

INTERNATIONAL STANDARD



**Photovoltaic (PV) module safety qualification –
Part 2: Requirements for testing**

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC (PV) MODULE SAFETY QUALIFICATION –

Part 2: Requirements for testing

FOREWORD

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International Standard IEC 61730-2 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

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

- a) Rearrange test sequences.
- b) MST 01: Visual inspection: added nameplate requirement and modified pass criteria.
- c) Added sharp edge test MST 06.
- d) Added insulation thickness test MST 04.
- e) MST 11: Accessibility test: defined force for test finger.
- f) MST 12: Cut susceptibility test: defined blade radius for cut test.
- g) MST 14: removed preconditioning requirement TC200 from Figure 1.
- h) MST 15: Partial discharge test removed.
- i) Renamed dielectric breakdown test MST 16 to insulation test.
- j) MST 21: Temperature test: rewritten test procedure: removed short circuit mode; allow alternative indoor test method.
- k) MST 23: Fire test: subclause rewritten; fire test requirements related to national building codes; moved optional test description to informative annex.
- l) Added ignitability test MST 24.
- m) MST 26: Reverse current overload test: changed specification of wooden board.
- n) MST 32: Module breakage test: defined new dimensions of impactor to allow other filling compounds; consider variety of mounting techniques for glass breakage test; reduced impact height to only 300 mm; corrected diameter of opening according to referenced standard (65 cm² instead of 6,5 cm²).
- o) Added screw connection test MST 33
- p) Added peel test MST 35 for proof of cemented joints.
- q) Added lap shear strength test MST 36 for proof of cemented joints.
- r) Added materials creep test MST 37.
- s) Added PV module test sequence with moisture and UV to stress polymers to Figure 1. The new UV sequence was added as a response to the Kyoto meeting, where it was decided to add a coupon test and a PV module test sequence. As it is not possible to perform the ISO UV test on PV modules (no affordable equipment available) it was decided to rely on already available PV module test equipment. R&D work has shown that cycling UV and HF are best to age polymers in PV modules.
- t) Added new sequence for Pollution Degree (PD) testing (sequence B1).
- u) Added annex: Recommendations for testing of PV modules from production.

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

FDIS	Report on voting
82/1129/FDIS	82/1147/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.

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WITHDRAWN

PHOTOVOLTAIC (PV) MODULE SAFETY QUALIFICATION –

Part 2: Requirements for testing

1 Scope and object

~~This part of IEC 61730 describes the testing requirements for photovoltaic (PV) modules in order to provide safe electrical and mechanical operation during their expected lifetime. Specific topics are provided to assess the prevention of electrical shock, fire hazards, and personal injury due to mechanical and environmental stresses. IEC 61730-1 pertains to the particular requirements of construction. This part of IEC 61730 outlines the requirements of testing.~~

~~This standard attempts to define the basic requirements for various application classes of photovoltaic modules, but it cannot be considered to encompass all national or regional building codes. The specific requirements for marine and vehicle applications are not covered. This standard is not applicable to modules with integrated AC inverters (AC modules).~~

~~This standard is designed so that its test sequence can coordinate with those of IEC 61215 or IEC 61646, so that a single set of samples may be used to perform both the safety and performance evaluation of a photovoltaic module design.~~

~~The test sequences of this standard are arranged in an optimal way so that tests of IEC 61215 or IEC 61646 can be used as basic preconditioning tests.~~

The scope of IEC 61730-1 is also applicable to this part of IEC 61730. While IEC 61730-1 outlines the requirements of construction, this part of the standard lists the tests a PV module is required to fulfill for safety qualification. IEC 61730-2 is applied for safety qualification only in conjunction with IEC 61730-1.

NOTE 4 The sequence of tests required in this standard may not test for all possible safety aspects associated with the use of PV modules in all possible applications. This standard utilizes the best sequence of tests available at the time of its writing. There are some issues – such as the potential danger of electric shock posed by a broken PV module in a high voltage system – that should be addressed by the systems design, location, restrictions on access and maintenance procedures.

The objective of this standard is to provide the testing sequence intended to verify the safety of PV modules whose construction has been assessed by IEC 61730-1. The test sequence and pass criteria are designed to detect the potential breakdown of internal and external components of PV modules that would result in fire, electric shock, and/or personal injury. The standard defines the basic safety test requirements and additional tests that are a function of the PV module end-use applications. Test categories include general inspection, electrical shock hazard, fire hazard, mechanical stress, and environmental stress.

