UL 62368-1

STANDARD FOR SAFETY

Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements

UL Standard for Safety for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1

Third Edition, Dated December 13, 2019

Summary of Topics

This revision of ANSI/UL 62368-1 dated October 22, 2021 includes updates to correlate with NFPA 70:2020 and NFPA 75:2020; Annex DVA, Annex DVF, Annex DVH, removes the reference of UL 60320-1 from Annex DVE and Annex DVF and miscellaneous editorial updates; R.3, T.7, and Figure V.5.

UL 62368-1 is an adoption of IEC 62368-1, Audio/video, information and communication technology equipment – Part 1: Safety requirements (Third Edition, issued October 2018). Please note that the national difference document incorporates all of the U.S. national differences for UL 62368-1.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated May 28, 2021 and July 30, 2021.

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Third Edition
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Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements

December 13, 2019

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This national standard is based on publication IEC 62368-1, Third Edition (2018).

ANSI/UL 62368-1-2021

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. The technical content of IEC and ISO publications is kept under constant review by IEC and ISO. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Third Edition including revisions through October 22, 2021.

The most recent designation of ANSI/UL 62368-1 as an American National Standard (ANSI) occurred on October 22, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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Preface

This is the harmonized CSA Group and UL standard for Audio/video, information and communication technology equipment – Part 1: Safety requirements. It is the third edition of CSA C22.2 No. 62368-1 and the third edition of UL 62368-1. This edition of CSA C22.2 No. 62368-1 supersedes the previous edition published on December 1, 2014. This edition of UL 62368-1 supersedes the previous edition published on December 1, 2014. This harmonized standard has been jointly revised on October 22, 2021. For this pupose, CSA Group and UL are issuing revision pages dated October 22, 2021.

This harmonized standard is based on IEC Publication 62368-1, third edition, Audio/video, information and communication technology equipment – Part 1: Safety requirements, issued October 2018. IEC Publication 62368-1 is copyrighted by the IEC.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Committee (THC 62368) for Audio/Video, Information Technology, and Communication Technology Equipment are gratefully acknowledged.

This Standard is considered suitable for use for conformity assessment within the stated scope of the Standard.

This standard was reviewed by the CSA Subcommittee on Safety of Electronic Equipment within the Field of Audio/Video, Information, and Communication Technology, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of harmonization

This standard adopts the IEC text with national differences.

This standard is published as an equivalent standard for CSA Group and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

All national differences from the IEC text are included in the CSA Group and UL versions of the standard. While the technical content is the same in each organization's version, the format and presentation may differ.

Reasons for differences from IEC

Differences from the IEC are being added in order to address safety and regulatory situations present in the US and Canada.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

IEC Copyright

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 62368-1, Audio/video, information and communication technology equipment – Part 1: Safety requirements, copyright 2018, are used in this standard with the consent of the International Electrotechnical Commission. The IEC Foreword and Introduction are not a part of the requirements of this standard but are included for information purposes only.

NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 62368-1, Audio/video, information and communication technology equipment – Part 1: Safety requirements, copyright 2018, are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUDIO/VIDEO, INFORMATION AND COMMUNICATION TECHNOLOGY EQUIPMENT – Part 1: Safety requirements

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.

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

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8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62368-1 has been prepared by TC 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology.

This third edition cancels and replaces the second edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– addition of requirements for outdoor equipment;

– new requirements for optical radiation;

– addition of requirements for insulating liquids;

– addition of requirements for work cells;

– addition of requirements for wireless power transmitters;

– addition of requirements for fully insulated winding wire (FIW);

– alternative method for determination of top, bottom and side openings for fire enclosures;

– alternative requirements for sound pressure.

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

FDIS	Report on voting
108/701/FDIS	108/707/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.

A list of all parts in the IEC 62368 series, published under the general title *Audio/video, information and communication technology equipment*, can be found on the IEC website.

The “in some countries” notes regarding differing national practices are contained in the following clauses, subclauses and tables:

0.2.1, 1, 3.3.8.1, 3.3.8.3, 4.1.15, 4.7.3, 5.2.2.2, 5.4.2.3.2.4, 5.4.2.5, 5.4.5.1, 5.4.10.2.1, 5.4.10.2.2, 5.4.10.2.3, 5.5.2.1, 5.5.6, 5.6.4.2.1, 5.6.8, 5.7.6, 5.7.7.1, 8.5.4.2.3, 10.5.3, 10.6.1, F.3.3.6, Y.4.1, Y.4.5, Table 12, Table 13, Table 14 and Table 39.

In this document, the following print types or formats are used:

– requirements proper and normative annexes: in roman type;

– compliance statements and test specifications: *in italic type*;

– notes/explanatory matter: in smaller roman type;

– normative conditions within tables: in smaller roman type;

– terms that are defined in 3.3: **bold**.

In figures and tables, if colour is available:

– green colour denotes a class 1 energy source;

– yellow colour denotes a class 2 energy source;

– red colour denotes a class 3 energy source.

A comparison of terms introduced in this document that are different from other existing IEC documents is given in Annex W.

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.

NOTE Explanatory information related to IEC 62368-1 is contained in IEC TR 62368-2. It provides rationale together with explanatory information related to this document.

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.

DV.1 DE *Modification: Add the following to the IEC Foreword:*

The numbering system in the standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

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INTRODUCTION

0 Principles of this product safety standard

0.1 Objective

This part of IEC 62368 is a product safety standard that classifies energy sources, prescribes SAFEGUARDS against those energy sources, and provides guidance on the application of, and requirements for, those SAFEGUARDS.

The prescribed SAFEGUARDS are intended to reduce the likelihood of pain, injury and, in the case of fire, property damage.

The objective of the INTRODUCTION is to help designers to understand the underlying principles of safety in order to design safe equipment. These principles are informative and not an alternative to the detailed requirements of this document.

0.2 Persons

0.2.1 General

This document describes SAFEGUARDS for the protection of three kinds of persons: the ORDINARY PERSON, the INSTRUCTED PERSON, and the SKILLED PERSON. Unless otherwise specified, the requirements for an ORDINARY PERSON apply. This document assumes that a person will not intentionally create conditions or situations that could cause pain or injury.

NOTE 1 In Australia, the work conducted by an instructed person or skilled person may require formal licensing from regulatory authorities.

NOTE 2 In Germany, a person may only be regarded as an instructed person or a skilled person if certain legal requirements are fulfilled.

0.2.2 Ordinary person

ORDINARY PERSON is the term applied to all persons other than INSTRUCTED PERSONS and SKILLED PERSONS. ORDINARY PERSONS include not only users of the equipment, but also all persons who may have access to the equipment or who may be in the vicinity of the equipment. Under NORMAL OPERATING CONDITIONS or ABNORMAL OPERATING CONDITIONS, ORDINARY PERSONS should not be exposed to parts comprising energy sources capable of causing pain or injury. Under a SINGLE FAULT CONDITION, ORDINARY PERSONS should not be exposed to parts comprising energy sources capable of causing injury.

0.2.3 Instructed person

INSTRUCTED PERSON is a term applied to persons who have been instructed and trained by a SKILLED PERSON, or who are supervised by a SKILLED PERSON, to identify energy sources that may cause pain (see Table 1) and to take precautions to avoid unintentional contact with or exposure to those energy sources. Under NORMAL OPERATING CONDITIONS, ABNORMAL OPERATING CONDITIONS or SINGLE FAULT CONDITIONS, INSTRUCTED PERSONS should not be exposed to parts comprising energy sources capable of causing injury.

0.2.4 Skilled person

SKILLED PERSON is a term applied to persons who have training or experience in the equipment technology, particularly in knowing the various energies and energy magnitudes used in the equipment. SKILLED PERSONS are expected to use their training and experience to recognize energy sources capable of causing pain or injury and to take action for protection from injury from those energies. SKILLED PERSONS should also be protected against unintentional contact or exposure to energy sources capable of causing injury.

0.3 Model for pain and injury

An energy source that causes pain or injury does so through the transfer of some form of energy to or from a body part.

This concept is represented by a three-block model (see Figure 1).

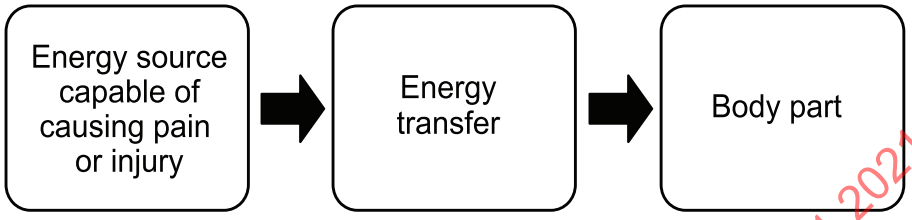

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Figure 1

Three block model for pain and injury

This safety standard specifies three classes of energy sources defined by magnitudes and durations of source parameters relative to the body responses to those electrical and thermal energy sources (see Table 1). Source parameters relative to responses to COMBUSTIBLE MATERIAL, mechanical energy sources and radiation energy sources are specified based on experience and basic safety standards.

Table 1
Response to energy class

Energy source	Effect on the body	Effect on combustible materials
Class 1	Not painful, but may be detectable	Ignition not likely
Class 2	Painful, but not an injury	Ignition possible, but limited growth and spread of fire
Class 3	Injury	Ignition likely, rapid growth and spread of fire

The energy threshold for pain or injury is not constant throughout the population. For example, for some energy sources, the threshold is a function of body mass; the lower the mass, the lower the threshold, and vice-versa. Other body variables include age, state of health, state of emotions, effect of drugs, skin characteristics, etc. Furthermore, even where outward appearances otherwise appear equal, individuals differ in their thresholds of susceptibility to the same energy source.

The effect of duration of energy transfer is a function of the specific energy form. For example, pain or injury from thermal energy can be very short (1 s) for high skin temperature, or very long (several hours) for low skin temperature.

Furthermore, the pain or injury may occur some considerable time after the transfer of energy to a body part. For example, pain or injury from some chemical or physiological reaction may not be manifested for days, weeks, months, or years.

0.4 Energy sources

Energy sources are addressed by this document, together with the pain or injury that results from a transfer of that energy to the body, and the likelihood of property damage that results from fire escaping the equipment.

An electrical product is connected to an electrical energy source (for example, the MAINS), an external power supply, or a BATTERY. An electrical product uses the electrical energy to perform its intended functions.

In the process of using electrical energy, the product transforms the electrical energy into other forms of energy (for example, thermal energy, kinetic energy, optical energy, audio energy, electromagnetic energy, etc.). Some energy transformations may be a deliberate part of the product function (for example, moving parts of a printer, images on a visual display unit, sound from a speaker, etc.). Some energy transformations may be a by-product of the product function (for example, heat dissipated by functional circuits, X-radiation from a cathode-ray tube, etc.).

Some products may use energy sources that are non-electrical energy sources such as moving parts or chemicals. The energy in these other sources may be transferred to or from a body part, or may be transformed into other energy forms (for example, chemical energy may be converted to electrical energy through a BATTERY, or a moving body part transfers its kinetic energy to a sharp edge).

Examples of the types of energy forms and the associated injuries and property damage addressed in this document are in Table 2.

Table 2
Examples of body response or property damage related to energy sources

Forms of energy	Examples of body response or property damage	Clause
Electrical energy (for example, energized conductive parts)	Pain, fibrillation, cardiac arrest, respiratory arrest, skin burn, or internal organ burn	5
Thermal energy (for example, electrical ignition and spread of fire)	Electrically-caused fire leading to burn-related pain or injury, or property damage	6
Chemical reaction (for example, electrical ignition and spread of fire)	Skin damage, organ damage, or poisoning	7
Kinetic energy (for example, moving parts of equipment, or a moving body part against an equipment part)	Laceration, puncture, abrasion, contusion, crush, amputation, or loss of a limb, eye, ear, etc.	8
Thermal energy (for example, hot ACCESSIBLE parts)	Skin burn	9
Radiated energy (for example, electromagnetic energy, optical energy, acoustic energy)	Loss of sight, skin burn, or loss of hearing	10

0.5 Safeguards

0.5.1 General

Many products necessarily use energy capable of causing pain or injury. Product design cannot eliminate such energy use. Consequently, such products should use a scheme that reduces the likelihood of such

energy being transferred to a body part. The scheme that reduces the likelihood of energy transfer to a body part is a SAFEGUARD (see Figure 2).

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Figure 2

Three block model for safety

A SAFEGUARD is a device or scheme or system that:

– is interposed between an energy source capable of causing pain or injury and a body part, and

– reduces the likelihood of transfer of energy capable of causing pain or injury to a body part.

NOTE SAFEGUARD mechanisms against transfer of energy capable of causing pain or injury include:

– attenuating the energy (reduces the value of the energy); or

– impeding the energy (slows the rate of energy transfer); or

– diverting the energy (changes the energy direction); or

– disconnecting, interrupting, or disabling the energy source; or

– enveloping the energy source (reduces the likelihood of the energy from escaping); or

– interposing a barrier between a body part and the energy source.

A SAFEGUARD can be applied to the equipment, to the local installation, to a person or can be a learned or directed behaviour (for example, resulting from an INSTRUCTIONAL SAFEGUARD) intended to reduce the likelihood of transfer of energy capable of causing pain or injury. A SAFEGUARD may be a single element or may be a set of elements.

Generally, this document uses an order of preference for providing SAFEGUARDS based on the requirements given in ISO/IEC Guide 51 as follows:

– EQUIPMENT SAFEGUARDS are always useful, since they do not require any knowledge or actions by persons coming into contact with the equipment;

– INSTALLATION SAFEGUARDS are useful when a safety characteristic can only be provided after installation (for example, the equipment has to be bolted to the floor to provide stability);

– behavioural SAFEGUARDS are useful when the equipment requires an energy source to be ACCESSIBLE.

In practice, SAFEGUARD selection accounts for the nature of the energy source, the intended user, the functional requirements of the equipment, and similar considerations.

0.5.2 Equipment safeguard

An EQUIPMENT SAFEGUARD may be a BASIC SAFEGUARD, a SUPPLEMENTARY SAFEGUARD, a DOUBLE SAFEGUARD, or a REINFORCED SAFEGUARD.

0.5.3 Installation safeguard

INSTALLATION SAFEGUARDS are not controlled by the equipment manufacturer, although in some cases, INSTALLATION SAFEGUARDS may be specified in the equipment installation instructions.

Generally, with respect to equipment, an INSTALLATION SAFEGUARD is a SUPPLEMENTARY SAFEGUARD.

NOTE For example, the SUPPLEMENTARY SAFEGUARD providing protective earthing is located partly in the equipment and partly in the installation. The SUPPLEMENTARY SAFEGUARD providing PROTECTIVE EARTHING is not effective until the equipment is connected to the PROTECTIVE EARTHING of the installation.

Requirements for INSTALLATION SAFEGUARDS are not addressed in this document. However, this document does assume some INSTALLATION SAFEGUARDS, such as PROTECTIVE EARTHING, are in place and are effective.

0.5.4 Personal safeguard

A PERSONAL SAFEGUARD may be a BASIC SAFEGUARD, a SUPPLEMENTARY SAFEGUARD, or a REINFORCED SAFEGUARD.

Requirements for PERSONAL SAFEGUARDS are not addressed in this document. However, this document does assume that PERSONAL SAFEGUARDS are available for use as specified by the manufacturer.

0.5.5 Behavioural safeguards

0.5.5.1 Introduction to behavioural safeguards

In the absence of an EQUIPMENT, INSTALLATION, or PERSONAL SAFEGUARD, a person may use a specific behaviour as a SAFEGUARD to avoid energy transfer and consequent injury. A behavioural SAFEGUARD is a voluntary or instructed behaviour intended to reduce the likelihood of transfer of energy to a body part.

Three kinds of behavioural SAFEGUARDS are specified in this document. Each kind of behavioural SAFEGUARD is associated with a specific kind of person. An INSTRUCTIONAL SAFEGUARD is usually addressed to an ORDINARY PERSON, but may also be addressed to an INSTRUCTED PERSON or a SKILLED PERSON. A PRECAUTIONARY SAFEGUARD is used by an INSTRUCTED PERSON. A SKILL SAFEGUARD is used by a SKILLED PERSON.

0.5.5.2 Instructional safeguard

An INSTRUCTIONAL SAFEGUARD is a means of providing information, describing the existence and location of an energy source capable of causing pain or injury, and is intended to invoke a specific behaviour on the part of a person to reduce the likelihood of transfer of energy to a body part (see Annex F).

An INSTRUCTIONAL SAFEGUARD may be a visual indicator (symbols or words or both) or an audible message, as applicable to the expected use of the product.

When accessing locations where the equipment needs to be energized to perform a service activity, an INSTRUCTIONAL SAFEGUARD may be considered acceptable protection to bypass an EQUIPMENT SAFEGUARD such that the person is made aware of how to avoid contact with a class 2 or class 3 energy source.

If EQUIPMENT SAFEGUARDS would interfere with or prohibit the equipment function, an INSTRUCTIONAL SAFEGUARD may replace an EQUIPMENT SAFEGUARD.

If exposure to an energy source capable of causing pain or injury is essential to the correct functioning of equipment, an INSTRUCTIONAL SAFEGUARD may be used to ensure protection of persons instead of another SAFEGUARD. Consideration should be given as to whether the INSTRUCTIONAL SAFEGUARD should require the use of a PERSONAL SAFEGUARD.

Provision of an INSTRUCTIONAL SAFEGUARD does not result in an ORDINARY PERSON becoming an INSTRUCTED PERSON (see 0.5.5.3).

0.5.5.3 Precautionary safeguard (used by an instructed person)

A PRECAUTIONARY SAFEGUARD is the training and experience or supervision of an INSTRUCTED PERSON by a SKILLED PERSON to use precautions to protect the INSTRUCTED PERSON against class 2 energy sources. PRECAUTIONARY SAFEGUARDS are not specifically prescribed in this document but are assumed to be effective when the term INSTRUCTED PERSON is used.

During equipment servicing, an INSTRUCTED PERSON may need to remove or defeat an EQUIPMENT SAFEGUARD. In this case, an INSTRUCTED PERSON is expected to then apply precaution as a SAFEGUARD to avoid exposure to class 2 energy sources.

0.5.5.4 Skill safeguard (used by a skilled person)

A SKILL SAFEGUARD is the education, training, knowledge and experience of the SKILLED PERSON that is used to protect the SKILLED PERSON against class 2 or class 3 energy sources. SKILL SAFEGUARDS are not specifically prescribed in this document but are assumed to be effective when the term SKILLED PERSON is used.

During equipment servicing, a SKILLED PERSON may need to remove or defeat an EQUIPMENT SAFEGUARD. In this case, a SKILLED PERSON is expected to then apply skill as a SAFEGUARD to avoid injury.

0.5.6 Safeguards during ordinary or instructed person service conditions

During ORDINARY PERSON or INSTRUCTED PERSON service conditions, SAFEGUARDS for such persons may be necessary. Such SAFEGUARDS can be EQUIPMENT SAFEGUARDS, PERSONAL SAFEGUARDS, or INSTRUCTIONAL SAFEGUARDS.

0.5.7 Equipment safeguards during skilled person service conditions

During SKILLED PERSON service conditions, EQUIPMENT SAFEGUARDS should be provided to protect against the effects of a body's involuntary reaction (for example, startle) that might cause unintentional contact with a class 3 energy source located outside the view of the SKILLED PERSON.

NOTE This SAFEGUARD typically applies in large equipment, where the SKILLED PERSON needs to partially or wholly enter between two or more class 3 energy source locations while servicing.

0.5.8 Examples of safeguard characteristics

Table 3 lists some examples of safeguard characteristics.

