

<b>Test report no.:</b> <i>Testrapport nr.:</i>	<b>89219251-05</b>	<b>Order No.:</b> <i>Opdracht nr.:</i>	21.A132 EN12600	Page 1 of 7 <i>Pagina 1 van 7</i>
<b>Client Reference No.:</b> <i>Klantreferentie nr.:</i>	-	<b>Order date:</b> <i>Opdrachtdatum:</i>	2021-04-20	
<b>Client:</b> <i>Klant:</i>	Borosil Renewables Limited Govali, Ankleshwar Rajpipala Road, Jhagadia Taluka, Dist. : Bharuch Gujarat, INDIA, 393001			
<b>Test item:</b> <i>Testvoorwerp:</i>	Low iron solar textured glass-Toughened glass			
<b>Identification/ Type No.:</b> <i>Benaming / Type nr.:</i>	Low iron solar textured glass			
<b>Order content:</b> <i>Inhoud opdracht:</i>	Samples for testing against EN 12600, as given in the standard			
<b>Test specification:</b> <i>Testomschrijving:</i>	EN 12600 : 2002 Glass in Building - Laminated glass and laminated safety glass <i>Low iron solar textured glass-Toughened glass</i>			
<b>Date of sample receipt:</b> <i>Ontvangstdatum monster:</i>	2021-12-02			
<b>Test sample No.:</b> <i>Testproefstuk nr.:</i>	89219251-1/4			
<b>Testing period:</b> <i>Testperiode:</i>	2021-12-02 - 2021-12-14			
<b>Place of testing:</b> <i>Testlocatie:</i>	Arnhem, the Netherlands			
<b>Testing laboratory:</b> <i>Testlaboratorium:</i>	TÜV Rheinland Nederland B.V.			
<b>Test result*:</b> <i>Testresultaat*:</i>	Pass			
<b>tested by:</b> <i>getest door:</i>	X			
<b>Date:</b> 2021-12-24 <i>Datum:</i>	Ondertekend door: Salah El Bardai	<b>Issue Date:</b> 2021-12-24 <i>Datum uitgave:</i>	Ondertekend door: Marc Schets	
<b>Position / functie:</b>	Expert	<b>Position / functie:</b>	Expert	
<b>Others /</b> <i>Andere:</i>	Test samples are representative of standard production			
<b>Condition of the test item at delivery:</b> <i>Toestand van het test voorwerp bij ontvangst:</i>	Test item complete and undamaged			
* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
* Legenda:	P(ass) = voldoet aan test omschrijving	F(ail) = voldoet niet aan test omschrijving	N/A = niet van toepassing	N/T = niet getest
<p><b>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</b></p> <p><i>Dit testrapport heeft alleen betrekking op het voorgenoemde test voorwerp. Zonder toestemming van het testcentrum mag dit testrapport niet in delen worden vermenigvuldigd. Dit keuringsrapport geeft geen recht op het dragen van enig keurmerk.</i></p>				

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**Remarks**  
*Opmerkingen*

1	<p>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. For the influence of the measuring uncertainties on the results, reference is made to the validation of the respective methods.</p> <p><i>De apparatuur welke tijdens de gespecificeerde testperiode is gebruikt, is gekalibreerd volgens ons kalibratieprogramma. De apparatuur voldoet aan de eisen welke zijn opgenomen in de relevante normen. De traceerbaarheid van de gebruikte testapparatuurs is gewaarborgd door naleving van de voorschriften in ons kwaliteitsmanagementsysteem. Gedetailleerde informatie over testomstandigheden, apparatuur en meetonzekerheid is beschikbaar in het testlaboratorium en kan op verzoek worden verstrekt. Voor de invloed van de meetonzekerheden op de resultaten wordt verwezen naar de validatie van de respectievelijke methode c.q. verrichting</i></p>
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3	<p>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Tests clauses marked with <sup>a</sup> are performed under ISO 17025 accreditation. Deviations of testing specification(s), test locations or customer requirements are listed in specific test clause in the report. This report is only to be read as a whole. No opinions or interpretation are included in this report. This test report consists of multiple pages and is only to be read as a whole. The number of pages can be seen in the header on the top right of each page, the report ends when the last page is reached. TÜV Rheinland Nederland B.V. is solely responsible for the content.</p> <p><i>Test onderdelen welke met * zijn gemarkeerd zijn uitbesteed aan gekwalificeerde onderaannemers en zijn beschreven in het respectievelijke test onderdeel van dit rapport. Test onderdelen welke met <sup>a</sup> zijn gemarkeerd zijn onder ISO 17025 accreditatie uitgevoerd. Afwijkingen van testspecificatie(s), testlocaties of klant eisen zijn vermeld in het van toepassing zijnde onderdeel in het rapport. Het rapport dient als geheel te worden gelezen. Er zijn geen opinies en interpretaties opgenomen binnen het rapport. Dit rapport bestaat uit meerdere pagina's en dient al geheel gelezen te worden. Het aantal pagina's is rechtsboven in de koptekst van dit rapport vermeld en eindigt wanneer de laatste pagina is bereikt. TÜV Rheinland Nederland is als enige verantwoordelijk voor de inhoud van het rapport.</i></p>
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**Product description**  
*Product omschrijving*

