

EXTENDED VERSION



This Extended version of IEC 62040-1:2017 includes the provisions of the general rules of IEC 62477-1:2012

**Uninterruptible power systems (UPS) –
Part 1: Safety requirements**

ITeH Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 62040-1:2017](#)

<https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cf3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017>



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2017 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, 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 either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
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.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

www.iec.ch
<https://standards.iteh.ai/>
<https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cff3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017>

<https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cff3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017>

REDLINE VERSION



This Extended version of IEC 62040-1:2017 includes the provisions of the general rules of IEC 62477-1:2012

Uninterruptible power systems (UPS) – Part 1: Safety requirements

iteh Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 62040-1:2017](https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cf3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017)

<https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cf3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.200

ISBN 978-2-8322-4886-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	14
4 Protection against hazards	27
5 Test requirements.....	95
6 Information and marking requirements.....	138
Annex A (normative) Additional information for protection against electric shock.....	151
Annex B (informative) Considerations for the reduction of the pollution degree	172
Annex C (informative) Symbols referred to in this document	173
Annex D (normative) Evaluation of clearance and creepage distances	174
Annex E (informative) Altitude correction for clearances	181
Annex F (normative) Clearance and creepage distance determination for frequencies greater than 30 kHz	182
Annex G (informative) Cross-sections of round conductors	188
Annex H (informative) Guidelines for RCD compatibility.....	189
Annex I (informative) Examples of overvoltage category reduction.....	193
Annex J (informative) Burn thresholds for touchable surfaces	201
Annex K (informative) Table of electrochemical potentials	204
Annex L (informative) Measuring instrument for touch current measurements	205
Annex M (informative) Test probes for determining access	206
Annex AA (informative) Minimum and maximum cross-section of copper conductors suitable for connection to terminals for external conductor.....	210
Annex BB (normative) Reference loads.....	211
Annex CC (normative) Ventilation of lead-acid battery compartments	215
Annex DD (informative) Guidance for disconnection of batteries during shipment	218
Annex EE (informative) Short-time withstand current test procedure – Guidance and typical values.....	220
Annex FF (informative) Maximum heating effect in transformer tests.....	224
Annex GG (normative) Requirements for the mounting means of rack-mounted equipment.....	226
Bibliography.....	228
Figure 1 – Touch time - d.c. peak voltage zones of ventricular fibrillation in dry skin condition.....	37
Figure 2 – Touch time - d.c. peak voltage zones of ventricular fibrillation in water-wet skin condition.....	37
Figure 3 – Touch time - d.c. peak voltage zones of ventricular fibrillation in saltwater-wet skin condition	38
Figure 4 – Example of a UPS assembly and its associated protective equipotential bonding.....	42
Figure 5 – Example of a UPS assembly and its associated protective equipotential bonding.....	43

