

AS/NZS 61730.2:2024



Australian/New Zealand Standard™

Photovoltaic (PV) module safety qualification

Part 2: Requirements for testing (IEC 61730-2:2023 (ED. 3.0), MOD)



AS/NZS 61730.2:2024

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The following are represented on Committee EL-042:

Australasian Fire and Emergency Service Authorities Council
Australian Energy Council
Australian Energy Market Operator
Australian Industry Group
Australian PV Institute
Better Regulation Division (Fair Trading, SafeWork NSW, TestSafe)
Clean Energy Council
Clean Energy Regulator
Communications, Electrical and Plumbing Union — Electrical Division
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**Part 2: Requirements for testing (IEC
61730-2:2023 (ED. 3.0), MOD)**

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-042, Renewable Energy Power Supply Systems and Equipment.

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 AS/NZS 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.

This document is identical with national modifications, and has been reproduced from IEC 61730-2:2023, *Photovoltaic (PV) module safety qualification — Part 2: Requirements for testing*.

The modifications are additional requirements and are set out in [Appendix ZZ](#), which has been added at the end of the source text.

[Appendix ZZ](#) lists the modifications to IEC 61730-2:2023 for the application of this document in Australia and New Zealand.

As this document has been reproduced from an International document, a full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

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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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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 4](#).

- 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.
- d) MST 24: Ignitability test revised.
- e) MST 26: Reverse current overload test revised.
- f) MST 32: Module breakage test is no longer required for Class 0 modules.
- g) MST 54: Instead of sequential test with one module now one module for sequence B shall be irradiated from the front side and another module from the backside during the 60 kWh/m² cycle.
- h) MST 57: Evaluation of insulation coordination added.
- i) All MQT references updated to revised IEC 61215 series Ed.2.0 2021.
- j) Bifacial modules: Requirements updated for MST 02 Performance at STC, MST 07 Bypass diode functionality test, MST 22 Hot-spot endurance test, MST 25 Bypass diode thermal test and MST 51 Thermal cycling (TC200).
- k) Term “Very large module” defined and [Annex C](#) (normative) “Usage of representative samples for very large modules” added.

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

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

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NOTES

Australian/New Zealand Standard

Photovoltaic (PV) module safety qualification

Part 2: Requirements for testing (IEC 61730-2:2023 (ED. 3.0), MOD)

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.

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, 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 60598-1:2020, *Luminaires – Part 1: General requirements and tests*

IEC 60664-1:2020, *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 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 60950-1:2005/AMD1:2009

IEC 60950-1:2005/AMD2:2013

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 (all parts), *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 61730-1:2023, *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 813, *Rubber, vulcanized or thermoplastic – Determination of adhesion to a rigid substrate – 90 degree peel method*

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 11925-2:2020, *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*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 61730-1 and IEC TS 61836, as well as 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 representative sample

sample that includes all the components of the module, except some repeated parts

3.2 very large module

module that exceeds 2,2 m in any dimension or exceeds 1,5 m in both dimensions

EXAMPLE a 2,3 m × 0,3 m module is considered very large, as is a 1,6 m × 1,6 m module.

4 Test categories

4.1 General

The hazards described in the following subclause might influence 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.

[Table 1](#) through [Table 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 [10.34](#). The other tests are based on or are identical to the MQT tests defined in the IEC 61215 series. References to the relevant tests are given in the last column. Some of the IEC 61215-based tests were modified for IEC 61730-2 and are included in [10.1](#) through [10.34](#).

4.2 Environmental stress tests

Table 1 — Environmental stress tests

Test	Title	Referenced standards	Based on
			IEC 61215-2
MST 51	Thermal cycling (TC50 or TC200)	-	MQT 11
MST 52	Humidity freeze (HF10)	-	MQT 12
MST 53	Damp heat (DH200 or DH1000)	-	MQT 13
MST 54	UV preconditioning	-	MQT 10
MST 55	Cold conditioning	IEC 60068-2-1	-
MST 56	Dry heat conditioning	IEC 60068-2-2	-

4.3 General inspection tests

Table 2 — General inspection tests

Test	Title	Referenced standards	Based on
			IEC 61215-2
MST 01	Visual inspection	-	MQT 01
MST 02	Performance at STC	-	MQT 6.1
MST 03	Maximum power determination	-	MQT 02
MST 04	Insulation thickness	-	-
MST 05	Durability of markings	IEC 60950-1	-
MST 06	Sharp edge test	-	-
MST 07	Bypass diode functionality test	-	-
MST 57	Evaluation of insulation coordination	IEC 60664-1	-

4.4 Electrical shock hazard tests

These tests are designed to assess the risk to persons due to shock or injury from contact with parts of a PV module that are electrically energised as a result of design, construction, or faults caused by environment or operation.

