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Glass in building — Laminated solar PV glass

Verre dans la construction — Verre solaire PV feuilleté

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing international standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare international standards. Draft international standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an international standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 18178 was prepared by Technical Committee ISO/TC 160, *Glass in building*, Subcommittee SC 1, *Product considerations*.

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Glass in building — Laminated solar PV glass

1 Scope

This International Standard describes component parts and specifies requirements of appearance, durability and safety, test methods and designation for laminated solar photovoltaic (PV) glass for use in buildings.

PV modules that are directly attached to a building and not integrated into building material are excluded from the scope of this standard.

This standard is a material test. It is not allowed to reference compliance with this standard for final product, as compliance with additional IEC standards is required for final product certification.

NOTE IEC standards, including IEC 61215, IEC 61646, IEC 61730-1 and IEC 61730-2 are relevant standards for PV product qualification.

This standard covers the performance not the electrical performance of laminated solar PV glass.

Where necessary the electrical performances of the individual parts, e.g. insulating strip, have no relevance to this standard, however, these electrical parts should conform to the applicable IEC standards.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 9050, *Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors*

ISO 16940, *Glass in building — Glazing and airborne sound insulation — Measurement of the mechanical impedance of laminated glass*

ISO 12543 (all parts), *Glass in building — Laminated glass and laminated safety glass*

ISO 22897, *Glass in building — Glazing and airborne sound insulation — Product descriptions and determination of properties*

ISO/TS 29584 *Glass in building — Pendulum impact testing and classification of safety glass for use in buildings*

IEC 61215, *Crystalline silicon terrestrial photovoltaic (PV) modules — Design qualification and type approval*

IEC 61646, *Thin-film terrestrial photovoltaic (PV) modules — Design qualification and type approval*

IEC 61730-1, *Photovoltaic (PV) module safety qualification — Part 1: Requirements for construction*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12543, Parts 1 to 6 and the following apply.

- 3.1 laminated solar PV glass**
laminated glass that integrates the function of photovoltaic power generation
- 3.2 laminated safety solar PV glass**
laminated solar PV glass where in case of breakage the interlayer serves to retain the glass fragments, limits the size of opening, offers residual resistance and reduces the risk of cutting or piercing injuries
- 3.3 solar cell**
semiconductor device that converts the energy of sunlight directly into electricity by photovoltaic effect
- 3.4 interlayer**
one or more layers of material acting as an adhesive and separator between plies of glass and solar cells
- 3.5 terminal**
component that extracts direct current from laminated solar PV glass
- 3.6 insulating strip**
material that is used for the insulating treatment of electric-circuit connection parts
- 3.7 interconnector**
conductor within the laminated solar PV glass providing a path for conducting electricity between solar cells
- 3.8 cell junction temperature**
temperature at the junction of a semiconductor, say, solar cell
- 3.9 nominal operating cell temperature (NOCT)**
equilibrium cell junction temperature within an open-rack mounted laminated solar PV glass pane operating near peak power in the standard reference environment (the environment temperature of 20 °C, an irradiance of 800 W/m², and wind speed 1 m/s)
- 3.10 standard test condition (STC)**
test condition at an irradiance of 1 000 W/m² with the IEC 60904-3 reference solar spectral irradiance distribution and 25 °C solar cell temperature
- 3.11 junction box**
electrical enclosure where electrical wiring connections are made
- NOTE It is a combination of parts, including boxes, covers, cover-plates, lids, box extensions, accessories, etc.
- 3.12 front glass**
layer of glass that faces the sunlight directly

