IEC 61140

Edition 3.1 2009-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Protection against electric shock – Common aspects for installation and equipment

Protection contre les chocs électriques – Aspects communs aux installations et aux matériels

IEC 61140:2001+A1:2004

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub
The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.
- IEC Just Published: www.iec.ch/online_news/justpub
Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.
- Electropedia: www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.
- Customer Service Centre: www.iec.ch/webstore/custserv
If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm
Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.
- Just Published CEI: www.iec.ch/online_news/justpub
Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.
- Electropedia: www.electropedia.org
Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.
- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

IEC 61140

Edition 3.1 2009-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Protection against electric shock – Common aspects for installation and equipment

Protection contre les chocs électriques – Aspects communs aux installations et aux matériels

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 13.260; 29.020; 91.140.50

ISBN 978-2-88910-415-4

CONTENTS

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 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.

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

This consolidated version of IEC 61140 consists of the third edition (2001) [documents 64/1191/FDIS and 64/1202/RVD] and its amendment 1 (2004) [documents 64/1402/FDIS and 64/1412/RVD].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 3.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

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

Annexes A, B and C are for information only.

The committee has decided that the contents of the base publication and its amendments 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

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

INTRODUCTION

This International Standard is a Basic Safety Publication intended for use by technical committees in the preparation of standards in accordance with the principles of IEC Guide 104 and ISO/IEC Guide 51.

PROTECTION AGAINST ELECTRIC SHOCK – COMMON ASPECTS FOR INSTALLATION AND EQUIPMENT

1 Scope

This International Standard applies to the protection of persons and animals against electric shock. It is intended to give fundamental principles and requirements which are common to electrical installations, systems and equipment or necessary for their co-ordination.

This standard has been prepared for installations, systems and equipment without a voltage limit.

NOTE There are some clauses in this standard which refer to low-voltage and high-voltage systems, installations and equipment. For the purpose 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.

The requirements of this standard apply only if they are incorporated, or are referred to, in the relevant standards. It is not intended to be used as a stand-alone standard.

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 60038:1983, *IEC standard voltages*

IEC 60050(131): *International Electrotechnical Vocabulary (IEV) – Chapter 131: Electric and magnetic circuits*

IEC 60050(195): 1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*
Amendment 1 (2001)

IEC 60050(351):1998, *International Electrotechnical Vocabulary – Part 351: Automatic control*

IEC 60050(826):1982, *International Electrotechnical Vocabulary – Chapter 826: Electrical installations of buildings*
Amendment 2 (1995)

IEC 60071-1:1993, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60364-4-41, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock*

IEC 60364-4-443:1995, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 44: Protection against overvoltages – Section 443: Protection against overvoltages of atmospheric origin or due to switching*

IEC 60364-5-54:1980, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Chapter 54: Earthing arrangements and protective conductors*

IEC 60364-6-61:1986, *Electrical installations of buildings – Part 6: Verification – Chapter 61: Initial verification*

IEC 60417-2, *Graphical symbols for use on equipment – Part 2: Symbol originals*

IEC 60446:1999, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or numerals*

IEC 60479-1:1994, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60601 (all parts), *Medical electrical equipment*

IEC 60601-1:1988, *Medical electrical equipment – Part 1: General requirements for safety*

IEC 60664-1:1992, *Insulation co-ordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60721 (all parts), *Classification of environmental conditions*

IEC 60990:1999, *Methods of measurement of touch current and protective conductor current*

IEC 61201:1992, *Extra-low-voltage (ELV) – Limit values*

IEC 62271-102:2001, *High-voltage switchgear and controlgear – Part 102 : Alternating current disconnectors and earthing switches*

ISO/IEC Guide 51:1999, *Safety aspects – Guidelines for their inclusion in standards*

IEC Guide 104:1997, *The preparation of safety publications and the use of basic safety publications and group safety publications*

3 Definitions

NOTE An index of definitions is given in annex C.

For the purpose of this International Standard the following definitions apply:

3.1
electric shock
physiological effect resulting from an electric current through a human or animal body

[IEV 195-01-04]

3.1.1
basic protection
protection against electric shock under fault-free conditions

[IEV 195-06-01]

NOTE For low-voltage installations, systems and equipment, basic protection generally corresponds to protection against direct contact as used in IEC 60364-4-41.

3.1.2
fault protection
protection against electric shock under single-fault conditions

[IEV 195-06-02]

NOTE For low-voltage installations, systems and equipment, fault protection generally corresponds to protection against indirect contact as used in IEC 60364-4-41, mainly with regard to failure of basic insulation.

3.2
(electric) circuit
an arrangement of devices or media through which electric current can flow

[IEV 131-01-01]

NOTE See also IEV 826-05-01 for electrical installations of buildings.

3.3
(electrical) equipment
any item used for such purposes as generation, conversion, transmission, storage, distribution or utilization of electrical energy, such as machines, transformers, apparatus, measuring instruments, protective devices, accessories for wiring systems, appliances

[IEV 826-07-01, modified]

3.4
live part
conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

[IEV 195-02-19]

NOTE 1 This concept does not necessarily imply a risk of electric shock.

NOTE 2 For definitions of PEM and PEL see IEV 195-02-13 and 195-02-14.

