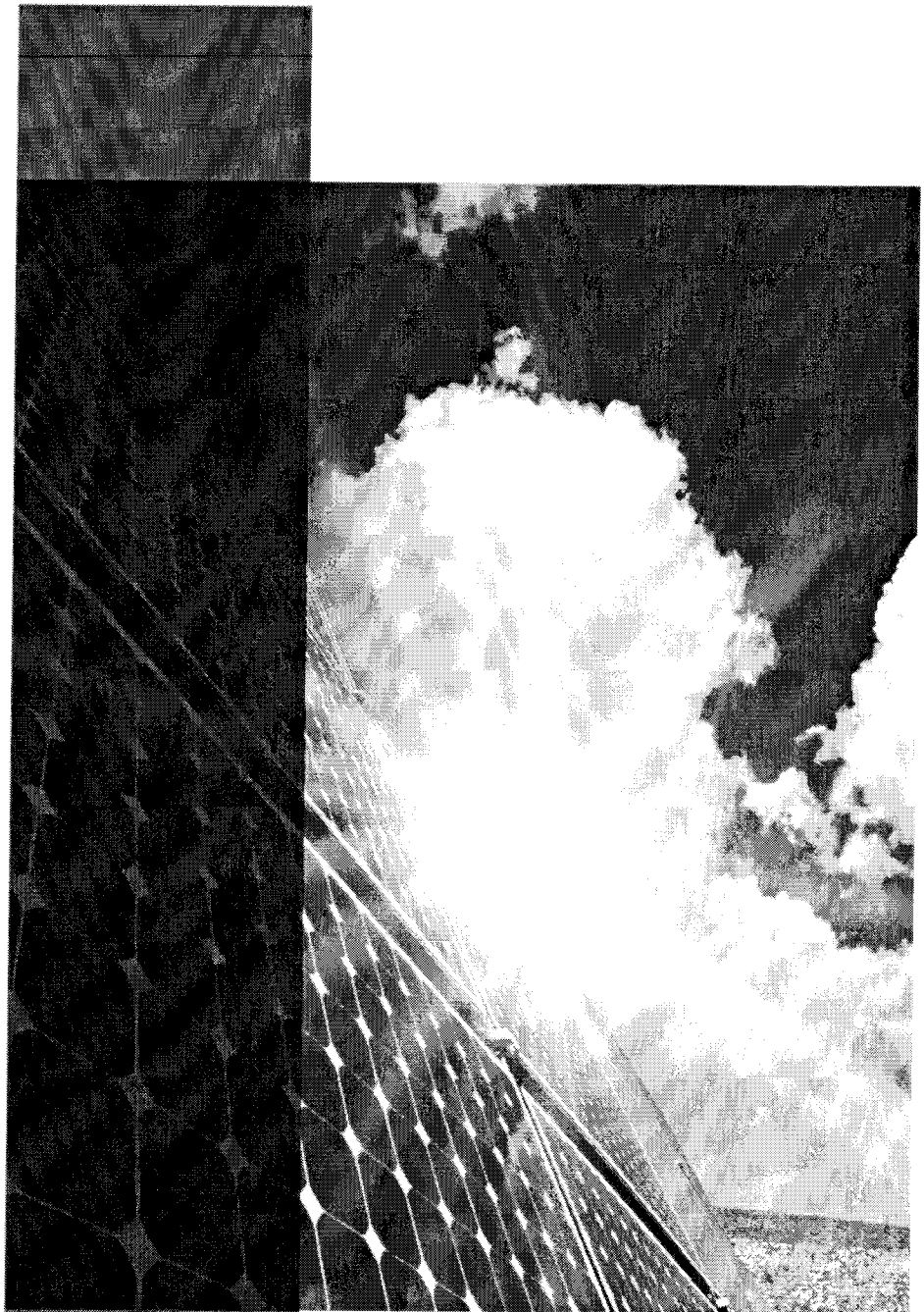


**BOROSIL**  
renewables

LOW IRON SOLAR TEXTURED GLASS


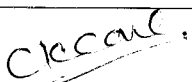
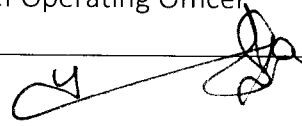
**SPECIFICATION  
SHEET**




Borosil Renewables Ltd.

