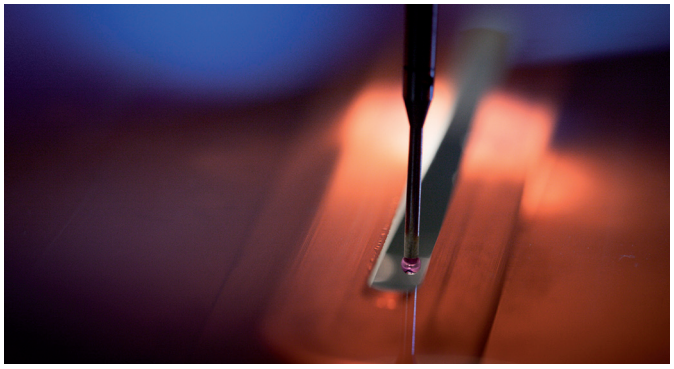
# BOROFLOAT® 33 & Optical Mirrors: A Union of Inspiration & Quality

## The sum of its properties is what makes it unique.

More than 20 years ago, SCHOTT set up the first micro-float production line for what would soon become one of the most influential specialty glass materials. The result was BOROFLOAT® – the world's first floated borosilicate glass. With high-quality German engineering at its core, BOROFLOAT® quickly became an outstanding example of what seamless interaction between advanced know-how, innovative technology and professional curiosity – all in combination with the developmental drive of our team of experts – can deliver.
The performance requirements for optical mirrors are extremely rigorous as slight deviations can have significant impacts on the outcome of specific performance. Thermal stability is a must if mirrors are used in environments subjected to temperature changes. Excellent surface quality combined with exceptionally high transmission and reasonable cost are other attributes that engineers consider when specifying their material of choice. BOROFLOAT® glass meets such demanding requirements and has been used for sophisticated optics around the globe.



### BOROFLOAT® - The sum of its properties is what makes it unique for optical mirrors

- Exceptionally high transparency
- Outstanding thermal resistance
- High chemical durability
- Broad range of sizes and thicknesses

BOROFLOAT®´s exceptionally high transparency makes it a key material of choice for optical applications in research and industry.

### Optical mirrors made of BOROFLOAT® glass offer outstanding transmission

BOROFLOAT®´s **exceptionally high transparency, outstanding visual quality and optical clarity** make it the material of choice for many optical applications in research and industry. **High transparency in visible and near IR & UV range of wavelengths** offers customers a vast wealth of new possibilities. Specific light transmittance values are thickness dependent and significantly influenced by $Fe_2O_3$ impurity levels. BOROFLOAT® specialty glass uses only the purest raw materials resulting in extremely low (~90 ppm) iron impurity levels and hence exceptionally high transmission values. In fact BOROFLOAT® is the industrial glass with the lowest level of iron impurity of all float glass materials in the market.

| Optical data | |
|---|---|
| Abbe number ($v_e = (n_e - 1) / (n_{F'} - n_{C'})$) | 65.41 |
| Refraction index ($n_d$ ($\lambda_{587.6\ nm}$)) | 1.47140 |
| Dispersion ($n_F - n_C$) | $71.4 \times 10^{-4}$ |
| Stress-optical coefficient (K) | $4.0 \times 10^{-6}$ mm² $N^{-1}$ |

Reference values, not guaranteed values.

