



# TECHNICAL SPECIFICATION



**Recommendations for small renewable energy and hybrid systems for rural electrification –  
Part 5: Protection against electrical hazards**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE



ICS 27.160; 27.180

ISBN 2-8318-8102-1

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	8
3 Terms and definitions.....	9
4 Classification of decentralised rural electrification systems.....	9
5 Protection against electric shock.....	10
5.1 General.....	10
5.2 Requirements on the d.c. side of a DRES.....	10
5.3 Requirements on the a.c. side of a DRES.....	10
6 Protection against overcurrent.....	11
6.1 General.....	11
6.2 Protection against overload currents.....	11
6.3 Protection against short-circuits.....	11
7 Protection against risk of fire.....	12
8 Protection against effects of lightning.....	12
8.1 Principle.....	12
8.2 Provisions for lightning protection of DRES.....	12
9 Selection and erection of electrical equipment.....	13
9.1 General.....	13
9.2 Operational conditions and external influences.....	13
9.3 Wiring system.....	14
9.4 Isolation and switching.....	14
9.5 Surge protective devices.....	16
9.6 Earthing arrangement, protective conductors and protective bonding conductors.....	16
10 Verification.....	17
11 Operation and maintenance.....	17
Annex A (informative) Protection against electric shock in electrical installations (for complete information, see IEC 61140 and IEC 60364-4-41).....	18
Annex B (informative) Types of LV distribution systems earthing.....	22
Annex C (informative) Classification of electrical equipment.....	29
Annex D (informative) General information concerning protection against lightning.....	32
Bibliography.....	34
Figure B.1 – TN-S system.....	23
Figure B.2 – TN-C-S system.....	23
Figure B.3 – TN-C system.....	23
Figure B.4 – TT system.....	24
Figure B.5 – TN-S d.c. system.....	25
Figure B.6 – TN-C d.c. system.....	26
Figure B.7 – TN-C-S d.c. system.....	27

Figure B.8 – TT d.c. system .....	28
Figure D.1 – Example of effects of a lightning stroke .....	32
Table 1 – Typology of decentralized electrification systems .....	9
Table 2 – Rated operating residual current of the protective device depending on the value of the earthing resistance .....	11
Table 3 – Number of protected poles regarding to the characteristics of the distribution system .....	15

Withdrawn

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

# RECOMMENDATIONS FOR SMALL RENEWABLE ENERGY AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –

## Part 5: Protection against electrical hazards

### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62257-5, which is a technical specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This document is based on IEC/PAS 62111(1997); it cancels and replaces the relevant parts of IEC/PAS 62111.

This technical specification is to be used in conjunction with IEC 62257 series.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
82/370/DTS	82/390/RVC

Full information on the voting for the approval of this technical specification 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.

IEC 62257 consists of the following parts, under the general title *Recommendations for small renewable energy and hybrid systems for rural electrification*:

- Part 1: General introduction to rural electrification
- Part 2: From requirements to a range of electrification systems
- Part 3: Project development and management
- Part 4: System selection and design
- Part 5: Protection against electrical hazards
- Part 6: Acceptance, operation, maintenance and replacement
- Part 7: Technical specifications: generators<sup>1</sup>
- Part 8: Technical specifications: batteries and converters<sup>1</sup>
- Part 9: Technical specifications: integrated systems<sup>1</sup>
- Part 10: Technical specifications: energy manager<sup>1</sup>
- Part 11: Technical specifications: considerations for grid connection<sup>1</sup>
- Part 12: Appliances<sup>1</sup>
- Part 13: Other topics<sup>1</sup>

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

- transformed into an International standard<sup>2</sup>,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual edition of this publication may be issued at a later date.

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

<sup>1</sup> Under consideration.

<sup>2</sup> This text is standard IEC text but it is not the intention of IEC technical committee 82 to convert this into an IEC standard. This might be done by another body at a later date, if needed.

