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Responsible committee: EPL/66 Safety of measuring, control and laboratory equipment

Interested committees:

Title: Draft BS EN IEC 61010-1 Amd.2 Ed.3.0 BS EN IEC 61010-1/AMD2 Amendment 2 - Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1: General requirements.

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- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 61010-1/AMD2 ED3	
DATE OF CIRCULATION: 2025-03-07	CLOSING DATE FOR VOTING: 2025-05-30
SUPERSEDES DOCUMENTS: 66/818/CD, 66/824B/CC	

IEC TC 66 : SAFETY OF MEASURING, CONTROL AND LABORATORY EQUIPMENT	
SECRETARIAT: United Kingdom	SECRETARY: Ms Stephanie Lavy
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S): TC 66 Horizontal Group Safety
ASPECTS CONCERNED: Safety	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE AC/22/2007 OR NEW GUIDANCE DOC).

TITLE:
Amendment 2 - Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

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FOREWORD

This second amendment to the third edition builds on the first amendment to the third edition, published in 2016. This amendment constitutes a technical revision.

Full information on the voting for the approval of this International Standard Amendment 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.

A list of all parts of the IEC 61010 series, under the general title *Safety requirements for electrical equipment for measurement, control, and laboratory use*, 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.

INTRODUCTION

Replace the text of the existing introduction with the following text:

This document specifies the safety requirements that are generally applicable to all equipment within its scope. For certain types of equipment, these requirements will be supplemented or modified by the special requirements of the following parts 2 which must be read in conjunction with the requirements of this document.

IEC 61010-2-010 Particular requirements for laboratory equipment for the heating of materials

IEC 61010-2-011 Particular requirements for refrigerating equipment

IEC 61010-2-012 Particular requirements for climatic and environmental testing and other temperature conditioning equipment

IEC 61010-2-020 Particular requirements for laboratory centrifuges

IEC 61010-2-030 Particular requirements for equipment having testing or measuring circuits

IEC 61010-2-032 Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement

IEC 61010-2-033 Particular requirements for hand-held multimeters and other meters for domestic and professional use, capable of measuring mains voltage

IEC 61010-2-034 Particular requirements for measurement equipment for insulation resistance and test equipment for electric strength

IEC 61010-2-040 Particular requirements for sterilizers and washer-disinfectors used to treat medical materials

IEC 61010-2-051 Particular requirements for laboratory equipment for mixing and stirring

IEC 61010-2-061 Particular requirements for laboratory atomic spectrometers with thermal atomization and ionization

IEC 61010-2-081 Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes

IEC 61010-2-091 Particular requirements for cabinet X-ray systems

IEC 61010-2-101 Particular requirements for in vitro diagnostic (IVD) medical equipment

IEC 61010-2-130 Particular requirements for equipment intended to be used in educational establishments by children

IEC 61010-2-201 Particular requirements for control equipment

IEC 61010-2-202 Particular requirements for electrically operated valve actuators

Attention is also drawn to the following standard:

IEC 61010-031 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 031: Safety requirements for hand-held and hand-manipulated probe assemblies for electrical test and measurement

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE –

Part 1: General requirements

1 Scope and object

1.1 Scope

1.1.1 Equipment included in scope

Replace the first two paragraphs with the following paragraph:

This document specifies general safety requirements for the following types of electrical equipment and their accessories, wherever they are intended to be used.

Delete the last sentence of note 1.

In the second paragraph of item a), replace the word “standard” with the word “document”.

Replace the two paragraphs of item c) with the following paragraph:

This is equipment which measures, indicates, monitors, inspects or analyses materials, or is used to prepare materials. This equipment may also be used in areas other than laboratories.

Add the following two paragraphs at the end of this subclause:

This group safety publication is primarily intended to be used as a product safety standard for the products mentioned in the scope but shall also be used by technical committees in the preparation of their publications for products similar to those mentioned in the scope of this document, in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications and/or group safety publications in the preparation of its publications.

1.1.2 Equipment excluded from scope

In the first paragraph, replace the word “standard” with the word “document”.

Replace item a) to item h) with the following item a) to item f) and renumber items i) and item j) to item f) and item g).

- a) IEC 60335-1 (Household and similar electrical appliances);
- b) IEC 60364-1 (Electrical installations of buildings);
- c) IEC 61439-1 (Low-voltage switchgear and control gear assemblies);
- d) IEC 60601-1 (Medical electrical equipment);
- e) IEC 62368-1 (Audio/video, information and communication technology equipment, except as specified in 14.1);
- f) IEC 61558-1 (Power transformers, power supply units and similar);

1.1.3 Computing equipment

In the first paragraph, replace the word “standard” with the word “document”.

Delete the note.

Add the following new clause 1.1.4

1.1.4 Detection or sensing equipment used for signalling or alarms

This document applies to equipment intended to detect and signal an imminent hazardous level of physical or electrical quantities only when used in conjunction with a standard providing additional requirements for performance and reliability (see 1.2.2). Where no such standard exists, a RISK assessment procedure is specified in Clause 17.

NOTE 1 Detecting an imminent hazard is understood to include measuring, sensing or other methods of detecting physical or electrical quantities with the intent of identifying a HAZARDOUS SITUATION.

NOTE 2 Signal is understood to include signalling, safety alarm initiation, notification and release, or other methods of signalling when an imminent hazard has been detected. Examples include signalling beacons, lights, audible alarms and sirens or automatic initiation of hazardous level mitigations such as ventilation or shutdown.

NOTE 3 Examples of standards that can be used in conjunction with this document (IEC 60079-29-1, IEC 62990-1).

1.2 Objects

Replace the existing title with this following new title:

1.2 Aspects

1.2.1 Aspects included in scope

Replace the two first paragraphs with the following new paragraphs:

The purpose of the requirements of this document is to ensure that HAZARDS to the OPERATOR, SERVICE PERSONNEL, and the surrounding area are reduced to a tolerable level. This document is intended to be used in conjunction with the manufacturer's process of RISK assessment and RISK reduction but not to replace it.

Requirements for protection against particular types of HAZARD are given in Clauses 6 to 0, and 16, as follows:

Replace item f) with the following new item f):

f) effects of radiation, sonic and ultrasonic pressure (see Clause 0);

Add a new item h):

h) HAZARDS related to the use and REASONABLY FORESEEABLE MISUSE of the equipment (see Clause 16).

In the last paragraph, replace Clause 16 with Clause 17

1.2.2 Aspects excluded from scope

In the first paragraph, replace the word “standard” with the word “document”.

In item b), delete the words “effectiveness of”

Add two new items e) and f)

e) performance requirements of detectors for toxic gases (see the IEC 62990 series);

f) cybersecurity (see the IEC 62443 series).

1.3 Verification

Delete this subclause.

1.4 Environmental conditions

Delete this subclause.

2 Normative references

Delete the following references:

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60335-2-24, *Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice-makers.*

IEC 60335-2-89, *Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor*

IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances IEC 60364-4-44:2007/AMD1:2015*

IEC 60947-1, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 61010-031, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test*

IEC 61180-1, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements*

IEC 61180-2, *High-voltage test techniques for low-voltage equipment – Part 2: Test equipment*

ISO 361, *Basic ionizing radiation symbol*

EN 378-2, *Refrigerating systems and heat pumps – Safety and environmental requirements. Design, construction, testing, marking and documentation*

Add the following references:

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

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*

- 186 IEC 60695-11-3, *Fire hazard testing – Part 11-3: Test flames – 500 W flames - Apparatus and*
187 *confirmational test methods*
- 188 IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement*
189 *techniques - Surge immunity test*
- 190 IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-*
191 *related systems*
- 192 IEC 62061, *Safety of machinery - Functional safety of safety-related control systems*
- 193 IEC 62368-1, *Audio/video, information and communication technology equipment - Part 1:*
194 *Safety requirements*
- 195 IEC 62471, *Photobiological safety of lamps and lamp systems*
- 196 IEC TR 62471-2, *Photobiological safety of lamps and lamp systems – Part 2: Guidance on*
197 *manufacturing requirements relating to non-laser optical radiation safety*
- 198 ISO 5349-1, *Mechanical vibration – Measurement and evaluation of human exposure to hand*
199 *transmitted vibration – Part 1: General requirements*
- 200 ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*
- 201 ISO 11228-1, *Ergonomics – Manual Handling – Part 1: Lifting and carrying*
- 202 ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General*
203 *principles for design*
- 204 ISO 13849-2, *Safety of machinery – Safety-related parts of control systems – Part 2: Validation*
- 205 EN 1005-2, *Safety of machinery – Human physical performance – Part 2: Manual handling of*
206 *machinery and component parts of machinery*
- 207
- 208 *Replace the following references:*
- 209 IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of*
210 *coating, potting or moulding for protection against pollution*
- 211 IEC 61180 (all parts), *High-voltage test techniques for low-voltage equipment*
- 212 ISO 306:2013, *Plastics – Thermoplastic materials – Determination of Vicat softening*
213 *temperature (VST)*
- 214 *with the following references:*
- 215 IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3:*
216 *Use of coating, potting or moulding for protection against pollution*
- 217 IEC 61180, *High-voltage test techniques for low-voltage equipment - Definitions, test and*
218 *procedure requirements, test equipment*
- 219 ISO 306:2022, *Plastics – Thermoplastic materials – Determination of Vicat softening*
220 *temperature (VST)*
- 221

