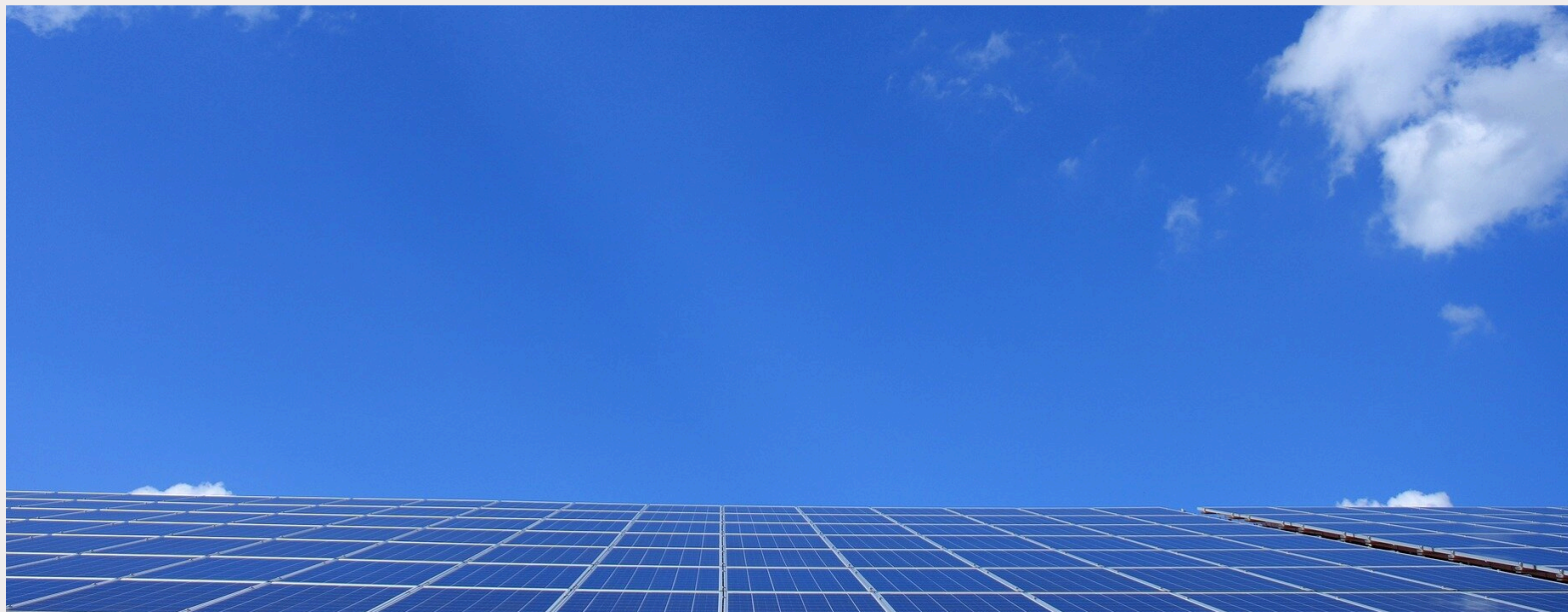


PRODUCT SPECIFICATION

LOW IRON SOLAR TEXTURED GLASS

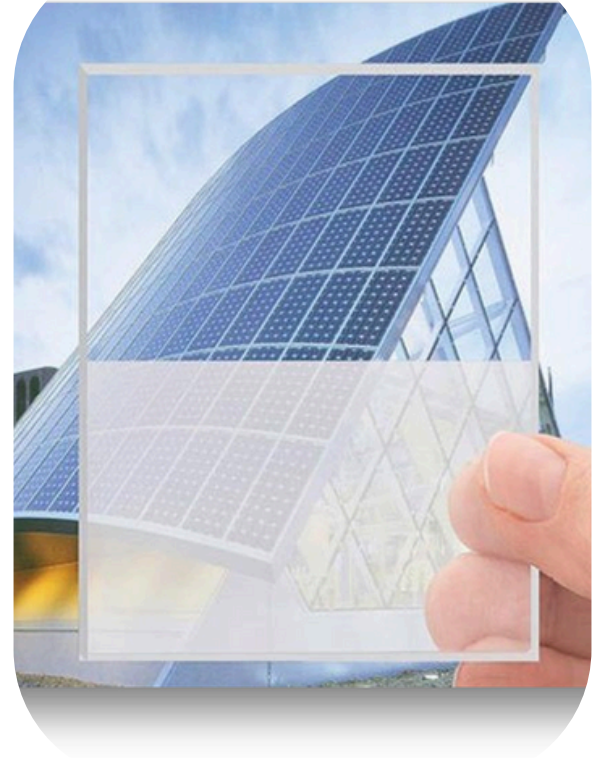
MANUFACTURER -
VISHAKHA GLASS PRIVATE LIMITED



