IEC 62817

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Photovoltaic systems – Design qualification of solar trackers

Systèmes photovoltaïques – Qualification de conception des suiveurs solaires

IEC 62817:2014-08(en-fr)

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International Standard IEC 62817 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

FDIS	Report on voting
82/853/FDIS	82/877/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 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 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- withdrawn,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
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PHOTOVOLTAIC SYSTEMS – DESIGN QUALIFICATION OF SOLAR TRACKERS

1 Scope and object

This International Standard is a design qualification standard applicable to solar trackers for photovoltaic systems, but may be used for trackers in other solar applications. The standard defines test procedures for both key components and for the complete tracker system. In some cases, test procedures describe methods to measure and/or calculate parameters to be reported in the defined tracker specification sheet. In other cases, the test procedure results in a pass/fail criterion.

The objective of this design qualification standard is twofold.

First, this standard ensures the user of the said tracker that parameters reported in the specification sheet were measured by consistent and accepted industry procedures. This provides customers with a sound basis for comparing and selecting a tracker appropriate to their specific needs. This standard provides industry-wide definitions and parameters for solar trackers. Each vendor can design, build, and specify the functionality and accuracy with uniform definition. This allows consistency in specifying the requirements for purchasing, comparing the products from different vendors, and verifying the quality of the products.

Second, the tests with pass/fail criteria are engineered with the purpose of separating tracker designs that are likely to have early failures from those designs that are sound and suitable for use as specified by the manufacturer. Mechanical and environmental testing in this standard is designed to gauge the tracker's ability to perform under varying operating conditions, as well as to survive extreme conditions. Mechanical testing is not intended to certify structural and foundational designs, because this type of certification is specific to local jurisdictions, soil types, and other local requirements.

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 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

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

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

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

IEC 60904-3:2008, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 12103-1, *Road vehicles – Test dust for filter evaluation – Part 1: Arizona test dust*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. For additional tracker-specific terminology, see Clause 6.

3.1
photovoltaics
PV
devices that use solar radiation to directly generate electrical energy

3.2
concentrator photovoltaics
CPV
devices that focus magnified sunlight on photovoltaics to generate electrical energy. The sunlight could be magnified by various different methods, such as reflective or refractive optics, in dish, trough, lens, or other configurations

3.3
concentrator module
CPV module
group of receivers (PV cells mounted in some way), optics, and other related components, such as interconnections and mechanical enclosures, integrated together into a modular package. The module is typically assembled in a factory and shipped to an installation site to be installed along with other modules on a solar tracker

Note 1 to entry: The module is typically assembled in a factory and shipped to an installation site to be installed along with other modules on a solar tracker.

Note 2 to entry: A CPV module typically does not have a field-adjustable focus point. In addition, a module could be made of several sub-modules. The sub-module is a smaller, modular portion of the full-size module, which might be assembled into the full module either in a factory or in the field.

3.4
concentrator assembly
concentrator assembly consisting of receivers, optics, and other related components that have a field-adjustable focus point and are typically assembled and aligned in the field

EXAMPLE: A system that combines a single large dish with a receiver unit that is aligned with the focal point of the disk.

Note 1 to entry: This term is used to differentiate certain CPV designs from the CPV modules mentioned above.

4 Specifications for solar trackers for PV applications

The manufacturer shall provide the test lab, as part of its product marking and documentation, a table in the form specified below (see Table 1). The third column of Table 1 is for information purposes regarding this standard and is not intended to be part of an actual specification template provided to the test lab. See later clauses/subclauses of this standard for further explanation of individual specifications.

Some of the specifications within Table 1 are required to be provided by the manufacturer and verified by the test lab, whereas others are the sole responsibility of the test lab. Still other specifications in Table 1 are optional; however, if a tracker manufacturer chooses to include optional information, it shall be reported and measured in the specific way shown in Table 1 (and in some cases, reporting requirements are further described in the appropriate clause of this standard). Refer to the third column of Table 1 to determine the responsibility of the specification or optional status ("T" indicates test lab responsibility, "M" indicates manufacturer responsibility, and "O" indicates an optional parameter).