<b>1</b>	<b>Product details:</b> <i>Product details:</i>	Name of the manufacturer: Borosil Renewables Limited Address of manufacturer: Govali, Ankleshwar Rajpipala Road, Jhagadia Taluka, Dist. : Bharuch, Gujarat INDIA Production plant of samples: Govali, Ankleshwar Rajpipala Road, Jhagadia Taluka, Dist. : Bharuch, Gujarat INDIA Line ID where samples are made: Solar Glass manufacturing Production date: May 2021 Sampling date: May 2021
<b>2</b>	<b>Other:</b> <i>Andere:</i>	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.
<b>3</b>	<b>Test sample obtaining:</b> <i>Selectie van het proefstuk:</i>	<input checked="" type="checkbox"/> Sending by customer <input type="checkbox"/> Sampling by TÜV Rheinland Group <input type="checkbox"/> others:

<b>EN 12600:2002</b>	<b>Impact test method and classification for flat glass</b>	
<b>Scope:</b>	EN 12600 specifies a pendulum impact test method for single flat glass for use in buildings. The test is intended to classify flat glass products in three principal classes by performance under impact and by mode of breakage.  The standard does not specify requirements for applications, nor does it specify requirements for durability.	
<b>Test requirements of clause 4 :</b>	When tested by the method given in clause 5 of the standard, each test piece shall either not break or shall break as defined in one of the following ways :  a) Numerous cracks appear, but no shear or opening is allowed within the test piece through which a 76mm diameter sphere can pass when a maximum force of 25 N is applied. Additionally, if particles are detached from the test piece up to 3 minutes after impact, they shall - in total – weigh no more than a mass equivalent to 10.000 mm <sup>2</sup> of the original test piece. The largest single particle shall weigh less than the mass equivalent to 4.400 mm <sup>2</sup> of the original test piece;  b) Disintegration occurs and the 10 largest crack-free particles collected within 3 minutes after impact and weighed, all together, within 5 minutes of impact shall weigh no more than the mass equivalent to 6.500 mm <sup>2</sup> of the original test piece. The particles shall be selected only from the portion of the original test piece exposed in the test frame. Only the exposed area of any particle retained in the test frame shall be taken into account in determining the mass equivalent.	Applicable clause :  (a) <input type="checkbox"/> (b) <input checked="" type="checkbox"/>

**PHOTO-DOCUMENTATION**  
*FOTO-DOCUMENTATIE*

<b>Test method:</b>	The test temperature shall be $(20 \pm 5) \text{ }^\circ\text{C}$ .  <b>Clause 5.</b>  Each test piece shall comprise a single pane of glass product and be representative of the normal production of the type of product submitted for test. Results obtained with test pieces of dimensions $(876 \pm 2) \times (1938 \pm 2)$ mm are valid for classification purposes of the glass product, whatever the service dimensions.  The test shall be carried out at each drop height on four pieces of identical structure and the same nominal thickness. In case of symmetrical samples, the classification obtained can be used for both sides of the product. For asymmetrical samples, the classification obtained, are intended solely for installation in situations where the risk of impact is from one side only.  Inspect the test piece after impact and note whether ; <ul style="list-style-type: none"> <li>- It remains unbroken; or</li> <li>- It broke in accordance with either the requirements a) or b) of clause 4; or</li> <li>- It broke and failed to conform to the requirements of clause 4.</li> </ul> If any of the initial four test pieces fails to conform to the requirements of clause 4, the procedure is terminated. If all four test pieces either do not break or else break according to the criteria given in clause 4, and it is required to test the material to a higher impact level, increase the drop height to the next impact level. Repeat the test on four more samples of the same material (If the material remained unbroken, the same sample(s) may be used.)	
	<b>Impact levels</b>	
	Classification	Drop height (mm)
	3	190
	2	450
1	1200	

<b>Measuring uncertainty:</b>	Caused by the destructive nature of the test and pass/fail result no measurement uncertainty can be determined. Based on the validation of the test procedure, measurement set-up and the associated parts (test frame / drop height, etc.) there is a presumption of conformity established which is approved with ISO 17025 accreditation.
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**PHOTO-DOCUMENTATION**  
*FOTO-DOCUMENTATIE*

**Sphere penetration test :**

The probe assembly shall consist of a sphere of diameter  $(76 \pm 1)$  mm connected to an arm with a device for measuring when a maximum force of 25 N has been applied.

The probe assembly shall be held horizontal. It shall then be pushed in any opening formed in the test piece. The weakest point of resistance shall be selected. A horizontal force shall be applied until :

- A maximum force of 25 N has been achieved without penetration by the sphere. The test piece shall be deemed to have passed the test; or
- The maximum diameter of the sphere has passed through the plan of the test piece without a force of 25 N being achieved. The test piece shall be deemed to have failed the test.

**Classification :**

**General**

Glazing conforming to this European standard is classified as follows :

- Its performance under the impact test;
- The drop height at which breakage occurred;
- The drop height at which the product passed in accordance with a) of clause 4;
- The drop height at which the product passed in accordance with b) of clause 4;
- The mode of breakage of the material if it remains unbroken after the impact test.

