

UL 60065

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Audio, Video and Similar Electronic Apparatus – Safety Requirements

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Underwriters Laboratories Inc. (UL)
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Northbrook, IL 60062-2096

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

Seventh Edition, Dated June 30, 2003

Revisions: This Standard contains revisions through and including March 20, 2006.

Summary of Topics

These editorial revisions to ANSI/UL 60065 replace all references to UL 1020, the Standard for Thermal Cutoffs for Use in Electrical Appliances and Components, with reference to UL 60691, the Standard for Thermal-Links – Requirements and Application Guide. UL 1020 was withdrawn and superseded by UL 60691.

UL Standards for Safety are developed and maintained in the Standard Generalized Markup Language (SGML). SGML -- an international standard (ISO 8879-1986) -- is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Due to formatting differences resulting from the use of UL's new electronic publishing system, please note that additional pages (on which no requirements have been changed) may be included in revision pages due to relocation of existing text and reformatting of the Standard.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding item

Future Effective Date	References
May 18, 2007	14.10.1, 14.10.6, Table 21

The revisions dated March 20, 2006 include a reprinted title page (page1) for this Standard.

The revisions dated March 20, 2006 editorially replace all references to UL 1020 with the reference to UL 60691.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfolnet.ul.com/ulforeword.html>

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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ANSI/UL 60065-2006

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UL 60065

Standard for Audio, Video and Similar Electronic Apparatus – Safety Requirements

Prior to this seventh edition, the requirements for the products covered by this standard were included in the Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use, UL 6500, First and Second Editions. This Standard UL 60065 is a new edition of UL 6500. The standard number and edition number have been changed to correspond with the equivalent IEC 60065 standard. No first through sixth editions of UL 60065 will be published.

Seventh Edition

June 30, 2003

The most recent designation of ANSI/UL 60065 as an American National Standard (ANSI) occurred on January 24, 2006.

This ANSI/UL Standard for Safety, which consists of the Seventh Edition with revisions through March 20, 2006, is under continuous maintenance, whereby each revision is ANSI approved upon publication. 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 <http://csds.ul.com>.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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UL PREFACE

This UL Standard is based on IEC Publication 60065: Seventh Edition, Audio, video and similar electronic apparatus – Safety requirements. IEC publication 60065 is copyrighted by the IEC.

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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.

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NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication IEC 60065, Audio, video and similar electronic apparatus – Safety requirements, copyright 2001, are indicated by notations next to the clause, sub-clause, Table, Figure or Annex number.

There are four types of National Differences in this Standard as noted below.

DU – These are National Differences which are either (1) based on **basic safety principles and requirements**, elimination of which would compromise safety for U.S. consumers and users of products, or (2) based on **safety practices**, where the IEC requirements may be acceptable, but adopting the IEC requirements would require considerable retesting or redesign on the manufacturer's part.

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**.

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

National Differences have been incorporated into the body of the standard. If National Differences necessitate the deletion of the IEC 60065 text, the IEC 60065 text has been retained but has been ~~lined-out~~. Text added as a result of National Differences has been underlined. Text added as the UL Preface and UL Foreword is not underlined.

INTERNATIONAL ELECTROTECHNICAL COMMISSION**AUDIO, VIDEO AND SIMILAR ELECTRONIC APPARATUS – SAFETY REQUIREMENTS****FOREWORD**

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

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

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

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

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

International Standard IEC 60065 has been prepared by IEC technical committee 92: Safety of audio, video and similar electronic equipment.

This seventh edition cancels and replaces the sixth edition published in 1998. This edition constitutes a technical revision.

It has the status of a group safety publication in accordance with IEC Guide 104.

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

FDIS	Report on voting
92/85/FDIS	92/89/RVD

Amendment 1 has been prepared by IEC technical committee 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology.

The text of Amendment 1 is based on the following documents:

FDIS	Report on voting
108/136/FDIS	108/148A/RVD

Full information on the voting for the approval of this standard and amendment can be found in the report of voting indicated in the above tables.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

In this standard, the following print types are used:

- requirements proper: roman type
- *test specifications: italic type*
- NOTES: smaller roman type

For terms defined in clause 2, SMALL CAPITALS are used.

DE Annexes A, B, C, D, E, F, G, H, J, and K, Q, R, S, T, U, V, X and Y form an integral part of this standard.

DE Annexes M, and N, P, W and Z are for information only.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Principles of safety

General

This introduction is intended to provide an appreciation of the principles on which the requirements of this standard are based. Such an understanding is essential in order that safe apparatus can be designed and manufactured.

The requirements of this standard are intended to provide protection to persons as well as to the surroundings of the apparatus.

Attention is drawn to the principle that the requirements, which are standardized, are the minimum considered necessary to establish a satisfactory level of safety.

Further development in techniques and technologies may entail the need for future modification of this standard.

NOTE The expression "protection to the surroundings of the apparatus" implies that this protection should also include protection of the natural environment in which the apparatus is intended to be used, taking into account the life cycle of the apparatus, i.e. manufacturing, use, maintenance, disposal and possible end-of-life recycling of parts of the apparatus.

Hazards

The application of this standard is intended to prevent injury or damage due to the following hazards:

- electric shock;
- excessive temperatures;
- radiation;
- implosion;
- mechanical hazards;
- fire.