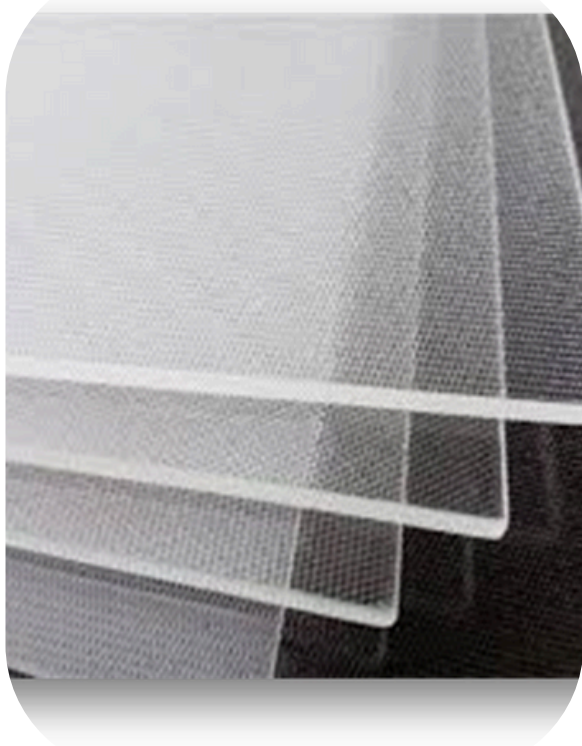
1.Scope of Application:

This specification applies to for ultra-clear solar glass for solar module and its different variants of glass are as below:

- AR Coated Full Tempered Glass;
- Higher Transmission AR (HTAR) Coated Full Tempered Glass;
- Semi-tempered Front Patterned Glass;
- Semi-tempered Back Patterned Glass:
- White Silk Grid printed Semi-tempered Back Patterned Glass;
- Mesh Film sticked (LRF) Semi-tempered Back Patterned Glass.



2.Processing Specification:



- Common Processed Thickness Range: From 1.6 mm to Max. up to 4.0 mm
- Process Glass Size (L*W): Maximum up to 2500 mm*1200 mm
- Glass Edge Processing: Circular Edging (C-Edge)
- Corner Processing: Rounded/Chamfer corner

3. Quality Characteristics/ Specification

Dimensional Glass Quality:

Parameters	Test Method/Standard	Specification/Requirement
Dimensional Tolerance (L x W) mm	Measuring Tape	Length(L): ± 1.5 mm Width(W): ± 1.0 mm
Nominal Thickness(mm)	Disc Micrometer (\varnothing 20mm)	1.6 mm ~ 4.0 mm ± 0.2 mm
Holes (Back Glass)	Vernier Caliper (150 mm)	Dia. ± 1.0 mm
Angularity (maximum difference in diagonal lengths)	Measuring Tape	Maximum 4.0 mm
Corner Cut (Circular)	Measuring Tape/Scale	Min: 1.0 mm, Max: 4.0 mm
Edge Processing	Visual/Measuring Scale	C-Edge grinding; Edging Depth: 1 -3 mm

