

Certificate of Conformity

We, the

SCHOTT Technical Glass Solution GmbH
Otto-Schott-Str.13
D-07740 Jena
Tel. (049) 03641 681600
Fax (049) 03641 681211

declare hereby that the products we deliver with the brand name

BOROFLOAT® 33

will in their manufacture and function conform the indicated value as set forth for the following item of the standard DIN EN 1748-1:

(Company stamp)

SCHOTT Technical Glass
Solutions GmbH
Otto-Schott-Straße 13
D-07745 Jena
www.schott.com

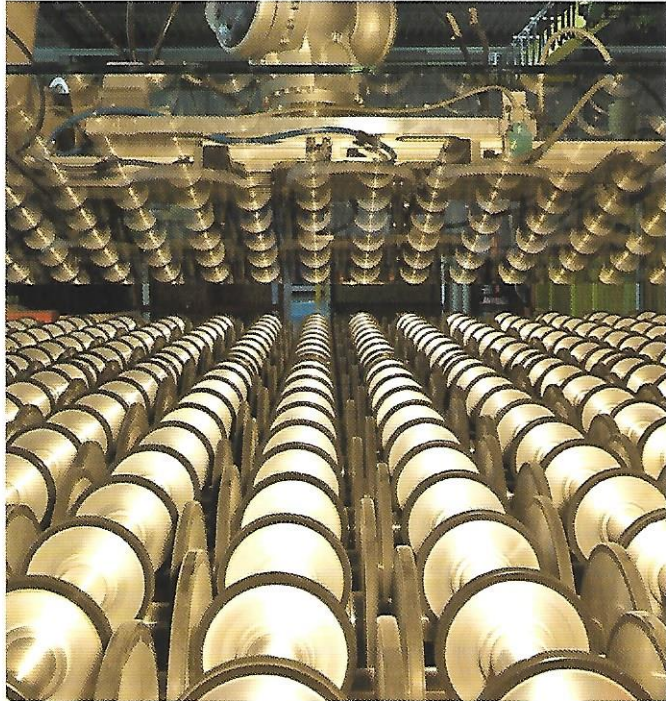
Signature:


Ulrich Leipold-Haas
Quality Manager

BOROFLOAT® 33 – General Information

The sum of its properties is what makes it unique.

BOROFLOAT® 33 from Germany is the world's first floated borosilicate flat glass. It combines superior quality and excellent flatness with outstanding thermal, optical, chemical and mechanical features. The chemical composition and physical properties of BOROFLOAT® 33 are in accordance with DIN ISO 3585 and EN 1748 T1. Rediscover BOROFLOAT® 33 and experience the infinite potential of our most versatile material platform. BOROFLOAT® – Inspiration through Quality.

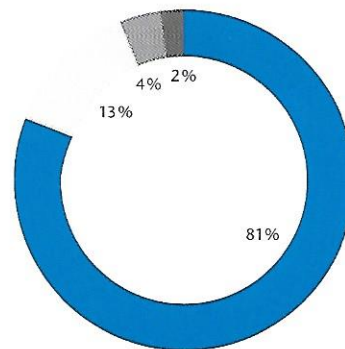


The world's first floated Borosilicate Glass – Made in Germany with IQ.

Key benefits:

- Outstanding thermal resistance
- Exceptionally high transparency
- High chemical durability
- Excellent mechanical strength

