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Tankoplastni prizemni fotonapetostni (PV) moduli – Ocena zasnove in odobritev tipa

Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval

Terrestrische Dünnschicht Photovoltaik (PV) Module - Bauarteignung und Bauartzulassung

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

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Modules photovoltaïques (PV) en couches minces pour application terrestre - Qualification de la conception et homologation (CEI 1646:1996)

Terrestrische Dünnschicht Photovoltaik (PV) Module - Bauarteignung und Bauartzulassung (IEC 1646:1996)

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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

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Foreword

The text of document 82/153/FDIS, future edition 1 of IEC 1646, 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 1996-12-09.

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) 1997-09-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-09-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annex A is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 1646:1996 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

Publication	Year	Title	EN/HD	Year
IEC 68-1	1988	Environmental testing Part 1: General and guidance		
+ A1	1992		EN 60068-1[1]	1994
IEC 68-2-2	1974	Part 2: Tests - Test B: Dry heat	EN 60068-2-2[2]	1993
A1	1993		A1	1993
A2	1994		A2	1994
IEC 68-2-3	1969	Test Ca: Damp heat, steady state	HD 323.2.3 S2[3]	1987
IEC 68-2-21	1983	Test U: Robustness of terminations and integral mounting devices	EN 60068-2-21[4]	1997
A2	1991		A2	1997
A3	1992		A3	1997
IEC 410	1973	Sampling plans and procedures for inspection by attributes	-	-
IEC 721-2-1	1982	Classification of environmental conditions Part 2: Environmental conditions appearing in nature - Temperature and humidity		
+ A1	1987		HD 478.2.1 S1	1989
IEC 891	1987	Procedures for temperature and irradiance corrections to measured I-V characteristics of crystalline silicon photovoltaic devices		
+ A1	1992		EN 60891	1994
IEC 904-1	1987	Photovoltaic devices Part 1: Measurement of photovoltaic current-voltage characteristics	EN 60904-1	1993

1) EN 60068-1 also includes corrigendum October 1988 to IEC 68-1.

2) EN 60068-2-2 includes supplement A:1976 to IEC 68-2-2.

3) HD 323.2.3 S2 includes A1:1984 to IEC 68-2-3.

4) EN 60068-2-21 includes A1:1985 to IEC 68-2-21.

Publication	Year	Title	EN/HD	Year
IEC 904-3	1989	Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data	EN 60904-3	1993
IEC 904-9	1995	Part 9: Solar simulator performance requirements	-	-
IEC 1215	1993	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval	EN 61215	1995
IEC QC 001002	1986	Rules of procedure of the IEC Quality Assessment System for Electronic Components (IECQ)	-	-
A2	1994		-	-

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Thin-film terrestrial photovoltaic (PV) modules – Design qualification and type approval

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters, express as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 1646 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

The text of this standard is based on International Standard IEC 1215 and on the following documents:

FDIS	Report on voting
82/153/FDIS	82/166/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.

Annex A is for information only.

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 moderate open-air climates as defined in IEC 721-2-1. It is written with amorphous silicon technology in mind, but may also be applicable to other thin-film PV modules. Modifications to this test sequence may be necessary due to the specific characteristics of these other new technologies.

The test sequence is based largely on that specified in IEC 1215 for the design qualification and type approval of terrestrial crystalline silicon PV modules. However, some changes have been made to account for the special features of amorphous silicon thin-film modules. Light-soaking is used to separate light-induced degradation from other degradation mechanisms, and to provide the maximum power at the end of the test sequence as an estimate of the long-term performance of thin-film modules. Modules are annealed before thermal cycling and damp heat tests in order to separate the annealing effects from any degradation resulting from these tests. For thin-film technologies other than amorphous silicon, pretreatments such as light-soaking and annealing may differ or may prove unnecessary. A wet leakage current test has been added because all types of thin-film modules are susceptible to moisture-induced corrosion.

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.

