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- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



82/2364/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 62446-1 ED2	
DATE OF CIRCULATION: 2025-03-28	CLOSING DATE FOR VOTING: 2025-06-20
SUPERSEDES DOCUMENTS: 82/2347/RR	

IEC TC 82 : SOLAR PHOTOVOLTAIC ENERGY SYSTEMS	
SECRETARIAT: United States of America	SECRETARY: Mr George Kelly
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED: Safety	
☐ SUBMITTED FOR CENELEC PARALLEL VOTING	☒ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 1: Grid connected systems - Documentation, commissioning tests and inspection

PROPOSED STABILITY DATE: 2031

NOTE FROM TC/SC OFFICERS:

This project was discussed and supported by WG3 during their meeting in 2024-10.

The project was restarted after reaching the 5-year limit (refer to 82/2311/RQ).

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance -

Part 1: Grid connected systems - Documentation, commissioning tests and inspection

FOREWORD

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IEC 62446-1 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

This second edition cancels and replaces the first edition, published in 2016, and Amendment 1:2018. This edition constitutes a technical revision.

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

a) ...;

The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62446 series, published under the general title *Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

Grid-connected PV systems are expected to have a lifetime of decades, with maintenance or modifications likely at some point over this period. The ownership of a system may also change over time, particularly for systems mounted on buildings. Only by the provision of adequate documentation at the outset can the long-term performance and safety of the PV system and works, on or adjacent to the PV system, be ensured.

This document is split into two:

- System documentation requirements ([Clause 4](#)) - These clauses detail the information provided to the customer following installation of a grid-connected PV system.
- Verification ([Clause 5](#), [Clause 6](#), [Clause 7](#) and [Clause 8](#)) - These clauses provide the information expected to be provided following initial (or periodic) verification of an installed system. It includes requirements for inspection and testing.

1 Scope

This part of IEC 62446 defines the information and documentation required to be handed over to a customer following the installation of a grid-connected PV system. It also describes the commissioning tests, inspection criteria and documentation expected to verify the safe installation and correct operation of the system. It can also be used for periodic retesting.

This document is for use by system designers and installers of grid-connected solar PV systems as a template to provide effective documentation to a customer. By detailing the expected commissioning tests and inspection criteria, it is also intended to assist in the verification/inspection of a grid-connected PV system after installation and for subsequent re-inspection, maintenance or modifications.

This document defines the different test regimes expected for different solar PV system types to ensure that the test regime applied is appropriate to the scale, type and complexity of the system in question.

Throughout this document, there are various requirements highlighted from the "Applicable Installation Standard" (AIS). Where a local AIS does not have the specific requirement detailed in this document, then the requirement from IEC 62548-1 shall be used.

Documentation, test and inspection requirements for systems incorporating a DC coupled battery are included in the scope of this document.

NOTE 1 Batteries may also be AC coupled to a PV system, but as such are considered out of the scope of this document.

Detailed system performance validation is not within the scope of this document.

NOTE 2 IEC 61724 series should be consulted for PV system performance validation

This document does not address off-grid systems, or concentrating PV systems, however many of the parts may apply.

NOTE 3 IEC TS 62257-100 provides an overview of the 62257 series, which cover off-grid renewable energy and hybrid products and systems.

2 Normative references

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.

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41, *Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock*

IEC 60364-5-52, *Low-voltage electrical installations - Part 5-52: Selection and erection of electrical equipment - Wiring systems*

IEC 60364-6, *Low voltage electrical installations - Part 6: Verification*

IEC 60891, *Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics*

IEC 61010 (all parts), *Safety requirements for electrical equipment for measurement, control, and laboratory use*

IEC 61215-1, *Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements*

IEC 61557 (all parts), *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring or monitoring of protective measures*

IEC 61724-1, *Photovoltaic system performance - Part 1: Monitoring*

IEC 61730 (all parts), *Photovoltaic (PV) module safety qualification*

IEC 61730-1, *Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction*

IEC TS 61836, *Solar photovoltaic energy systems - Terms, definitions and symbols*