4. Physical Quality

PARAMETERS	TEST METHOD/ STANDARD	SPECIFICATIONS
Iron Content	AAS	≤ 120 PPM
General/Overall Bow	EN 12150-1:2015	≤ 0.2% (Thik. ≥ 3.0 mm) ≤ 0.3% (Thik. < 3.0 mm)
Local Bow	EN 12150-1:2015	Maximum 0.65 mm / 300 mm
Light Transmission	ISO 424-71/ISO 9050:2003 AM 1.5, 380 1100 nm Wavelength	≥ 91.5% (Back Glass Without ARC) ≥ 93.8% (Front Glass With ARC) ≥ 94.2% (Front Glass With HTAR)
Steel Ball Impact Test	IS 2553 (Part 3): 2019	Glass should not break through 227 ± 1 gm. steel ball from height of 1 meter.
Fragmentation	EN 12150-1:2015 / IS 17004	For Heat strengthened: Not more than 3 "ISLAND" fragments; For Full Tempered: Minimum fragments should be 40 particle.
Surface Compression	ASTM 1048-12	For Heat Strengthened: ≥ 60 Mpa For Full Tempered: ≥ 69 Mpa
Four Point Bending Strength	EN 12150-1:2015	For Heat Strengthened: ≥ 55 Mpa For Full Tempered: ≥ 90 Mpa
Glass Surface Roughness(Ra)	Measured with Mitutoyo surface roughness tester	Ra: 0.4 μm 1.9 μm

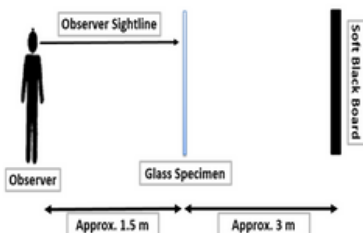
5. Appearance Glass quality

Appearance Glass Quality

Visual Standard As per (EN 572 - 5: 2012 /5.2.1) & (ASTM C 1036):

1.) The glass pane to be examined is illuminated in conditions approximating to diffuse light and is observed in front of a matt grey screen

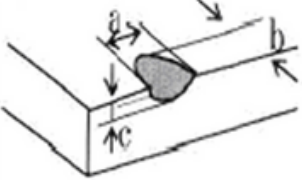
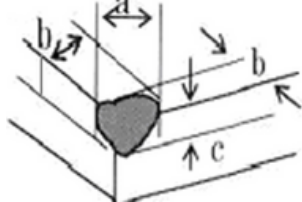
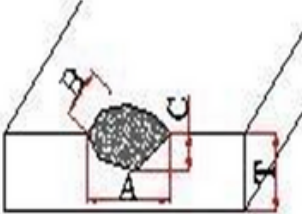
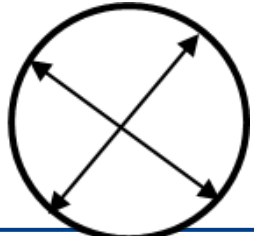
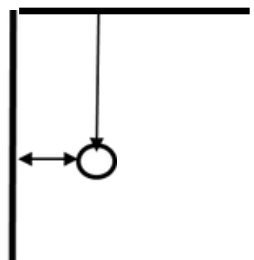
2.) Place the pane of Glass to be examined vertically 3m in front of parallel to a matt grey screen. Arrange the point of observation 1.5m from the glass, keeping the direction of observation normal to the glass surface.



	Defect Name	Judgment Standard	Acceptable Limits		
	Spherical Bubbles		$\Phi < 0.5 \text{ mm}$	Not densely present	
		$0.5 \text{ mm} < \Phi \leq 1.0 \text{ mm}$	5 x S		
		$1.0 \text{ mm} < \Phi \leq 2.0 \text{ mm}$	3 x S		
		$\Phi > 2.0 \text{ mm}$	Not Allowed		
Longitudinal Bubbles	Length	$> 1.5 \text{ mm}$	$> 5 \text{ mm} - L -$	$L > 10 \text{ mm}$	
	Width	$\leq 5 \text{ mm}$	$\leq 10 \text{ mm}$		
	$W \leq 0.5 \text{ mm}$	3 x S	1 x S	Not Allowed	
	$W > 0.5 \text{ mm}$	Not Allowed	Not Allowed	Not Allowed	
Open Bubbles	$L < 4.75 \text{ mm} \ \& \ W < 0.8 \text{ mm}$	1			
Spot Faults /Foreign Matter		$\leq 0.5 \text{ mm}$	Unlimited		
		$> 0.5 \text{ mm} \text{ to } \leq 1 \text{ mm}$	2		
		$> 1 \text{ mm} \text{ to } \leq 3 \text{ mm}$	1		
		$> 3 \text{ mm}$	Not Allowed		
Scratches	Length	$L < 5 \text{ mm}$	$5 \text{ mm} \leq L \leq 10 \text{ mm}$	$L > 10 \text{ mm}$	
	Width				
	$W \leq 0.5 \text{ mm}$	4	1	Not Allowed	
	$W > 0.5 \text{ mm}$	Not Allowed	Not Allowed	Not Allowed	
Cleanliness	Non-Removable Dirt	Not Allowed			