Table 1 – Tracker specification template

Characteristic	Example	Responsibility/Clause/Subclause
Manufacturer	The XYZ Company	(M)
Model number	XX1090	(M)
Type of tracker	CPV Tracker, Dual Axis	(M) 6.2, 6.3
Payload characteristics		
Minimum/maximum mass supported	100 kg/1 025 kg	(M) 6.8.3
Payload center of mass restrictions	0 m to 0,3 m distance perpendicular to mounting surface	(M) 6.8.3
Maximum payload surface area	30 m^2	(M) 6.8.3
Nominal payload surface area	28 m^2	(M)
Maximum dynamic torques allowed while moving	Azimuth (Θ_z):10 kN m Θ_x, Θ_y: 5 kN m [shall provide a set of diagrams to clarify torques and which axes they are relative to]	(M) 8.4.5
Maximum static torques allowed while in stow position	[shall provide a set of diagrams]	(M) 8.4.4, 8.4.5
Installation characteristics		
Allowable foundation	Reinforced concrete	(M) 6.6.2
Foundation tolerance in primary axis	± 0,5°	(O) 6.9
Foundation tolerance in secondary axis	± 0,5°	(O) 6.9
Installation effort	5 man-hours, 40 metric ton crane	(O) 6.8.8
Payload interface flexibility	The interface can be configured to mount modules from manufacturers "A", "B", and "C". Bolting configurations "X", "Y", and "Z" are allowable.	(O)
Electrical characteristics		
Includes backup power?	No	(M) N/A
Daily energy consumption	1,5 kWh	(T) 6.7.1
Stow energy consumption	1 kWh	(T) 6.7.2
Input power requirements	AC, 100 V to 240 V, 50 Hz to 60 Hz, 5 A	(M) No specifics defined
Effective (and apparent) peak power consumption tracking	500 W (550 VA)	(T) 8.3.2
Effective (and apparent) peak power consumption non-tracking	50 W (55 VA)	(T) 8.3.2
Effective (and apparent) peak power consumption stow positioning.	1 000 W (1 100 VA)	(T) 8.3.3

Characteristic	Example	Responsibility/Clause/Subclause
Tracking accuracy		
Accuracy, typical (low wind, min deflect point)	0,1°	(T) 7.4.6
Accuracy, typical (low wind, max deflect point)	0,3°	(T) 7.4.6
Accuracy, 95th percentile (low wind, min deflect point)	0,5°	(T) 7.4.6
Accuracy, 95th percentile (low wind, max deflect point)	0,8°	(T) 7.4.6
Mean wind speed during the “low wind” test conditions	3,1 m/s	(T) 7.4.6
Accuracy, typical (high wind, min deflect point)	0,7°	(T) 7.4.6
Accuracy, typical (high wind, max deflect point)	1,0°	(T) 7.4.6
Accuracy, 95th percentile (high wind, min deflect point)	1,1°	(T) 7.4.6
Accuracy, 95th percentile (high wind, max deflect point)	1,6°	(T) 7.4.6
Mean wind speed during the “high wind” test conditions	5,2 m/s	(T) 7.4.6
Weight and area of payload installed during testing	500 kg payload evenly distributed over a 50 m^2 area	(T) 7.4.2.1
Payload center of mass installed during testing	Payload center of mass 0,2 m above the module mounting surface	(T) 7.4.2.1
Control characteristics		
Control algorithm	Hybrid	(M) 6.5
Control interface	None	(M) 6.8.9
External communication interface	Ethernet/TCP-IP	(M) No specific description
Emergency stow provided?	Yes, at wind speeds 14 m/s	(M) 6.6.3.1
Stow time	4 min	(M) 6.6.4
Clock accuracy	1 s per year	(M) N/A
Hard limit switches	Not included	(M) 7.2.3
Mechanical design		
Actuation type	Distributed	(M) 6.4.1
Drive type	Electric	(M) 6.4.3
Actuators	DC motor, 185 W	(M) No specific description
Range of motion, primary axis	± 160° azimuth	(M) 6.6.3.3
Range of motion, secondary axis	10° to 90° elevation	(M) 6.6.3.3
System stiffness	See test lab report on measurement locations, applied loads, and measured deflections	(T),(O) 6.9.4, 8.4.3
Drive train torsional stiffness	See plot of angular displacement versus applied torque	(T) 8.4.4, Figure 9
Backlash	0,1° maximum	(T) 6.9.3, 8.4.4
Environmental conditions		
Maximum allowable wind speed during tracking	14 m/s	(M) 6.12.4

