IEC TS 62257-9-5

Edition 5.0 2024-12

TECHNICAL SPECIFICATION

Renewable energy off-grid systems – Part 9-5: Integrated systems – Laboratory evaluation of stand-alone renewable energy products for rural electrification

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 27.160

ISBN 978-2-8322-9980-7

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FOREWORD

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IEC TS 62257-9-5 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is a Technical Specification.

This fifth edition cancels and replaces the fourth edition issued in 2018. This edition constitutes a technical revision.

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

a) Decreased the sample size to 2 for QTM tests and changed the minimum stock for warehouse sampling to 150 units regardless of the number of samples selected.
b) Defined a new renewal test method that is distinct from the market check method.

c) Removed the example product specification template.

d) Added the PV module wiring inspection, partial shading test, bending or folding test, and visual inspection steps for PV modules.

e) Simplified the visual screening procedure by removing requirements to measure or record unnecessary information and convey information using photos when possible.

f) Made the light distribution test, charging efficiency test, and continuation of the lumen maintenance test to 2 000 h optional.

g) Improved accuracy of the solar operation efficiency calculation for products that do not fully utilize the PV module energy generation capacity.

h) Added steps to S.4.2.5 to minimize battery discharge before the full-battery run time test.

i) Added a detailed procedure for assessment of conformal coatings on printed circuit boards.

j) Removed the PV overvoltage protection test procedure for products with batteries that cannot be disconnected in normal operation.

k) Removed the dynamic measurement for DC ports; added procedures for steady-state measurement of USB ports supporting fast-charging protocols such as USB Power Delivery.

l) Added power consumption measurement for computers; modified television set power consumption test conditions to better match typical use.

m) Corrected the energy service calculations for appliance combinations including lights that automatically step down to a lower setting.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
82/2289/DTS	82/2312/RVDTS

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 Technical Specification 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 62257 series, published under the general title *Renewable energy off-grid systems*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

The IEC 62257 series provides support and strategies for institutions involved in rural electrification projects. It documents technical approaches for designing, building, testing, and maintaining off-grid renewable energy and hybrid systems with AC nominal voltage below 500 V, DC nominal voltage below 750 V and nominal power below 100 kVA.

These documents are recommendations to support buyers who want to connect with good quality options in the market:

- to choose the right system for the right place,
- to design the system, and
- to operate and maintain the system.

These documents are focused only on technical aspects of rural off-grid electrification concentrating on, but not specific to, developing countries. They are not considered as all inclusive to rural electrification. The documents do not describe a range of factors that can determine project or product success: environmental, social, economic, service capabilities, and others. Further developments in this field could be introduced in future steps.

This consistent set of documents is best considered as a whole, with different parts corresponding to items for safety, sustainability of systems, and costs. The main objectives are to support the capabilities of households and communities that use small renewable energy and hybrid off-grid systems and inform organizations and institutions in the off-grid power market.

The purpose of this document is to specify laboratory test methods for evaluating the quality assurance of stand-alone renewable energy products. This document is specifically related to renewable energy products that are packaged and made available to end-use consumers at the point of purchase as single, stand-alone products that do not require additional system components to function.

The term "stand-alone renewable energy product" is used in this document to describe this class of products. Other equivalent terms, including "off-grid solar" or "rechargeable," are often used by manufacturers, distributors, and other stakeholders to describe these products. Many of these systems meet the definition of type T_2I (individual electrification systems with energy storage) in IEC TS 62257-2.

The intended users of this document are:

- Market support programmes that support the off-grid lighting market with financing, consumer education, awareness, and other services;
- Manufacturers, distributors, and other companies in order to verify the quality and performance of products;
- Bulk procurement programmes that facilitate or place large orders of products; and,
- Trade regulators such as government policymakers and officials who craft and implement trade and tax policy.

This document establishes the framework for creating a product specification, the basis for evaluating quality for a particular context. Product specifications include minimum requirements for quality standards and warranty requirements. Products are compared to specifications based on test results and other information about the product. The product specification framework is flexible and can accommodate the goals of diverse organizations and institutions. The tests and inspections are designed to be widely applicable across different markets, countries, and regions.

