Solutions for Bending of Borosilicate Glass for Windshield Application

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seeing it through®

What advantages does our floated borosilicate glass offer for windshield glazing?

Presented by
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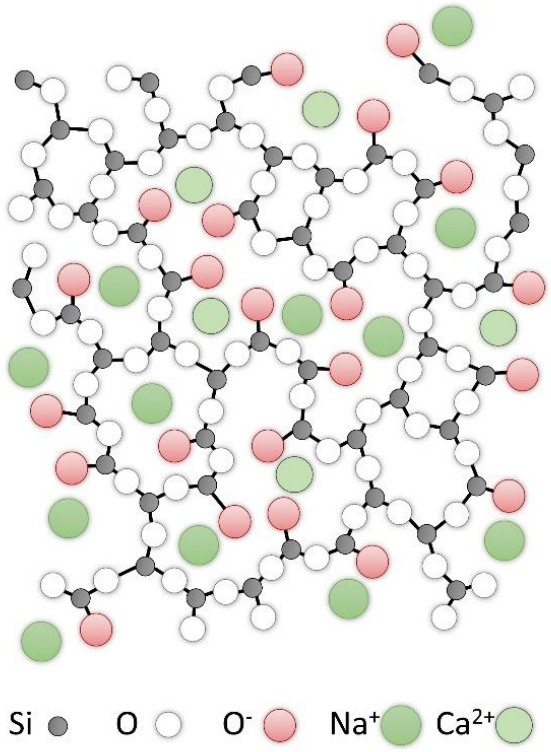
The Structure of a Material Determines its Properties, and the Properties Enable the use of the Material in certain Applications

Soda Lime Glass



Comparison

Network connectivity

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Packing density & Material density

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Free volume

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Elastic modulus

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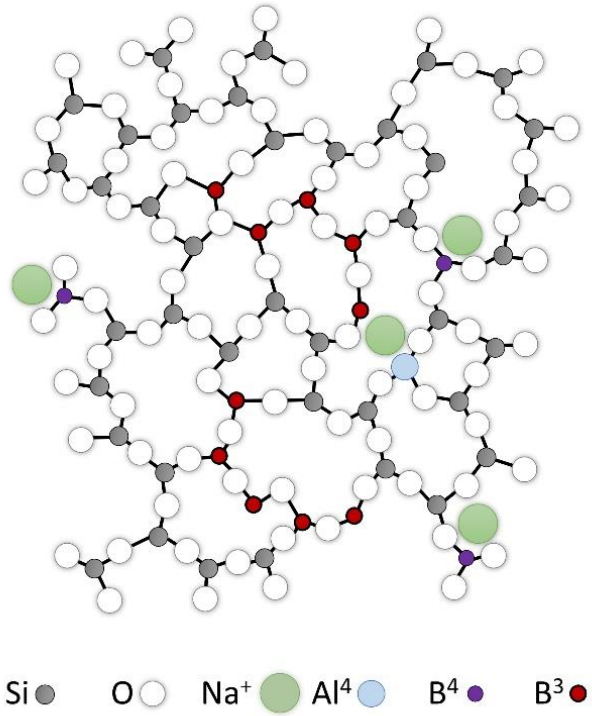
Borosilicate glass