Table 3
Examples of safeguard characteristics

Safeguard	Basic safeguard	Supplementary safeguard	Reinforced safeguard
EQUIPMENT SAFEGUARD: a physical part of an equipment	Effective under NORMAL OPERATING CONDITIONS	Effective in the event of failure of the BASIC SAFEGUARD	Effective under NORMAL OPERATING CONDITIONS and in the event of a SINGLE FAULT CONDITION elsewhere in the equipment
	Example: BASIC INSULATION	Example: SUPPLEMENTARY INSULATION	Example: REINFORCED INSULATION
	Example: normal temperatures below ignition temperatures	Example: FIRE ENCLOSURE	Not applicable
INSTALLATION SAFEGUARD: a physical part of a man-made installation	Effective under NORMAL OPERATING CONDITIONS	Effective in the event of failure of an equipment BASIC SAFEGUARD	Effective under NORMAL OPERATING CONDITIONS and in the event of a SINGLE FAULT CONDITION elsewhere in the equipment
	Example: wire size	Example: overcurrent protective device	Example: socket outlet
PERSONAL SAFEGUARD: a physical device worn on the body	In the absence of any EQUIPMENT SAFEGUARD, effective under NORMAL OPERATING CONDITIONS	Effective in the event of failure of an equipment BASIC SAFEGUARD	In the absence of any EQUIPMENT SAFEGUARD, effective under NORMAL OPERATING CONDITIONS and in the event of a SINGLE FAULT CONDITION elsewhere in the equipment
	Example: gloves	Example: insulating floor mat	Example: electrically-insulated glove for handling live conductors
INSTRUCTIONAL SAFEGUARD: a voluntary or instructed behaviour intended to reduce the likelihood of transfer of energy to a body part	In the absence of any EQUIPMENT SAFEGUARD, effective under NORMAL OPERATING CONDITIONS	Effective in the event of failure of an equipment BASIC SAFEGUARD	Only effective on an exceptional basis, when providing all appropriate SAFEGUARDS would prevent the intended functioning of the equipment
	Example: INSTRUCTIONAL SAFEGUARD to disconnect telecommunication cable before opening the cover	Example: after opening a door, an INSTRUCTIONAL SAFEGUARD against hot parts	Example: INSTRUCTIONAL SAFEGUARD of hot parts in an office photocopier, or a continuous roll paper cutter on a commercial printer

0.6 Electrically-caused pain or injury (electric shock)

0.6.1 Models for electrically-caused pain or injury

Electrically-caused pain or injury may occur when electrical energy capable of causing pain or injury is transferred to a body part (see Figure 3).

Electrical energy transfer occurs when there are two or more electrical contacts to the body:

– the first electrical contact is between a body part and a conductive part of the equipment;

– the second electrical contact is between another body part and

- earth, or
- another conductive part of the equipment.

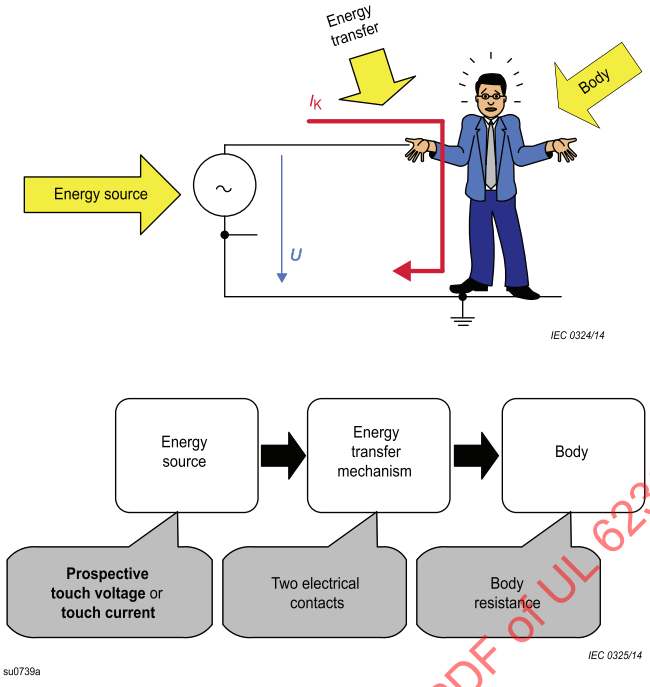

Figure 3

Schematic and model for electrically-caused pain or injury

Depending on the magnitude, duration, wave shape, and frequency of the current, the effect on the human body varies from undetectable to detectable to painful to injurious.

0.6.2 Models for protection against electrically-caused pain or injury

One or more SAFEGUARDS are interposed between an electrical energy source capable of causing pain or injury and a body part to protect against electrically-caused pain or injury (see Figure 4).

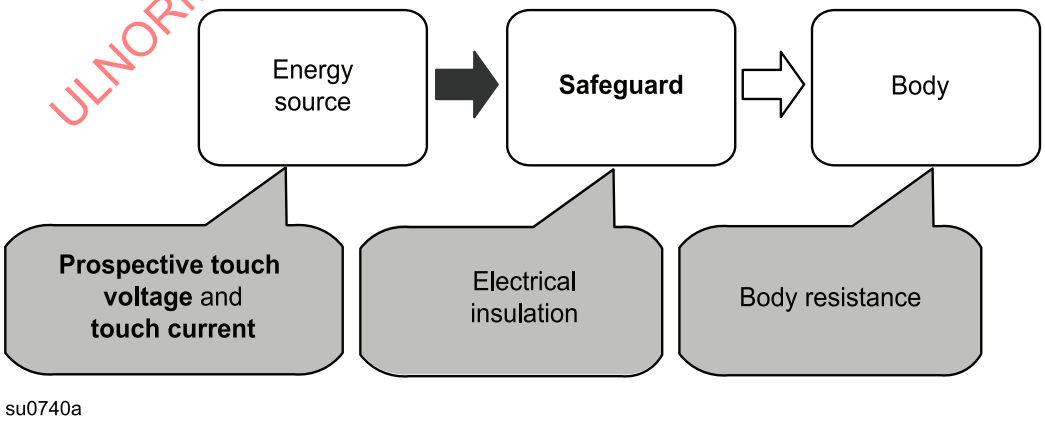

Figure 4

Model for protection against electrically-caused pain or injury

Protection against electrically-caused pain is provided under NORMAL OPERATING CONDITIONS and ABNORMAL OPERATING CONDITIONS. For such protection, under NORMAL OPERATING CONDITIONS and ABNORMAL OPERATING CONDITIONS, a BASIC SAFEGUARD is interposed between an electrical energy source capable of causing pain and an ORDINARY PERSON.

The most common BASIC SAFEGUARD against an electrical energy source capable of causing pain is electrical insulation (also known as BASIC INSULATION) interposed between the energy source and a body part.

Protection against electrically-caused injury is provided under NORMAL OPERATING CONDITIONS, ABNORMAL OPERATING CONDITIONS, and SINGLE FAULT CONDITIONS. For such protection, under NORMAL OPERATING CONDITIONS and ABNORMAL OPERATING CONDITIONS, both a BASIC SAFEGUARD and a SUPPLEMENTARY SAFEGUARD are interposed between an electrical energy source capable of causing injury and an ORDINARY PERSON (see 4.3.2.4), or an INSTRUCTED PERSON (see 4.3.3.3). In the event of a failure of either SAFEGUARD, the other SAFEGUARD becomes effective. The SUPPLEMENTARY SAFEGUARD against an electrical energy source capable of causing injury is placed between the BASIC SAFEGUARD and a body part. A SUPPLEMENTARY SAFEGUARD may be additional electrical insulation (SUPPLEMENTARY INSULATION) or a protectively earthed conductive barrier or other construction that performs the same function.

Another SAFEGUARD against an electrical energy source capable of causing injury is electrical insulation (also known as DOUBLE INSULATION or REINFORCED INSULATION) placed between the energy source and a body part.

Likewise, a REINFORCED SAFEGUARD may be placed between an electrical energy source capable of causing injury and a body part.

0.7 Electrically-caused fire

0.7.1 Models for electrically-caused fire

Electrically-caused fire is due to conversion of electrical energy to thermal energy (see Figure 5), where the thermal energy heats a fuel material followed by ignition and combustion.

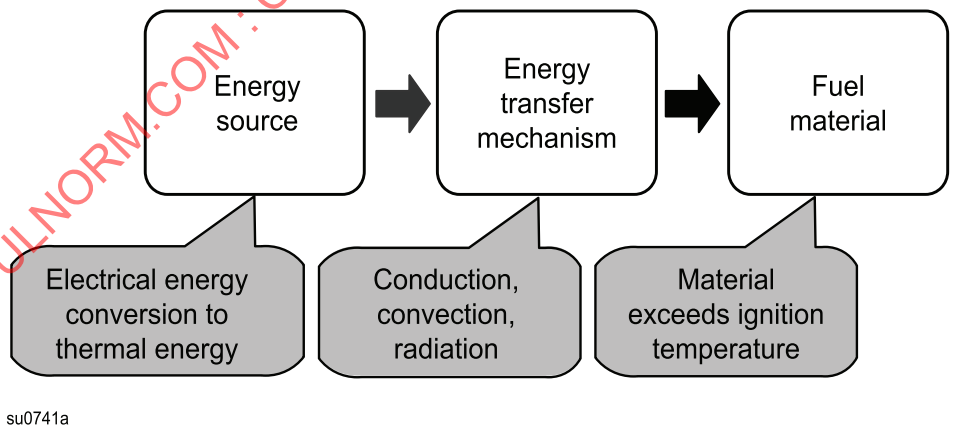

Figure 5

Model for electrically-caused fire

Electrical energy is converted to thermal energy either in a resistance or in an arc and is transferred to a fuel material by conduction, convection, or radiation. As the fuel material heats, it chemically decomposes

into gases, liquids and solids. When the gas is at its ignition temperature, the gas can be ignited by an ignition source. When the gas is at its spontaneous ignition temperature, the gas ignites by itself. Both result in fire.

0.7.2 Models for protection against electrically-caused fire

The BASIC SAFEGUARD against electrically-caused fire (see Figure 6) is that the temperature of a material, under NORMAL OPERATING CONDITIONS and ABNORMAL OPERATING CONDITIONS, does not cause the material to ignite.

The SUPPLEMENTARY SAFEGUARD against electrically-caused fire reduces the likelihood of ignition or, in the case of ignition, reduces the likelihood of spread of fire.

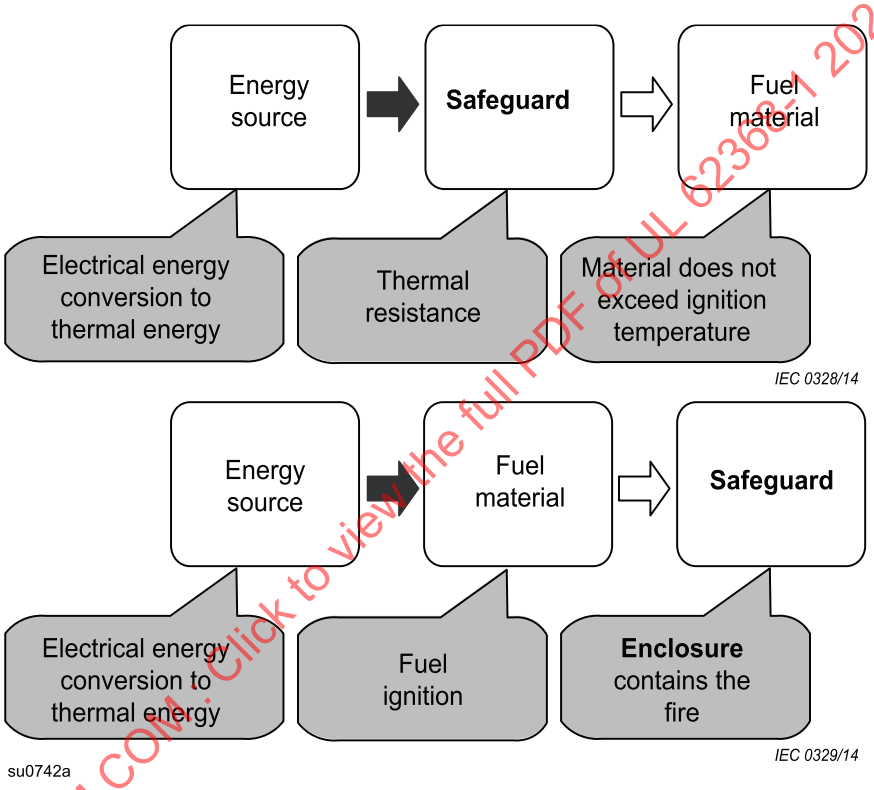

Figure 6

Models for protection against fire

0.8 Injury caused by hazardous substances

Injury caused by HAZARDOUS SUBSTANCES is due to a chemical reaction with a body part. The extent of injury by a given substance depends on both the magnitude and duration of exposure and on the body part susceptibility to that substance.

The BASIC SAFEGUARD against injury caused by HAZARDOUS SUBSTANCES is containment of the material.

SUPPLEMENTARY SAFEGUARDS against injury caused by HAZARDOUS SUBSTANCES may include:

– a second container or a spill-resistant container;

– containment trays;

– tamper-proof screws to prevent unauthorized access;

– INSTRUCTIONAL SAFEGUARDS.

National and regional regulations govern the use of and exposure to HAZARDOUS SUBSTANCES used in equipment. These regulations do not enable a practical classification of HAZARDOUS SUBSTANCES in the manner in which other energy sources are classified in this document. Therefore, energy source classifications are not applied in Clause 7.

0.9 Mechanically-caused injury

Mechanically-caused injury is due to kinetic energy transfer to a body part when a collision occurs between a body part and an equipment part. The kinetic energy is a function of the relative motion between a body part and ACCESSIBLE parts of the equipment, including parts ejected from the equipment that collide with a body part.

Examples of kinetic energy sources are:

– body motion relative to sharp edges and corners;

– part motion due to rotating or other moving parts, including pinch points;

– part motion due to loosening, exploding, or imploding parts;

– equipment motion due to instability;

– equipment motion due to wall, ceiling, or rack mounting means failure;

– equipment motion due to handle failure;

– part motion due to an exploding BATTERY;

– equipment motion due to cart or stand instability or failure.

The BASIC SAFEGUARD against mechanically-caused injury is a function of the specific energy source. BASIC SAFEGUARDS may include:

– rounded edges and corners;

– an ENCLOSURE to prevent a moving part from being ACCESSIBLE;

– an ENCLOSURE to prevent expelling a moving part;

– a SAFETY INTERLOCK to control access to an otherwise moving part;

– means to stop the motion of a moving part;

– means to stabilize the equipment;

– robust handles;

– robust mounting means;

– means to contain parts expelled during EXPLOSION or implosion.

The SUPPLEMENTARY SAFEGUARD against mechanically-caused injury is a function of the specific energy source. SUPPLEMENTARY SAFEGUARDS may include:

– INSTRUCTIONAL SAFEGUARDS;

– instructions and training;

– additional ENCLOSURES or barriers;

– SAFETY INTERLOCKS.

The REINFORCED SAFEGUARD against mechanically-caused injury is a function of the specific energy source. REINFORCED SAFEGUARDS may include:

– extra thick glass on the front of a CRT;

– rack slide-rails and means of support;

– SAFETY INTERLOCK.

0.10 Thermally-caused injury (skin burn)

0.10.1 Models for thermally-caused injury

Thermally-caused injury may occur when thermal energy capable of causing injury is transferred to a body part (see Figure 7).

Thermal energy transfer occurs when a body touches a hot equipment part. The extent of injury depends on the temperature difference, the thermal mass of the object, rate of thermal energy transfer to the skin, and duration of contact.

The requirements in this document only address SAFEGUARDS against thermal energy transfer by conduction. This document does not address SAFEGUARDS against thermal energy transfer by convection or radiation.

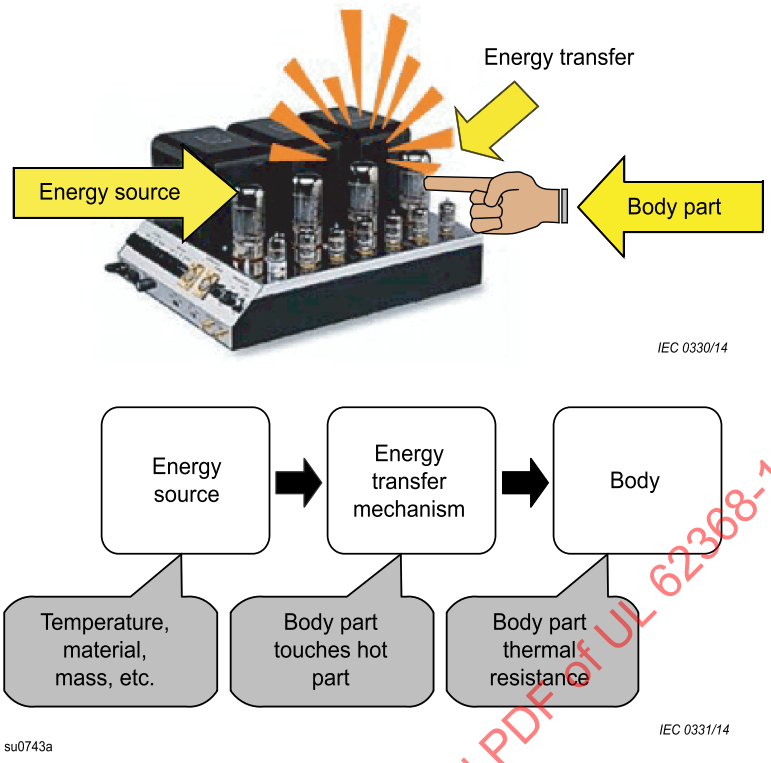

Figure 7

Schematic and model for thermally-caused injury

Depending on the temperature, contact duration, material properties, and mass of the material, the perception of the human body varies from warmth to heat that may result in pain or injury (burn).

0.10.2 Models for protection against thermally-caused pain or injury

One or more SAFEGUARDS are interposed between a thermal energy source capable of causing pain or injury and an ORDINARY PERSON (see Figure 8).

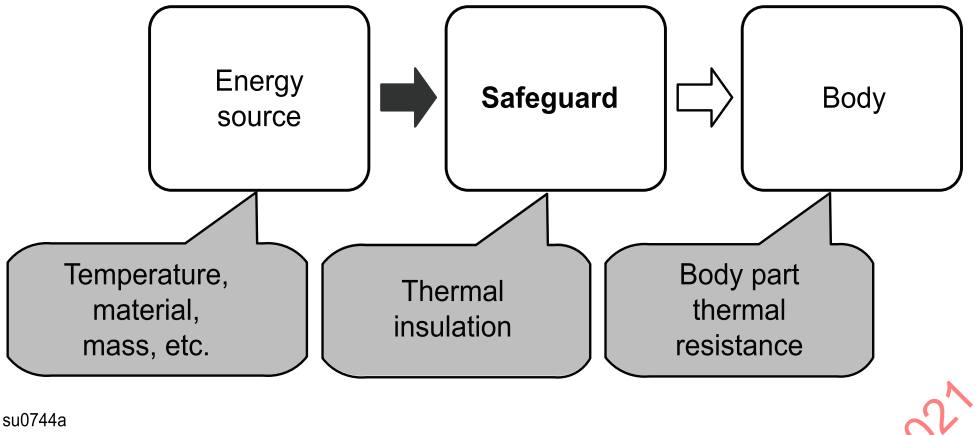

Figure 8

Model for protection against thermally-caused injury

Under NORMAL OPERATING CONDITIONS and ABNORMAL OPERATING CONDITIONS, protection is used against thermally-cause pain. For such protection, a BASIC SAFEGUARD is interposed between a thermal energy source capable of causing pain and an ORDINARY PERSON.

Under NORMAL OPERATING CONDITIONS, ABNORMAL OPERATING CONDITIONS and SINGLE FAULT CONDITIONS, protection is used against thermally-caused injury. For such protection, a BASIC SAFEGUARD and a SUPPLEMENTARY SAFEGUARD are interposed between a thermal energy source capable of causing injury and an ORDINARY PERSON.

The BASIC SAFEGUARD against a thermal energy source capable of causing pain or injury is thermal insulation placed between the energy source and a body part. In some cases, a BASIC SAFEGUARD against a thermal energy source capable of causing pain or injury may be an INSTRUCTIONAL SAFEGUARD identifying the hot parts and how to reduce the likelihood of injury. In some cases, a BASIC SAFEGUARD reduces the likelihood of a non-injurious thermal energy source from becoming a thermal energy source capable of causing pain or injury.

Examples of such BASIC SAFEGUARDS are:

– control of electrical energy being converted to thermal energy (for example, a THERMOSTAT);

– heat sinking, etc.

The SUPPLEMENTARY SAFEGUARD against a thermal energy source capable of causing injury is thermal insulation placed between the energy source and a body part. In some cases, a SUPPLEMENTARY SAFEGUARD against a thermal energy source capable of causing pain or injury may be an INSTRUCTIONAL SAFEGUARD identifying the hot parts and how to reduce the likelihood of injury.

0.11 Radiation-caused injury

Radiation-caused injury within the scope of this document is generally attributed to one of the following energy transfer mechanisms:

– heating of a body organ caused by exposure to non-ionising radiation, such as the highly localised energy of a laser impinging on the retina; or

– auditory injury caused by over stimulation of the ear by excessive peaks or sustained loud sound, leading to physical or nerve damage; or

– X-radiation; or

– UV radiation.

Radiated energy is transferred by impingement of wave emission upon a body part.