3.5
hazardous-live-part
live part which, under certain conditions, can give a harmful electric shock

[IEV 195-06-05]

NOTE In case of high voltage, a hazardous voltage may be present on the surface of solid insulation. In such a case the surface is considered to be a hazardous-live-part.

3.6
exposed-conductive-part
conductive part of equipment, which can be touched and which is not normally live, but which can become live when basic insulation fails

[IEV 195-06-10]

NOTE A conductive part of electrical equipment which can only become live through contact with an exposed-conductive-part which has become live, is not considered to be an exposed-conductive-part itself.

3.7
extraneous-conductive-part
conductive part not forming part of the electrical installation and liable to introduce an electric potential, generally the electric potential of a local earth

[IEV 195-06-11]

3.8
touch voltage

3.8.1
(effective) touch voltage
voltage between conductive parts when touched simultaneously by a person or an animal

NOTE The value of the effective touch voltage may be appreciably influenced by the impedance of the person or the animal in electric contact with these conductive parts.

[IEV 195-05-11]

3.8.2
prospective touch voltage
voltage between simultaneously accessible conductive parts when those conductive parts are not being touched, by a person or an animal

[IEV 195-05-09]

3.9
touch current
electric current passing through a human body or through an animal body when it touches one or more accessible parts of an installation or of equipment

[IEV 195-05-21]

3.10
insulation

NOTE Insulation can be a solid, a liquid or a gas (e.g. air), or any combination.

3.10.1
basic insulation
insulation of hazardous-live-parts which provides basic protection

NOTE This concept does not apply to insulation used exclusively for functional purposes.

[IEV 195-06-06]

3.10.2
supplementary insulation
independent insulation applied in addition to basic insulation, for fault protection

[IEV 195-06-07]

3.10.3
double insulation
insulation comprising both basic insulation and supplementary insulation

[IEV 195-06-08]

3.10.4
reinforced insulation
insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to double insulation

NOTE Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[IEV 195-06-09]

3.11
non-conducting environment
provision whereby a person or an animal touching an exposed-conductive-part that has become hazardous-live is protected by the high impedance of his environment (e.g. insulating walls and floors) and by the absence of earthed conductive parts

[IEV 195-06-21]

3.12
(electrically) protective obstacle
part preventing unintentional direct contact, but not preventing direct contact by deliberate action

[IEV 195-06-16]

NOTE Direct contact is defined in IEV 195-06-03.

3.13
(electrically) protective barrier
part providing protection against direct contact from any usual direction of access

[IEV 195-06-15]

NOTE Direct contact is defined in IEV 195-06-03.

3.14
(electrically) protective enclosure
electrical enclosure surrounding internal parts of equipment to prevent access to hazardous-live-part from any direction

[IEV 195-06-14]

NOTE In addition, an enclosure generally provides protection against internal or external influences, e.g. ingress of dust or water or prevention of mechanical damage.

3.15
arm's reach
zone of accessibility to touch extending from any point on a surface where persons usually stand or move about to the limits which a person can reach with the hand, in any direction, without assistance

[IEV 195-06-12]

3.16
equipotential bonding
provision of electric connections between conductive parts, intended to achieve equipotentiality

[IEV 195-01-10]

NOTE The effectiveness of the equipotential bonding may depend on the frequency of the current in the bonding.

3.16.1
protective equipotential bonding
equipotential bonding for purposes of safety (e.g. protection against electric shock)

[IEV 195-01-15, modified]

NOTE Functional equipotential bonding is defined in IEV 195-01-16.

3.16.2
equipotential bonding terminal
terminal provided on equipment or on a device and intended for the electric connection with the equipotential bonding system

[IEV 195-02-32]

3.16.3
protective bonding terminal
terminal intended for protective-equipotential-bonding purposes

3.16.4
protective conductor, PE
conductor provided for purposes of safety, for example protection against electric shock

[IEV 195-02-09]

3.16.5
PEN conductor
conductor combining the functions of both protective conductor and neutral conductor

[IEV 195-02-12, modified]

3.17
earth

NOTE The concept "Earth" means the planet and all its physical matter

3.17.1
reference earth
reference ground (US)
part of the earth considered as conductive, the electric potential of which is conventionally taken as zero, being outside the zone of influence of any earthing arrangement

[IEV 195-01-01]

3.17.2
(local) earth
(local) ground (US)
part of the earth which is in electric contact with an earth electrode and the electric potential of which is not necessarily equal to zero

[IEV 195-01-03]

3.17.3
earth electrode
ground electrode (US)
conductive part, which may be embedded in a specific conductive medium, e.g. concrete or coke, in electric contact with the earth

[IEV 195-02-01]

3.17.4
earthing conductor
grounding conductor (US)
conductor which provides a conductive path, or part of the conductive path, between a given point in a system or in an installation or in equipment and an earth electrode

[IEV 195-02-03]

3.17.5
earthing arrangement
grounding arrangement (US)
all the electric connections and devices involved in the earthing of a system, an installation and equipment

[IEV 195-02-20]

NOTE This could be a locally limited arrangement of interconnected earth electrodes on the high-voltage side.

3.17.6
protective earthing
protective grounding (US)
earthing a point or points in a system or in an installation or in equipment for purposes of electrical safety

[IEV 195-01-11]

3.17.7
functional earthing
functional grounding (US)
earthing a point or points in a system or in an installation or in equipment, for purposes other than electrical safety

[IEV 195-01-13]