

BS EN 61140:2016



BSI Standards Publication

Protection against electric shock — Common aspects for installation and equipment

National foreword

This British Standard is the UK implementation of EN 61140:2016. It is identical to IEC 61140:2016. It supersedes BS EN 61140:2002+A1:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee JPEL/64, Electrical installations of buildings - Joint committee.

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 81329 0

ICS 13.260; 29.020; 91.140.50

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2016.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

EUROPEAN STANDARD

EN 61140

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2016

ICS 13.260; 29.020; 91.140.50

Supersedes EN 61140:2002

English Version

**Protection against electric shock - Common aspects for
installation and equipment
(IEC 61140:2016)**

Protection contre les chocs électriques - Aspects communs
aux installations et aux matériels
(IEC 61140:2016)

Schutz gegen elektrischen Schlag - Gemeinsame
Anforderungen für Anlagen und Betriebsmittel
(IEC 61140:2016)

This European Standard was approved by CENELEC on 2016-02-11. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 64/2076/FDIS, future edition 4 of IEC 61140, prepared by IEC/TC 64 "Electrical installations and protection against electric shock" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61140:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-11-27
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-05-27

This document supersedes EN 61140:2002.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Endorsement notice

The text of the International Standard IEC 61140:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60364-4-41:2005	NOTE	Harmonized as HD 60364-4-41:2007 (modified).
IEC 60364-4-44:2007	NOTE	Harmonized as HD 60364-4-442:2012 (modified) and as HD 60364-4-444:2010 (modified).
IEC 60364-6:2006	NOTE	Harmonized as HD 60364-6:2007 (modified).
IEC 60601-1	NOTE	Harmonized as EN 60601-1.
IEC 61558-2-6	NOTE	Harmonized as EN 61558-2-6.
IEC 61936-1	NOTE	Harmonized as EN 61936-1.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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 undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60038	-	IEC standard voltages	EN 60038	-
IEC 60068	series	Environmental testing	EN 60068	series
IEC 60071-1	-	Insulation co-ordination - Part 1: Definitions, principles and rules	EN 60071-1	-
IEC 60071-2	-	Insulation co-ordination - Part 2: Application guide	EN 60071-2	-
IEC 60364-5-54	2011	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors	HD 60364-5-54	2011
IEC 60417	-	Graphical symbols for use on equipment	-	-
IEC 60445	-	Basic and safety principles for man- machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors	EN 60445	-
IEC/TS 60479-1	2005	Effects of current on human beings and livestock - Part 1: General aspects	-	-
IEC/TR 60479-5	-	Effects of current on human beings and livestock - Part 5: Touch voltage threshold values for physiological effects	-	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	EN 60529	-
IEC 60664	series	Insulation coordination for equipment within low-voltage systems	EN 60664	series
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60721	series	Classification of environmental conditions	EN 60721	series
IEC 60990	-	Methods of measurement of touch current and protective conductor current	EN 60990	-
IEC/TS 61201	2007	Use of conventional touch voltage limits - Application guide	-	-
IEC 62271-102	-	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches	EN 62271-102	-
IEC Guide 104	-	The preparation of safety publications and the use of basic safety publications and group safety publications	-	-
ISO/IEC Guide 51	2014	Safety aspects - Guidelines for their inclusion in standards	-	-

CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms and definitions	8
4 Fundamental rule of protection against electric shock	18
4.1 General	18
4.2 Normal conditions	19
4.3 Single-fault conditions	20
4.3.1 General	20
4.3.2 Protection by independent protective provisions	20
4.3.3 Protection by an enhanced protective provision	20
4.4 Additional protection	20
4.5 Protection against electric burns	21
4.6 Protection against physiological effects without adverse health effect	21
4.6.1 General	21
4.6.2 Muscular reaction	21
4.6.3 Effects of touch current of discharge of electrostatic charges	22
4.6.4 Thermal effects	22
5 Protective provisions (elements of protective measures)	22
5.1 General	22
5.2 Provisions for basic protection	22
5.2.1 General	22
5.2.2 Basic insulation	22
5.2.3 Protective barriers or enclosures	23
5.2.4 Obstacles	23
5.2.5 Placing out of arm's reach	23
5.2.6 Limitation of voltage	24
5.2.7 Limitation of steady-state touch current and energy	24
5.2.8 Potential grading	25
5.2.9 Other provisions for basic protection	25
5.3 Provisions for fault protection	25
5.3.1 General	25
5.3.2 Supplementary insulation	25
5.3.3 Protective-equipotential-bonding	25
5.3.4 Protective screening	27
5.3.5 Indication and disconnection in high-voltage installations and systems	27
5.3.6 Automatic disconnection of supply	27
5.3.7 Simple separation (between circuits)	28
5.3.8 Non-conducting environment	28
5.3.9 Potential grading	28
5.3.10 Other provisions for fault protection	28
5.4 Enhanced protective provisions	28
5.4.1 General	28
5.4.2 Reinforced insulation	29
5.4.3 Protective separation between circuits	29
5.4.4 Limited current source	29

