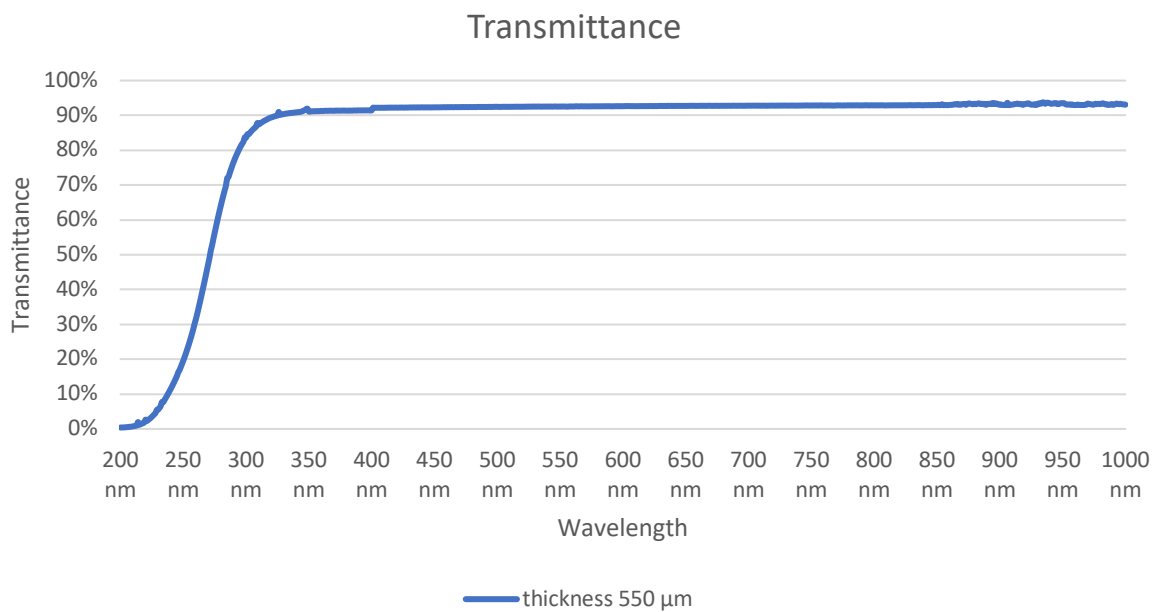
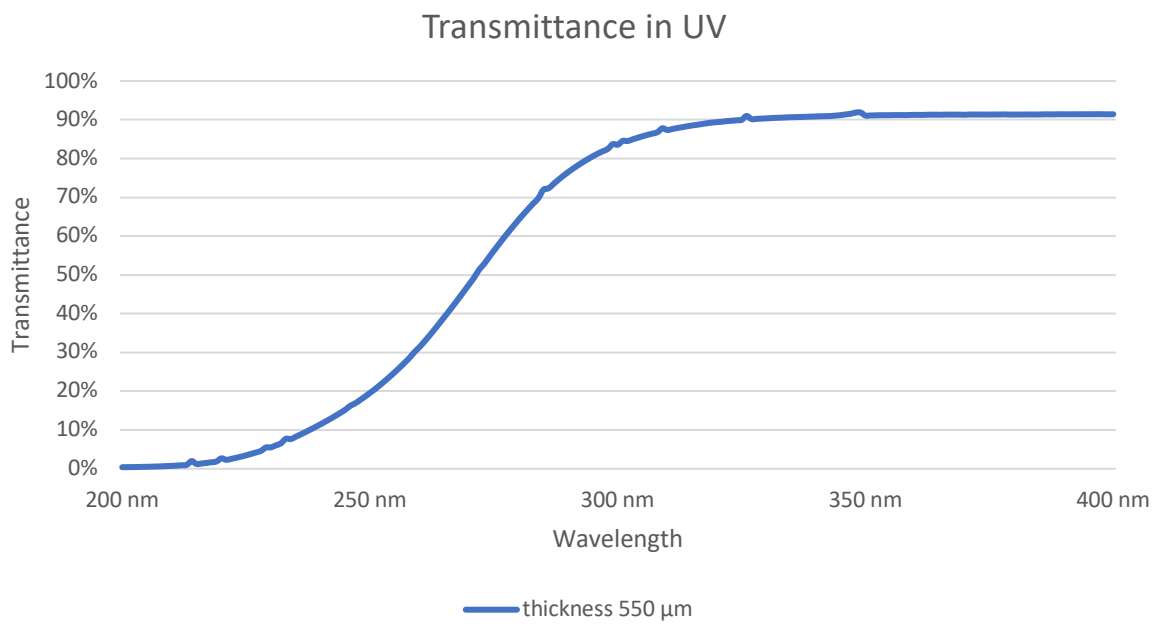
Wavelength [nm]	Refractive Index
435.8	1.48015
479.9	1.47676
546.1	1.47311
589.3	1.47133
643.8	1.46953
656.3	1.46916