IEC TS 62446-3, *Photovoltaic (PV) systems - requirements for testing, documentation and maintenance - Part 3 - Photovoltaic modules and plants - Outdoor infrared thermography*

IEC 62548, *Photovoltaic (PV) arrays - Design requirements*

IEC 62933-5-2, *Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES systems - Electrochemical-based systems*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in IEC TS 61836 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

AC module

PV module with an integrated inverter in which the electrical terminals are AC only

3.2

Applicable Installation Standard

AIS

relevant installation standard for the PV system that applies in that region/country (for example: IEC 62548, IEC 60364-7-712)

3.3

bifacial PV module

device where both surfaces (front and back sides) of the PV module are used for electricity generation

3.4 cable type

description of a cable to enable its rating and suitability for a particular use or environment to be determined

3.5 data sheet

basic product description and specification

Note 1 to entry: Typically one or two pages. Not a full product manual.

3.6 inspection

examination of an electrical installation in order to ascertain correct selection and proper erection of electrical equipment

3.7 grid code

regulations defining the voltage, frequency and other parameters / functionality an inverter (or other generator) must implement in order to connect to the electricity grid at that location

3.8 inverter

electric energy converter that changes direct electric current to single-phase or polyphase alternating current

3.9 DC current rating adjustment factor, K_I

factor dependent on site PV module type and installation properties such as module orientation, module shading or module rear side irradiance

Note 1 to entry: See the AIS for calculation of k_I .

3.10 Micro-inverter

small inverter designed to be connected directly to the PV module leads, or integrated into the PV module.

3.11 module level electronics

any electronic device fitted to a PV module intended to provide control, monitoring or power conversion functions

Note 1 to entry: Module-integrated electronics may be factory fitted or assembled on site.

Note 2 to entry: A micro-inverter may sometimes also be a module-integrated electronic device.

3.12 potential induced degradation

PID

performance degradation in some types of photovoltaic modules influenced by environmental factors such as humidity and temperature

Note 1 to entry: Some module technologies require "anti-PID" measures to be implemented to prevent permanent damage, for example, a bias voltage applied at certain times of the day.

Note 2 to entry: IEC 62548-1 Annex H provide examples of anti-PID system configurations

3.13

PV array

assembly of electrically interconnected PV modules, PV strings or PV sub-arrays

3.14

PV cell

most elementary device within a PV module that exhibits the photovoltaic effect, i.e the direct non-thermal conversion of radiant energy into electrical energy

3.15

PV module

smallest complete environmentally protected assembly of interconnected PV cells

3.16

PV string

circuit of one or more series-connected PV modules

3.17

PV string combiner box

junction box where PV strings are connected, which may also contain items including: overcurrent protection devices, electronics and switch-disconnectors

3.18

PV sub-array

electrical subset of a PV array formed of parallel connected PV strings

3.19

PV sub-array combiner box

junction box where PV sub-arrays are connected, which may contain items including: overcurrent protection devices, electronics and switch-disconnectors

3.20

$I_{MOD_MAX_OCPR}$

PV module maximum overcurrent protection rating determined by the test described in [IEC 61730-2 \[1\]](#)

Note 1 to entry: This is sometimes specified by module manufacturers as the maximum series fuse rating.

3.21

reports

recording of the results of inspection and testing

3.22

testing

implementation of measures in an electrical installation by means of which its effectiveness is proved

Note 1 to entry: It includes ascertaining values by means of appropriate measuring instruments, said values not being detectable by inspection.

3.23

verification

all measures by means of which compliance of the electrical installation to the relevant standards is checked

Note 1 to entry: It comprises inspection, testing and report.

3.24

string wiring harness

prefabricated cable assembly that aggregates the output of multiple PV string conductors along a single main cable

Note 1 to entry: The harness may or may not include fusing on the individual string conductors. The wiring harness typically does not include a disconnect device in line.

Note 2 to entry: An IEC standard for string wiring harnesses is under development.