The BASIC SAFEGUARD against radiation-caused injury is containment of the energy within an ENCLOSURE that is opaque to the radiated energy.

There are several SUPPLEMENTARY SAFEGUARDS against radiation-caused injury. The SUPPLEMENTARY SAFEGUARDS may include SAFETY INTERLOCKS to disconnect power to the generator, tamper-proof screws to prevent unauthorized access, etc.

The BASIC SAFEGUARD against auditory injury is to limit the acoustic output of personal music players and their associated headphones and earphones.

Examples of SUPPLEMENTARY SAFEGUARDS against auditory pain and injury are the provision of warnings and information advising the user how to use the equipment correctly.

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AUDIO/VIDEO, INFORMATION AND COMMUNICATION TECHNOLOGY EQUIPMENT – Part 1: Safety requirements

1 Scope

This part of IEC 62368 is applicable to the safety of electrical and electronic equipment within the field of audio, video, information and communication technology, and business and office machines with a RATED VOLTAGE not exceeding 600 V. This document does not include requirements for performance or functional characteristics of equipment.

NOTE 1 Examples of equipment within the scope of this document are given in Annex A.

NOTE 2 A RATED VOLTAGE of 600 V is considered to include equipment rated 400/690 V.

This document is also applicable to:

– components and subassemblies intended for incorporation in this equipment. Such components and subassemblies need not comply with every requirement of this document, provided that the complete equipment, incorporating such components and subassemblies, does comply;

– external power supply units intended to supply other equipment within the scope of this document;

– accessories intended to be used with equipment within the scope of this document;

– large equipment installed in RESTRICTED ACCESS AREAS. For equipment having large machinery aspects, additional requirements may apply; and

– equipment to be used in tropical regions.

This document also includes requirements for audio/video, information and communication technology equipment intended to be installed in an OUTDOOR LOCATION. The requirements for OUTDOOR EQUIPMENT also apply, where relevant, to OUTDOOR ENCLOSURES suitable for direct installation in the field and supplied for housing audio/video, information and communication technology equipment to be installed in an OUTDOOR LOCATION. See Annex Y for specific construction requirements not covered elsewhere in this document.

Each installation may have particular requirements. In addition, requirements for protection of the OUTDOOR EQUIPMENT against the effects of direct lightning strikes are not covered by this document.

NOTE 3 For information on this subject, see IEC 62305-1.

This document assumes a maximum altitude of 2 000 m unless otherwise specified by the manufacturer.

Additional requirements for equipment having the capability to supply DC power over commonly used communication cables, such as USB or Ethernet (PoE), are given in IEC 62368-3. IEC 62368-3 does not apply to:

– equipment supplying power using proprietary connectors; or

– equipment using a proprietary protocol for power selection.

This document specifies SAFEGUARDS for ORDINARY PERSONS, INSTRUCTED PERSONS, and SKILLED PERSONS. Additional requirements may apply for equipment that is clearly designed or intended for use by children or specifically attractive to children.

NOTE 4 In Australia, the work conducted by an INSTRUCTED PERSON or a SKILLED PERSON may require formal licensing from regulatory authorities.

NOTE 5 In Germany, in many cases a person may only be regarded as an INSTRUCTED PERSON or a SKILLED PERSON if certain legal requirements are fulfilled.

This document does not apply to:

– equipment with non-self-contained hazardous moving parts, such as robotic equipment; and

NOTE 6 For requirements related to robotic equipment in an industrial environment, see IEC 60204-1, IEC 60204-11, ISO 10218-1 and ISO 10218-2.

– personal care robots, including mobile servant robots, physical assistant robots, and person carrier robots; and

NOTE 7 For requirements related to personal care robots, see ISO 13482.

– power supply systems that are not an integral part of the equipment, such as motor-generator sets, BATTERY backup systems and distribution transformers.

This document does not address:

– manufacturing processes except for ROUTINE TESTS;

– injurious effects of gases released by thermal decomposition or combustion;

– disposal processes;

– effects of transport (other than as specified in this document);

– effects of storage of materials, components, or the equipment itself;

– the likelihood of injury from particulate radiation such as alpha particles and beta particles;

– the likelihood of thermal injury due to radiated or convected thermal energy;

– the likelihood of injury due to flammable liquids;

– the use of the equipment in oxygen-enriched or EXPLOSIVE atmospheres;

– exposure to chemicals other than as specified in Clause 7;

– electrostatic discharge events;

– exposure to electromagnetic fields;

– environmental aspects; or

– requirements for functional safety, except for those related to WORK CELLS.

NOTE 8 For specific functional and software safety requirements of electronic safety-related systems (for example, protective electronic circuits), see IEC 61508-1.

1DV.1 DR *Modify this clause by adding the following text:*

1DV.1.1 This standard is applicable to equipment designed to be installed in accordance with the Canadian Electrical Code (CE Code), Part I, CSA C22.1-18; the National Electrical Code, NFPA 70-2017; and the National Electrical Safety Code, IEEE C2 2017.

1DV.1.2 The standard is applicable to equipment, when identified by a marking or instruction [see Annex DVK (Annex DVA, Clause 1 entry)], designed to be installed in accordance with Article 645 of the National Electrical Code, NFPA 70-2017, and the Standard for the Protection of Information Technology Equipment, NFPA 75-2017.

1DV.1.3 See Annex DVA for requirements and references to regulatory requirements that apply to this equipment, as applicable.

1DV.2 D2 *Modify Clause 1 by adding the following text:*

1DV.2.1 This standard includes additional requirements for equipment used for entertainment purposes intended for installation in general patient care areas of health care facilities. See Annex DVB.

1DV.2.2 This standard includes additional requirements for equipment intended for mounting under cabinets. See Annex DVC.

1DV.2.3 Additional requirements for equipment with DC power transfer through communication cables and ports are given in IEC 62368-3. IEC 62368-3 clause 5 for DC power transfer at ES1 or ES2 voltage levels is considered informative. IEC 62368-3 clause 6 for remote power feeding telecommunication (RFT) circuits is considered normative (see ITU K.50). Alternatively, equipment with RFT circuits are given in either UL 2391 or CSA/UL 60950-21. RFT-C circuits are not permitted unless the RFT-C circuit complies with RFT-V limits (≤ 200V per conductor to earth).

1DV.2.4 This standard does not cover Modular Data Centers (MDCs), only the information and communication technology equipment contained within.

NOTE In the U.S., Modular Data Centers are covered by UL 2755, Modular Data Centers.

1DV.3 DR *Modify Clause 1 by replacing Note 3 with the following:*

NOTE 3 For information on this subject, see IEC 62305-1, NFPA 780 or CAN/CSA-B72.

1DV.4 DC *Modify Clause 1 by adding the following paragraph and Note:*

Battery backup systems including storage batteries and battery management equipment that are not an integral part of stationary AV and ICT equipment, such as provided in separate cabinets, are subject to the appropriate standard for battery backup systems, such as UL 1973, Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications.

NOTE 9DV See Figures 1.1 and 1.2 of UL 1973 for more information on independent electric energy storage systems (EESS) covered by UL 1973, which can consist of both low voltage (class ES or ES2) and high voltage (class ES3) subsystems, battery management, thermal management, and related features and safeguards. When interconnected with AV, IT, and CT Equipment, and typically used in conjunction with an uninterruptible power supply (UPS), such EESS typically serve as a short-term substitution of the mains supply during power outages and similar disturbances.

1DV.5 DC *Add Clause 1DV.5.1 to Clause 1*

1DV.5.1 Power Distribution Equipment and Subassemblies

1DV.5.1.1 This standard also is applicable to power distribution subassemblies connected to a mains used to distribute power entirely within a system of equipment also covered by this standard, such as power distribution units (PDUs) in the form of cord-connected power strips and shelves with multiple power outlets (receptacles) and intended to be installed in system racks, cabinets, home entertainment centers, etc.

1DV.5.1.2 For equipment covered by this standard that incorporates components and subassemblies that perform a power distribution and control function covered by other standards, such as panelboards, load transfer equipment, or uninterruptible power systems utilized in power conditioners and computer power centers, this standard only may be used for investigation of safety for those aspects not covered by the other standards.

1DV.5.1.3 This standard also does not apply to stand-alone equipment used for distribution of mains power that is covered by individual power distribution equipment standards.

1DV.5.1.4 Based on the specific function, the following requirements are applicable to the stand-alone distribution equipment, or apply additionally to power distribution subassemblies and components of equipment covered by this standard, as described in Clauses 1DV.5.1.1 to 1DV.5.1.3:

- **For Industrial Control Equipment, see CSA C22.2 No. 14 and UL 508;**
- **For Panelboards, see CSA C22.2 No. 29 and UL 67;**
- **For Switchboards, see CSA C22.2 No. 244 and UL 891;**
- **For Transfer Switch Equipment, see CSA C22.2 No.178.1 and UL 1008;**
- **For Uninterruptible Power Systems, see CSA C22.2 No. 107.3 and UL 1778;**
- **For Power Distribution Centers for Communications Equipment, see UL 1801; and**
- **For other forms of power distribution units for general applications, such as,**

  – Relocatable Power Taps, see CSA C22.2 No. 21, Cord Sets and Power Supply Cords or C22.2 No. 308, Cord Reels and Multi-outlet assemblies, and UL 1363, Relocatable Power Taps.

  – Cord-connected Surge Protective Devices, see CSA C22.2 No. 21, Cord Sets and Power Supply Cords or C22.2 No. 269.3, Surge protective device – Type 2 – cord connected, direct plug-in and receptacle type, and UL 1449, Surge Protective Devices.

– Furniture Power Distribution Units, see CSA C22.2 No. 21, Cord Sets and Power Supply Cords, and UL 962A, Furniture Power Distribution Units.

NOTE 1 It is assumed that power distribution equipment covered by the scope of this standard is interconnected to the "outlet" of a "branch circuit" as defined in Section 0 of the CE Code, Part I, and Article 100 of the NEC. In the case of cord-connected equipment, the outlet is the receptacle associated with the building wiring. In the case of permanently connected equipment, the outlet is the interface between the branch circuit conductors associated with the building wiring and the input terminals, pressure connectors, or leads associated with the power distribution equipment covered in whole or part by this standard.

NOTE 2 The following are common definitions of the hardware with related functions that require additional investigation to the appropriate Canadian and U.S. standards:

– Industrial Control Panel: An assembly of two or more components consisting of one of the following:

• power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers;

• control circuit components only, such as pushbuttons, pilot lights, selector switches, timers, switches, control relays; or

• a combination of power and control circuit components.

These components, with associated wiring and terminals, are mounted on or contained within an enclosure or mounted on a subpanel. The industrial control panel does not include the controlled equipment.

– Panelboard: a single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.

– Switchboard: a large single panel, frame, or assembly of panels on which are mounted, on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets.

– Transfer switch: an automatic or nonautomatic device for transferring one or more load conductor connections from one power source to another.

– Uninterruptible Power Supply: a power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

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 60027-1, *Letter symbols to be used in electrical technology – Part 1: General*

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

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

IEC 60068-2-11, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

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

IEC 60073, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC 60076-14, *Power transformers – Part 14: Liquid-immersed power transformers using high-temperature insulation materials*

IEC TR 60083, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

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

IEC 60086-4, *Primary batteries – Part 4: Safety of lithium batteries*

IEC 60086-5, *Primary batteries – Part 5: Safety of batteries with aqueous electrolyte*

IEC 60107-1:1997, *Methods of measurement on receivers for television broadcast transmissions – Part 1: General considerations – Measurements at radio and video frequencies*

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

IEC 60127 (all parts), *Miniature fuses*

IEC 60227-1, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60227-2:1997, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 2: Test methods*
IEC 60227-2:1997/AMD1:2003

IEC 60245-1, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60296, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

IEC 60309 (all parts), *Plugs, socket-outlets and couplers for industrial purposes*

IEC 60317 (all parts), *Specifications for particular types of winding wires*

IEC 60317-0-7:2017, *Specifications for particular types of winding wires – Part 0-7: General requirements – Fully insulated (FIW) zero-defect enamelled round copper wire*

IEC 60317-43, *Specifications for particular types of winding wires – Part 43: Aromatic polyimide tape wrapped round copper wire, class 240*

IEC 60317-56, *Specifications for particular types of winding wires – Part 56: Solderable fully insulated (FIW) zero-defect polyurethane enamelled round copper wire, class 180*

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60320-1, *Appliance couplers for household and similar general purposes – Part 1: General requirements*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60332-1-3, *Tests on electric and optical fibre cables under fire conditions – Part 1-3: Test for vertical flame propagation for a single insulated wire or cable – Procedure for determination of flaming droplets/particles*

IEC 60332-2-2, *Tests on electric and optical fibre cables under fire conditions – Part 2-2: Test for vertical flame propagation for a single small insulated wire or cable – Procedure for diffusion flame*

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 60417, *Graphical symbols for use on equipment, available from: <http://www.graphical-symbols.info/equipment>*

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

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

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

IEC 60691:2015, *Thermal-links – Requirements and application guide*

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

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

IEC 60695-10-3, *Fire hazard testing – Part 10-3: Abnormal heat – Mould stress relief distortion test*

IEC 60695-11-5:2016, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

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

IEC 60695-11-20:2015, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test methods*

IEC TS 60695-11-21, *Fire hazard testing – Part 11-21: Test flames – 500 W vertical flame test method for tubular polymeric materials*

IEC 60728-11:2016, *Cable networks for television signals, sound signals and interactive services – Part 11: Safety*

IEC 60730 (all parts), *Automatic electrical controls for household and similar use*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*

IEC 60738-1:2006, *Thermistors – Directly heated positive temperature coefficient – Part 1: Generic specification*

IEC 60747-5-5:2007, *Semiconductor devices – Discrete devices – Part 5-5: Optoelectronic devices – Photocouplers*

IEC 60747-5-5:2007/AMD1:2015

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

IEC 60825-12, *Safety of laser products – Part 12: Safety of free space optical communication systems used for transmission of information*

IEC 60836, *Specifications for unused silicone insulating liquids for electrotechnical purposes*

IEC 60851-3:2009, *Winding wires – Test methods – Part 3: Mechanical properties*
IEC 60851-3:2009/AMD1:2013

IEC 60851-5:2008, *Winding wires – Test methods – Part 5: Electrical properties*
IEC 60851-5:2008/AMD1:2011

IEC 60884-1, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 60896-11, *Stationary lead-acid batteries – Part 11: Vented types – General requirements and methods of tests*

IEC 60896-21:2004, *Stationary lead-acid batteries – Part 21: Valve regulated types – Methods of test*

IEC 60896-22, *Stationary lead-acid batteries – Part 22: Valve regulated types – Requirements*

IEC 60906-1, *IEC system of plugs and socket-outlets for household and similar purposes – Part 1: Plugs and socket-outlets 16 A 250 V AC*

IEC 60906-2, *IEC system of plugs and socket-outlets for household and similar purposes – Part 2: Plugs and socket-outlets 15 A 125 V AC*

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

IEC 60947-5-5, *Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function*

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

IEC 60990:2016, *Methods of measurement of touch current and protective conductor current*

IEC 60998-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 1: General requirements*

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm^2 up to 35 mm^2 (included)*

IEC 60999-2, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm^2 up to 300 mm^2 (included)*

IEC 61039, *Classification of insulating liquids*

IEC 61051-1, *Varistors for use in electronic equipment – Part 1: Generic specification*

IEC 61051-2:1991, *Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors*
IEC 61051-2:1991/AMD1:2009

IEC 61056-1, *General purpose lead-acid batteries (valve-regulated types) – Part 1: General requirements, functional characteristics – Methods of test*

IEC 61056-2, *General purpose lead-acid batteries (valve-regulated types) – Part 2: Dimensions, terminals and marking*

IEC 61058-1:2016, *Switches for appliances – Part 1: General requirements*

IEC 61099, *Insulating liquids – Specifications for unused synthetic organic esters for electrical purposes*

IEC 61204-7, *Low-voltage power supplies – Part 7: Safety requirements*

IEC 61293, *Marking of electrical equipment with ratings related to electrical supply – Safety requirements*

IEC 61427 (all parts), *Secondary cells and batteries for renewable energy storage – General requirements and methods of test*

IEC TS 61430, *Secondary cells and batteries – Test methods for checking the performance of devices designed for reducing explosion hazards – Lead-acid starter batteries*

IEC 61434, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Guide to designation of current in alkaline secondary cell and battery standards*

IEC 61558-1:2017, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 61558-2-16, *Safety of transformers, reactors, power supply units and similar products for voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units*

IEC 61643-11:2011, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

IEC 61643-331:2017, *Components for low-voltage surge protective devices – Part 331: Performance requirements and test methods for metal oxide varistors (MOV)*

IEC 61810-1:2015, *Electromechanical elementary relays – Part 1: General and safety requirements*

IEC 61959, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Mechanical tests for sealed portable secondary cells and batteries*

IEC 61965, *Mechanical safety of cathode ray tubes*

IEC 61984, *Connectors – Safety requirements and tests*

IEC 62133 (all parts), *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

IEC 62133-1, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 1: Nickel systems*

IEC 62133-2, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary lithium cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems*

IEC 62281, *Safety of primary and secondary lithium cells and batteries during transport*

IEC TS 62332-1, *Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 1: General requirements*

IEC 62440:2008, *Electric cables with a rated voltage not exceeding 450/750 V – Guide to use*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

IEC 62471-5:2015, *Photobiological safety of lamps and lamp systems – Part 5: Image projectors*

IEC 62485-2, *Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries*

IEC 62619, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

ISO 37, *Rubber, vulcanized or thermoplastic – Determination of tensile stress-strain properties*

ISO 178, *Plastics – Determination of flexural properties*

ISO 179-1, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 180, *Plastics – Determination of Izod impact strength*

ISO 306, *Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)*

ISO 527 (all parts), *Plastics – Determination of tensile properties*

ISO 871, *Plastics – Determination of ignition temperature using a hot-air furnace*

ISO 1798, *Flexible cellular polymeric materials – Determination of tensile strength and elongation at break*

ISO 1817:2015, *Rubber, vulcanized or thermoplastic – Determination of the effect of liquids*

ISO 2719, *Determination of flash point – Pensky-Martens closed cup method*

ISO 3231, *Paints and varnishes – Determination of resistance to humid atmospheres containing sulfur dioxide*

ISO 3679, *Determination of flash no-flash and flash point – Rapid equilibrium closed cup method*

ISO 3864 (all parts), *Graphical symbols – Safety colours and safety signs*

ISO 3864-2, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels*

ISO 4892-1, *Plastics – Methods of exposure to laboratory light sources – Part 1: General guidance*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-4, *Plastics – Methods of exposure to laboratory light sources – Part 4: Open-flame carbon-arc lamps*

ISO 7000, *Graphical symbols for use on equipment – Registered symbols, available from:* <http://www.graphical-symbols.info/equipment>

ISO 7010, *Graphical symbols – Safety colours and safety signs – Safety signs used in workplaces and public areas*

ISO 8256, *Plastics – Determination of tensile-impact strength*

ISO 9772, *Cellular plastics – Determination of horizontal burning characteristics of small specimens subjected to a small flame*

ISO 9773, *Plastics – Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source*

ISO 14993, *Corrosion of metals and alloys – Accelerated testing involving cyclic exposure to salt mist, "dry" and "wet" conditions*

ISO 21207, *Corrosion tests in artificial atmospheres – Accelerated corrosion tests involving alternate exposure to corrosion-promoting gases, neutral salt-spray and drying*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension*

ASTM D471-98, *Standard Test Method for Rubber Property – Effect of Liquids*

ASTM D3574, *Standard Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams*

EN 50332-1:2013, *Sound system equipment: Headphones and earphones associated with portable audio equipment – Maximum sound pressure level measurement methodology and limit considerations – Part 1: General method for "one package equipment"*

EN 50332-2, *Sound system equipment: Headphones and earphones associated with portable audio equipment – Maximum sound pressure level measurement methodology and limit considerations – Part 2: Matching of sets with headphones if either or both are offered separately*

EN 50332-3, *Sound system equipment: Headphones and earphones associated with personal music players – maximum sound pressure level measurement methodology – Part 3: Measurement method for sound dose management*

2DV DE ***Modify Clause 2 by adding the following references:***

CSA Group Documents

CAN/CSA-B72, ***Installation Code for Lightning Protection Systems***

CSA C22.1, ***Canadian Electrical Code, Part I***

CAN/CSA C22.2 No. 0, ***Canadian Electrical Code, Part II, General Requirements***

CSA C22.2 No. 0.12, ***Wiring Space and Wire Bending Space in Enclosures for Equipment Rated 750 V or Less***