3 Terms and definitions

3.1 Equipment and states of equipment

Add the new defined terms:

3.1.7**MOVABLE EQUIPMENT**

equipment intended to be moved from one location to another while supported by its own wheels or equivalent means

[IEC 62368-1:2023, 903-04-06, modified]

3.1.8**PANEL-MOUNTED EQUIPMENT**

equipment where a portion of the equipment may form part of the ENCLOSURE

3.2 Parts and accessories**3.2.5****PROTECTIVE BARRIER**

Replace the existing reference of the term with:

[IEC 60050-195:2021, 195-06-15]

3.5 Safety terms

Replace the existing terms with the following new terms:

3.5.1**ACCESSIBLE (of a part)**

able to be touched with a standard test finger or test pin, when used as specified in 6.2

3.5.2**HARM**

injury or damage to the health of people, or damage to property or the environment

[ISO/IEC Guide 51:2014, 3.1]

3.5.3**HAZARD**

potential source of HARM

[ISO/IEC Guide 51:2014, 3.2]

3.5.4**HAZARDOUS SITUATION**

circumstance in which people, property or the environment is/are exposed to one or more HAZARDS

[ISO/IEC Guide 51:2014, 3.4]

3.5.5**HAZARDOUS LIVE**

capable of rendering an electric shock or electric burn

3.5.6**MAINS**

Low-voltage a.c. or d.c. electrical power distribution system (external to the equipment) that supplies operating power to the equipment

Note 1 to entry: MAINS include public or private electrical utilities and, unless otherwise specified, equivalent sources such as motor-driven generators and uninterruptible power supplies

[IEC 60664-1:2020, 3.1.2 (mains supply) modified]

3.5.7**MAINS CIRCUIT**

circuit which is intended to be directly connected to the MAINS for the purpose of powering the equipment

3.5.8**PROTECTIVE IMPEDANCE**

component or assembly of components whose impedance, construction and reliability are suitable to provide protection against electric shock

3.5.9**PROTECTIVE BONDING**

electrical connection of ACCESSIBLE conductive parts or protective screening to provide electrical continuity to the means for connection of an external protective conductor

3.5.10**NORMAL USE**

operation, including stand-by, according to the instructions for use or for the obvious intended purpose

3.5.11**NORMAL CONDITION**

condition in which all means for protection against HAZARDS are intact

3.5.12**SINGLE FAULT CONDITION**

condition in which one means for protection against HAZARD is defective or one fault is present which could result in a HAZARDOUS SITUATION

Note 1 to entry: If a SINGLE FAULT CONDITION results unavoidably in one or more other fault conditions, all the failures are considered as one SINGLE FAULT CONDITION [IEC Guide 104].

3.5.13**OPERATOR**

person operating equipment for its intended purpose

3.5.14**SERVICE PERSONNEL**

persons having appropriate technical training and experience necessary to be aware of HAZARDS to which they are exposed when performing a task and of measures to minimize the danger to themselves or other persons

Note 1 to entry: Servicing may include, but is not limited to, installing, changing or repairing the equipment.

3.5.15**RESPONSIBLE BODY**

individual or group responsible for the safe use and maintenance of equipment

3.5.16**WET LOCATION**

location where water or another conductive liquid may be present and is likely to cause reduced human body impedance due to wetting of the contact between the human body and the equipment, or wetting of the contact between the human body and the environment

3.5.17**REASONABLY FORESEEABLE MISUSE**

use of a product in a way not intended by the supplier, but which may result from readily predictable human behaviour

3.5.18**RISK**

combination of the probability of occurrence of HARM and the severity of that HARM

3.5.19**TOLERABLE RISK**

RISK which is accepted in a given context based on the current values of society

[ISO/IEC Guide 51:2014, 3.7]

3.5.20**OVERVOLTAGE CATEGORY**

numeral defining a TRANSIENT OVERVOLTAGE condition (see Annex K)

3.5.21**TRANSIENT OVERVOLTAGE**

short duration overvoltage of a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped

[IEC 60664-1:2020, 3.1.13]

3.5.22**TEMPORARY OVERVOLTAGE**

power frequency overvoltage of relatively long duration

3.5.23**SAFETY FUNCTION**

function of the equipment, whose failure can result in an immediate increase of the RISK(s)

[ISO 12100:2010, 3.30, modified]

3.5.24**SOFTWARE**

assembly of programs, procedures, rules, documentation and data, pertaining to the operation of an information processing device or system

EXAMPLE Firmware, operating system, application software.

[IEC 60050-195:2021, 171-01-21]

3.6 Insulation

Replace the existing terms with the following new terms:

3.6.1**BASIC INSULATION**

insulation that provides basic protection

[IEC 60050-195:2021, 195-06-06]

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes

3.6.2**SUPPLEMENTARY INSULATION**

independent insulation applied in addition to BASIC INSULATION, that provides fault protection

[IEC 60050-195:2021, 195-06-07]

3.6.3**DOUBLE INSULATION**

insulation comprising both BASIC INSULATION and SUPPLEMENTARY INSULATION

[IEC 60050-195:2021, 195-06-08]

3.6.4**REINFORCED INSULATION**

insulation which provides protection against electric shock equivalent to DOUBLE INSULATION

Note 1 to entry: REINFORCED INSULATION can comprise several layers which cannot be tested singly as BASIC INSULATION or SUPPLEMENTARY INSULATION.

[IEC 60050-195:2021, 195-06-09, modified]

3.6.5

POLLUTION

addition of foreign matter, solid, liquid or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity

3.6.6

POLLUTION DEGREE

numeral indicating the level of POLLUTION that may be present in the environment

3.6.7

POLLUTION DEGREE 1

no POLLUTION or only dry, non-conductive POLLUTION occurs, which has no influence

3.6.8

POLLUTION DEGREE 2

only non-conductive POLLUTION occurs except that occasionally a temporary conductivity caused by condensation is expected

3.6.9

POLLUTION DEGREE 3

conductive POLLUTION occurs, or dry, non-conductive POLLUTION occurs which becomes conductive due to condensation which is expected

Note 1 to entry: In such conditions, equipment is normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.

3.6.10

POLLUTION DEGREE 4

continuous conductivity occurs due to conductive dust, rain or other wet conditions

3.6.11

CLEARANCE

shortest distance in air between two conductive parts

[IEC 60050-426:2020, 426-04-12]

3.6.12

CREEPAGE DISTANCE

shortest distance along the surface of a solid insulating material between two conductive parts

[IEC 60050-151:2001, 151-15-50]

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4 Tests

Replace the existing title with this following new title:

4 Assessment, tests, and environmental conditions

398

4.1 General

Replace the existing text with the following new subclauses and text:

4.1.1 Conformity assessment

This document also specifies methods of checking conformity to the requirements of this document. These are included in the conformity statements in all clauses of the document and specifically in 4.3 and 4.4. The methods include inspection, TYPE TESTS and ROUTINE TESTS.

4.1.2 TYPE TESTS

In this document are TYPE TESTS to be carried out on samples of equipment or parts. Their only purpose is to check that the design and construction ensure conformity with this document. In addition, manufacturers shall perform the ROUTINE TESTS of Annex F on 100 % of equipment produced which has both HAZARDOUS LIVE parts and ACCESSIBLE conductive parts.

The equipment shall at least meet the requirements of this document. It is permissible to exceed the requirements. If, in this document, a lower limit is specified for a conformity value, then the equipment may demonstrate a larger value. If an upper limit is specified for a conformity value, the equipment may demonstrate a lower value.

