

**SLOVENSKI
STANDARD**

SIST-TS IEC/TS 62257-5:2006

may 2006

Priporočila za sisteme malih obnovljivih virov energije in hibridne sisteme za elektrifikacijo podeželja – 5. del: Zaščita pred električnimi nevarnostmi

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TS IEC/TS 62257-5:2006](https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006)

<https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006>

ICS 27.190

Referenčna številka
SIST-TS IEC/TS 62257-5:2006(en)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TS IEC/TS 62257-5:2006](https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006)

<https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006>

TECHNICAL SPECIFICATION

IEC TS 62257-5

First edition
2005-07

Recommendations for small renewable energy and hybrid systems for rural electrification –

Part 5: Protection against electrical hazards

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TS IEC/TS 62257-5:2006](https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006)

<https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006>

© IEC 2005 — Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE

V

For price, see current catalogue

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TS IEC/TS 62257-5:2006](https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006)

<https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006>

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 ¹
- Part 8: Technical specifications: batteries and converters ¹
- Part 9: Technical specifications: integrated systems ¹
- Part 10: Technical specifications: energy manager ¹
- Part 11: Technical specifications: considerations for grid connection ¹
- Part 12: Appliances ¹
- Part 13: Other topics ¹

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 ²,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

¹ Under consideration.

² 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 (CO₂ 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.

[SIST-TS IEC/TS 62257-5:2006](https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006)

<https://standards.iteh.ai/catalog/standards/sist/2fe17c6f-c3be-49e0-80c9-d216f5c33789/sist-ts-iec-ts-62257-5-2006>

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 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 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*³

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

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

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

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

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

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

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

³ Under consideration.

3 Terms and definitions

For the purpose of this part of IEC 62257, the following terms and definitions apply.

3.1

DRES

decentralized rural electrification system

3.2

REN

renewable energy

3.3

micro-grid

subsystem of a DRES intended for power distribution

NOTE The prefix «micro» being intended to express the low level of transmitting capacity, usually less than 50 kVA.

3.4

micro-powerplant

subsystem of a DRES intended for power generation. The prefix «micro» being intended to express the low power level generated (from a few kVA to a few tens of kVA)

3.5

SPD

Surge Protection Device

iTeh STANDARD PREVIEW
(standards.iteh.ai)

4 Classification of decentralised rural electrification systems

SIST-TS IEC/TS 62257-5:2006

DRES are classified into six different types. See Table 1.

Table 1 – Typology of decentralized electrification systems

Type of generator		Classification of associated systems	
		Individual	Collective
REN only, hybrid or not	no storage	T _{1.I}	T _{1.C}
REN only, hybrid or not	storage	T _{2.I}	T _{2.C}
REN, hybrid or not plus Genset	no storage	T _{3.I}	T _{3.C}
REN, hybrid or not plus Genset	storage	T _{4.I}	T _{4.C}
Genset only	no storage	T _{5.I}	T _{5.C}
Genset only	storage	T _{6.I}	T _{6.C}

Notation principle: T_{i.I} = individual system, type i; T_{j.C} = collective system, type j.
 "Storage" = storage of energy produced by one of the generator of the system and which can be reconverted.

Architecture and characteristics of the different electrification system types are developed in Clause 6 of IEC 62257-2.

5 Protection against electric shock

5.1 General

Basic rules for protection against electric shock are given in IEC 61140 and IEC 60364-4-41. Information is also available in Annex A.

5.2 Requirements on the d.c. side of a DRES

The principles for the design and erection of a d.c. electrical circuit are similar to those for an a.c. circuit. The main differences concern short-circuit current calculation and the selection of the protective devices.

Protection by extra-low voltage (SELV and PELV systems) or protection by double or reinforced insulation should preferably be adopted on the d.c. side of DRES.

NOTE Protection by automatic disconnection of supply on the d.c. side requires special measures which are under consideration.

Simple separation, at least, should be provided between the a.c. side and the d.c. side unless the inverter is not able, by construction, to feed d.c. fault current into the a.c. installation.

Earthing of one of the live conductors of the d.c. side is permitted, if there is at least simple separation between the d.c. side and the a.c. side.

5.3 Requirements on the a.c. side of a DRES

5.3.1 General

Protection by use of automatic disconnection of supply should preferably be adopted on the a.c. side of a DRES. For each circuit, maximum disconnecting times given in IEC 60364-4-41 should apply.

TN-S system should preferably be used for user's installations, TN-S or TN-C system being preferably used for the micro-grid.

TT system is acceptable. IT system is normally not used for DRES and has hence not been dealt with in this specification.

A residual current protective device, with a rated operating residual current not exceeding 30 mA, should be provided as additional protection for each installation or for a group of installations.

5.3.2 TT system

Basic protection is provided by basic insulation of live parts or by barriers or enclosures. Fault protection is provided by residual current devices regarding the resistance value of the earth electrode to which the PE conductor is connected. The fault current should be high enough to activate the differential current device. The rated operating residual current $I_{\Delta n}$ of the device should fulfil the formula:

$$I_{\Delta n} \leq \frac{U_L}{R_A} \quad \text{with} \quad U_L = 50 \text{ V}$$

where U_L is the conventional maximum voltage and R_A is the earthing resistance.