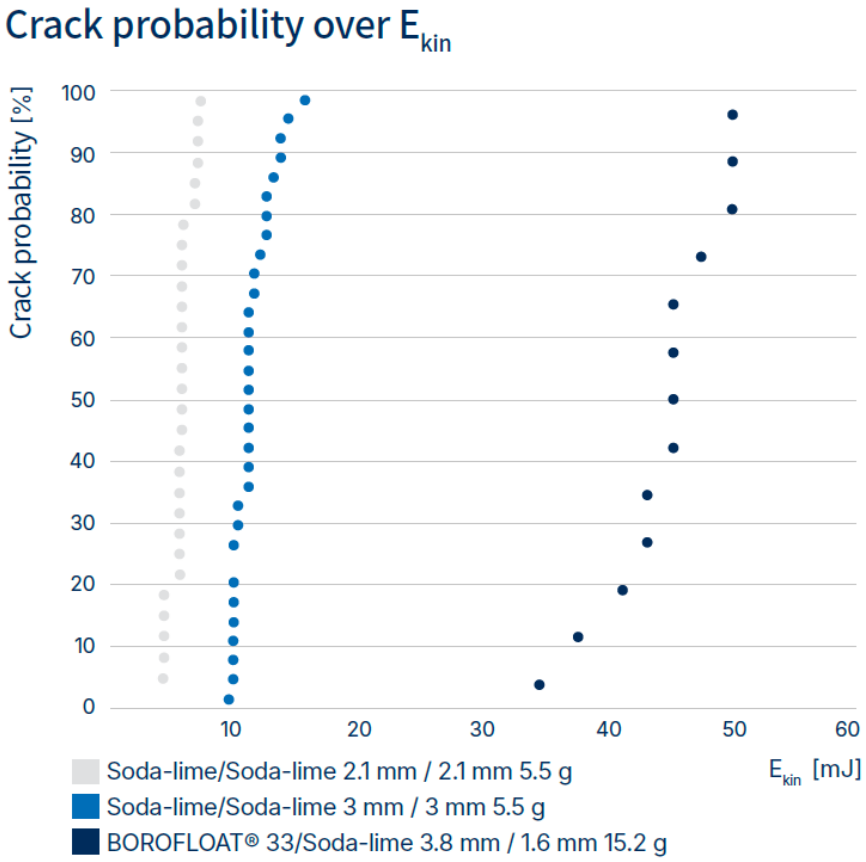
BOROFLOAT®



Vickers Sharp Impact Test on Laminates

Test stand for Vickers drop test

Vickers Indenter

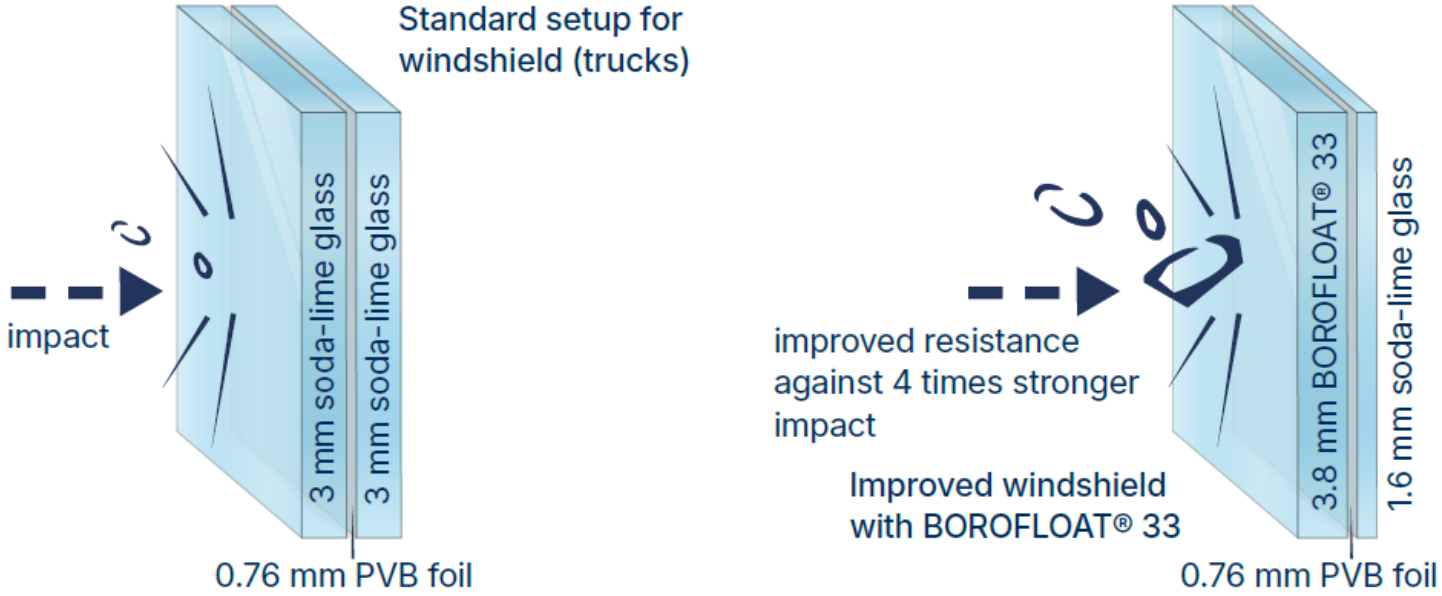


Disclaimer:

This technical information is limited to the information about the test results in SCHOTT's laboratories. Processors have to evaluate the mechanical resistance in the relevant end product. Different designs and processing methods (e.g. coating, different laminate setups, thermal treatment, and others) might influence the properties and results of the mechanical resistance in the relevant end product.

