

TECHNICAL SPECIFICATION



Photovoltaic (PV) modules – Type approval, design and safety qualification –
Retesting

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC (PV) MODULES – TYPE APPROVAL, DESIGN AND SAFETY QUALIFICATION – RETESTING

FOREWORD

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IEC TS 62915 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is a Technical Specification.

This publication contains attached files in the form of xls document. These files are intended to be used as a complement and do not form an integral part of the publication.

This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

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

- Prior references to specific process-related changes to PV modules have been removed in this edition and replaced with a general requirement to ensure that a consistent quality management system is in place per IEC 62941

- References to IEC 61215 and IEC 61730 have been updated to the latest editions (2021 and 2023 respectively)
 - Retest requirements with respect to new added tests such as cyclic (dynamic) mechanical load (MQT 20) and potential-induced degradation (MQT 21) are addressed in this edition
- Retest requirements for IEC 61215 and IEC 61730 have been separated for the sake of clarity
- A comprehensive matrix table summarizing all the retest requirements for each possible change in material(s) or design modification is provided in this edition
- References to component level standards, namely IEC 62788-1 series and IEC 62788-2 series, are included in this edition to address changes that could be made to the critical sub-components going into new PV module constructions
- Crystalline silicon and thin film references have been updated to be consistent with nomenclature in the updated IEC 61215 and IEC 61730 standards; namely, wafer-based technology (WBT) and monolithically integrated (MLI) thin film PV modules
- In this edition, 4.3 which addresses retest requirements for MLI thin film PV modules has been truncated and simplified by removing redundant sections that are identical with the subclauses in 4.2
- Guidance for retesting modules according to IEC TS 63126, “Guidelines for qualifying PV modules, components and materials for operation at high temperatures” has been added to this edition
- In this edition, requirements have been added for changes affecting system compatibility with variants of the same model

The text of this technical specification is based on the following documents:

Enquiry draft	Reports on voting
82/2121/DTS	82/2157A/RVDTS

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

The language used for the development of this Technical Specification 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.

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, or
- revised.

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PHOTOVOLTAIC (PV) MODULES – TYPE APPROVAL, DESIGN AND SAFETY QUALIFICATION – RETESTING

1 Scope

This document sets forth a uniform approach to maintain type approval, design and safety qualification of terrestrial PV modules that have undergone or will undergo modification from their originally assessed design. This document addresses two types of PV module technologies, wafer-based technologies (WBT) and monolithically-integrated (MLI) thin-film based technologies.

Changes in material selection, components and manufacturing process can impact electrical performance, reliability and safety of the modified product. This document lists typical modifications and the resulting requirements for retesting based on the different test standards. It provides assistance; at some level, engineering judgement may be needed.

The test sequences are selected to identify adverse changes to the modified product.

Those products successfully following the herein defined test sequences are considered to be compliant with the standard against which they have originally been assessed in a full qualification.

The number of samples to be included in the retesting program and the pass/fail criteria are listed in the referenced standards IEC 61215 and IEC 61730. In addition, a representative sample may be used as described in IEC 61215 and IEC 61730 as applicable.

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 61215-1:2021, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements*

IEC 61215-2:2021, *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 61730-2:2023, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols* IEC 62788-2-1, *Measurement procedures for materials used in photovoltaic modules – Part 2-1: Polymeric materials – Frontsheet and backsheet – Safety requirements*

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

IEC 62941:2019, *Terrestrial photovoltaic (PV) modules - Quality system for PV module manufacturing*

IEC TS 63126 2020, *Guidelines for qualifying PV modules, components, and materials for operation at high temperatures*

ISO 9001, *Quality management systems – Requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61215-1, IEC 61215-2, 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

different material

material that differs in its chemical composition, type designation, or specification from the material it replaces (including, e.g., electrical, optical, mechanical properties; the nominal values including tolerances shall be considered)

Note 1 to entry: However the same material provided by a different supplier or manufacturing location is not necessarily a different material as long as it can be clearly demonstrated.

Note 2 to entry: See relevant component clauses for further definition and clarification. For polymeric components, refer to the relevant standards, IEC 62788-1 and, IEC 62788-2 series, for more specific definition of materials with alternate constructions that could qualify as the same model designation.

