Product specification
PV module series

This specification applies as a guideline for assessing the technical, electrical and optical quality of our photovoltaic modules.
It serves as the basis for our quotations and, in the event of an order, is deemed to be an integral part of the contract, unless otherwise agreed in writing.

1. structure of the photovoltaic elements

We divide our modules into two groups.

1.1 Glass-glass-modules

1.1.1 Standard version

A 4 - 6 mm heat strengthened or tempered low-iron glass with seamed edges is used as the outer pane. The PV cells are embedded between two PVB (polyvinyl butyral) films and laminated together with another 4 - 6 mm TVG/ESG pane with seamed edges.

1.1.2 Special version

Tempered (ESG) or partially tempered (TVG) white glass (low-iron oxide glass) with seamed edges is used as the outer pane. The thickness of the two panes is determined by static requirements or the customer. Thicknesses from 4 mm to 19 mm are available. As a matter of principle, toughened safety glass is not subjected to a hot storage test (HS test). Spontaneous breakage due to nickel sulphide inclusions can therefore not be ruled out. At the customer's request, this test can be carried out at an extra charge.

The number of cells and the cell spacing can be designed variably.
Glasses can be specially processed:

- KG edges cut
- KGS edges hemmed
- KGN edges ground
- KPO edges polished
- GK mitred edges

Coloured design is possible as follows:

- Screen printing (full-surface printing, dots, stripes, cell matrix, special shapes)
- Enamelling in the case of full-surface printing
- Coloured PVB film
- Bulk coloured glass

1.2 Glass insulating glass modules

1.2.1 Standard version

Tempered (ESG) or partially tempered (TVG) white glass (low-iron oxide glass) with seamed edges is used as the outer pane.
The PV cells are embedded between two PVB (polyvinyl butyral) films and laminated with another ESG or TVG pane.
The pane thicknesses are 4 - 6mm depending on the size of the module.
Aluminium or stainless steel profiles as well as TGI are used as spacers, creating a gas-filled (argon) 16mm space between the panes.
The glass used on the rear side is toughened safety glass or TVG with a thickness of 4 - 6 mm. The edge seal corresponds to a standard insulating glass structure.

1.2.2 Special version

The thickness of the two outer panes is determined by static requirements or the customer. Thicknesses from 4mm to 19mm are available.
The number of cells and the cell spacing can be varied and thus the light transparency can be changed.
Aluminium or stainless steel profiles are used as spacers, which create a gas-filled (argon, krypton) space between the panes, which can optionally be 6 mm to 22 mm. For increased U-values, a multi-layer glass structure can be used, in which case the interspace is filled with krypton (if available).
A toughened safety glass pane is used as the rear pane, the thickness of which is adjusted to the static requirements. This pane can be further processed into a laminated safety glass (with PVB film) and can thus be used in overhead areas. For further glass processing, see paragraph 1.1.2.

2 Dimensions/Tolerances

The maximum dimensions are

- Glass-glass modules
  - for 4-19mm glass: 4800 x 2200mm
- Insulating glass modules
  - for 4-19mm 4800 x 2200mm

Other special sizes on request

The EN 12153 standard is decisive for the tolerances.

Size tolerances in width W and length H in mm					
Fixed dimensions cut and hemmed			Edges matt - polished - mitred		
Dimensions in mm W or H	Nominal thickness ≤ 8 mm	Each glass unit > 8mm Nominal thickness	< 24mm Glass thickness	< 35mm Glass thickness	>35mm 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

	Element thickness mm	Tolerance mm
Glass thickness tolerance	≤ 6	±0,4
	6,1-12	± 0,6
	12,1-18	± 1
	>18,1	±2
	Nominal size in mm	Offset in mm
Offset	≤ 1000	2,0
	1001-2000	3,0
	2001-4000	4,0
	> 4000	6,0

Deviating tolerances will be indicated on the order confirmation. The maximum aspect ratio width to length is 1:20.

3 Labelling

All modules are provided with a type plate showing the module type, serial number and manufacturer's

details. This type plate is located on the back of the module. All production data and performance values can be assigned on the basis of the serial number.

