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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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 61730-1:2016-08(en-fr)

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PHOTOVOLTAIC (PV) MODULE SAFETY QUALIFICATION –

Part 1: Requirements for construction

FOREWORD

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

This second edition cancels and replaces the first edition of IEC 61730-1, issued in 2004, and its amendments 1 (2011) and 2 (2013); it constitutes a technical revision.

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

a) Adaption of horizontal standards and inclusion of IEC 60664 and IEC 61140.
b) Implementation of insulation coordination, overvoltage category, classes, pollution degree (PD), and material groups (MG).
c) Implementation of component qualification.
d) IEC Guide 108 *Guidelines for ensuring the coherency of IEC publications – Application of horizontal standards.*

e) Definition of creepage (cr), clearance (cl) and distance through insulation.

The text of this standard is based on the following documents:

FDIS	Report on voting
82/1128/FDIS	82/1146/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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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 part of IEC 61730 pertains to the particular requirements of construction. IEC 61730-2 defines the requirements for testing.

This International Standard series lays down IEC requirements of terrestrial photovoltaic modules suitable for long-term operation in open-air climates. This standard 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 standard are limited to a maximum DC system voltage of 1 500 V.

This International Standard 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, marine and vehicle applications, are not covered.

This International Standard 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.

While parts of this standard may be applicable to flat plate PV modules with internally generated low level concentration below 3 times, it was not written specifically to address these concerns.

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

The object of this International Standard is to define the requirements for the construction of photovoltaic modules with respect to safety. These requirements are intended to minimize the misapplication and misuse of PV modules or the failure of their components which could result in fire, electric shock and personal injury.

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, should be considered in addition to the requirements contained within this standard.

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.

IEC 60050 (all parts), *International Electrotechnical Vocabulary*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

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 thermal endurance 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, *Electrical installations of buildings – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

IEC 60417-DB, *Graphical symbols for use on equipment*

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

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC TR 60664-2-1, *Insulation coordination for equipment within low-voltage systems – Part 2-1: Application guide – Explanation of the application of the IEC 60664 series, dimensioning examples and dielectric testing*

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

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

IEC 60904-3, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

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 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 61701, *Salt mist corrosion testing of photovoltaic (PV) modules*

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

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

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

IEC 62716, *Photovoltaic (PV) modules – Ammonia corrosion testing*

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

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

IEC TS 62915, *Photovoltaic (PV) Modules – Retesting for type approval, design and safety qualification*[1]

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*

EN 50618, *Electric cables for Photovoltaic systems*

UL 746B, *Polymeric Material – Long Term Property Evaluations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050, IEC 60664-1, IEC 61140, and IEC TS 61836 together with the following, apply.

NOTE Some terms from IEC 60050 were modified to make them more specific and applicable to PV modules.

3.1 General terms and definitions

3.1.1
functional earthing
earthing point or points in a system or in an installation or in equipment, for purposes other than electrical safety

[SOURCE: IEC 60050-195:1998, 195-01-13]

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

[SOURCE: IEC 60050-426:2008, 426-11-32]

3.1.3
laminate
product made by bonding together two or more layers of the same or different materials. This includes all components prior to attaching the junction box, frame or rail, and name plate

[SOURCE: IEC 60050-212:2010, 212-15-52, modified: Second sentence added]

3.1.4
manufacturer
any legal entity manufacturing a product or has a product designed or manufactured, and markets that product under its name or trademark

3.1.5
module quality test
MQT
PV module quality test in accordance with IEC 61215-2

3.1.6
module safety test
MST
PV module safety test in accordance with IEC 61730-2

3.1.7
polymeric material
natural or synthetic material primarily composed of chained molecules of monomers, combinations of monomers, combined polymers, crosslinking agents, inorganic fillers, colorants, and other materials

3.1.8
tool
screwdriver, coin, key, or any other object that is used to operate a screw, latch, or similar fastening means

3.1.9
wiring <external>
wiring that is not internal wiring, including, but not limited to, output cables

3.1.10
thin layer
cohesive material of uniform thickness which is small in proportion to length and width

3.2 Components

3.2.1
backsheet
(combination of) outer layer(s) of the PV module, located on the back of PV module and providing protection of the inner components of the PV module from external stresses and weather elements, as well as 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]

3.2.3
encapsulant
intermediate layer(s) of the PV module, located between the frontsheet and the backsheet that enclose the live parts of the PV module

