IEC TS 62257-9-8

Edition 2.0 2025-01
REDLINE VERSION

TECHNICAL SPECIFICATION

colour inside

Renewable energy ~~and hybrid systems for rural electrification~~ off-grid systems Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RENEWABLE ENERGY ~~AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION~~ OFF-GRID SYSTEMS –

Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC TS 62257-9-8:2020. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC TS 62257-9-8 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is a Technical Specification.

This second edition cancels and replaces the first edition issued in 2020. It constitutes a technical revision.

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

a) Removed the PV module wiring inspection, partial shading test, and visual screening and durability tests for photovoltaic modules. Applicable tests are now referenced from IEC TS 62257-9-5.
b) Increased the interval for recurring testing from two years to three years.
c) Tightened the truth-in-advertising tolerance for numerical aspects other than luminous flux from 15 % to 10 %.
d) Revised consumer information requirements to allow more flexibility and remove requirements for information that is not known to be valuable to consumers.
e) Simplified and reorganized the requirements for 12 V and 5 V ports, and allow non-standard output voltages if clearly marked.
f) Added requirements for ports with USB fast charging support.
g) Revised the requirements for non-plug-and-play products to allow connectors that require special tools or training in products installed by trained technicians.
h) Clarified cell- and pack-level safety requirements for single-cell lithium batteries.

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

Draft	Report on voting
82/2292/DTS	82/2321/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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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.

This series provides 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.

This series is 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 series 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 provide baseline standards for quality, durability and truth-in-advertising to protect consumers 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. This document applies to products with peak power ratings of 350 W or less. While most provisions apply to all products in this range, a few are applicable only to products with peak power ratings greater than 10,5 W and less than or equal to 350 W.

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~~ companies, 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~~ Companies and distributors that need 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 minimum requirements for quality standards and warranty requirements. Products are compared to specifications based on test results from IEC TS 62257-9-5 and other information about the product. The requirements are designed to be widely applicable across different markets, countries, and regions.

RENEWABLE ENERGY ~~AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION~~ OFF-GRID SYSTEMS –

Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W

1 Scope

This part of the IEC 62257 series provides baseline requirements for quality, durability and truth in advertising to protect consumers of off-grid renewable energy products. Evaluation of these requirements is based on tests described in IEC TS 62257-9-5. This document can be used alone or in conjunction with other international standards that address the safety and durability of components of off-grid renewable energy products.

This document applies to stand-alone renewable energy products having the following characteristics:

- The products are powered by photovoltaic (PV) modules or electromechanical power generating devices (such as dynamos), or are designed to use grid electricity to charge a battery or other energy-storage device for off-grid use. The requirements may also be appropriate as guidance for evaluating the quality of ~~devices~~ products with other power sources, such as thermoelectric generators.
- The peak power rating of the PV module or other power generating device is less than or equal to 350 W.
- All components required to provide basic energy services are sold~~/~~ and installed as a kit, included as a part of a family of products as defined in 4.2.5, 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).
- The system evaluated includes all the loads (lighting, television, radio, fan, etc.) and load adapter cables that are sold or included as part of the kit or integrated into kit components.
- 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, and systems that include PV modules (or combinations of PV modules) with ~~ratings that exceed 240 W at peak power, 35 V at open circuit or 8 A at short circuit are subject to~~ open-circuit voltage greater than 35 V that meet additional safety requirements beyond those assessed in IEC TS 62257-9-5.

NOTE This voltage limit corresponds to the definition of decisive voltage classification A (DVC-A) for wet locations in IEC 62109-1~~:2010~~. The limits of 240 W, 35 V and 8 A are consistent with the definition of Class III in IEC 61730-1.

- These requirements cover only DC outputs and loads. Products that include inverters, AC outputs~~/~~ or outlets, or AC appliances are not within the scope of this document. Products can have AC inputs.
- No design expertise is required to choose appropriate system components.
- All electrical connections, except for permanent connections made at the time of installation, can be made using plug-and-socket connectors without the use of any tools. ~~All connections made in the field are straightforward to make and do not require technical expertise, such as wrapping wire in a specific direction, soldering, or crimping.~~

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 the IEC 60335 series 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 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-2-29, *Household and similar electrical appliances – Safety – Part 2-29: Particular requirements for battery chargers*

IEC 60364-7-712:2017, *Low voltage electrical installations – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

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

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

~~IEC 60904-9, *Photovoltaic devices – Part 9: Solar simulator performance requirements*~~

~~IEC 61215 (all parts), *Terrestrial photovoltaic (PV) modules – Design qualification and type approval*~~

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 61730 (all parts). *Photovoltaic (PV) module safety qualification*~~

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

IEC 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

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

IEC 62109-1~~:2010~~, *Safety of power converters for use in photovoltaic power systems – Part 1: General requirements*

IEC 62133-2, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary ~~lithium~~ cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems*

IEC TS 62257-9-5:2024, *Recommendations for renewable energy and hybrid systems for rural electrification: Integrated systems – Laboratory evaluation of stand-alone renewable energy products for rural electrification*

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

IEC 62281, *Safety of primary and secondary lithium cells and batteries during transport*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

IEC 62619, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC 62790, *Junction boxes for photovoltaic modules – Safety requirements and tests*

~~IEC 62930, *Electric cables for photovoltaic systems with a voltage rating of 1,5 kV DC*~~

IEC TS 63163, *Terrestrial photovoltaic (PV) modules for consumer products – Design qualification and type approval*

ISO 4892 (all parts), *Plastics – Methods of exposure to laboratory light sources*

~~EN 50618, *Electric cables for photovoltaic systems*~~

~~HD 605, *Electric cables – Additional test methods*~~

ANSI/CAN/UL 9540, *Energy Storage Systems and Equipment*

UL 1741, *Standard for inverters, converters, controllers and interconnection system equipment for use with distributed energy resources*

UL 1973, *Standard for batteries for use in stationary, vehicle auxiliary power and light electric rail (LER) applications*

UL 2054, *Standard for Household and Commercial Batteries*

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

UL 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

UL 62133-2, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

United Nations. *Recommendations on the transport of dangerous goods: manual of tests and criteria, Section 38.3: Lithium batteries (UN 38.3)*

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TECHNICAL SPECIFICATION

colour inside

Renewable energy off-grid systems – Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RENEWABLE ENERGY OFF-GRID SYSTEMS –

Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W

FOREWORD

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IEC TS 62257-9-8 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is a Technical Specification.