3.2

control plan

documented description of the systems and processes required for controlling the product and process quality by addressing the key characteristics and engineering requirements

[SOURCE IEC 62941:2019, 3.2]

3.3

nominal value

value of a quantity used to designate and identify a component, device, equipment, or system

[SOURCE IEC 60050-151:2001, 151-16-09]

3.4

UV cut-off wavelength

λ_{cUV}

wavelength of light below which the material is considered optically absorbing and above which the material is considered transmitting

Note 1 to entry: In this procedure, the absolute transmittance of 10 % (corresponding to the optical absorbance of 1) is considered as the threshold of the UV cut-off wavelength.

[SOURCE IEC 62788-1-4:2016, 3.3]

3.5

tolerance

manufacturing deviation of declared nominal value

3.6

98th-percentile temperature

when temperature data from a varying temperature process are placed into rank order, the 98th-percentile temperature represents a temperature that is larger than 98 percent of remaining temperatures and is exactly met or exceeded only 2 % of the time

Note 1 to entry: The 98th-percentile temperature is to be determined from data taken at hourly, or more frequent, measurements. For a standard year, the 98th-percentile temperature would be met or exceeded for 175,2 h.

[SOURCE IEC TS 63126:2020, 3.4]

3.7

temperature level 1

is used to categorize test modifications and applies for PV modules whose 98th-percentile temperature falls into the range greater than 70 °C but less than or equal to 80 °C

[SOURCE IEC TS 63126:2020, 3.5]

3.8

temperature level 2

is used to categorize test modifications and applies for PV modules whose 98th-percentile temperature falls into the range greater than 80 °C but less than or equal to 90 °C

[SOURCE IEC TS 63126:2020, 3.6]

4 Retesting

4.1 General

This clause is separated into one subclause each for WBT and for MLI technologies. Within those subclauses, retest requirements are defined for both IEC 61215 and IEC 61730 whether standalone or combined. The document is organized by major modification headings with specific supporting examples and parenthetical reference to the specific clauses of the relevant IEC standards.

The manufacturer shall have the responsibility of disclosing changes in the design, materials, components, material combinations, manufacturers or processing of the PV module type family from the last tested version. Such changes may require a repetition of some or all of the qualification tests according to the clauses that follow in order to maintain type and safety approval. The manufacturer is also responsible for providing any necessary data to support component level changes which may reduce re-test requirements. For any assessment of a new thickness or dimension of a material or component, the initially tested thickness or dimension shall be used as reference. Any variation of a parameter may be assessed as a change if the new value is out of the tolerance from the nominal value of this parameter. If the declared tolerance of the manufacturer exceeds the relative percentage change that would trigger a required re-test (e.g. 10 % reduction in thickness of glass frontsheet), then the component under question shall be submitted for testing with the extreme worst-case value.

Annex A provides a comprehensive summary table of all the test requirements as well as a new version of the detailed combined test flow of IEC 61730:2023 and IEC 61215:2021.

All combinations of materials and components shall be evaluated based on the provided detailed matrix tables in Clause A.3. The test sequences required for single-component modifications can be identified from the look-up table in Clause A.3 and comparing against the requirements of a second material alteration. If the combination is not shared between the combination being evaluated or is not available, then that particular combination testing is not required. A specific example is provided in Figure A.2 for clarification.

Each PV module delivered for retesting shall be subjected to electrical stabilisation (MQT 19), as applicable by the relevant type approval standard.

Initial and final measurements as listed in the referenced standards shall be performed before and after the specific tests, for example:

- a) Tests MQT 01 / 03 / 06.1 / 15 / 19 for an IEC 61215 retest program.
- b) Tests MST 01 / 03 / 16 / 17 for an IEC 61730 retest program.

Refer to the testing tree in unclear cases. For example, the module breakage test (MST 32) does not require MST 03 / 16 / 17 for an IEC 61730 retest program but does however require MST 01.

Any scenario including a change in the optical path or electric circuitry that may or may not require retesting detailed in Clause A.3 as defined hereinafter shall include an STC output power measurement (MQT 06.1). For IEC 61215 related re-test programs (standalone or combined with IEC 61730), the measured stabilized power, open-circuit voltage and short-circuit current shall be assessed against the rating (Gate No. 1), and the relative change in output power (in the event of a retest) shall be assessed (Gate No. 2) according to the pass criteria defined in IEC 61215-1.