Tests on subassemblies that meet the requirements of the relevant standards specified in this document, and used in accordance with them, need not be repeated during TYPE TESTS of the whole equipment.

Conformity with the requirements of this document is checked by carrying out all applicable tests, except that a test may be omitted if examination of the equipment and design documentation demonstrates conclusively that the equipment would pass the test. Tests are carried out both under reference test conditions (see 4.3) and under fault conditions (see 4.4).

Where conformity statements in this document require inspection, this may include examination of the equipment by measurement, examination of the markings on the equipment, examination of the instructions supplied with the equipment, examination of the data sheets of the materials or components from which the equipment is manufactured, etc. In each case, the inspection will either demonstrate that the equipment meets the applicable requirements, or will indicate that further testing is required.

Where the intended use or equipment functions present RISKS other than those mitigated in clauses 6 to 0 and 16, Clause 17 is used to demonstrate-such RISKS are reduced to a tolerable level.

If, when carrying out a conformity test, there is any uncertainty about the exact value of an applied or measured quantity (for example voltage) due to the tolerance:

- a) manufacturers should ensure that at least the specified test value is applied;*
- b) test houses should ensure that no more than the specified test value is applied.*

4.1.3 Environmental conditions

4.1.3.1 Normal environmental conditions

This document applies to equipment designed to be safe at least under the following conditions:

- a) indoor use;
 - b) altitude up to 2 000 m;
 - c) ambient temperature 5 °C to 40 °C;
 - d) maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
 - e) MAINS supply voltage fluctuations up to ± 10 % of the nominal voltage;
 - f) TRANSIENT OVERVOLTAGES up to the levels of OVERVOLTAGE CATEGORY II;
- NOTE 1 These levels of TRANSIENT OVERVOLTAGE are typical for equipment supplied from the building wiring.
- g) TEMPORARY OVERVOLTAGES occurring on the MAINS supply;
 - h) applicable POLLUTION DEGREE of the intended environment (POLLUTION DEGREE 2 in most cases).

NOTE 2 Manufacturers can specify more restricted environmental conditions for operation.

4.1.3.2 Extended environmental conditions

This document applies to equipment designed to be safe not only in the environmental conditions specified in 4.1.3.1, but also in any of the following conditions as RATED by the manufacturer of the equipment:

- a) outdoor use;
- b) altitude above 2 000 m;
- c) ambient temperatures below 5 °C or above 40 °C;
- d) relative humidity above the levels specified in 4.1.3.1;
- e) MAINS supply voltage fluctuations exceeding ± 10 % of the nominal voltage;
- f) TRANSIENT OVERVOLTAGES up to the levels of OVERVOLTAGE CATEGORY III or IV (see Annex K).
- g) WET LOCATION;

4.2 Sequence of tests

The sequence of tests is optional unless otherwise specified. The equipment under test shall be carefully inspected after each test. If the result of a test causes doubt whether any earlier tests would have been passed if the sequence had been reversed, these earlier tests shall be repeated.

4.3 Reference test conditions

4.3.1 Environmental conditions

Replace the existing title with this following new title:

4.3.1 Environmental conditions for tests

Replace the existing text with the following new text:

- a) a temperature of 15 °C to 35 °C;
- b) a relative humidity of not more than 75 %, but not exceeding the limits of 4.1.3.1 d);
- c) an atmospheric pressure of 75 kPa to 106 kPa;
- d) no hoar-frost, dew, percolating water, rain, solar radiation, etc.

TRANSIENT OVERVOLTAGES, TEMPORARY OVERVOLTAGES, and POLLUTION DEGREE need not be applied during the conformity tests of this document unless otherwise specified.

4.3.2 State of equipment

4.3.2.1 General

Replace the existing text with the following new text:

Unless otherwise specified, each test shall be carried out on the equipment assembled for NORMAL USE and under the least favourable combination of the conditions given in 4.3.2.2 to 4.3.2.14.

NOTE In case of doubt, tests should be performed in more than one combination of conditions.

If dimensions or mass make it unsuitable to carry out particular tests on completely assembled equipment, tests on sub-assemblies are allowed, provided it is verified that the assembled equipment will meet the requirements of this document.

Combinations of reference test conditions may be different for each individual test and they shall be recorded together with any measurements for each test. In case of doubt, tests shall be performed in more than one combination of reference test conditions. If testing at the least favourable RATED environmental conditions is necessary to allow assessment of conformity criteria, the tests shall be conducted under these conditions.

4.3.2.2 Position of equipment

Replace the existing text with the following new text:

The equipment shall be placed in any position of NORMAL USE as specified in the equipment instructions. Equipment intended to be built into a wall, recess, cabinet, etc., shall be installed as specified in the equipment instructions. For HAND-HELD EQUIPMENT, all possible orientations are considered to be positions of NORMAL USE.

NOTE See also requirements for equipment installation in 5.4.3

If there is no information in the equipment instructions for positioning or ventilation, the temperature tests in NORMAL CONDITION shall be applied with the following requirements:

- a) the equipment shall be placed in a corner in any orientation.
- b) connected cables and supply lines shall bend freely.
- c) for equipment sides without external connections, the equipment shall be as close to the corner walls as practicable.

Equipment which can be oriented in more than one position, shall be assessed in every position. If an examination of the equipment shows that the worst-case conditions can be found in one position, a single test is sufficient in that case.

4.3.2.5 Electrical supply source

Replace the existing text with the following new text:

The following requirements apply as applicable.

- a) The MAINS voltage shall be between 90 % and 110 % of any RATED supply voltage for which the equipment can be set or, if the equipment is RATED for a greater fluctuation, at any supply voltage within the fluctuation range.
- b) The frequency shall be any RATED frequency.
- c) Equipment for both a.c. and d.c. shall be connected to an a.c. or d.c. supply.
- d) Equipment for single-phase a.c. supply shall be connected both with normal and reverse polarity.
- e) If the means of connection permits reversal, battery-operated and d.c. equipment shall be connected with both reverse and normal polarity.
- f) Equipment powered by other external means (for example: USB, 4-20 mA loop, PoE [Power over Ethernet], wireless power transfer, etc.) shall be operated at each RATED voltage or according to the specifications of each interface used as the electrical supply source.
- g) Batteries shall be at whichever state of charge that represents the least favourable condition. For test purposes, a d.c. source may be used.

4.3.2.6 Input and output voltages

Replace the existing text with the following new text:

Input and output voltages, including floating voltages but excluding the electrical supply source voltage (see 4.3.2.5), shall be set to any voltage within the RATED voltage range.

4.3.2.12 Duty cycle

In the first paragraph, replace the word “manufacturer’s” with the word “equipment”.

Add the following new subclause:

4.3.2.14 External services

External services shall be supplied at the least favourable setting allowed by the equipment instructions.

NOTE 1 External services include but are not limited to air or coolant.

NOTE 2 Least favourable settings can include but are not limited to temperature, pressure, and flow rate.

4.4 Testing in SINGLE FAULT CONDITION**4.4.1 General**

Replace the existing text with the following new text:

The following requirements apply.

- a) The equipment design, circuit diagrams, specifications, and operating instructions shall be examined to identify the fault conditions which are liable to result in HAZARDOUS SITUATIONS and which, therefore, shall be applied.
- b) Fault tests shall be made as specified for checking conformity, unless it can be demonstrated that no HAZARD could arise from a particular fault condition.
- c) The equipment shall be operated under the least favourable combination of reference test conditions (see 4.3). These combinations may be different for different faults and they shall be recorded for each test. If the environmental limits of the reference test conditions (see 4.3) do not allow realistic assessment of SINGLE FAULT CONDITIONS, the test shall be conducted at the least favourable RATED environmental conditions of the equipment.
- d) SOFTWARE used in a SAFETY FUNCTION shall be considered to provide protection during fault condition testing only if compliant with requirements of Clause 15. For SOFTWARE not evaluated to Clause 15, the SOFTWARE function shall be disabled and is not considered a SINGLE FAULT CONDITION.

4.4.2 Application of fault conditions**4.4.2.1 General**

Replace the existing text with the following new text:

Fault conditions shall include:

- 1) Any fault conditions determined as applicable through the examination of the equipment as required in clause 4.4.1.
- 2) Applicable fault conditions specified in 0 to 05.
- 3) Any fault condition specified in Clauses 6 to 16 dealing with the protection against each HAZARD.

The fault conditions shall be applied only one at a time and shall be applied in turn in any convenient order. Multiple simultaneous faults shall not be applied unless they are a consequence of an applied fault.