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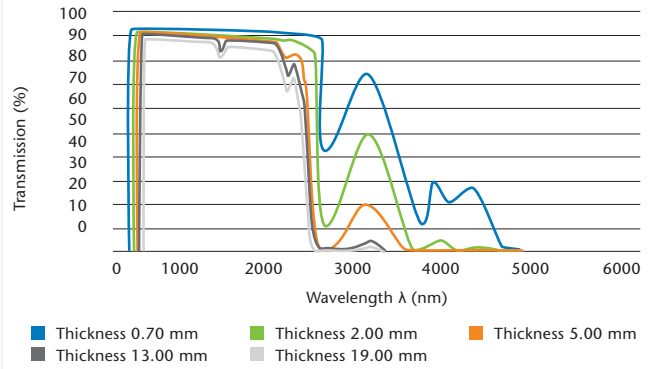
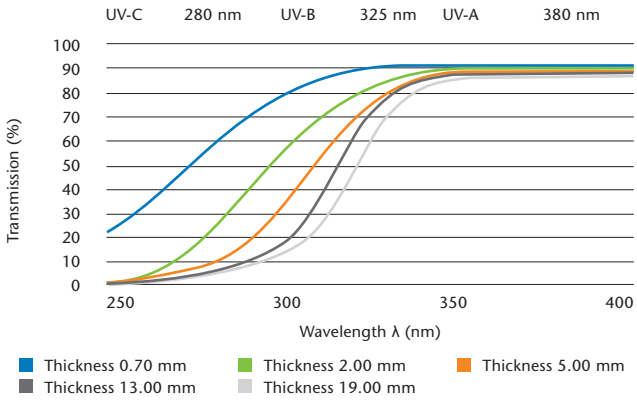
## Transmission



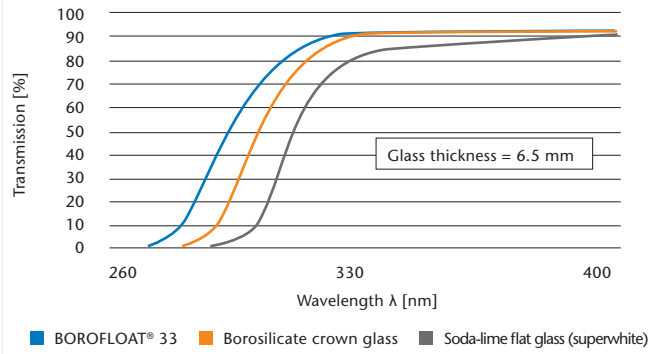

Transmission values for other thicknesses are available on request.

## Transmission in UV range



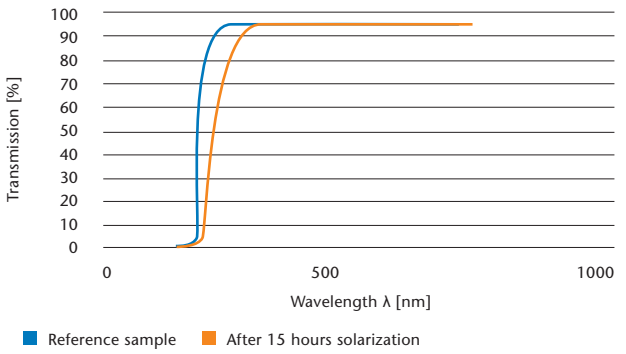

Transmission values for other thicknesses are available on request.

## Transmission of various glass types



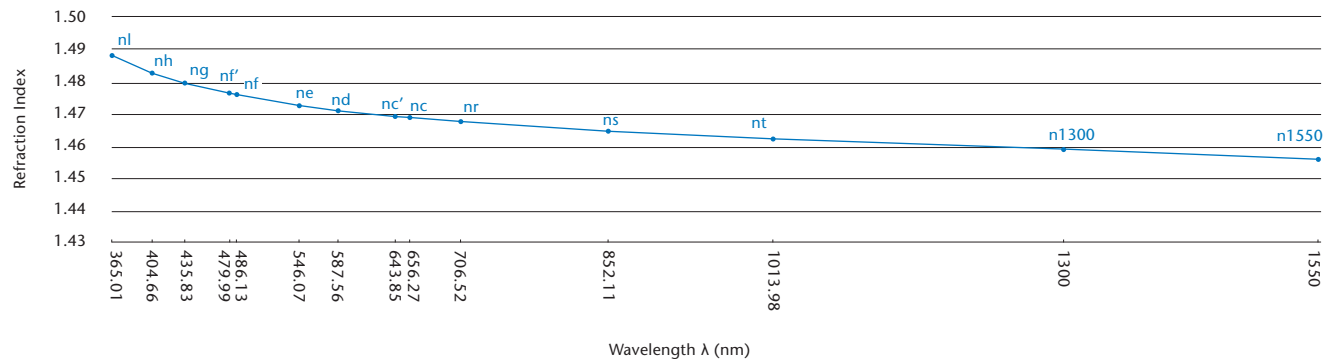

Transmission of BOROFLOAT® 33 in comparison to borosilicate crown glass and soda-lime flat glass.