Remarks: The above legends “Φ”- represents the diameter; “L”- represents the length; “W” - represents the width; “S”- is the number of bubbles per square meter.

6. Glass Edge/Grinding Defects

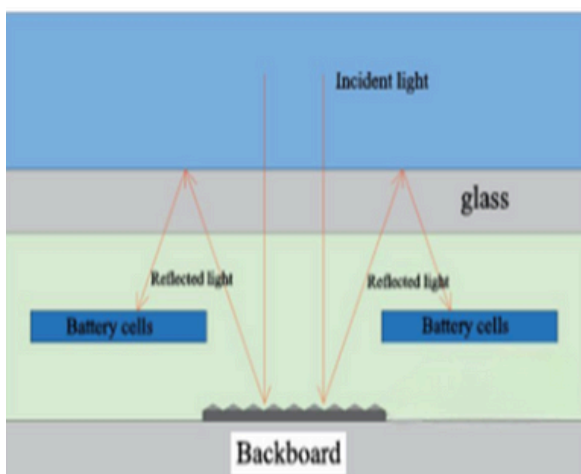
Edge Defects	Defect Picture	Judgement Criteria
Edge Chipping		<p> $a(\text{Length}) \leq 5.0\text{mm}$; $b(\text{Width}) \leq 3.0\text{mm}$; $c(\text{Depth}) \leq 2.0\text{mm}$ </p> <p>Each panel not more than two locations.</p>
Corner Chipping		<p> $a(\text{Length}) \leq 6.0\text{mm}$; $b(\text{Width}) \leq 3.0\text{mm}$; $c(\text{Depth}) \leq 2.0\text{mm}$ </p> <p>Each panel not more than 2 locations.</p>
Chipping inside the hole/Glass Edge		<p> $A(\text{Length}) \leq 1.5T$; $B(\text{Width}) \leq 1.5T$; $C(\text{Depth}) \leq 0.5T$ </p> <p>Not more than one place only in one hole out of three holes.</p>
Hole diameter tolerance		<p>Hole diameter(Φ): $\pm 1.0\text{mm}$</p>
Hole position tolerance		<p>Tolerance in distance from hole edge to glass short edge & glass long edge: $\pm 1.0\text{mm}$</p>

Remarks -The above legends "T"- Thickness of glass specimen;

7. LRF Mesh Film Sticking Quality:

- Scope/Application:
- Light Reflected Film (LRF) is suitable for laminating in the gaps between photovoltaic
- Module cells, reflecting sunlight at different angles, and then fully reflecting it onto the cells
- Through glass, improving the overall power of the modules.

Parameters	Specification
Mesh Film Detail	LRF Metallic/Non-Metallic
Mesh Film Width	5 / 6 ±0.2mm
Mesh Film Thickness	Non-Metallic: 0.130±0.020 mm Metallic: 0.125 ± 0.015 mm
Mesh Film Colour	Non-Metallic: White Metallic: AL Metallic Reflective
Mesh Film Sticking Dimension	As Per Customer Approved Drawing