This standard does not apply to modules used with concentrators.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 68-1: 1988, *Environmental testing – Part 1: General and guidance*
Amendment 1 (1992)

IEC 68-2-2: 1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*
Amendment 1 (1993)
Amendment 2 (1994)

IEC 68-2-3: 1969, *Environmental testing – Part 2: Tests – Test Ca: Damp heat, steady state*

IEC 68-2-21: 1983, *Environmental testing – Part 2: Tests – Test U: Robustness of terminations and integral mounting devices*
Amendment 2 (1991)
Amendment 3 (1992)

IEC 410: 1973, *Sampling plans and procedures for inspection by attributes*

IEC 721-2-1: 1982, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Temperature and humidity*
Amendment 1 (1987)

IEC 891: 1987, *Procedures for temperature and irradiance corrections to measured I-V characteristics of crystalline silicon photovoltaic devices*
Amendment 1 (1992)

IEC 904-1: 1987, *Photovoltaic devices – Part 1: Measurements of photovoltaic current-voltage characteristics*

IEC 904-3: 1989, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

IEC 904-9: 1995, *Photovoltaic devices – Part 9: Solar simulator performance requirements*

IEC 1215: 1993, *Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval*

IEC QC 001002: 1986, *Rules of Procedure of the IEC Quality Assessment System for Electronic Components (IECQ)*
Amendment 2 (1994)

3 Sampling

Eight modules for qualification testing (plus spares as desired) shall be taken at random from a production batch or batches, in accordance with the procedure given in IEC 410. The modules shall have been manufactured from specified materials and components in accordance with the relevant drawings and process sheets and shall have been subjected to the manufacturer's normal inspection, quality control and production acceptance procedures. The modules shall be complete in every detail and shall be accompanied by the manufacturer's handling, mounting and connection instructions, including the maximum permissible system voltage.

When the 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 8).

4 Marking

Each module shall carry the following clear and indelible markings:

- name, monogram or symbol of manufacturer;
- type or model number;
- serial number;
- polarity of terminals or leads (colour coding is permissible);
- maximum system voltage for which the module is suitable;
- nominal and minimum values of maximum output power at STC, as specified by the manufacturer for the product type.

The date and place of manufacture shall be marked on the module or be traceable from the serial number.

5 Testing

The modules shall be divided into groups and subjected to the qualification test sequences in figure 1, carried out in the order laid down. Each box refers to the corresponding subclause in this standard. Test procedures and severities, including initial and final measurements where necessary, are detailed in clause 10. However, with regard to the tests of 10.2, 10.4, 10.6 and 10.7, it should be noted that the procedures laid down in IEC 891 for temperature and irradiance corrections to measured I-V characteristics apply only to linear modules. If the module is non-linear these tests shall be carried out within ± 5 % of the specified irradiance and within ± 2 °C of the specified temperature.

NOTE – Where the final measurements for one test serve as the initial measurements for the next test in the sequence, they need not be repeated. In these cases, the initial measurements are omitted from the test.

Any single test, executed independently of a test sequence, shall be preceded by the initial tests of 10.1, 10.2 and 10.3.

In carrying out the tests, the tester shall strictly observe the manufacturer's handling, mounting and connection instructions. Tests given in 10.4 may be omitted if the temperature coefficients α and β are already known. For thin-film technologies other than amorphous silicon, annealing and light-soaking may be omitted if these have been conclusively proven to have no effect (change in maximum power less than 0,5 %). The test report shall state the basis for any such omission.

Test conditions are summarized in table 1.

6 Pass criteria

A module design shall be judged to have passed the qualification tests, and therefore, to be IEC type approved, if each test sample meets all the following criteria:

a) the degradation of maximum output power at standard test conditions (STC) does not exceed the prescribed limit after each test;

b) after the final light-soaking, the maximum output power at STC is not less than 90 % of the minimum value specified by the manufacturer in clause 4;

c) no sample has exhibited any open-circuit or ground fault during the tests;

d) there is no visual evidence of a major defect, as defined in clause 7;

e) the requirements of tests 10.3 and 10.20 are met.

If two or more modules do not meet these test criteria, the design shall be deemed not to have met the qualification requirements. Should one module fail any test, another two modules meeting the requirements of clause 3 shall be subjected to the whole of the relevant test sequence from the beginning. If one or both of these modules also fail, the design shall be deemed not to have met the qualification requirements. If, however, both modules pass the test sequence, the design shall be judged to have met the qualification requirements.