BOROFLOAT® 33 – Technical information for Vickers Sharp Impact

Mechanical Resistance of BOROFLOAT® 33 – containing laminates compared to standard automotive glazing

Introduction: Mechanical Resistance against flying objects like gravel or stones is a critical property of a windshield in the automotive industry. These objects posses sharp edges and a high kinetic energy which can cause windshield damage and breakage, leading to downtime and replacement costs. This technical information presents the results of mechanical tests comparing laminates that include BOROFLOAT® 33 with standard automotive glazing in thicknesses that are relevant to the automotive sector.

Test setup Vickers Sharp Impact Resistance in SCHOTT's laboratories:
For the test setup (Figure 1 Test Equipment) a repeatable procedure was used. A slide equipped with an electromagnetic Vickers indenter, featuring a diamond tip, was accelerated by gravity towards the test substrate. At a distance of 10 cm above the surface of the test sample the slide was deaccelerated and freeing the Vickers indenter by turning off the electromagnet to collide with the sample surface.

The time of falling is measured by a light barrier. In combination with the weight of the indenter the kinetic energy of the diamond tip of the Vickers indenter can be calculated. Damages (cracks) larger than 7 mm length led to a fail and will result in reducing the drop height for the next turn. Damages less 7 mm will result in increasing the drop height for the next turn. With these input parameters, graphs as crack probability over kinetic energy were created.

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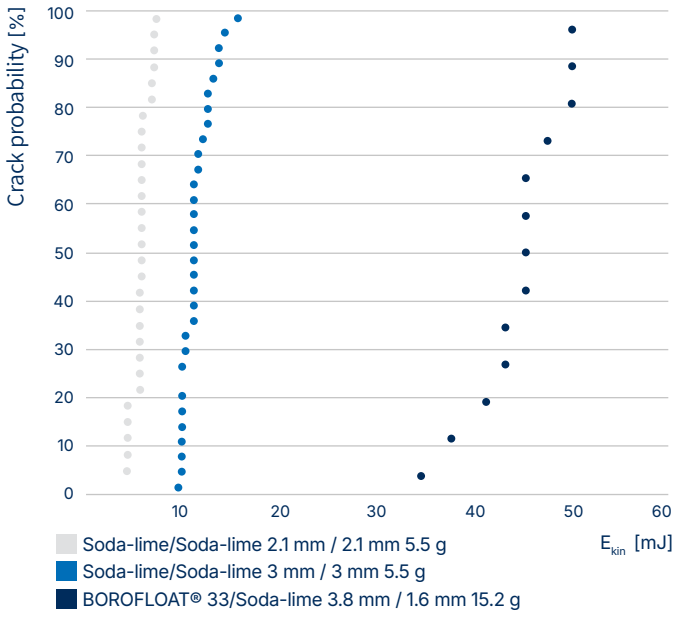
Figure 1 Test Equipment

Test stand for Vickers drop test

Vickers Indenter

Crack probability over E_{kin}



Comparison of different laminates:

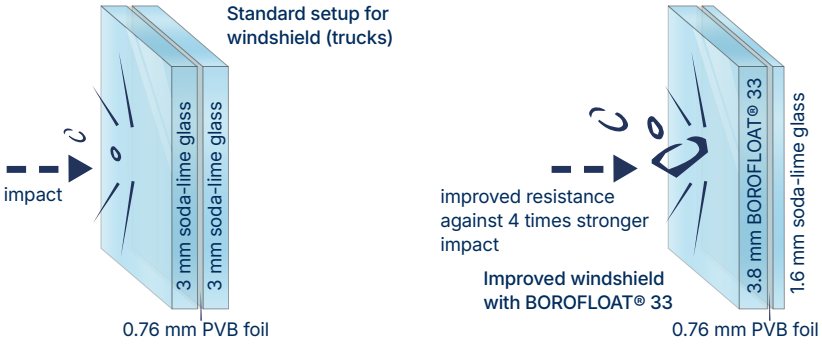
Three different types of laminates were evaluated in the tests. Two symmetric laminates made of soda-lime glass with a thickness of 2.1 mm + 2.1 mm and 3 mm + 3 mm were tested. These are representative for standard car and truck windshields. Furthermore an asymmetric laminate with BOROFLOAT® 33 of thickness 3.8 mm combined with a 1.6 mm soda-lime glass pane was tested. The results show a slightly improved resistance of the thicker soda-lime glass laminate 3 mm + 3 mm compared to the laminate with the thinner soda-lime glass 2.1 mm + 2.1 mm.

The laminate of 3.8 mm outer BOROFLOAT® 33 in combination with a 1.6 mm inner soda-lime glass panel yielded a 4 fold higher resistance over the other laminates tested. In order to even create any damage, the weight of the Vickers indenter had to be increased.

Conclusion of the tests in SCHOTT's laboratories:

The combination of BOROFLOAT® 33 with soda-lime glass showed a significant improvement in resistance to sharp impacts compared to the state-of-the-art windshields commonly used. Our testing illustrates that such a laminate produced a 4 fold higher resistance to objects, larger objects and even greater velocity of those objects compared to a standard windshield.

Fourfold increase in crack resistance



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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.

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