UL 6500

STANDARD FOR SAFETY

Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use

UL Standard for Safety for Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use, UL 6500

Second Edition, Dated September 30, 1999

Summary of Topics

This revision of UL 6500 is being issued to revise the requirements for button cell batteries to clarify that the construction requirement applies to the entire battery compartment door/cover.

UL 6500 is an adoption of IEC 60065, Safety of Audio, video and similar electronic apparatus – Safety Requirements (Sixth Edition, issued July 1998).

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. 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 new and/or revised requirements are substantially in accordance with Proposal(s) on this subject dated May 3, 2013.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

The following table lists the future effective dates with the corresponding reference.

Future Effective Date	Reference
May 9, 2014	Annex T

SEPTEMBER 30, 1999
(Title Page Reprinted: July 24, 2013)

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UL 6500

Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use

First Edition – May, 1996

Second Edition

September 30, 1999

This UL Standard for Safety consists of the Second Edition including revisions through July 24, 2013.

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.

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UL PREFACE

This UL Standard is based on IEC Publication 60065: sixth edition, Safety of Audio, video and similar electronic apparatus – Safety Requirements. IEC publication 60065 is copyrighted by the IEC.

The text, figures and tables of IEC Publication Safety of Audio, video and similar electronic apparatus – Safety Requirements, 60065, copyright 1998, are used in this Standard with the consent of the IEC and the American National Standards Institute (ANSI). The IEC copyrighted material has been reproduced with permission from ANSI. ANSI should be contacted regarding the reproduction of any portion of the IEC material. The IEC Foreword and Introduction are not part of the requirements of the Standard but are included for information purposes only. Copies of IEC Publication 60065 may be purchased from ANSI, 11 West 42nd Street, New York, New York, 10036, (212) 642-4900.

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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DEVIATIONS

GENERAL

Deviations from the text of International Electrotechnical Commission (IEC) Publication 60065, Audio, video and similar electronic apparatus – Safety Requirements, copyright 1998 are indicated by notations next to the clause, sub-clause, Table, Figure or Annex number.

There are basically four types of deviations:

DR – Deviations based on the National Electrical Code (NEC) and other U.S. Regulatory Requirements.

DU – Deviations based on Basic Safety Principles and safety practices: These are deviations which are either 1) based on basic safety principles and requirements, elimination of which would compromise safety for U.S. consumers, or 2) deviations for IEC requirements that may be acceptable, but adopting the IEC requirements would require considerable retesting or redesign on the manufacturer's part.

DC – Deviations based on component standards: These are deviations based on the component standards and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – Deviations based on absolute statements or editorial corrections.

Deviations have been incorporated into the body of the standard. If deviations 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 deviations has been <u>underlined</u>. 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 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 sixth edition cancels and replaces the fifth edition published in 1985, its amendments 1 (1987), 2 (1989) and 3 (1992). 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
92/60/FDIS	92/61/RVD

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

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.

Annexes A, B, C, D, E, F and G form an integral part of this standard.

Annexes N and P are for information only.

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

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

Cause	Prevention
Contact with parts normally at hazardous voltage	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 protective earth 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 Standard applies to electronic apparatus designed to be fed from the MAINS or from a SUPPLY APPARATUS 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 concerns only safety aspects of the above apparatus; it does not concern other matters, such as style or performance.

For above-mentioned apparatus, which are fed from a supply source other than the MAINS or from a SUPPLY APPARATUS, and which contain a LASER SYSTEM or produce an internal OPERATING VOLTAGE greater than 4000 V (peak), this standard applies as far as applicable.

NOTE 1 – In Australia, Canada, Denmark, Japan, Rumania, South Africa, United States of America and United Kingdom this standard is, where relevant, used as a guide for the testing of battery operated apparatus.

This standard applies to the above-mentioned apparatus, if it is 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;

– video cameras and video monitors;

– household video games and flipper games;

NOTE 2 – Video and flipper games for commercial use are covered by ~~IEC 60335-2-82 [7]~~* UL 22

– juke boxes;

*Figures in square brackets refer to the bibliography given in annex P.

– household electronic gaming and scoring machines;

NOTE 3 – Electronic gaming and scoring machines for commercial use are covered by ~~IEC 60335-2-82 [7]~~ UL 22

– teletext equipment;

– record and optical disc players;

– tape and optical disc recorders;

– antenna signal converters and amplifiers;

– satellite receiver antenna positioners;

– Citizen's Band apparatus;

– apparatus for IMAGERY;

– light effect apparatus;

– intercommunication apparatus, using low voltage MAINS as the transmission medium.

