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Protection against electric shock – Common aspects for installations and equipment

INTERNATIONAL
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CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms and definitions	9
4 Fundamental rule of protection against electric shock	20
4.1 General	20
4.2 Normal conditions	20
4.3 Single-fault conditions	21
4.3.1 General	21
4.3.2 Protection by two independent protective provisions	22
4.3.3 Protection by an enhanced protective provision	22
4.4 Special cases Additional protection	22
4.5 Protection against electric burns	22
4.6 Protection against physiological effects without adverse health effect	23
4.6.1 General	23
4.6.2 Muscular reaction	23
4.6.3 Effects of touch current of discharge of electrostatic charges	23
4.6.4 Thermal effects	23
5 Protective provisions (elements of protective measures)	24
5.1 General	24
5.2 Provisions for basic protection	24
5.2.1 General	24
5.2.2 Basic insulation	24
5.2.3 Protective barriers or enclosures	24
5.2.4 Obstacles	25
5.2.5 Placing out of arm's reach	25
5.2.6 Limitation of voltage	26
5.2.7 Limitation of steady-state touch current and charge energy	26
5.2.8 Potential grading	27
5.2.9 Other provisions for basic protection	27
5.3 Provisions for fault protection	27
5.3.1 General	27
5.3.2 Supplementary insulation	27
5.3.3 Protective-equipotential-bonding	27
5.3.4 Protective screening	29
5.3.5 Indication and disconnection in high-voltage installations and systems	29
5.3.6 Automatic disconnection of supply	30
5.3.7 Simple separation (between circuits)	30
5.3.8 Non-conducting environment	30
5.3.9 Potential grading	30
5.3.10 Other provisions for fault protection	31
5.4 Enhanced protective provisions	31
5.4.1 General	31
5.4.2 Reinforced insulation	31
5.4.3 Protective separation between circuits	31
5.4.4 Limited current source	31

5.4.5	Protective impedance device	32
5.4.6	Other provisions for enhanced protection.....	32
5.5	Provisions for additional protection	32
5.5.1	Additional protection by residual current protective device (RCD) $I_{\Delta n} \leq 30 \text{ mA}$	32
5.5.2	Additional protection by supplementary equipotential bonding	32
6	Protective measures	33
6.1	General.....	33
6.2	Protection by automatic disconnection of supply	33
6.3	Protection by double or reinforced insulation.....	33
6.4	Protection by protective equipotential bonding	33
6.5	Protection by electrical separation	33
6.6	Protection by non-conducting environment (low-voltage).....	34
6.7	Protection by SELV system.....	34
6.8	Protection by PELV system	34
6.9	Protection by limitation of steady-state touch current and charge	34
6.10	Additional protection	35
6.10.1	Additional protection by residual current protective device (RCD) $I_{\Delta n} \leq 30 \text{ mA}$	35
6.10.2	Additional protection by supplementary protective equipotential bonding	35
6.11	Protection by other measures	35
7	Co-ordination of between electrical equipment and of protective provisions within an electrical installation	35
7.1	General.....	35
7.2	Class 0 equipment	36
7.1.1	Insulation.....	36
7.3	Class I equipment	37
7.3.1	General	37
7.3.2	Insulation.....	37
7.3.3	Protective equipotential bonding Connection to the protective conductor	37
7.3.4	Accessible surfaces of parts of insulating material	37
7.3.5	Connection of a protective conductor	38
7.4	Class II equipment	38
7.4.1	General	38
7.4.2	Insulation.....	38
7.4.3	Protective bonding.....	39
7.4.4	Marking	39
7.5	Class III equipment	39
7.5.1	General	39
7.5.2	Voltages	40
7.5.3	Protective bonding.....	40
7.5.4	Marking	40
7.6	Touch currents, protective conductor currents, leakage currents	40
7.6.1	General	40
7.6.2	Touch currents	40
7.6.3	Protective conductor currents	41
7.6.4	Other requirements.....	43
7.6.5	Other effects.....	43

7.7	Safety and boundary clearances and warning labels hazard marking for high-voltage installations	43
7.8	Functional earthing	44
8	Special operating and servicing conditions	44
8.1	General.....	44
8.2	Devices to be operated manually and components intended to be replaced manually	44
8.2.1	General	44
8.2.2	Devices to be operated or components intended to be replaced by ordinary persons in low-voltage installations, systems and equipment	44
8.2.3	Devices to be operated or components intended to be replaced by skilled or instructed persons	45
8.3	Electrical values after isolation.....	45
8.4	Devices for isolation.....	46
8.4.1	General	46
8.4.2	Devices for isolation for low voltage.....	46
8.4.3	Devices for isolation for high voltage	47
	Annex A (informative) Survey of protective measures as implemented by protective provisions	49
	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)	49
	Annex B (informative) Index of definitions terms	56
	Annex C (informative) List of notes concerning certain countries	61
	Bibliography.....	62
	Figure A.1 – Protective measures with basic and fault protection	51
	Figure A.2 – Protective measures with limited values of electrical quantities	53
	Figure A.3 – Protective measure: additional protection (in addition to basic and/or fault protection)	54
	Table 1 – Limits for voltage bands	21
	Table 2 – Touch voltage thresholds for reaction.....	23
	Table 4 3 – Application of equipment in a low-voltage installation	36
	Table 4 – Maximum protective conductor current for frequencies up to 1 kHz	41
	Table 5 – Maximum protective conductor current for DC	42
	Table 6 – Minimum impulse withstand voltage of devices for isolation related to the nominal voltage	47