Chemical composition

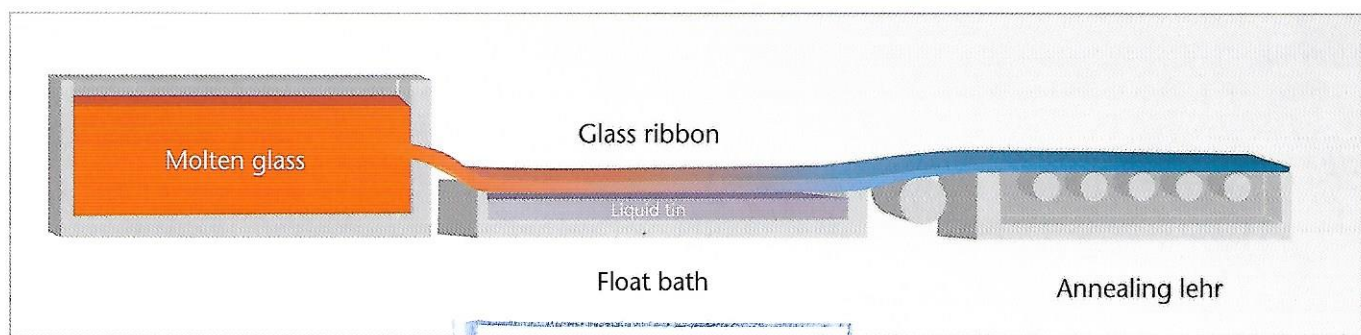


■ SiO₂ ■ B₂O₃ ■ Na₂O/K₂O ■ Al₂O₃

Chemical components of BOROFLOAT® 33.

Production in the Microfloat Process

SCHOTT manufactures BOROFLOAT® 33 using proprietary, state-of-the-art Microfloat technology. The Microfloat process delivers highly homogeneous glass quality with a mirror-like surface, excellent flatness and outstanding optical properties.



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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
18.00	± 0.50
19.00	± 0.50
20.00	± 0.70
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.

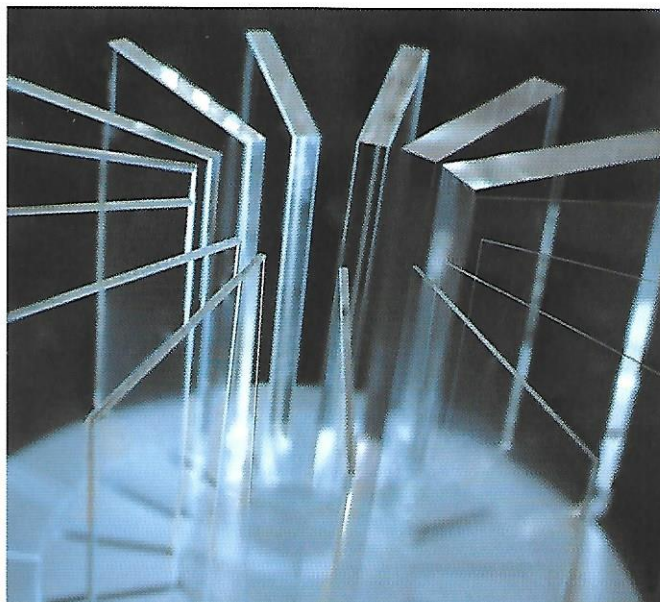
Sizes

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 broad range of thicknesses.

Processing and finishing

BOROFLOAT® 33 is also available in a broad range of cut-to-size formats (cut from standard BOROFLOAT® sheet sizes) and with various processing and finishing options to meet our customer's specification requirements. Further information regarding cut-to-size solutions, including processing options and associated tolerances, is available on request.

Cleaning

BOROFLOAT® 33 sheets can be cleaned using any commercially available glass cleaner. Note: Under no circumstances should abrasive sponges, scouring powders or other corrosive or abrasive cleaners be used, as these can cause damage to the surface of the borosilicate glass.

Further data and information available on request.

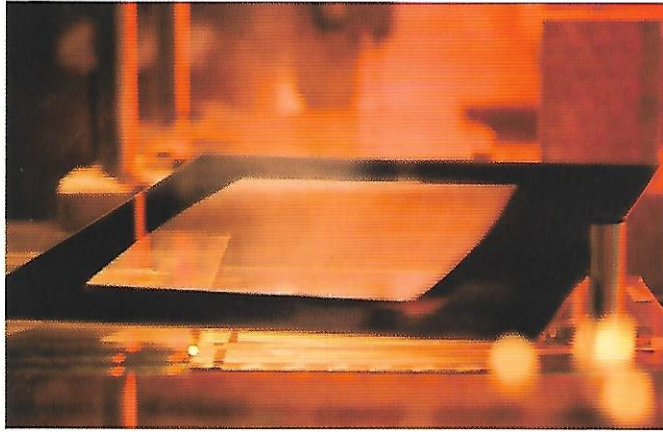
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BOROFLOAT® 33 – Thermal Properties

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Thermally resistant oven door made with BOROFLOAT® 33.