Figure 6 – Fire enclosure bottom openings below an unenclosed or partially enclosed fire-hazardous component.....	71
Figure 7 – Fire enclosure baffle construction.....	72
Figure 8 – Supported and unsupported enclosure parts	89
Figure 9 – Impact test using a steel ball.....	101
Figure 10 – Voltage test procedures	109
Figure 11 – Protective equipotential bonding impedance test for separate unit with power fed from the UPS with protection for the power cable	115
Figure 12 – Protective equipotential bonding impedance test for sub-assembly with accessible parts and with power fed from the UPS.....	116
Figure 13 – Circuit for high-current arcing test	131
Figure 14 – Test fixture for hot-wire ignition test	132
Figure 101 – Examples of design of openings preventing vertical access.....	40
Figure 102 – Test circuit for load-induced change of reference potential – Single-phase output.....	119
Figure 103 – Test circuit for load-induced change of reference potential – Three-phase output.....	119
Figure 104 – Voltage backfeed warning label.....	146
Figure A.1 – Protection by DVC As with protective separation.....	151
Figure A.2 – Protection by means of protective impedance	152
Figure A.3 – Protection by using limited voltages	153
Figure A.4 – Touch time- d.c. voltage zones for dry skin condition	156
Figure A.5 – Touch time- d.c. voltage zones for water-wet skin condition.....	156
Figure A.6 – Touch time- d.c. voltage for saltwater-wet skin condition.....	157
Figure A.7 – Touch time- d.c. voltage zones of dry skin condition	158
Figure A.8 – Touch time- d.c. voltage zones of water-wet skin condition	158
Figure A.9 – Touch time- d.c. voltage zones of saltwater-wet skin condition.....	159
Figure A.10 – Touch time- d.c. voltage zones of dry skin condition	160
Figure A.11 – Touch time- d.c. voltage zones of water-wet skin condition	160
Figure A.12 – Touch time- a.c. voltage zones for dry skin condition	161
Figure A.13 – Touch time- a.c. voltage zones of water-wet skin condition	162
Figure A.14 – Touch time- a.c. voltage of saltwater-wet skin condition.....	162
Figure A.15 – Touch time- a.c. voltage zones of dry skin condition	163
Figure A.16 – Touch time- a.c. voltage zones of water-wet skin condition	164
Figure A.17 – Touch time- a.c. voltage zones of saltwater-wet skin condition.....	164
Figure A.18 – Touch time- a.c. voltage zones of dry skin condition	165
Figure A.19 – Touch time- a.c. voltage zones of water-wet skin condition	166
Figure A.20 – Typical waveform for a.c. working voltage.....	167
Figure A.21 – Typical waveform for d.c. working voltage.....	167
Figure A.22 – Typical waveform for pulsating working voltage.....	168
Figure F.1 – Diagram for dimensioning of clearances.....	183
Figure F.2 – Diagram for dimensioning of creepage distances	185
Figure F.3 – Permissible field strength for dimensioning of solid <i>insulation</i> according to Equation (1).....	187
Figure H.1 – Flow chart leading to selection of the RCD type upstream of a UPS.....	189

Figure H.2 – Fault current waveforms in connections with power electronic converter devices	191
Figure I.1 – Basic insulation evaluation for circuits connected to the origin of the installation mains supply	193
Figure I.2 – Basic insulation evaluation for circuits connected to the mains supply.....	194
Figure I.3 – Basic insulation evaluation for single and three phase equipment not permanently connected to the mains supply.....	194
Figure I.4 – Basic insulation evaluation for circuits connected to the origin of the installation mains supply where internal SPDs are used.....	194
Figure I.5 – Basic insulation evaluation for circuits connected to the mains supply where internal SPDs are used.....	195
Figure I.6 – Example of protective separation evaluation for circuits connected to the mains supply where internal SPDs are used	195
Figure I.7 – Example of protective separation evaluation for circuits connected to the mains supply where internal SPDs are used	196
Figure I.8 –Example of protective separation evaluation for circuits connected to the mains supply where internal SPDs are used	196
Figure I.9 – Basic insulation evaluation for circuits not connected directly to the mains supply	197
Figure I.10 – Basic insulation evaluation for circuits not connected directly to the supply mains.....	197
Figure I.11 – Functional insulation evaluation within circuits affected by external transients.....	198
Figure I.12 – Basic insulation evaluation for circuits both connected and not connected directly to the mains supply.....	198
Figure I.13 – <i>Insulation</i> evaluation for accessible circuit of DVC A	199
Figure I.14 – UPS with mains and non-mains supply without galvanic separation.....	199
Figure I.15 – Transformer (basic) isolated UPS inverter with SPD and transformer to reduce impulse voltage for functional and basic insulation.	200
Figure J.1 – Burn threshold spread when the skin is in contact with a hot smooth surface made of bare (uncoated) metal.....	201
Figure J.2 – Rise in the burn threshold spread from Figure J.1 for metals which are coated by shellac varnish of a thickness of 50 µm, 100 µm and 150 µm.....	202
Figure J.3 – Rise in the burn threshold spread from Figure J.1 for metals coated with the specific materials	202
Figure J.4 – Burn threshold spread when the skin is in contact with a hot smooth surface made of ceramics, glass and stone materials	203
Figure J.5 – Burn threshold spread when the skin is in contact with a hot smooth surface made of plastics	203
Figure K.1 – Electrochemical potentials (V).....	204
Figure L.1 – Measuring instrument.....	205
Figure M.2 – Jointed test finger (IPXXB)	207
Figure M.3 – Test rod 2,5 mm (IP3X)	208
Figure M.101 – Jointed test finger (IP2X).....	209
Figure BB.1 – Reference resistive load	211
Figure BB.2 – Reference inductive-resistive load (series)	212
Figure BB.3 – Reference inductive-resistive load (parallel)	212
Figure BB.4 – Reference capacitive-resistive load (series).....	212
Figure BB.5 – Reference capacitive-resistive load (parallel).....	212

