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Edition 3.0 2023-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction

Qualification pour la sûreté de fonctionnement des modules photovoltaïques (PV) – Partie 1: Exigences pour la construction



IEC 61730-1:2023-09(en-fr)



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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction

Qualification pour la sûreté de fonctionnement des modules photovoltaïques (PV) – Partie 1: Exigences pour la construction

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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PHOTOVOLTAIC (PV) MODULE SAFETY QUALIFICATION –

Part 1: Requirements for construction

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IEC 61730-1 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

This third edition cancels and replaces the second edition published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Revision of Clauses 2 and 3.
b) Addition of requirements for qualification of specific components according to their standard documents (junction box, connectors, frontsheets/backsheets).
c) Significant changes to the definition and testing of relied upon insulation materials (RUI). These requirements are described in the pre-qualification document for frontsheets and backsheets (IEC 62788-2-1). This includes:
    1) clarifications on the concept and measurement of DTI, and related materials test requirements;

2) frontsheet/backsheet weathering requirements.

d) Removal of all reference to "open rack", with updates according to an intended use for applications according to the application's 98th percentile module operating temperature.

e) Modules meeting Class 0 for use in restricted access areas are not required to pass the breakage test, (MST 32).

f) Marking and documentation subclauses have been revised and aligned with the IEC 61215 series.

g) Electronic copies are now allowed instead of paper copies of required safety documentation.

h) Requirements for bifacial modules:

1) addition of new term, aBSI;

2) relevant tests have been changed to account for higher current of bifacial modules;

3) for bifacial modules, marking that indicates which side is designed as the front side, or if both are designed for prolonged exposure to direct sunlight (> 300 W/m^2);

4) relevant parameters for installing bifacial modules clarified;

5) overprotection rating;

6) documentation has been modified.

i) In 6.2, marking requirements for connectors have been added.

j) Related to the intended use temperature range:

1) Clause 5 and 6.2 have been modified to include temperature ratings, with > 70 °C 98th percentile module operating temperature as the default maximum. Guidance for factors which could impact the module operating temperature for a system design/location are provided, and responsibility for proper installation is placed upon the installer.

2) Changes to insulation coordination sections (6.6, Annex B and Annex C).

3) Subclauses on insulation coordination (6.6.3) and distance through solid insulation (6.6.4) have been updated to clearly state the insulation coordination requirements, and are aligned with Annex B.

4) Annex B has been revised to show the basis for the dimensioning related to insulation coordination and is aligned with 6.6.3 and 6.6.4.

5) Annex C has been created to show specific use cases and describe how changes to materials or use of additional testing can modify the required dimensioning. Diagrams have been updated.

6) A new term, distance through functional insulation (DTFI), has been defined to describe the spacing between fully encapsulated live parts of different potential (the larger of creepage and clearance for the relevant voltage).

7) Testing requirements to verify a clearance value less than the listed value (but not below the creepage distance) are defined.

8) Requirements for junction boxes, cables and connectors, and polymeric frontsheets/backsheets have been removed (these are now covered in their respective standards).

9) In Table 2, functional insulation is required for insulation between live parts of different potential inside a PV module for all module types.

10) In Table 3 and Table 4:

i) lines related to pollution degree 3 have been removed, since this is not applicable to module laminates passing the requirements of IEC 61730-2;

ii) the minimum values for DTI have been increased to include the minimum 0,030 mm thickness (pinhole considerations);

iii) lines related to reinforced insulation have been combined;

iv) lines related to basic insulation have been combined, and functional insulation included on those lines;

v) lines for DTFI have been added.

11) Insulation coordination requirements for Class III modules have been removed from Table 4, and functional insulation requirements are included in text (no DTI thickness requirement).

The text of this International Standard is based on the following documents:

Draft	Report on voting
82/2140/FDIS	82/2165/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

A list of all parts in the IEC 61730 series, under the general title *Photovoltaic (PV) module safety qualification*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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PHOTOVOLTAIC (PV) MODULE SAFETY QUALIFICATION –

Part 1: Requirements for construction

1 Scope

This part of IEC 61730 specifies and describes the fundamental construction requirements for photovoltaic (PV) modules in order to provide safe electrical and mechanical operation. Specific topics are provided to assess the prevention of electrical shock, fire hazards, and personal injury due to mechanical and environmental stresses. This document pertains to the particular requirements of construction. IEC 61730-2 defines the requirements for testing. Modules with modified construction are qualified as described in IEC TS 62915.

This document lays down requirements for terrestrial PV modules suitable for long-term operation in open-air climates with 98th percentile module operating temperatures of 70 °C or less. Guidelines for modules to be used at higher operating temperatures are described in IEC TS 63126. The useful service life of modules so qualified will depend on their design, their environment, and the conditions under which they are operated. Therefore, test results are not construed as a quantitative prediction of module lifetime.

This document is intended to apply to all terrestrial flat plate module materials, such as crystalline silicon module types as well as thin-film modules.

PV modules covered by this document are limited to a maximum DC system voltage of 1 500 V.