Electric shock

Electric shock is due to current passing through the human body. Currents of the order of a milliampere can cause a reaction in persons in good health and may cause secondary risks due to involuntary reaction. Higher currents can have more damaging effects. Voltages below certain limits are generally regarded as not dangerous under specified conditions. In order to provide protection against the possibility of higher voltages appearing on parts which may be touched or handled, such parts are either earthed or adequately insulated.

For parts which can be touched, two levels of protection are normally provided to prevent electric shock caused by a fault. Thus a single fault and any consequential faults will not create a hazard. The provision of additional protective measures, such as supplementary insulation or protective earthing, is not

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considered a substitute for, or a relief from, properly designed basic insulation.

Cause

Contact with parts normally at hazardous voltage

Prevention

Prevent access to parts at hazardous voltage by fixed or locked covers, interlocks, etc. Discharge capacitors at hazardous voltages.

Breakdown of insulation between parts normally at hazardous voltage and accessible parts.

Either use double or reinforced insulation between parts normally at hazardous voltages and accessible parts so that breakdown is not likely to occur, or connect accessible conductive parts to protective earth so that the voltage which can develop is limited to a safe value. The insulations shall have adequate mechanical and electrical strength.

Breakdown of insulation between parts normally at hazardous voltage and circuits normally at non-hazardous voltages, thereby putting accessible parts and terminals at hazardous voltage.

Segregate hazardous and non-hazardous voltage circuits either by double or reinforced insulation so that breakdown is not likely to occur, or by a protective earthed screen, or connect the circuit normally at non-hazardous voltage to protective earth, so that the voltage which can develop is limited to a safe value.

Touch current from parts at hazardous voltage through the human body. (Touch current can include current due to RFI filter components connected between mains supply circuits and accessible parts or terminals.)

Limit touch current to a safe value or provide a protective earthing connection to the accessible parts.

Excessive temperatures

Requirements are included to prevent injury due to excessive temperatures of accessible parts, to prevent damaging of insulation due to excessive internal temperatures, and to prevent mechanical instability due to excessive temperatures developed inside the apparatus.

Radiation

Requirements are included to prevent injury due to excessive energy levels of ionizing and laser radiation, for example by limiting the radiation to non-hazardous values.

Implosion

Requirements are included to prevent injury due to implosion of picture tubes.

Mechanical hazards

Requirements are included to ensure that the apparatus and its parts have adequate mechanical strength and stability, to avoid the presence of sharp edges and to provide guarding or interlocking of dangerous moving parts.

Fire

A fire can result from:

- overloads;
- component failure;

- insulation breakdown;
- bad connections;
- arcing.

Requirements are included to prevent any fire which originates within the apparatus from spreading beyond the immediate vicinity of the source of the fire or from causing damage to the surroundings of the apparatus.

The following preventive measures are recommended:

- the use of suitable components and sub-assemblies;
- the avoidance of excessive temperatures which might cause ignition under normal or fault conditions;
- the use of measures to eliminate potential ignition sources such as inadequate contacts, bad connections, interruptions;
- the limitation of the quantity of combustible material used;
- the control of the position of combustible materials in relation to potential ignition sources;
- the use of materials with high resistance to fire in the vicinity of potential ignition sources;
- the use of encapsulation or barriers to limit the spread of fire within the apparatus;
- the use of suitable fire retardant materials for the enclosure.

AUDIO, VIDEO AND SIMILAR ELECTRONIC APPARATUS – SAFETY REQUIREMENTS

1 General

1.1 Scope

1.1.1 DU This International Safety Standard applies to electronic apparatus designed to be fed from the MAINS, from a SUPPLY APPARATUS, from batteries or from REMOTE POWER FEEDING and intended for reception, generation, recording or reproduction respectively of audio, video and associated signals. It also applies to apparatus designed to be used exclusively in combination with the above-mentioned apparatus.

This standard primarily concerns apparatus intended for household and similar general use. ~~but It also covers COMMERCIAL APPARATUS and PROFESSIONAL APPARATUS~~ which may also be used in places of public assembly such as schools, theatres, places of worship and the workplace. ~~PROFESSIONAL APPARATUS intended for use as described above is also covered unless falling specifically within the scope of other standards may be evaluated to requirements in this standard, or to the requirements in UL 1419.~~

This standard concerns only safety aspects of the above apparatus; it does not concern other matters, such as style or performance.

This standard applies to the above-mentioned apparatus, if designed to be connected to the TELECOMMUNICATION NETWORK or similar network, for example by means of an integrated modem.

Some examples of apparatus within the scope of this standard are:

- receiving apparatus and amplifiers for sound and/or vision;
- independent LOAD TRANSDUCERS and SOURCE TRANSDUCERS;
- SUPPLY APPARATUS intended to supply other apparatus covered by the scope of this standard;
- ELECTRONIC MUSICAL INSTRUMENTS, and electronic accessories such as rhythm generators, tone generators, music tuners and the like for use with electronic or non-electronic musical instruments;
- audio and/or video educational apparatus;
- video projectors;

NOTE 1 Film projectors, slide projectors, overhead projectors are covered by IEC 60335-2-56 [5]¹⁾ UL 122

- video cameras and video monitors;
- household video games and flipper games;

¹ Figures in square brackets refer to the bibliography.