Characteristic	Example	Responsibility/Clause/Subclause
Maximum allowable wind speed in stow	40 m/s	(M) 6.12.5
Temperature operational range	–20 °C to +50 °C	(M) 6.12.1
Temperature survival range	–40 °C to +60 °C	(M) 6.12.2
Snow rating	Up to 20 kg/m^2 of snow load allowed	(M) 6.12.6
Maintenance and Reliability		
Maintenance schedule	Grease application every 12 months (0,75 man-hours required) Drive train fluid change every 3 years (1,25 man-hours required)	(O)
MTBF	3,5 years	(O) 6.11.2
MTTR	2 h (azimuth or elevation motor) (list components that are expected to need repair or replacement within a 10-year period)	(O) 6.11.4

For an alternate template for the presentation of accuracy specifications, see Table 2.

5 Report

A certified report of the qualification tests, with measured performance characteristics and details of any failures and re-tests, shall be prepared by the test agency in accordance with ISO/IEC 17025. The report shall contain the specification sheet per Table 1. Each certificate or test report shall include at least the following information:

a) a title;

b) name and address of the test laboratory and location where the tests were carried out;

c) unique identification of the certification or report and of each page;

d) name and address of client, where appropriate;

e) description and identification of the item tested;

f) characterization and condition of the test item;

g) date of receipt of test item and date(s) of test, where appropriate;

h) identification of test method used;

i) reference to sampling procedure, where relevant;

j) any deviations from, additions to, or exclusions from, the test method and any other information relevant to a specific test;

k) measurements, examinations and derived results supported by tables, graphs, sketches, and photographs as appropriate, and any failures observed;

l) a statement of the estimated uncertainty of the test results (where relevant);

m) a signature and title, or equivalent identification of the person(s) accepting responsibility for the content of the certificate or report, and the date of issue;

n) where relevant, a statement to the effect that the results relate only to the items tested;

o) a statement that the certificate or report shall not be reproduced except in full, without the written approval of the laboratory.

A copy of this report shall be kept by the manufacturer for reference purposes.

6 Tracker definitions and taxonomy

6.1 General

Solar trackers are mechanical devices used to track or follow the sun across the sky on a daily basis. Although a solar tracker can be used for many purposes, the scope of this standard is focused on solar trackers for photovoltaic (PV) applications. In PV applications, the primary purpose of the tracker is to enhance the capture of available solar irradiance to be converted to electricity. Photovoltaic trackers can be classified into two types: standard PV trackers and concentrator photovoltaic (CPV) trackers. Each of these tracker types can be further categorized by the number and orientation of their axes, their actuation architecture and drive type, their intended applications, and their vertical supports and foundation type.

6.2 Payload types

6.2.1 Standard photovoltaic (PV) module trackers

6.2.1.1 Uses

Standard PV trackers are used to minimize the angle of incidence between incoming light and a PV module. This increases the amount of energy produced from a fixed amount of power-generating capacity.

6.2.1.2 Type of light accepted

Photovoltaic modules accept both direct and diffuse light from all angles. This means that systems implementing standard PV trackers produce energy even when not directly pointed at the sun. Tracking in standard PV systems is used to increase the amount of energy produced by the direct component of the incoming light.

6.2.1.3 Accuracy requirements

In standard PV systems, the energy contributed by the direct beam drops off with the cosine of the angle between the incoming light and the module. Thus, trackers that have accuracies of ± 5° can deliver 99,6 % of the energy supplied by the direct beam. As a result, high-accuracy tracking is not typically used.

6.2.2 Concentrator photovoltaic (CPV) module trackers

6.2.2.1 Uses

Concentrator photovoltaic trackers are used to enable the optics used in CPV systems. These trackers typically align CPV optical elements with the sun’s direct beam with a higher degree of accuracy than standard PV trackers.

6.2.2.2 Type of light accepted

Direct solar radiation, as opposed to diffuse solar radiation, is the primary energy source for CPV modules. Optics are designed specifically to focus the direct radiation on PV cells. If this focus is not maintained, power output drops substantially.

If the CPV module concentrates in one dimension, then single-axis tracking is required. If the CPV module concentrates in two dimensions, then two-axis tracking is required.

6.2.2.3 Accuracy requirements

In concentrator modules, tracking accuracy requirements are typically related to energy production through the module acceptance angle. When the sun-pointing error is less than the acceptance angle, the modules will typically deliver 90 % or more of the rated power output.