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Irish Standard  
I.S. EN 61646:2008

# Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval (IEC 61646:2008 (EQV))

## I.S. EN 61646:2008

*Incorporating amendments/corrigenda issued since publication:*

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English version

**Thin-film terrestrial photovoltaic (PV) modules -  
Design qualification and type approval  
(IEC 61646:2008)**

Modules photovoltaïques (PV)  
en couches minces  
pour application terrestre -  
Qualification de la conception  
et homologation  
(CEI 61646:2008)

Terrestrische Dünnschicht-Photovoltaik  
(PV)-Module -  
Bauartegnung und Bauartzulassung  
(IEC 61646:2008)

This European Standard was approved by CENELEC on 2008-06-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

**I.S. EN 61646:2008**

EN 61646:2008

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**Foreword**

The text of document 82/512/FDIS, future edition 2 of IEC 61646, prepared by IEC TC 82, Solar photovoltaic energy systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61646 on 2008-06-01.

This European Standard supersedes EN 61646:1997.

EN 61646:2008 includes the following significant technical changes with respect to EN 61646:1997:

The major change is in the pass/fail criteria. It no longer relies on meeting a plus/minus criterion before and after each test, but rather on meeting the rated power after all of the tests have been completed and the modules have been light-soaked. This was done to eliminate the technology-specific preconditioning necessary to accurately measure the changes caused by the test. (Some modules lose power in light while others lose power during dark heat.) Since all modules must work after exposure to light, this seemed like a good approach and will streamline the test procedure, hopefully reducing the testing cost.

- updated normative references;
- added a definition of “minimum value of maximum output power”;
- modified the wording in major visual defects to allow some bending and misalignment without failure;
- added requirements to the report from EN ISO/IEC 17025;
- removed the “Twist Test” as was done from EN 61215, since no one has ever failed this test;
- made the pass/fail criteria for insulation resistance and wet leakage current dependent on the module area;
- added the temperature coefficient of power ( $\delta$ ) to the required measurements;
- modified temperature coefficient section to allow for measurements under natural sunlight or a solar simulator;
- deleted reference plate method from NOCT;
- added apparatus sections to those test procedures that did not have apparatus sections in EN 61646:1997;
- rewrote the hot-spot test;
- eliminated edge dip method from wet leakage current test;
- changed mechanical load test to 3 cycles to be consistent with other standards;
- added bypass diode thermal test.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2009-03-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2011-06-01

Annex ZA has been added by CENELEC.

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### **Endorsement notice**

The text of the International Standard IEC 61646:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60904-5            NOTE Harmonized as EN 60904-5:1995 (not modified).

IEC 60904-8            NOTE Harmonized as EN 60904-8:1998 (not modified).



## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-1	- <sup>1)</sup>	Environmental testing - Part 1: General and guidance	EN 60068-1	1994 <sup>2)</sup>
IEC 60068-2-21	- <sup>1)</sup>	Environmental testing - Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices	EN 60068-2-21	2006 <sup>2)</sup>
IEC 60068-2-78	2001	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78	2001 <sup>2)</sup>
IEC 60410	- <sup>1)</sup>	Sampling plans and procedures for inspection - by attributes		-
IEC 60721-2-1	- <sup>1)</sup>	Classification of environmental conditions - Part 2-1: Environmental conditions appearing in nature - Temperature and humidity	HD 478.2.1 S1	1989 <sup>2)</sup>
IEC 60891	- <sup>1)</sup>	Procedures for temperature and irradiance corrections to measured I-V characteristics of crystalline silicon photovoltaic devices	EN 60891	1994 <sup>2)</sup>
IEC 60904-1	2006	Photovoltaic devices - Part 1: Measurement of photovoltaic current- voltage characteristics	EN 60904-1	2006 <sup>2)</sup>
IEC 60904-2	- <sup>1)</sup>	Photovoltaic devices - Part 2: Requirements for reference solar devices	EN 60904-2	2007 <sup>2)</sup>
IEC 60904-3	- <sup>1)</sup>	Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data	EN 60904-3	2008 <sup>2)</sup>
IEC 60904-7	- <sup>1)</sup>	Photovoltaic devices - Part 7: Computation of spectral mismatch error introduced in the testing of a photovoltaic device	EN 60904-7	1998 <sup>2)</sup>
IEC 60904-9	- <sup>1)</sup>	Photovoltaic devices - Part 9: Solar simulator performance requirements	EN 60904-9	2007 <sup>2)</sup>
IEC 60904-10	- <sup>1)</sup>	Photovoltaic devices - Part 10: Methods of linearity measurement	EN 60904-10	1998 <sup>2)</sup>
IEC 61215	- <sup>1)</sup>	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval	EN 61215	2005 <sup>2)</sup>

<sup>1)</sup> Undated reference.