NOTE For example, fans are stopped one fan at a time unless they share a common power or control source. In that case, the common fans are stopped simultaneously by interrupting the power or control source.

After each application of a fault condition, the equipment or part shall pass the applicable tests of 4.4.4.

4.4.2.7 MAINS transformers

Replace the existing title with this following new title:

4.4.2.7 Transformers relied upon for safety

Replace the existing subclauses with the following new subclauses:

4.4.2.7.1 General

The output windings of transformers shall be short-circuited as specified in 4.4.2.7.2, and overloaded as specified in 4.4.2.7.3.

A transformer damaged during one test may be repaired or replaced before the next test.

Tests for transformers tested as separate components are specified in 0.

Switch mode transformers and other pulse driven transformers shall be tested in the circuitry, by short-circuiting an applicable component or connecting a load in parallel with the component.

4.4.2.7.2 Short circuit

Each untapped output winding, and each section of a tapped output winding, which is loaded in NORMAL USE, shall be tested in turn, one at a time, to simulate short circuits in the load. Overcurrent protection devices remain fitted during the test. All other windings are loaded or not loaded, whichever load condition of NORMAL USE is less favourable.

NOTE The least favourable load conditions for other windings may vary for each test depending on the winding subjected to short circuit conditions.

4.4.2.7.3 Overload

Each untapped output winding, and each section of a tapped output winding, is overloaded in turn one at a time. During each test any other windings shall be loaded or not loaded, to achieve the highest current through primary or output winding overcurrent protection without them activating, whichever load condition of NORMAL USE is less favourable.

NOTE This test is to achieve the highest winding temperature of the transformer without exceeding the 1 hour characteristic of any overcurrent protection.

If any overloads arise from testing in the fault conditions of 4.4, output windings shall be subjected to those overloads.

Overloading is carried out by connecting a variable resistor across the winding or, in the case of a switch mode transformer after the output rectifier. The resistor is adjusted as quickly as possible and readjusted, if necessary, after 1 min to maintain the applicable overload. No further readjustments are then permitted.

If overcurrent protection is provided by a current-breaking device, the overload test current is the maximum current which the overcurrent protection device is just capable of passing for 1 h. Before the test, the device is replaced by a link with negligible impedance. If this value cannot be derived from the specification, it is to be established by test.

For equipment in which the output voltage is designed to collapse when a specified overload current is reached, the overload current is slowly increased to just before the point which causes the output voltage to collapse.

In all other cases, the loading is the maximum current obtainable from the output winding under test, with any other windings loaded or not loaded, whichever represents the least favourable condition.

Transformers with overtemperature protection which meets the requirements of 14.3 during the short-circuit test of 4.4.2.7.2 need not be subjected to overload tests.

4.4.2.8 Outputs

Replace the existing text with the following new text:

Outputs shall be short-circuited and overloaded one at a time.

The output shall be overloaded to achieve the highest current through the overcurrent protection without it activating, whichever load condition of NORMAL USE is less favourable.

Overloading is carried out by connecting a variable resistor on the output. The resistor is adjusted as quickly as possible and readjusted, if necessary, after 1 min to maintain the applicable overload. No further readjustments are then permitted.

If overcurrent protection is provided by a current limiting device, the overload test current is the maximum current which the overcurrent protection device is just capable of passing for 1 h. Before the test, the device is replaced by a link with negligible impedance. If the maximum current of the current limiting device cannot be derived from its specification, it is to be established by a test prior to the overload test.

For equipment in which the output voltage is designed to collapse when a specified overload current is reached, the overload current is slowly increased to just before the point which causes the output voltage to collapse.

Add the following new subclause:

4.4.2.15 Equipment design

For each circuit and component of the equipment design, the means of protection provided by the equipment against a HAZARDOUS SITUATION arising under a SINGLE FAULT CONDITION shall be assessed. In case of doubt, each component shall be tested under SINGLE FAULT CONDITION to ensure the means of protection provided is not compromised. Particular attention shall be paid to SINGLE FAULT CONDITIONS that may affect REINFORCED INSULATION or other singular means of protection.

4.4.3 Duration of tests

4.4.3.1 General

Replace the existing text with the following new text:

The equipment shall be operated until further change as a result of the applied fault is unlikely. If there is an indication that a HAZARD of electric shock, spread of fire or injury to persons may eventually occur, the test shall be continued until the HAZARD occurs or until it becomes evident that a HAZARD will not occur.

4.4.4 Conformity after application of fault conditions

4.4.4.2 Temperature

Replace the existing title with this following new title:

4.4.4.2 Touch temperature

5 Marking and documentation

5.1 Marking

5.1.1 General

Replace note 1 with the following new note:

NOTE Other IEC and ISO symbols are available.

Replace note 2 with the following text:

Markings shall not be on the bottom of the equipment, except on HAND-HELD or PORTABLE EQUIPMENT where visibility by the operator is expected during installation or NORMAL USE conditions.

5.1.2 Identification

Replace the note of item b) with the new note:

NOTE The marking of factory location can be in code and need not be on the equipment exterior.

5.1.3 MAINS supply

Replace the existing title with this following new title:

5.1.3 External electrical supply sources

Replace the existing text and table with the following new text and table:

The equipment shall be marked with the following information from a) to e).

Where space is limited, symbols 1, 2, 3, or 4 of Table 1 as applicable or, alternatively, equivalent letter symbols according to IEC 60027-1 shall be marked as close as possible to the supply TERMINALS with information as required in a) to e) included in the equipment documentation.

Marking from a) to e) is not required for equipment where the electrical power is only supplied from specific equipment through either:

- a dedicated connector; or
- marked with specific equipment identification.

a) Nature of supply:

- 1) a.c.: RATED frequency or range of frequencies;
- 2) d.c.: symbol 1 of Table 1 or d.c..

NOTE 1 For information purposes it can be useful to mark

- equipment intended for a.c. with symbol 2 of Table 1;
- equipment suitable for both a.c. and d.c. with symbol 3 of Table 1;
- equipment for three-phase supply with symbol 4 of Table 1.

b) The RATED supply voltage(s) or the RATED range of supply voltages.

NOTE 2 RATED voltage fluctuations can also be marked.

c) The maximum RATED power in watts (active power) or volt-amperes (apparent power), or the maximum RATED input current, with all accessories or plug-in modules connected. If the equipment can be used on more than one voltage range, separate values shall be marked for each voltage range unless the maximum and minimum values do not differ by more than 20 % of the mean value. The measured value shall not exceed the marked value by more than 10 %. For equipment not supplied by MAINS, the measured input current or power shall not exceed the RATINGS of the equipment.

d) Equipment which can be manually set for different RATED supply voltages shall be provided with means for the indication of the voltage for which the equipment is set. Except for PERMANENTLY CONNECTED EQUIPMENT, the indication shall be visible from the exterior. If the equipment is so constructed that the supply voltage setting can be altered without the use of a TOOL, the action of changing the setting shall also change the indication.

e) Accessory MAINS socket-outlets accepting standard MAINS plugs shall be marked with the voltage if it is different from the MAINS supply voltage. If the outlet is for use only with specific equipment, it shall be marked to identify the equipment for which it is intended. If not, the maximum RATED current or power shall be marked, or symbol 14 of Table 1 placed beside the outlet with the full details included in the documentation.

Conformity is checked by inspection and by measurement of power or input current to check the requirements of 0 c) have been met. The measurement is made at each RATED voltage range with the equipment in the condition of maximum power or current consumption as applicable with all accessories or plug-in modules connected. If the input current varies during the normal operating cycle, the steady-state current is taken as the mean indication of the

724 *highest measured r.m.s. value during a 10 s period of the normal operation cycle. To exclude*
 725 *any initial inrush current the measurement is not made until the current has stabilized (usually*
 726 *after 1 min). Transients are ignored.*

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Table 1 – Symbols

Number	Symbol	Reference	Description
1		IEC 60417-5031 (2002-10)	Direct current
2		IEC 60417-5032 (2002-10)	Alternating current
3		IEC 60417-5033 (2002-10)	Both direct and alternating current
4		IEC 60417-5032-1 (2002-10)	Three-phase alternating current
5		IEC 60417-5017 (2006-08)	Earth (ground) TERMINAL
6		IEC 60417-5019 (2006-08)	PROTECTIVE CONDUCTOR TERMINAL
7		IEC 60417-5020 (2002-10)	Frame or chassis TERMINAL
8			Not used
9		IEC 60417-5007 (2009-02)	On (Power)
10		IEC 60417-5008 (2009-02)	Off (Power)
11		IEC 60417-5172 (2003-02)	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
12		IEC 60417-6042 (2010-11)	Caution, risk of electric shock
13		IEC 60417-5041 (2002-10)	Caution, hot surface
14		ISO 7000-0434B (2004-01)	Caution ^a
15		IEC 60417-5268 (2002-10)	In position of a bi-stable push control
16		IEC 60417-5269 (2002-10)	Out position of a bi-stable push control
17		ISO 7010 – W003 (2011-05)	Warning; Radioactive material or ionizing radiation
18		ISO 7010 – W010 (2011-05)	Caution, RISK of frostbite
19		ISO 7000-1321B (2014-08)	Mass of equipment
^a See 0 which requires manufacturers to state that documentation must be consulted in all cases where this symbol is marked.			