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.
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- 6) All users should ensure that they have the latest edition of this publication.
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- 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.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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.

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 publication using a colour printer.

INTRODUCTION

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 ~~animals~~ 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.

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

NOTE 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..

~~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.~~

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 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 60038, IEC standard voltages

IEC 60068 (all parts), Environmental testing

IEC 60071-1:1993, Insulation coordination – Part 1: Definitions, principles and rules

IEC 60071-2:1996, Insulation coordination – 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 2011, Low-voltage electrical installations of buildings – Part 5-54: 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, Graphical symbols for use on equipment
(available at <http://www.graphical-symbols.info/equipment>)

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

IEC 60445, Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors

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

IEC TS 60479-1:1994 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 60529:1989, 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 (all parts), Insulation coordination for equipment within low-voltage systems

IEC 60664-1:1992 2007, Insulation coordination 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 TS 61201:~~1992~~ 2007, ~~Extra-low-voltage (ELV) – Limit values~~ *Use of conventional touch voltage limits – Application guide*

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

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

ISO/IEC Guide 51:~~1999~~ 2014, *Safety aspects – Guidelines for their inclusion in standards*

INTERNATIONAL STANDARD

NORME INTERNATIONALE

BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Protection against electric shock – Common aspects for installations and equipment

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

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

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1 Scope

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

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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>)

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

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 enclosure (IP Code)*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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

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

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*

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*

SOMMAIRE

AVANT-PROPOS	59
1 Domaine d'application	61
2 Références normatives	61
3 Termes et définitions	62
4 Règle fondamentale de protection contre les chocs électriques	73
4.1 Généralités	73
4.2 Conditions normales	73
4.3 Conditions de premier défaut	74
4.3.1 Généralités	74
4.3.2 Protection par des mesures de protection indépendantes	75
4.3.3 Protection par une mesure de protection renforcée	75
4.4 Protection complémentaire	75
4.5 Protection contre les brûlures électriques	75
4.6 Protection contre les effets physiologiques sans effet nocif pour la santé	76
4.6.1 Généralités	76
4.6.2 Réaction musculaire	76
4.6.3 Effets du courant de contact de décharge des charges électrostatiques	76
4.6.4 Effets thermiques	76
5 Mesures de protection (éléments de mesures de prévention)	77
5.1 Généralités	77
5.2 Mesures pour la protection principale	77
5.2.1 Généralités	77
5.2.2 Isolation principale	77
5.2.3 Barrières ou enveloppes de protection	77
5.2.4 Obstacles	78
5.2.5 Mise hors de volume d'accessibilité au toucher	78
5.2.6 Limitation de la tension	79
5.2.7 Limitation du courant de contact en régime établi et de l'énergie	79
5.2.8 Gradient de potentiel	80
5.2.9 Autres mesures pour la protection principale	80
5.3 Mesures de protection en cas de défaut	80
5.3.1 Généralités	80
5.3.2 Isolation supplémentaire	80
5.3.3 Liaison équipotentielle de protection	80
5.3.4 Protection par écran	82
5.3.5 Indication et déconnexion dans les installations et systèmes à haute tension	82
5.3.6 Coupure automatique de l'alimentation	82
5.3.7 Séparation simple (entre circuits)	83
5.3.8 Environnement non conducteur	83
5.3.9 Gradient de potentiel	83
5.3.10 Autres mesures pour la protection en cas de défaut	83
5.4 Mesures de protection renforcée	83
5.4.1 Généralités	83
5.4.2 Isolation renforcée	84
5.4.3 Séparation de protection entre circuits	84