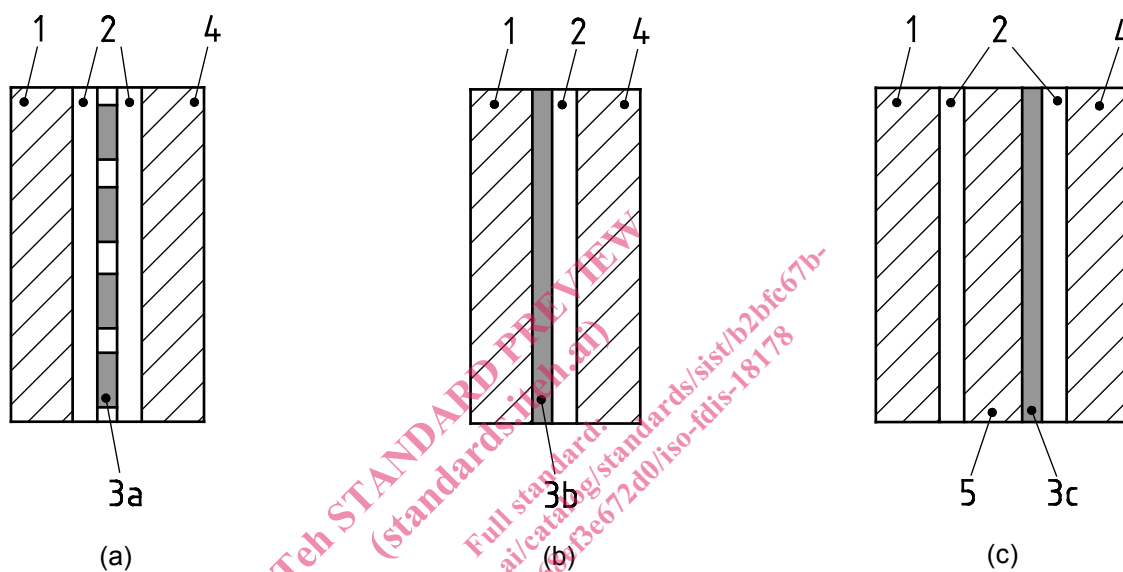
3.13**edge area**

perimeter of the pane without solar cells, which is generally contained within the glazing system

4 Descriptions of component parts**4.1 General**

Laminated solar PV glass shall be manufactured from the combinations of glass, solar cell, interlayers, interconnector and junction box. The possible constructions of laminated solar PV glass are shown in Figure 1.

NOTE The description of component parts in this clause is not exhaustive.



Key			
1	front glass	4	back glass
2	interlayer	5	glass substrate of thin film solar cell
3	solar cell (3a: crystal silicon solar cell; 3b & 3c: thin-film solar cell)		

Figure 1 — Example configurations of laminated solar PV glass in buildings

The glass, interlayer and other composition materials are subject to standardization. If materials are not subject to standardization, they should be subject to the manufacturer's specification. These specifications are usually subject to the manufacturer's own quality procedure for factory production control or quality assurance system.

4.2 Types of glass

The type of glass used in laminated solar PV glass may be:

- float glass;
- patterned glass.

The glass may also be:

- clear, tinted or coated;

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- transparent, translucent or opaque;
- annealed, heat strengthened, tempered or chemically strengthened;
- surface treated (e.g. by sandblast or acid etched).

NOTE Glass compositions and types are the subject of product standards.

4.3 Solar cells

The types of solar cell used in laminated glass may be:

- crystal silicon solar cell;
- thin-film solar cell.

The types of thin film solar cell include but are not limited to:

- amorphous silicon (a-Si) or microcrystalline silicon (uc-Si);
- copper indium gallium selenide (CIGS), or copper zinc tin sulfide (CZTS);
- cadmium telluride (CdTe);
- dye-sensitized solar cell (DSSC or DSC);
- organic solar cell.

NOTE The terms, a-Si, uc-Si, CIGS, CZTS, CdTe, DSSC and DSC, are commonly used in the photovoltaic industry.

4.4 Interlayer

The following is a non-exhaustive list of commonly used materials as interlayers:

- polyvinyl butyral (PVB);
- ethylene vinyl acetate (EVA);
- ionomer.

4.5 Interconnector

Materials with good conductivity of electricity and good weldability, such as copper and aluminium, could be selected and used.

4.6 Insulating strip

Polyethylene terephthalate (PET) and other materials with good electrical insulation could be selected and used to provide the sole insulation between a live part and an accessible metal part or between uninsulated live parts not of the same potential.