CAN/CSA-C22.2 No. 0.17, ***Evaluation of Properties of Polymeric Materials***

CSA C22.2 No. 14, ***Industrial Control Equipment***

CSA C22.2 No. 21, ***Cord Sets and Power Supply Cords***

CSA C22.2 No. 29, ***Panelboards and Enclosed Panelboards***

CSA C22.2 No. 31, ***Switchgear Assemblies***

CSA C22.2 No. 42, ***General Use Receptacles, Attachment Plugs, and Similar Wiring Devices***

CSA C22.2 No. 94.1, ***Enclosures for Electrical Equipment, Non-Environmental Considerations***

CSA C22.2 No. 94.2, ***Enclosures for Electrical Equipment, Environmental Considerations***

CSA C22.2 No. 107.3, ***Uninterruptible Power Systems***

CSA C22.2 No. 178.1, ***Transfer Switch Equipment***

CSA C22.2 No. 205, ***Signal Equipment***

CAN/CSA C22.2 No. 226, ***Protectors in Telecommunication Networks***

CSA C22.2 No. 233, ***Cords and Cord Sets for Communication Systems***

CSA C22.2 No. 244, ***Switchboards***

CSA C22.2 No. 269, ***Surge Protector Package***

CSA C22.2 No. 269.3, ***Surge Protective Devices – Type 3 – cord connected, direct plug-in and receptacle type***

CSA C22.2 No 308, ***Cord Reels and Multi-outlet Assemblies***

CAN/CSA C22.2 No. 60065, ***Audio, Video and Similar Electronic Apparatus -Safety Requirements***

CAN/CSA C22.2 No. 60601-1, ***Medical Electrical Equipment – Part 1-1: General Requirements for Basic Safety and Essential Performance***

CAN/CSA C22.2 No. 60950-1, ***Information Technology Equipment – Safety – Part 1: General Requirements***

CAN/CSA C22.2 No. 60950-21, ***Information Technology Equipment – Safety – Part 21: Remote Power Feeding***

CSA C22.3 No. 1, ***Overhead Systems***

CAN/CSA-E60825-1, ***Safety of Laser Products – Part 1: Equipment Classification and Requirements***

UL Documents

UL 50, ***Enclosures for Electrical Equipment, Non-Environmental Considerations***

UL 50E, ***Enclosures for Electrical Equipment, Environmental Considerations***

UL 67, ***Panelboards***

UL 157, ***Gaskets and Seals***

UL 497, ***Protectors for Paired-Conductor Communications Circuits***

UL 497A, ***Secondary Protectors for Communications Circuits***

UL 498, ***Attachment Plugs and Receptacles***

UL 508, ***Industrial Control Equipment***

UL 723, ***Tests for Surface Burning Characteristics of Building Materials***

UL 746A, ***Polymeric Materials – Short Term Property Evaluations***

UL 746C, ***Polymeric Materials – Use in Electrical Equipment Evaluations***

UL 891, ***Switchboards***

UL 962A, ***Furniture Power Distribution Units***

UL 1008, ***Transfer Switch Equipment***

UL 1059, ***Terminal Blocks***

UL 1069, ***Hospital Signaling and Nurse-Call Equipment***

UL 1363, ***Relocatable Power Taps***

UL 1449, ***Surge Protective Devices***

UL 1778, *Uninterruptible Power Systems*

UL 1801, *Outline for Power Distribution Centers for Communications Equipment*

UL 1863, *Communications-Circuit Accessories*

UL 1973, *Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications*

UL 2043, *Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces*

UL 2391, *Outline of Investigation for Equipment with Remote Feeding Telecommunication Circuits Intended for Backwards Compatibility in Legacy Telecommunication Equipment*

UL 2556, *Wire and Cable Test Methods*

UL 2755, *Modular Data Center Certification Scope and Process*

UL 60065, *Audio, Video, and Similar Electronic Apparatus – Safety Requirements*

UL 60950-1, *Information Technology Equipment Safety – Part 1: General Requirements*

UL 60950-21 , *Information Technology Equipment – Safety – Part 21: Remote Power Feeding*

ANSI Documents

ANSI/ASA S3.25-1989, *American National Standard for Occluded Ear Simulator*

ANSI/IEEE C62.11, *Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)*

ASTM International Documents

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

ASTM E162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*

ASTM F2951, *Consumer Safety Specification for Baby Monitors*

Canadian Regulatory Documents

C.R.C, Canadian Radiation Emitting Devices Regulations (REDR)

Canada – Hazardous Products Act – Hazardous Products (Toys) Regulations; Canada – Consumer Packaging and Labelling Act

IEC Documents

IEC 60318, *Electroacoustics – Simulators of human head and ear – Part 1: Ear simulator for the measurement of supra-aural and circumaural earphones*

IEC 60651, ***Sound Level Meters***

IEC 61672-1, ***Electroacoustics – Sound level meters – Part 1: Specifications***

IEC/TR 62102, ***Electrical safety – Classification of interfaces for equipment to be connected to information and communications technology networks***

IEC 62305-1, ***Protection against lightning – Part 1: General principles***

IEC 62368-3, ***Audio/video, information and communication technology equipment – Part 3: Safety aspects for DC power transfer through communication cables and ports***

IEEE Documents

IEEE C2, ***National Electrical Safety Code***

IEEE 269, ***Standard Methods for Measuring Transmission Performance of Analog and Digital Telephone Sets, Handsets, and Headsets***

IEEE 487, ***Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Power Locations***

IEEE 1613, ***Standard Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations***

ISO Documents

ISO 261, ***ISO general purpose metric screw threads – General plan***

ISO 262, ***ISO general purpose metric screw threads – Selected sizes for screws, bolts and nuts***

NEMA Documents

NEMA C84.1, ***American National Standard for Electric Power Systems and Equipment-Voltage Ratings (60 Hz)***

NFPA Documents

NFPA 30, ***Flammable and Combustible Liquids Code***

NFPA 70, ***National Electrical Code***

NFPA 72, ***National Fire Alarm and Signaling Code***

NFPA 75, ***Standard for the Protection of Information Technology Equipment***

NFPA 99, ***Health Care Facilities Code***

NFPA 780, ***Standard for the Installation of Lightning Protection Systems***

U.S. CFR Documents

U.S. Code of Federal Regulations (CFR), Title 21, Chapter I, Subchapter J, Part 1020, Section 1020.10

U.S. Code of Federal Regulations (CFR), Title 21, Chapter I, Subchapter J, Part 1040

U.S. Code of Federal Regulations (CFR), Title 16, Chapter II, Subchapter C, Part 1505

3 Terms, definitions and abbreviated terms

3.1 Energy source abbreviations

Abbreviation	Description	
ES	Electrical energy source	see 5.2
ES1	Electrical energy source class 1	
ES2	Electrical energy source class 2	
ES3	Electrical energy source class 3	
MS	Mechanical energy source	see 8.2
MS1	Mechanical energy source class 1	
MS2	Mechanical energy source class 2	
MS3	Mechanical energy source class 3	
PS	Power source	see 6.2
PS1	Power source class 1	
PS2	Power source class 2	
PS3	Power source class 3	
RS	Radiation energy source	see 10.2
RS1	Radiation energy source class 1	
RS2	Radiation energy source class 2	
RS3	Radiation energy source class 3	
TS	Thermal energy source	see 9.2
TS1	Thermal energy source class 1	
TS2	Thermal energy source class 2	
TS3	Thermal energy source class 3	

3.2 Other abbreviations

Abbreviation	Description
CD	compact disk
CD ROM	compact disc read-only memory

Abbreviation	Description
CRT	cathode ray tube
CSD	calculated sound dose
CTI	comparative tracking index
DVD	digital versatile disc
E	sound exposure
EIS	electrical insulation system
EUT	equipment under test
FIW	fully insulated winding wire
GDT	gas discharge tube
IC	integrated circuit
ICX	integrated circuit with X-capacitor function
IR	infrared
LED	light emitting diode
LEL	lower explosion limit
LFC	liquid filled component
LPS	limited power source
MEL	momentary exposure level
MOV	metal oxide varistor
NEMA	National Electrical Manufacturers Association
NiCd	nickel cadmium
PIS	potential ignition source
PMP	personal music player
PoE	power over Ethernet
PPE	personal protective equipment
PTC	positive temperature coefficient
PTI	proof tracking index
RC	resistor-capacitor
RG	risk group
Sb	antimony
SEL	sound exposure level
SPD	surge protective device
SRME	slide rail mounted equipment
TSS	thyristor surge suppressor
UPS	uninterruptible power supply
USB	universal serial bus
UV	ultraviolet
VDR	voltage dependent resistor
VRLA	valve regulated lead acid

3.3 Terms and definitions

For the purposes of this document the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

• IEC Electropedia: available at http://www.electropedia.org/

• ISO Online browsing platform: available at http://www.iso.org/obp

For the convenience of the user, the defined terms are listed below in alphabetical order indicating the number of the defined term.

Where the words “voltage” and “current” or their abbreviations are used, they are RMS values unless otherwise specified.

3.3DV DE *Modify 3.3 by adding the term “telecommunication network” to the list.*

5VA class material	3.3.4.2.1
5VB class material	3.3.4.2.2
abnormal operating condition	3.3.7.1
accessible	3.3.6.1
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class III equipment	3.3.15.4
clearance	3.3.12.1
coin / button cell battery	3.3.17.3
combustible material	3.3.4.1
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direct plug-in equipment	3.3.3.1
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double insulation	3.3.5.2
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fully insulated winding wire, FIW	3.3.18.1
functional earthing	3.3.6.5
functional insulation	3.3.5.3
grade of FIW	3.3.18.2
hand-held equipment	3.3.3.3
hazardous substance	3.3.16.4
HB40 class material	3.3.4.2.3
HB75 class material	3.3.4.2.4
HBF class foamed material	3.3.4.2.5
HF-1 class foamed material	3.3.4.2.6
HF-2 class foamed material	3.3.4.2.7
highest specified charging temperature	3.3.17.4
installation safeguard	3.3.11.5
instructed person	3.3.8.1
instructional safeguard	3.3.11.6
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intermittent operation	3.3.7.2
lowest specified charging temperature	3.3.17.5
mains	3.3.1.2
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maximum specified charging voltage	3.3.17.7
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non-clipped output power	3.3.7.3
non-detachable power supply cord	3.3.6.6
normal operating condition	3.3.7.4
ordinary person	3.3.8.2
outdoor enclosure	3.3.2.5

outdoor equipment	3.3.3.5
outdoor location	3.3.6.7
peak response frequency	3.3.7.5
permanently connected equipment	3.3.3.6
personal safeguard	3.3.11.7
pluggable, type A equipment	3.3.3.7
pluggable, type B equipment	3.3.3.8
pollution degree	3.3.6.8
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precautionary safeguard	3.3.11.8
professional equipment	3.3.3.9
prospective touch voltage	3.3.14.3
protective bonding conductor	3.3.11.9
protective conductor current	3.3.14.4
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rated current	3.3.10.1
rated frequency	3.3.10.2
rated load impedance	3.3.7.6
rated power	3.3.10.3
rated voltage range	3.3.10.5
rated voltage	3.3.10.4
reasonably foreseeable misuse	3.3.7.7
reinforced insulation	3.3.5.5
reinforced safeguard	3.3.11.13
required withstand voltage	3.3.14.5
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RMS working voltage	3.3.14.6
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sampling test	3.3.6.11
secondary lithium battery	3.3.17.8
short-time operation	3.3.7.8
single fault condition	3.3.7.9
skill safeguard	3.3.11.16
skilled person	3.3.8.3

solid insulation	3.3.5.6
sound exposure, E	3.3.19.3
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stationary equipment	3.3.3.10
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telecommunication network	3.3.1.3DV.1
temperature limiter	3.3.13.1
temporary overvoltage	3.3.14.7
thermal cut-off	3.3.13.2
thermostat	3.3.13.3
tool	3.3.6.13
touch current	3.3.6.14
transportable equipment	3.3.3.11
type test	3.3.6.15
V-0 class material	3.3.4.2.8
V-1 class material	3.3.4.2.9
V-2 class material	3.3.4.2.10
VTM-0 class material	3.3.4.2.11
VTM-1 class material	3.3.4.2.12
VTM-2 class material	3.3.4.2.13
wireless power transmitter	3.3.3.12
work cell	3.3.6.16
working voltage	3.3.14.8
wrapping tissue	3.3.6.17

3.3.1 Circuit terms

3.3.1.1 EXTERNAL CIRCUIT
electrical circuit that is external to the equipment and is not MAINS

Note 1 to entry: An EXTERNAL CIRCUIT is classified as ES1, ES2 or ES3, and PS1, PS2, or PS3.

3.3.1.2 MAINS
AC or DC power distribution system (external to the equipment) that supplies operating power to the equipment and is PS3

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

3.3.1.2DV D2 ***Modify 3.3.1.2 by adding the following Note:***

Note 2DV to entry: For additional information on low voltage d.c. mains (with 48 V and 60 V "station battery" interface in accordance with IEC/TR 62102, or more commonly known as "'centralized d.c. power systems"), refer to Annex DVD.

3.3.1.3DV D1 ***Add the following definition to Clause 3:***

telecommunication network
metallically terminated transmission medium intended for communication between equipment that may be located in separate buildings, excluding:

– the mains system for supply, transmission, and distribution of electrical power, if used as a telecommunication transmission medium;

– cable distribution systems;

– ES1 circuits connecting units of audio/video, information, and communication technology equipment.

3.3.2 Enclosure terms

3.3.2.1 ELECTRICAL ENCLOSURE
ENCLOSURE intended as a SAFEGUARD against electrically-caused injury

[SOURCE: IEC 60050-195:1998, 195-06-13, modified – the term SAFEGUARD has been used]

3.3.2.2 ENCLOSURE
housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 60050-195:1998, 195-02-35]

3.3.2.3 FIRE ENCLOSURE
ENCLOSURE intended as a SAFEGUARD against the spread of fire from within the ENCLOSURE to outside the ENCLOSURE

3.3.2.4 MECHANICAL ENCLOSURE
ENCLOSURE intended as a SAFEGUARD against mechanically-caused pain and injury

3.3.2.5 OUTDOOR ENCLOSURE
ENCLOSURE that is intended to provide protection from specific conditions in an OUTDOOR LOCATION

Note 1 to entry: An OUTDOOR ENCLOSURE can also perform the functions of another ENCLOSURE, for example: a FIRE ENCLOSURE; an ELECTRICAL ENCLOSURE; a MECHANICAL ENCLOSURE.

Note 2 to entry: A separate cabinet or housing into which the equipment is placed can provide the function of an OUTDOOR ENCLOSURE.

3.3.3 Equipment terms

3.3.3.1 DIRECT PLUG-IN EQUIPMENT
equipment in which the MAINS plug forms an integral part of the equipment ENCLOSURE

3.3.3.2 FIXED EQUIPMENT
equipment that is specified in the installation instructions to only be secured in place by a means defined by the manufacturer

Note 1 to entry: Equipment that has a screw hole or other means to secure the equipment by an ORDINARY PERSON, such as for securement to a table or for earthquake protection, is not considered to be FIXED EQUIPMENT.

Note 2 to entry: Typically, FIXED EQUIPMENT will be wall, ceiling or floor mounted.

3.3.3.3 HAND-HELD EQUIPMENT
MOVABLE EQUIPMENT, or a part of any kind of equipment, that is intended to be held in the hand during normal use

3.3.3.4 MOVABLE EQUIPMENT
equipment that is either:

– 18 kg or less in mass and is not FIXED EQUIPMENT; or

– provided with wheels, casters, or other means to facilitate movement by an ORDINARY PERSON as required to perform its intended use

3.3.3.5 OUTDOOR EQUIPMENT
equipment that is installed or exposed in an OUTDOOR LOCATION, specified by the manufacturer to comply wholly or in part under specific conditions

Note 1 to entry: TRANSPORTABLE EQUIPMENT, for example, a laptop or notebook computer, or a telephone, is not outdoor equipment unless specified by the manufacturer for continuous use in an OUTDOOR LOCATION.

3.3.3.6 PERMANENTLY CONNECTED EQUIPMENT
equipment that can only be electrically connected to or disconnected from the MAINS by the use of a TOOL

3.3.3.7 PLUGGABLE EQUIPMENT TYPE A
equipment that is intended for connection to the MAINS via a non-industrial plug and socketoutlet or via a non-industrial appliance coupler, or both

Note 1 to entry: Examples are plugs and socket-outlets covered by standards such as IEC TR 60083 and IEC 60320-1.

3.3.3.7DV DE *Modify 3.3.3.7 by adding the following NOTE:*

Note 2DV to entry: 1-15, 2-15, 2-20, 5-15 and 5-20 plugs and outlets as specified in IEC/TR 60083 are considered to be non-industrial within the meaning of this standard.

3.3.3.8 PLUGGABLE EQUIPMENT TYPE B
equipment that is intended for connection to the MAINS via an industrial plug and socket-outlet or via an industrial appliance coupler, or both

Note 1 to entry: Examples are plugs and socket-outlets covered by standards such as IEC 60309-1.

3.3.3.9 PROFESSIONAL EQUIPMENT
equipment for use in trades, professions or industries and which is not intended for sale to the general public

[SOURCE: IEC 60050-161:1990, 161-05-05]

3.3.3.10 STATIONARY EQUIPMENT

– FIXED EQUIPMENT, or

– PERMANENTLY CONNECTED EQUIPMENT, or

– equipment that, due to its physical characteristics, is normally not moved

Note 1 to entry: STATIONARY EQUIPMENT is neither MOVABLE EQUIPMENT nor TRANSPORTABLE EQUIPMENT.

3.3.3.11 TRANSPORTABLE EQUIPMENT
equipment that is intended to be routinely carried

Note 1 to entry: Examples include notebook computers, CD players and portable accessories, including their external power supplies.

3.3.3.12 WIRELESS POWER TRANSMITTER
equipment that uses electromagnetic fields to transfer electrical power for charging BATTERY operated hand-held devices

3.3.4 Flammability terms

3.3.4.1 COMBUSTIBLE MATERIAL
material that is capable of being ignited or burned

Note 1 to entry: All thermoplastic materials are considered capable of being ignited or burned regardless of the MATERIAL FLAMMABILITY CLASS.

3.3.4.2 MATERIAL FLAMMABILITY CLASS
recognition of the burning behaviour of materials and their ability to extinguish if ignited

Note 1 to entry: Materials are classified when tested in accordance with IEC 60695-11-10, IEC 60695-11-20, ISO 9772 or ISO 9773.

3.3.4.2.1 5VA CLASS MATERIAL
material tested in the thinnest significant thickness used and classified 5VA according to IEC 60695-11-20

3.3.4.2.2 5VB CLASS MATERIAL
material tested in the thinnest significant thickness used and classified 5VB according to IEC 60695-11-20

3.3.4.2.3 HB40 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified HB40 according to IEC 60695-11-10

3.3.4.2.4 HB75 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified HB75 according to IEC 60695-11-10

3.3.4.2.5 HBF CLASS FOAMED MATERIAL
foamed material tested in the thinnest significant thickness used and classified HBF according to ISO 9772

3.3.4.2.6 HF-1 CLASS FOAMED MATERIAL
foamed material tested in the thinnest significant thickness used and classified HF-1 according to ISO 9772

3.3.4.2.7 HF-2 CLASS FOAMED MATERIAL
foamed material tested in the thinnest significant thickness used and classified HF-2 according to ISO 9772

3.3.4.2.8 V-0 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified V-0 according to IEC 60695-11-10

3.3.4.2.9 V-1 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified V-1 according to IEC 60695-11-10

3.3.4.2.10 V-2 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified V-2 according to IEC 60695-11-10

3.3.4.2.11 VTM-0 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified VTM-0 according to ISO 9773

3.3.4.2.12 VTM-1 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified VTM-1 according to ISO 9773

3.3.4.2.13 VTM-2 CLASS MATERIAL
material tested in the thinnest significant thickness used and classified VTM-2 according to ISO 9773

3.3.5 Electrical insulation

3.3.5.1 BASIC INSULATION
insulation to provide a BASIC SAFEGUARD against electric shock

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

3.3.5.2 DOUBLE INSULATION
insulation comprising both BASIC INSULATION and SUPPLEMENTARY INSULATION

[SOURCE: IEC 60050-195:1998, 195-06-08]

3.3.5.3 FUNCTIONAL INSULATION
insulation between conductive parts which is necessary only for the proper functioning of the equipment

3.3.5.4 INSULATING LIQUID
insulating material consisting entirely of a liquid

[SOURCE: IEC 60050-212:2010, 212-11-04]

3.3.5.5 REINFORCED INSULATION
single insulation system that provides a degree of protection against electric shock equivalent to DOUBLE INSULATION

3.3.5.6 SOLID INSULATION
insulation consisting entirely of solid material

[SOURCE: IEC 60050-212:2010, 212-11-02]

3.3.5.7 SUPPLEMENTARY INSULATION
independent insulation applied in addition to BASIC INSULATION to provide a SUPPLEMENTARY SAFEGUARD for fault protection against electric shock

3.3.6 Miscellaneous

3.3.6.1 ACCESSIBLE
touchable by a body part

Note 1 to entry: A body part is represented by one or more of the probes specified in Annex V, as applicable.