Vickers Sharp Impact Test on Laminates

Fourfold increase in crack resistance



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Borosilicate glass is a good material for the **outer pane** of the windshield

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Good windshield bending furnace is needed for bending of borosilicate glass and soda-lime glass combination

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Typical windscreen bending furnace

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First tests with small glass sizes

Bending tests for borosilicate – soda-lime glass combination

Glass size 500 mm x 300 mm

Top glass:

Soda-lime

- Thickness 1.6 – 5.8 mm

Bottom glass:

Borofloat® 33

- Thickness: 2.0 – 3.8 mm

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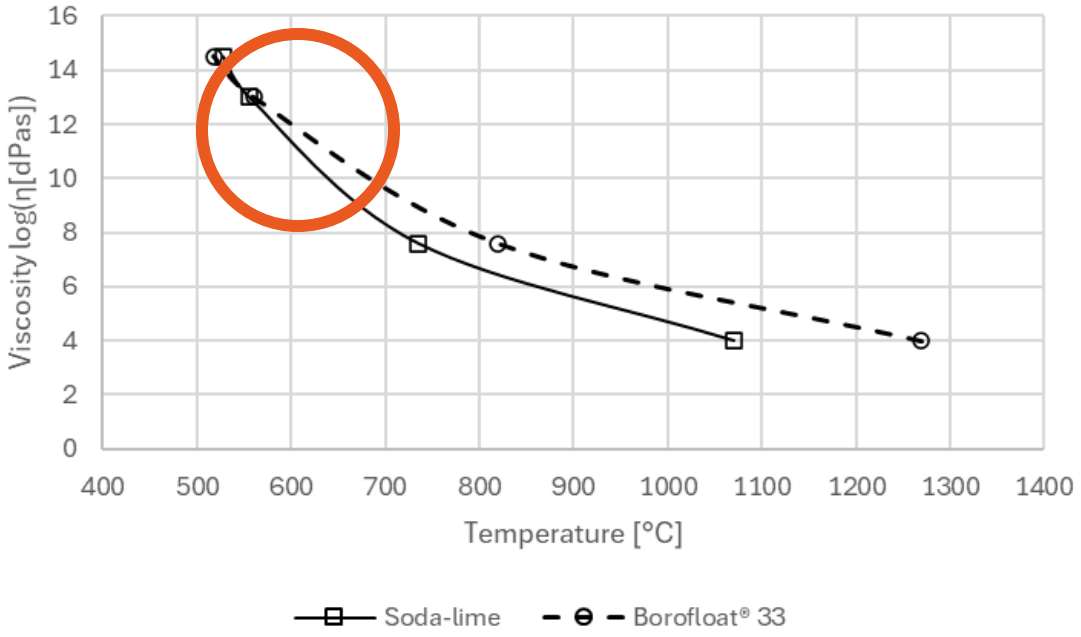
Viscosity and thermal expansion coefficient are different between borosilicate and soda-lime glasses



Thermal expansion coefficients

@ 0-300 °C

Sodalime glass

- $9 \cdot 10^{-6}$ 1/K

Borofloat® 33

- $3.25 \cdot 10^{-6}$ 1/K

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Hotspots on soda-lime glass

No hotspots

Hotspots

Picture taken at 45° angle

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Effect of glass thickness combination and bending temperature on bending quality

Test #	Glass thickness [mm]		Final furnace bottom temp [°C]	Final furnace top temp [°C]	Visual quality	
	Borofloat® 33	soda-lime			Borofloat® 33	soda-lime
1	3.3	2.1	701	609	Ok	hotspots
2	2	2.1	685	595	Ok	Ok
3	2	1.58	687	576	Ok	hotspots
4	3.3	3.1	707	615	Ok	hotspots
5	3.8	6	714	605	Ok	hotspots
6	3.8	1.58	638	612	Ok	hotspots
7	3.8	1.58	634	609	Ok	hotspots
8	2.75	1.58	648	600	Ok	hotspots
9	2.75	2.6	648	680	Ok	hotspots
10	2.75	2.6	623	596	Ok	Ok
11	2.75	3.1	625	599	Ok	Ok
12	3.3	1.58	630	604	Ok	Ok
13	3.3	1.58	629	603	Ok	Ok
14	3.3	1.58	651	606	Ok	Ok