Thermal properties

Coefficient of

Linear Thermal Expansion (C.T.E.) $\alpha_{(20-300\text{ °C})}$ $3.25 \times 10^{-6} \text{ K}^{-1} *$

Specific heat capacity $c_p_{(20-100\text{ °C})}$ $0.83 \text{ kJ}/(\text{kg}\cdot\text{K})^{-1}$

Thermal conductivity $\lambda_{(90\text{ °C})}$ $1.2 \text{ W}/(\text{m}\cdot\text{K})^{-1}$

* According to ISO 7991.

Maximum operating temperatures

Maximum Operating Temperature

For short-term usage ($< 10 \text{ h}$) 500 °C

For long-term usage ($\geq 10 \text{ h}$) 450 °C

Viscosity of BOROFLOAT® 33

Working Point (10^4 dPas) 1270 °C

LITTLETON temperature/Softening point ($10^{7.6} \text{ dPas}$) 820 °C

Annealing Point (10^{13} dPas) 560 °C

Strain Point ($10^{14.5} \text{ dPas}$) 518 °C

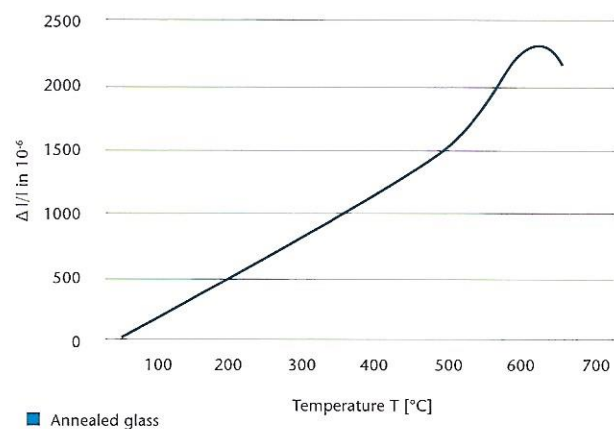
Transformation temperature (T_g) 525 °C

Key benefits:

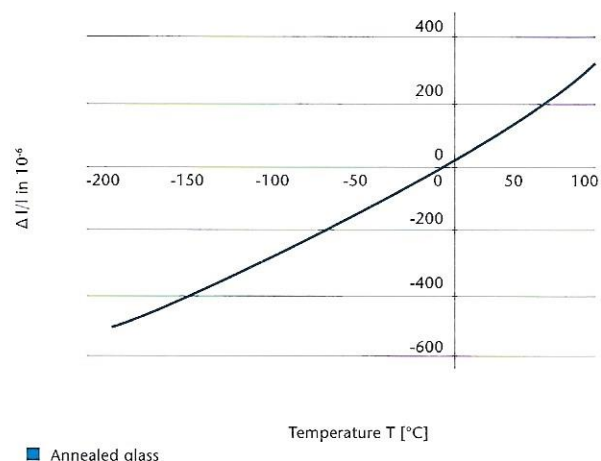
Outstanding thermal resistance

- Very good temperature stability
- Excellent resistance to thermal shock
- Can be thermally toughened
- Can be thermally shaped (3D)

Thermal expansion



Expansion behavior in lowest temperature range



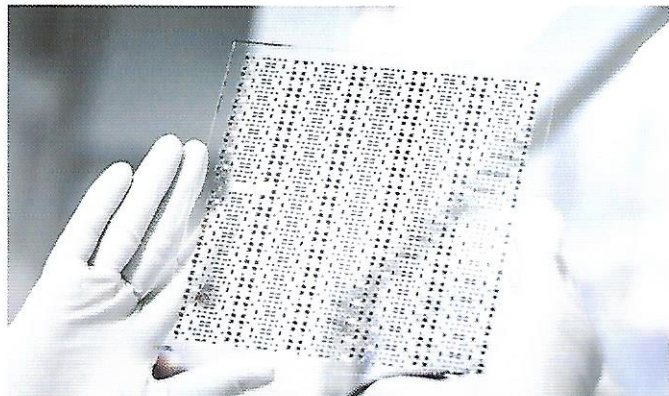
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BOROFLOAT® 33 – Chemical Properties

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Bonded glass for Lithium Monitoring Chips made of BOROFLOAT® 33.