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5.1.5 TERMINALS, connections and operating devices**5.1.5.2 TERMINALS**

Replace the note of item c) with the new note:

NOTE This symbol can also be considered as a warning symbol in that it indicates that a HAZARDOUS LIVE voltage must not be connected to the TERMINAL. The symbol should also be used if it is likely that an OPERATOR could make such a connection inadvertently.

5.1.6 Add « symbol 12 or » before « symbol 14 » in item d). Switches and circuit-breakers

Replace the existing text with the following new text:

If the MAINS switch or circuit-breaker is used as the disconnecting device, it shall be marked as specified in 6.11.4.2.

If a push-button switch is used as the MAINS switch, symbols 9 and 15 of Table 1 may be used to indicate the on-position, or symbols 10 and 16 to indicate the off-position, with the pair of symbols (9 and 15, or 10 and 16) close together.

Conformity is checked by inspection.

5.2 Warning markings

Replace the two first paragraphs with the following two paragraphs:

Warning markings specified in this document shall meet the following requirements.

Warning markings shall be visible and legible when the equipment is ready for NORMAL USE. If a warning applies to a particular part of the equipment, the marking shall be placed on or near that part.

safety aspects are used and explained in the documentation.

In the fourth paragraph, replace the word “used” with the word “marked”.

Delete the last paragraph before the conformity statement.

5.4 Documentation

Replace the existing subclauses 5.4.1 to 5.4.5 with the following new subclauses:

5.4.1 General

The following information necessary for safety purposes, as needed by the OPERATOR or the RESPONSIBLE BODY, shall be contained in the documentation provided with the equipment. Documentation shall identify the equipment, or types of equipment described. Safety documentation for SERVICE PERSONNEL authorized by the manufacturer shall be made available to such personnel:

- a) intended use of the equipment;
- b) technical specification;
- c) name and address of the manufacturer or supplier from whom technical assistance may be obtained;
- d) the information specified in 5.4.2 to 1;

- e) information about the residual RISKS and how to mitigate residual RISKS (see 17.2);
- f) for equipment which for safety reasons requires specific accessories (for example probe assemblies) with specific characteristics, the documentation shall indicate that only accessories which meet the equipment specifications shall be used;
- g) if a HAZARD could be caused by an incorrect reading when measuring, indicating or detecting harmful or corrosive substances, or HAZARDOUS LIVE electrical quantities, the instructions shall provide guidance on how to determine that the equipment is functioning correctly;
- h) instructions for lifting and carrying (see 7.5.1);
- i) instructions related to ingress protection RATING – IP RATING (see 11.6.1);
- j) Instructions for disabling UPS output (see 6.11.2)
- k) Instructions for manually moving MOVEABLE EQUIPMENT (see 16.5)

Warning symbols and warning statements that are marked on the equipment shall be explained in the documentation. In particular, the documentation shall include a statement that it must be consulted in all cases where symbol 14 of Table 1 is marked, in order to find out the nature of the potential HAZARDS and any actions which have to be taken to avoid them.

NOTE 1 Markings and text on equipment are considered equivalent to the documentation.

If NORMAL USE involves the handling of harmful or corrosive substances, instructions shall be given on correct use and safety provisions. If any harmful or corrosive substance is specified or supplied by the equipment manufacturer, the necessary information on its constituents and the correct disposal procedure shall also be given.

Documentation may be provided on printed or electronic media, however printed information is required for all information necessary for safety that might not be available in electronic form at the time it is needed. This documentation shall be delivered with the equipment. Consideration shall be given to the ability of the RESPONSIBLE BODY to read the media.

NOTE 2 National regulations can require documentation in a nationally accepted language.

Conformity is checked by inspection.

5.4.2 Equipment RATINGS

Documentation shall include the following:

- a) the supply voltage or voltage range, frequency or frequency range, and power or current RATING;
- b) a description of all input and output connections as required by 6.6.1 a);
- c) the RATING of the insulation of external circuits as required by 6.6.1 b);
- d) a statement of environmental condition RATINGS for which the equipment is designed including:
 - 1) indoor or outdoor use
 - 2) altitude
 - 3) temperature
 - 4) relative humidity
 - 5) MAINS supply voltage fluctuations
 - 6) OVERVOLTAGE CATEGORY, except for cord/plug-connected equipment
 - 7) WET LOCATION, if applicable
 - 8) POLLUTION DEGREE of the intended environment,
- e) for equipment RATED for ingress protection according to IEC 60529 the information required in 11.6.1;
- f) for equipment with an impact RATING less than 5 J, the information specified in 8.1 0.

Conformity is checked by inspection.

5.4.3 Equipment installation

The documentation shall include installation and specific commissioning instructions and, if necessary for safety, warnings against HAZARDS which could arise during installation or commissioning or as a result of improper installation or commissioning of the equipment. Such information includes, if applicable:

- a) assembly, location, and mounting requirements;
 - b) instructions for protective earthing;
 - c) connections to the supply;
 - d) for PERMANENTLY CONNECTED EQUIPMENT:
 - 1) supply wiring requirements;
 - 2) requirements for any external switch or circuit-breaker (see 1.1.1) and external overcurrent protection devices (see 9.6.2) and a recommendation that the switch or circuit-breaker be near the equipment;
 - e) the required field wiring temperature RATING (see 1.1);
 - f) ventilation requirements;
 - g) requirements and safety characteristics for special external services;
- NOTE Examples include but are not limited to maximum and minimum pressure, flow rate, and temperature.
- h) instructions relating to sound level (see 12.5.1);
 - i) instructions related to verification of equipment connection to potentially hazardous substances (see 0).

NOTE It is recommended to add a statement in the documentation for the installation that the safety of any system incorporating the equipment is the responsibility of the assembler of the system.

Conformity is checked by inspection.

5.4.4 Equipment operation

Instructions for use shall include, if applicable:

- a) identification and description of operating controls and their use in all operating modes;
- b) instructions not to position the equipment so that it is difficult to operate the disconnecting device;
- c) instructions for interconnection to accessories and other equipment, including indication of suitable accessories, detachable parts and any special materials;
- d) specifications of limits for intermittent operation;
- e) explanations of symbols related to safety which are used on the equipment;
- f) instructions for replacement of consumable materials;
- g) instructions for cleaning and decontamination;
- h) a statement listing potentially poisonous or injurious substances that can be liberated from the equipment, and possible quantities;
- i) detailed instructions about RISK reduction procedures relating to flammable liquids (see 9.5 0);
- j) details of methods of reducing the RISKS of burns or frostbite from surfaces permitted to surpass the temperature limits of 0.
- k) instructions to the RESPONSIBLE BODY regarding equipment intended for unattended operation to provide suitable means of protection for bystanders (see 16.3)

There shall be a statement in the instructions that, if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Conformity is checked by inspection.

5.4.5 Equipment maintenance and service

Instructions shall be provided to the RESPONSIBLE BODY in sufficient detail to permit safe maintenance, inspection and testing of the equipment, and to ensure continued safety of the equipment after the maintenance, inspection and test procedure.

If applicable, equipment documentation shall instruct against replacing detachable MAINS supply cords by inadequately RATED cords.

For equipment using replaceable batteries, the specific battery type shall be stated.

The manufacturer shall specify any parts which are required to be examined or supplied only by the manufacturer or his agent.

The RATING and characteristics of replaceable fuses shall be stated.