## INTRODUCTION

The IEC 62257 series of documents intends to provide to different players involved in rural electrification projects (such as project implementers, project contractors, project supervisors, installers, etc.) documents for the setting up of renewable energy and hybrid systems with a.c. nominal voltage below 500 V, d.c. nominal voltage below 750 V and nominal power below 100 kVA.

These documents are recommendations:

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

These documents are focused only on rural electrification concentrating on but not specific to developing countries. They should not be considered as all inclusive to rural electrification. The documents try to promote the use of renewable energies in rural electrification; they do not deal with clean mechanisms developments at this time (CO<sub>2</sub> emission, carbon credit, etc.). 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 at the lowest life cycle cost as possible. One of the main objectives is to provide the minimum sufficient requirements, relevant to the field of application that is: small renewable energy and hybrid off-grid systems.

The purpose of this part of IEC 62257 is to specify the general requirements for the protection of persons and equipment against electrical hazards to be applied in decentralized rural electrification systems.

## RECOMMENDATIONS FOR SMALL RENEWABLE ENERGY AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –

### Part 5: Protection against electrical hazards

#### 1 Scope

Decentralized Rural Electrification Systems (DRES) are designed to supply electric power for sites which are not connected to a large interconnected system, or a national grid, in order to meet basic needs.

The majority of these sites are:

- isolated dwellings,
- village houses,
- community services (public lighting, pumping, health centers, places of worship or cultural activities, administrative buildings, etc.),
- economic activities (workshops, micro-industry, etc.).

The DRES systems fall into three categories:

- process electrification systems (for example for pumping),
- individual electrification systems (IES) for single users,
- collective electrification systems (CES) for multiple users.

Process or individual electrification systems exclusively consist of two subsystems:

- an electric energy generation subsystem,
- the user's electrical installation.

Collective electrification systems, however, consist of 3 subsystems:

- an electric energy generation subsystem,
- a distribution subsystem, also called micro-grid,
- user's electrical installations including interface equipment between the installations and the micro-grid.

The purpose of this document is to specify the general requirements for the protection of persons and equipment against electrical hazards to be applied in decentralised rural electrification systems. Requirements dealing with protection against electric shock are based on basic rules from IEC 61140 and IEC 60364.

These general requirements are to be applied to all the identified categories of DRES. Application to each subsystem of a DRES is dealt within a specific section of IEC 62257-9.

## 2 Normative references

The following referenced documents are indispensable for the application 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 60050-826, *International Electrotechnical Vocabulary (IEV) – Part 826: Electrical installations*

IEC 60364 (all parts), *Electrical installations of buildings*

IEC 61024-1:1990, *Protection of structures against lightning – Part 1: General principles*

IEC 61140:1997, *Protection against electric shock – Common aspects for installation and equipment*

IEC 62257-1, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 1: General introduction to rural electrification*

IEC 62257-2, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 2: From requirements to a range of electrification systems*

IEC 62257-3, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 3: Project development and management*

IEC 62257-4, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 4: System selection and design*

IEC 62257-5, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 5: Safety rules*

IEC 62257-6, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 6: Acceptance, operation, maintenance and replacement*

IEC 62257-7, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 7: Technical specifications: generators*<sup>3</sup>

IEC 62257-8, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 8: Technical specifications: batteries and converters*<sup>3</sup>

IEC 62257-9, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9: Technical specifications: integrated systems*<sup>3</sup>

IEC 62257-10, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 10: Technical specifications: energy manager*<sup>3</sup>

IEC 62257-11, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 11: Technical specifications: considerations for grid connection*<sup>3</sup>

IEC 62257-12, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 12: Appliances*<sup>3</sup>

IEC 62257-13, *Recommendations for small renewable energy and hybrid systems for rural electrification – Part 13: Other topics*<sup>3</sup>

IEC 62305-2:2005, *Protection against lightning – Part 2: Risk management*

---

<sup>3</sup> Under consideration.