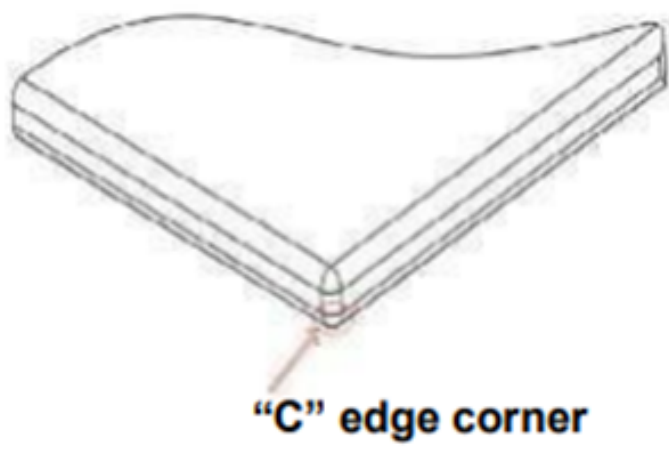
8. Mesh Grid Printing Glass Quality

Scope/Application:

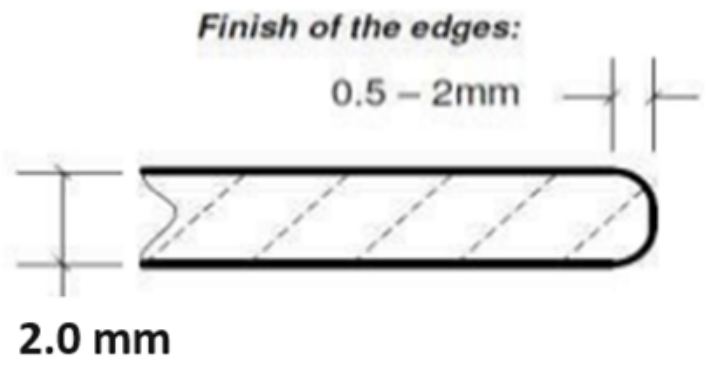
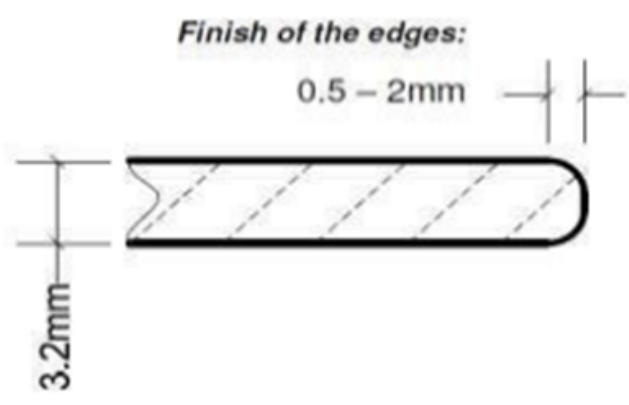
The Mesh Grid printing on the glass is in a form of ceramic paint on texture side in white color as per customer requirement and the application of printing is done by screen printing process.

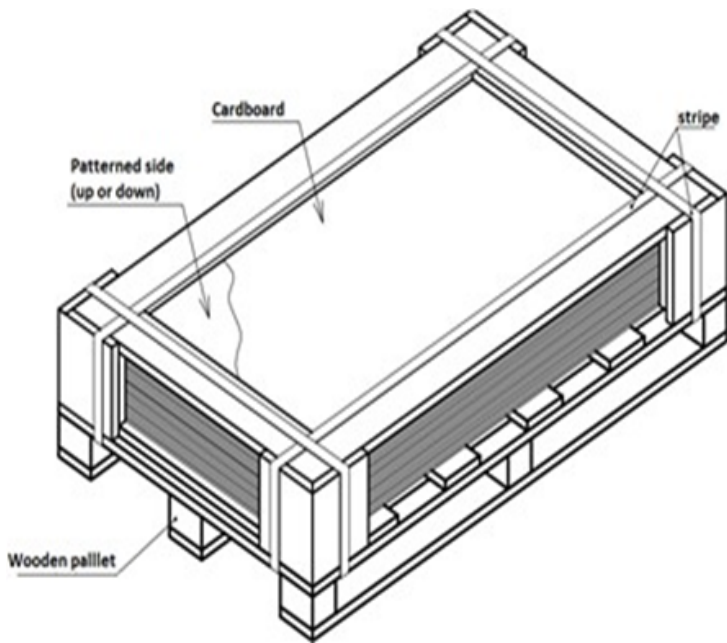
Parameter	Test Method/ Standard	Specification /Requirement
Dimension (Length & Width)	As Per Customer Approved Drawing	
Printing reflectance	Average reflectance in 380 to 560 nm through spectrophotometer	White Printing: >75%
Printing Thickness	Roller Dial Gauge	20 to 25 micron
Printing missing/Pinhole	Visual Inspection	0.5 mm < Φ < 1.5 mm : 30 defects/m ² ; 1.5 mm < Φ < 2.0 mm : 2 defects/m ² ; > 2.0 mm :Not Allowed
Scratch	Visual Inspection	W < 0.5 mm & L < 15 mm: 3 defects/m ² W > 0.5 mm & L >15 mm: Not Allowed