Instructions on the following subjects shall be provided for SERVICE PERSONNEL, as necessary to permit safe servicing and continued safety of the equipment after servicing if the equipment is suitable to be serviced:

- a) product-specific RISKS that may affect the SERVICE PERSONNEL;
- b) protective measures for these RISKS;
- c) verification of the safe state of the equipment after repair.
- d) specifications of all special equipment, TOOLS and accessories essential to enable it to be safely adjusted and maintained.
- e) guidance on verification of connections to hazardous substances (see 0)

Instructions for installing, replacing, or repairing the equipment need not be supplied to the RESPONSIBLE BODY but shall be made available to authorized SERVICE PERSONNEL.

Conformity is checked by inspection.

6 Protection against electric shock

6.1 General

6.1.1 Requirements

Replace the existing conformity statement with the following new conformity statement:

Conformity is checked by the determination of ACCESSIBLE parts as specified in 6.2 and by the measurements of 6.3 to establish that the levels of 0 and 6.3.2 are not exceeded, and as specified in 6.4 to 6.11.

6.2 Determination of ACCESSIBLE parts

6.2.1 General

In the last paragraph, replace the word “manufacturer’s” with the word “equipment”.

6.2.2 Examination

Add the following sentence at the end of the first paragraph:

Equipment having mass exceeding 40 kg is not tilted during examination.

6.3 Limit values for ACCESSIBLE parts

Replace the existing subclauses and figures with the following new subclauses and figures:

6.3.1 Levels in NORMAL CONDITION

Voltages above the levels of a) are deemed to be HAZARDOUS LIVE if any of the levels of b) or c) are exceeded.

a) The a.c. voltage levels are 30 V r.m.s., 42,4 V peak and the d.c. voltage level is 60 V. For equipment intended for use in WET LOCATIONS, the a.c. voltage levels are 16 V r.m.s., 22,6 V peak and the d.c. voltage level is 35 V.

b) The current levels are:

1) 0,5 mA r.m.s. for sinusoidal waveforms, 0,7 mA peak for non-sinusoidal waveforms or mixed frequencies, or 2 mA d.c., when measured with the measuring circuit of Figure A.1a up to 1 MHz. If the frequency does not exceed 100 Hz, the measuring circuit of Figure A.2 can be used. The measuring circuit of Figure A.4 is used for equipment intended for use in WET LOCATIONS.

2) 70 mA r.m.s. when measured with the measuring circuit of Figure A.3. This relates to possible burns at higher frequencies (above 30 kHz).

c) The levels of capacitive charge or energy are:

1) 45 μ C charge for voltages up to 15 kV peak or d.c.; line A of Figure 2 shows the capacitance versus voltage where the charge is 45 μ C.

2) 350 mJ stored energy for voltages above 15 kV peak or d.c.

6.3.2 Levels in SINGLE FAULT CONDITION

Voltages above the levels of a) are deemed to be HAZARDOUS LIVE if any of the levels of b) or c) are exceeded.

a) The a.c. voltage levels are 50 V r.m.s., 70 V peak and the d.c. voltage level is 120 V. For equipment intended for use in WET LOCATIONS, the a.c. voltage levels are 33 V r.m.s., 46,7 V peak and the d.c. voltage level is 70 V.

b) The current levels are:

1) 5,0 mA r.m.s. for sinusoidal waveforms, 7,07 mA peak for non-sinusoidal waveforms or mixed frequencies, or 25 mA d.c., when measured with the measuring circuit of Figure A.1b up to 1 MHz. If the frequency does not exceed 100 Hz, the measuring circuit of Figure A.2 can be used. The measuring circuit of Figure A.4 is used for equipment intended for use in WET LOCATIONS;

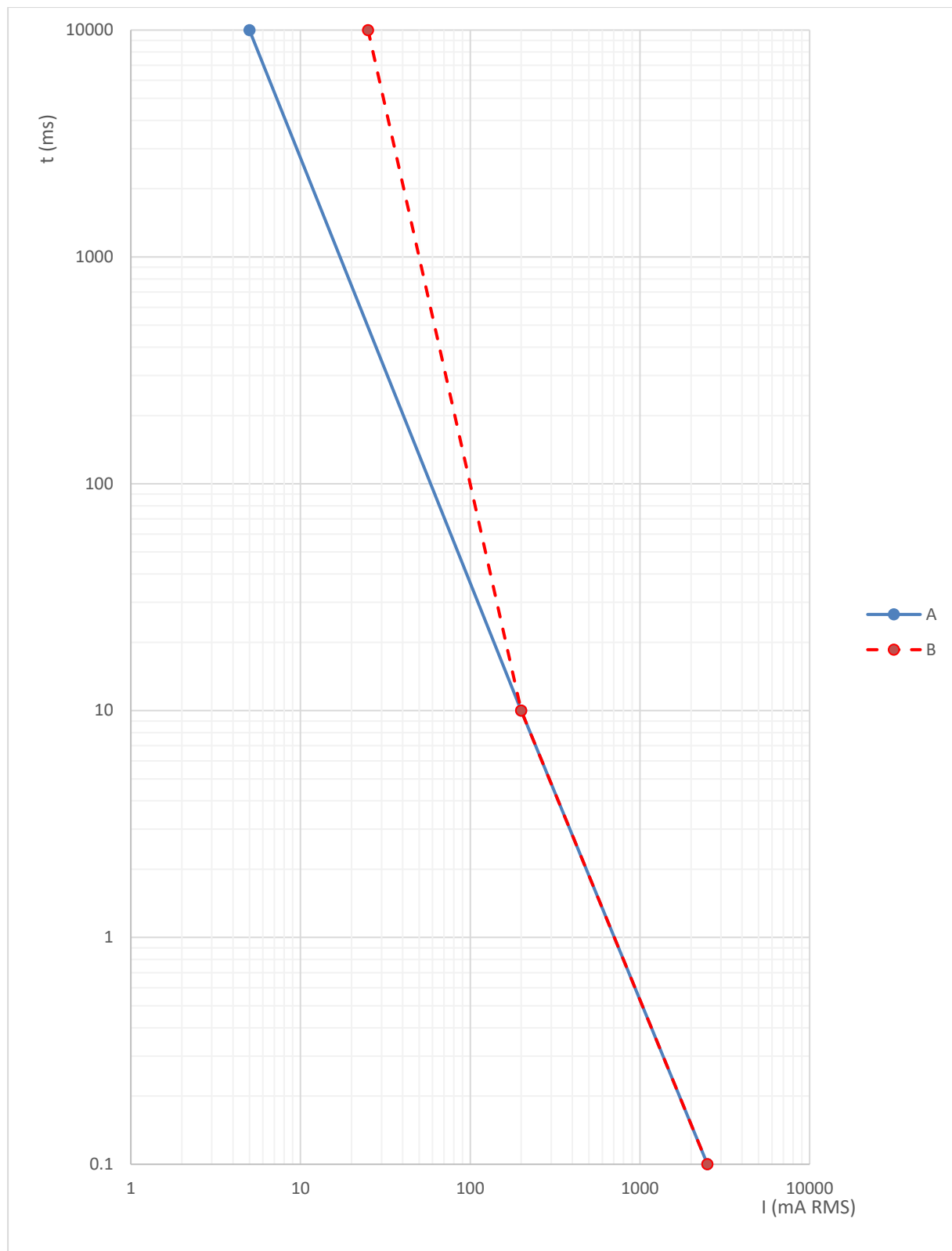
For short-term currents, the maximum duration versus current is defined by Figure 1. For durations of less than 0,1 ms, the maximum current is 2500 mA peak.

2) 500 mA r.m.s. when measured with the measuring circuit of Figure A.3. This relates to possible burns at higher frequencies (above 30 kHz).

c) The levels of capacitance or energy are:

1) line B of Figure 2 or

2) 1,6 J stored energy for voltages above 40 kV peak or d.c.