Abbe Constant	65.41
Dispersion	$71.4 \times 10^{-4}$
Birefringence Constant [ $\text{mm}^2/\text{N}$ ]	400

- Dispersion of Borofloat 33, Index of Refraction vs. Wavelength:



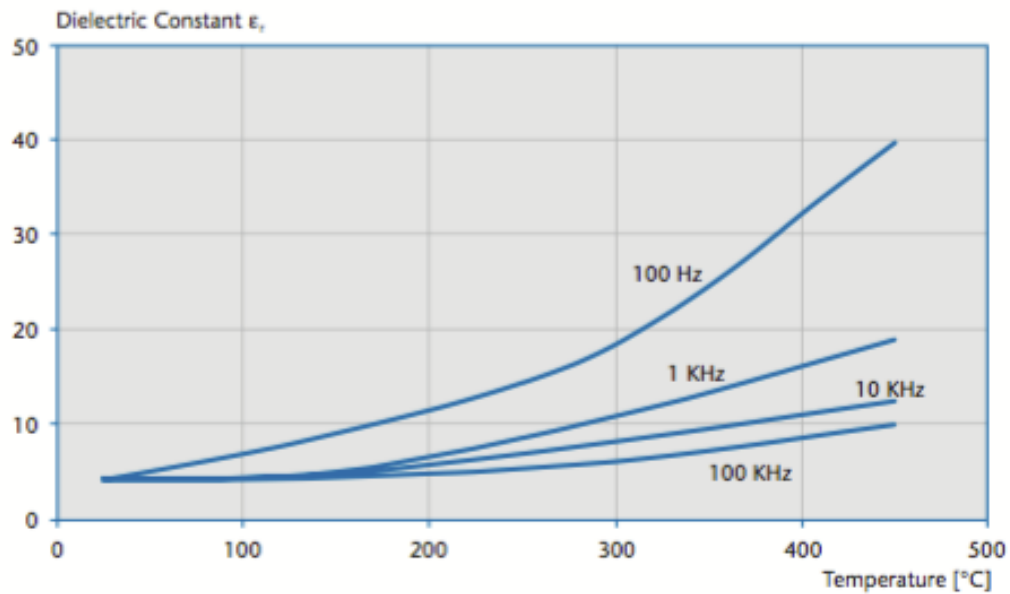
Wavelength	Transmittance
200 nm	0.4 %
250 nm	19.6 %
300 nm	83.58 %
350 nm	91.1 %
400 nm	91.4 %
500 nm	92.5 %
750 nm	92.9 %
1000 nm	93.1 %



