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TECHNICAL SPECIFICATION

Terrestrial photovoltaic (PV) modules – Guidelines for increased confidence in PV module design qualification and type approval

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TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – GUIDELINES FOR INCREASED CONFIDENCE IN PV MODULE DESIGN QUALIFICATION AND TYPE APPROVAL

FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62941, which is a technical specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

FDIS	Report on voting
82/994/DTS	82/1049/RVC

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.

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

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

- Transformed into an International standard
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – GUIDELINES FOR INCREASED CONFIDENCE IN PV MODULE DESIGN QUALIFICATION AND TYPE APPROVAL

1 Scope

This Technical Specification is applicable to sites manufacturing photovoltaic (PV) modules certified to IEC 61215 or IEC 61646 for design qualification and type approval. The design qualification and type approval of PV modules depend on appropriate methods for product and process design, as well as appropriate control of materials and processes used to manufacture the product. This technical specification lays out best practices for product design, manufacturing processes, and selection and control of materials used in the manufacture of PV modules that have met the requirements of IEC 61215, IEC 61646, or IEC 62108. These guidelines also form the basis for factory audit criteria of such sites by various certifying and auditory bodies.

The object of this technical specification is to provide more confidence in the ongoing consistency of performance and reliability of certified PV modules. The requirements of this technical specification are defined with the assumption that the quality management system of the organization has already fulfilled the requirements of ISO 9001 or equivalent quality management system. By maintaining a manufacturing system in accordance with this guideline, PV modules are expected to maintain their performance as determined from the test sequences in IEC 61215, IEC 61646, or IEC 62108.

This technical specification is applicable to all PV modules independent of design and technology i.e. flat panel, concentrator photovoltaic (CPV). Quality controls for CPV and nonconventional flat-plate manufacturing will differ somewhat from those of more conventional designs; this technical specification has not considered these differences.

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 60812, *Analysis techniques for system reliability –Procedure for failure mode and effects analysis (FMEA)*

IEC 60891, *Photovoltaic devices – Procedure for temperature and irradiance corrections to measured I-V characteristics*

IEC 60904-1, *Photovoltaic devices – Part 1: Measurement of photovoltaic current-voltage characteristics*

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

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

IEC 60904-4, *Photovoltaic devices – Part 4: Reference solar devices – Procedures for establishing calibration traceability*

IEC 60904-7, *Photovoltaic devices – Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices*

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

IEC 61215, *Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval*

IEC 61646, *Thin-film terrestrial photovoltaic (PV) modules – Design qualification and type approval*

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

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

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

IEC 61853-1, *Photovoltaic (PV) module performance testing and energy rating – Part 1: Irradiance and temperature performance measurements and power rating*

IEC 62108, *Concentrator photovoltaic (CPV) modules and assemblies – Design qualification and type approval*

IEC 62759-1, *Photovoltaic (PV) modules – Transportation testing – Part 1: Transportation and shipping of module package units*

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

IEC TS 62916, *Bypass diode electrostatic discharge susceptibility testing for PV modules*[1]

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement*

3 Terms, definitions and acronyms

For the purposes of this document, the terms and definitions in ISO 9000:2005, IEC TS 61836 and the following apply.

3.1
containment
action taken to protect the customer from the effect of a situation. Containment may include correcting an existing situation or adding additional screening or retesting

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

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1 To be published.

3.3
customer
end user, investor, installer who purchases modules from the organization

3.4
design lifetime
design target period during which PV modules are expected to safely satisfy the specified performance under the specified conditions

Note 1 to entry: Specified conditions include application of use, installation environment configurations and operation conditions of the PV module in use. The design target period is set considering changes in performance of PV modules due to aging degradation of parts and materials used in the stated environment.

3.5
Design Failure Mode and Effects Analysis
DFMEA
application of the Failure Mode and Effects Analysis (FMEA) method specifically to product/service

3.6
define, measure, analyse, improve and control
DMAIC
data-driven quality strategy for improving processes and an integral part of a Six Sigma quality initiative

3.7
electrostatic discharge
ESD
sudden flow of electricity between two electrically charged objects caused by contact, an electrical short, or dielectric breakdown

Note 1 to entry: Electrostatic discharge events are known to damage semiconductor devices such as diodes.

3.8
Failure, Modes and Effects Analysis
FMEA
document that defines the design, process, or solution with requirements and includes potential modes, causes and severity of effects of failure, along with an evaluation of the likelihood of their occurrence and ease of detection

Note 1 to entry: FMEA provides a mechanism to prioritize the risks and take appropriate mitigation steps.

3.9
key materials
materials that affect safety, reliability, or product performance of the PV module

Note 1 to entry: Key materials may include indirect materials. Those materials which are used during the manufacturing process of PV modules, but are not found in the end product. In most chemical processes, catalyzers are indirect materials.

3.10
organization
entity that supplies modules to the customer and that has responsibility for design, production, and after-service for the modules

Note 1 to entry: The organization may subcontract some of its responsibilities for design, production, and the after-sales service.

3.11
out of box audit
pre-shipment audit
is meant to simulate what a customer would experience when they open the packing box

Note 1 to entry: Usually the out-of box audit is carried out as follows: Samples of crates or packing boxes are taken from the delivery waiting for shipment and audited for compliance to packing, labeling instructions, documents along with the product, and finally the product itself. Product is verified for compliance to customer requirements including visual, dimension and functional. Non-conformances from these audits are escapes from the processes and outgoing inspection controls. These non-conformances are analyzed and fed back to improve the processes and controls to prevent recurrence.

3.12
out of control action plan
OCAP
supporting document to an SPC (Statistical Process Control) chart. An OCAP is typically presented as a flowchart that guides manufacturing floor employees' reactions to out-of-control situations. An OCAP consists of activators (which define out-of-control conditions); checkpoints (which are likely causes for the conditions); and terminators (which contain the action that should resolve the conditions). OCAPs should be dynamic and updated continually as and when new knowledge and information become available. A frequently occurring OCAP activator is an indication of a systemic issue in the process

3.13
Plan, Do, Check, Act
PDCA
four-step process for quality improvement

Note 1 to entry: In the first step (Plan), a way to affect improvement is developed. In the second step (Do), the plan is carried out, preferably on a small scale. In the third step (Check), a study takes place between what was predicted and what was observed in the previous step. In the last step (Act), action is taken on the causal system to affect the desired change.

3.14
performance warranty
warranty provided by the party ensuring product liability to guarantee the specified performance of PV modules over the specified period and under the specified conditions

3.15
Process Failure Modes and Effects Analysis
PFMEA

3.16
Product Life-Cycle Management
PLCM
the process of managing the entire life cycle of a product from inception, through engineering design and manufacture, to service and disposal of manufactured products

3.17
prototype
early sample, model, or release of a product built to test a concept or process, but may not have been produced with the intended future processes

3.18
Quality Management System
QMS
formalized system that documents the structure, responsibilities, and procedures required to achieve effective quality management

3.19
quality plan
document, or several documents, that together specify quality standards, practices, resources, specifications, and the sequence of activities relevant to a particular product, service, project, or contract