Table 3 — Electrical shock hazard tests

Test	Title	Referenced standards	Based on
			IEC 61215-2
MST 11	Accessibility test	IEC 61032	-
MST 12	Cut susceptibility test	ANSI/UL 1703:2015	-
MST 13	Continuity test for equipotential bonding	ANSI/UL 1703:2015	-
MST 14	Impulse voltage test	IEC 60060-1	-
MST 16	Insulation test	-	MQT 03
MST 17	Wet leakage current test	-	MQT 15
MST 42	Robustness of terminations test	IEC 62790	MQT 14
MST 57	Evaluation of insulation coordination	IEC 60664-1	-

4.5 Fire hazard tests

These tests assess the potential fire hazard due to the operation of a PV module or failure of its components.

Table 4 — Fire hazard tests

Test	Title	Referenced standards	Based on
			IEC 61215-2
MST 22	Hot-spot endurance test	-	MQT 09
MST 23 ^a	Fire test	-	National/Local code
MST 24	Ignitability test	ISO 11925-2:2020	-
MST 25	Bypass diode thermal test	-	MQT 18
MST 26	Reverse current overload test	-	-
^a Fire tests are locally regulated and typically only required for building integrated or building added products, typically to verify their ability to resist fire from external sources.			

4.6 Mechanical stress tests

These tests are to minimise potential injury due to mechanical failure.

Table 5 — Mechanical stress tests

Test	Title	Referenced standards	Based on
			IEC 61215-2
MST 32	Module breakage test	ANSI Z97.1	-
MST 33	Screw connection test	IEC 60598-1	-
MST 34	Static mechanical load test	-	MQT 16
MST 35	Peel test	ISO 5893	-
MST 36	Lap shear strength test	ISO 4587:2003	-
MST 37	Materials creep test	-	-
MST 42	Robustness of terminations test		MQT 14

Recommendations for testing of PV modules from production are given in [Annex A](#).

5 Classes and their necessary test procedures

The specific tests to which a PV module will be subjected, depending on the Class defined in IEC 61730-1 referring to IEC 61140, are described in [Table 6](#). The order in which the tests are carried out shall be in accordance with [Figure 1](#). Some tests shall be carried out as preconditioning tests.

Table 6 — Required tests, depending on the Class

Class according to IEC 61140			Tests
II	0	III	
X	X	X	Environmental stress tests: MST 51 Thermal cycling (T50 or T200) MST 52 Humidity freeze (HF10) MST 53 Damp heat (DH200 or DH1 000) MST 54 UV pre-conditioning (15 kWh/m ² or 60 kWh/m ²) MST 55 Cold conditioning MST 56 Dry heat conditioning
X	X	X	
X	X	X	
X	X	X	
X ^a	X ^a	X ^a	
X ^a	X ^a	X ^a	
X	X	X	General inspection test: MST 01 Visual Inspection MST 02 Performance at STC MST 03 Maximum power determination MST 04 Insulation thickness MST 05 Durability of markings MST 06 Sharp edge test MST 07 Evaluation of insulation coordination
X	X	X	
X	X	X	
X ^c	X ^c	-	
X	X	X	
X	X	X	
X	X	X	
X	X	X	Electrical shock hazard tests: MST 11 Accessibility test MST 12 Cut susceptibility test MST 13 Continuity test for equipotential bonding MST 14 Impulse voltage test MST 16 Insulation test MST 17 Wet leakage current test MST 42 Robustness of terminations test MST 57 Evaluation of insulation coordination
X	X	-	
X ^c	X ^c	-	
X	X	-	
X	X	-	
X	X	X	
X	X	-	
X	X	X	
X	X	X	Fire hazard tests: MST 22 Hot-spot endurance test MST 23 Fire test MST 24 Ignitability test MST 25 Bypass diode thermal test MST 26 Reverse current overload test
X	X	X	
X ^b	X ^b	X ^b	
X	X	X	
X	X	X	
X	X	-	
X	-	X	Mechanical stress tests: MST 32 Module breakage test MST 33 Screw connection test MST 34 Static mechanical load test MST 35 Peel test MST 36 Lap shear strength test MST 37 Materials creep test
X	X	X	
X	X	X	
X ^{c, e}	X ^{c, e}	X ^{c, e}	
X ^{d, e}	X ^{d, e}	X ^{d, e}	
X	X	X	
X	X	X	