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

Corrosion test for Display Glass

Reagent	Abrasion [mg/cm ²]	Visual observations
24 h at 95 °C		
5 Vol.% HCl	< 0.01	Unchanged
0.02 n H ₂ SO ₄	< 0.01	Unchanged
H ₂ O	< 0.01	Unchanged
6 h at 95 °C		
5 % NaOH	1.1	White stains
0.02 n NaOH	0.16	White haze
0.02 n Na ₂ CO ₃	0.16	Unchanged
20 min. at 23 °C		
10 % HF	1.1	Stained white haze
10 % NH ₄ F x HF	0.14	Unchanged

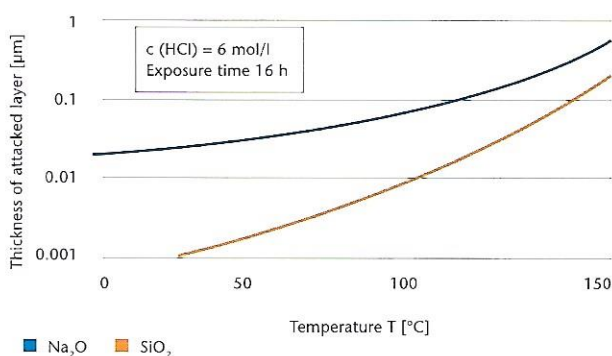
Chemical resistance of BOROFLOAT® 33 to selected reagents.

Key benefits:

High chemical durability

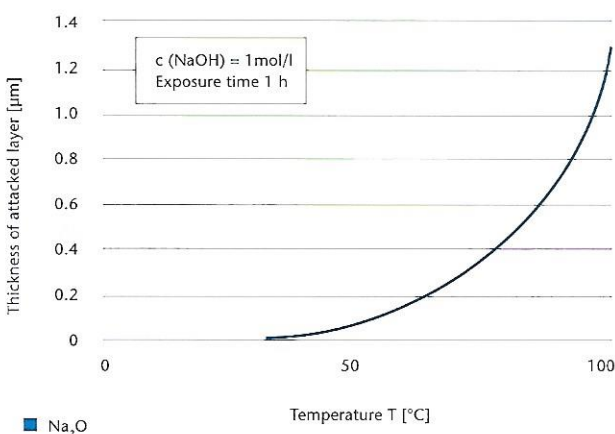
- High hydrolytic resistance
- Excellent resistance to acids
- High resistance to alkalis
- Low alkali diffusion

Resistance to acids



Acid resistance of BOROFLOAT® 33 as a function of temperature (very low loss of mass).

Resistance to alkalis



Alkali resistance of BOROFLOAT® 33 as a function of temperature (moderate loss of mass).

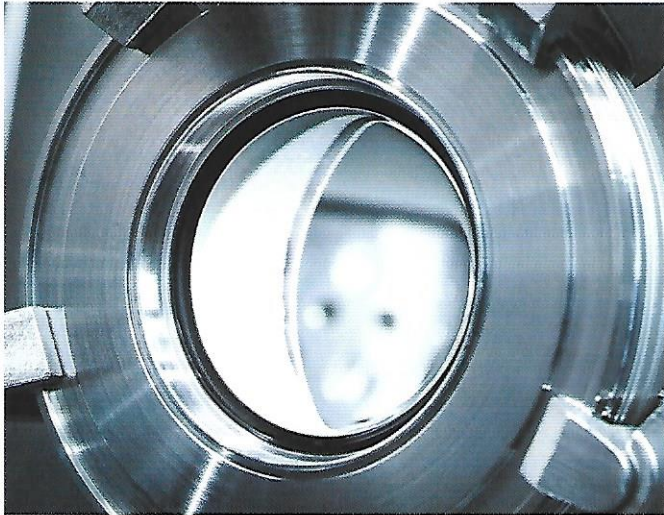
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BOROFLOAT® 33 – Mechanical Properties

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Sightglass made of BOROFLOAT® 33.

Mechanical properties

Density ρ (25 °C)	2.23 g/cm ³
Young's Modulus E (according to DIN 13316)	64 kN/mm ²
Poisson's Ratio μ (according to DIN 13316)	0.2
Knoop Hardness $H_{0.1/20}$ (according to ISO 9385)	480
Bending Strength σ (according to DIN 52292 T 1)	25 MPa
Impact resistance	

The impact resistance of BOROFLOAT® 33 depends on the way it is fitted, the size and thickness of the panel, the type of impact involved, presence of drill holes and their arrangement as well as other parameters.

Reference values, not guaranteed values.