3.3.6.2 BACKFEED
condition in which a voltage or energy available within a BATTERY backed up supply is fed back to any of the input terminals, either directly or by a leakage path while operating in the STORED ENERGY MODE and with MAINS power not available

3.3.6.3 CHEESECLOTH
bleached cotton cloth of approximately 40 g/m^2

Note 1 to entry: CHEESECLOTH is a coarse, loosely woven cotton gauze, originally used for wrapping cheese.

3.3.6.4 DISCONNECT DEVICE
means to electrically disconnect equipment from the MAINS that, in the open position, complies with the requirements specified for isolation

3.3.6.5 FUNCTIONAL EARTHING
earthing a point or points in a system or in an installation or in equipment, for purposes other than electrical safety

[SOURCE: IEC 60050-195:1998/AMD1:2001, 195-01-13]

3.3.6.6 NON-DETACHABLE POWER SUPPLY CORD
flexible supply cord affixed to or assembled to the equipment and that cannot be removed from the equipment without the use of TOOLS

3.3.6.7 OUTDOOR LOCATION
location for equipment where protection from the weather and other outdoor influences provided by a building or other structure is limited or non-existent

3.3.6.8 POLLUTION DEGREE
numeral characterizing the expected pollution of the micro-environment

[SOURCE: IEC 60050-581:2008, 581-21-07]

3.3.6.9 RESTRICTED ACCESS AREA
area ACCESSIBLE only to SKILLED PERSONS and to INSTRUCTED PERSONS with the proper authorization

3.3.6.10 ROUTINE TEST
test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria

[SOURCE: IEC 60664-1:2007, 3.19.2]

3.3.6.11 SAMPLING TEST
test on a number of devices taken at random from a batch

[SOURCE: IEC 60664-1:2007, 3.19.3]

3.3.6.12 STORED ENERGY MODE
stable mode of operation that a BATTERY backed up supply attains under specified conditions

Note 1 to entry: In accordance with IEC 62040-1:2017, the specified conditions are as follows:

– AC input power is disconnected or is out of required tolerance;

– operating and output power is supplied by the energy storage device;

– the load is within the specified rating of the BATTERY backed up supply.

3.3.6.13 TOOL
object that can be used to operate a screw, latch or similar fixing means

Note 1 to entry: Examples of tools include coins, tableware, screwdrivers, pliers, etc.

3.3.6.14 TOUCH CURRENT
electric current through a human body when body parts touch two or more ACCESSIBLE parts or one ACCESSIBLE part and earth

3.3.6.15 TYPE TEST
test on a representative sample with the objective of determining if, as designed and manufactured, it can meet the requirements of this document

3.3.6.16 WORK CELL
space within the equipment of such size that a person can enter completely or partially (for example, entire limb or head) for servicing or operating the equipment and where mechanical hazards may be present

Note 1 to entry: A WORK CELL can contain more than one compartment. A compartment can be used for either operational or service purposes.

Note 2 to entry: The equipment containing the WORK CELL is typically installed within a RESTRICTED ACCESS AREA.

3.3.6.17 WRAPPING TISSUE
tissue between 12 g/m^2 and 30 g/m^2

Note 1 to entry: The WRAPPING TISSUE is soft, thin, usually translucent paper used for wrapping delicate articles.

3.3.7 Operating and fault conditions

3.3.7.1 ABNORMAL OPERATING CONDITION
temporary operating condition that is not a NORMAL OPERATING CONDITION and is not a SINGLE FAULT CONDITION of the equipment itself

Note 1 to entry: ABNORMAL OPERATING CONDITIONS are specified in Clause B.3.

Note 2 to entry: An ABNORMAL OPERATING CONDITION may be introduced by the equipment or by a person.

Note 3 to entry: An ABNORMAL OPERATING CONDITION may result in a failure of a component, a device or a SAFEGUARD.

3.3.7.2 INTERMITTENT OPERATION
operation in a series of cycles, each composed of a period of operation followed by a period with the equipment switched off or running idle

3.3.7.3 NON-CLIPPED OUTPUT POWER
sine wave power dissipated in the RATED LOAD IMPEDANCE, measured at 1 000 Hz at the onset of clipping on either one or both peaks

3.3.7.4 NORMAL OPERATING CONDITION

mode of operation that represents as closely as possible the range of normal use that can reasonably be expected

Note 1 to entry: Unless otherwise specified, the most severe conditions of normal use are the most unfavourable default values as specified in Clause B.2.

Note 2 to entry: REASONABLY FORESEEABLE MISUSE is not covered by NORMAL OPERATING CONDITIONS. Instead, it is covered by ABNORMAL OPERATING CONDITIONS.

3.3.7.5 PEAK RESPONSE FREQUENCY
test frequency that produces the maximum output power measured at the RATED LOAD IMPEDANCE

Note 1 to entry: The frequency applied should be within the amplifier/transducer's intended operating range.

3.3.7.6 RATED LOAD IMPEDANCE
impedance or resistance, as declared by the manufacturer, by which an output circuit should be terminated

3.3.7.7 REASONABLY FORESEEABLE MISUSE
use of a product, process or service in a way not intended by the supplier, but which can result from readily predictable human behaviour

Note 1 to entry: REASONABLY FORESEEABLE MISUSE is considered to be a form of ABNORMAL OPERATING CONDITIONS.

[SOURCE: ISO/IEC Guide 51:2014, 3.7, modified – In the definition, "product or system" has been replaced by "product, process or service". The Notes to entry have been replaced.]

3.3.7.8 SHORT-TIME OPERATION
operation under NORMAL OPERATING CONDITIONS for a specified period, starting when the equipment is cold, the intervals after each period of operation being sufficient to allow the equipment to cool down to room temperature

3.3.7.9 SINGLE FAULT CONDITION
condition of equipment with a fault under normal operating condition of a single SAFEGUARD (but not a REINFORCED SAFEGUARD) or of a single component or a device

Note 1 to entry: Single fault conditions are specified in Clause B.4.

3.3.8 Persons

3.3.8.1 INSTRUCTED PERSON
person instructed or supervised by a SKILLED PERSON as to energy sources and who can responsibly use EQUIPMENT SAFEGUARDS and PRECAUTIONARY SAFEGUARDS with respect to those energy sources

Note 1 to entry: Supervised, as used in the definition, means having the direction and oversight of the performance of others.

Note 2 to entry: In Germany, in many cases, a person may only be regarded as an INSTRUCTED PERSON if certain legal requirements are fulfilled.

3.3.8.2 ORDINARY PERSON
person who is neither a SKILLED PERSON nor an INSTRUCTED PERSON

[SOURCE: IEC 60050-826:2004, 826-18-03]

3.3.8.3 SKILLED PERSON

person with relevant education or experience to enable him or her to identify hazards and to take appropriate actions to reduce the risks of injury to themselves and others

Note 1 to entry: In Germany, in many cases, a person may only be regarded as an SKILLED PERSON if certain legal requirements are fulfilled.

[SOURCE: IEC 60050-826:2004, 826-18-01, modified – The definition has been made applicable to all types of hazards.]

3.3.9 Potential ignition sources

3.3.9.1 POTENTIAL IGNITION SOURCE
PIS
location where electrical energy can cause ignition

3.3.9.2 ARCING PIS
PIS where an arc may occur due to the opening of a conductor or a contact

Note 1 to entry: An electronic protection circuit or additional constructional measures may be used to prevent a location from becoming an ARCING PIS.

Note 2 to entry: A faulty contact or interruption in an electric connection that may occur in conductive patterns on printed boards is considered to be within the scope of this definition.

3.3.9.3 RESISTIVE PIS
PIS where a component may ignite due to excessive power dissipation

Note 1 to entry: An electronic protection circuit or additional constructional measures may be used to prevent a location from becoming a RESISTIVE PIS.

3.3.10 Ratings

3.3.10.1 RATED CURRENT
input current of the equipment, as declared by the manufacturer, at NORMAL OPERATING CONDITIONS

3.3.10.2 RATED FREQUENCY
supply frequency or frequency range as declared by the manufacturer

3.3.10.3 RATED POWER
input power of the equipment, as declared by the manufacturer, at NORMAL OPERATING CONDITIONS

3.3.10.4 RATED VOLTAGE
value of voltage assigned by the manufacturer to a component, device or equipment and to which operation and performance characteristics are referred

Note 1 to entry: Equipment may have more than one RATED VOLTAGE value or may have a RATED VOLTAGE RANGE.

[SOURCE: IEC 60664-1:2007, 3.9]

3.3.10.5 RATED VOLTAGE RANGE
supply voltage range, as declared by the manufacturer, expressed by its lower and upper RATED VOLTAGES

3.3.10.6 PROTECTIVE CURRENT RATING
current rating of an overcurrent protective device that is in the building installation or in the equipment to protect a circuit

3.3.11 Safeguards

3.3.11.1 BACKFEED SAFEGUARD
control scheme that reduces the risk of electric shock due to backfeed

3.3.11.2 BASIC SAFEGUARD
SAFEGUARD that provides protection under NORMAL OPERATING CONDITIONS and under ABNORMAL OPERATING CONDITIONS whenever an energy source capable of causing pain or injury is present in the equipment

3.3.11.3 DOUBLE SAFEGUARD
SAFEGUARD comprising both a BASIC SAFEGUARD and a SUPPLEMENTARY SAFEGUARD

3.3.11.4 EQUIPMENT SAFEGUARD
SAFEGUARD that is a physical part of the equipment

3.3.11.5 INSTALLATION SAFEGUARD
SAFEGUARD that is a physical part of a man-made installation

3.3.11.6 INSTRUCTIONAL SAFEGUARD
instruction invoking specified behaviour

3.3.11.7 PERSONAL SAFEGUARD
personal protective equipment that is worn on the body and that reduces exposure to an energy source

Note 1 to entry: Examples are shields, goggles, gloves, aprons, face masks or breathing apparatus.

3.3.11.8 PRECAUTIONARY SAFEGUARD
INSTRUCTED PERSON behaviour to avoid contact with or exposure to a class 2 energy source based on supervision or instructions given by a SKILLED PERSON

3.3.11.9 PROTECTIVE BONDING CONDUCTOR
PROTECTIVE CONDUCTOR in the equipment provided for protective equipotential-bonding of parts required to be earthed for safety purposes

Note 1 to entry: A PROTECTIVE BONDING CONDUCTOR is internal in the equipment.

3.3.11.10 PROTECTIVE CONDUCTOR
conductor provided for the purposes of safety (for example, protection against electric shock)

Note 1 to entry: A PROTECTIVE CONDUCTOR is either a PROTECTIVE EARTHING CONDUCTOR or a PROTECTIVE BONDING CONDUCTOR.

[SOURCE: IEC 60050-195:1998, 195-02-09]

3.3.11.11 PROTECTIVE EARTHING
earthing a point or points in a system or in an installation or in equipment for purposes of electrical safety

[SOURCE: IEC 60050-195:1998/AMD1:2001, 195-01-11]

3.3.11.12 PROTECTIVE EARTHING CONDUCTOR
PROTECTIVE CONDUCTOR connecting a main PROTECTIVE EARTHING terminal in the equipment to an earth point in the building installation for PROTECTIVE EARTHING

3.3.11.13 REINFORCED SAFEGUARD
single SAFEGUARD that is effective under:

– NORMAL OPERATING CONDITIONS;

– ABNORMAL OPERATING CONDITIONS; and

– SINGLE FAULT CONDITIONS

3.3.11.14 SAFEGUARD
physical part or system or instruction specifically provided to reduce the likelihood of pain or injury, or, for fire, to reduce the likelihood of ignition or spread of fire

Note 1 to entry: See 0.5 for further explanation of a SAFEGUARD.

3.3.11.15 SAFETY INTERLOCK
means to automatically change an energy source to a lower class energy source prior to the potential for transfer of the higher energy to a body part

Note 1 to entry: A SAFETY INTERLOCK encompasses the system of components and circuits that are directly involved in the SAFEGUARD function, including electro-mechanical devices, conductors on printed boards, wiring and their terminations, etc., as applicable.

3.3.11.16 SKILL SAFEGUARD
SKILLED PERSON behaviour to avoid contact with or exposure to a class 2 or class 3 energy source based on education and experience

3.3.11.17 SUPPLEMENTARY SAFEGUARD
SAFEGUARD applied in addition to the BASIC SAFEGUARD that is or becomes operational in the event of failure of the BASIC SAFEGUARD

3.3.12 Spacings

3.3.12.1 CLEARANCE
shortest distance in air between two conductive parts

[SOURCE: IEC 60664-1:2007, 3.2]

3.3.12.2 CREEPAGE DISTANCE
shortest distance along the surface of an insulating material between two conductive parts

[SOURCE: IEC 60664-1:2007, 3.3, modified – In the definition, “solid” has been deleted.]

3.3.13 Temperatures and controls

3.3.13.1 TEMPERATURE LIMITER
device for limiting the temperature of a system, either below or above a particular value, by controlling, either directly or indirectly, the flow of thermal energy into or out of the system

Note 1 to entry: A TEMPERATURE LIMITER may be of the automatic reset or of the manual reset type.

3.3.13.2 THERMAL CUT-OFF
device for limiting the temperature of a system, under SINGLE FAULT CONDITIONS, by controlling, either directly or indirectly, the flow of thermal energy into or out of the system

3.3.13.3 THERMOSTAT

device for maintaining the temperature of a system within a range by controlling, either directly or indirectly, the flow of thermal energy into or out of the system

3.3.14 Voltages and currents

3.3.14.1 DC VOLTAGE
voltage having a peak-to-peak ripple not exceeding 10 % of the average value

Note 1 to entry: Where peak-to-peak ripple exceeds 10 % of the average value, the requirements related to peak voltage are applicable.

3.3.14.2 MAINS TRANSIENT VOLTAGE
highest peak voltage expected at the MAINS input to the equipment arising from external transients

3.3.14.3 PROSPECTIVE TOUCH VOLTAGE
voltage between simultaneously ACCESSIBLE conductive parts or between one ACCESSIBLE conductive part and earth when those conductive parts are not being touched

[SOURCE: IEC 60050-195:1998, 195-05-09, modified – In the definition, "or between one ACCESSIBLE conductive part and earth" has been added.]

3.3.14.4 PROTECTIVE CONDUCTOR CURRENT
current flowing through the PROTECTIVE EARTHING CONDUCTOR under NORMAL OPERATING CONDITIONS

Note 1 to entry: PROTECTIVE CONDUCTOR CURRENT was previously included in the term “leakage current”.

3.3.14.5 REQUIRED WITHSTAND VOLTAGE
peak voltage that the insulation under consideration is required to withstand

3.3.14.6 RMS WORKING VOLTAGE
true RMS value of the WORKING VOLTAGE

Note 1 to entry: True RMS value of the WORKING VOLTAGE includes any DC component of the waveform.

Note 2 to entry: The resultant RMS value of a waveform having an AC RMS voltage A and a DC component voltage *B* is given by the following formula:

$$\text{RMS value} = (A^2 + B^2)^{1/2}$$

3.3.14.7 TEMPORARY OVERVOLTAGE
overvoltage at MAINS power frequency of relatively long duration

3.3.14.8 WORKING VOLTAGE
voltage across any particular insulation while the equipment is supplied at RATED VOLTAGE or any voltage in the RATED VOLTAGE RANGE under NORMAL OPERATING CONDITIONS

Note 1 to entry: External transients are disregarded.

Note 2 to entry: Recurring peak voltages are disregarded.

3.3.15 Classes of equipment with respect to protection from electric shock

3.3.15.1 CLASS I EQUIPMENT

equipment with BASIC INSULATION used as a BASIC SAFEGUARD, and with protective bonding and PROTECTIVE EARTHING used as a SUPPLEMENTARY SAFEGUARD

Note 1 to entry: CLASS I EQUIPMENT may be provided with CLASS II CONSTRUCTION.

[SOURCE: IEC 60050-851:2008, 851-15-10, modified – The definition has been adapted to the SAFEGUARD principle.]

3.3.15.2 CLASS II CONSTRUCTION

part of an equipment for which protection against electric shock relies upon DOUBLE INSULATION or REINFORCED INSULATION

3.3.15.3 CLASS II EQUIPMENT

equipment in which protection against electric shock does not rely on BASIC INSULATION only, but in which a SUPPLEMENTARY SAFEGUARD is provided, there being no provision for PROTECTIVE EARTHING or reliance upon installation conditions

3.3.15.4 CLASS III EQUIPMENT

equipment in which protection against electric shock relies upon supply from ES1 and in which ES3 is not generated

3.3.16 Chemical terms

3.3.16.1 CONSUMABLE MATERIAL

material that is used by the equipment in performing its intended function, and intended to be periodically or occasionally replaced or replenished, including any material that has a life expectancy less than that of the equipment

Note 1 to entry: Air filters are not considered to be CONSUMABLE MATERIALS.

3.3.16.2 EXPLOSION

chemical reaction of any chemical compound or mechanical mixture that, when initiated, undergoes a very rapid combustion or decomposition, releasing large volumes of highly heated gases that exert pressure on the surrounding medium

Note 1 to entry: EXPLOSION can also be a mechanical reaction in which failure of the container causes sudden release of pressure, and the contents, from within a pressure vessel. Depending on the rate of energy release, an explosion can be categorized as a deflagration, a detonation or pressure rupture.

3.3.16.3 EXPLOSIVE

substance or mixture of substances that can undergo a rapid chemical change with or without an outside source of oxygen, generating large quantities of energy generally accompanied by hot gases

3.3.16.4 HAZARDOUS SUBSTANCE

substance that has the potential for adversely impacting human health

Note 1 to entry: The criteria for determining whether a substance is classified as hazardous are usually defined by law or regulation.

3.3.17 Batteries

3.3.17.1 BATTERY

assembly of one or more CELLS ready for use as a source of electrical energy characterized by its voltage, size, terminal arrangement, capacity and rate capability

Note 1 to entry: The term BATTERY pack is considered to be a BATTERY.

3.3.17.2 CELL
basic manufactured unit providing a source of electrical energy by direct conversion of chemical energy, that consists of electrodes, separators, electrolyte, container and terminals

3.3.17.3 COIN / BUTTON CELL BATTERY
small, single CELL BATTERY having a diameter greater than its height

3.3.17.4 HIGHEST SPECIFIED CHARGING TEMPERATURE
highest temperature specified by the manufacturer at a site on each individual CELL comprising the BATTERY during charging of a secondary BATTERY

Note 1 to entry: It is usually assumed that the end-product manufacturer is responsible to specify the safety-sensitive temperature, voltage or current of the BATTERY, based on the specifications provided by BATTERY supplier.

3.3.17.5 LOWEST SPECIFIED CHARGING TEMPERATURE
lowest temperature specified by the manufacturer at a site on each individual CELL comprising the BATTERY during charging of a secondary BATTERY

Note 1 to entry: It is usually assumed that the end-product manufacturer is responsible to specify the safety sensitive temperature, voltage or current of the BATTERY, based on the specifications provided by BATTERY supplier.

3.3.17.6 MAXIMUM SPECIFIED CHARGING CURRENT
highest charging current specified by the manufacturer during charging of a secondary BATTERY

3.3.17.7 MAXIMUM SPECIFIED CHARGING VOLTAGE
highest charging voltage specified by the manufacturer during charging of a secondary BATTERY

3.3.17.8 SECONDARY LITHIUM BATTERY
BATTERY that

– incorporates one or more secondary lithium CELLS, and

– has a housing and a terminal arrangement, and

– may have electronic control devices, and

– is ready for use

Note 1 to entry: Examples of a SECONDARY LITHIUM BATTERY include a rechargeable lithium-ion BATTERY, a rechargeable lithium-polymer BATTERY and a rechargeable lithium manganese BATTERY.