NOTE 2 Video and flipper games for commercial use are covered by IEC 60335-2-82 [6] UL 22

- juke boxes;
- household electronic gaming and scoring machines;

NOTE 3 Electronic gaming and scoring machines for commercial use are covered by IEC 60335-2-82 [6] UL 22

- teletext equipment;
- record and optical disc players;
- tape and optical disc recorders;
- antenna signal converters and amplifiers;
- satellite receiver antenna positioners;

NOTE 3A UHF and VHF antenna rotators are covered by UL 150

- Citizen's Band apparatus;
- apparatus for IMAGERY;
- electronic light effect apparatus;
- apparatus for use in alarm systems;

NOTE 3B Includes cameras, stop motion recorders and the like used in alarm systems. This Standard does not cover the investigation of the actual alarm system.

- intercommunication apparatus, using low voltage MAINS as the transmission medium;
- cable head-end receivers;
- multimedia apparatus;

NOTE 4 The requirements of IEC 60950 UL 60950 may also be used to meet the requirements for safety of multi media apparatus (see also IEC Guide 112 [16])

- professional general use amplifiers, record or disc players, tape players, recorders, and public address systems;
- professional sound/video systems.

NOTE 5 The requirements of UL 1419 may also be used to meet the requirements for safety of PROFESSIONAL APPARATUS.

- electronic flash apparatus for photographic purposes (see Annex L) are covered by UL 122

MAINS connected apparatus covered by this standard is intended for installation in compliance with the National Electrical Code, ANSI/NFPA 70.

1.1.1 revised November 18, 2005

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1.1.2 This standard applies to apparatus with a RATED SUPPLY VOLTAGE not exceeding

- 250 V a.c. single phase or d.c. supply;
- 433 V a.c. in the case of apparatus for connection to a supply other than single-phase.

1.1.3 DU This standard applies to apparatus for use at altitudes not exceeding 2 000 m above sea level, primarily in dry locations and in regions with moderate or tropical climates.

For apparatus ~~with protection against splashing water~~ intended for outdoor use, additional requirements are given in annex A.

For apparatus to be connected to TELECOMMUNICATION NETWORKS, additional requirements are given in annex B.

For apparatus intended to be used in vehicles, ships or aircraft, or at altitudes exceeding 2 000 m above sea level, additional requirements may be necessary.

NOTE See table A.2 of IEC 60664-1.

Requirements, additional to those specified in this standard, may be necessary for apparatus intended for special conditions of use.

1.1.4 For apparatus designed to be fed from the MAINS, this standard applies to apparatus intended to be connected to a MAINS supply with transient overvoltages not exceeding overvoltage category II according to IEC 60664-1.

For apparatus subject to transient overvoltages exceeding those for overvoltage category II, additional protection may be necessary in the MAINS supply of the apparatus.

1.1.5 DU Certain apparatus covered by the requirements in this standard are also required to comply with applicable requirements in other appropriate standards because of their intended end use applications or environmental conditions.

1.2 DC Normative references

1.2 revised March 20, 2006

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

ASTM D495, Standard Test for High-Voltage, Low-Current, Arc Resistance of Solid Electrical Insulating Material

IEC 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60038:1983, *IEC standard voltages*
Amendment 1 (1994) Amendment 2 (1997)

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IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-32:1975, *Environmental testing – Part 2: Tests – Test Ed: Free fall (Procedure 2)*

IEC 60068-2-75:1997, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

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

IEC 60085:2004, *Thermal evaluation and classification of electrical insulation*

~~IEC 60086-4:2000, *Primary batteries – Part 4: Safety of lithium batteries*~~

~~IEC 60112:2003, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*~~

IEC 60127-6 (all parts), *Miniature fuses*

IEC 60167:1964, *Methods of test for the determination of the insulation resistance of solid insulating materials*

IEC 60216 (all parts), *Guide for the determination of thermal endurance properties of electrical insulating materials*

IEC 60227-2 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

~~IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*~~

~~IEC 60249-2 (all specifications), *Base materials for printed circuits – Part 2: Specifications*~~

IEC 60268-1:1985, *Sound system equipment – Part 1: General*

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

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

IEC 60335-1:2004, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60384-1:1999, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60384-14:1993, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains Amendment 1 (1995)*

IEC 60417 (all parts), *Graphical symbols for use on equipment*

IEC 60454 (all parts), *Specifications for pressure-sensitive adhesive tapes for electrical purposes*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code) Amendment 1 (1999)*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*
Amendment 1 (2000) Amendment 2 (2002)

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coatings to achieve insulation coordination of printed board assemblies*

IEC 60691:2002, *Thermal links – Requirements and application guide*

IEC 60695-2-2:1991, *Fire hazard testing – Part 2: Test methods – Section 2: Needle flame test*

IEC 60695-11-10:1999, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods Amendment 1 (2003)*

IEC 60707:1999, *Flammability of solid non-metallic materials when exposed to flame sources – List of test methods*

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

IEC 60825-1:1993, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide¹⁾* Amendment 1 (1997) Amendment 2 (2001)

IEC 60851-3:1996, *Methods of test for winding wires – Part 3: Mechanical properties*
Amendment 1 (1997)

IEC 60851-5:1996, *Methods of test for winding wires – Part 5: Electrical properties*
Amendment 1 (1997) Amendment 2 (2004)

IEC 60851-6:1996, *Methods of test for winding wires – Part 6: Thermal properties*

IEC 60884 (all parts), *Plugs and socket-outlets for household and similar purposes*