Critical forces

Material	Mean value F_c [mN]	Stdev.* [mN]
BOROFLOAT® 33	363.8	4.3
Other borosilicate glass	271.2	1.9
Soda-lime flat glass	214.4	4.6

Summary of critical forces in Scanning-Scratch-Test.

*Standard deviation

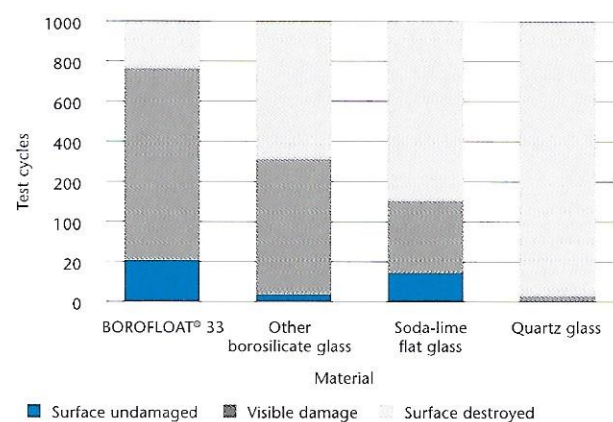
Key benefits:

Excellent mechanical strength

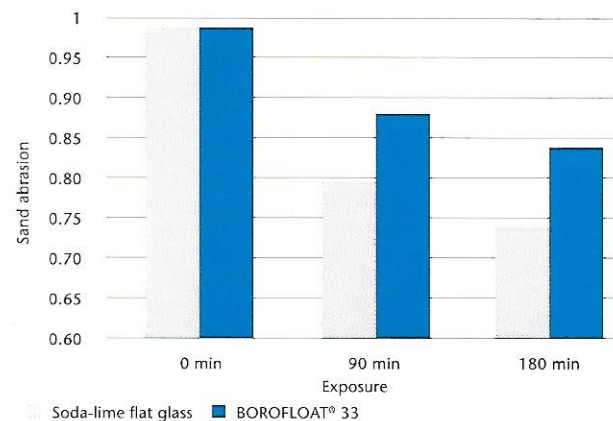
- Low weight
- Strong resistance to abrasion and scratches
- High elasticity

Resistance to abrasion and scratches

Resistance to abrasion



Comparison of sand abrasion BOROFLOAT® 33 & soda-lime flat glass



According to a study conducted by the Fraunhofer Institute for Applied Optics and Precision Engineering, BOROFLOAT® 33 displayed the highest resistance to mechanical forces in comparison to other Materials.

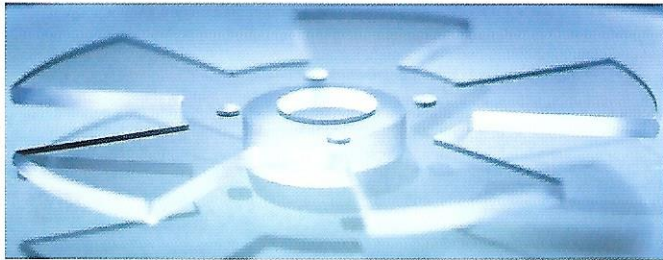
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BOROFLOAT® 33 – Optical Properties

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Optical wheel made of BOROFLOAT® 33.

Optical index of refraction

Wavelength λ (nm)	Refraction index n
435.8	1.48015
479.9	1.47676 (n_F)
546.1	1.47311 (n_D)
589.3	1.47133
643.8	1.46953 (n_C)
656.3	1.46916

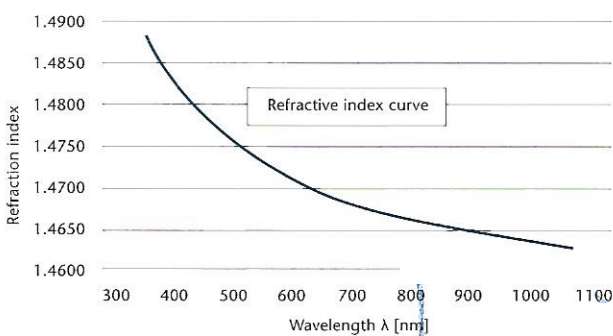
Reference values, not guaranteed values.

