

---

---

## Glass in building — Laminated solar photovoltaic glass for use in buildings

*Verre dans la construction — Verre feuilleté photovoltaïque pour utilisation dans les bâtiments*

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO/TS 18178:2018](https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489ce6/iso-ts-18178-2018)

<https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489ce6/iso-ts-18178-2018>



**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO/TS 18178:2018

<https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489ce6/iso-ts-18178-2018>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2018

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

	Page
<b>Foreword</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Description of components</b> .....	<b>2</b>
4.1 General.....	2
4.2 Types of glass.....	3
4.3 Typical types of solar cells.....	4
4.4 Interlayer.....	4
4.5 Interconnector.....	4
4.6 Insulating strip.....	4
4.7 Termination.....	4
<b>5 Requirements</b> .....	<b>5</b>
5.1 General.....	5
5.2 Appearance.....	5
5.2.1 Major visual defects.....	5
5.2.2 Defects in the main area.....	6
5.2.3 Defects in the edge area.....	6
5.3 Dimensions and edge finishing.....	6
5.4 High temperature test.....	6
5.5 Damp heat test.....	6
5.6 Radiation test.....	6
5.7 Thermal cycling test.....	7
5.8 Humidity freeze test.....	7
5.9 Measurement of NMOT.....	7
5.10 Hot-spot endurance test.....	7
5.11 Impact test.....	7
5.12 Ball drop test.....	7
5.13 Insulation test.....	7
5.14 Wet leakage current test.....	7
5.15 Robustness of terminations test.....	8
<b>6 Test specimens</b> .....	<b>8</b>
<b>7 Test methods</b> .....	<b>9</b>
7.1 Test sequences.....	9
7.2 Visual inspection.....	9
7.3 High temperature test.....	10
7.4 Damp heat test.....	10
7.5 Radiation test.....	10
7.6 Thermal cycling test.....	10
7.7 Humidity-freeze test.....	10
7.8 Measurement of NMOT.....	10
7.9 Hot-spot endurance test.....	10
7.10 Ball drop test.....	10
7.10.1 Purpose.....	10
7.10.2 Specimen.....	10
7.10.3 Apparatus.....	10
7.10.4 Procedure.....	11
7.11 Insulation test.....	11
7.12 Wet leakage current test.....	12
7.13 Robustness of terminations test.....	12
<b>8 Designation</b> .....	<b>12</b>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO/TS 18178:2018

<https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489ce6/iso-ts-18178-2018>

## 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO/TS 18178:2018

<https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489ce6/iso-ts-18178-2018>

# Glass in building — Laminated solar photovoltaic glass for use in buildings

## 1 Scope

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

This document is applicable to building-integrated photovoltaics (BIPV). Building-attached photovoltaics (BAPV) can refer to this document.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3290-1, *Rolling bearings — Balls — Part 1: Steel balls*

ISO 12543-1, *Glass in building — Laminated glass and laminated safety glass — Part 1: Definitions and description of component parts*

ISO 12543-2:2011, *Glass in building — Laminated glass and laminated safety glass — Part 2: Laminated safety glass*

ISO 12543-3, *Glass in building — Laminated glass and laminated safety glass — Part 3: Laminated glass*

ISO 12543-4:2011, *Glass in building — Laminated glass and laminated safety glass — Part 4: Test methods for durability*

ISO 12543-5, *Glass in building — Laminated glass and laminated safety glass — Part 5: Dimensions and edge finishing*

ISO 12543-6:2011, *Glass in building — Laminated glass and laminated safety glass — Part 6: Appearance*

ISO 29584, *Glass in building — Pendulum impact testing and classification of safety glass*

IEC 61215-2:2016, *Terrestrial photovoltaic (PV) modules — Design qualification and type approval — Part 2: Test procedures*

IEC/TS 61836, *Solar photovoltaic energy systems — Terms, definitions and symbols*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12543-1, ISO 12543-2, ISO 12543-3, ISO 12543-4, ISO 12543-5, ISO 12543-6, IEC/TS 61836 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

**3.1 laminated solar PV glass**

laminated glass that integrates the function of photovoltaic power generation

Note 1 to entry: This term covers both laminated glass (see ISO 12543-3) and laminated safety glass (see ISO 12543-2).

**3.2 interlayer**

layer of material acting as an adhesive and separator between either piles of glass or between piles of glass and electrical components, which it can embed

Note 1 to entry: Different interlayer materials may be combined within one PV composition.

EXAMPLE Electrical components such as solar cells, interconnectors, diodes or cables.

**3.3 termination**

component that extracts power from *laminated solar PV glass* (3.1)

**3.4 insulating strip**

material that is used for the insulating treatment of electrical circuit connection parts

**3.5 building-integrated photovoltaics BIPV**

photovoltaic materials that are designed to be a component of the building envelope

Note 1 to entry: If the BIPV material is removed, it has to be replaced by an appropriate building material.

EXAMPLE The building envelope would comprise the roof, skylights or facades.

ISO/TS 18178:2018  
<https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489ce6/iso-ts-18178-2018>

**3.6 building-attached photovoltaics BAPV**

photovoltaic materials that are simply attached to the building

Note 1 to entry: If the BAPV material is removed, it may not be replaced by another building material.

