

PD IEC/TS 62257-5:2015



BSI Standards Publication

# Recommendations for renewable energy and hybrid systems for rural electrification

Part 5: Protection against  
electrical hazards

**bsi.**

...making excellence a habit.™

### **National foreword**

This Published Document is the UK implementation of IEC/TS 62257-5:2015. It supersedes DD IEC/TS 62257-5:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/82, Photovoltaic Energy Systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.  
Published by BSI Standards Limited 2016

ISBN 978 0 580 89917 1  
ICS 27.160; 27.180

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 January 2016.

### **Amendments/corrigenda issued since publication**

<b>Date</b>	<b>Text affected</b>
-------------	----------------------

---



# TECHNICAL SPECIFICATION



---

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 27.160

ISBN 978-2-8322-3070-1

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD .....	5
INTRODUCTION .....	7
1 Scope .....	8
2 Normative references .....	8
3 Terms and definitions .....	9
4 Classification of decentralised rural electrification systems .....	11
5 Protection against electric shock .....	11
5.1 General .....	11
5.2 Requirements on the d.c. side of a DRES .....	11
5.3 Requirements on the a.c. side of a DRES .....	12
5.3.1 General .....	12
5.3.2 TT system .....	12
5.3.3 TN system .....	12
6 Protection against overcurrent .....	13
6.1 General .....	13
6.2 Protection against overload currents .....	13
6.3 Protection against short-circuits .....	13
7 Protection against risk of fire .....	13
8 Protection against effects of lightning .....	14
8.1 Principle .....	14
8.2 Examples .....	14
8.3 Protection against overvoltage .....	14
8.4 Protection against direct lightning .....	14
9 Determination of the pick up area of a rod or wire (see IEC 62305-3:2010) .....	14
9.1 General .....	14
9.2 Operational conditions and external influences .....	14
9.3 Wiring system .....	15
9.4 Isolation and switching .....	15
9.4.1 Isolation .....	15
9.4.2 Over-current protective devices .....	16
9.4.3 Residual Current Devices (RCD) .....	17
9.5 Surge protective devices .....	17
9.6 Earthing arrangement, protective conductors and protective bonding conductors .....	18
9.6.1 Earth electrodes .....	18
9.6.2 Protective bonding conductors .....	19
10 Verification .....	19
11 Operation and maintenance .....	19
Annex A (informative) Protection against electric shock in electrical installations .....	20
A.1 Protection against electric shock .....	20
A.2 Automatic disconnection of supply .....	20
A.2.1 General .....	20
A.2.2 In TN systems .....	21
A.2.3 In TT systems .....	21
A.3 Double or reinforced insulation .....	22

A.4	Extra-low-voltage (SELV and PELV) .....	22
A.5	Electrical separation .....	22
A.6	Additional protection .....	23
Annex B (informative)	Types of LV distribution systems earthing .....	24
B.1	Terms and definitions.....	24
B.2	Types of system earthing used in DRES (Figures are from IEC 60364-1:2005) .....	25
B.2.1	General .....	25
B.2.2	AC TN systems.....	27
B.2.3	AC TT systems .....	34
B.2.4	DC distribution systems .....	36
Annex C (informative)	Classification of electrical equipment .....	41
C.1	Classification of residual current devices (RCDs) (see IEC 61008, IEC 61009, IEC 60755, IEC 60947-2, IEC 62423) .....	41
C.2	Classification of circuit breakers for a.c. operation (see IEC 60898-1, IEC 60947-2) .....	42
C.3	Classification of surge protective devices (see IEC 61643-11) .....	43
Annex D (informative)	General information concerning protection against lightning .....	44
D.1	General.....	44
D.2	Protection against lightning – Principles.....	45
Bibliography	.....	46
Figure B.1	– General outline of the distribution system .....	24
Figure B.2	– Distribution system of the smallest type .....	25
Figure B.3	– TN-S system 3-phase, 4-wire with separate neutral conductor and protective conductor throughout the distribution system .....	28
Figure B.4	– TN-S system 3-phase, 3-wire with separate earthed line conductor and protective conductor throughout the distribution system .....	29
Figure B.5	– TN-S system 3-phase, 3-wire with protective conductor and no distributed neutral conductor throughout the distribution system .....	30
Figure B.6	– TN-C-S system 3-phase, 4-wire where the PEN conductor is separated into the protective conductor PE and the neutral conductor N elsewhere in the electrical installation .....	31
Figure B.7	– TN-C-S system 3-phase, 4-wire where the PEN conductor is separated into the protective conductor PE and the neutral conductor N at the origin of the electrical installation .....	32
Figure B.8	– TN-C-S system – single-phase, 2-wire where the PEN conductor is separated into the protective conductor PE and the neutral conductor N at the origin of the electrical installation .....	32
Figure B.9	– TN-C system 3-phase, 4-wire with neutral and protective conductor functions combined in a single conductor throughout the distribution system .....	33
Figure B.10	– TN-S multiple source system 3-phase, 4-wire with separate protective conductor and neutral conductor to current using equipment.....	34
Figure B.11	– TT system 3-phase, 4-wire with earthed protective conductor and neutral conductor throughout the distribution system .....	35
Figure B.12	– TT system 3-phase, 3-wire with earthed protective conductor and no distributed neutral conductor throughout the distribution system .....	35
Figure B.13	– TN-S d.c. system .....	37
Figure B.14	– TN-C d.c. system .....	38
Figure B.15	– TN-C-S d.c. system.....	39

Figure B.16 – TT d.c. system .....	40
Figure D.1 – Example of effects of a lightning stroke .....	44
Table 1 – Typology of decentralized electrification systems .....	11
Table 2 – Rated operating residual current of the protective device depending on the value of the earthing resistance .....	12
Table 3 – Number of protected poles with regard to the characteristics of the distribution system .....	16

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RECOMMENDATIONS FOR 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 itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 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 second edition cancels and replaces the first edition issued in 2005. It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

- redefine the maximum AC voltage from 500 V to 1 000 V, the maximum DC voltage from 750 V to 1 500 V;
- removal of the limitation of 100 kVA system size. Hence the removal of the word “small” in the title and related references in this technical specification.

This technical specification is to be used in conjunction with the IEC 62257 series (specifically IEC TS 62257-1 to IEC TS 62257-6).

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

Enquiry draft	Report on voting
82/950/DTS	82/1001A/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.

A list of all parts in the IEC 62257 series, published under the general title *Recommendations for renewable energy and hybrid systems for rural electrification*, 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 publication will remain unchanged until the stability date indicated on the IEC website 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,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version 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 document using a colour printer.**



## INTRODUCTION

The IEC 62257 series 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 AC voltage below 1 000 V and DC voltage below 1 500 V.

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 aiming 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: renewable energy and hybrid off-grid systems.

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

## Part 5: Protection against electrical hazards

### 1 Scope

This part of IEC 62257 specifies 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.

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 DRE 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 three subsystems:

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

The general requirements specified in this part of IEC 62257 should be applied to all the identified categories of DRES. Application to each subsystem of a DRES is dealt within a specific subpart of IEC TS 62257-9.

### 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