Table 6 (continued)

Class according to IEC 61140			Tests
II	0	III	
X Test required.			
- Test does not need to be carried out.			
a Only required to prove reduction of Pollution Degree PD=2 to PD=1.			
b Fire tests are nationally regulated and typically only required for building integrated or building added products. Hence, the applicability of a fire test does not depend on the Class, but on the mounting location.			
c This test is not applicable to rigid-to-rigid bonded assemblies (e.g. glass/glass PV modules).			
d This test is not applicable to rigid-to-flexible or flexible-to-flexible bonded assemblies.			
e Only required for proof of cemented joints around the PV module edges.			

6 Sampling

A minimum of 10 PV modules and two unframed PV modules are used for safety testing (plus spares as desired). In order to prove reduction of Pollution Degree to PD 1, one additional PV module is required. If tests of Sequence F are performed in parallel, between one and three additional modules are required.

If cemented joints according to MST 35 or MST 36 are to be qualified, one of the following is required:

- Two unframed PV modules are tested in sequence B, one with the front-side facing the light and one with the backside facing the light. The front-side exposed specimen shall be used in the evaluation. One additional unframed PV module is required to test initial adhesion strength if a peel test (MST 35) is used for evaluation.
- For Glass/Glass constructions 20 additional samples according to [10.25.2](#) are required for the lap shear strength test (MST 36) to prove cemented joints.

All specimens shall be technically identical (same components). For MST 24, and MST 32 PV modules which are complete in every detail, but not functioning or of low power, etc., are acceptable.

All test specimens except for MST 35 and MST 36, should be taken at random from a production batch or batches.

Additional PV modules for MST 23 might be necessary (PV modules which are complete in every detail, but not functioning or of low power, etc., are acceptable).

The PV modules shall have been manufactured from specified materials and components in accordance with the relevant drawings and process sheets and have been subjected to the module manufacturer's normal inspection, quality control and production acceptance procedures. The PV modules shall be complete in every detail and shall be accompanied by the manufacturer's handling, mounting, and connection instructions. When the PV modules to be tested are prototypes of a new design and not from production, this fact shall be noted in the test report (see [Clause 7](#)). For sampling in the context of retesting, e.g. multiple bill of material (BOM), please see [Clause 8](#) as well as IEC TS 62915.

The use of representative samples as substitutes for very large modules is described in [Annex C](#).

7 Test report

The results of the assessment against IEC 61730-1 and IEC 61730-2 shall be laid down in one combined or two separate test reports. The results shall be reported, normally in a test report and shall include

all the information requested by the client and necessary for the interpretation of the test and all information required by the method used:

- a) a title;
- b) name and address of the test laboratory and location where the tests were carried out;
- c) unique identification of the report and of each page;
- d) name and address of client, where appropriate;
- e) description and identification of the item tested;
- f) characterization and condition of the test item;
- g) date of receipt of test item and date(s) of test, where appropriate;
- h) identification of test method used;
- i) reference to sampling procedure, where relevant;
- j) any deviations from, additions to or exclusions from the test method, and any other information relevant to specific tests, such as environmental conditions or test method or procedure;
- k) measurements, examinations and derived results supported by tables, graphs, sketches and photographs as appropriate including maximum systems voltage, Class according to IEC 61140, mounting technique and any failures observed;
- l) a statement indicating whether the impulse voltage test was performed on PV module or laminate (PV module without a frame);
- m) a statement of the estimated uncertainty of the test results (where relevant);
- n) a signature and title, or equivalent identification of the person(s) accepting responsibility for the content of the report, and the date of issue;
- o) where relevant, a statement to the effect that the results relate only to the items tested;
- p) a statement that the report shall not be reproduced except in full, without the written approval of the laboratory.