IEC 60885-1:1987, *Electrical test methods for electric cables – Part 1: Electrical tests for cables, cords and wires for voltages up to and including 450/750 V*

IEC 60906 (all parts), *IEC system of plugs and socket-outlets for household and similar purposes*

IEC 60950:1999, *Safety of information technology equipment*

IEC 60990:1999, *Methods of measurements of touch current and protective conductor current*

IEC 60998-2-2:2002, *Connecting devices for low voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units*

IEC 60999-1:1999, *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 mm² up to 35 mm² (included)*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

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

IEC 61058-1:2000, *Switches for appliances — Part 1: General requirements*

IEC/TR2 61149:1995, *Guide for safe handling and operation of mobile radio equipment*

IEC 61260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters*

IEC 61293:1994, *Marking of electrical equipment with ratings related to electrical supply — Safety requirements*

IEC 61558-1:1997, *Safety of power transformers, power supply units and similar — Part 1: General requirements and tests*¹⁾ Amendment 1 (1998)

IEC 61558-2-17:1997, *Safety of power transformers, power supply units and similar — Part 2-17: Particular requirements for transformers for switch mode power supplies*

IEC 61965:2003, *Mechanical safety of cathode ray tubes*

IEC 62151:2000, *Safety of equipment electrically connected to a telecommunication network*

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

ISO 261:1973, *ISO general purpose metric screw threads — General plan*

ISO 262:1973, *ISO general-purpose metric screw threads — Selected sizes for screws, bolts and nuts*

ISO 306:1994, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

ISO 7000:1989, *Graphical symbols for use on equipment — Index and synopsis*

ITU-T Recommendation K17:1988, *Tests on power-fed repeaters using solid-state devices in order to check the arrangements for protection from external interference*

ITU-T Recommendation K21:1996, *Resistibility of telecommunication equipment installed in customer's premises to overvoltages and overcurrents*

UL 94 , Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 101 , Leakage Current for Appliances

UL 122 , Photographic Equipment

UL 150 , Antenna Rotators

UL 224 , Extruded Insulating Tubing

UL 248-14 , Low Voltage Fuses — Part 14: Supplemental Fuses

UL 508 , Industrial Control Equipment

UL 510 , Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

¹⁾ There exists a consolidated edition 1.1 (1998) that includes edition 1.0 and its amendment 1.

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UL 746A , Polymeric Materials – Short Term Property Evaluations

UL 746B , Polymeric Materials – Long Term Property Evaluations

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

UL 746D , Polymeric Materials – Fabricated Parts

UL 796 , Printed-Wiring Boards

UL 817 , Cord Sets and Power-Supply Cords

UL 873 , Temperature-Indicating and -Regulating Equipment

UL 935 , Fluorescent-Lamp Ballasts

UL 1054 , Special-Use Switches

UL 1069 , Hospital Signaling and Nurse-Call Equipment

UL 1310 , Class 2 Power Units

UL 1414 , Capacitors and Suppressors for Radio- and Television-Type Appliances

UL 1416 , Overcurrent and Overtemperature Protectors for Radio- and Television-Type Appliances

UL 1417 , Special Fuses for Radio- and Television-Type Appliances

UL 1418 , Cathode Ray Tubes

UL 1434 , Thermistor-Type Devices

UL 1441 , Coated Electrical Sleeving

UL 1446 , Systems of Insulating Materials – General

UL 1449 , Transient Voltage Surge Suppressors

UL 1577 , Optical Isolators

UL 1598 , High Intensity Discharge Lighting Fixtures

UL 1950 , Information Technology Equipment

UL 2054 , Household and Commercial Batteries

UL 2089 , Vehicle Battery Adapters

UL 2111 , Overheating Protection for Motors

UL 2601-1 , Medical Electrical Equipment, Part 1: General Requirements for Safety

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UL 8730-2-9 , Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls

UL 60691 , Thermal-Links – Requirements and Application Guide

UL 60730-2-9 , Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls

UL 60950 , Safety of Information Technology Equipment

UL 61058-1 , Switches for Appliances

UL 61965 , Mechanical Safety for Cathode Ray Tubes

UL Subject 2353 , Special Transformer Winding Wire

2 Definitions

For the purpose of this International Standard, the following definitions apply.

2.1 DU Definitions in alphabetical order

	Subclause
ACCESSIBLE	2.8.3
<u>ACCESSORY</u>	<u>2.8.13</u>
AUDIO AMPLIFIER	2.2.1
AVAILABLE POWER	2.3.7
BASIC INSULATION	2.6.3
BY HAND	2.8.4
CLASS I	2.6.1
CLASS II	2.6.2
CLEARANCE	2.6.11
<u>COMMERCIAL APPARATUS</u>	<u>2.2.12</u>
CONDUCTIVELY CONNECTED TO THE MAINS	2.4.4
CONDUCTIVE PATTERN	2.7.13
CREEPAGE DISTANCE	2.6.12
DIRECTLY CONNECTED TO THE MAINS	2.4.3
DOUBLE INSULATION	2.6.4
ELECTRONIC MUSICAL INSTRUMENT	2.2.2
FIRE ENCLOSURE	2.8.10
<u>FUNCTIONAL INSULATION</u>	<u>2.6.13</u>
HAZARDOUS LIVE	2.6.10
IMAGERY	2.2.8
INSTRUCTED PERSON	2.8.6
ISOLATING TRANSFORMER	2.7.1
LASER	2.2.7
LASER SYSTEM	2.2.6
LOAD TRANSDUCER	2.5.4
MAINS	2.4.1
MAINS SWITCH	2.7.11
<u>MAJOR ENCLOSURE PART</u>	<u>2.8.12</u>
MANUALLY OPERATED MECHANICAL SWITCH	2.7.10
MICRO-DISCONNECTION	2.7.7
NOISE SIGNAL	2.5.2
NON-CLIPPED OUTPUT POWER	2.3.4