9. Cut Corner: Min. – 1.0 mm, Max. – 4.0 mm (Sharp edge not allowable)



10. Edge grinding (C-Edge):





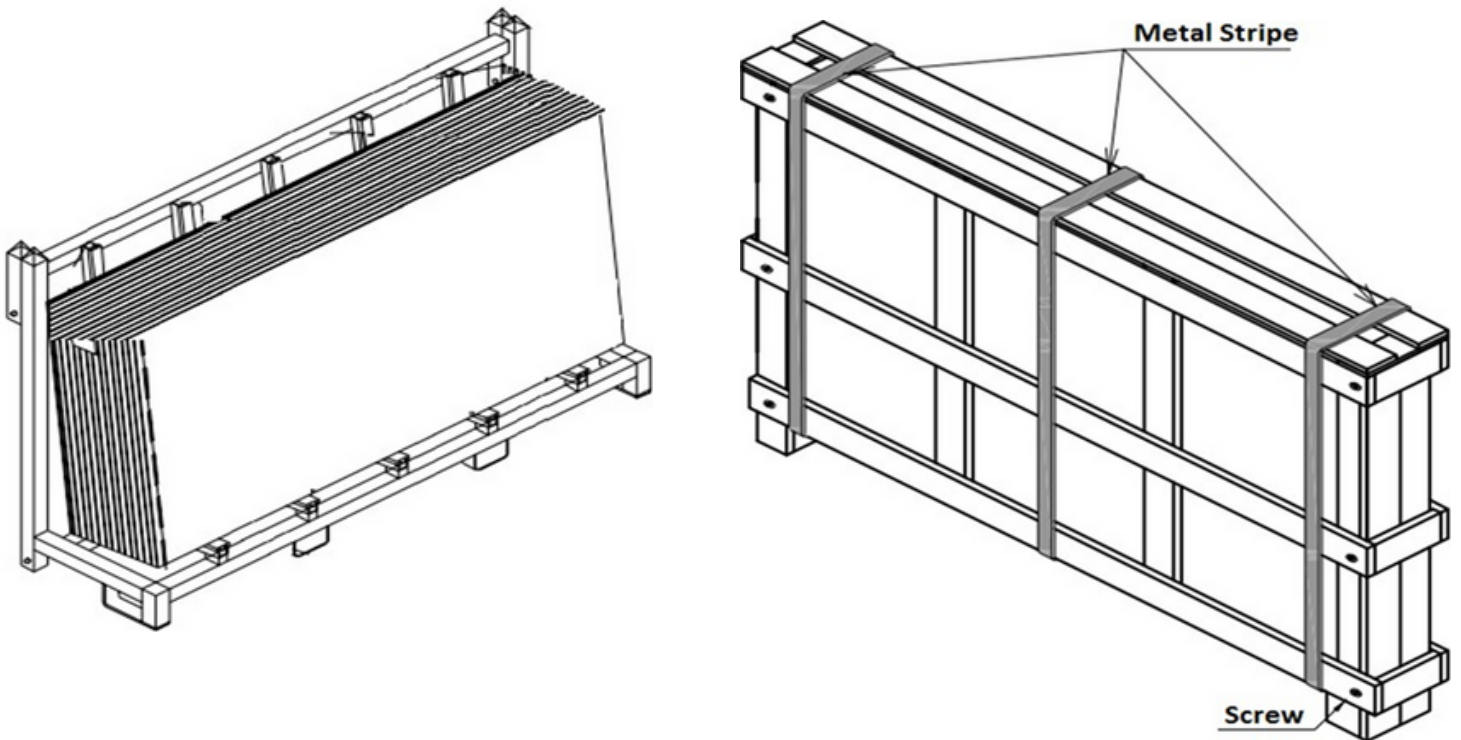
Wooden Pallet Packing with interlayering paper