A copy of this report shall be kept by the manufacturer for reference purposes.

8 Testing

The PV modules shall be divided into groups and subjected to the safety tests shown in [Figure 1](#), carried out in the order specified. The PV modules shall be selected such that the environmental stress tests of [4.2](#) are met. Each box in [Figure 1](#) refers to the corresponding subclause as described in [Clause 4](#).

Spare PV modules may be included in the safety test program provided that they have been appropriately environmentally tested to meet the necessary prerequisites.

Test procedures and criteria, including initial and final measurements where necessary, are detailed in [10.2](#) through [10.34](#). Some tests are identical to tests in IEC 61215-2 and are referenced in [Clause 4](#). In carrying out these tests, the manufacturer's handling, mounting, and connection instructions shall be strictly observed.

One PV module for sequence B shall be irradiated from the front side of the specimen and another from the backside during the 60 kWh/m² cycle (MST 54).

The intermediate control measurements (MST 01, MST 16, MST 17) after each stress test in [Figure 1](#) are informative and may be skipped. Final measurements are required.

The wait time (48 h to 96 h) at the end of the sequence shall ensure that a minimum time between the immediate control inspection after completion of each environmental test (time counter starts after completion of MST 51, MST 52 and MST 53) and a second visual inspection is maintained. This is due to possible variation in visual defects apparent a few hours versus several days after an environmental stress test. The wait time does not apply to any other control check other than the visual inspection.

The tests in sequence F may be performed on separate modules. The test for MST 25 may be performed on specially prepared samples (e.g. thermocouples within the laminate or junction box). If any of the individual tests of the sequence impacts the outcome of one of the subsequent tests, a separate sample shall be used. Potential impact on module output can be verified by MST 02.

The number of PV modules required for the fire test MST 23 will depend on the relevant test procedure. Retesting, e.g. multiple BOM, shall be performed according to IEC TS 62915. The recommended test sequences have been selected to identify adverse changes to the modified product.



For MST 16 after MST 12, preparation-requirements of [10.10.4](#) apply.

Maximum power determination shall not be performed for Sequence [B.1](#).

Figure 1 — Test sequences - Pass criteria

9 Pass criteria

The product under evaluation shall be judged to have passed the safety qualification test, if the test samples meet all of the criteria of each individual test and no loss of electrical continuity occurs during testing in sequences A through F. The product is deemed not to comply with this document if any sample fails in one or more of the tests.

In case of failure the manufacturer shall prepare a failure analysis and propose corrective actions. Depending on the proposed modification(s), a re-evaluation program can be defined before testing (IEC TS 62915), including design review to IEC 61730-1.

10 Test procedures

10.1 General

If not otherwise specified, all applied forces in N shall have an accuracy of 5 %.

If not otherwise specified, all torques (Nm) shall have an accuracy of 5 %.

10.2 Visual inspection MST 01

10.2.1 Purpose

To detect and document any visual defects and changes in the PV module.

10.2.2 Procedure

This test is identical with MQT 01 of IEC 61215-2 with the additional inspection criteria of

- any other conditions which may affect safety.
- during final inspection check compliance of markings with 5.2 of IEC 61730-1:2022 subsequent to the Durability of markings test (MST 05) as described in [10.6](#).
- during final inspection check for sharp edges as described in [10.7](#) (MST 06).
- during final inspection check of minimum distances as defined in Tables 3 and 4 of IEC 61730-1:2022 according to MST 57. See [Figure 2a](#) and [Figure 2b](#) for examples of creepage distance measurement when bubbles occur. Bubbles are assumed to be conductive for this evaluation. For clearance and creepage assessment check Annex C of IEC 61730-1:2022.

It is advisable to check distances during the initial inspection to validate that the PV module meets the insulation requirements.

- During final inspection check the joint between junction boxes and modules for signs of creeping.

Make note of and/or photograph the nature and position of any cracks, bubbles or delaminations, etc., which may worsen and adversely affect the PV module safety in subsequent tests. Visual conditions other than the major defects listed below are acceptable for the purpose of safety test approval.