3.25

harness sub-array

HSA

group of PV strings connected in parallel using a string wiring harness. In the context of this document, a HSA shall have a combined I_{SC-STC} of no greater than 30 A and combine no more than 10 PV strings

3.26

module level monitoring

MLM

device or equipment used at module level to monitor at least voltage at module level

Note 1 to entry: Micro-inverter and DC-DC converters can include such functions

3.27

shutdown equipment

equipment that provides DC isolation or disconnection functions for all or sections of the PV array

Note 1 to entry: Shutdown equipment may operate by manual local control or via remote control (for example operating in the case of a fault or upon AC isolation).

Note 2 to entry: In some countries automatically operating shutdown equipment is described as "rapid shutdown" equipment for emergency services.

4 System documentation requirements

4.1 General

The purpose of [Clause 4](#) is to list the minimum documentation that shall be provided following the installation of a grid-connected PV system. This information will ensure key system data is readily available to a customer, inspector or maintenance engineer. The documentation includes basic system data and the information expected to be provided in the operation and maintenance manual.

4.2 System Information

4.2.1 Basic system information

As a minimum, the following basic system information shall be provided. This "nameplate" information would typically be presented on the cover page of the system documentation pack.

- a) Project identification reference (where applicable);
- b) Rated (nameplate) system power (kW DC and kVA AC);
- c) PV modules and inverters - manufacturer, model and quantity;
- d) Installation date;
- e) Customer name;

f) Site address.

Where systems use bifacial modules, this should be noted next to the PV module information. This shall also include an instruction to refer to the module data sheet for information on parameter increase due to bifacial gain.

4.2.2 System supplier information

As a minimum, the following information shall be provided for the company supplying the PV system (the company selling the system to the customer).

- a) Supplier, company;
- b) Supplier, contact person;
- c) Supplier, postal address, telephone number and e-mail address.

4.2.3 System designer information

As a minimum, the following information shall be provided for all bodies responsible for the design of the system. Where more than one company has responsibility for the design of the system, the following information should be provided for all companies together with a description of their role in the project.

- a) System designer, company;
- b) System designer, contact person;
- c) System designer, postal address, telephone number and e-mail address.

4.2.4 Codes and standards

A list of the codes, applicable regulations and standard(s) to which the system has been designed shall be provided. This information shall include the document number, title and year of issue.

NOTE This is intended to capture the main standards used in the system design, not individual products.

4.2.5 System installer information

As a minimum, the following information shall be provided for all bodies responsible for the installation of the system. Where more than one company has responsibility for the installation of the system, the following information should be provided for all companies together with a description of their role in the project.

- a) System installer, company;
- b) System installer, contact person;
- c) System installer, postal address, telephone number and e-mail address.

4.3 Wiring diagram

4.3.1 General

As a minimum, a wiring diagram with single line presentation shall be provided. This diagram shall be annotated to include the information detailed in [4.3.2](#) to [4.3.4](#).

In general, it is expected that this information will be presented as annotations to the single line wiring diagram. In some circumstances, typically for larger systems where space on the diagram may be limited, this information may be presented in table form.

4.3.2 Array - General specifications

The wiring diagram or system specification shall include the following array design information:

- a) Module manufacturer and model;
- b) Total number of modules;
- c) The DC current rating adjustment factor, K_1 , used in all sizing calculations;
- d) General string configuration, including:
 - 1) Number of modules per string. Where applicable, this should include clear identification of strings of differing lengths;
 - 2) Number of strings per inverter;
 - 3) Identification of which strings connect to which inverter;
 - 4) Identification of any inverter with differing number of strings;
- e) Where a system includes module-level electronics (e.g. DC-DC converters):
 - 1) Manufacturer and model;
 - 2) Connection to PV modules;
- f) Inverter manufacturer and model;
- g) Total number of inverters;
- h) Where an array is split into sub-arrays, the wiring diagram shall show the array - sub-array design and include all of the above information for each sub-array.

4.3.3 PV string information

The wiring diagram or system specification shall include the following PV string information.

- a) PV string cable specifications - size and type / ratings;
- b) PV string overcurrent protective device specifications (where installed) - type and voltage/current ratings;
- c) Blocking diode type (if relevant).

4.3.4 PV array electrical details

The wiring diagram or system specification shall include the following array / sub-array, electrical information (where applicable).