**Paperless Glass in Metal Pallet Packing
Horizontal Packing Method**

11.Packaging:

- The raw glass is packaged either by end-cap vertical method or iron frame vertical method and the glass is directly applied with mold powder or spate by isolation paper through robotic Stacking.



Vertical Packaging Method

- Tempered glass are horizontally stacked on wood pallets or iron pallets (recyclable) and protected by an isolated paper between the glasses; paperless stacking allowed if condition permitted.
- Silica gel has to be provided for absorbing moisture 200micron polythene/Aluminum foil to be used for wrapping the sheets fully covered or as per the last supplies delivered, for any material change prior approval is mandatory.
- There has to be interleaving protective in form of paper
- (a) GSM - 50 ± 2 ;

12. Transport



- Transportation can be by road/rail transport, shipping and anti-dumping and anti-skid measures
- Shall be taken during loading and unloading.
- When storing and transporting, there should be a corresponding rainproof measures, and be dry and ventilated.
- After loading, reinforcement measures shall be taken to prevent displacement, tilt, etc. during transportation.

13. Caution Note



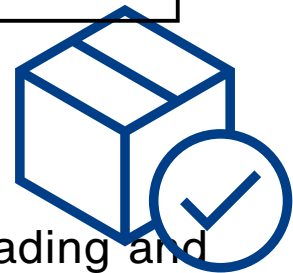
- Ensure that the path for unloading is clear and smooth, with no steep slopes, to facilitate safe movement of goods.
- When using forklifts to move goods, handle them gently and avoid aggressive or abrupt movements to prevent damage.
- Before unloading glass from the container, ensure that all reinforced fixtures are removed to avoid interference during the transfer process.
- Do not use a forklift to forcibly pull goods out of the container. Limit the forklift speed to no more than 5 km/h to ensure safe and controlled movement.
- For paperless glass, do not stack more than 2 pallets high. Only 1 pallet should be moved at a time by forklift.
- For standard glass, stacking should not exceed 4 pallets high
- It is recommended that paperless glass not be unpacked before being delivered to the production line to avoid potential scratches.
- Allow the glass to acclimate in the workshop for a period of time before unpacking. This ensures that the glass temperature is as close to the workshop temperature as possible, reducing the risk of condensation on the glass surface which can affect its performance.

14. Container Size

The number of pallet depends of the size of the Glass-

CONTAINER SIZE	2272MM	2450MM
20FT	14 PALLET	6 PALLET
40FT	14 PALLET	12 PALLET
FOR 3.2 MM GLASS : 1 PALLET CONTAINS 95 GLASSES FOR 2MM GLASS : 1 PALLET CONTAINS 150 GLASSES		

15. Storage



- The glass is fragile. Attention should be paid when loading and unloading to avoid collision and Injury.
- Tempered glass has the risk of self-detonation and should be tested and protected at all times storage period: suitable for use within 3months from the date of production storage environment requirements: ventilated, cool, dry environment (suggested optimal storage temperature $-15\text{ }^{\circ}\text{C} \sim 45\text{ }^{\circ}\text{C}$, humidity $20\% \sim 60\%$).
- The forklift is prohibited to fork the goods when found the strapping or wooden box has been broken or has a crack;
- When storage, different specifications, different thicknesses, different quantity, etc. must be classified and placed accordingly.
- Hard demolition is prohibited, use appropriate tools to open the case to avoid unnecessary damage.

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