<sup>2)</sup> Valid edition at date of issue.

**I.S. EN 61646:2008**

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO/IEC 17025	- <sup>1)</sup>	General requirements for the competence of testing and calibration laboratories	EN ISO/IEC 17025	2005 <sup>2)</sup>

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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### THIN-FILM TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – DESIGN QUALIFICATION AND TYPE APPROVAL

#### 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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- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61646 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This second edition cancels and replaces the first edition published in 1996. This edition constitutes a technical revision.

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

The major change is in the pass/fail criteria. It no longer relies on meeting a plus/minus criterion before and after each test, but rather on meeting the rated power after all of the tests have been completed and the modules have been light-soaked. This was done to eliminate the technology-specific preconditioning necessary to accurately measure the changes caused by the test. (Some modules lose power in light while others lose power during dark heat.) Since all modules must work after exposure to light, this seemed like a good approach and will streamline the test procedure, hopefully reducing the testing cost.

- Updated Normative references.
- Added a definition of “minimum value of maximum output power”.

- Modified the wording in Major visual defects to allow some bending and misalignment without failure.
- Added requirements to the report from ISO/IEC 17025.
- Removed the "Twist Test" as was done from IEC 61215, since no one has ever failed this test.
- Made the pass/fail criteria for insulation resistance and wet leakage current dependent on the module area.
- Added the temperature coefficient of power ( $\delta$ ) to the required measurements.
- Modified temperature coefficient section to allow for measurements under natural sunlight or a solar simulator.
- Deleted reference plate method from NOCT.
- Added apparatus sections to those test procedures that did not have apparatus sections in edition 1.
- Rewrote the hot-spot test.
- Eliminated edge dip method from wet leakage current test.
- Changed mechanical load test to 3 cycles to be consistent with other standards.
- Added bypass diode thermal test.

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

FDIS	Report on voting
82/512/FDIS	82/528/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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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

## THIN-FILM TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – DESIGN QUALIFICATION AND TYPE APPROVAL

### 1 Scope and object

This International Standard lays down requirements for the design qualification and type approval of terrestrial, thin-film photovoltaic modules suitable for long-term operation in general open-air climates as defined in IEC 60721-2-1. This standard is intended to apply to all terrestrial flat plate module materials not covered by IEC 61215.

The test sequence is derived from IEC 61215 for the design qualification and type approval of terrestrial crystalline silicon PV modules. However, it no longer relies on meeting a plus/minus criterion before and after each test, but rather on meeting a specified percentage of the rated minimum power after all of the tests have been completed and the modules have been light-soaked. This eliminates the technology-specific preconditioning necessary to accurately measure the changes caused by the test.

This standard does not apply to modules used with concentrators.

The object of this test sequence is to determine the electrical and thermal characteristics of the module and to show, as far as possible within reasonable constraints of cost and time, that the module is capable of withstanding prolonged exposure in climates described in the scope. The actual life expectancy of modules so qualified will depend on their design, their environment and the conditions under which they are operated.

### 2 Normative references

The following referenced documents are indispensable for the application 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 60068-1: *Environmental testing – Part 1: General and guidance*

IEC 60068-2-21: *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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

IEC 60721-2-1, *Classification of environmental conditions – Part 2-1: Environmental conditions appearing in nature – Temperature and humidity*

IEC 60891, *Procedures for temperature and irradiance corrections to measured I-V characteristics of crystalline silicon photovoltaic (PV) devices*

IEC 60904-1:2006, *Photovoltaic devices – Part 1: Measurements of photovoltaic current-voltage characteristics*

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

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