Optical data

Abbe number ($v_e = (n_D - 1) / (n_F - n_C)$)	65.41
Refraction index ($n_d (\lambda_{587.6 \text{ nm}})$)	1.47140
Dispersion ($n_F - n_C$)	71.4×10^{-4}
Stress-optical coefficient (K)	$4.0 \times 10^{-6} \text{ mm}^2 \text{ N}^{-1}$

Reference values, not guaranteed values.

Dispersion

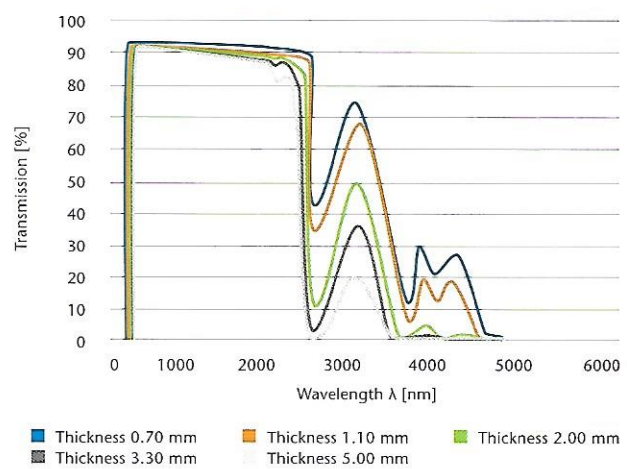


Key benefits:

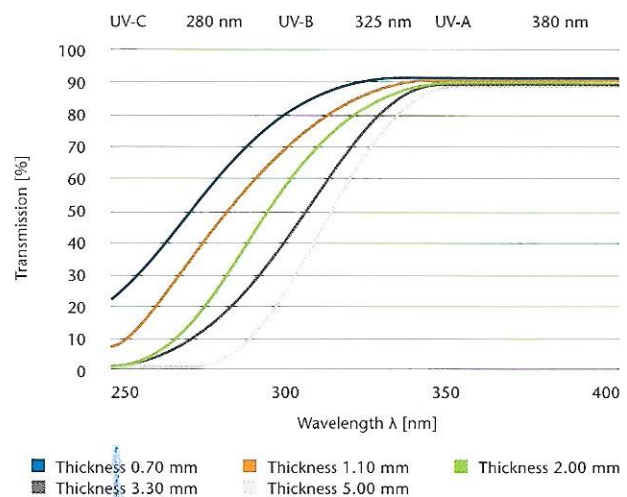
Exceptionally high transparency

- High transparency in visible and near IR & UV range of wavelengths
- Outstanding visual quality and optical clarity
- Low inherent fluorescence and solarisation tendency

Transmission

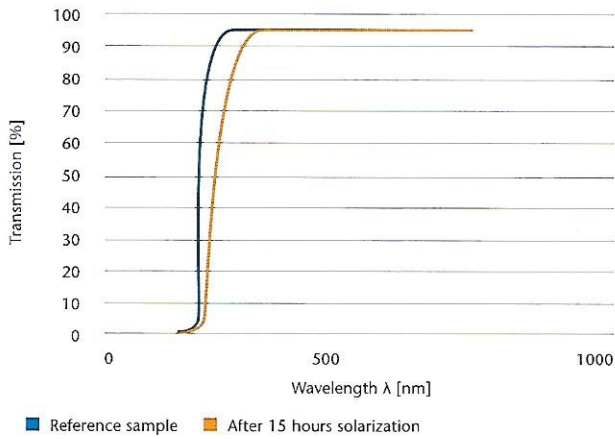


Transmission in UV range



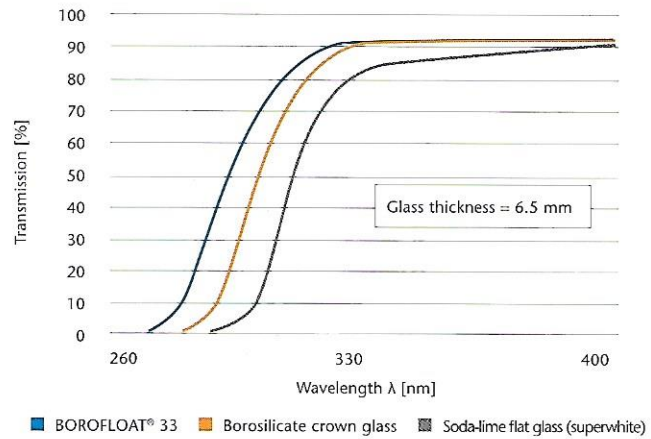
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Solarization



The glass sample of a size 30 x 15 x 1 mm³ is radiation-exposed by using the high-pressure mercury vapor lamp HOK 4/120. This lamp works with a radiation intensity of 850 W/cm² and with a main wavelength of 365 nm.

