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colour inside

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PHOTOVOLTAIC (PV) MODULE SAFETY QUALIFICATION –

Part 2: Requirements for testing

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61730-2:2016. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61730-2 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) MST 06: Sharp edge test revised.

b) MST 14: Impulse voltage test contains technical corrections to Figure 6.

c) MST 21: Temperature test has been removed from this standard because modules tested individually in unrestricted mounting systems in open-air climates below 40 °C operate at or below a 98th-percentile operating temperature of 70 °C. As a result, the existing IEC 61730-1 requirement for a minimum RTI/RTE/TI of 90 °C is adequate. To address modules operating at higher temperatures, IEC TS 63126 includes an informative annex to describe tests and analysis techniques suitable for estimating the 98th-percentile operating temperature. This covers system effects such as mounting methods that restrict airflow and result in a 98th-percentile module operating temperature in excess of 70 °C.

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i) All MQT references updated to revised IEC 61215 series Ed.2.0 2021.

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k) Term “Very large module” defined and Annex C (normative) “Usage of representative samples for very large modules” added.

l) MST 37: Materials creep test revised.

m) MST 56: Dry heat conditioning test revised.

n) MST 53: Damp heat test (1 000 h) revised.

o) Robustness of terminations test added in Sequence D for junction boxes qualified with a cemented joint.

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

Draft	Report on voting
82/2122/FDIS	82/2166/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.

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/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

The content of the corrigendum 1 (2024-10) has been included in this copy.

PHOTOVOLTAIC (PV) MODULE SAFETY QUALIFICATION –

Part 2: Requirements for testing

1 Scope

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 document lists the tests a PV module is required to fulfill for safety qualification. This document applies for safety qualification only in conjunction with IEC 61730-1.

The sequence of tests required in this document may not test for all possible safety aspects associated with the use of PV modules in all possible applications. This document 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 system design, location, restrictions on access and maintenance procedures.~~

The objective of this document 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. This document 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.

The additional testing requirements outlined in relevant ISO documents, or the national or local codes which govern the installation and use of these PV modules in their intended locations, ~~should be~~ are considered in addition to the requirements contained within 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.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *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~~2020, *Luminaires – Part 1: General requirements and tests*

IEC 60664-1:~~2007~~2020, *Insulation co-ordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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 devices*~~

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

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*
IEC 60950-1:2005/AMD1:2009
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IEC 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*

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

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IEC 61730-1:~~2016~~2023, *Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction*

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

IEC 62788-2-1:2023, *Measurement procedures for materials used in photovoltaic modules – Part 2-1: Polymeric materials – Frontsheet and backsheet – Safety requirements*

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

IEC TS 62915, *Photovoltaic (PV) modules – Type approval, design and safety qualification – Retesting*

~~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~~2020, *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*

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IEC 61730-2

Edition 3.0 2023-09

INTERNATIONAL STANDARD

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

Qualification pour la sûreté de fonctionnement des modules photovoltaïques (PV) – Partie 2: Exigences pour les essais

IEC 61730-2:2023-09(en-fr)

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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QUALIFICATION POUR LA SÛRETÉ DE FONCTIONNEMENT DES MODULES PHOTOVOLTAÏQUES (PV) –

Partie 2: Exigences pour les essais

AVANT-PROPOS

1) La Commission Électrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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L'IEC 61730-2 a été établie par le comité d'études 82 de l'IEC: Systèmes de conversion photovoltaïque de l'énergie solaire. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition de l'IEC 61730-2 parue en 2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) MST 06: Révision de l'essai des angles vifs;
b) MST 14: L'essai de tension de choc comprend des corrections techniques de la Figure 6;

c) MST 21: L'essai en température a été retiré de la présente norme, car les modules individuellement soumis à l'essai dans les systèmes à montage non limité dans les climats de plein air inférieurs à 40 °C fonctionnent à la température de fonctionnement au 98^{e} centile de 70 °C ou au-dessous de celle-ci. Par conséquent, les exigences minimales d'IRT/de RTE/d'IT de 90 °C de l'IEC 61730-1 sont adéquates. Afin de couvrir les modules qui fonctionnent à des températures plus élevées, l'IEC TS 63126 comprend une annexe informative qui décrit les essais et les techniques d'analyse adaptés pour estimer la température de fonctionnement au 98^{e} centile. Ceci couvre les effets de système tels que les méthodes de montage qui limitent le flux d'air et entraînent une température de fonctionnement au 98^{e} centile du module supérieure à 70 °C;

d) MST 24: Révision de l'essai d'allumabilité;

e) MST 26: Révision de l'essai de surcharge de courant inverse;

f) MST 32: L'essai de détérioration du module n'est plus exigé pour les modules de classe 0;

g) MST 54: Au lieu d'un essai séquentiel avec un module unique, à présent un module pour la séquence B doit recevoir les rayonnements sur sa face avant et un autre module sur sa face arrière pendant le cycle à 60 kWh/m^{2};

h) MST 57: Ajout de l'évaluation de la coordination de l'isolement;

i) actualisation de toutes les références MQT afin de s'aligner sur la série révisée IEC 61215 Éd.2.0:2021;

j) modules bifaces: Actualisation des exigences pour: MST 02 Performances dans les conditions normales d'essai, MST 07 Essai fonctionnel de la diode de dérivation, MST 22 Essai de tenue à l'échauffement localisé, MST 25 Essai thermique de la diode de dérivation et MST 51 Cycle thermique (TC200);

k) définition du terme "module photovoltaïque de grande surface" et ajout de l'Annexe C (normative) "Utilisation d'échantillons représentatifs pour les modules photovoltaïques de grande surface".

l) MST 37: Essai de fluage des matériaux révisé.

m) MST 56: Essai de conditionnement à chaleur sèche révisé.

n) MST 53: Essai de chaleur humide (1 000 h) révisé.

o) Essai de robustesse des sorties ajouté à la séquence D pour les boîtes de jonction qualifiées avec un joint collé.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
82/2122/FDIS	82/2166/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 61730, publiées sous le titre général *Qualification pour la sûreté de fonctionnement des modules photovoltaïques (PV)*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherchée. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de ce document indique qu'il contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer ce document en utilisant une imprimante couleur.