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Windshield bending with full size borosilicate (3.8 mm) – soda-lime (1.6 mm) combination

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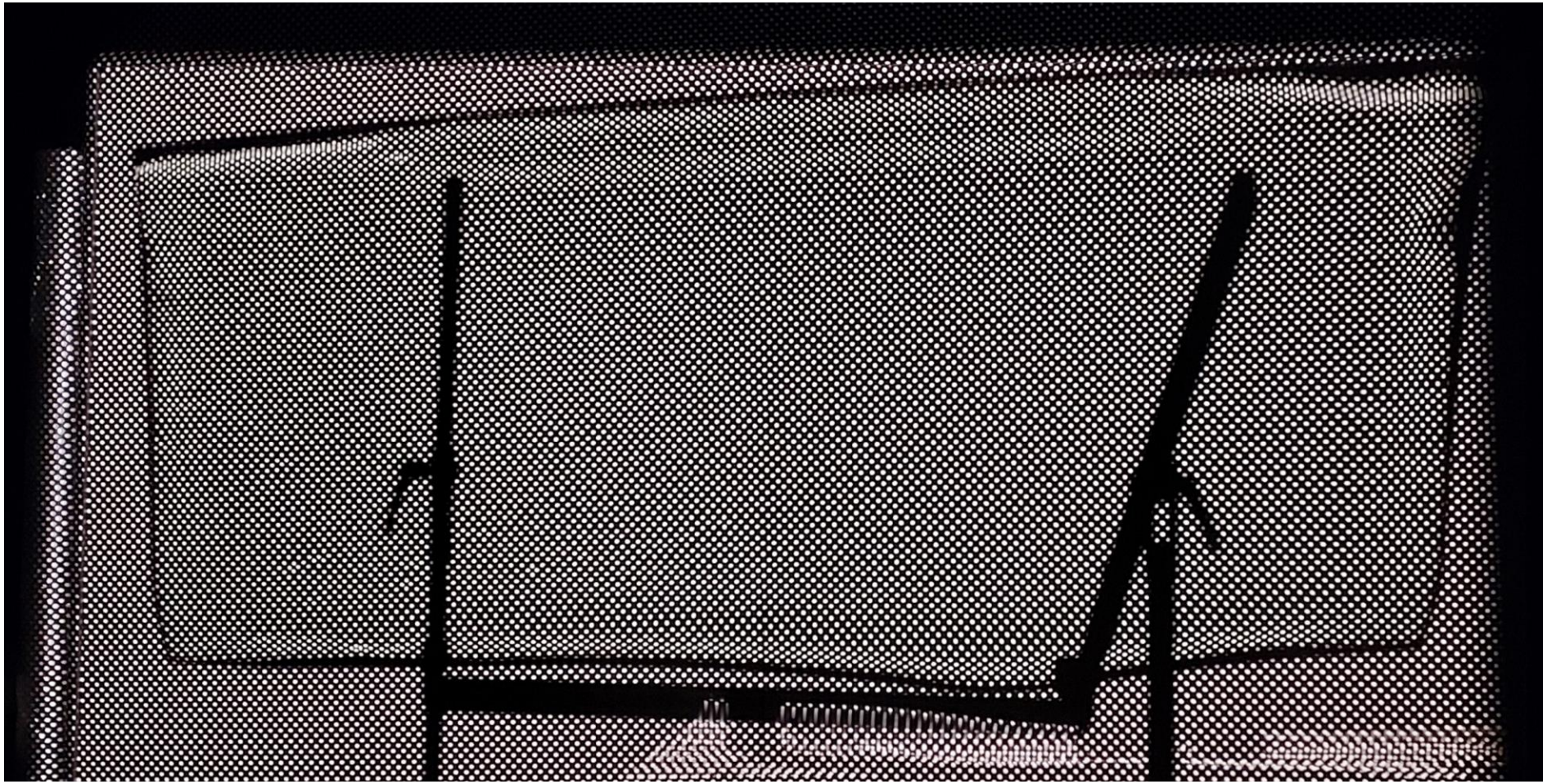
Bending process causes optical changes in windshield