<b>BOROSIL</b> renewables	<b>BOROSIL RENEWABLES LIMITED</b>	DOC. NO: DOM SPEC 001
		ISSUE NO. / DATE: 01 / 12.02.2020
	SPECIFICATION FOR LOW IRON SOLAR TEXTURED GLASS	REV. NO: 02
		REV. DATE: 06.11.2023

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## 1. GENERAL DESCRIPTION

The specified glass is a low iron, soda-lime textured glass for use in photovoltaic panels, flat solar thermal collectors and Greenhouses. The product is available with surface structures Matt –matt and Prismatic –matt. Product is available in 2.0 mm, 2.5 mm, 2.8 mm, 3.2 mm and 4 mm thickness.

## 2. GENERAL PROPERTIES

### 2.1 Chemical composition:


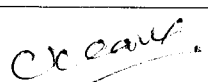
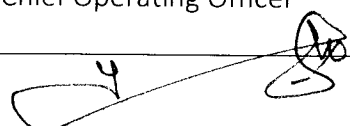
Sl. No	ANALYTE	OXIDE %
1	Silicon dioxide (SiO <sub>2</sub> )	71-74%
2	Sodium oxide (Na <sub>2</sub> O)	12.5-14%
3	Calcium oxide (CaO)	8.5-11%
4	Magnesium oxide (MgO)	1- 4%
5	Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	1- 2%
6	Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	<0.012%
7	Titanium Oxide (TiO <sub>2</sub> )	<0.010%
8	Sulfur Tri Oxide (SO <sub>3</sub> )	0.30%

### 2.2 General Characteristic value as per EN 572-1:

CHARACRERISTICS	SYMBOL	VALUE AND UNIT
Density (at 18°C)	$\rho$	2500 kg/m <sup>3</sup>
Hardness (Knoop)	HK	470
Young's modulus (modulus of elasticity)	E	7x10 <sup>10</sup> Pa (Typical value)
Poisson's ratio	$\mu$	0.2 (Typical value)
Nominal value of average coefficient of linear expansion between 20°C and 300°C	$\alpha$	9 x 10 <sup>-6</sup> K <sup>-1</sup>
Thermal durability		0-250 °C unchanged

### 2.3 Light transmission (ISO 410:2012/ ISO 9050:2003 AM1.5, 380 - 1100 nm):

GLASS TYPE	GLASS THICKNESS	LIGHT TRANSMISSION
Matt/ Matt and Prismatic / Matt Without AR Coating	2.0 mm, 2.5 mm, 2.8 mm, 3.2 mm, 4.0 mm	≥ 91.5 %
Matt/ Matt and Prismatic / Matt with AR Coating	2.0 mm, 2.5 mm, 2.8 mm, 3.2 mm 4.0 mm	≥ 94 % ≥ 93.8 %
Selene: Antiglare	3.2 mm, 4.0 mm	≥ 90.5 %

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### 3. GEOMETRICAL TOLERANCES

Glass thickness: $\pm 0.2$ mm
Length and Width: Length and width $\leq 2$ m $\pm 1.0$ mm and Length and width $\geq 2$ m to 3 m $\pm 1.5$ mm. as per customer requirement.
Angularity (difference between lengths of both diagonals):- 3 mm Max.
Hole diameter tolerance & Hole position from the glass edges ( L , W ) $\pm 1$ mm
Distance between two holes (Minimum requirement) – 300 mm

### 4. SURFACE ROUGHNESS OF GLASS (Measured with Mitutoyo Surface Roughness Tester)

Ra value of glass (Matt / Sunny side): 0.40 – 2.5 $\mu$ m
---

### 5. TEMPERED GLASS / HEAT STRENGTHENED GLASS

#### 5.1 Flatness:

DESCRIPTION	TEMPERED GLASS	HS GLASS
Reference Standard	EN 12150-1:2015	EN 12150-1:2015
Local Bow	0.5 mm /300 mm	0.5 mm /300 mm
General Bow	4 mm / meter	4 mm / meter

\*General Bow (Measured by supporting glass at  $7^\circ$  from vertical)


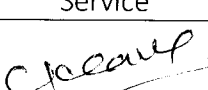
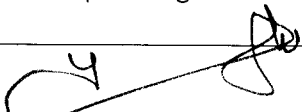
#### 5.2 Impact Test:

DESCRIPTION	TEMPERED GLASS	HS GLASS
Reference Standard	IS 2553 (Part 3) :2019	IS 2553 (Part 3) :2019
Impact test of mass $227 \pm 1$ gm. steel ball freely dropped from a height of 1 meter	Glass should not break	Glass should not break ( Front Glass only )

\*Interpretation of results as per IS 17004 -6.2.1.2

#### 5.3 Bending strength: (Measured with LISEC four-point bending equipment):

DESCRIPTION	TEMPERED GLASS	HS GLASS
Reference Standard	EN 12150-1:2015	IS 16982:2018
Mechanical Strength	$\geq 90$ N/ mm <sup>2</sup>	$\geq 55$ N/ mm <sup>2</sup>