3.3.18 FIW terms

3.3.18.1 FULLY INSULATED WINDING WIRE
FIW
polyurethane enamelled round copper wire, class 180

Note 1 to entry: The insulating properties are in accordance with IEC 60317-0-7, IEC 60317-56 and IEC 60851-5:2008. These standards also refer to this type of wire as “zero-defect wire”, which they define as “winding wire that exhibits no electrical discontinuities when tested under specific conditions”.

Note 2 to entry: The term “zero-defect wire” is commonly used to refer to FIW.

3.3.18.2 GRADE OF FIW
range of overall diameter of a wire (FIW3 to FIW9)

3.3.19 Sound exposure

3.3.19.1 CALCULATED SOUND DOSE
CSD
one week rolling estimate of SOUND EXPOSURE expressed as a percentage of the maximum regarded as safe

Note 1 to entry: See B.4 of EN 50332-3:2017 for additional information.

3.3.19.2 MOMENTARY EXPOSURE LEVEL
MEL
metric for estimating 1 s SOUND EXPOSURE level from a specific test signal applied to both channels, based on EN 50332-1:2013, 4.2

Note 1 to entry: MEL is measured in dB(A).

Note 2 to entry: See B.3 of EN 50332-3:2017 for additional information.

3.3.19.3 SOUND EXPOSURE
E
A-weighted sound pressure (p) squared and integrated over a stated period of time, T

$$E = \int_0^T p(t)^2 \, \mathrm{d}t$$

Note 1 to entry: The SI unit is Pa^2 s.

3.3.19.4 SOUND EXPOSURE LEVEL
SEL
logarithmic measure of SOUND EXPOSURE relative to a reference value, E_0

$$\mathrm{SEL} = 10\log_{10}\left(\frac{E}{E_0}\right)$$

Note 1 to entry: SEL is measured in dB(A).

Note 2 to entry: The reference value E_0 is typically the 1 kHz threshold of hearing in humans.

Note 3 to entry: See B.4 of EN 50332-3:2017 for additional information.

3.3.19.5 DIGITAL SIGNAL LEVEL RELATIVE TO FULL SCALE
dBFS
level of a DC-free 997 Hz sine wave whose undithered positive peak value is positive digital full scale, leaving the code corresponding to negative digital full scale unused

Note 1 to entry: Levels reported in dBFS are always RMS.

Note 2 to entry: It is invalid to use dBFS for non-RMS levels. Because the definition of full scale is based on a sine wave, the level of signals with a crest factor lower than that of a sine wave may exceed 0 dBFS. In particular, square-wave signals may reach +3,01 dBFS.

4 General requirements

4.1 General

4.1.1 Application of requirements and acceptance of materials, components and subassemblies

Requirements are specified in the relevant clauses and, where referenced in those clauses, in the relevant annexes.

Where compliance of materials, components or subassemblies is demonstrated by inspection, such compliance may be by review of published data or previous test results.

Internal and external components and subassemblies that comply with IEC 60950-1 or IEC 60065 are acceptable as part of equipment covered by this document without further evaluation other than to give consideration to the appropriate use of the component or subassembly in the end-product.

NOTE The paragraph above will be deleted in the next revision of this document, subject to a vote of National Committees at the time. It is added here to provide a smooth transition from the latest editions of IEC 60950-1 and IEC 60065 to this document.

4.1.1DV.1 D2 ***Modify 4.1.1 by adding the following text:***

In the U.S. and Canada, components and subassemblies that comply with the regulations referenced in Annex DVA are required in addition to or as a replacement for the requirements in this standard.

4.1.1DV.2 DC ***Modify 4.1.1 by adding the following text:***

In the U.S. and Canada, components and subassemblies that comply with the standards referenced in Annex DVE are required in addition to or as a replacement for the requirements in this standard. Components complying with these standards are considered acceptable as part of equipment covered by this standard without further evaluation other than to give consideration to the appropriate use of the component or subassembly in the end product.

4.1.1DV.3 DC ***Modify 4.1.1 by adding the following text:***

In the U.S. and Canada, components and subassemblies that comply with the standards referenced in Annex DVG are acceptable as an alternative to requirements as part of equipment covered by this standard without further evaluation other than to give consideration to the appropriate use of the component or subassembly in the end product.

4.1.2 Use of components

Where the component, or a characteristic of a component, is a SAFEGUARD or a part of a SAFEGUARD, components shall comply with the requirements of this document or, where specified in a requirements clause, with the safety aspects of the relevant IEC component standards.

NOTE 1 An IEC component standard is considered relevant only if the component in question clearly falls within its scope.

NOTE 2 The applicable test for compliance with a component standard is, in general, conducted separately.

Where use of an IEC component standard is permitted above, evaluation and testing of components shall be conducted as follows:

– a component shall be checked for correct application and use in accordance with its rating;

– a component that has been demonstrated to comply with a standard harmonized with the relevant IEC component standard shall be subjected to the applicable tests of this document, as part of the equipment, with the exception of those tests that are part of the relevant IEC component standard;

– a component that has not been demonstrated to comply with a relevant standard as above shall be subjected to the applicable tests of this document, as part of the equipment, and to the applicable tests of the component standard, under the conditions occurring in the equipment; and

– where components are used in circuits not in accordance with their specified ratings, the components shall be tested under the conditions occurring in the equipment. The number of samples required for test is, in general, the same as required by an equivalent standard.

Compliance is checked by inspection and by the relevant data or tests.

4.1.2DV DC *Modify 4.1.2 by adding the following text:*

In the U.S. and Canada, some UL/CSA component standards may be used as alternatives to referenced IEC standards for the purposes of North America certifications or surveillance programs. Components and subassemblies that comply with the standards referenced in Annex DVF are acceptable as part of equipment covered by this standard without further evaluation other than to give consideration to the appropriate use of the component or subassembly in the end product.

4.1.3 Equipment design and construction

Equipment shall be so designed and constructed that, under NORMAL OPERATING CONDITIONS as specified in Clause B.2), ABNORMAL OPERATING CONDITIONS as specified in Clause B.3, and SINGLE FAULT CONDITIONS as specified in Clause B.4), SAFEGUARDS are provided to reduce the likelihood of injury or, in the case of fire, property damage.

Parts of equipment that could cause injury shall not be ACCESSIBLE, and ACCESSIBLE parts shall not cause an injury.

Compliance is checked by inspection and by the relevant tests.

4.1.4 Equipment installation

Except as given in 4.1.6, equipment evaluation according to this document shall take into account manufacturer's instructions with regard to installation, relocation, servicing and operation, as applicable.

OUTDOOR ENCLOSURES providing a SAFEGUARD function shall comply with Annex Y. OUTDOOR EQUIPMENT and OUTDOOR ENCLOSURES shall be suitable for use at any temperature in the range specified by the manufacturer. If not specified by the manufacturer, the range shall be taken as:

– minimum ambient temperature: –33 °C;

– maximum ambient temperature: +40 °C.

Compliance is checked by inspection and by evaluation of the data provided by the manufacturer.

NOTE 1 The temperature values are based on IEC 60721-3-4, Class 4K2. These temperatures do not take into account severe environments (for example, extremely cold or extremely warm), nor do they include provision for heating by radiation from the sun (solar loading).

NOTE 2 Attention is drawn to IEC 61587-1 for additional information on performance levels C1, C2 and C3.

4.1.5 Constructions and components not specifically covered

Where the equipment involves technologies, components and materials or methods of construction not specifically covered in this document, the equipment shall provide SAFEGUARDS not less than that generally afforded by this document and the principles of safety contained herein.

The need for additional detailed requirements to cope with a new situation should be brought promptly to the attention of the appropriate committee.

4.1.6 Orientation during transport and use

Where it is clear that the orientation of use of equipment is likely to have a significant effect on the application of the requirements or the results of tests, all orientations of use specified in the installation or user instructions shall be taken into account. However, if equipment has means for fixing in place by an ORDINARY PERSON, such as the provision of screw holes for direct attachment to a mounting surface or through the use of brackets or the like, either provided with the equipment or readily available in the market, all likely positions of orientation of the equipment shall be taken into account, including the possibility of mounting to a non-vertical surface regardless of the installation or user instructions that are provided by the manufacturer.

In addition, for TRANSPORTABLE EQUIPMENT, all orientations of transport shall be taken into account.

4.1.7 Choice of criteria

Where this document indicates a choice between different criteria for compliance, or between different methods or conditions of test, the choice is specified by the manufacturer.

4.1.8 Liquids and liquid filled components (LFC)

Unless specified as an INSULATING LIQUID, liquids shall be treated as electrically conductive materials.

Constructions and test requirements for pressurized LFCs used inside the equipment where an injury can occur within the meaning of this document due to leaks of the liquid in the LFC shall comply with Clause G.15. However, Clause G.15 does not apply to the following:

– an LFC that is sealed but open to the atmosphere in the equipment; or

– components containing small amounts of liquids not likely to cause any injury (for example, liquid crystal displays, electrolytic capacitors, liquid cooling heat pipes, etc.); or

– wet CELL BATTERIES (for wet CELL BATTERIES, see Annex M); or

– an LFC and its associated parts that comply with P.3.3; or

– equipment with more than 1 l of liquid.

4.1.9 Electrical measuring instruments

Electrical measuring instruments shall have sufficient bandwidth to provide accurate readings, taking into account all components (DC, MAINS frequency, high frequency and harmonic content) of the parameter being measured.

If an RMS value is measured, care shall be taken that the measuring instrument gives a true RMS reading of non-sinusoidal waveforms as well as sinusoidal waveforms.

Measurements shall be made with a meter whose input impedance has a negligible influence on the measurement.

4.1.10 Temperature measurements

Unless otherwise specified, where the result of a test is likely to depend upon the ambient temperature, the manufacturer's specified ambient temperature range of the equipment (T_{ma}) shall be taken into account. When performing the test at a specific ambient temperature (T_{amb}), extrapolation (above and below) the results of the test may be used to consider the impact of T_{ma} on the result. Components and subassemblies may be considered separately from the equipment if the test results and extrapolation is representative of the whole equipment being so tested. Relevant test data and manufacturer's specifications may be examined in order to determine the effect of temperature variability on a component or subassembly (see B.1.5).

4.1.11 Steady state conditions

Steady state conditions are conditions when temperature stability is considered to exist (see B.1.5).

4.1.12 Hierarchy of safeguards

SAFEGUARDS that are required for ORDINARY PERSONS are acceptable, but may not be required, for INSTRUCTED PERSONS and SKILLED PERSONS. Likewise, SAFEGUARDS that are required for INSTRUCTED PERSONS are acceptable, but may not be required, for SKILLED PERSONS.

A REINFORCED SAFEGUARD may be used in place of a BASIC SAFEGUARD or a SUPPLEMENTARY SAFEGUARD or a DOUBLE SAFEGUARD. A DOUBLE SAFEGUARD may be used in place of a REINFORCED SAFEGUARD.

SAFEGUARDS, other than EQUIPMENT SAFEGUARDS, are specified in specific clauses.

4.1.13 Examples mentioned in this document

Where examples are given in this document, other examples, situations, and solutions are not excluded.

4.1.14 Tests on parts or samples separate from the end-product

If a test is conducted on a part or sample separate from the end-product, the test shall be conducted as if the part or sample was in the end-product.

4.1.15 Markings and instructions

Equipment that is required by this document to:

– bear markings; or

– be provided with instructions; or

– be provided with INSTRUCTIONAL SAFEGUARDS

shall meet the relevant requirements of Annex F.

Compliance is checked by inspection.

NOTE In Finland, Norway and Sweden, CLASS I PLUGGABLE EQUIPMENT TYPE A intended for connection to other equipment or a network shall, if safety relies on connection to reliable earthing or if surge suppressors are connected between the network terminals and accessible parts, have a marking stating that the equipment must be connected to an earthed MAINS socket-outlet.

4.1.16DV DE *Add Clause 4.1.16DV.1:*

4.1.16DV.1 Mains connections

4.1.16DV.1.1 DE See Clause G.7 for Mains Supply Cords for Pluggable (Cord Connected) Equipment.

4.1.16DV.1.2 DR See Clause G.7ADV for Mains Supply Cords for Pluggable (Cord Connected) Equipment (Canadian and U.S. regulatory-based requirements).

4.1.16DV.1.3 D2 See Annex DVH for requirements for Permanently Connected Equipment.

4.1.16DV.1.4 DR See Annex DVH for requirements for Permanently Connected Equipment (Canadian and U.S. regulatory-based requirements).

4.1.17DV D2 *Add Clause 4.1.17DV.1:*

4.1.17DV.1 External interconnecting cable and wiring

4.1.17DV.1.1 General

External interconnecting cable and wiring shall be investigated to the requirements of Clause 6.5 and either Clause 4.1.17DV.1.2 or 4.1.17DV.1.3, as appropriate.

External interconnecting cable and wiring 3,05 m or less may be investigated as part of the equipment (system) to the requirements of this standard. See Clause 4.1.17DV.1.2.

External interconnect cable and wiring longer than 3,05 m shall be subject to associated requirements. See Clause 4.1.17DV.1.3.

Alternatively, detachable external interconnecting cable and wiring (with terminations) may be excluded from the equipment evaluation if specified by the manufacturer.

4.1.17DV.1.2 Equipment (system) interconnecting cable and wiring

The following requirements apply to detachable and nondetachable external interconnecting cable and wiring investigated as part of the equipment (system):

– The length of the external interconnecting cable or wiring shall not exceed 3,05 m.

– For external interconnecting cable and wiring connected to PS2 and PS3 circuits, see Clause 6.5 for fire (flammability) considerations.

– There are no fire (flammability) considerations for external interconnecting cable and wiring specified by the manufacturer for connection to circuits that are PS1.

– External interconnecting cable and wiring intended to be connected to an ES3 or PS3 circuit require a jacket for mechanical protection in accordance with Table G.7ADV.2, or equivalent.

– Detachable external interconnecting cable and wiring (with terminations) intended to be connected to a PS2, PS3, ES2, or ES3 circuit and furnished as part of the equipment shall be either marked, or similarly identified in the installation instructions, with the name, trademark, or trade name of the organization that is responsible for the equipment and with the organization's identifying number or equivalent designation for the cable. See Annex DVK.

• The marking may be applied on the cable and wiring at any location.

• This marking is not required to comply with the test for permanence of markings, Clause F.3.9.

NOTE This marking is required to allow authorities having jurisdiction to identify external interconnecting cables and wiring that are evaluated as a part of the equipment (system).

Optical fiber interconnecting cables 3,05 m or less are not subject to the above requirements.

4.1.17DV.1.3 External interconnecting cable and wiring considered part of the building installation

External interconnect cable longer than 3,05 m designed to carry audio and/or video signals only, and that is not specified by the manufacturer to be routed inside the building structure (e.g., walls, ceilings, etc.), shall be subject to the applicable requirements of Clause 4.1.17DV.1.2. For purposes of Clause 4.1.17DV.1.2, it is assumed such cables are connected to PS1 circuits.

External interconnecting cables and wiring longer than 3,05 m are regulated by the Canadian Electrical Code, Part I, CSA C22.1, and the National Electrical Code, NFPA 70. See Annex DVA (Annex Q entry).

4.2 Energy source classifications

4.2.1 Class 1 energy source

Unless otherwise specified, a class 1 source is an energy source with levels not exceeding class 1 limits under:

– NORMAL OPERATING CONDITIONS; and

– ABNORMAL OPERATING CONDITIONS that do not lead to a SINGLE FAULT CONDITION; and

– SINGLE FAULT CONDITIONS that do not result in class 2 limits being exceeded.

A PROTECTIVE CONDUCTOR is a class 1 electrical energy source.

4.2.2 Class 2 energy source

Unless otherwise specified, a class 2 source is an energy source with levels exceeding class 1 limits and not exceeding class 2 limits under NORMAL OPERATING CONDITIONS, ABNORMAL OPERATING CONDITIONS, or SINGLE FAULT CONDITIONS.

4.2.3 Class 3 energy source

A class 3 source is an energy source with levels exceeding class 2 limits under NORMAL OPERATING CONDITIONS, ABNORMAL OPERATING CONDITIONS, or SINGLE FAULT CONDITIONS, or any energy source declared to be a class 3 source, as given in 4.2.4.

A neutral conductor is a class 3 electrical energy source.

4.2.4 Energy source classification by declaration

The manufacturer may declare:

– a class 1 energy source to be either a class 2 energy source or a class 3 energy source;

– a class 2 energy source to be a class 3 energy source.

4.3 Protection against energy sources

4.3.1 General

The terms “persons”, “body”, and “body parts” are represented by the probes of Annex V.

4.3.2 Safeguards for protection of an ordinary person

4.3.2.1 Safeguards between a class 1 energy source and an ordinary person

No SAFEGUARDS are required between a class 1 energy source and an ORDINARY PERSON (see Figure 9). Consequently, a class 1 energy source may be ACCESSIBLE to an ORDINARY PERSON.

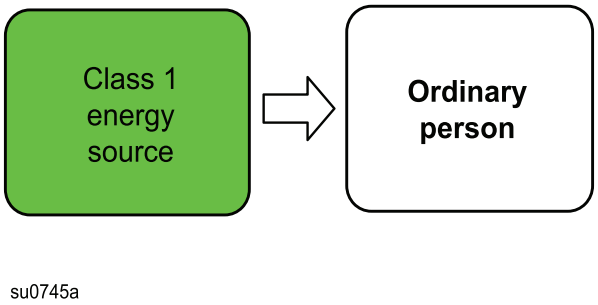


Figure 9

Model for protection of an ordinary person against a class 1 energy source

4.3.2.2 Safeguards between a class 2 energy source and an ordinary person

At least one BASIC SAFEGUARD is required between a class 2 energy source and an ORDINARY PERSON (see Figure 10).

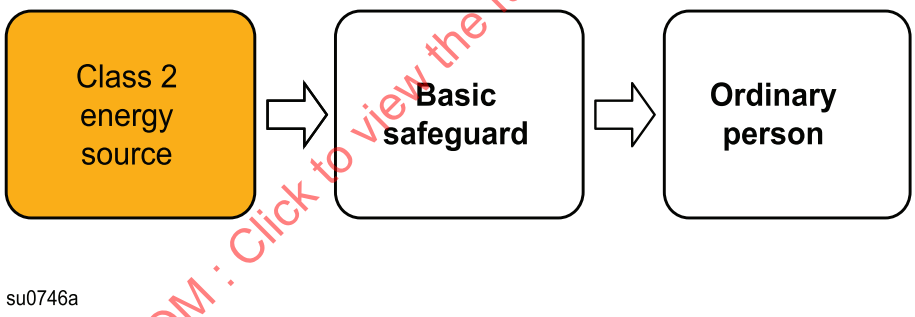


Figure 10

Model for protection of an ordinary person against a class 2 energy source

4.3.2.3 Safeguards between a class 2 energy source and an ordinary person during ordinary person servicing conditions

If ORDINARY PERSON servicing conditions require a BASIC SAFEGUARD to be removed or defeated, an INSTRUCTIONAL SAFEGUARD as described in Clause F.5 shall be provided and located in such a way that an ORDINARY PERSON will see the instruction prior to removing or defeating the BASIC SAFEGUARD (see Figure 11).

The INSTRUCTIONAL SAFEGUARD (see F.5) shall include all of the following:

– identify parts and locations of the class 2 energy source;

– specify actions that will protect persons from that energy source; and

– specify actions to reinstate or restore the BASIC SAFEGUARD.

If ORDINARY PERSON servicing conditions require a BASIC SAFEGUARD to be removed or defeated, and where the equipment is intended for use in the home, an INSTRUCTIONAL SAFEGUARD (see Clause F.5), directed towards adults, shall warn against removing or defeating the BASIC SAFEGUARD by children.

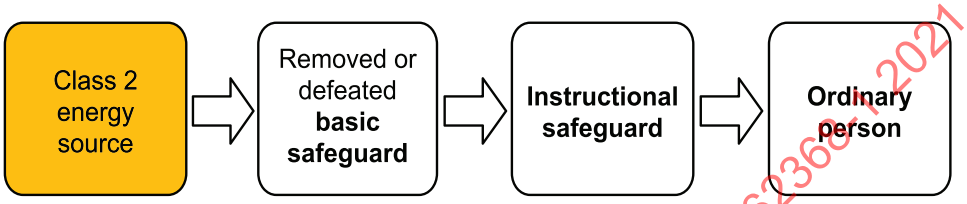


Figure 11

Model for protection of an ordinary person against a class 2 energy source during ordinary person servicing conditions

4.3.2.4 Safeguards between a class 3 energy source and an ordinary person

Unless otherwise specified,

– an EQUIPMENT BASIC SAFEGUARD and an EQUIPMENT SUPPLEMENTARY SAFEGUARD (together forming a DOUBLE SAFEGUARD); or

– a REINFORCED SAFEGUARD

required between a class 3 energy source and an ORDINARY PERSON (see Figure 12).