Figure BB.6 – Reference non-linear load	213
Figure DD.1 – Precautionary label for products shipped with the battery disconnected	218
Figure DD.2 – Precautionary label for products shipped with the battery connected	219
Figure EE.1 – 3-wire test circuit for UPS short-time withstand current.....	220
Figure EE.2 – 4-wire test circuit for UPS short-time withstand current.....	221
Figure EE.3 – 2-wire test circuit for single phase UPS short-time withstand current	222
Table 1 – Alphabetical list of terms	14
Table 2 – Selection of <i>DVC</i> for touch voltage to protect against ventricular fibrillation.....	35
Table 3 – Selection of body contact area	35
Table 4 – Selection of humidity condition of the skin	35
Table 5 – Steady state voltage limits for the <i>decisive voltage classes</i>	36
Table 6 – Protection requirements for circuit under consideration	39
Table 7 – PE conductor cross-section ^a	44
Table 8 – Definitions of pollution degrees	50
Table 9 – Impulse withstand voltage and temporary overvoltage versus system voltage	52
Table 10 – Clearance distances for functional, basic or supplementary insulation	58
Table 11 – Creepage distances (in millimetres).....	60
Table 12 – Generic materials for the direct support of uninsulated live parts	62
Table 13 – Permitted openings in fire enclosure bottoms	72
Table 14 – Maximum measured total temperatures for internal materials and components	74
Table 15 – Maximum measured temperatures for accessible parts of the UPS	76
Table 16 – Limits for sources without an overcurrent protective device	77
Table 17 – Limits for power sources with an overcurrent protective device.....	77
Table 19 – Wire bending space from terminals to enclosure.....	86
Table 20 – Thickness of sheet metal for enclosures: carbon steel or stainless steel.....	90
Table 21 – Thickness of sheet metal for enclosures: aluminium, copper or brass	91
Table 22 – Test overview	97
Table 23 – Pull values for handles and manual control securement.....	103
Table 24 – Impulse voltage test	105
Table 25 – Impulse test voltage	106
Table 26 – AC or d.c. test voltage for circuits connected directly to mains supply	107
Table 27 – A.c. or d.c. test voltage for circuits connected to non-mains supply without temporary overvoltages.....	108
Table 28 – Partial discharge test.....	111
Table 29 – Test duration for protective equipotential bonding test.....	117
Table 30 – Environmental tests	135
Table 31 – Dry heat test (steady state)	136
Table 32 – Damp heat test (steady state).....	137
Table 101 – UPS input port configuration.....	32
Table 102 – Overvoltage categories.....	51
Table 103 – Maximum temperature limits for magnetic components during stored energy mode of operation	73

Table 104 – Short-time withstand current.....	121
Table 105 – Temperature limits for transformer windings	124
Table A.1 – Selection of touch voltage sets to protect against ventricular fibrillation	154
Table A.2 – Selection of touch voltage sets to protect against muscular reaction	155
Table A.3 – Selection of touch voltage sets to protect against startle reaction.....	155
Table A.4 – Examples for protection against electrical shock	170
Table A.101 – Comparison of limits of working voltage	171
Table C.1 – Symbols used	173
Table D.1 – Width of grooves by pollution degree	174
Table E.1 – Correction factor for clearances at altitudes between 2 000 m and 20 000 m	181
Table E.2 – Test voltages for verifying clearances at different altitudes	181
Table F.1 – Minimum values of clearances in air at atmospheric pressure for inhomogeneous field conditions (Table 1 of IEC 60664-4:2005)	184
Table F.2 – Multiplication factors for clearances in air at atmospheric pressure for approximately homogeneous field conditions	184
Table F.3 – Minimum values of creepage distances for different frequency ranges (Table 2 of IEC 60664-4:2005).....	186
Table G.1 – Standard cross-sections of round conductors.....	188
Table AA.1 – Conductor cross-sections (extract from IEC 61439-1:2011).....	210
Table FF.1 – Test steps	224