Transmission



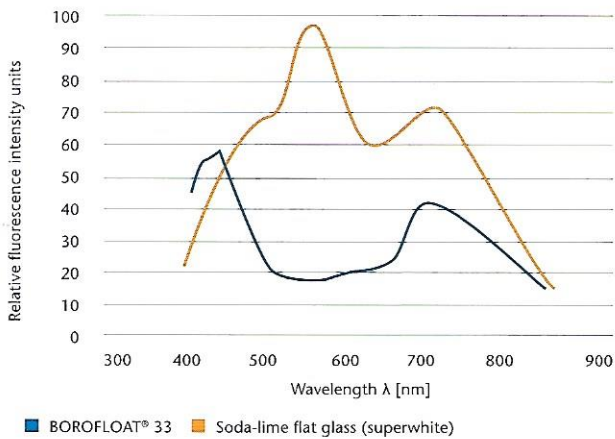
Transmission of BOROFLOAT® 33 in comparison to borosilicate crown glass and soda-lime flat glass.

Inherent fluorescence of BOROFLOAT® 33

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.

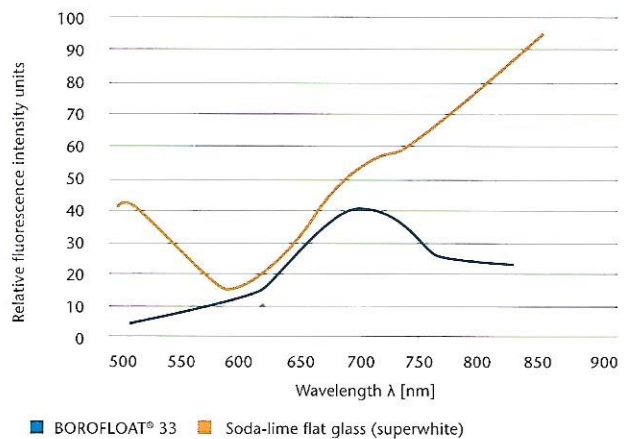
BOROFLOAT® 33 is a highly transparent glass with a much lower inherent fluorescence than soda-lime flat glass.

Inherent fluorescence at 365 nm



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

Inherent fluorescence at 488 nm



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

Further data and information available on request.

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Fecha:

Ref.ª SEGUN DIN 28120

Su escrito del:

Su Ref.ª

Asunto: VIDRIO TEMPLADO O SECURIZADO PARA MIRILLAS

MATERIAL: VIDRIO SODOCALCICO (LUNA PULIDA O FLOAT)

ESPESORES: DE 5 a 19 mm.

RESISTENCIA QUIMICA: Agua y Vapor: pérdida de 18 mg./dm²/24 horas.

Acidos: " 5,5 " (CLH 5% 95°C)

Alcalis: " 250 " (NAOH 5% 95°C)

TEMPERATURA DE TRABAJO: En régimen permanente 240°C
(admite puntas de 300°C durante breves periodos)

PRESION DE TRABAJO EN REGIMEN PERMANENTE:

Ø 45 X 8 40 Kg.cm.2

Ø 60 X 8 25 Kg.cm.2

Ø 70 X 10 20 Kg.cm.2

Ø 120 X 15 22 Kg.cm.2

Ø 150 X 15 17 Kg.cm.2

Ø 160 X 19 17 Kg.cm.2

Ø 170 X 19 15 Kg.cm.2

Ø 180 X 19 13 Kg.cm.2

Ø 240 X 12 8 Kg.cm.2

210 X 19. 8 Kg.cm.2.

SE ACONSEJA SU REPOSICIÓN
A LAS 500 HORAS DE TRABAJO

ESTAS CONDICIONES DE TRABAJO SE REFIEREN A MIRILLAS NUEVAS DEBIDAMENTE
COLOCADAS, CON JUNTAS ADECUADAS Y APRIETE CORRECTO.