NOTE 2 The additional testing 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 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

~~IEC 60068-1, *Environmental testing – Part 1: General and guidance*~~

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

~~IEC 60410, *Sampling plans and procedures for inspection by attributes*~~

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-3-5, *Environmental testing – Part 3-5: Supporting documentation and guidance; Confirmation of the performance of temperature chambers*

IEC 60598-1:2014, *Luminaires – Part 1: General requirements and tests*

IEC 60664-1:1992 2007, *Insulation co-ordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

~~Amendment 2 (2002)~~

IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60904-2, *Photovoltaic devices – Part 2: Requirements for photovoltaic reference solar cells devices*

~~IEC 60904-6, *Photovoltaic devices – Part 6: Requirements for reference solar modules*~~

IEC 60904-9, *Photovoltaic devices – Part 9: Solar simulator performance requirements*

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

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use – 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 61215:2004 (all parts), ~~Crystalline silicon~~ *Terrestrial photovoltaic (PV) modules – Design qualification and type approval*

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

~~IEC 61646:1996, *Thin-film Terrestrial photovoltaic (PV) modules – Design qualification and type approval*~~

IEC 61730-1:2004 2016, *Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction*

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

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 813, *Rubber, vulcanized or thermoplastic – Determination of adhesion to a rigid substrate – 90 degree peel method*

ISO 4046-4, *Paper, board, pulps and related terms – Vocabulary – Part 4: Paper and board grades and converted products*

ISO 4587:2003, *Adhesives – Determination of tensile lap-shear strength of rigid-to-rigid bonded assemblies*

ISO 5893, *Rubber and plastics test equipment – Tensile, flexural and compression types (constant rate of traverse) – Specification*

ISO 8124-1, *Safety of toys – Part 1: Safety aspects related to mechanical and physical properties*

ISO 11925-2:2010, *Reaction to fire tests – Ignitability of products subjected to direct impingement of flame – Part 2: Single-flame source test*

ISO 23529, *Rubber – General procedures for preparing and conditioning test pieces for physical test methods*

~~ANSI/UL 514C, *Non-metallic outlet boxes, flush device boxes and covers*~~

~~ANSI/UL 790, *Tests for Fire Resistance of Roof Covering Materials*~~

~~ANSI/UL 1703, *Flat-plate Photovoltaic Modules and Panels*~~

~~ANSI Z97.1:2009, *American National Standard – Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test*~~

~~ANSI/UL 1703:2015, *Flat-plate photovoltaic modules and panels*~~

~~3 Application classes~~

~~3.1 General~~

~~Photovoltaic modules may be installed in many different applications. Therefore, it is important to evaluate the potential hazards associated with those applications and to evaluate the construction of the module accordingly.~~

~~Relevant safety requirements and necessary tests shall be performed to verify the conformance to the requirements of that application class. This clause defines those application classes and construction qualities required for each class.~~

~~Application classes for PV modules are defined as follows:~~

~~3.2 Class A: General access, hazardous voltage, hazardous power applications~~

~~Modules rated for use in this application class may be used in systems operating at greater than 50 V DC or 240 W, where general contact access is anticipated. Modules qualified for safety through IEC 61730-1 and this part of IEC 61730 within this application class are considered to meet the requirements for safety class II.~~

~~3.3 Class B: Restricted access, hazardous voltage, hazardous power applications~~

~~Modules rated for use in this application class are restricted to systems protected from public access by fences, location, etc. Modules evaluated within this application class provide protection by basic insulation, are considered to meet the requirements for safety class 0.~~

~~3.4 Class C: Limited voltage, limited power applications~~

~~Modules rated for use in this application class are restricted to systems operating at less than 50 V DC and 240 W, where general contact access is anticipated. Modules qualified for safety through IEC 61730-1 and this part of IEC 61730 within this application class are considered to meet the requirements for safety class III.~~

~~NOTE Safety classes are defined within IEC 61140.~~

3 Terms and definitions

The Clause of Part 1 applies.

4 Test categories

4.1 General

The hazards described in the following subclause might influence ~~the lifetime and~~ the safety of PV modules. In accordance with these hazards, test procedures and criteria are described. The specific tests to which a PV module will be subjected will depend on the end-use application for which the minimum tests are specified in Clause 5.

NOTE PV module safety tests are labelled MST.

Tables 1 to 5 show the origin of the required tests. For some tests the third column lists the origin of the tests for information ~~only~~; the appropriate test requirements are given in 10.1 through 10.32. ~~The rest of the other tests are based on or are identical to the module qualification tests MQT defined in the IEC 61215 series/IEC 61646.~~ References to the relevant ~~Clauses tests~~ are given in the last ~~two~~ columns. Some of the IEC 61215/~~IEC 61646~~-based tests were modified for IEC 61730-2 and are included in 10.1 through 10.32.

4.2 ~~Preconditioning~~ Environmental stress tests

Table 1 – ~~Preconditioning~~ Environmental stress tests

Test	Title	Referenced standards	According to Based on	
			IEC 61215-2	IEC 61646
MST 51	Thermal cycling (TC50 or TC200)	-	40.11 MQT 11	40.11
MST 52	Humidity freeze (HF10)	-	40.12 MQT 12	40.12
MST 53	Damp heat (DH1000)	-	40.13 MQT 13	40.13
MST 54	UV preconditioning test	-	40.10 MQT 10	40.10
MST 55	Cold conditioning	IEC 60068-2-1	-	-
MST 56	Dry hot conditioning	IEC 60068-2-2	-	-