## Solarization




The glass sample of a size 30 x 15 x 1 $mm^3$ is radiation-exposed by using the high-pressure mercury vapor lamp HOK 4/120. This lamp works with a radiation intensity of 850 $W/cm^2$ and with a main wavelength of 365 nm.

## Refraction Index




| Wavelength: | nl | nh | ng | nf' | nf | ne | nd | nc' | nc | nr | nt | n1300 | n1550 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refraction Index: | 1.48856 | 1.48330 | 1.48019 | 1.47679 | 1.47639 | 1.47315 | 1.47144 | 1.46957 | 1.46922 | 1.46792 | 1.46273 | 1.45920 | 1.45613 |

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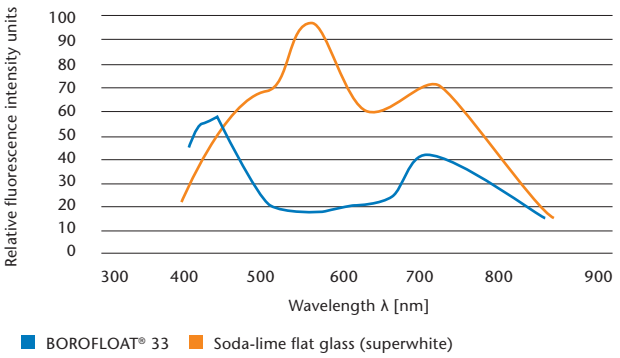
## BOROFLOAT® glass - the ideal substrate for applications that require low inherent fluorescence

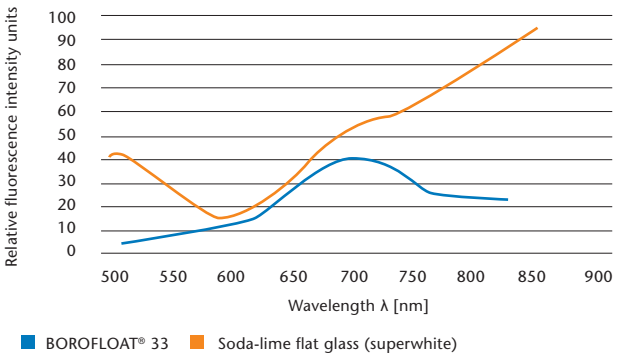
Some materials have the ability to emit electromagnetic radiation after being activated by high energy radiation. This property is referred to as fluorescence. It depends on the material's purity and structural characteristics as well as the radiation's excitation energy and excitation wavelength.
BOROFLOAT® 33 is a highly transparent glass with a much **lower inherent fluorescence** than soda-lime flat glass.

### Inherent fluoresence at 365 nm




Inherent fluoresence of BOROFLOAT® 33 and soda-lime flat glass with an excitation wavelength of 365 nm.

### Inherent fluoresence at 488 nm

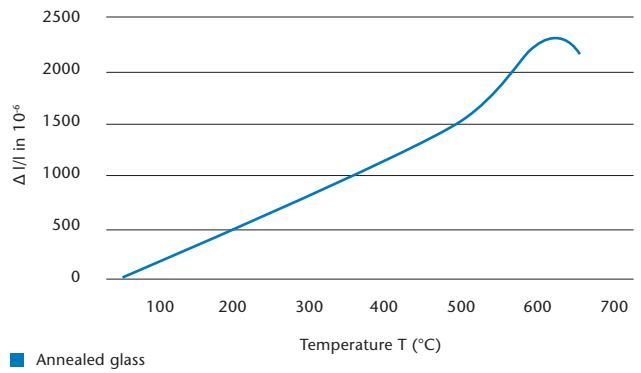



Inherent fluoresence of BOROFLOAT® 33 and soda-lime flat glass with an excitation wavelength of 488 nm.