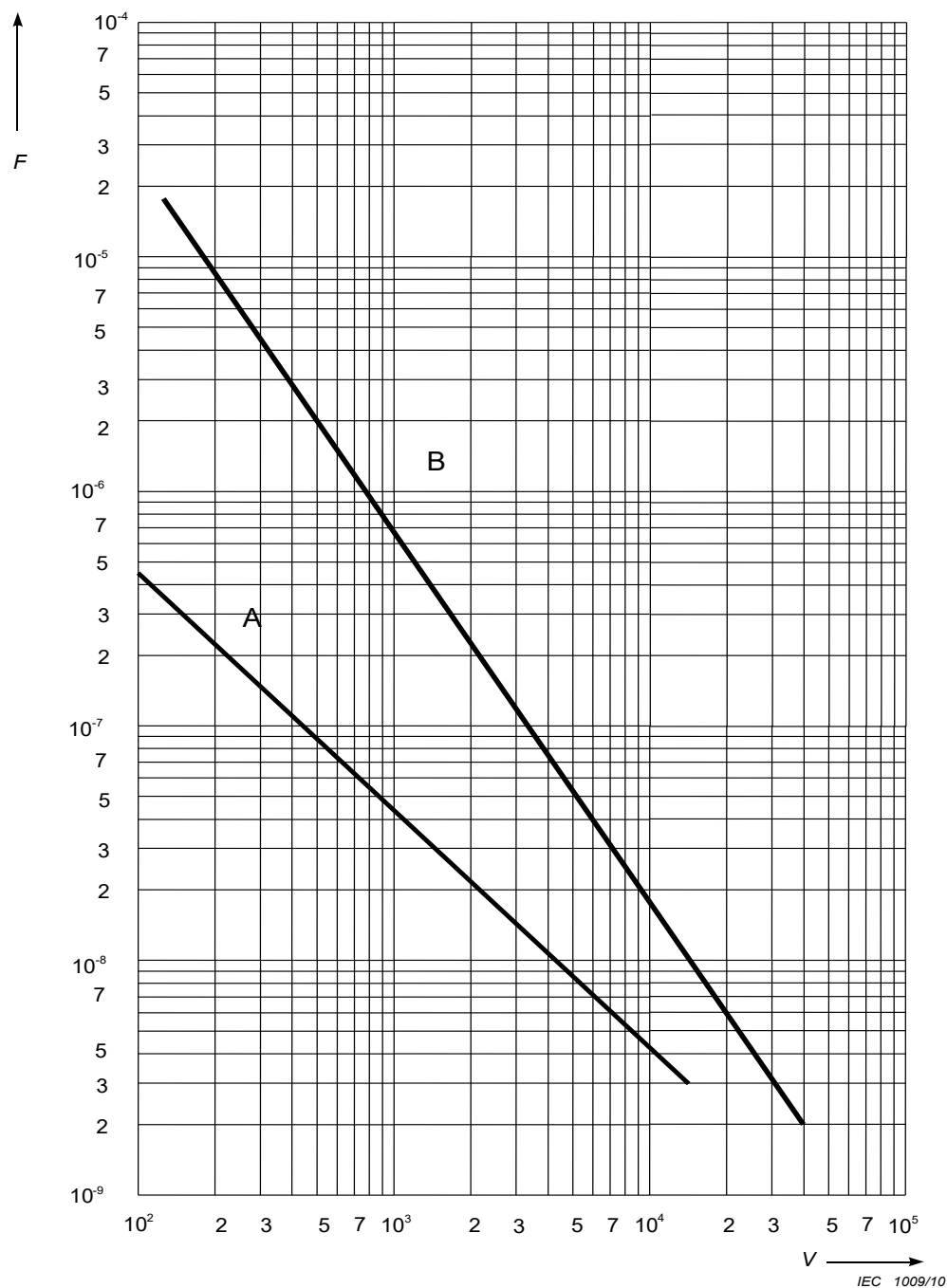
**Key**

A Current a.c. r.m.s.

B Current d.c.

NOTE This figure is based on IEC 60479-1:2018 Figures 20 and 22.

**Figure 1 – Maximum duration of short-term current
in SINGLE FAULT CONDITION (see 6.3.2 b))**



950

951 **Key**

952 A NORMAL CONDITION

953 B SINGLE FAULT CONDITION

954 **Figure 2 – Capacitance level versus voltage in NORMAL CONDITION and SINGLE FAULT**
 955 **CONDITION (see 0 c) and 6.3.2 c))**

956

6.4 Primary means of protection**6.4.1 General**

Replace the first paragraph with the following new paragraph, delete item a) and renumber item b) and c) to item a) and b).

Access to HAZARDOUS LIVE parts shall be prevented by ENCLOSURES or PROTECTIVE BARRIERS (see 6.4.2) and ACCESSIBLE parts shall be prevented from becoming HAZARDOUS LIVE by one or both of the following means (see Annex A).

6.4.2 ENCLOSURES and PROTECTIVE BARRIERS

Replace the conformity statement with the new conformity statement:

Conformity is checked as specified in 6.7, 8.1. and 8.2. Rack-mounted and PANEL-MOUNTED EQUIPMENT shall be installed as specified in the equipment instructions before checking.

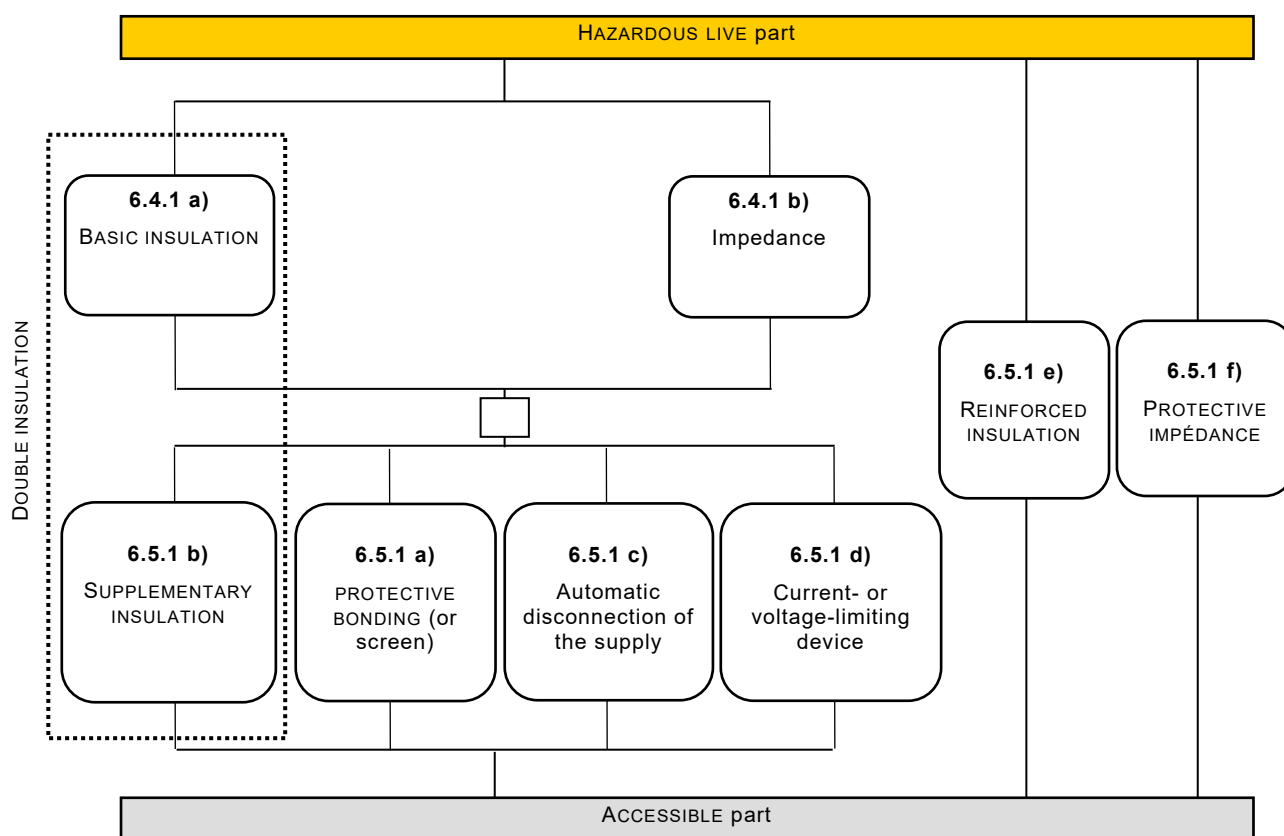
6.5 Additional means of protection in case of SINGLE FAULT CONDITIONS**6.5.1 General**

Replace the text and Figure 4 with the following new text and new Figure 4.

ACCESSIBLE parts shall be prevented from becoming HAZARDOUS LIVE in SINGLE FAULT CONDITION by one of the following means: Items a), b), c) and d) are applied in conjunction with the primary means of protection identified in 6.4. Items e) and f) are applied as single means of protection. See Figure 3 and Annex A.

- a) PROTECTIVE BONDING (see 6.5.2);
- b) SUPPLEMENTARY INSULATION (see 1.1.1);
- c) automatic disconnection of the supply (see 1.1);
- d) current- or voltage-limiting device (see 1.1);
- e) REINFORCED INSULATION (see 1.1.1);
- f) PROTECTIVE IMPEDANCE (see 6.5.4).

