Protection against electric shock – Common aspects for installation and equipment

This English-language version is derived from the original bilingual publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.
Protection against electric shock –
Common aspects for installation 
and equipment

© IEC 2001 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 Varembé, 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 X

For price, see current catalogue
CONTENTS

FOREWORD ....................................................................................................................... 7
INTRODUCTION .................................................................................................................. 11

1 Scope ............................................................................................................................ 13
2 Normative references .................................................................................................... 13
3 Definitions ...................................................................................................................... 15
4 Fundamental rule of protection against electric shock .................................................. 31
  4.1 Normal conditions ................................................................................................... 31
  4.2 Single-fault conditions .............................................................................................. 31
    4.2.1 Protection by two independent protective provisions .................................. 33
    4.2.2 Protection by an enhanced protective provision ............................................ 33
  4.3 Special cases ............................................................................................................ 33
5 Protective provisions (elements of protective measures) .............................................. 35
  5.1 Provisions for basic protection ............................................................................... 35
    5.1.1 Basic insulation ............................................................................................... 35
    5.1.2 Barriers or enclosures .................................................................................... 35
    5.1.3 Obstacles ......................................................................................................... 37
    5.1.4 Placing out of arm’s reach .............................................................................. 37
    5.1.5 Limitation of voltage ...................................................................................... 39
    5.1.6 Limitation of steady-state touch current and charge ..................................... 39
    5.1.7 Potential grading ............................................................................................ 39
    5.1.8 Other provisions ............................................................................................. 39
  5.2 Provisions for fault protection ................................................................................ 39
    5.2.1 Supplementary insulation .............................................................................. 39
    5.2.2 Protective-equipotential-bonding ................................................................... 41
    5.2.3 Protective screening ....................................................................................... 43
    5.2.4 Indication and disconnection in high-voltage installations and systems .......... 45
    5.2.5 Automatic disconnection of supply ............................................................... 45
    5.2.6 Simple separation (between circuits) ............................................................ 45
    5.2.7 Non-conducting environment ....................................................................... 45
    5.2.8 Potential grading ............................................................................................ 47
    5.2.9 Other provisions ............................................................................................. 47
  5.3 Enhanced protective provisions ............................................................................. 47
    5.3.1 Reinforced insulation ..................................................................................... 47
    5.3.2 Protective-separation between circuits ......................................................... 47
    5.3.3 Limited-current-source .................................................................................. 49
    5.3.4 Protective impedance device ........................................................................ 49
    5.3.5 Other provisions ............................................................................................. 49
6 Protective measures .................................................................................................... 49
  6.1 Protection by automatic disconnection of supply ..................................................... 49
  6.2 Protection by double or reinforced insulation ........................................................ 49
  6.3 Protection by equipotential bonding ....................................................................... 51
  6.4 Protection by electrical separation ......................................................................... 51
  6.5 Protection by non-conducting environment (low-voltage) ..................................... 51
  6.6 Protection by SELV ............................................................................................... 51
6.7 Protection by PELV ................................................................. 53
6.8 Protection by limitation of steady-state touch current and charge .......... 53
6.9 Protection by other measures .................................................. 53
7 Co-ordination of electrical equipment and of protective provisions within an electrical installation ........................................................................................................... 53
  7.1 Class 0 equipment ................................................................. 55
    7.1.1 Insulation ................................................................. 55
  7.2 Class I equipment ......................................................................... 55
    7.2.1 Insulation ................................................................. 55
    7.2.2 Protective-equipotential-bonding ....................................... 55
    7.2.3 Accessible surfaces of parts of insulating material ............... 55
    7.2.4 Connection of a protective conductor ................................... 57
  7.3 Class II equipment .......................................................................... 57
    7.3.1 Insulation ................................................................. 57
    7.3.2 Protective bonding ......................................................... 59
    7.3.3 Marking .................................................................................. 59
  7.4 Class III equipment .......................................................................... 59
    7.4.1 Voltages .................................................................................. 59
    7.4.2 Protective bonding ......................................................... 61
    7.4.3 Marking .................................................................................. 61
  7.5 Touch currents, protective conductor currents, leakage currents .................. 61
    7.5.1 Touch currents ............................................................. 61
    7.5.2 Protective conductor currents ............................................. 63
    7.5.3 Other requirements ......................................................... 65
  7.6 Safety and boundary clearances and warning labels for high-voltage installations .................................................................................................................. 65
8 Special operating and servicing conditions ............................................... 67
  8.1 Devices to be operated manually and components intended to be replaced manually .................................................................................................................. 67
    8.1.1 Devices to be operated or components intended to be replaced by ordinary persons in low-voltage installations, systems and equipment ........ 67
    8.1.2 Devices to be operated or components intended to be replaced by skilled or instructed persons .......................................................... 67
  8.2 Electrical values after isolation ......................................................... 69

Annex A (informative) Survey of protective measures as implemented by protective provisions .................................................................................................................. 71
Annex B (informative) Values of maximum a.c. limits of protective conductor currents for cases 7.5.2.2 a) and 7.5.2.2 b) ......................................................................................... 75
Annex C (informative) Index of definitions .................................................. 77
FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The 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 third edition cancels and replaces the second edition, published in 1997, and constitutes a technical revision.

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

<table>
<thead>
<tr>
<th>FDIS</th>
<th>Report on voting</th>
</tr>
</thead>
<tbody>
<tr>
<td>64/1191/FDIS</td>
<td>64/1202/RVD</td>
</tr>
</tbody>
</table>

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 3.

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 this publication will remain unchanged until 2006. 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.
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 normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

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

Amendment 1 (2001)


Amendment 2 (1995)


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
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

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

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

---

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 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