Le contenu du corrigendum 1 (2024-10) a été pris en considération dans cet exemplaire.

QUALIFICATION POUR LA SÛRETÉ DE FONCTIONNEMENT DES MODULES PHOTOVOLTAÏQUES (PV) –

Partie 2: Exigences pour les essais

1 Domaine d'application

Le domaine d'application de l'IEC 61730-1 s'applique également à la présente partie de l'IEC 61730. Alors que l'IEC 61730-1 définit les exigences de construction, le présent document répertorie les essais auxquels un module PV doit satisfaire à des fins de qualification pour la sûreté de fonctionnement. Le présent document n'est appliqué à des fins de qualification pour la sûreté de fonctionnement que conjointement à l'IEC 61730-1.

La séquence d'essais exigée dans le présent document peut ne pas soumettre à l'essai tous les aspects de sécurité potentiels associés à l'utilisation des modules PV dans toutes les applications possibles. Le présent document utilise la meilleure séquence d'essais disponible au moment de sa rédaction.

L'objectif du présent document est de fournir la séquence d'essais destinée à vérifier la sûreté des modules PV dont la construction a été évaluée par l'IEC 61730-1. La séquence d'essais et les critères d'acceptation sont conçus pour détecter le claquage éventuel de composants internes et externes des modules PV, qui peut entraîner des incendies, des chocs électriques et/ou des dommages corporels. Le présent document définit les exigences de base relatives aux essais de sécurité, ainsi que des essais supplémentaires qui dépendent des applications finales du module PV. Les catégories d'essai incluent un contrôle général, les dangers de chocs électriques, le risque de feu, les contraintes mécaniques et les contraintes environnementales.

Outre les exigences contenues dans le présent document, les exigences d'essai supplémentaires suivantes sont prises en considération: exigences indiquées dans les documents ISO appropriés ou exigences spécifiées dans les codes nationaux ou locaux qui régissent l'installation et l'utilisation de ces modules PV dans leurs emplacements destinés.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60060-1, *Technique des essais à haute tension – Partie 1: Définitions et exigences générales*

IEC 60068-2-1:2007, *Essais d'environnement – Partie 2-1: Essais – Essai A: Froid*

IEC 60068-2-2:2007, *Essais d'environnement – Partie 2-2: Essais – Essai B: Chaleur sèche*

IEC 60068-3-5, *Essais d'environnement – Partie 3-5: Documentation d'accompagnement et guide – Confirmation des performances des chambres d'essai en température*

IEC 60598-1:2020, *Luminaires – Partie 1: Exigences générales et essais*

IEC 60664-1:2020, *Coordination de l'isolement des matériels dans les réseaux d'énergie à basse tension – Partie 1: Principes, exigences et essais*

IEC 60695-2-10, *Essais relatifs aux risques du feu – Partie 2-10: Essais au fil incandescent/chauffant – Appareillage et méthode commune d'essai*

IEC 60950-1:2005, *Matériel de traitement de l'information – Sécurité – Partie 1: Exigences générales*
IEC 60950-1:2005/AMD1:2009
IEC 60950-1:2005/AMD2:2013

IEC 61010-1, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 1: Exigences générales*

IEC 61032:1997*, Protection des personnes et des matériels par les enveloppes – Calibres d'essai pour la vérification*

IEC 61140, *Protection contre les chocs électriques – Aspects communs aux installations et aux matériels*

IEC 61215 (toutes les parties), *Modules photovoltaïques (PV) pour applications terrestres – Qualification de la conception et homologation*

IEC 61215-2, *Modules photovoltaïques (PV) pour applications terrestres – Qualification de la conception et homologation – Partie 2: Procédures d'essai*

IEC 61730-1:2023, *Qualification pour la sûreté de fonctionnement des modules photovoltaïques (PV) – Partie 1: Exigences pour la construction*

IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols* (disponible en anglais seulement)

IEC 62788-2-1:2023, *Measurement procedures for materials used in photovoltaic modules – Part 2-1: Polymeric materials – Frontsheet and backsheet – Safety requirement* (disponible en anglais seulement)

IEC 62790:2020, *Boîtes de jonction pour modules photovoltaïques – Exigences de sécurité et essais*

IEC TS 62915, *Photovoltaic (PV) modules – Type approval, design and safety qualification – Retesting* (disponible en anglais seulement)

ISO 813, *Caoutchouc vulcanisé ou thermoplastique – Détermination de l'adhérence à un substrat rigide – Méthode par pelage à angle droit*

ISO 4587:2003, *Adhésifs – Détermination de la résistance au cisaillement d'assemblages collés rigide sur rigide à recouvrement simple*

ISO 5893, *Appareils d'essai du caoutchouc et des plastiques – Types pour traction, flexion et compression (vitesse de translation constante) – Spécifications*

ISO 11925-2:2020, *Essais de réaction au feu – Allumabilité de produits soumis à l'incidence directe de la flamme – Partie 2: Essai à l'aide d'une source à flamme unique*

ISO 23529, *Caoutchouc – Procédures générales pour la préparation et le conditionnement des éprouvettes pour les méthodes d'essais physiques*

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

ANSI Z 97.1:2009, *Standard – Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test*