



**SLOVENSKI STANDARD**  
**SIST EN 60904-9:2008**  
**01-marec-2008**

---

: c h c b U d Y h c g h b Y b U d f U j Y ! - " X Y . ' N U h j U b Y " U g h b c g h j g c b b Y [ U g ] a i ` U h c f U f i 9 7  
\* \$ - \$ ( ! - . & \$ \$ + L

Photovoltaic devices - Part 9: Solar simulator performance requirements

Photovoltaische Einrichtungen - Teil 9: Leistungsanforderungen an Sonnensimulatoren

Dispositifs photovoltaïques - Partie 9: Exigences pour le fonctionnement des simulateurs solaires

ITeH STANDARD PREVIEW  
(standards.iteh.ai)

**Ta slovenski standard je istoveten z: EN 60904-9:2007**

<https://standards.iteh.ai/catalog/standards/sist/9f9c0c8f-7ac1-4d24-b0d4-b855b2c964d6/sist-en-60904-9-2008>

**ICS:**

27.160

**SIST EN 60904-9:2008**

**en,fr,de**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 60904-9:2008

<https://standards.iteh.ai/catalog/standards/sist/9f9c0c8f-7ac1-4d24-b0d4-b855b2c964d6/sist-en-60904-9-2008>

**Photovoltaic devices -  
Part 9: Solar simulator performance requirements  
(IEC 60904-9:2007)**

Dispositifs photovoltaïques -  
Partie 9: Exigences pour le  
fonctionnement des simulateurs solaires  
(CEI 60904-9:2007)

Photovoltaische Einrichtungen -  
Teil 9: Leistungsanforderungen  
an Sonnensimulatoren  
(IEC 60904-9:2007)

This European Standard was approved by CENELEC on 2007-11-01. 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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

## 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**

## Foreword

The text of document 82/488/FDIS, future edition 2 of IEC 60904-9, prepared by IEC TC 82, Solar photovoltaic energy systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60904-9 on 2007-11-01.

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) 2008-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2010-11-01

Annex ZA has been added by CENELEC.

---

## Endorsement notice

The text of the International Standard IEC 60904-9:2007 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 60904-1	NOTE Harmonized as EN 60904-1:2006 (not modified).
IEC 60904-2	NOTE Harmonized as EN 60904-2:2007 (not modified).
IEC 60904-7	NOTE Harmonized as EN 60904-7:1998 (not modified).
IEC 60904-8	NOTE Harmonized as EN 60904-8:1998 (not modified).
IEC 60904-10	NOTE Harmonized as EN 60904-10:1998 (not modified).
IEC 61215	NOTE Harmonized as EN 61215:2005 (not modified).
IEC 61646	NOTE Harmonized as EN 61646:1997 (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 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	1993 <sup>2)</sup>

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

SIST EN 60904-9:2008

<https://standards.iteh.ai/catalog/standards/sist/9f9c0c8f-7ac1-4d24-b0d4-b855b2c964d6/sist-en-60904-9-2008>

---

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

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

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 60904-9:2008

<https://standards.iteh.ai/catalog/standards/sist/9f9c0c8f-7ac1-4d24-b0d4-b855b2c964d6/sist-en-60904-9-2008>



IEC 60904-9

Edition 2.0 2007-10

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

---

Photovoltaic devices – **STANDARD PREVIEW**  
Part 9: Solar simulator performance requirements  
(standards.iteh.ai)

Dispositifs photovoltaïques – **SIST EN 60904-9:2008**  
Partie 9: Exigences pour le fonctionnement des simulateurs solaires  
b855b2c964d6/sist-en-60904-9-2008

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX

P

## CONTENTS

FOREWORD.....	3
1 Scope and object.....	5
2 Normative references .....	5
3 Terms and definitions .....	5
3.1 solar simulator.....	5
3.2 test plane .....	6
3.3 designated test area.....	6
3.4 data sampling time .....	6
3.5 data acquisition time .....	6
3.6 time for acquiring the I-V characteristic .....	6
3.7 effective irradiance.....	6
3.8 spectral range .....	7
3.9 spectral match.....	7
3.10 non-uniformity of irradiance in the test plane .....	7
3.11 temporal instability of irradiance.....	7
3.12 solar simulator classification.....	8
4 Simulator requirements .....	8
5 Measurement procedures .....	9
5.1 Introductory remarks .....	9
5.2 Spectral match .....	9
5.3 Non-uniformity of irradiance on the test plane .....	10
5.4 Temporal instability of irradiance.....	11
5.4.1 Solar simulators for I-V measurement.....	11
5.4.2 Solar simulators for irradiance exposure.....	13
6 Name plate and data sheet.....	13
Bibliography.....	15
Figure 1 – Evaluation of STI for a long pulse solar simulator.....	12
Figure 2 – Evaluation of STI for a short pulse solar simulator .....	12
Table 1 – Global reference solar spectral irradiance distribution given in IEC 60904-3.....	7
Table 2 – Definition of solar simulator classifications .....	8
Table 3 – Example of solar simulator rating measurements.....	9



## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## PHOTOVOLTAIC DEVICES –

## Part 9: Solar simulator performance requirements

## 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 60904-9 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This second edition cancels and replaces the first edition issued in 1995. It constitutes a technical revision.

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

- Added "Terms and definitions" clause
- Redefinition of solar simulator classification
- Added procedures for the measurement of classification parameters: Spectral match, temporal instability, non-uniformity of irradiance
- Provided details and guidance to address technology specific measurement effects

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

FDIS	Report on voting
82/488/FDIS	82/498/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.

A list of all parts of the IEC 60904 series, under the general title *Photovoltaic devices*, can be found on the IEC web site.

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.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST EN 60904-9:2008

<https://standards.iteh.ai/catalog/standards/sist/9f9c0c8f-7ac1-4d24-b0d4-b855b2c964d6/sist-en-60904-9-2008>

## PHOTOVOLTAIC DEVICES –

### Part 9: Solar simulator performance requirements

#### 1 Scope and object

IEC standards for photovoltaic devices require the use of specific classes of solar simulators deemed appropriate for specific tests. Solar simulators can be either used for performance measurements of PV devices or endurance irradiation tests. This part of IEC 60904 provides the definitions of and means for determining simulator classifications. In the case of PV performance measurements, using a solar simulator of high class does not eliminate the need to quantify the influence of the simulator on the measurement by making spectral mismatch corrections and analyzing the influences of uniformity of irradiance of the test plane and temporal stability on that measurement. Test reports for devices tested with the simulator shall list the class of simulator used for the measurement and the method used to quantify the simulator's effect on the results.

The purpose of this standard is to define classifications of solar simulators for use in indoor measurements of terrestrial photovoltaic devices, solar simulators are classified as A, B or C for each of the three categories based on criteria of spectral distribution match, irradiance non-uniformity on the test plane and temporal instability. This standard provides the required methodologies for determining the rating achieved by a solar simulator in each of the categories.

This standard is referred to by other IEC standards in which class requirements are laid down for the use of solar simulators. Solar simulators for irradiance exposure should at least fulfil class CCC requirements where the third letter is related to long term instability. In the case of use for PV performance measurements, classification CBA is demanded where the third letter is related to the short term instability.

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

#### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

##### 3.1 solar simulator

A solar simulator can be used for two different applications:

- a) I-V measurement.
- b) Irradiance exposure.

The equipment is used to simulate the solar irradiance and spectrum. Simulators usually consist of three main components: (1) light source(s) and associated power supply; (2) any optics and filters required to modify the output beam to meet the classification requirements;