5.4.4	Source à courant limité	84
5.4.5	Dispositif d'impédance de protection.....	84
5.4.6	Autres mesures pour la protection renforcée.....	85
5.5	Mesures pour la protection complémentaire	85
5.5.1	Protection complémentaire par dispositif de protection à courant différentiel résiduel (DDR) $I_{\Delta n} \leq 30$ mA	85
5.5.2	Protection complémentaire par liaison équipotentielle supplémentaire	85
6	Mesures de prévention	85
6.1	Généralités	85
6.2	Protection par coupure automatique de l'alimentation	86
6.3	Protection par double isolation ou par isolation renforcée	86
6.4	Protection par liaison équipotentielle de protection	86
6.5	Protection par séparation électrique.....	86
6.6	Protection par environnement non conducteur (basse tension).....	87
6.7	Protection par schéma TBTS	87
6.8	Protection par schéma TBTP	87
6.9	Protection par limitation du courant de contact en régime établi et de la charge électrique	87
6.10	Protection complémentaire.....	88
6.10.1	Protection complémentaire par dispositif de protection à courant différentiel résiduel (DDR) $I_{\Delta n} \leq 30$ mA.....	88
6.10.2	Protection complémentaire par liaison équipotentielle de protection supplémentaire	88
6.11	Protection par d'autres mesures.....	88
7	Coordination des matériels électriques et des mesures de protection dans une installation électrique.....	88
7.1	Généralités	88
7.2	Matériel de la classe 0	89
7.3	Matériel de classe I.....	89
7.3.1	Généralités	89
7.3.2	Isolement.....	89
7.3.3	Connexion au conducteur de protection	89
7.3.4	Surfaces accessibles de parties en matériau isolant	89
7.3.5	Connexion d'un conducteur de protection	90
7.4	Matériel de classe II.....	90
7.4.1	Généralités	90
7.4.2	Isolement.....	91
7.4.3	Equipotentialité de protection	91
7.4.4	Marquage	92
7.5	Matériel de classe III.....	92
7.5.1	Généralités	92
7.5.2	Tensions.....	92
7.5.3	Equipotentialité de protection	92
7.5.4	Marquage	92
7.6	Courants de contact, courants dans le conducteur de protection	93
7.6.1	Généralités	93
7.6.2	Courants de contact.....	93
7.6.3	Courants dans le conducteur de protection	93
7.6.4	Autres exigences	95
7.6.5	Autres effets	95

7.7	Distances de sécurité et distances d'isolement et signaux d'avertissement pour installations à haute tension.....	95
7.8	Mise à la terre pour des raisons fonctionnelles	96
8	Conditions spéciales d'exploitation et d'entretien	96
8.1	Généralités	96
8.2	Dispositifs à manœuvre manuelle et composants destinés à être remplacés manuellement	96
8.2.1	Généralités	96
8.2.2	Dispositifs destinés à être manœuvrés ou composants destinés à être remplacés par des personnes ordinaires dans des installations, systèmes et matériels à basse tension.....	96
8.2.3	Dispositifs destinés à être manœuvrés ou composants destinés à être remplacés par des personnes qualifiées ou averties	97
8.3	Valeurs électriques après sectionnement	98
8.4	Dispositifs de sectionnement	98
8.4.1	Généralités	98
8.4.2	Dispositifs de sectionnement en basse tension	98
8.4.3	Dispositifs de sectionnement en haute tension	99
	Annexe A (informative) Étude des mesures de prévention mises en œuvre par des mesures de protection	101
	Annexe B (informative) Index des termes.....	106
	Annexe C (informative) Liste de notes concernant certains pays.....	110
	Bibliographie.....	111
	Figure A.1 – Mesures de prévention avec protection principale et protection en cas de défaut	102
	Figure A.2 – Mesures de prévention avec des valeurs limitées de grandeurs électriques	103
	Figure A.3 – Mesure de prévention: protection complémentaire (en plus de la protection principale et/ou de la protection en cas de défaut).....	105
	Tableau 1 – Limites pour bandes de tension	74
	Tableau 2 – Seuils de tension de contact pour réaction	76
	Tableau 3 – Mise en œuvre des matériels dans une installation à basse tension	89
	Tableau 4 – Courant maximal dans le conducteur de protection pour des fréquences jusqu'à 1 kHz	94
	Tableau 5 – Courant maximal dans le conducteur de protection pour le courant continu	94
	Tableau 6 – Tension de tenue aux chocs minimale des dispositifs de sectionnement par rapport à la tension nominale.....	99

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**PROTECTION CONTRE LES CHOCs ÉLECTRIQUES –
ASPECTS COMMUNS AUX INSTALLATIONS ET AUX MATÉRIELS**

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La Norme internationale IEC 61140 a été établie par le comité d'études 64 de l'IEC: Installations électriques et protection contre les chocs électriques.

Cette quatrième édition annule et remplace la troisième édition parue en 2001 et l'Amendement 1:2004. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) Introduction du contenu de l'IEC 60449
- b) Meilleure distinction entre les dispositions et les mesures
- c) Prise en compte des effets autres que la fibrillation ventriculaire
- d) Introduction d'une protection complémentaire
- e) TBT définie comme partie intégrante de BT

- f) Dispositifs adaptés au sectionnement exigés pour la coupure automatique de l'alimentation (BT)
- g) Les exigences relatives au courant circulant dans le conducteur de protection ont été déplacées dans le corps du texte de la norme

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
64/2076/FDIS	64/2091/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Elle a le statut d'une publication fondamentale de sécurité conformément au Guide IEC 104.