3.2.4
enclosure
part of an assembly providing a specified degree of protection of equipment against external influences and a specified degree of protection against approach to or contact with live parts

[SOURCE: IEC 60050-441:1984, 441-13-01, modified: “moving parts” deleted]

3.2.5
frontsheet

(combination of) outer layer(s) of the PV module, located on the front of PV module and providing protection of the inner components of the PV module from external stresses and weather elements, as well as electrical insulation

3.2.6
insulation barrier
raised or recessed configuration of an insulator to increase creepage distance between conducting surfaces

[SOURCE: IEC 60050-581:2008, 581-22-15]

3.2.7
junction box
electrical enclosure in which electrical wiring connections are made

3.2.8
potting
sealing of components and associated conductors with a compound to exclude contaminants

[SOURCE: IEC 60050-581:2008, 581-24-20]

3.2.9
terminal
conductive part of a device, electric circuit or electric network, provided for connecting that device, electric circuit or electric network to one or more external conductors

Note 1 to entry: The term "terminal" is also used for a connection point in circuit theory. [IEC 60050-151:2001, 151-12-12]

Note 2 to entry: Terminals can contain one or several contacts and the term therefore includes sockets, connectors, etc.

3.3 Installation and application

3.3.1
building attached PV
BAPV
photovoltaic modules are considered to be building attached if the PV modules are mounted on a building envelope and do not fulfil the criteria for building integrated PV

3.3.2
building integrated PV
BIPV
photovoltaic modules are considered to be building integrated if the PV modules form a building component providing additional functions as defined in 4.5 b)

3.3.3
installation <fixed>
permanent wiring system such as a raceway or conduit that prevents or reduces wire and cable movement

3.3.4
installation <non-fixed>
unconstrained wiring system that consists of cables or wires able to move freely

3.3.5
non-restricted access area
area where general access by persons who are not skilled, trained or instructed in electrical safety is anticipated

Note 1 to entry: Examples for non-restricted access areas are PV installations which are not protected against public access by any means.

3.3.6
restricted access area
area marked as restricted for access by unauthorized persons as per IEC 60050-826:2004, 826-18-04

Note 1 to entry: Examples for restricted access areas are utility scale PV installations which are protected against public access by fences, location, etc., and where only persons skilled, trained or instructed in electrical safety have access.

3.4 Insulation system

3.4.1
accessible part
part which can be touched by means of a standard test finger

[SOURCE: IEC 60050-442:1998, 442-01-15]

3.4.2
cemented joint
joint comprised of two insulating materials where the interface has been demonstrated to be cemented, and thus be considered as solid insulation with no interface for creepage

3.4.3
comparative tracking index
CTI
numerical index value related to the maximum voltage which a material can withstand without a permanent electrically conductive carbon path tracking when evaluated under specified test conditions defined in IEC 60112

Note 1 to entry: The mentioned maximum test voltage is not in conjunction with any system or operational voltage, but it is used for evaluation of material groups.

[SOURCE: IEC 60050-212:2010, 212-11-59, modified: clarified that CTI is an index value to evaluate material groups]

3.4.4
clearance
shortest distance through air between two conductive parts, or between a conductive part and an accessible surface. (used abbreviation in this standard: “cl”)

[SOURCE: IEC 60050-581:2008, 581-27-76, modified: added information after “comma” and abbreviation]

3.4.5
creepage distance
shortest distance along the surface of a solid insulating material between two conductive live parts or between conductive live parts and accessible parts. (used abbreviation in this standard: “cr”)

[SOURCE: IEC 60050-581:2008, 581-21-23, modified: added information after “or” and abbreviation]

3.4.6
insulation <electrical>
part of an electrotechnical product which separates conducting parts at different electric potentials during operation or insulates such parts from the surroundings

[SOURCE: IEC 60050-212:2010, 212-11-07]

3.4.7
live part
conductor or conductive part intended to be energized in normal operation

[SOURCE: IEC 60050-195:1998, 195-02-19, modified: second part of definition deleted because not applicable to DC]

3.4.8 Insulation concepts

3.4.8.1
basic insulation
insulation of hazardous live parts which provides basic protection against electric shock

Note 1 to entry: The concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-826:2004, 826-12-14, modified: added: “against electric shock”]

3.4.8.2
double insulation
insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-826:2004, 826-12-16]