RENEWABLE ENERGY OFF-GRID SYSTEMS –

Part 9-5: Integrated systems – Laboratory evaluation of stand-alone renewable energy products for rural electrification

1 Scope

This part of IEC 62257, which is a Technical Specification, applies to stand-alone renewable energy products having the following characteristics:

- All components required to provide basic energy services are sold and installed as a kit or integrated into a single component, including at a minimum:
  - A battery, batteries or other energy storage device(s)
  - Power generating device, such as a solar panel, capable of charging the battery, batteries or other energy storage device(s)
  - Cables, switches, wiring, connectors and protective devices sufficient to connect the power generating device, power control unit(s) and energy storage device(s)
  - Loads (optional), such as lighting, load adapter cables (e.g. for mobile devices), and appliances (television, radio, fan, etc.).
- The PV module maximum power point voltage and the working voltage of any other components in the kit do not exceed 35 V. Exceptions are made for AC-to-DC converters that meet appropriate safety standards.

NOTE This voltage limit corresponds to the definition of decisive voltage classification A (DVC-A) for wet locations in Table 6 of IEC 62109-1:2010.

- The peak power rating of the PV module or other power generating device is less than or equal to 350 W.
- No design expertise is required to choose appropriate system components.

This document was written primarily for off-grid renewable energy products with batteries and PV modules with DC system voltages not exceeding 35 V and peak power ratings not exceeding 350 W. The tests contained herein are capable in many cases of adequately assessing systems at either higher voltages or power ratings, or both. In situations where the specifying organization agrees to apply these tests to products with higher voltages and power ratings, the test laboratory is responsible for ensuring that adequate safety measures are employed to protect technicians and test equipment. The specifying organization is also responsible for defining the consumer safety requirements of these products.

This document includes provisions related to safety; however, it is not intended to be a comprehensive safety standard. In particular, this document is not intended to be used as an alternative to safety standards such as IEC 62368-1 or IEC 60335 (all parts) for appliances such as radios and televisions that are included with stand-alone renewable energy products. Nor is it intended to replace the safety requirements of IEC 62281 or UN 38.3 for battery safety during transport, or safety requirements of IEC 61730-1 and IEC 61730-2 for PV modules intended for use outside the context of stand-alone renewable energy products.

This document does not address electromagnetic compatibility (EMC). Field experience has not shown EMC to be a major concern in typical applications of stand-alone renewable energy products within the scope of this document. In applications where EMC is a concern (e.g. systems that include medical devices), the standards relevant to the specific application should be referenced.

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

IEC 60598-1, *Luminaires – Part 1: General requirements and tests*

IEC 60891:2021, *Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics*

IEC 60904-1:2020, *Photovoltaic devices – Part 1: Measurement of photovoltaic current-voltage characteristics*

IEC 60904-9, *Photovoltaic devices – Part 9: Classification of solar simulator characteristics*

IEC 61056-1:2012, *General purpose lead-acid batteries (valve-regulated types) – Part 1: General requirements, functional characteristics – Methods of test*

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

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

IEC 61427-1:2013, *Secondary cells and batteries for renewable energy storage – General requirements and methods of test – Part 1: Photovoltaic off-grid application*

IEC 61951-2:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary sealed cells and batteries for portable applications – Part 2: Nickel-metal hydride*

IEC 61960-3:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 3: Prismatic and cylindrical lithium secondary cells and batteries made from them*

IEC 62087-2:2023, *Audio, video, and related equipment – Determination of power consumption – Part 2: Signals and media*

IEC 62087-3:2023, *Audio, video, and related equipment – Determination of power consumption – Part 3: Television sets*

IEC 62087-6:2015, *Audio, video, and related equipment – Determination of power consumption – Part 6: Audio equipment*

IEC TS 62257-12-1, *Recommendations for renewable energy and hybrid systems for rural electrification – Part 12-1: Laboratory evaluation of lamps and lighting appliances for off-grid electricity* systems

IEC 62509:2010, *Battery charge controllers for photovoltaic systems – Performance and functioning*

IEC 62623, *Desktop and notebook computers – Measurement of energy consumption*

CIE 13.3, *Method of measuring and specifying colour rendering properties of light sources*

CIE 15, *Colorimetry*

CIE 084, *The measurement of luminous flux*

CIE 127, *Measurement of LEDs*

CIE 177, *Colour rendering of white LED light sources*

ANSI/IES LM-78, *Approved method: total luminous flux measurement of lamps using an integrating sphere photometer*

ANSI/IES LM-79, *Approved method: Optical and electrical measurements of solid-state lighting products*

ANSI/IES LM-80, *Approved method: measuring lumen maintenance of LED light sources*

JCGM 100, *Evaluation of measurement data – Guide to the expression of uncertainty in measurement*