Product specification and quality criteria
Glass/ Glass PV module

This specification sets out the requirements for assessing the technical, electrical and optical quality of **Intelligent Solar** photovoltaic modules. It acts as a basis for our tenders and forms part of the contract when an order is placed, unless otherwise agreed in writing.

1. **Design of photovoltaic elements: Glass-glass modules**

Fully tempered (ESG) or heat-treated (TVG) white glass (low iron oxide content) with bordered edges is used for the outer panes. The thickness of both panes is determined by static requirements or by the customer. Thicknesses between 3.2 mm and 12 mm are available. As a general rule, fully tempered (ESG) glass is not subject to a heat-soak test (HS test). Spontaneous breakage as a result of a nickel sulphide inclusion cannot, therefore, be ruled out. This chargeable test can be carried out at the customer's request.
The number of cells and the cell spacing can be varied.

The thickness of both outer panes is determined by static requirements or by the customer.
Thicknesses between 8 mm and 12 mm are available.

The number of cells and the cell spacing can be varied, thus altering light transparency.

The maximum dimensions are as follows:
Glass-glass modules - 3700 x 2300 mm

2. Glass characteristics:

Size tolerances for width W and length H in mm					
Fixed dimensions, cut and bordered			Edges matt - polished - mitred		
Dimensions in mm W or H	Nominal thickness ≤ 8 mm	Each glass unit > 8 mm nominal thickness	< 24 mm Glass thickness	< 35 mm Glass thickness	> 35 mm Glass thickness
< 1000	± 1	± 2.5	+1 / - 2	+1 / - 3	+1 / - 4
< 1500	± 1.5	± 3	+1 / - 3	+1 / - 3	+1 - 4
< 2500	± 2.5	± 4	+1 / - 3	+1 / - 3	+1 / - 4
> 2500	± 3	± 4.5	+1 / - 3	+1 / - 3	+1 / - 4

Glass thickness tolerance	Element thickness mm	Tolerance mm
	≤ 6	± 0.4
	6.1-12	± 0.6
	12.1-18	± 1
	>18.1	± 2
Offset	Nominal size in mm	Offset in mm
	≤ 1000	2.0
	1001-2000	3.0
	2001-4000	4.0
	> 4000	6.0

Alternative tolerances are specified on the order confirmation. The maximum ratio between width and length is 1:20.

3. Marking

All modules are provided with a type plate specifying the module type, serial number and manufacturer's information. This type plate is located at the back of the module. All production data and performance values can be traced using the serial number.

4. The different colour.

Shades on the cells are due to the production process and may vary within a module. These are not regarded as defects. Other cell formats or colours can also be processed at the customer's request.

5. Strings

Cell spacing: min. 1.8 mm; max. 150 mm
String dimensions can vary due to the dimensional tolerances of cells (+/- 1 mm) and the manufacturing process.
The following are fixed tolerances:
Distance from glass edges: +/- 3 mm
Distance between cells: +/- 2mm
Distance between strings: +/- 3 mm
Length of all strings with respect to one another: +/- 3 mm
Parallel with edge of panes: +/- 4 mm/lm
Solder strips / cell connectors: +/- 3 mm
Connecting plates: +/- 3 mm
Plate return +/-10 mm/lm
All tolerances relate to the default dimensions specified in writing.

6. Cell breakage

- Opaque panels (foil or enamel coating)

If the electrical function is within the tolerance range, any kind of cell breakage is permitted.

- Semi-transparent panels (glass-glass)

If the electrical function is within the tolerance range, any kind of cell breakage is permitted. However, if more than three cells or up to 5 % of the cells in each module are affected; these should be marked as "B-grade goods" and marketed separately.

7. Air inclusions

Small air bubbles may remain in the modules as a result of the production process. These should not affect the electrical properties or longevity of products and should not exceed the following limits:

up to 10 bubbles measuring 1 - 3 mm
up to 8 bubbles measuring 3 - 5 mm
up to 5 bubbles measuring 5 - 10 mm
up to 2 bubbles measuring > 10 mm

All details refer to one square meter of module surface.

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8. Changes in colour

All materials used in PV production have individual colours due to the raw materials used. This individual colouring may appear differently when looking through and/or looking at the glass. Variations in colour are inevitable due to the type of glass, thickness of the glass and the structure of the panes. They are not regarded as defects and are no different from discolouration of the foil at the edges or in the solder strips.

9. Foreign bodies

Dirt inside the laminate, such as soldering splashes, small cell fragments, inclusions in the glass or fluff should not affect the overall optical image.

10. Linear defects

Scratches or grinding marks on the glass surface, and small fractures at the edge of the glass are also not regarded as defects provided that modules meet their inspection criteria.

11. Inspection criteria

The specifications described above are subject to the following inspection criteria.

12. Technical details

All technical details should be defined in writing before production commences and are confirmed by drawings and by the order confirmation.

13. Electrical data

The specified electrical values are documented in the form of "flash reports" (measurement reports). All values are subject to a tolerance of +/- 5 %. Modules are regarded as being electrically acceptable if the output measured under STC is within the tolerance limit for the specified rated output.

14. Optical criteria

As inspection criteria from the glass technology sector do not apply due to the specific manufacturing process, the following inspection method is used:
The module in question is placed in a vertical position. The inspector stands 3-5 m away from the module and inspects it in daylight, but away from direct sunlight.