iJob Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 62040-1:2017](#)

<https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cf3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 1: Safety requirements

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.

DISCLAIMER

This Extended version is intended only to provide the user with a comprehensive content consisting of a product standard and its reference document. An Extended version is not an official IEC Standard. Only the current versions of the related standards are to be considered the official documents.

This Extended version of IEC 62040-1:2017 includes the provisions of the general rules dealt with in IEC 62477-1:2012. Clauses and subclauses of IEC 62477-1:2012 that are applicable in IEC 62040-1:2017 have been introduced in the content in red text.

International Standard IEC 62040-1 has been prepared by subcommittee 22H: Uninterruptible power systems (UPS), of IEC technical committee 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 2008 and its Amendment 1:2013. This edition constitutes a technical revision.

This edition includes the following significant technical change with respect to the previous edition: the reference document has been changed from IEC 60950-1:2005 (safety for IT equipment) to IEC 62477-1 (group safety standard for power electronic converters).

The text of this International Standard is based on the following documents:

FDIS	Report on voting
22H/217/FDIS	22H/218/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

~~This International Standard is to be read in conjunction with IEC 62477-1:2012.~~

~~The provisions of the general rules dealt within IEC 62477-1:2012 are only applicable to this document insofar as they are specifically cited. Clauses and subclauses of IEC 62477-1:2012 that are applicable in this document are identified by reference to IEC 62477-1:2012, for example, "Clause 4 of IEC 62477-1:2012 applies, except as follows".~~

~~The exceptions are then listed. The exceptions can take the form of a deletion, a replacement or an addition of subclauses, tables, figures or annexes.~~

~~Subclauses, tables and figures that are additional to those in IEC 62477-1:2012 are, in this document, identified by a suffix in the format of X.10x, for example 4.3.101.~~

~~Annexes that are additional to those in IEC 62477-1:2012 are, in this document, lettered AA, BB, etc.~~

In this document, the following print types are used:

- requirements and normative annexes: roman type
- compliance statements and test specifications: *italic type*
- notes and other informative matter: smaller roman type
- normative conditions within tables: smaller roman type
- terms that are defined in Clause 3: **bold**

A list of all parts in the IEC 62040 series, published under the general title *Uninterruptible Power Systems (UPS)*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document 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 document using a colour printer.

INTRODUCTION

IEC technical sub-committee 22H: Uninterruptible power systems (UPS) carefully considered the relevance of each paragraph of IEC 62477-1:2012 in UPS applications. This part of IEC 62040 utilizes IEC 62477-1:2012 as a reference document and references, adds, replaces or modifies requirements as relevant. This is because product-specific topics not covered by the reference document are the responsibility of the technical committee using the reference document.

IEC 62477-1:2012 relates to products that include power electronic converters, with a rated system voltage not exceeding 1 000 V AC or 1 500 V DC. It specifies requirements to reduce risks of fire, electric shock, thermal, energy and mechanical hazards, except functional safety as defined in IEC 61508 (all parts). The objectives of this document are to establish a common terminology and basis for the safety requirements of products that contain power electronic converters across several IEC technical committees.

IEC 62477-1:2012 was developed with the intention:

- to be used as a reference document for product committees inside IEC technical committee 22: Power electronic systems and equipment in the development of product standards for power electronic converter systems and equipment;
- to replace IEC 62103 as a product family standard providing minimum requirements for safety aspects of power electronic converter systems and equipment in apparatus for which no product standard exists; and

NOTE The scope of IEC 62103 contains reliability aspects, which are not covered by this document.