L'attention du lecteur est attirée sur le fait que l'Annexe C énumère tous les articles traitant des différences à caractère moins permanent inhérentes à certains pays, concernant le sujet de la présente norme.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives à la publication recherchée. À cette date, la publication sera

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- amendée.

PROTECTION CONTRE LES CHOCS ÉLECTRIQUES – ASPECTS COMMUNS AUX INSTALLATIONS ET AUX MATÉRIELS

1 Domaine d'application

La présente Norme internationale est une publication fondamentale de sécurité avant tout destinée à être utilisée par les comités d'études lors de l'élaboration de normes conformément aux principes établis dans le Guide IEC 104 et le Guide ISO/IEC 51.

Elle n'est pas destinée à être utilisée seule.

Conformément au Guide 104, il est demandé aux comités d'études, lors de l'élaboration, de l'amendement ou de la révision de leurs publications, d'utiliser toute publication fondamentale de sécurité applicable, telle que l'IEC 61140.

La présente Norme internationale est applicable à la protection des personnes et des animaux d'élevage contre les chocs électriques. Elle est destinée à donner des principes fondamentaux et des exigences communes aux installations, aux systèmes et aux matériels électriques, ou nécessaires à leur coordination sans limitation en ce qui concerne l'amplitude de tension ou de courant, ou le type de courant, et pour des fréquences jusqu'à 1 000 Hz.

Certains articles dans la présente norme se réfèrent à des systèmes, installations et matériels à basse tension et à haute tension. Pour les besoins de la présente norme, la basse tension correspond à toute tension assignée jusqu'à et y compris 1 000 V en courant alternatif ou 1 500 V en courant continu. La haute tension correspond à toute tension assignée supérieure à 1 000 V en courant alternatif ou 1 500 V en courant continu.

Il convient de noter que, pour une conception et une sélection efficaces des mesures de prévention, il est nécessaire de considérer le type de tension qui peut survenir et sa forme d'onde, c'est-à-dire la tension en courant alternatif ou en courant continu, sinusoïdale, transitoire, à commande de phase, en courant continu superposé, ainsi qu'un éventuel mélange de ces formes. Les installations ou matériels peuvent influencer la forme d'onde de la tension, par exemple, au moyen d'onduleurs ou de convertisseurs. Les courants circulant dans des conditions normales de fonctionnement et dans des conditions de défaut dépendent de la tension décrite.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60038, *Tensions normales de la CEI*

IEC 60068 (toutes les parties), *Essais d'environnement*

IEC 60071-1, *Coordination de l'isolement – Partie 1: Définitions, principes et règles*

IEC 60071-2, *Coordination de l'isolement – Partie 2: Guide d'application*

IEC 60364-5-54:2011, *Installations électriques basse-tension – Partie 5-54: Choix et mise en œuvre des matériels électriques – Installations de mise à la terre et conducteurs de protection*

IEC 60417, *Symboles graphiques utilisables sur le matériel* (disponible à l'adresse <http://www.graphical-symbols.info/equipment>)

IEC 60445, *Principes fondamentaux et de sécurité pour les interfaces homme-machines, le marquage et l'identification – Identification des bornes de matériels, des extrémités de conducteurs et des conducteurs*

IEC TS 60479-1:2005, *Effets du courant sur l'homme et les animaux domestiques – Partie 1: Aspects généraux*

IEC TR 60479-5, *Effets du courant sur l'homme et les animaux domestiques – Partie 5: Valeurs des seuils de tension de contact pour les effets physiologiques*

IEC 60529, *Degrés de protection procurés par les enveloppes (Code IP)*

IEC 60664 (toutes les parties), *Coordination de l'isolement des matériels dans les systèmes (réseaux) à basse tension*

IEC 60664-1:2007, *Coordination de l'isolement des matériels dans les systèmes (réseaux) à basse tension – Partie 1: Principes, exigences et essais*

IEC 60721 (toutes les parties), *Classification des conditions d'environnement*

IEC 60990, *Méthodes de mesure du courant de contact et du courant dans le conducteur de protection*

IEC TS 61201:2007, *Utilisation des tensions limites conventionnelles de contact – Guide d'application*

IEC 62271-102, *Appareillage à haute tension – Partie 102: Sectionneurs et sectionneurs de terre à courant alternatif*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications* (disponible en anglais seulement)

ISO/IEC Guide 51:2014, *Aspects liés à la sécurité – Principes directeurs pour les inclure dans les normes*