The strip should be of adequate thickness and of a material appropriate for the application, as defined in IEC 61140.

4.7 Junction box

The junction box shall be provided with wiring terminals, connectors, or leads to accommodate current-carrying conductors of the load circuit.

The junction box shall conform to the requirements of IEC 61730-1.

4.8 Edge protection material

The edge protection material shall conform to the following requirements:

- a) the material shall be resistant to weathering in accordance with ISO 4892-2 or ISO 4892-3;
- b) the bond strength of the material to surfaces to form a sealant joint shall not be reduced by more than 50 % after exposure to:
 - UV weathering in accordance with ISO 4892-2;
 - high-temperature test, and;
 - dump heat test.
- c) chemical compatibility with the interlayer at the edges should be checked.

5 Requirements

5.1 General

The requirements of laminated solar PV glass shall be in accordance with those listed in Table 1.

Table 1 — Technical requirements and test methods

	Item	Requirement	Test method
Appearance and dimensions	Appearance	5.2	7.1
	Dimensions and edge finishing	5.3	-
Durability	High-temperature test	5.4	7.2
	Dump heat test	5.5	7.3
	Radiation test	5.6	7.4
	Thermal cycling test	5.7	7.5
	Humidity freeze test	5.8	7.6
	Measurement of NOCT	5.9	7.7
	Hot-spot test	5.10	7.8
Safety	Impact test	5.11	ISO/TS 29584
	Ball drop test	5.12	7.9
	Insulation test	5.13	7.10
	Immersion test	5.14	7.11
Acoustics	Acoustic property	5.15	ISO 22897

NOTE The insulation test and immersion test are not independent tests, but the subsequent test of dump heat test radiation test and humidity freeze test to verify the electrical safety of the product.

For curved or specified laminated solar PV glass, the appearance, dimension and technical requirement should be agreed with the manufacturer.

5.2 Appearance

5.2.1 Major defects

Laminated solar PV glass shall be tested in accordance with 7.1. The following major defects are not permitted:

- a) broken, cracked, bent, misaligned or torn external surfaces, including front glass, back glass, and terminations;
- b) for thin film PV products: voids in, or visible corrosion of any of the thin film layers of the active circuitry of the product, extending over more than 10 % of any cell;
- c) visible corrosion of output connections, interconnections and busbars;
- d) bubbles or delamination forming a continuous path between any part of the electrical circuit and the edge of the pane, or which exhibited significant growth during the testing and would, if testing were continued, reach such a condition;
- e) haze and cloudiness in the main area;
- f) creases and streaks introduced into interlayer in the main area;
- g) evidence of any molten, burned or broken solar cell, diode or active PV component;
- h) loss of mechanical integrity, to the extent that the installation and/or operation of the pane would be impaired.

5.2.2 Defects in the main area

For the purpose of product quality, permissible spot and linear defects in the main area shall be in accordance with 8.1 and 8.2 of ISO 12543-6:2011.

5.2.3 Defects in the edge area

For laminated solar PV glass installed in frames, defects which do not exceed 5 mm in diameter or 5 % of edge area are permitted.

For unframed laminated solar PV glass, its edges may be ground, polished, bevelled. Shells and bubbles are permissible if they do not become obvious. Interlayer defects, i.e. extrusions and retractions, are permissible.

5.3 Dimensions and edge finishing

The dimensions and edge finishing of laminated solar PV glass shall be in accordance with ISO 12543-5.

Requirements for holes in tempered glass shall be in accordance with 7.4 of EN 12150-1:2000.

NOTE An ISO standard, *Glass in building — Tempered soda lime silicate safety glass* is in development.

The distance between the edge of the outmost solar cells to the edge of the pane shall be greater than 10 mm.

5.4 High-temperature resistance

Laminated solar PV glass shall be tested in accordance with 7.2. No fault (i.e. bubbles, delamination, haze and cloudiness) shall be found in three test specimens.