Picture taken at 30° angle from horizontal

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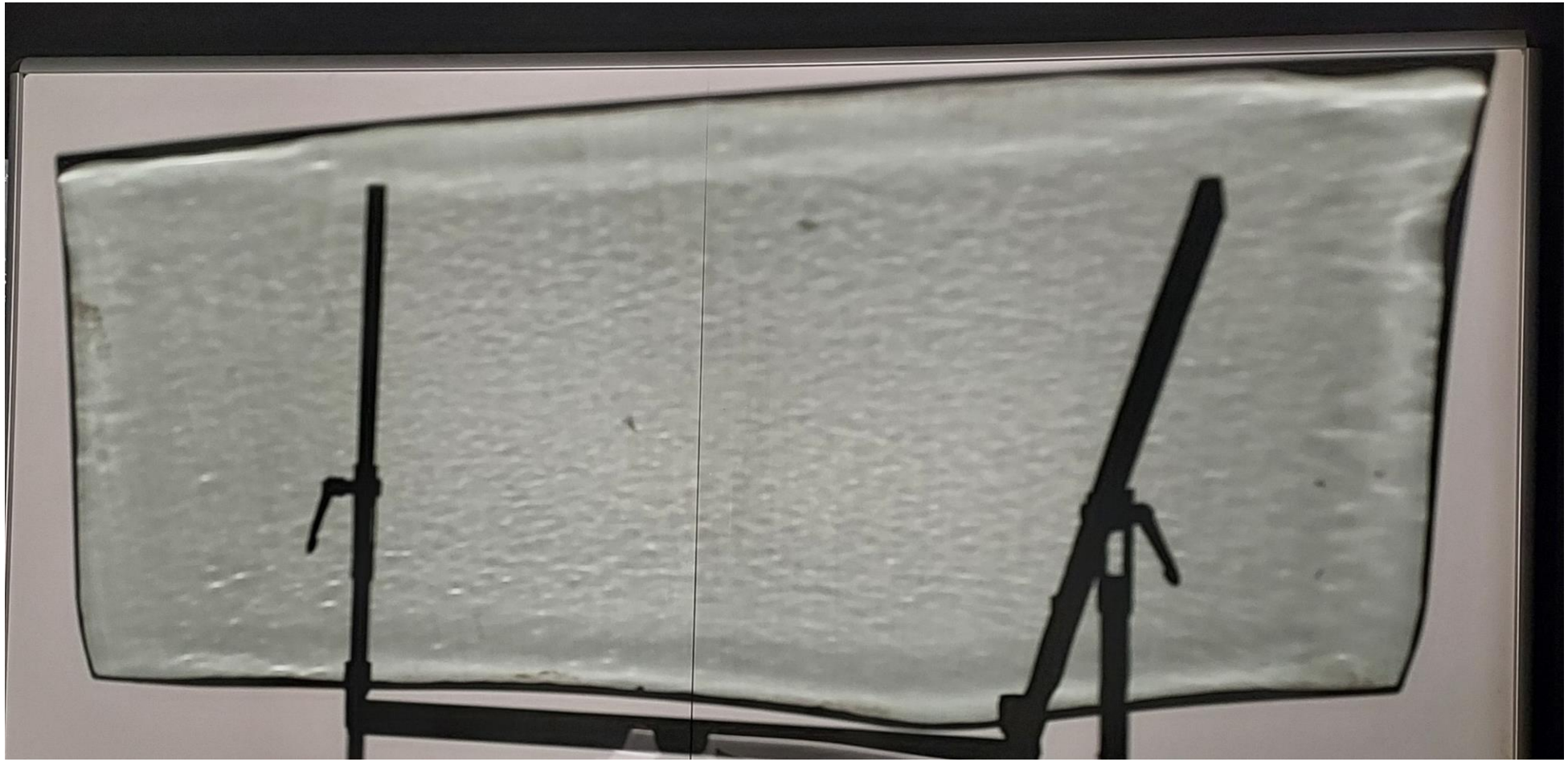
Bending process causes optical changes in windshield



Picture taken at 30° angle from horizontal

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Challenges when changing outer glass from soda-lime glass to borosilicate glass

- Higher bending temperature
- More heating needed from bottom side (borosilicate glass)
- Soda-lime glass will easily overheat
- Optical quality issues

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With flexible windshield bending furnace the bending of borosilicate and soda-lime glass combination is possible

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