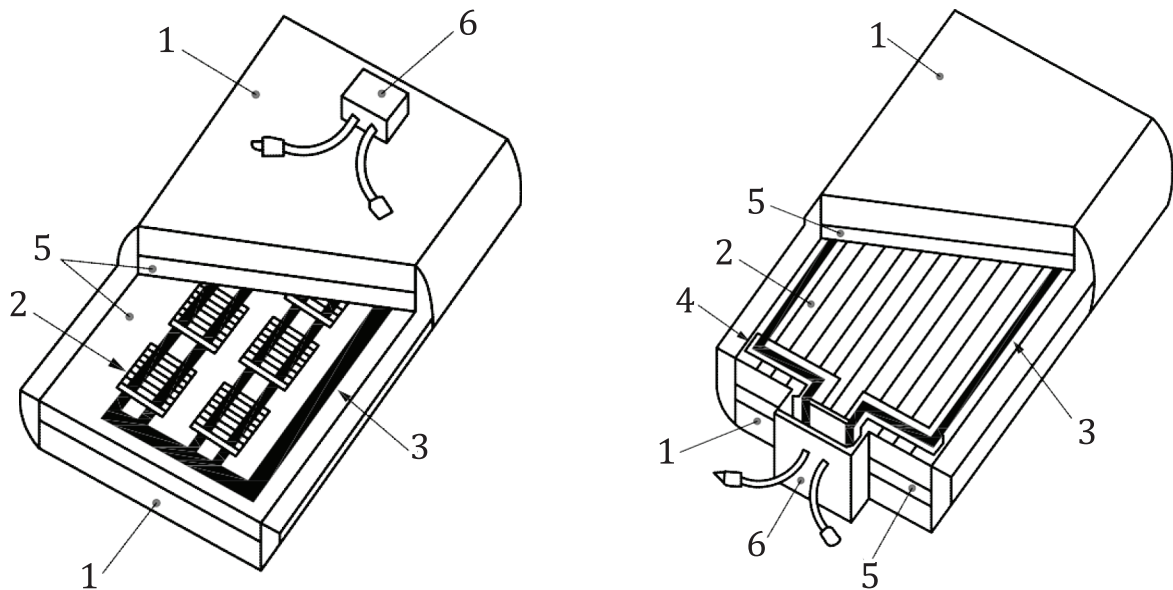
**4 Description of components**

**4.1 General**

Laminated solar PV glass shall be manufactured from the combinations of one or more sheets of glass, solar cell, interlayers, interconnector and termination. [Figure 1](#) shows examples of laminated solar PV glass for use in buildings.

NOTE Drawings are not to scale. The description of components in this clause is not exhaustive. Not all components need to be present.





a) Crystalline silicon type laminated solar PV glass

b) Thin-film type laminated solar PV glass

**Key**

- 1 glass
- 2 solar cell (a: crystalline silicon solar cell, b: thin-film solar)
- 3 interconnector
- 4 insulating strip
- 5 interlayer
- 6 termination

<https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489cef/iso-ts-18178-2018>  
 (standards.iteh.ai)

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

The glass, interlayer and other component 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 as follows (see ISO 16293-1):

- float glass;
- patterned glass.

The glass may also be as follows:

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

The layer of glass that faces the sunlight directly shall be transparent or translucent.

**NOTE** Glass compositions and types are subject to product standards.

### 4.3 Typical types of solar cells

Typical types of solar cells used in laminated glass may be as follows:

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

Typical types of thin-film solar cell include but are not limited to the following:

- 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

Typical types of interlayers are as follows:

- polyvinyl butyral (PVB);
- ethylene vinyl acetate (EVA);
- ionomer;
- silicone;
- liquid resin;
- olefin.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**  
<https://standards.iteh.ai/catalog/standards/sist/41a8a846-e2bf-4ca1-b7dc-7fa636489ce6/iso-ts-18178-2018>

### 4.5 Interconnector

Materials with suitable conductivity of electricity, and suitable weldability or solderability, typical type of interconnector, such as copper and aluminium, should be selected and used.

### 4.6 Insulating strip

Polyethylene terephthalate (PET) and other materials with suitable electrical insulation should 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 given in IEC 61730-1.

### 4.7 Termination

Terminal consists of junction box (see IEC 62790), cable and connector.

## 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	<a href="#">7.2</a>
	Dimensions and edge finishing	—
Durability	High temperature test	<a href="#">7.3</a>
	Damp heat test	<a href="#">7.4</a>
	Radiation test	<a href="#">7.5</a>
	Thermal cycling test	<a href="#">7.6</a>
	Humidity freeze test	<a href="#">7.7</a>
	Measurement of nominal module operating temperature (NMOT)	<a href="#">7.8</a>
	Hot-spot endurance test	<a href="#">7.9</a>
Safety	Impact test	ISO 29584
	Ball drop test	<a href="#">7.10</a>
	Insulation test	<a href="#">7.11</a>
	Wet leakage current test	<a href="#">7.12</a>
	Robustness of terminations test	<a href="#">7.13</a>

For curved or oversized laminated solar PV glass, the appearance, dimensions and technical requirements should be agreed with the manufacturer.

### 5.2 Appearance

#### 5.2.1 Major visual defects

The following are considered to be major visual defects and shall not be permitted:

- broken, cracked or torn external surfaces, including front glass, back glass and terminations;
- bent or misaligned external surfaces, including superstrates, substrates, frames and junction boxes to the extent that the installation and/or operation of the module would be impaired;
- voids in or visible corrosion of visible surfaces, extending over more than 10 % of any cell area;
- visible corrosion of output connections, interconnections and busbars;
- bubbles or delamination forming a continuous path between any part of the electrical circuit and the edge of the pane, or which exhibits significant growth during the testing and will, if testing is continued, reach such a condition;
- haze and cloudiness in the main area;
- creases and streaks introduced into interlayer in the main area;
- evidence of any molten, burned or broken solar cell, diode or active PV component;