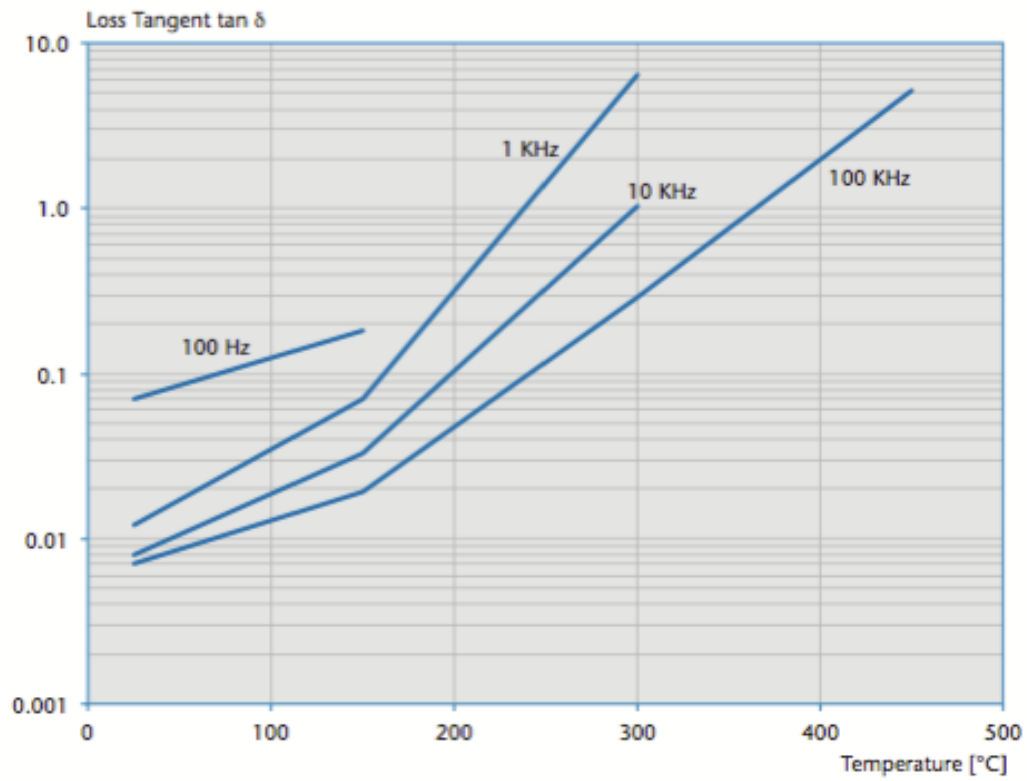
## Electrical Properties

Dielectric Constant @ 25°C, 1 MHz	4.6
Loss Tangent @ 25°C, 1 MHz	0.0037
LOG10 Volumen Resistivity @ 250°C [ $\Omega$ cm]	8.0
LOG10 Volumen Resistivity @ 230°C [ $\Omega$ cm]	6.5

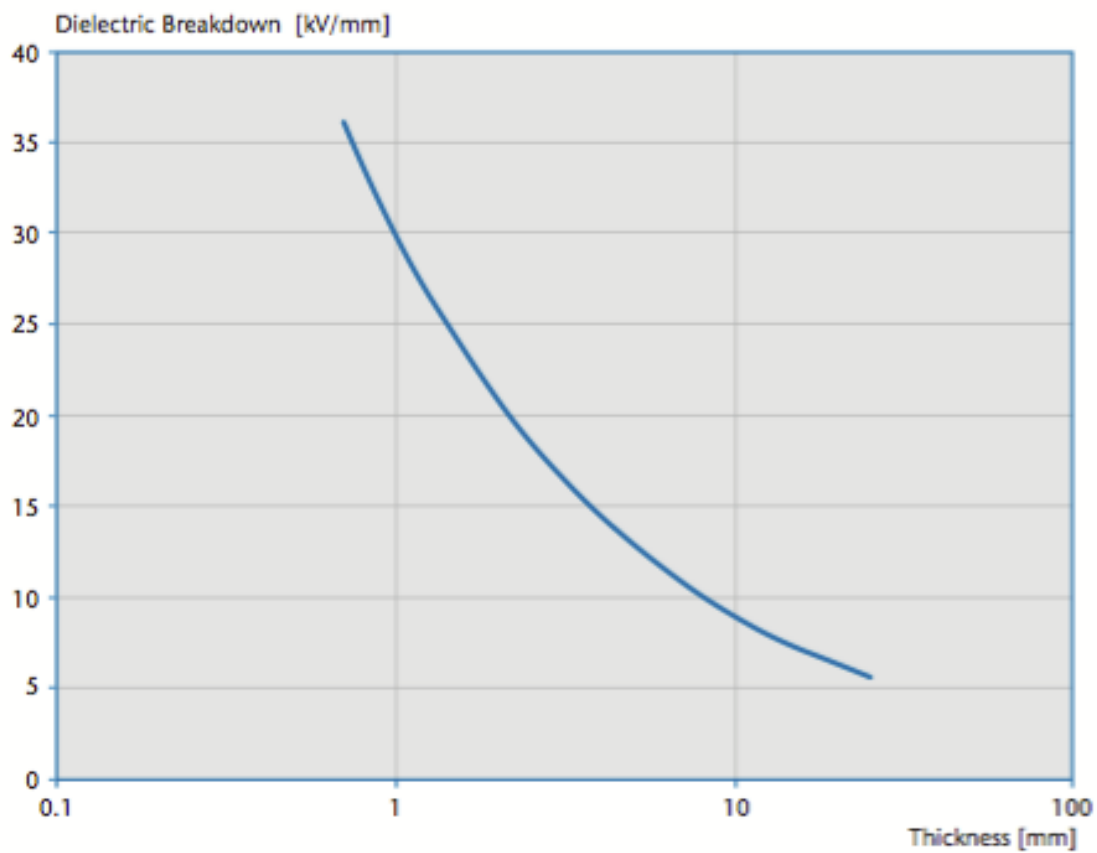
- Dielectric Constant as Function of Temperature:



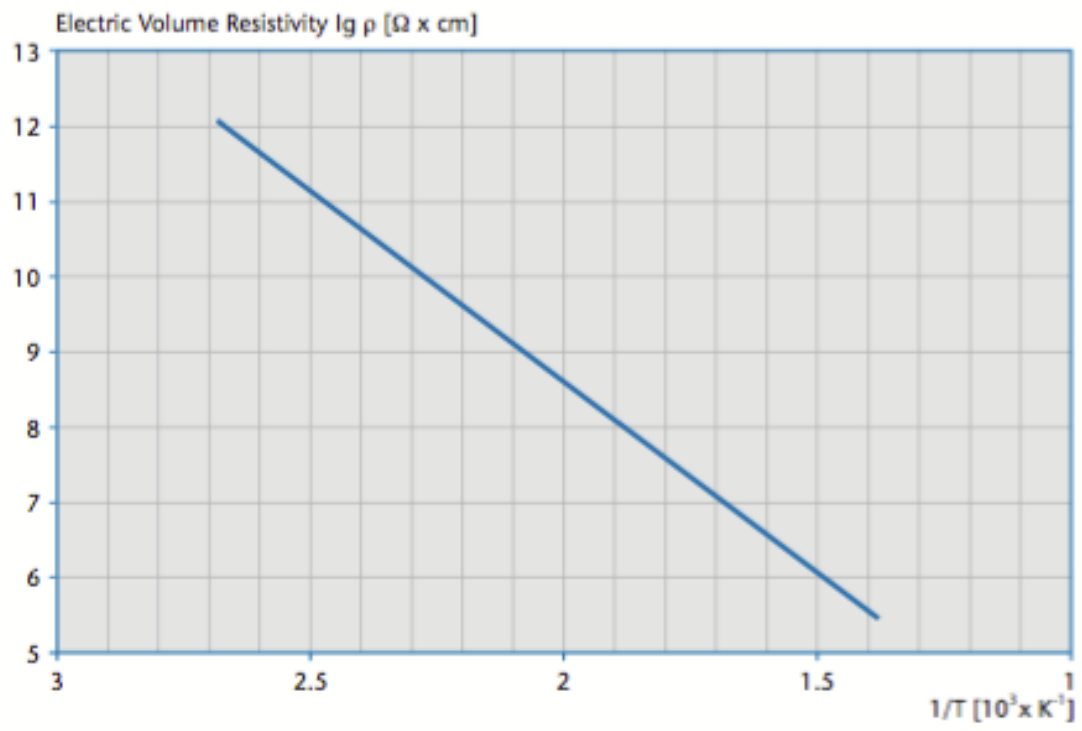
- Loss Tangent as a Function of Temperature:



- Dielectric Breakdown as a Function of Glass Thickness:



- Electric Volume Resistivity as a Function of Temperature



### **Disclaimer:**

The above data has been taken from the original raw material specification of the raw material producer. Completeness and validity cannot be guaranteed.

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