5.4.5	Protective impedance device	29
5.4.6	Other provisions for enhanced protection.....	30
5.5	Provisions for additional protection	30
5.5.1	Additional protection by residual current protective device (RCD) $I_{\Delta n} \leq 30 \text{ mA}$	30
5.5.2	Additional protection by supplementary equipotential bonding	30
6	Protective measures	30
6.1	General.....	30
6.2	Protection by automatic disconnection of supply	31
6.3	Protection by double or reinforced insulation.....	31
6.4	Protection by protective equipotential bonding	31
6.5	Protection by electrical separation	31
6.6	Protection by non-conducting environment (low-voltage).....	31
6.7	Protection by SELV system.....	32
6.8	Protection by PELV system	32
6.9	Protection by limitation of steady-state touch current and charge	32
6.10	Additional protection	32
6.10.1	Additional protection by residual current protective device (RCD) $I_{\Delta n} \leq 30 \text{ mA}$	32
6.10.2	Additional protection by supplementary protective equipotential bonding	32
6.11	Protection by other measures	33
7	Co-ordination between electrical equipment and protective provisions within an electrical installation	33
7.1	General.....	33
7.2	Class 0 equipment	33
7.3	Class I equipment	34
7.3.1	General	34
7.3.2	Insulation.....	34
7.3.3	Connection to the protective conductor	34
7.3.4	Accessible surfaces of parts of insulating material	34
7.3.5	Connection of a protective conductor	35
7.4	Class II equipment	35
7.4.1	General	35
7.4.2	Insulation.....	35
7.4.3	Protective bonding.....	36
7.4.4	Marking	36
7.5	Class III equipment	36
7.5.1	General	36
7.5.2	Voltages	36
7.5.3	Protective bonding.....	37
7.5.4	Marking	37
7.6	Touch currents, protective conductor currents.....	37
7.6.1	General	37
7.6.2	Touch currents	37
7.6.3	Protective conductor currents	37
7.6.4	Other requirements.....	39
7.6.5	Other effects.....	39
7.7	Safety and boundary clearances and hazard marking for high-voltage installations	39

7.8	Functional earthing	40
8	Special operating and servicing conditions	40
8.1	General.....	40
8.2	Devices to be operated manually and components intended to be replaced manually	40
8.2.1	General	40
8.2.2	Devices to be operated or components intended to be replaced by ordinary persons in low-voltage installations, systems and equipment	40
8.2.3	Devices to be operated or components intended to be replaced by skilled or instructed persons	41
8.3	Electrical values after isolation.....	41
8.4	Devices for isolation.....	42
8.4.1	General	42
8.4.2	Devices for isolation for low voltage.....	42
8.4.3	Devices for isolation for high voltage	43
Annex A (informative)	Survey of protective measures as implemented by protective provisions	45
Annex B (informative)	Index of terms	48
Annex C (informative)	List of notes concerning certain countries	53
Bibliography.....		54
Figure A.1	– Protective measures with basic and fault protection	45
Figure A.2	– Protective measures with limited values of electrical quantities	46
Figure A.3	– Protective measure: additional protection (in addition to basic and/or fault protection)	47
Table 1	– Limits for voltage bands	19
Table 2	– Touch voltage thresholds for reaction.....	21
Table 3	– Application of equipment in a low-voltage installation	33
Table 4	– Maximum protective conductor current for frequencies up to 1 kHz	38
Table 5	– Maximum protective conductor current for DC	38
Table 6	– Minimum impulse withstand voltage of devices for isolation related to the nominal voltage	43

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PROTECTION AGAINST ELECTRIC SHOCK –
COMMON ASPECTS FOR INSTALLATION AND EQUIPMENT**

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.

International Standard IEC 61140 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

This fourth edition cancels and replaces the third edition published in 2001 and Amendment 1:2004. This edition constitutes a technical revision.

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

- a) Introduction of the content of IEC 60449
- b) Better distinction between provisions and measures
- c) Consideration of effects other than ventricular fibrillation
- d) Additional protection was introduced
- e) ELV defined as part of LV
- f) Devices suitable for isolation required for automatic disconnection of supply (LV)

- g) Requirements relating to current in the protective conductor were moved to the main body of the standard

The text of this standard is based on the following documents:

FDIS	Report on voting
64/2076/FDIS	64/2091/RVD

Full information on the voting for the approval of this standard 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.

It has the status of a basic safety publication in accordance with IEC Guide 104.

The reader's attention is drawn to the fact that Annex C lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this standard.

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

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

PROTECTION AGAINST ELECTRIC SHOCK – COMMON ASPECTS FOR INSTALLATIONS AND EQUIPMENT

1 Scope

This International Standard is a basic safety publication primarily intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

It is not intended to be used as a stand-alone standard.

According to IEC Guide 104, technical committees, when preparing, amending, or revising their publications, are required to make use of any basic safety publication such as IEC 61140.

This International Standard applies to the protection of persons and livestock against electric shock. The intent is to give fundamental principles and requirements which are common to electrical installations, systems and equipment or necessary for their coordination, without limitations with regard to the magnitude of the voltage or current, or the type of current, and for frequencies up to 1 000 Hz.

Some clauses in this standard refer to low-voltage and high-voltage systems, installations and equipment. For the purposes of this standard, low-voltage is any rated voltage up to and including 1 000 V a.c. or 1 500 V d.c.. High voltage is any rated voltage exceeding 1 000 V a.c. or 1 500 V d.c..

It should be noted that, for an efficient design and selection of protective measures, the type of voltage that may occur and its waveform needs to be considered, i.e. a.c. or d.c. voltage, sinusoidal, transient, phase controlled, superimposed d.c., as well as a possible mixture of these forms. The installations or equipment may influence the waveform of the voltage, e.g. by inverters or converters. The currents flowing under normal operating conditions and under fault conditions depend on the described voltage.

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 undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038, *IEC standard voltages*

IEC 60068 (all parts), *Environmental testing*

IEC 60071-1, *Insulation coordination – Part 1: Definitions, principles and rules*

IEC 60071-2, *Insulation coordination – Part 2: Application guide*

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 60417, *Graphical symbols for use on equipment*
(available at <http://www.graphical-symbols.info/equipment>)