This second edition cancels and replaces the first edition issued in 2020. It constitutes a technical revision.

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

a) Removed the PV module wiring inspection, partial shading test, and visual screening and durability tests for photovoltaic modules. Applicable tests are now referenced from IEC TS 62257-9-5.
b) Increased the interval for recurring testing from two years to three years.

c) Tightened the truth-in-advertising tolerance for numerical aspects other than luminous flux from 15 % to 10 %.

d) Revised consumer information requirements to allow more flexibility and remove requirements for information that is not known to be valuable to consumers.

e) Simplified and reorganized the requirements for 12 V and 5 V ports, and allow non-standard output voltages if clearly marked.

f) Added requirements for ports with USB fast charging support.

g) Revised the requirements for non-plug-and-play products to allow connectors that require special tools or training in products installed by trained technicians.

h) Clarified cell- and pack-level safety requirements for single-cell lithium batteries.

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

Draft	Report on voting
82/2292/DTS	82/2321/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.

This series provides 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.

This series is 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 series 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 provide baseline standards for quality, durability and truth-in-advertising to protect consumers 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. This document applies to products with peak power ratings of 350 W or less. While most provisions apply to all products in this range, a few are applicable only to products with peak power ratings greater than 10,5 W and less than or equal to 350 W.

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 companies, 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;
- Companies and distributors that need 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 minimum requirements for quality standards and warranty requirements. Products are compared to specifications based on test results from IEC TS 62257-9-5 and other information about the product. The requirements are designed to be widely applicable across different markets, countries, and regions.

RENEWABLE ENERGY OFF-GRID SYSTEMS –

Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W

1 Scope

This part of the IEC 62257 series provides baseline requirements for quality, durability and truth in advertising to protect consumers of off-grid renewable energy products. Evaluation of these requirements is based on tests described in IEC TS 62257-9-5. This document can be used alone or in conjunction with other international standards that address the safety and durability of components of off-grid renewable energy products.

This document applies to stand-alone renewable energy products having the following characteristics:

- The products are powered by photovoltaic (PV) modules or electromechanical power generating devices (such as dynamos), or are designed to use grid electricity to charge a battery or other energy-storage device for off-grid use. The requirements may also be appropriate as guidance for evaluating the quality of products with other power sources, such as thermoelectric generators.
- The peak power rating of the PV module or other power generating device is less than or equal to 350 W.
- All components required to provide basic energy services are sold and installed as a kit, included as a part of a family of products as defined in 4.2.5, 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).
- The system evaluated includes all the loads (lighting, television, radio, fan, etc.) and load adapter cables that are sold or included as part of the kit or integrated into kit components.
- 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, and systems that include PV modules (or combinations of PV modules) with open-circuit voltage greater than 35 V that meet additional safety requirements beyond those assessed in IEC TS 62257-9-5.

NOTE This voltage limit corresponds to the definition of decisive voltage classification A (DVC-A) for wet locations in IEC 62109-1. The limits of 240 W, 35 V and 8 A are consistent with the definition of Class III in IEC 61730-1.

- These requirements cover only DC outputs and loads. Products that include inverters, AC outputs or outlets, or AC appliances are not within the scope of this document. Products can have AC inputs.
- No design expertise is required to choose appropriate system components.
- All electrical connections, except for permanent connections made at the time of installation, can be made using plug-and-socket connectors without the use of any tools.

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 the IEC 60335 series 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 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-2-29, *Household and similar electrical appliances – Safety – Part 2-29: Particular requirements for battery chargers*

IEC 60364-7-712:2017, *Low voltage electrical installations – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

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

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

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

IEC 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

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

IEC 62109-1, *Safety of power converters for use in photovoltaic power systems – Part 1: General requirements*

IEC 62133-2, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems*

IEC TS 62257-9-5:2024, *Recommendations for renewable energy and hybrid systems for rural electrification: Integrated systems – Laboratory evaluation of stand-alone renewable energy products for rural electrification*

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 62281, *Safety of primary and secondary lithium cells and batteries during transport*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

IEC 62619, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC 62790, *Junction boxes for photovoltaic modules – Safety requirements and tests*

IEC TS 63163, *Terrestrial photovoltaic (PV) modules for consumer products – Design qualification and type approval*

ISO 4892 (all parts), *Plastics – Methods of exposure to laboratory light sources*

ANSI/CAN/UL 9540, *Energy Storage Systems and Equipment*

UL 1741, *Standard for inverters, converters, controllers and interconnection system equipment for use with distributed energy resources*

UL 1973, *Standard for batteries for use in stationary, vehicle auxiliary power and light electric rail (LER) applications*

UL 2054, *Standard for Household and Commercial Batteries*

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

UL 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

UL 62133-2, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

United Nations. *Recommendations on the transport of dangerous goods: manual of tests and criteria, Section 38.3: Lithium batteries (UN 38.3)*