– video apparatus intended for entertainment purposes in health-care facilities;

– cellular phones, wireless modems, and similar transceiving devices;

– audio or video apparatus that are used with a battery supply.

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

Any undated reference to a code or a standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

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 2000 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 2000 m above sea level, additional requirements may be necessary.

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 This standard does not apply to the following apparatus, except where this standard is referenced in the relevant standard:

– apparatus falling within the scope of IEC 60950,

– dictation apparatus,

– projectors not mentioned in 1.1.1, for example film projectors, slide projectors, overhead projectors, epidiascopes. (See IEC 60335-2-56 [6].)

1.1.6 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.

1.1.6 revised August 15, 2001

1.2 DC Normative references

1.2 revised October 25, 2006

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and 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. Members of IEC and ISO maintain registers of currently valid International Standards.

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

IEC 60038:1983, *IEC standard voltages*

IEC 60068-2-3:1969, *Environmental testing – Part 2: Tests – Test Ca: Damp heat, steady state*

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 1)*

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

~~IEC 60085:1984, *Thermal evaluation and classification of electrical insulation*~~

IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

IEC 60127 (all parts), *Miniature fuses*

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

IEC 60227 (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 60335-1:1991, *Safety of household and similar electrical appliances – Part 1: General requirements*

IEC 60384-1:1982, *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, Index, survey and compilation of single sheets*

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

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

IEC 60536:1976, *Classification of electrical and electronic equipment with regard to protection against electric shock*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:1992, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coatings to achieve insulation coordination of printed board assemblies*

~~IEC 60691:1993, *Thermal-links– Requirements and application guide*~~

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

IEC 60707:1981, *Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source*

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

IEC 60738 (all parts), *Directly heated positive step-function temperature coefficient thermistors*

~~IEC 60825-1:1993, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide*~~

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 60950:1991, *Safety of information technology equipment*
~~IEC 60990:1990, *Methods of measurements of touch-current and protective conductor current*~~

IEC 60998-2-2:1991, *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 60999:1990, *Connecting devices – Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors*

IEC 61032:1990, *Test probes to verify protection by enclosures*

~~IEC 61058-1:1996, *Switches for appliances – Part 1: General requirements*~~

IEC 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*

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*

UL 50, *Enclosures for Electrical Equipment*

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

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*

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 1020, *Thermal Cutoffs for Use in Electrical Appliances and Components*

UL 1054, *Special-Use Switches*

UL 1310, *Class 2 Power Units*

UL 1414, *Across-The-Line, Antenna-Coupling, and Line-By-Pass Capacitors 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 1434 , *Thermistor-Type Devices*

UL 1441 , *Coated Electrical Sleeving*

UL 1446 , *Systems of Insulating Materials – General*

UL 1577 , *Optical Isolators*

UL 1598 , *Luminaires*

UL 1950 Third Edition , *Information Technology Equipment*

UL 2111 , *Overheating Protection for Motors*

UL 60601-1 , *Medical Electrical Equipment, Part 1: General Requirements for Safety*

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*

2 Definitions

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

2.1 DU Definitions in alphabetical order

No Text on This Page

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 synthesizer that produces music under the control of the player

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)

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

PORTABLE APPARATUS

specific apparatus designed to be carried easily BY HAND, the mass of which does not exceed 18 kg

2.2.11

TRANSPORTABLE APPARATUS

apparatus specifically designed to be moved frequently from place to place

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 1000 Hz at the onset of clipping on either one, or both peaks

In cases where an amplifier is not intended for operation at 1000 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 maximize the power for more than 2 min when the circuit supplied is disconnected (see figure 1)

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 2000 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 EARTH TERMINAL

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

2.4.7

TELECOMMUNICATION NETWORK

metallically-terminated circuit intended to carry TELECOMMUNICATION SIGNALS for voice, data or other communication. Such networks may be publicly or privately owned. They may be subjected to overvoltages due to atmospheric discharges and power line failures

NOTE – It is assumed that adequate measures according to ITU-T Recommendation K.11 have been taken to reduce the risk that over-voltages presented to apparatus exceed 1.5 kV (peak).

Excluded are:

– MAINS systems for supply, transmission and distribution of electrical power, used as telecommunication transmission medium;

– TV distribution systems using cable;

– public or private mobile radio systems;

– radio paging systems.