## Optics made of BOROFLOAT® glass are resistant to thermal loads and chemical attacks

The glass composition of BOROFLOAT® specialty glass is not only tailored towards excellent optical properties. It is also designed to provide very low thermal expansion and high chemical durability. The element boron plays a significant role in delivering such special properties as it determines how strong the bonds are within the glass network. BOROFLOAT® glass is used whenever **very good temperature stability** and **excellent resistance to thermal shock** are required. I**t can be thermally toughened** and **thermally shaped (3D)**. BOROFLOAT® is also **highly resistant to hydrolytics, acids and alkalis** and is known for its **low alkali diffusion.**

### Thermal expansion




### Thermal properties

| | |
|---|---|
| Coefficient of Linear Thermal Expansion (C.T.E.) $\alpha_{(20-300\,°C)}$ | $3.25 \times 10^{-6}\ K^{-1}$ * |
| Specific heat capacity $c_{p\ (20-100\,°C)}$ | 0.83 kJ/(kg·K) |
| Thermal conductivity $\lambda_{(90\,°C)}$ | 1.2 W/(m·K) |

* According to ISO 7991.

### Chemical durability

| | | |
|---|---|---|
| Hydrolytic resistance | (according to ISO 719 / DIN 12 111) | HGB 1 |
| | (according to ISO 720) | HGA 1 |
| Acid resistance | (according to ISO 1776 / DIN 12 116) | 1 |
| Alkali resistance | (according to ISO 695 / DIN 52 322) | A 2 |

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## The right size and thickness for any application

### Forms supplied

BOROFLOAT® 33 is available in the following standard thicknesses and tolerances:

**Standard thicknesses**

| Thickness mm | Tolerance mm |
|---|---|
| 0.70 | ± 0.05 |
| 1.10 | ± 0.05 |
| 1.75 | ± 0.05 |
| 2.00 | ± 0.05 |
| 2.25 | ± 0.05 |
| 2.75 | ± 0.10 |
| 3.30 | ± 0.20 |
| 3.80 | ± 0.20 |
| 5.00 | ± 0.20 |
| 5.50 | ± 0.20 |
| 6.50 | ± 0.20 |
| 7.50 | ± 0.30 |
| 9.00 | ± 0.30 |
| 11.00 | ± 0.30 |
| 13.00 | ± 0.30 |
| 15.00 | ± 0.40 |
| 16.00 | ± 0.50 |
| 19.00 | ± 0.50 |
| 21.00 | ± 0.70 |
| 25.40 | ± 1.00 |

Panel thickness is continuously measured during production using laser thickness measuring equipment. Further thicknesses and tolerances are available on request.

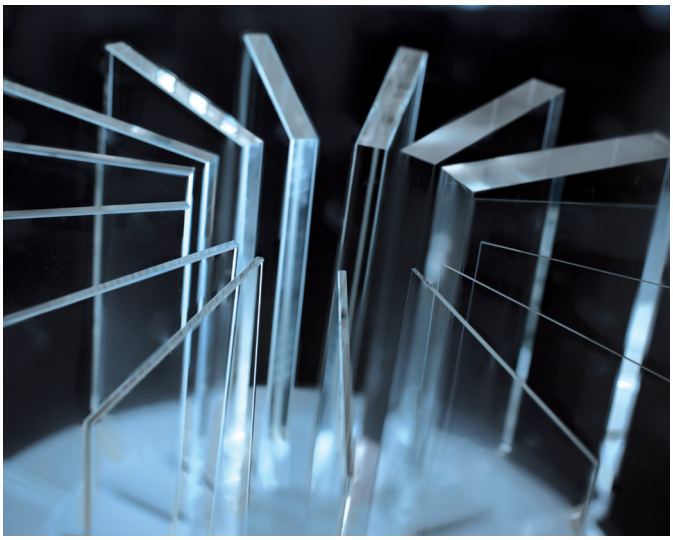
### Sizes

BOROFLOAT® 33 is available in the following standard sizes:

**Standard sizes**

| Size | Thickness |
|---|---|
| 1,150 x 850 mm | 0.7 – 25.4 mm |
| 1,700 x 1,300 mm | 16.0 – 21.0 mm |
| 2,300 x 1,700 mm | 0.7 – 15.0 mm |

Standard sizes of BOROFLOAT® 33.



BOROFLOAT® 33 is available in a broad range of thicknesses.

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