- a) PV string and PV sub-array combiner box - location;
- b) PV array cable specifications - size and type / ratings;
- c) DC switch disconnecter - location and rating;
- d) Array overcurrent protective devices - type, location and rating;
- e) Other array protective circuitry (such as arc fault detection or ground fault protection) - type, location and rating;
- f) Rating information shall include DC voltage and current ratings.

4.4 String layout

For systems with three or more strings, and optionally for smaller systems, a string layout drawing of the PV system showing how the array is split and connected into strings shall be provided. From the string layout, it shall be possible to trace modules in the array to their respective string and inverter, and vice versa.

For large systems, a physical layout including the string layout and the location of inverters, any major pieces of equipment, and key access concerns should be included.

NOTE This is particularly useful for finding faults in larger systems and on building mounted arrays where access to the modules is difficult.

The identification of modules within strings can also be achieved by marking each module using a unique reference, in accordance with IEC 81346.

4.5 AC system

The wiring diagram or system specification shall include the following AC system information.

- a) AC isolator location, type and rating;
- b) AC overcurrent protective device location, type and rating;
- c) Residual current device location, type and rating (where applicable);
- d) Transformer location, type and rating (where applicable);
- e) Rating information shall include AC voltage and current ratings.

NOTE Typically, information contained in the wiring diagram / system specification would be up to the point of connection to the AC electrical power network.

4.6 Earthing and overvoltage protection

The wiring diagram or system specification shall include the following earthing and overvoltage protection information.

- a) Details of all earth bonding conductors - size and type; Including details of array frame equipotential bonding cables, where applicable;
- b) Details of any connections to a Lightning Protection System (LPS);
- c) Details of any surge protection device installed (on both AC and DC lines) - location, type and rating.

4.7 Anti-PID systems

The type, location and rating of anti-PID systems shall be documented, where applicable. Operating information shall also be provided, including:

- a) The times of the day the system is operational;
- b) The voltage present during operation;
- c) Procedures for verification of correct operation.

4.8 Batteries

Where applicable, information on any batteries connected to the DC side of PV system shall be provided. The information to be provided shall include:

- a) The type of battery (chemistry);
- b) The location of the battery;
- c) The nominal voltage of the battery;
- d) The energy capacity of the battery;
- e) Maximum fault current from the battery (required to size overcurrent protection devices);
- f) Location and rating of battery overcurrent protection devices.

NOTE 1 Batteries may also be AC coupled to a PV system, but as such are out of the scope of this document.

NOTE 2 More information on grid-integrated Electrical Storage Systems can be found within IEC 62933-5-2

4.9 Cable routing and controlled areas by shutdown measures

Where shutdown equipment is installed or installation measures are applied to support firefighters, information or drawings shall be provided to describe the measures applied.

4.10 Structural design information

Information on the PV array mounting system, including manufacturer and model, shall be provided.

Where a mounting structure was custom engineered, design documentation shall be provided.

If structural and/or ground analysis were performed, a copy of the final report shall be provided

4.11 Equipment documentation

As a minimum, equipment specifications and ratings shall be provided (e.g. via a "datasheet") for the following system components.

- a) All PV module types (documentation to be as described in IEC 61215-1 and IEC 61730-1);
- b) All inverter types (documentation to be as described in IEC 62894);
- c) All module level electronics

The provision of datasheets, specifications and ratings for other significant system components is recommended. Examples include:

- DC cables and connectors
- DC isolator
- DC fuse / circuit breaker
- PV arc fault and ground fault protection equipment.
- Anti-PID systems
- Any DC coupled batteries
- Data-loggers, SCADA systems
- Meteorological sensors
- Transformers
- High Voltage Switchgear

4.12 System performance information

Information shall be provided to enable subsequent system performance assessments. This information should include array tilt and orientation and any factors which could be expected to affect the performance of the system (such as use of bifacial PV modules, significant shade, snow coverage, stowing features of trackers, etc.).

NOTE 1 Information on assessing shade is contained in [8.4](#).

Where a pre-installation (design stage) performance assessment is provided, this should be accompanied by the assumptions used to make the calculation (irradiance, shade, etc.).

NOTE 2 For system performance assessments see IEC 61724 series and IEC 61891.