**Drop height class**

Glazing shall be classified as follows :

- Class 3: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm;
- Class 2: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm and 450 mm;
- Class 1: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm 450 mm and 1200 mm.

**Mode of breakage**

If all test pieces remain unbroken at the drop height appropriate to its intended drop height class, the mode of breakage shall be determined as per Annex C of this standard. The mode of breakage shall be described as follows :

- Type A : numerous cracks appear forming separate fragments with sharp edges, some of which are large (typical of annealed glass);
- Type B : numerous cracks appear, but the fragments hold together and do not separate (typical of laminated glass);
- Type C : disintegration occurs, leading to a large number of small particles that are relatively harmless (typical of toughened glass).

**Performance classification**

The performance classification of a glass product shall be given as follows :

$\alpha ( \beta ) \phi$  , where

- $\alpha$  : is the highest drop height class at which the product either did not break or broke in accordance with a) or b) of clause 4;
- $\beta$  : is the mode of breakage;
- $\phi$  : is the highest drop height class at which the product either did not break or when broke, broke in accordance with a) clause.

When a glass product breaks at a drop height of 190 mm and the breakage is not in accordance with a) of clause 4 then the value of  $\phi$  quoted shall be zero.

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**PHOTO-DOCUMENTATION**  
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Expression of test results				
<b>Performance under impact test</b>	<b>Composition (from the attack side) :Smooth Side</b>			
	Sample number			
	89219251 #1	89219251 #2	89219251 #3	89219251 #4
<b>Asymmetrical yes/no</b>	yes			
<b>Attack face?</b>	Smooth Side			
<b>Dimensions</b>	876 x 1938 mm			
<b>Nominal thickness</b>	2.5 and 2.1 mm			
<b>Tyre pressure (0,35 ± 0,02) MPa ? yes/no</b>	yes			
<b>In case of applied films, film clamped in frame ? yes/no</b>	n.a.			
<b>Behaviour at each drop height</b>	<ul style="list-style-type: none"> <li>- did the test piece broke or not</li> <li>- if broken, the mode of breakage</li> <li>- was it broken in accordance with clause 4, a) or b)</li> </ul>			

Thickness 2.5 mm

Class	Drop height (mm)	Result test 1	Result test 2	Result test 3	Result test 4
3	190	No breakage	No breakage	No breakage	No breakage
2	450	No breakage	No breakage	No breakage	No breakage
1	1200	Breakage 4b	Breakage 4b	Breakage 4b	Breakage 4b

Average thickness of the 4 measurements	2,41 mm
Because of asymmetric composition: Impact side	Smooth side
Performance classification	1 (C) 2

Thickness 2,1 mm

Class	Drop height (mm)	Result test 1	Result test 2	Result test 3	Result test 4
3	190	No breakage	No breakage	No breakage	No breakage
2	450	No breakage	No breakage	No breakage	No breakage
1	1200	Breakage 4b	Breakage 4b	Breakage 4b	Breakage 4b

Average thickness of the 4 measurements	2,10 mm
Because of asymmetric composition: Impact side	Smooth side
Performance classification	1 (C) 2

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**PHOTO-DOCUMENTATION**  
*FOTO-DOCUMENTATIE*

1.	<b>Based on EN 12600:2002, Clause 6</b>					
	Glazing conforming to this European Standard is classified by the performance of four consecutive samples under impact.					
	<table border="1"><tr><td><b>Composition : Low iron solar textured glass 2.5 and 2.1 mm</b></td><td>Pass <input checked="" type="checkbox"/></td></tr><tr><td><b>Classification EN 12600 : 1 (C) 2</b></td><td>Fail <input type="checkbox"/></td></tr><tr><td><b>Classification is applicable for Smooth surfaces</b></td><td>Not applicable <input type="checkbox"/></td></tr></table>	<b>Composition : Low iron solar textured glass 2.5 and 2.1 mm</b>	Pass <input checked="" type="checkbox"/>	<b>Classification EN 12600 : 1 (C) 2</b>	Fail <input type="checkbox"/>	<b>Classification is applicable for Smooth surfaces</b>
<b>Composition : Low iron solar textured glass 2.5 and 2.1 mm</b>	Pass <input checked="" type="checkbox"/>					
<b>Classification EN 12600 : 1 (C) 2</b>	Fail <input type="checkbox"/>					
<b>Classification is applicable for Smooth surfaces</b>	Not applicable <input type="checkbox"/>					
Remarks	<b>The test results exclusively relate to the tested objects.</b> <i>When and if changes are made in production method and/or equipment, assessment according to this standard shall be reconsidered and re-tests shall be performed when the changes can lead to different specifications of the glass. The decision and responsibility lies at the manufacturer.</i>					
	<i>If no reference of the product description was supplied by the manufacturer, than that document shall be added to this test report by the manufacturer. It was to the manufacturer's responsibility that the samples delivered for initial type test are representative to the production and deviations from perfection were included in the delivered test samples.</i>					