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OPERATING VOLTAGE	2.3.2
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POTENTIAL IGNITION SOURCE	2.8.11
PRINTED BOARD	2.7.12
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PROTECTIVE EARTHING TERMINAL	2.4.6
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RATED CURRENT CONSUMPTION	2.3.6
RATED LOAD IMPEDANCE	2.3.5
RATED POWER CONSUMPTION	2.3.10
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REMOTE CONTROL	2.2.9
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REQUIRED WITHSTAND VOLTAGE	2.3.8
RIPPLE FREE	2.3.3
ROUTINE TEST	2.8.2
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SEPARATING TRANSFORMER	2.7.2
SKILLED PERSON	2.8.5
SOURCE TRANSDUCER	2.5.3
SPECIAL BATTERY	2.7.14
SPECIAL SUPPLY APPARATUS	2.2.5
STAND-BY	2.8.8
<u>STATIONARY APPARATUS</u>	<u>2.2.10.1</u>
SUPPLEMENTARY INSULATION	2.6.5
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2.2 Types of apparatus

2.2.1

AUDIO AMPLIFIER

either an independent audio signal amplifying apparatus or the audio signal amplifying part of an apparatus to which this standard applies

2.2.2

ELECTRONIC MUSICAL INSTRUMENT

electronic apparatus such as an electronic organ, electronic piano or music synthesiser that produces music under the control of the USER

2.2.3

SUPPLY APPARATUS

apparatus which takes power from the MAINS and from which one or more other apparatus are fed

2.2.4

SUPPLY APPARATUS FOR GENERAL USE

SUPPLY APPARATUS which can be used without special measures not only for the supply of apparatus within the scope of this standard, but also for the supply of other appliances or devices, for example pocket-calculators

2.2.5

SPECIAL SUPPLY APPARATUS

SUPPLY APPARATUS which is designed to be used only for the supply of specified apparatus within the scope of this standard

2.2.6

LASER SYSTEM

LASER in combination with an appropriate laser energy source with or without additional incorporated components (see 3.44 of IEC 60825-1)

2.2.7

LASER

device which can be made to produce or amplify electromagnetic radiation in the wavelength range from 180 nm to 1 mm primarily by the process of controlled stimulated emission (see 3.36 of IEC 60825-1)

NOTE Devices to which this definition does not apply are Light Emitting Diodes (LEDs) used for displays, infrared remote controls, infrared audio/visual signal transmission and optocouplers.

2.2.8

IMAGERY

processing, editing, manipulation and/or storing of video signals

2.2.9

REMOTE CONTROL

controlling of an apparatus from a distance, for example mechanically, electrically, acoustically or by means of radiation

2.2.10 DU

PORTABLE APPARATUS

specific apparatus designed to be carried easily, the mass of which does not exceed 18 kg a product that complies with one or more of the following:

- it is provided with a carrying handle or similar carrying means and has a mass less than or equal to 18 kilograms. For the purpose of this definition, rackmounted product handles are not considered to be carrying handles.
- it has no carrying handles or other similar carrying means and has a mass less than or equal to 1 kilogram when weighed without batteries and is likely to be moved frequently.
- any product that might be held in one hand during any phase of normal operation regardless of mass.

Lightweight products such as preamplifiers, tuners, tape decks, decoders, or noise reduction units that depend upon connection to other products to be functional and by virtue of this are not frequently moved from one location to another are not considered to be portable.

2.2.10.1 DU

STATIONARY APPARATUS

a cord and plug connected apparatus that is intended to be fastened in place or located in a dedicated space

2.4.14 relocated as 2.2.10.1 November 18, 2005

2.2.11

TRANSPORTABLE APPARATUS

apparatus, the mass of which exceeds 18 kg, specifically designed to be moved frequently from place to place

NOTE Examples of TRANSPORTABLE APPARATUS are musical instruments and their associated amplifiers.

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2.2.12 DU

~~PROFESSIONAL APPARATUS~~ COMMERCIAL APPARATUS

apparatus for use in trades, professions or industries and which is not intended for sale to the general public

NOTE The designation should be specified by the manufacturer.

2.2.13 DU

PROFESSIONAL APPARATUS

video and audio apparatus operated and maintained by trained personnel under the conditions of controlled access

2.3 Ratings and electrical values

2.3.1

RATED SUPPLY VOLTAGE

supply voltage or voltage range (for three-phase supply, the line-to-line voltage) for which the manufacturer has designed the apparatus

2.3.2

OPERATING VOLTAGE

highest voltage, non-repetitive transients being disregarded, to which the insulation under consideration is, or can be subjected when the apparatus is operating at its RATED SUPPLY VOLTAGE under normal operating conditions

2.3.3

RIPPLE FREE

d.c. voltage with a r.m.s. value of a ripple content of not more than 10 % of the d.c. component. The maximum peak voltage does not exceed 140 V for a nominal 120 V ripple free d.c. system, and does not exceed 70 V for a nominal 60 V ripple free d.c. system

2.3.4

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.