This document defines the basic requirements for various applications of PV modules, but it cannot be considered to encompass all national or regional codes. Specific requirements, e.g. for building, floating, marine and vehicle applications, are not covered.

This document does not address specific requirements for products that combine a PV module with power conversion equipment, monitoring or control electronics, such as integrated inverters, converters or output disabling functions, which are addressed in IEC 62109-3.

While it is possible that parts of this document are applicable to flat plate PV modules with internally generated low-level concentration below three times, it was not written specifically to address these concerns.

This document is designed to coordinate with the test sequences in the IEC 61215 series, so that a single set of samples can be used to perform both the safety and design qualification of a PV module.

Additional construction requirements outlined in relevant ISO standards, or the national or local codes which govern the installation and use of these PV modules in their intended locations, can apply in addition to the requirements contained within this document.

Any change to materials, design, or internal spacing are subject to a re-evaluation of the PV module or its component(s), as applicable, according to the IEC 61730 series and IEC TS 62915.

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.

IEC 60216-1, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria*

IEC 60216-5, *Electrical insulating materials – Thermal endurance properties – Part 5: Determination of relative temperature index (RTE) of an insulating material*

IEC 60243-1:2013, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60243-2:2013, *Electric strength of insulating materials – Test methods – Part 2: Additional requirements for tests using direct voltage*

IEC 60269-6, *Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems*

IEC 60364-7-712, *Low voltage electrical installations – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

IEC 60417, *Graphical symbols for use on equipment*, available at https://www.graphical-symbols.info/equipment

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC TS 60904-1-2, *Photovoltaic devices – Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61215 (all parts), *Terrestrial photovoltaic (PV) modules – Design qualification and type approval*

IEC 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

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

IEC 62548, *Photovoltaic (PV) arrays – Design requirements*

IEC 62788-1 (all parts), *Measurement procedures for materials used in photovoltaic modules – Part 1: Encapsulants*

IEC 62788-1-2, *Measurement procedures for materials used in photovoltaic modules – Part 1-2: Encapsulants – Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials*

IEC TS 62788-2, *Measurement procedures for materials used in photovoltaic modules – Part 2: Polymeric materials – Frontsheets and backsheets*

IEC 62788-2-1, *Measurement procedures for materials used in photovoltaic modules – Part 2-1: Polymeric materials – Frontsheets and backsheets – Safety requirements*

IEC 62790:2020, *Junction boxes for photovoltaic modules – Safety requirements and tests*

IEC 62852, *Connectors for DC-application in photovoltaic systems – Safety requirements and tests*

IEC 62930, *Electric cables for photovoltaic systems with a voltage rating of 1,5 kV DC*

IEC TS 63126, *Guidelines for qualifying PV modules, components and materials for operation at high temperatures*

IEC TR 63225, *Incompatibility of connectors for DC-application in photovoltaic systems*

ISO 1456, *Metallic and other inorganic coatings – Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium*

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods*

ISO 2081, *Metallic and other inorganic coatings – Electroplated coatings of zinc with supplementary treatments on iron or steel*

ISO 2093, *Electroplated coatings of tin – Specification and test methods*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*, available at https://www.iso.org/obp

ISO 9224:2012, *Corrosion of metals and alloys – Corrosivity of atmospheres – Guiding values for the corrosivity categories*

EN 50618, *Electric cables for photovoltaic systems*

UL 746B, *Standard for Polymeric Materials – Long Term Property Evaluations*

IEC/IEEE 82079-1, *Preparation of information for use (instructions for use) of products – Part 1: Principles and general requirements*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 60664-1, IEC TS 60904-1-2, IEC 61140, IEC TS 61836, IEC 61215-1and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/

- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 General terms and definitions

3.1.1
functional earthing
earthing for purposes other than electrical safety

[SOURCE: IEC 60050-195:2021, 195-01-13]

3.1.2
internal wiring
wiring and electrical connections that are made within the apparatus by its manufacturer

[SOURCE: IEC 60050-426:2020, 426-11-32]

3.1.3
external wiring
wiring that is not *internal wiring* (3.1.2), including, but not limited to, output cables

3.1.4
laminate
product made by bonding together two or more layers of the same or different materials

Note 1 to entry: It includes all components prior to attaching the junction box, frame or rail, and nameplate.

[SOURCE: IEC 60050-212:2010, 212-15-52, modified – Note 1 to entry has been added]

3.1.5
manufacturer
legal entity that manufactures a product, or that has a product designed or manufactured, and that markets the product under its name or trademark

3.1.6
module quality test
MQT
PV module quality test in accordance with IEC 61215-2

3.1.7
module safety test
MST
PV module safety test in accordance with IEC 61730-2

3.2 Components

3.2.1
backsheet
outer layer or combination of outer layers of the PV module, located as substrate on the back of the PV module and providing protection of the inner components of the PV module from external stresses and weather elements, as well as providing electrical insulation

3.2.2
connector
component which terminates conductors for the purpose of providing connection to and disconnection from a suitable mating component

[SOURCE: IEC 60050-581:2008, 581-06-01]