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5.4 Fragmentation:

GLASS TYPE	STANDARD	THICKNESS	DESCRIPTION
Heat Strengthened	IS 16982:2018	2.0 mm, 2.5 mm, 2.8 mm, 3.2 mm, 4.0 mm	At least one edge of the fragment shall reach the excluded area OR Shall no more than 2 "ISLAND" fragments (ISLAND: Fragment with area/mass equivalent greater than or equal 100 mm <sup>2</sup> ).
Tempered	EN 12150-1: 2015	2.1 mm, 2.5 mm, 2.8 mm	Minimum fragment particle - 15
		3.2 mm, 4.0 mm	Minimum fragment particle - 40

\* < 4 mm fragmentation for HS glass manufacture follow procedure as per IS 17004, 6.1

For tempered glass BRL does not assume any liability for spontaneous breakages as we are not using nickel for glassProcessing.

6. EDGES AND CORNERS

Edge processing	At least seamed
Corner cut / dubbing	Min 1.0 mm and Max 4.0 mm
Shells (L x W x D) Please refer appendix	Max. 12 mm x 2 mm x 1 mm

7. GLASS QUALITY

GLASS QUALITY PER SQMT				
<u>Test criteria (EN 572-5:2012 / 5.2.1)</u> The glass pane to be examined is illuminated in conditions approximating to diffuse daylight and Observed in front of a matt grey backgroundscreen. Place the pane of Glass to be examined vertically 3 m in front and Parallel to a matt grey screen. Arrange the point of observation 1.5 m from glass, keepingthe direction of observation normal tothe glass surface	<b>Spherical bubbles/core/solid inclusions Ø</b>			
	Diameter		Max Allowed	
	< 0.5 mm		Unlimited	
	0.5 to 1.5 mm		6	
	1.5 to 3.0 mm		2	
	> 3.0 mm		0	
	<b>Longitudinal bubbles</b>			
	Length	< 10 mm	10mm - 25 mm	>25 mm
	Width < 1 mm	6	2	0
	Width 1.0 - 2.0 mm	2	0	0
Width > 2.0 mm	0	0	0	
<b>Scratches</b>				
Scratch Length	< 5.0 mm	5.0 –10.0 mm	> 10.0 mm - <15mm	
Scratch Width < 1.0 mm	4	2	1	
Scratch Width > 1.0 mm	0	0	0	
a) Un-removable dirt and contamination with foreign material is not allowed b) Scratches on pattern side are allowed. c) Scratches, rubbing marks and dirt within 5mm of the border on both sides permitted. d) Pattern aberrations at isolated locations are permitted				

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
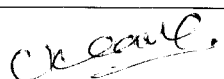
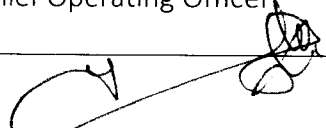
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## 8. ANTI - REFLECTIVE COATING

The anti-reflective coating of glass is a sol-gel form of Nano particles of SiO<sub>2</sub> and the application of coating is done by single side roller coating process.

### 8.1 Coating Quality:

<b>Test Criteria: (EN 572-5:2012) / 5.2.1</b>	<b>Quality of coating on the edges of the glass surface</b>	
The glass pane to be examined is illuminated in conditions approximating to diffuse daylight and Observed in front of a matt grey backgroundscreen. Place the pane of Glass to be examined vertically 3 m in front and Parallel to a matt grey screen. Arrange the point of observation 1.5 m from glass, keepingthe direction of observation normal to the glass surface	Distance from edges ≤ 12mm	Allowed
	Distance from edge > 12mm	Not Allowed
	Minor Aberrations in the Coating	
	Spot Diameter up to 10mm	Allowed
	Spot Diameter > 10mm	Not Allowed
	ARC border area appearance (Residues and color gradient)	
	Distance from edge ≤ 7mm	Allowed
	Distance from edge > 7mm	Not Allowed
	Coating Scratch:	
	W ≤ 0.3mm, L ≤ 60mm	4 nos./SQM with an interval of not less than 100mm
	W > 0.3mm, L > 60mm	Not Allowed
	Surface contamination with coating liquid polluted by foreign substance	
	Diameter ≤ 1.2mm	No cluster (less than 20 within an area of Dia.100mm)
	Diameter > 1.2mm	Not Allowed

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
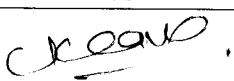
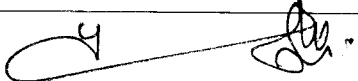
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## 9. GRID PRINTING

The Grid printing on glass is in a form of ceramic paint on texture side (black or white, as per the requirement) and the application of printing is done by screen printing process.