In cases where an amplifier is not intended for operation at 1 000 Hz, a test frequency at the peak response shall be used

2.3.5

RATED LOAD IMPEDANCE

resistance, specified by the manufacturer, by which an output circuit should be terminated

2.3.6

RATED CURRENT CONSUMPTION

current consumption of an apparatus operating at its RATED SUPPLY VOLTAGE under normal operating conditions

2.3.7

AVAILABLE POWER

maximum power which can be drawn from the supplying circuit through a resistive load whose value is chosen to maximise the power for more than 2 min when the circuit supplied is disconnected (see figure 1)

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2.3.8

REQUIRED WITHSTAND VOLTAGE

peak voltage that the insulation under consideration is required to withstand

2.3.9

TELECOMMUNICATION NETWORK TRANSIENT VOLTAGE

highest peak voltage expected at the TELECOMMUNICATION NETWORK connection point of the apparatus, arising from external transients on the network

2.3.10

RATED POWER CONSUMPTION

power in watts consumed in an apparatus operating at its RATED SUPPLY VOLTAGE under normal operating conditions

2.4 Supply and external connections**2.4.1**

MAINS

power source with a nominal voltage of more than 35 V (peak) a.c or d.c. which is not used solely to supply apparatus specified in 1.1.1

2.4.2

PERMANENTLY CONNECTED APPARATUS

apparatus which is intended for connection to the MAINS by a connection which cannot be loosened BY HAND

2.4.3

DIRECTLY CONNECTED TO THE MAINS

electrical connection with the MAINS in such a way that a connection to either pole of the MAINS causes in that connection a permanent current equal to or greater than 9 A, protective devices in the apparatus being not short-circuited

NOTE A current of 9 A is chosen as the minimum breaking current of a 6 A fuse.

2.4.4

CONDUCTIVELY CONNECTED TO THE MAINS

electrical connection with the MAINS in such a way that a connection through a resistance of 2 000 Ω to either pole of the MAINS causes in that resistance a permanent current greater than 0,7 mA (peak), the apparatus not being connected to earth

2.4.5

TERMINAL

part of an apparatus by which connection is made to external conductors or other apparatus. It may contain several contacts

2.4.6

PROTECTIVE EARTHING TERMINAL

TERMINAL to which parts are connected which are required to be connected to earth for safety reasons

2.4.7

TELECOMMUNICATION NETWORK

metallically-terminated transmission medium intended for communication between apparatus that may be located in separate buildings, excluding

- the MAINS systems for supply, transmission and distribution of electrical power, if used as a telecommunication transmission medium;
- television distribution systems using cable

NOTE 1 The term TELECOMMUNICATION NETWORK is defined in terms of its functionality, not its electrical characteristics. A TELECOMMUNICATION NETWORK is not itself defined as being a TNV CIRCUIT. Only the circuits in apparatus are so classified.

NOTE 2 A TELECOMMUNICATION NETWORK may be

- publicly or privately owned;
- subject to transient overvoltages due to atmospheric discharges and faults in power distribution systems;
- subject to permanent longitudinal (common mode) voltages induced from nearby power lines or electric traction lines.

NOTE 3 Examples of TELECOMMUNICATION NETWORKS are:

- a public switched telephone network;
- a public data network;
- an ISDN network;
- a private network with electrical interface characteristics similar to the above.

2.4.8

REMOTE POWER FEEDING

supply of power to apparatus via a cable network, for example a TELECOMMUNICATION NETWORK or a cable distribution network for antenna signals

2.4.9

TNV CIRCUIT

circuit which is in the apparatus and to which the ACCESSIBLE area of contact is limited (except for a TNV-0 CIRCUIT) and that is so designed and protected that, under normal operating and fault conditions, the voltages do not exceed specified limiting values

A TNV CIRCUIT is considered to be a circuit which is not CONDUCTIVELY CONNECTED TO THE MAINS.

NOTE 1 The specified limiting values of voltages under normal operating and fault conditions are given in annex B. For requirements regarding accessibility of TNV CIRCUITS, see 4.2.2 of IEC 62151.

TNV CIRCUITS are classified as TNV-0, TNV-1, TNV-2 and TNV-3 CIRCUITS as defined in 2.4.10, 2.4.11, 2.4.12, and 2.4.13 respectively.

NOTE 2 The voltage relationships between TNV CIRCUITS are shown in the table below.

Table 1 – Voltage ranges of TNV circuits

Overvoltages from TELECOMMUNICATION NETWORKS possible?	Voltage ranges	
	Within TNV-0 CIRCUIT limits	Exceeding TNV-0 CIRCUIT limits but within TNV CIRCUIT limits
Yes	TNV-1 CIRCUIT	TNV-3 CIRCUIT
No	TNV-0 CIRCUIT	TNV-2 CIRCUIT

2.4.10

TNV-0 CIRCUIT

TNV CIRCUIT:

whose voltages do not exceed a safe value under normal operating conditions and under fault conditions; and

which is not subject to overvoltages from TELECOMMUNICATION NETWORKS

NOTE The limiting values of voltages under normal operating and fault conditions are specified in 9.1.1.1 a) and 11.1 respectively.

