

Photovoltaic devices - Part 9: Classification of solar
simulator characteristics

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 60904-9:2020 sisaldab Euroopa standardi EN IEC 60904-9:2020 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 60904-9:2020 consists of the English text of the European standard EN IEC 60904-9:2020.
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English Version

**Photovoltaic devices - Part 9: Classification of solar simulator
characteristics
(IEC 60904-9:2020)**

Dispositifs photovoltaïques - Partie 9: Classification des
caractéristiques des simulateurs solaires
(IEC 60904-9:2020)

Photovoltaische Einrichtungen - Teil 9: Klassifizierung der
Eigenschaften von Sonnensimulatoren
(IEC 60904-9:2020)

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European foreword

The text of document 82/1756/FDIS, future edition 3 of IEC 60904-9, prepared by IEC/TC 82 "Solar photovoltaic energy systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60904-9:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2021-07-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-10-23

This document supersedes EN 60904-9:2007 and all of its amendments and corrigenda (if any).

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

IEC 60891	NOTE	Harmonized as EN 60891
IEC 60904-2	NOTE	Harmonized as EN 60904-2
IEC 60904-7:2019	NOTE	Harmonized as EN IEC 60904-7:2019 (not modified)

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60904-1	-	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics	EN IEC 60904-1	-
IEC 60904-3	-	Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data	EN IEC 60904-3	-
IEC/TR 60904-14	— ¹	Photovoltaic devices - Part 14: Guidelines for production line measurements of single junction PV module maximum power output and reporting at standard test conditions	-	-
IEC/TS 61836	-	Solar photovoltaic energy systems - Terms, definitions and symbols	-	-

¹ To be published. Stage at the time of publication: 82/1748/DTR.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Photovoltaic devices –
Part 9: Classification of solar simulator characteristics**

**Dispositifs photovoltaïques –
Partie 9: Classification des caractéristiques des simulateurs solaires**



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

Tel.: +41 22 919 02 11
info@iec.ch
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INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Photovoltaic devices –
Part 9: Classification of solar simulator characteristics**

**Dispositifs photovoltaïques –
Partie 9: Classification des caractéristiques des simulateurs solaires**

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PHOTOVOLTAIC DEVICES –

Part 9: Classification of solar simulator characteristics

FOREWORD

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International Standard IEC 60904-9 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

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

- Changed title;
- Added spectral match classification in an extended wavelength range;
- Introduction of new A+ class;
- Definition of additional parameters for spectral irradiance evaluation;
- Added apparatus sections for spectral irradiance measurement and spatial uniformity measurement;

- Revised procedure for spectral match classification (minimum 4 measurement locations);
- Revised measurement procedure for spatial uniformity of irradiance;
- Added informative Annex A for sensitivity analysis of spectral mismatch error related to solar simulator spectral irradiance.

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

FDIS	Report on voting
82/1756/FDIS	82/1775/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

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

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PHOTOVOLTAIC DEVICES –

Part 9: Classification of solar simulator characteristics

1 Scope

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 at the required irradiance levels used for electrical stabilization and characterisation of PV devices.

This document is applicable for solar simulators used in PV test and calibration laboratories and in manufacturing lines of solar cells and PV modules. The A+ category is primarily intended for calibration laboratories and is not considered necessary for power measurements in PV manufacturing and in qualification testing. Class A+ has been introduced because it allows for reduction in the uncertainty of secondary reference device calibration, which is usually performed in a calibration laboratory. Measurement uncertainty in PV production lines will directly benefit from a lower uncertainty of calibration, because production line measurements are performed using secondary reference devices.

In the case of PV performance measurements, using a solar simulator of a particular class does not eliminate the need to quantify the influence of the simulator on the measurement by making spectral mismatch corrections and analysing the influences of spatial non-uniformity of irradiance in the test plane and temporal stability of irradiance on that measurement. Test reports for PV devices tested with the simulator report 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 document is to define classifications of solar simulators for use in indoor measurements of terrestrial photovoltaic devices. Solar simulators are classified as A+, A, B or C based on criteria of spectral distribution match, irradiance non-uniformity in the test plane and temporal instability of irradiance. This document provides the required methodologies for determining the classification of solar simulators in each of the categories. A solar simulator which does not meet the minimum requirements of class C cannot be classified according to this document.

For spectral match classification a new procedure has been added. This procedure addresses the actual need for an extended wavelength range, which is arising from advances in solar cell technology (such as increased spectral responsivity below 400 nm) as well as solar simulator technology (use of component LEDs). The procedure of the second edition of this standard is still valid, but is only applied if backward compatibility of classification for solar simulators already in use and for solar simulators in production/sale is required. This document is referred to by other IEC standards, in which class requirements are laid down for the use of solar simulators. The solar simulator characteristics described in this document are not used in isolation to imply any level of measurement confidence or measurement uncertainty for a solar simulator application (for example, PV module power measurement). Measurement uncertainties in each application depend on many factors, several of which are outside the scope of this document:

- Characteristics of the solar simulator, possibly including characteristics not covered by this document;
- Methods used to calibrate and operate the solar simulator;
- Characteristics of the device(s) under test (for example, size and spectral responsivity);
- Quantities measured from the device(s) under test, including equipment and methods used for measurement;