4 Electrical connections / shading

Bypass diodes are located in the connections, which are splash-proof and cast in an electrically insulating manner. A maximum of 20-24 cells are stranded and fitted with a diode. Our project-specific data sheets and previously agreed customer-specific solutions are decisive. Different connection situations can be realised:

4.1 Front side of the glasses: Side connection
4.2 Back of the panel: Back box

The modules must be free of shading on site.

5 Cells

The following cells are installed in our modules:

- Silicon cells on crystalline basis
- Alternatively with black coloured cell connectors

The different colour shades on the cells are production-related and may vary within a module. This does not represent a defect. Other cell formats or colours can also be processed at the customer's request.

6 Strings

Cell distance min. 3mm max.50mm

Due to the dimensional tolerances of the cells (+/- 1mm) and the manufacturing process, strings can differ in their dimensions.

The following are considered to be specified tolerances:

Distance to the edges of the glass:	+/- 3mm
Distance between the cells:	+/- 2mm
Distance between the strings:	+/- 3mm
Length of all strings to one another:	+/- 3mm
Parallelism to the edge of the pane:	+/- 4mm/rm.
Solder ribbons / cell connectors:	+/- 3mm
Connection plate:	+/- 3mm
Ribbon return	+/-10mm/rm.

All tolerances refer to the specified dimensions fixed in writing.

6.1 Opaque panels (foil or enamel coating)
If the electrical functionality is within the tolerance range, any type of cell breakage is permitted.

6.2 Semi-transparent panels (glass-glass)
If the electrical functionality is within the tolerance range, any type of cell breakage is permitted. However, if more than three cells or max. 5% of the cells per module are affected, this must be marked as "B-goods" and offered separately.

7 Air inclusions
Due to the production process, small air bubbles may remain in the modules. These must not affect the electrical properties or the durability and must not exceed the following limit values:

- Max. 10 bubbles with 1 - 3mm
- Max. 8 bubbles with 3 - 5mm
- Max. 5 bubbles with 5 - 10mm
- Max. 2 bubbles bigger than 10mm
  All data refer to one square metre of module surface.

8 Colour change
All materials used in PV production have inherent colours due to the raw material. This inherent colour may be visible in different ways when looking through the glass and/or from above. Variations in the colour impression cannot be avoided due to the type of glass, the thickness of the glass and the structure of the pane and do not represent a defect, nor does discolouration of the film in the edge area or at the soldering bands.

9 Optical criteria
Due to the special manufacturing process, no test criteria from glass technology can be applied.
The following test procedure applies:
The module to be viewed is set up vertically. The observer is at a distance of
3m from the module and the module is tested in daylight without direct sunlight.
Possible variations in the colour impression occur due to the iron oxide content of the glass, the coating process and the coating composition.

10 Foreign body
Contamination within the laminate such as solder splashes, small cell breaks, inclusions in the glass or fluff must not impair the overall visual appearance.

11 Linear error
Scratches or grinding marks on the surface of the glass, as well as small chips on the edges of the glass, do not constitute a defect, provided they meet the test criteria.

12 Test criteria
The specifications described in the above points are subject to the following test criteria.

12.1. Technical specifications
All technical details must be specified in writing before the start of production and are fixed by means of drawing and order confirmation.

12.2. Electrical specifications
The specified electrical values are documented and relatively measured by "flash reports" (measurement protocols) based on random samples. All specifications are subject to a tolerance of +/- 5%. Modules are considered to be electrically OK if the power measured under STC is within the tolerance limit to the specified

nominal power. Excepted from this are modules in oversizes (from 1.4x3m), which can only be measured for function using a multimeter.

13 Certificates

The PV modules we produce are subject to strict internal and external checks.

13.1. Glass-glass modules

Our standard glass modules are EN 61215 as well as EN 61730 and protection class II certified. A test report according to EN1449 on ball drop and pendulum impact tests as laminated safety glass with photovoltaic inserts is available. Entry MA39 -21 - 03445.

13.2. Insulating glass modules

With regard to the U-value, the provisions according to EN 673 apply. There are measurement results with regard to g-value for different degrees of transparency for double insulating glass available.

13.3. For special modules, which are manufactured on customer request, certifications can be offered against payment. This applies in particular to different glass structures, cell types, diode boxes, enamelling, edge sealing.

14. Benefit commitment and guarantee

In this regard, we refer to our GTC valid march,2015

15. With regard to product-specific tolerances and quality requirements, we refer to the respectively valid Austrian and European product standards.