2.4.11

TNV-1 CIRCUIT

TNV CIRCUIT:

whose voltages do not exceed the limits for a TNV-0 CIRCUIT under normal operating conditions; and

on which overvoltages from TELECOMMUNICATION NETWORKS are possible

2.4.12

TNV-2 CIRCUIT

TNV CIRCUIT:

whose voltages exceed the limits for a TNV-0 CIRCUIT under normal operating conditions; and

which is not subject to overvoltages from TELECOMMUNICATION NETWORKS

2.4.13

TNV-3 CIRCUIT

TNV CIRCUIT:

whose voltages exceed the limits for a TNV-0 CIRCUIT under normal operating conditions; and

on which overvoltages from TELECOMMUNICATION NETWORKS are possible

2.4.14 Relocated as 2.2.10.1 November 18, 2005

2.5 Signals, sources, loads

2.5.1

PINK NOISE

NOISE SIGNAL whose energy per unit bandwidth ($\Delta W/\Delta f$) is inversely proportional to frequency

2.5.2

NOISE SIGNAL

stationary random signal having normal probability distribution of instantaneous values. Unless otherwise stated, the mean value is zero

2.5.3

SOURCE TRANSDUCER

apparatus intended to convert the energy of a non electrical signal to electrical energy

NOTE Examples are microphone, image sensor, magnetic reproducing head, laser pick-up.

2.5.4

LOAD TRANSDUCER

apparatus intended to convert the energy of an electrical signal into another form of energy

NOTE Examples are loudspeaker, picture tube, liquid crystal display, magnetic recording head.

2.6 Protection against electric shock, insulations

2.6.1

CLASS I

design in which protection against electric shock does not rely on BASIC INSULATION only, but which includes an additional safety precaution in such a way that means are provided for the connection of ACCESSIBLE conductive parts to the protective (earthing) conductor in the fixed wiring of the installation, in such a way that ACCESSIBLE conductive parts cannot become HAZARDOUS LIVE in the event of a failure of the BASIC INSULATION

NOTE Such a design may have parts of CLASS II.

2.6.2

CLASS II

design in which protection against electric shock does not rely on BASIC INSULATION only, but in which additional safety precautions, such as DOUBLE INSULATION OR REINFORCED INSULATION, are provided, there being no provision for protective earthing or reliance upon installation conditions

2.6.3

BASIC INSULATION

insulation applied to HAZARDOUS LIVE parts to provide basic protection against electric shock

NOTE BASIC INSULATION does not necessarily include insulation used exclusively for functional purposes.

2.6.4

DOUBLE INSULATION

insulation comprising both BASIC INSULATION and SUPPLEMENTARY INSULATION

2.6.5

SUPPLEMENTARY INSULATION

independent insulation applied in addition to BASIC INSULATION in order to reduce the risk of electric shock in the event of a failure of the BASIC INSULATION

2.6.6

REINFORCED INSULATION

single insulation applied to HAZARDOUS LIVE parts which provides a degree of protection against electric shock equivalent to DOUBLE INSULATION

NOTE REINFORCED INSULATION may comprise several layers which cannot be tested singly as BASIC INSULATION OR SUPPLEMENTARY INSULATION.

2.6.7

PROTECTIVE SEPARATION

separation between circuits by means of basic and supplementary protection (BASIC INSULATION plus SUPPLEMENTARY INSULATION or plus PROTECTIVE SCREENING) or by an equivalent protective provision, for example REINFORCED INSULATION

2.6.8

PROTECTIVE SCREENING

separation from HAZARDOUS LIVE parts by means of an interposed conductive screen, connected to the PROTECTIVE EARTHING TERMINAL

2.6.9

TOUCH CURRENT

electric current through a human body when it touches one or more ACCESSIBLE parts [IEV 195-05-21, modified]

2.6.10

HAZARDOUS LIVE

electrical condition of an object from which a hazardous TOUCH CURRENT (electric shock) could be drawn (see 9.1.1)

2.6.11

CLEARANCE

shortest distance in air between two conductive parts

2.6.12

CREEPAGE DISTANCE

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

2.6.13 DU

FUNCTIONAL INSULATION

functional insulation is insulation that is not relied upon as BASIC, SUPPLEMENTARY, DOUBLE, OR REINFORCED INSULATION

2.7 Components

2.7.1

ISOLATING TRANSFORMER

transformer with PROTECTIVE SEPARATION between the input and output windings

2.7.2

SEPARATING TRANSFORMER

transformer, the input windings of which are separated from the output windings by at least BASIC INSULATION

NOTE Such transformers may have parts meeting the requirements of ISOLATING TRANSFORMERS.

2.7.3

THERMAL RELEASE

device which prevents the maintenance of excessively high temperatures in certain parts of the apparatus by disconnecting these parts from their supply

NOTE PTC THERMISTORS (see 2.7.8) are not THERMAL RELEASES in the sense of this definition.

2.7.4

THERMAL CUT-OUT

THERMAL RELEASE with reset which has no provision for temperature setting by the USER

NOTE A THERMAL CUT-OUT may be of the automatic or of the manual reset type.

2.7.5

THERMAL LINK

THERMAL RELEASE without reset, which operates only once and then requires partial or complete replacement

2.7.6

TRIP-FREE

automatic action, with a reset actuating member, so designed that the automatic action is independent of manipulation or position of the reset mechanism

2.7.7

MICRO-DISCONNECTION

adequate contact separation so as to ensure functional security

NOTE There is a requirement for the dielectric strength of the contact gap but no dimensional requirement.