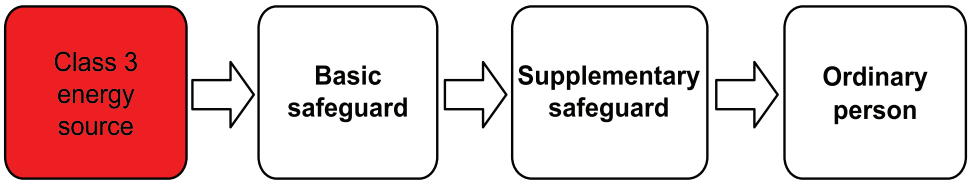


Figure 12

Model for protection of an ordinary person against a class 3 energy source

4.3.3 Safeguards for protection of an instructed person

4.3.3.1 Safeguards between a class 1 energy source and an instructed person

No SAFEGUARDS are required between a class 1 energy source and an INSTRUCTED PERSON (see Figure 13).

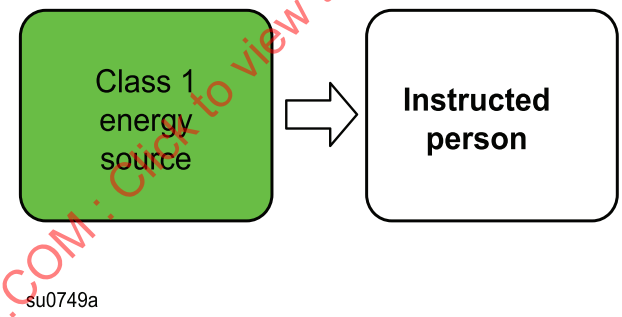


Figure 13

Model for protection of an instructed person against a class 1 energy source

4.3.3.2 Safeguards between a class 2 energy source and an instructed person

An INSTRUCTED PERSON uses a PRECAUTIONARY SAFEGUARD (see Figure 14). No additional SAFEGUARDS are required between a class 2 energy source and an INSTRUCTED PERSON. Consequently, a class 2 energy source may be ACCESSIBLE to an INSTRUCTED PERSON.

Figure 14

Model for protection of an instructed person against a class 2 energy source

4.3.3.3 Safeguards between a class 3 energy source and an instructed person

Unless otherwise specified,

– an EQUIPMENT BASIC SAFEGUARD and an EQUIPMENT SUPPLEMENTARY SAFEGUARD (together forming a DOUBLE SAFEGUARD); or

– a REINFORCED SAFEGUARD

is required between a class 3 energy source and an INSTRUCTED PERSON (see Figure 15).

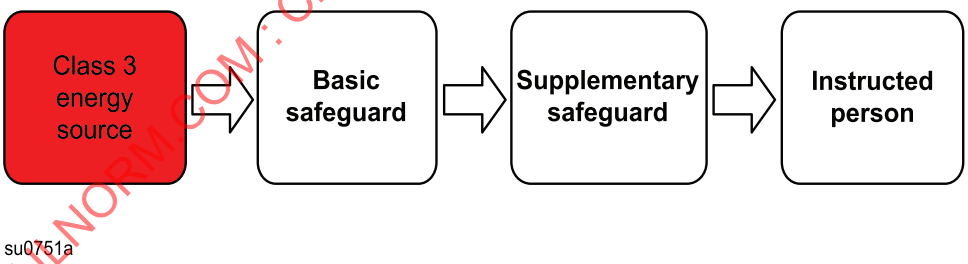


Figure 15

Model for protection of an instructed person against a class 3 energy source

4.3.4 Safeguards for protection of a skilled person

4.3.4.1 Safeguards between a class 1 energy source and a skilled person

No SAFEGUARD is required between a class 1 energy source and a SKILLED PERSON. Consequently, a class 1 energy source may be ACCESSIBLE to a SKILLED PERSON (see Figure 16).

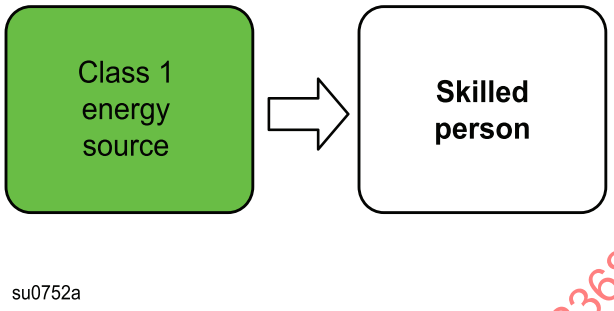


Figure 16

Model for protection of a skilled person against a class 1 energy source

4.3.4.2 Safeguards between a class 2 energy source and a skilled person

A SKILLED PERSON uses a SKILL SAFEGUARD (see Figure 17). No additional SAFEGUARDS are required between a class 2 energy source and a SKILLED PERSON. Consequently, a class 2 energy source may be ACCESSIBLE to a SKILLED PERSON.

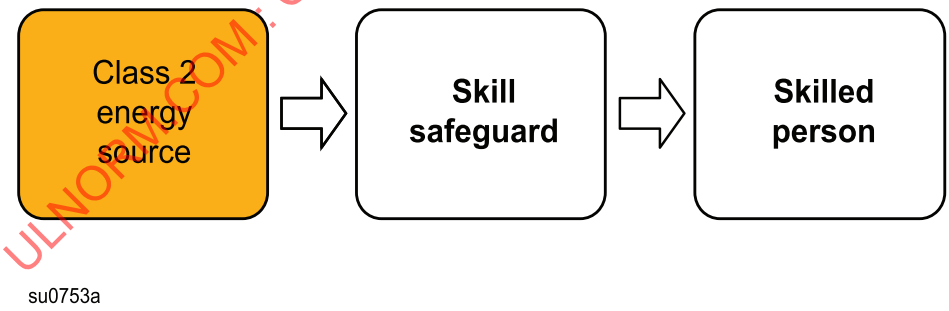


Figure 17

Model for protection of a skilled person against a class 2 energy source

4.3.4.3 Safeguards between a class 3 energy source and a skilled person

A SKILLED PERSON uses a SKILL SAFEGUARD (see Figure 18). Unless otherwise specified (for example, see 8.5.4), no additional SAFEGUARDS are required between a class 3 energy source and a SKILLED PERSON. Consequently, a class 3 energy source may be ACCESSIBLE to a SKILLED PERSON.

su0754a

Figure 18

Model for protection of a skilled person against a class 3 energy source

During equipment servicing conditions on a class 3 energy source, a SAFEGUARD intended to reduce the likelihood of injury due to an involuntary reaction is required between:

– another class 3 energy source, not undergoing service and in the same vicinity as the class 3 energy source being serviced; and

– a SKILLED PERSON (see 0.5.7 and Figure 19).

su0755a

Figure 19

Model for protection of a skilled person against class 3 energy sources during equipment servicing conditions

4.3.5 Safeguards in a restricted access area

Certain equipment is intended for installation exclusively in RESTRICTED ACCESS AREAS. Such equipment shall have SAFEGUARDS as required in 4.3.3 for instructed persons and 4.3.4 for skilled persons.

4.4 Safeguards

4.4.1 Equivalent materials or components

Where this document specifies a particular SAFEGUARD parameter, such as thermal class of insulation or MATERIAL FLAMMABILITY CLASS, a SAFEGUARD with a better parameter may be used.

NOTE For a hierarchy of the material flammability classes see Table S.1, Table S.2 and Table S.3.

4.4.2 Composition of a safeguard

A SAFEGUARD may be comprised of one or more elements.

4.4.3 Safeguard robustness

4.4.3.1 General

Where a solid SAFEGUARD (for example, an ENCLOSURE, barrier, SOLID INSULATION, earthed metal, glass, etc.) is ACCESSIBLE to an ORDINARY PERSON or to an INSTRUCTED PERSON, the SAFEGUARD shall comply with the relevant robustness tests as specified in 4.4.3.2 to 4.4.3.10.

For a SAFEGUARD that is ACCESSIBLE after opening an external ENCLOSURE, see 4.4.3.5.

Requirements for:

– adhesion of metallized coatings; and

– adhesives securing parts serving as SAFEGUARDS; and

– parts that may defeat a SAFEGUARD if an adhesive fails

are specified in Clause P.4.

4.4.3.2 Steady force tests

An ENCLOSURE or barrier that is ACCESSIBLE and that is used as a SAFEGUARD of:

– TRANSPORTABLE EQUIPMENT; and

– HAND-HELD EQUIPMENT; and

– DIRECT PLUG-IN EQUIPMENT

shall be subjected to the steady force test of Clause T.4.

A SAFEGUARD that is ACCESSIBLE and that only acts as a FIRE ENCLOSURE or fire barrier shall be subjected to the steady force test of Clause T.3.

All other ENCLOSURES or barriers that are ACCESSIBLE and that are used as a SAFEGUARD shall be subjected to the steady force test of Clause T.5. There are no requirements for the bottom of equipment having a mass of more than 18 kg unless the user instructions permit an orientation in which the bottom of the ENCLOSURE becomes the top or a side of the equipment.

This subclause does not apply to glass. Requirements for glass are given in 4.4.3.6.

4.4.3.3 Drop tests

The following equipment shall be subjected to the drop test of Clause T.7:

– HAND-HELD EQUIPMENT;

– DIRECT PLUG-IN EQUIPMENT;

– TRANSPORTABLE EQUIPMENT;

– MOVABLE EQUIPMENT requiring lifting or handling by an ORDINARY PERSON as part of its intended use, including routine relocation;

NOTE An example of such equipment is a paper shredder that rests on a waste container that requires removal of the paper shredder to empty the container.

– desk-top equipment having a mass of 7 kg or less that is intended for use with any one of the following:

- a cord-connected telephone handset; or
- another cord-connected hand-held accessory with an acoustic function; or
- a headset.

4.4.3.4 Impact tests

All equipment, other than that specified in 4.4.3.3, shall be subjected to the impact test of Clause T.6.

The impact test of Clause T.6 is not applied to the following:

– the bottom of an ENCLOSURE, except if the user instructions permit an orientation in which the bottom of the ENCLOSURE becomes the top or a side of the equipment;

– glass;

NOTE Impact tests for glass are in 4.4.3.6.

– the surface of the ENCLOSURE of STATIONARY EQUIPMENT, including equipment for building-in, that is

- not ACCESSIBLE; or
- protected after installation.

4.4.3.5 Internal accessible safeguard tests

An internal solid SAFEGUARD that is accessible to an ORDINARY PERSON after opening an external ENCLOSURE and whose failure would allow class 2 or class 3 energy sources to be ACCESSIBLE shall be subjected to the steady force test of Clause T.3.

4.4.3.6 Glass impact tests

The requirements below are applicable to all parts made of glass, with the exception of:

– platen glass used on copiers, scanners and the like, where the glass has been subjected to the steady force test of Clause T.3 and is provided with a cover or device to protect the platen glass; and

– CRTs: Requirements for CRTs are given in Annex U; and

– glass that is laminated or has a construction such that glass particles do not separate from each other if the glass is broken.

NOTE Laminated glass includes constructions such as plastic film affixed to a single side of a glass.

Glass that is ACCESSIBLE to an ORDINARY PERSON or to an INSTRUCTED PERSON:

– having a surface area exceeding 0,1 m^2; or

– having a major dimension exceeding 450 mm; or

– that prevents access to class 3 energy sources other than PS3

shall be subjected to the glass impact test of Clause T.9.

4.4.3.7 Glass fixation test

Laminated glass used as a SAFEGUARD that prevents access to class 3 energy sources other than PS3 shall be subjected to the following fixation tests:

– a glass impact test as given in Clause T.9 with an impact of 1 J applied three times; and

– a push/pull test with 10 N applied in the centre of the glass in the least favourable direction.

NOTE To perform the test, any suitable method can be used, such as using suction handles or gluing a support to the glass.

4.4.3.8 Thermoplastic material tests

If a SAFEGUARD is of moulded or formed thermoplastic material, the SAFEGUARD shall be so constructed that any shrinkage or distortion of the material due to release of internal stresses shall not defeat its SAFEGUARD function. The thermoplastic material shall be subjected to the stress relief test of Clause T.8.

4.4.3.9 Air comprising a safeguard

Where a SAFEGUARD is comprised of air (for example, a CLEARANCE), a barrier or ENCLOSURE shall prevent displacement of the air by a body part or a conductive part. The barrier or enclosure shall comply with the mechanical strength test specified in Annex T, as applicable.

4.4.3.10 Compliance criteria

During and after the tests:

– except for PS3, class 3 energy sources shall not become ACCESSIBLE to an ORDINARY PERSON or to an INSTRUCTED PERSON; and

– glass shall:

- *not break or crack; or*
- *not expel pieces of glass greater than 30 g in mass or greater than 50 mm in any dimension; or*
- *pass the fragmentation test of Clause T.10 on a separate test sample; and*

– all other SAFEGUARDS shall remain effective.

4.4.4 Displacement of a safeguard by an insulating liquid

If an INSULATING LIQUID displaces air comprising a SAFEGUARD:

– the requirements of 5.4.12 and 6.4.9 apply to the INSULATING LIQUID; and

– the requirements of 5.4.2 and 5.4.3 apply to the equipment both with and without the INSULATING LIQUID present.

Partial or total loss of the INSULATING LIQUID shall be considered an ABNORMAL OPERATING CONDITION of the equipment.

If the power supplied to parts immersed in INSULATING LIQUID is disconnected in the event of partial or total loss of the INSULATING LIQUID, the requirements of 6.4.2 to 6.4.8 do not apply for the immersed parts. An example of such a disconnect system is a float switch system complying with Annex K.

NOTE The use of INSULATING LIQUIDS to replace a BASIC INSULATION, a SUPPLEMENTARY INSULATION or a REINFORCED INSULATION is not covered by the requirements of this document.

4.4.5 Safety interlocks

Unless otherwise specified, if a SAFETY INTERLOCK is used as a SAFEGUARD for protection against:

– a class 2 or a class 3 energy source for an ORDINARY PERSON; or

– a class 3 energy source for an INSTRUCTED PERSON,

the SAFETY INTERLOCK shall comply with Annex K.

4.5 Explosion

4.5.1 General

EXPLOSION can be caused by:

– chemical reaction;

– mechanical deformation of a sealed container;

– rapid combustion or decomposition, producing a large volume of hot gas;

– high pressure; or

– high temperature.

NOTE 1 Depending on the energy rate, explosion can be categorized as a deflagration, a detonation, or pressure rupture.

NOTE 2 An ultracapacitor (for example, a double layer capacitor) is a high energy source and can explode following overcharging and high temperature.

For requirements regarding EXPLOSION of BATTERIES, see Annex M.

4.5.2 Requirements

During NORMAL OPERATING CONDITIONS and ABNORMAL OPERATING CONDITIONS, an EXPLOSION shall not occur.

If an EXPLOSION occurs during SINGLE FAULT CONDITIONS, it shall not cause injury and the equipment shall comply with the relevant parts of this document.

Compliance is checked by inspection and tests as specified in Clause B.2, Clause B.3 and Clause B.4.

4.6 Fixing of conductors

4.6.1 Requirements

Conductors shall be such that displacement cannot defeat a SAFEGUARD, such as reducing CLEARANCES or CREEPAGE DISTANCES below the values specified in 5.4.2 and 5.4.3.

The fixing of the conductors shall be such that, if a conductor becomes loose or detached, the conductor cannot defeat a SAFEGUARD, such as reducing CLEARANCES or CREEPAGE DISTANCES below the values specified in 5.4.2 and 5.4.3.

For the purpose of these requirements, it is assumed that:

– two independent fixings will not become loose or detached at the same time; and

– parts fixed by means of screws or nuts provided with self-locking washers or other means of locking are not liable to become loose or detached.

NOTE Spring washers and the like can provide satisfactory locking.

4.6.2 Compliance criteria

Compliance is checked by inspection, by measurement or, in case of doubt, by the test of Clause T.2 applied in the most unfavourable direction.

EXAMPLE Constructions regarded as meeting the requirements include:

– close-fitting tubing (for example, a heat shrink or rubber sleeve), applied over the wire and its termination;

– conductors connected by soldering and held in place near to the termination, independently of the soldered connection;

– conductors connected by soldering and securely hooked in before soldering, provided that the hole through which the conductor is passed is not unduly large;

– conductors connected to screw terminals, with an additional fixing near to the terminal that clamps, in the case of stranded conductors, the insulation and not only the conductors;

– conductors connected to screw terminals and provided with terminators that are unlikely to become free (for example, ring lugs crimped onto the conductors), however, the pivoting of such terminators is considered; or

– short rigid conductors that remain in position when the terminal screw is loosened.

4.6.2DV D2 *Modify 4.6.2 by adding the following text:*

– wire-wrap terminals used for the connection of ES1 and ES2 that are:

• provided on equipment that forms part of the telecommunication network, up to and including the demarcation point, and are located in areas only accessible to skilled persons. (This equipment is generally considered central office equipment, although it may be deployed elsewhere in similarly controlled environments.); and

• provided with a guard or cover that prevents unintentional contact during normal operating conditions and abnormal operating condition.

are tested with a steady force of 2,5 N ± 0,25 N.

4.7 Equipment for direct insertion into mains socket-outlets

4.7.1 General

Equipment incorporating integral pins for insertion into MAINS socket-outlets shall not impose undue torque on the socket-outlet. The means for retaining the pins shall withstand the forces to which the pins are likely to be subjected in normal use.

4.7.2 Requirements

The MAINS plug part shall comply with the relevant standard for the MAINS plug.

The equipment is inserted, as in normal use, into a fixed socket-outlet of a configuration as intended by the manufacturer, which is pivoted about a horizontal axis intersecting the centre lines of the contacts at a distance of 8 mm behind the engagement face of the socket outlet parallel to the engagement face.

4.7.3 Compliance criteria

Compliance is checked by inspection and, the additional torque that has to be applied to the socket-outlet to maintain the engagement face in the vertical plane shall not exceed 0,25 Nm. The torque to keep the socket-outlet itself in the vertical plane is not included in this value.

NOTE 1 In Australia and New Zealand, compliance is checked in accordance with AS/NZS 3112.

NOTE 2 In the United Kingdom, the torque test is performed using a socket-outlet complying with BS 1363, and the plug part shall be assessed to the relevant clauses of BS 1363.

4.8 Equipment containing coin / button cell batteries

4.8.1 General

These requirements apply to equipment, including remote controls, that:

– are likely to be ACCESSIBLE to children; and

– include COIN / BUTTON CELL BATTERIES with a diameter of 32 mm or less.

These requirements do not apply to:

– PROFESSIONAL EQUIPMENT;

– equipment for use in locations where it is unlikely that children will be present; or

– equipment containing COIN / BUTTON CELL BATTERIES that are soldered in place.

4.8.2 Instructional safeguard

Equipment containing one or more COIN / BUTTON CELL BATTERIES shall have an INSTRUCTIONAL SAFEGUARD in accordance with Clause F.5.

The INSTRUCTIONAL SAFEGUARD is not required where these BATTERIES are not intended to be replaced or are only ACCESSIBLE after damaging the equipment.

The elements of the INSTRUCTIONAL SAFEGUARD shall be as follows:

– element 1a: not available

– element 2: “Do not ingest battery, Chemical Burn Hazard” or equivalent wording

– element 3: the following or equivalent text

> [The remote control supplied with] This product contains a coin / button cell battery. If the coin / button cell battery is swallowed, it can cause severe internal burns in just 2 hours and can lead to death.

– element 4: the following or equivalent text

> Keep new and used batteries away from children.
>
> If the battery compartment does not close securely, stop using the product and keep it away from children.
>
> If you think batteries might have been swallowed or placed inside any part of the body, seek immediate medical attention.

4.8.3 Construction

Equipment having a BATTERY compartment door / cover shall be designed to reduce the possibility of children removing the BATTERY by one of the following methods:

– a TOOL, such as a screwdriver or coin, is required to open the BATTERY compartment, in which case a minimum torque of 0,5 Nm and a minimum angle of 90 degrees of rotation shall be required to open the compartment; or

– the BATTERY compartment door / cover requires the application of a minimum of two independent and simultaneous movements to open by hand.

4.8.3DV D2 ***Modify 4.8.3 by adding the following as a new paragraph following the second dashed paragraph:***

If screws or similar fasteners are used to secure the door/cover providing access to the battery compartment, the fasteners shall be captive to ensure that they remain with the door/cover. This does not apply to side panel doors on larger devices which are necessary for the functioning of the equipment and which are not likely to be discarded or left off the equipment.