The Durability of markings (MST 05) and the Sharp edge test (MST 06) need to be considered in general for all design changes which may impact the results of these tests. Unless otherwise noted, reference to Damp Heat testing (MST 53) per IEC 61730 shall mean the full duration of 1000 h.

The Bypass diode functionality test (MST 07), Accessibility test (MST 11), and Continuity test of equipotential bonding (MST 13) shall also be considered for all design changes which may impact the results of these tests.

If multiple tests from a test sequence are required, they shall be done in the sequence prescribed by the referenced standard even if only a portion of the tests from a given sequence are required for re-testing (e.g. in Sequence B of IEC 61730, if the frontside UV exposure is omitted, the rest of the sequence shall be done sequentially as in the original standard).

Any changes in the design of the PV module shall comply with IEC 61730-1 and/or IEC 61215-1 (requirements for construction) depending on the scope of the retest project, whether standalone or combined. Furthermore, any changes in the design of the PV module requiring a modification in the installation method which would not qualify as a compatible alternative requires the designation of a new model number in accordance with 4.2.19 or 4.3.20, as applicable.

4.2 Test programs for WBT PV modules (including crystalline silicon)

NOTE See Table A.1 for a summary of the retest requirements for WBT PV modules.

4.2.1 Modification to frontsheet

A change from glass to non-glass or vice-versa requires a full qualification. Modifications to polymeric frontsheets shall be confirmed to comply with the requirements of IEC 62788-2-1.

For the following modifications:

- Any of the following changes resulting in a different polymeric frontsheet model designation according to the requirements of IEC 62788-2-1:
 - Reduction of thickness by more than the larger of 10 % or $\pm 5 \mu\text{m}$ of any one of the individual relied upon insulation (RUI) layers (while maintaining the required minimum distance through insulation)
 - If the reduction in thickness is less than 10 % in any one of the individual RUI layers, the minimum distance through insulation should be rechecked (MST 04). MST 04 can be done on a fresh laminate in this case
 - For non-RUI layers, a reduction in thickness by more than 20 %
 - Different surface treatment, e.g. any coating on frontsheet (inside or outside)
 - A different material, i.e. any change other than those listed above that results in a model designation change per IEC 62788-2-1

NOTE For polymeric frontsheets refer to IEC 62788-2-1 for guidance on frontsheet model designation and testing requirements for a series of frontsheets of similar construction.

- Different material (for glass)
 - It could be considered the same material from a different supplier or manufacturing location as long as the following properties are the same: thickness, anti-reflective coating employing identical chemistry and process, patterned or float solar glass, maximum bow allowed (e.g. 3 mm to 4 mm across entire glass surface), and thermal or chemical strengthening process (e.g. full-tempered or thermally/chemically toughened glass). Nominal values and tolerances shall be considered when determining similarity.
- Glass: reduction of thickness by more than 10 %
- For glass, if there is a reduction in the strengthening process (for example retest if change is from tempered glass to heat strengthened or annealed)
- For glass, different surface treatment, e.g. any coating on frontsheet (inside or outside)

Repeat for IEC 61215 (w/o IEC 61730; standalone):

- Hot-spot endurance test (MST 09) if change in material, strengthening process or if thickness is reduced.
- UV preconditioning test (MST 10) / Cyclic (dynamic) mechanical load test (MST 20) / Thermal cycling test, 50 cycles (MST 11) / Humidity freeze test (MST 12) / Retention of junction box on mounting surface (MST 14.1)
 - Entire sequence can be omitted for glass with λ_{cUV} at or above the glass which was previously tested.
 - MST 14.1 can be omitted if junction box is not mounted on the frontsheet or for change in glass thickness
- Damp heat test (MST 13) if non-glass or if surface treatment is added/changed (inside or outside)
- Bending Test (MST 22) if non-glass and if module is considered to be “flexible” per the definition specified in IEC 61215
 - Can be omitted for changes related only to outside surface treatment
- Static mechanical load test (MST 16) (can be omitted for different outside surface treatments)
- Hail test (MST 17) (can be omitted for different surface treatment)

Repeat for IEC 61730 (w/o IEC 61215; standalone):

- Hot-spot endurance test (MST 22) if change in material, strengthening process or if thickness is reduced for non-glass frontsheet
- UV test (MST 54) / Thermal cycling test, 50 cycles (MST 51) / Humidity freeze test (MST 52) / Robustness of terminations test (MST 42).