### 9.1 Printing Quality:

9.1(a)	Dimensions tolerance ( L , W )	As per customer requirement
9.1(b)	Reflectance	Average reflectance (380 740nm): White print: >70% Black print: ≤10%
9.1(c)	Thickness	20 to 50 microns
9.1(d)	Missing printing (pin holes)	0.5mm < $\phi$ < 1.5mm: 50 defects/m <sup>2</sup> 1.5mm < $\phi$ < 2.5mm: 5 defects/m <sup>2</sup> >2.5mm: not allowed
9.1(e)	Scratch	W < 0.5mm or L < 50mm: max.6 scratches/m <sup>2</sup> W > 0.5mm or L > 50mm: Not allowed
9.1(f)	Hardness	Pencil hardness ≥ 3H
9.1(g)	Chemistry	Heavy metal free. REACH and RoHS compliance

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10. PACKAGING

<b>Packing</b>	Horizontal Packing on wooden pallet/full cover with plastic wrap	
<b>Packing Orientation</b>	Front glass: ARC Side (Smooth side) Facing downwards in pallets Back glass: Prism Side (Rough Side) Facing downwards in pallets	
<b>Interleaving Paper</b>	Technically, free of chlorine & oxygen, folding's, knots Packing interleaving paper in $45 \pm 5$ GSM quality	
<b>Interleaving Paper PH</b>	Universal indicator / PH meter	$6.0 \pm 0.8$

11. APPENDIX

Here in this appendix, the detail corner and edge chips' tolerance is stated. The figures related to the tolerance as follows

Shells – L X W X D (12 mm x 2 mm x 1 mm)

Figure 1– Chip projecting into the face of the glass

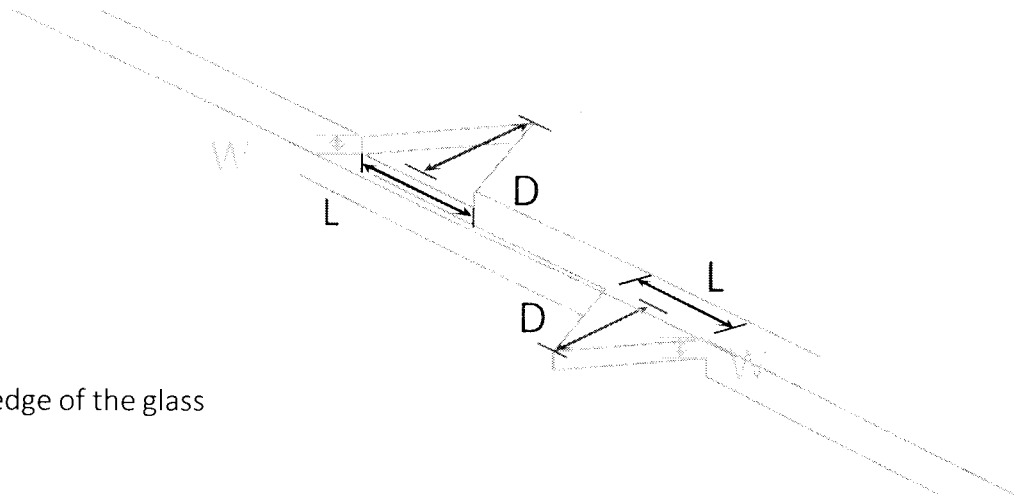
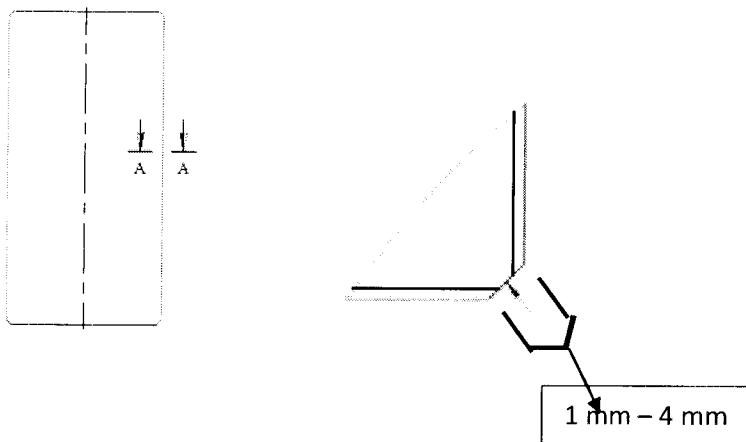


Figure 2 – Chip protruding off the edge of the glass

Corner Cut



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