4.8.4 Tests

4.8.4.1 Test sequence

One sample shall be subjected to the applicable tests of 4.8.4.2 to 4.8.4.6. If applicable, the test in 4.8.4.2 shall be conducted first.

4.8.4.2 Stress relief test

If the BATTERY compartment utilizes moulded or formed thermoplastic materials, the sample consisting of the complete equipment, or of the complete ENCLOSURE together with any supporting framework, is tested according to the stress relief test of Clause T.8.

During the test, the BATTERY may be removed.

4.8.4.3 Battery replacement test

For equipment with a BATTERY compartment door / cover, the BATTERY compartment shall be opened and closed and the BATTERY removed and replaced ten times to simulate normal replacement according to the manufacturer's instructions.

If the BATTERY compartment door / cover is secured by one or more screws, the screws are loosened and then tightened applying a continuous linear torque according to Table 37, using a suitable screwdriver, spanner or key. The screws are to be completely removed and reinserted each time.

4.8.4.4 Drop test

Portable equipment having a mass of 7 kg or less are subjected to three drops from a height of 1 m onto a horizontal surface in positions likely to produce the maximum force on the BATTERY compartment in accordance with Clause T.7.

If the equipment is a remote control, it shall be subjected to ten drops.

4.8.4.5 Impact test

The BATTERY compartment door / cover shall be subjected to three impacts in a direction perpendicular to the BATTERY compartment door / cover according to the test method of Clause T.6 with a force of:

– 0,5 J (102 mm ± 10 mm height) for glasses for watching, for example, 3 dimensional television; or

– 2 J (408 mm ± 10 mm height) for all other doors / covers.

4.8.4.5DV D2 *Modify 4.8.4.5 by deleting the first dashed paragraph.*

4.8.4.6 Crush test

Hand held remote control devices are to be supported by a fixed rigid supporting surface in a position likely to produce the most adverse results as long as the position can be self-supported. A crushing force of 330 N ± 5 N is applied to the exposed top and back surfaces of remote control devices placed in a stable condition by a flat surface measuring approximately 100 mm by 250 mm for a period of 10 s.

4.8.5 Compliance criteria

Compliance is checked by applying a force of 30 N ± 1 N for 10 s to the BATTERY compartment door / cover by the straight unjointed version of the test probe of Figure V.1 at the most unfavourable place and in the most unfavourable direction. The force shall be applied in one direction at a time.

The BATTERY compartment door / cover shall remain functional, and:

– the BATTERY shall not become ACCESSIBLE; or

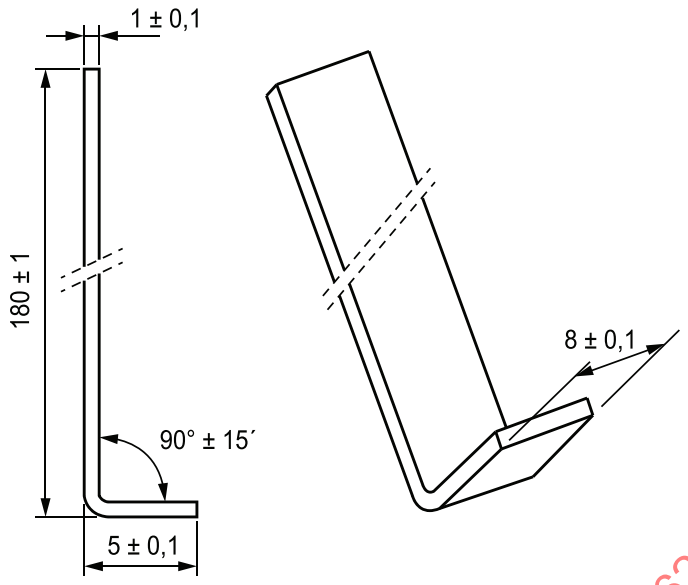
– it shall not be possible remove the BATTERY from the product with the test hook of Figure 20 using a force of approximately 20 N.

4.8.5DV.1 D2 *Modify 4.8.5 by replacing the value of 30 N in the first paragraph with 45 N.*

4.8.5DV.2 D2 *Modify 4.8.5 by replacing the first and second dashed paragraphs with the following:*

– the battery compartment door/cover shall not open; and

– the battery shall not become accessible.



Dimensions in millimetres

su1790

Material: steel

Figure 20

Test hook

Figure 20DV D2 *Delete Figure 20:*

This figure does not apply.

4.9 Likelihood of fire or shock due to entry of conductive objects

Where the entry of a conductive object from outside the equipment or from another part of the equipment can result in:

– bridging within PS3 and ES3 circuits; or

– bridging an ES3 circuit to ACCESSIBLE, unearthed conductive parts,

top and side openings above PS3 and ES3 circuits shall:

– be located more than 1,8 m above the floor; or

– comply with Annex P.

Compliance is checked by inspection or according to Annex P.

4.10 Components requirements

4.10.1 Disconnect device

Equipment connected to the MAINS shall be provided with a DISCONNECT DEVICE in accordance with Annex L.

4.10.2 Switches and relays

Switches and relays located in a PS3 circuit or used as a SAFEGUARD shall comply with Clause G.1 or Clause G.2 respectively.

5 Electrically-caused injury

5.1 General

To reduce the likelihood of painful effects and injury due to electric current passing through the human body, equipment shall be provided with the SAFEGUARDS specified in Clause 5.

5.2 Classification and limits of electrical energy sources

5.2.1 Electrical energy source classifications

5.2.1.1 ES1

ES1 is a class 1 electrical energy source with current or voltage levels:

– not exceeding ES1 limits under

- NORMAL OPERATING CONDITIONS, and
- ABNORMAL OPERATING CONDITIONS, and
- SINGLE FAULT CONDITIONS of a component, device or insulation not serving as a SAFEGUARD; and

– not exceeding ES2 limits under SINGLE FAULT CONDITIONS of a BASIC SAFEGUARD or of a SUPPLEMENTARY SAFEGUARD.

NOTE For accessibility requirements, see 5.3.1.

5.2.1.2 ES2

ES2 is a class 2 electrical energy source where:

– both the voltage and the current exceed the limits for ES1; and

– under

- NORMAL OPERATING CONDITIONS, and
- ABNORMAL OPERATING CONDITIONS, and
- SINGLE FAULT CONDITIONS,

either the voltage or the current does not exceed the limit for ES2.

NOTE For accessibility requirements, see 5.3.1.

5.2.1.3 ES3

ES3 is a class 3 electrical energy source where both the voltage and current exceed the limit for ES2.

5.2.2 Electrical energy source ES1 and ES2 limits

5.2.2.1 General

The limits specified in 5.2.2 are with respect to earth or with respect to an ACCESSIBLE part.

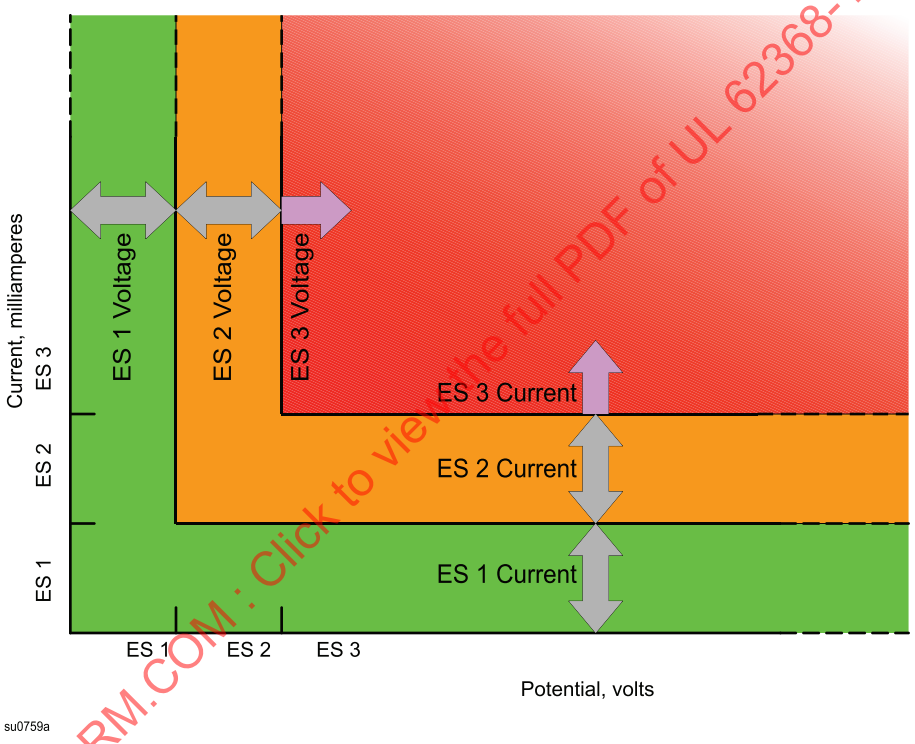


Figure 21

Illustration showing ES limits for voltage and current

For any voltage up to the voltage limit, there is no limit for the current. Likewise for any current up to the current limit, there is no limit for the voltage, see Figure 21.

5.2.2.2 Steady state voltage and current limits

An electrical energy source class is determined from both the voltage and the current under NORMAL OPERATING CONDITIONS, ABNORMAL OPERATING CONDITIONS, and SINGLE FAULT CONDITIONS (see Table 4).

The values are the maximum that can be delivered by the source. Steady state is considered established when the voltage or current values persist for 2 s or longer, otherwise the limits of 5.2.2.3, 5.2.2.4 or 5.2.2.5 apply, as appropriate.

NOTE In Denmark, a warning (marking SAFEGUARD) for high TOUCH CURRENT is required if the TOUCH CURRENT exceeds the limits of 3,5 mA AC or 10 mA DC.

Table 4
Electrical energy source limits for steady state ES1 and ES2

Energy Source	ES1 limits		ES2 limits		ES3
	Voltage	Current [a, c, d]	Voltage	Current [b, c, e]	
DC [d]	60V	2 mA	120 V	25 mA	> ES2
AC up to 1 kHz	30 V RMS 42,4 V peak	0,5 mA RMS 0,707 mA peak	50 V RMS 70,7 V peak	5 mA RMS 7,07 mA peak	
AC > 1 kHz up to 100 kHz	30 V RMS + 0,4 f 42,4 V peak. + 0,4 2 f		50 V RMS + 0,9 f 70,7 V peak + 0,9 2 f		
AC above 100 kHz	70 V RMS 99 V peak		140 V RMS 198 V peak		
Combined AC and DC	$\frac{U_{DC}(V)}{60} + \frac{U_{AC\ RMS}(V)}{U_{RMS\ limit}} \leq 1$ $\frac{U_{DC}(V)}{60} + \frac{U_{AC\ peak}(V)}{U_{peak\ limit}} \leq 1$	$\frac{I_{DC}(mA)}{2} + \frac{I_{AC\ RMS}(mA)}{0,5} \leq 1$ $\frac{I_{DC}(mA)}{2} + \frac{I_{AC\ peak}(mA)}{0,707} \leq 1$	See Figure 23	See Figure 22	

As an alternative to the requirements above, the values below can be used for purely sinusoidal waveforms

Energy source	ES1 limits	ES2 limits	ES3
	Current [c] RMS	Current [c] RMS	
AC up to 1 kHz	0,5 mA	5 mA	
AC > 1 kHz up to 100 kHz	0,5 mA × f [d]	5 mA + 0,95 f [e]	
AC above 100 kHz	50 mA [d]	100 mA [e]	

f is in kHz.

Peak values shall be used for non-sinusoidal voltage and current. RMS values may be used only for sinusoidal voltage and current.

See 5.7 for measurement of PROSPECTIVE TOUCH VOLTAGE and TOUCH CURRENT.

[a] Current is measured using the measuring network specified in Figure 4 of IEC 60990:2016.

[b] Current is measured using the measuring network specified in Figure 5 of IEC 60990:2016.

[c] For sinusoidal waveforms and DC, the current may be measured using a 2 000 Ω resistor.

[d] Above 22 kHz the ACCESSIBLE area is limited to 1 cm^2.

[e] Above 36 kHz the ACCESSIBLE area is limited to 1 cm^2.

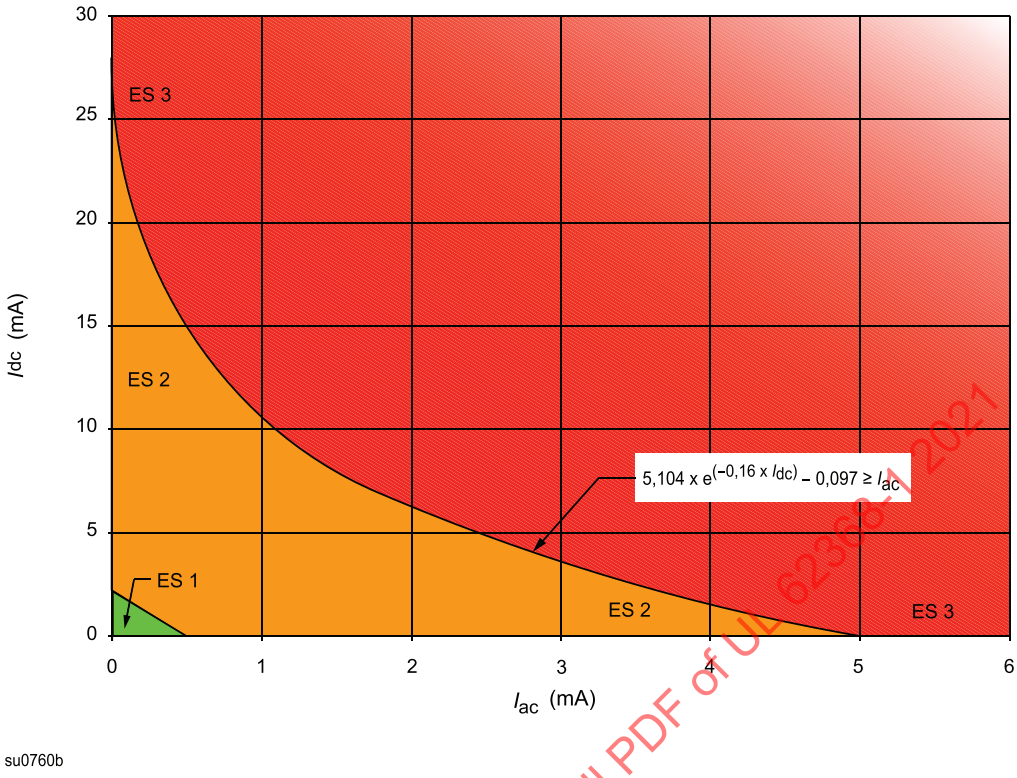


Figure 22

Maximum values for combined AC current and DC current

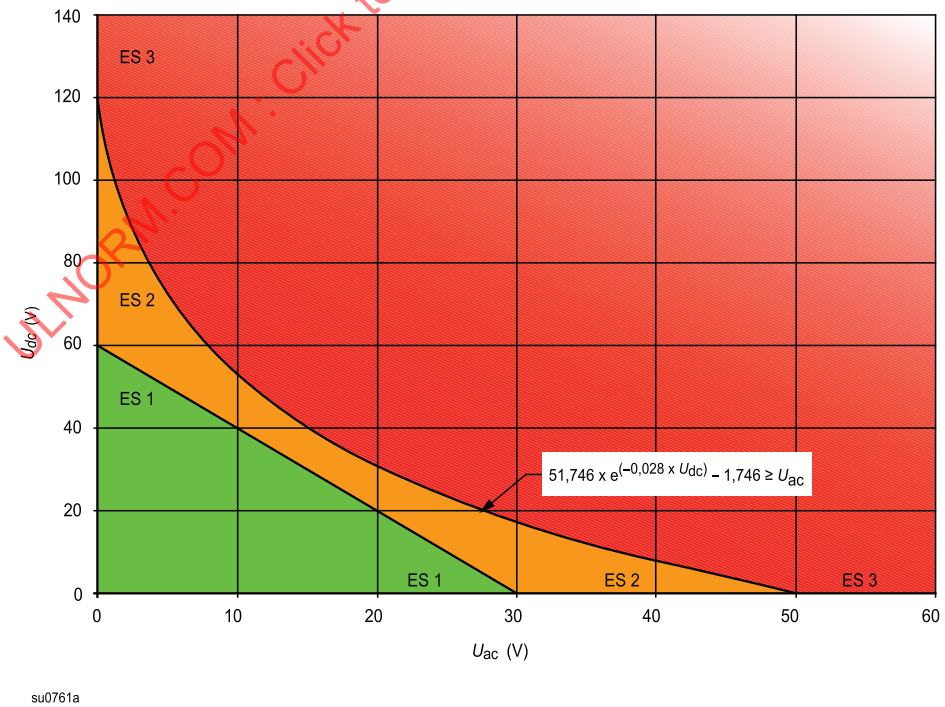


Figure 23

Maximum values for combined AC voltage and DC voltage

5.2.2.3 Capacitance limits

Where the electrical energy source is a capacitor, the energy source is classified from both the charge voltage and the capacitance.

The capacitance is the rated value of the capacitor plus the specified tolerance.

The ES1 and ES2 limits for various capacitance values are listed in Table 5.

NOTE 1 The capacitance values for ES2 are derived from Table A.2 of IEC TS 61201:2007.

NOTE 2 The values for ES1 are calculated by dividing the values from Table A.2 of IEC TS 61201:2007, by two (2).

Table 5
Electrical energy source limits for a charged capacitor

C nF	ES1 U_{peak} V	ES2 U_{peak} V	ES3 U_{peak} V
300 or greater	60	120	> ES2
170	75	150	
91	100	200	
61	125	250	
41	150	300	
28	200	400	
18	250	500	
12	350	700	
8,0	500	1 000	
4,0	1 000	2 000	
1,6	2 500	5 000	
0,8	5 000	10 000	
0,4	10 000	20 000	
0,2	20 000	40 000	
0,133 or less	30 000	60 000	
Linear interpolation may be used between the nearest two points.			

5.2.2.4 Single pulse limits

Where the electrical energy source is a single pulse, the energy source is classified from both the voltage and the duration or from both the current and the duration. Values are given in Table 6 and Table 7. If the voltage exceeds the limit, then the current shall not exceed the limit. If the current exceeds the limit, the voltage shall not exceed the limit. Currents are measured according to 5.7. For repetitive pulses, see 5.2.2.5.

For pulse durations up to 10 ms, the voltage or current limit for 10 ms applies.

If more than one pulse is detected within a period of 3 s, then the electrical energy source is treated as a repetitive pulse and the limits of 5.2.2.5 apply.

NOTE 1 The pulse limits are calculated from Figure 22 and Table 10 of IEC TS 60479-1:2005.

NOTE 2 These single pulses do not include transients.

NOTE 3 Pulse duration is considered to be the time duration when the voltage or current exceeds ES1 limits.

Table 6
Voltage limits for single pulses

Pulse duration up to and including ms	ES1 U_{peak} V	ES2 U_{peak} V	ES3 U_{peak} V
10	60	196	> ES2
20		178	
50		150	
80		135	
100		129	
200 and longer		120	

If the time duration lies between the values in any two rows, either the lower ES2 value of U_{peak} shall be used or a linear interpolation may be used between any two adjacent rows with the calculated peak voltage value rounded down to the nearest volt.

If the peak voltage for ES2 lies between the values in any two rows, either the shortest time duration may be used or a linear interpolation may be used between any two adjacent rows with the calculated time duration rounded down to the nearest millisecond.

Table 7
Current limits for single pulses

Pulse duration up to and including ms	ES1 I_{peak} mA	ES2 I_{peak} mA	ES3 I_{peak} mA
10	2	200	> ES2
20		153	
50		107	
100		81	
200		62	
500		43	
1 000		33	
2 000 and longer		25	

If the time duration lies between the values in any two rows, either the lower ES2 value of I_{peak} shall be used or a linear interpolation may be used between any two adjacent rows with the calculated value rounded down to the nearest milliampere.

If the peak current for ES2 lies between the values in any two rows, either the value of the shortest time duration may be used or a linear interpolation may be used between any two adjacent rows with the calculated time duration rounded down to the nearest millisecond.

5.2.2.5 Limits for repetitive pulses

Except for pulses covered in Annex H, a repetitive pulse electrical energy source class is determined from either the available voltage or the available current. If the voltage exceeds the limit, then the current shall not exceed the limit. If the current exceeds the limit, the voltage shall not exceed the limit. Currents are measured according to 5.7.

For pulse off times less than 3 s, the peak values of 5.2.2.2 apply. For longer durations, the values of 5.2.2.4 apply.