- to be used as a reference document for product committees outside TC 22 in the development of product standards of power electronic converter systems and equipment intended for renewable energy sources. TC 82, TC 88, TC 105 and TC 114, in particular, have been identified as relevant technical committees at the time of publication.

The reference document, being a group safety standard, will not take precedence over this product-specific standard according to IEC Guide 104. IEC Guide 104 provides information about the responsibility of product committees to use group safety standards for the development of their own product standards.

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 1: Safety requirements

1 Scope

This part of IEC 62040 applies to movable, stationary, fixed or built-in **UPS** for use in low-voltage distribution systems and that are intended to be installed in an area accessible by an **ordinary person** or in a **restricted access area** as applicable, that deliver fixed frequency AC output voltage with **port** voltages not exceeding 1 000 V AC or 1 500 V DC and that include an energy storage device. It applies to pluggable and to **permanently connected UPS**, whether consisting of a system of interconnected units or of independent units, subject to installing, operating and maintaining the **UPS** in the manner prescribed by the manufacturer.

NOTE 1 Typical **UPS** configurations, including voltage and/or frequency converters and other topologies, are described in IEC 62040-3, the test and performance product standard for **UPS**.

NOTE 2 **UPS** generally connect to their energy storage device through a DC link. A chemical battery is used throughout the standard as an example of an energy storage device. Alternative devices exist, and as such, where "battery" appears in the text of this document, this is to be understood as "energy storage device".

This document specifies requirements to ensure safety for the **ordinary person** who comes into contact with the **UPS** and, where specifically stated, for the **skilled person**. The objective is to reduce risks of fire, electric shock, thermal, energy and mechanical hazards during use and operation and, where specifically stated, during service and maintenance.

This product standard is harmonized with the applicable parts of group safety publication IEC 62477-1:2012 for **power electronic converter systems** and contains additional requirements relevant to **UPS**.

[IEC 62040-1:2017](https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cf3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017)

<https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cf3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017>

This document does not cover:

- **UPS** that have a DC output;
- systems for operation on moving platforms including, but not limited to, aircrafts, ships and motor vehicles;
- external AC or DC input and output distribution boards covered by their specific product standard;
- stand-alone static transfer systems (STS) covered by IEC 62310-1;
- systems wherein the output voltage is directly derived from a rotating machine;
- telecommunications apparatus other than **UPS** for such apparatus;
- functional safety aspects covered by IEC 61508 (all parts).

NOTE 3 Even if this document does not cover the applications listed above, it is commonly taken as a guide for such applications.

NOTE 4 Specialized **UPS** applications are generally governed by additional requirements covered elsewhere, for example **UPS** for medical applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60364-4-42, *Low-voltage electrical installations – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC TR 60755, *General requirements for residual current operated protective devices*

IEC 60947-2:2006, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*¹

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage power supply systems*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC 62040-2:2005, *Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements*²

IEC 62477-1:2012, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

<https://standards.iteh.ai/catalog/standards/iec/8b8e2331-cff3-4f54-afc9-cf22aff68b9e/iec-62040-1-2017>

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-68, *Environmental testing – Part 2-68: Tests – Test L: Dust and sand*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

¹ 4th edition (2006). This 4th edition has been replaced in 2016 by a 5th edition IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*.

² 2nd edition (2005). This 2nd edition has been replaced in 2016 by a 3rd edition IEC 62040-2:2016, *Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements*.

IEC 60216-4-1, *Electrical insulating materials – Thermal endurance properties – Part 4-1: Ageing ovens – Single-chamber ovens*

IEC 60364-1, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

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

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

IEC 60617, *Graphical symbols for diagrams* (available from <<http://std.iec.ch/iec60617>>)

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

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60664-4:2005, *Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat - Ball pressure test*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60721-3-3, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations*

IEC 60721-3-4, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations*

IEC 60730-1, *Automatic electrical controls for household and similar use – Part 1: General requirements*

IEC/TR 60755, *General requirements for residual current operated protective devices*

IEC 60949, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*