

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Concentrator photovoltaic (CPV) modules and assemblies – Design qualification and type approval

Modules et ensembles photovoltaïques à concentration – Qualification de la conception et homologation





THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2016 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Concentrator photovoltaic (CPV) modules and assemblies – Design qualification and type approval

Modules et ensembles photovoltaïques à concentration – Qualification de la conception et homologation

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 27.160

ISBN 978-2-8322-3627-7

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	5
1 Scope and object.....	7
2 Normative references.....	7
3 Terms and definitions	7
4 Sampling.....	9
5 Marking.....	10
6 Testing.....	10
7 Pass criteria.....	11
8 Report.....	18
9 Modifications	19
10 Test procedures	19
10.1 Visual inspection.....	19
10.1.1 General	19
10.1.2 Procedure.....	19
10.1.3 Major visual defects	20
10.1.4 Requirements	20
10.2 Electrical performance measurement.....	20
10.2.1 Purpose.....	20
10.2.2 Outdoor side-by-side I-V measurement.....	20
10.2.3 Solar simulator I-V measurement.....	22
10.2.4 Dark I-V measurement	22
10.3 Ground path continuity test.....	23
10.3.1 General	23
10.3.2 Purpose.....	23
10.3.3 Procedure.....	23
10.3.4 Requirements	23
10.4 Electrical insulation test.....	24
10.4.1 Purpose.....	24
10.4.2 Procedure.....	24
10.4.3 Requirements	24
10.5 Wet insulation test.....	25
10.5.1 Purpose.....	25
10.5.2 Procedure.....	25
10.5.3 Requirements	25
10.6 Thermal cycling test.....	25
10.6.1 Purpose.....	25
10.6.2 Test sample.....	26
10.6.3 Procedure.....	26
10.6.4 Requirements	27
10.7 Damp heat test.....	28
10.7.1 Purpose.....	28
10.7.2 Test sample.....	28
10.7.3 Procedure.....	28
10.7.4 Requirements	29
10.8 Humidity freeze test	29

10.8.1	Purpose	29
10.8.2	Test sample	29
10.8.3	Procedure	29
10.8.4	Requirements	29
10.9	Hail impact test	30
10.9.1	Purpose	30
10.9.2	Apparatus	30
10.9.3	Procedure	31
10.9.4	Requirements	31
10.10	Water spray test.....	31
10.10.1	General	31
10.10.2	Purpose	31
10.10.3	Procedure	32
10.10.4	Requirements	32
10.11	Bypass/blocking diode thermal test.....	32
10.11.1	Purpose	32
10.11.2	Test sample	33
10.11.3	Apparatus	33
10.11.4	Procedure	33
10.11.5	Requirements	33
10.11.6	Procedure 2 – Alternate method	34
10.12	Robustness of terminations test.....	35
10.12.1	Purpose	35
10.12.2	Types of terminations.....	35
10.12.3	Procedure	35
10.12.4	Requirements	36
10.13	Mechanical load test	36
10.13.1	Purpose	36
10.13.2	Procedure	37
10.13.3	Requirements	37
10.14	Off-axis beam damage test.....	37
10.14.1	General	37
10.14.2	Purpose.....	37
10.14.3	Special case	37
10.14.4	Procedure.....	37
10.14.5	Requirements	38
10.15	Color exposure test.....	38
10.15.1	Purpose	38
10.15.2	Procedure	38
10.15.3	Requirements	38
10.16	Hot-spot endurance test	39
10.17	Dust ingress protection test	39
10.17.1	Purpose	39
10.17.2	Procedure	39
10.17.3	Requirements	39
Annex A (informative) Summary of test conditions and requirements.....		40
Annex B (normative) Retesting guideline		43
B.1	Product or process modifications requiring limited retesting to maintain certification	43

B.2	Modifications of CPV cell technology	43
B.3	Modifications in optical encapsulation on the cell (Includes optical coupling between the cell and a glass secondary optical element bonded to the cell)	44
B.4	Modification in cell encapsulation outside of intended light path	44
B.5	Modification of cell package substrate used for heat transfer	44
B.6	Accessible optics (primary or secondary)	45
B.7	Inaccessible optics (secondary)	45
B.8	Frame and/or mounting structure	45
B.9	Enclosure	46
B.10	Wiring compartment/junction box	46
B.11	Interconnection terminals	46
B.12	Interconnection materials or technique (to cells and between receivers)	47
B.13	Change in electrical circuit design in an identical package	47
B.14	Output power	47
B.15	Thermal energy transfer means	48
B.16	Adhesives	48
Figure 1	– Schematic of point-focus dish PV concentrator	12
Figure 2	– Schematic of linear-focus trough PV concentrator	13
Figure 3	– Schematic of point-focus fresnel lens PV concentrator	14
Figure 4	– Schematic of linear-focus fresnel lens PV concentrator	15
Figure 5	– Schematic of a heliostat CPV	16
Figure 6	– Qualification test sequence for CPV modules	17
Figure 7	– Qualification test sequence for CPV assemblies	18
Figure 8	– Temperature and current profile of thermal cycle test (not to scale)	28
Figure 9	– Profile of humidity-freeze test conditions	30
Figure 10	– Bypass diode thermal test	34
Table 1	– Terms used for CPV	9
Table 2	– Allocation of test samples to typical test sequences	11
Table 3	– Thermal cycle test options for sequence A	27
Table 4	– Humidity freeze test options for sequence B	29
Table 5	– Minimum wind loads	36
Table A.1	– Summary of test conditions and requirements	40

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CONCENTRATOR PHOTOVOLTAIC (CPV) MODULES AND ASSEMBLIES –
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.
- 2) The formal decisions or agreements of 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 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 62108 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This second edition cancels and replaces the first edition, issued in 2007. It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

- a) Changes in outdoor exposure from 1000 h to 500 h.
- b) Changes in current cycling during thermal cycling test.
- c) Added dust ingress test.
- d) Eliminated thermal cycling associated with damp heat test.
- e) Eliminated UV exposure test.

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

FDIS	Report on voting
82/1142/FDIS	82/1161/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 stability date indicated on the IEC website 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.

CONCENTRATOR PHOTOVOLTAIC (CPV) MODULES AND ASSEMBLIES – DESIGN QUALIFICATION AND TYPE APPROVAL

1 Scope and object

This International Standard specifies the minimum requirements for the design qualification and type approval of concentrator photovoltaic (CPV) modules and assemblies suitable for long-term operation in general open-air climates as defined in IEC 60721-2-1. The test sequence is partially based on that specified in IEC 61215-1 for the design qualification and type approval of flat-plate terrestrial crystalline silicon PV modules. However, some changes have been made to account for the special features of CPV receivers and modules, particularly with regard to the separation of on-site and in-lab tests, effects of tracking alignment, high current density, and rapid temperature changes, which have resulted in the formulation of some new test procedures or new requirements.

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

This standard shall be used in conjunction with the test guidelines described in Annex B.

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 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61215-2:2016, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures*

IEC 62670-1, *Photovoltaic concentrators (CPV) – Performance testing – Part 1: Standard conditions*

IEC 61703:2002, *Standard for Safety: Flat-Plate Photovoltaic Modules and Panels*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. See also Table 1.

3.1

concentrator

term associated with photovoltaic devices that use concentrated sunlight