2.7.8

PTC THERMISTOR

thermally sensitive semiconductor resistor, which shows a step-like increase in its resistance when the increasing temperature reaches a specific value. The change of temperature is obtained either by the flow of current through the thermosensitive element, or by a change in the ambient temperature, or by a combination of both

2.7.9

SAFETY INTERLOCK

means either of preventing access to a hazardous area until the hazard is removed or of automatically removing the hazardous condition when access is gained

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2.7.10

MANUALLY OPERATED MECHANICAL SWITCH

device operated BY HAND, not incorporating semiconductors, and situated anywhere in the circuit of the apparatus, which can interrupt the intended function, such as sound and/or vision, by moving contacts

NOTE Examples of MANUALLY OPERATED MECHANICAL SWITCHES are single-pole or all-pole MAINS SWITCHES, functional switches and switching systems which, for example, can be a combination of relays and switches controlling the relays.

2.7.11

MAINS SWITCH

MANUALLY OPERATED MECHANICAL SWITCH which interrupts either one pole or all poles of the MAINS, except the protective earthing conductor

2.7.12

PRINTED BOARD

base material cut to size, containing all needed holes and bearing at least one CONDUCTIVE PATTERN

2.7.13

CONDUCTIVE PATTERN

configuration formed by electrically conductive material of a PRINTED BOARD

2.7.14

SPECIAL BATTERY

rechargeable battery or group of rechargeable batteries, identified by battery manufacturer's name and catalogue number, provided with the apparatus or recommended by the manufacturer

2.8 Miscellaneous**2.8.1**

TYPE TEST

test of one or more specimens made on a certain design to show that the design meets all requirements of this standard

2.8.2

ROUTINE TEST

test to which each specimen is subjected during or after manufacture to ascertain whether it complies with certain criteria

2.8.3 DU

ACCESSIBLE

possibility of touching by the test finger according to IEC 61032, test probe B the articulated finger probe as shown in figure 18.

NOTE Any ACCESSIBLE area of a non-conductive part is considered as being covered with a conductive layer (see figure 3 as an example).

2.8.3 revised November 18, 2005

2.8.4

BY HAND

operation that does not require the use of any object such as a tool, coin, etc.

2.8.5

SKILLED PERSON

person with relevant education and experience to enable him or her to avoid dangers and to prevent risks which electricity may create

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2.8.6

INSTRUCTED PERSON

person adequately advised or supervised by SKILLED PERSONS to enable him or her to avoid dangers and to prevent risks which electricity may create

2.8.7

USER

any person, other than a SKILLED PERSON or an INSTRUCTED PERSON, who may come into contact with the apparatus

2.8.8

STAND-BY

operating condition where the main functions, such as sound and/or vision, are switched-off and where the apparatus is only partly in operation. In this condition, permanent functions, such as a clock, are maintained and it allows the apparatus to be brought into full operation, for example by REMOTE CONTROL or automatically

2.8.9

WOOD-BASED MATERIAL

material in which the main ingredient is machined natural wood, coupled with a binder

NOTE Examples of WOOD-BASED MATERIAL are materials incorporating ground or chipped wood, such as hard fibre board or chip board.

2.8.10

FIRE ENCLOSURE

part of the apparatus intended to minimize the spread of fire or flames from within

2.8.11

POTENTIAL IGNITION SOURCE

possible fault which can start a fire if the open-circuit voltage measured across an interruption or faulty contact exceeds a value of 50 V (peak) a.c. or d.c. and the product of the peak value of this voltage and the measured r.m.s. current under normal operating conditions exceeds 15 VA.

Such a faulty contact or interruption in an electrical connection includes those which may occur in CONDUCTIVE PATTERNS ON PRINTED BOARDS

NOTE An electronic protection circuit may be used to prevent such a fault from becoming a POTENTIAL IGNITION SOURCE.

2.8.12 DU

MAJOR ENCLOSURE PART

a part that forms more than 50 % of the area of any surface of an enclosure that is required to comply with the requirements to reduce the risk of fire, electric shock, or injury to persons

2.8.13 DU

ACCESSORY

a part intended for use with an apparatus when it is packed with the apparatus, when it is referenced by the manufacturer's name and catalog number in an apparatus marking, or when the apparatus manufacturer's literature indicates or implies use of the accessory by manufacturer's name and catalog number with the apparatus

3 General requirements

3.1 The apparatus shall be so designed and constructed as to present no danger when used for its intended purpose, either in normal operating conditions or under fault conditions, particularly providing protection against

- hazardous currents passing through the human body (electric shock);
- excessive temperatures;
- hazardous radiations;
- effects of implosion and explosion;
- mechanical instability;
- injury by mechanical parts;
- start and spread of fire.

In general, compliance is checked under normal operating conditions and under fault conditions, as specified in 4.2 and 4.3, by carrying out all the relevant tests specified.

3.2 Apparatus designed to be fed from the MAINS shall be constructed according to the requirements of CLASS I, or CLASS II apparatus.

4 General test conditions

4.1 Conduct of tests

4.1.1 DE Tests according to this standard are TYPE TESTS.

NOTE — For ROUTINE TEST, recommendations are given in annex N.