Conformity is checked by inspection and as specified in 6.5.2 to 1.1.



986 6.5.2 PROTECTIVE BONDING

987 6.5.2.3 PROTECTIVE CONDUCTOR TERMINAL

988 *Replace item a) and its note with the following new item a) and renumber note 2 of item i) to note:*

- 989 a) The contact surfaces shall be metal. Materials of PROTECTIVE BONDING systems shall be
 990 chosen to minimize electro-chemical corrosion between the TERMINAL and the protective
 991 conductor, or any other metal in contact with them (see Annex P).

992 6.5.2.6 Transformer PROTECTIVE BONDING screen

993 *Replace the conformity statement with the following new conformity statement:*

994 *Conformity is checked by the following test:*

995 *The test of 1.1.1.1 using a test current twice the value of the overcurrent protection means of*
 996 *the winding. The impedance shall not exceed 0,1 Ω.*

1000 *A specially prepared sample transformer having an extra lead-out wire from the free end of the*
 1001 *screen may be necessary to ensure that the current during the test passes through the screen.*

1002 6.5.4 PROTECTIVE IMPEDANCE

1003 *Replace the existing item a) 1) with the following new item a) 1):*

- 1004 1) RATED for twice the maximum WORKING VOLTAGE except single Y1 capacitor bridging
 1005 DOUBLE INSULATION or REINFORCED INSULATION. (see 14.9 and Table 24);

6.6 Connections to external circuits**6.6.1 General**

In the third paragraph, Replace the word “manufacturer’s” with the word “equipment”.

The equipment instructions or equipment markings shall include the following information, if applicable, for each external TERMINAL:

a) RATED conditions at which the TERMINAL has been designed to operate while maintaining safety (maximum RATED input/output voltage, specific type of connector, designated use, etc.);

b) RATING of the insulation required for the external circuit to conform to the requirements for protection against electric shock, arising from the connection to the TERMINAL, in NORMAL CONDITION and SINGLE FAULT CONDITION.

In the conformity statement, delete item 2) and renumber items 3 and 4) to items 2) and 3).

6.6.2 TERMINALS for external circuits

At the end of the first paragraph, replace “interruption of the power supply” with “disconnection”.

6.6.3 Circuits with TERMINALS which are HAZARDOUS LIVE

Replace the existing text with the following new text:

These circuits shall not be connected to ACCESSIBLE conductive parts, except for circuits which are not MAINS CIRCUITS, and which are designed to be operated with one TERMINAL contact at earth potential. In such cases, the ACCESSIBLE conductive parts shall not be HAZARDOUS LIVE.

HAZARDOUS LIVE TERMINALS shall be anchored, fitted or designed so that internal conductors and TERMINAL mechanical mountings will not work loose when the TERMINALS are tightened or loosened, or when connections are made.

If such a circuit is also designed to be operated with one ACCESSIBLE TERMINAL contact floating at a voltage which is not HAZARDOUS LIVE, this TERMINAL contact is permitted to be connected to a common FUNCTIONAL EARTH TERMINAL or system (for example, a coaxial screening system). This common FUNCTIONAL EARTH TERMINAL or system is also permitted to be connected to other ACCESSIBLE conductive parts. Unless it is self-evident, TERMINALS which are connected to ACCESSIBLE conductive parts shall be marked with symbol 7.

Conformity is checked by inspection.

6.7 Insulation requirements**6.7.1 The nature of insulation****6.7.1.1 General**

At the end of item 4) add the following sentence:

(See Annex E for requirements permitting the reduction of POLLUTION DEGREE for a micro-environment within equipment);

6.7.1.2 CREEPAGE DISTANCES

Add the following new paragraph before the least paragraph:

A CREEPAGE DISTANCE may be split into several parts made with the same insulation material, including or separated by floating conductors as long as the sum of the distances across each

individual part is equal or greater than the CREEPAGE DISTANCE required if the floating conductor did not exist (see Annex C, Example 11).

1054

1055 6.7.1.3 Solid insulation

1056 *Add a new note at the end of the subclause:*

1057 NOTE When using insulating materials, the intended life of the equipment is linked to the resistance to aging of
1058 insulating materials which depends on a combination of several factors that influence the performance of polymers
1059 over time including WORKING VOLTAGE, overvoltages, temperature, UV exposure, oxidizing agents, creep rate,
1060 chemical structure and stabilizing additives.

1061

1062 6.7.1.4 Requirements for insulation according to type of circuit

1063 *Move the note 1 just before the note 2.*

1064

1065 6.7.2 Insulation for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II with a nominal supply 1066 voltage up to 300 V

1067 6.7.2.1 CLEARANCES and CREEPAGE DISTANCES

1068 *Replace the existing Table 4 with the following new table 4:*

1069 **Table 2 – CLEARANCES and CREEPAGE DISTANCES for MAINS CIRCUITS of**
1070 **OVERVOLTAGE CATEGORY II up to 300 V**

Voltage line-to- neutral a.c. r.m.s. or d.c.	Values for CLEAR- ANCE	Values for CREEPAGE DISTANCE								
		Printed wiring board material		Other insulating material						
		POLLUTION DEGREE 1	POLLUTION DEGREE 2	POLLUTION DEGREE 1	POLLUTION DEGREE 2			POLLUTION DEGREE 3		
		All material groups	Material groups I, II, IIIa	All material groups	Material group I	Material group II	Material group III	Material group I	Material group II	Material group III
V	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
≤150	0,5	0,5	0,5	0,5	0,8	1,1	1,6	2,0	2,2	2,5
>150 ≤ 300	1,5	1,5	1,5	1,5	1,5	2,1	3,0	3,8	4,1	4,7

CREEPAGE DISTANCES values from this Table 2 are based on the maximum line-to-neutral voltage. CREEPAGE DISTANCES, which are associated with the actual WORKING VOLTAGE values, may be determined according to Table 4.

1071

1072 6.7.2.2 Solid insulation

1073 6.7.2.2.1 General

1074 *Delete the note.*

1075 *Replace the existing item c) with the following new item c):*

1076 c) for insulating layers of printed wiring boards, the requirements of 6.7.2.2.3;

1077

1078 6.7.2.2.2 Moulded and potted parts

1079 *Replace the existing conformity statement with the following new conformity statement:*

1080 *Conformity is checked by inspection.*

1081

1082 *Replace the existing key of Figure 6 with the following new key:*

Key

- 1 Insulating Layer 1
 2 Insulating Layer 2
 C Conductor
 L Distance between adjacent conductors

6.7.2.2.3 Inner insulating layers of printed wiring boards

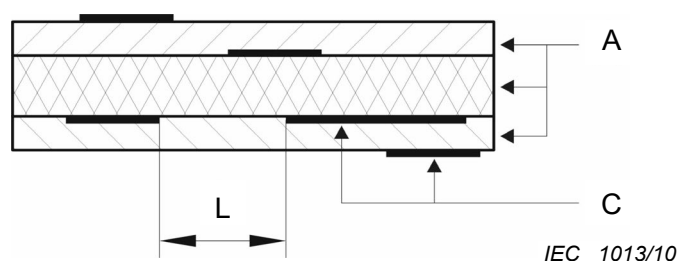
Replace the existing title with this following new title:

6.7.2.2.3 Insulating layers of printed wiring boards

Replace the existing text and figure 7 statement with the following text and figure 7:

For BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION, conductors located between the same two layers shall be separated by at least 0,4 mm (see Figure 7, item L).

Conformity is checked by inspection.

**Key**

- L Distance between adjacent conductors
 A Insulating Layers
 C Conductors

Figure 4 – Distance between adjacent conductors along an interface of two insulating layers

Insulating layers of printed wiring boards suitable for REINFORCED INSULATION shall also meet the requirements of one of the following methods:

a) the thickness of the insulation is at least 0,4 mm;

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

b) the insulation is assembled from at least two separate insulating layers of printed wiring board materials, each of which is RATED by the manufacturer of the material for an electric strength of at least the value of the test voltage of **Erreur ! Source du renvoi introuvable.** for BASIC INSULATION;

Conformity is checked by inspection of the manufacturer's specifications.

c) the insulation is assembled from at least two separate insulating layers of printed wiring board materials, and the combination of insulating layers is RATED by the manufacturer of the material for an electric strength of at least the value of the test voltage of **Erreur ! Source du renvoi introuvable.** for REINFORCED INSULATION.

Conformity is checked by inspection of the manufacturer's specifications.