2.4.8 DU

STATIONARY APPARATUS

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

2.4.8 revised June 23, 2000

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 nonelectrical signal to electrical energy

NOTE – Examples are microphone, image sensor, magnetic reproducing head, laser-pickup.

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 (see 3.2 of IEC 60536)

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 (see 3.3 of IEC 60536)

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 (see 2.3 of IEC 60536)

2.6.5

SUPPLEMENTARY INSULATION

independent insulation applied in addition to BASIC INSULATION in order to provide protection against electric shock in the event of a failure of the BASIC INSULATION (see 2.2 of IEC 60536)

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 (see 2.9 of IEC 60536-2)

2.6.8

PROTECTIVE SCREENING

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

2.6.9

TOUCH CURRENT

current which passes through the human body when it touches one or more ACCESSIBLE parts of an apparatus under normal operating or fault conditions

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

2.7 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-S 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-S 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

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

ALL-POLE MAINS SWITCH

MANUALLY OPERATED MECHANICAL SWITCH which interrupts all poles of the MAINS supply except the protective earth 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.

2.8 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 with web stop as shown in figure 14.

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

2.8.4

BY HAND

operation 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

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 can 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

a possible fault such as a faulty contact or interruption in an electrical connection, including a CONDUCTIVE PATTERN on PRINTED BOARDS, which can start a fire if, under normal operating conditions, the open circuit voltage exceeds 50 V (peak) a.c. or d.c. and the product of this open circuit voltage and the measured current through this possible fault exceeds 15 VA

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.

NOTE – Australia has special requirements with respect to d.c. components in the equipment neutral conductor.

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 *Tests according to this standard are* TYPE TESTS.

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

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4.1.2 *The sample or samples under test shall be representative of the apparatus the USER would receive, or shall be the actual equipment ready for shipment to the USER.*

As an alternative to carrying out tests on the complete apparatus, tests may be carried out separately on circuits, components or sub-assemblies outside the apparatus, provided that inspection of the apparatus and circuit arrangements ensures that such testing will indicate that the assembled apparatus would conform to the requirements of this standard.

If any such test indicates a likelihood of non-compliance in the complete apparatus, the test shall be repeated in the apparatus.

If a test specified in this standard could be destructive, it is permitted to use a physical model to represent the condition to be evaluated.

NOTE 1 – The tests should be carried out in the following order:

- component or material pre-selection;
- component or sub-assembly bench tests;
- tests where the apparatus is not energized;
- live tests:
  - under normal operating conditions,
  - under abnormal operating conditions,
  - involving likely destruction.

NOTE 2 – In view of the amount of resources involved in testing and in order to minimize waste, it is recommended that all parties concerned jointly consider the test programme, the test samples and the test sequence.

4.1.3 *Unless otherwise specified, the tests are carried out under normal operating conditions at:*

- *an ambient temperature between 15°C and 35°C, and*
- *a relative humidity of 75% maximum.*

4.1.4 *Any position of intended use of the apparatus, normal ventilation not being impeded.*

The temperature measurements shall be carried out with the apparatus positioned in accordance with the instructions for use provided by the manufacturer, or, in the absence of instructions, the apparatus shall be positioned 5 cm behind the front edge of an open-fronted wooden test box with, 1 cm free space along the sides and top, and 5 cm depth behind the apparatus.

Tests on apparatus, intended to be part of an assembly not provided by the apparatus manufacturer, shall be carried out according to the instructions for use provided by the manufacturer, specifically those dealing with the proper ventilation of the apparatus.

4.1.5 *The characteristics of the supply source, except those specified in 4.2.1, used during the tests shall not appreciably influence the test results.*

Examples of such characteristics are source impedance and waveform.

4.1.6 *Where relevant, a standard signal consisting of* PINK NOISE*, band-limited by a filter whose response conforms to that given in C.1 in annex C.*

NOTE – If appropriate, the standard signal may be used to modulate a carrier wave.

The output measuring equipment shall indicate true r.m.s. values for crest factors up to at least 3, and the frequency response shall conform to that shown in annex C.

4.1.7 *The a.c. values given in this standard are r.m.s. values, unless specified otherwise.*

The d.c. values given in this standard are RIPPLE FREE *values.*

4.2 Normal operating conditions

Normal operating conditions are the most unfavourable combination of the following conditions.

4.2.1 DU *The apparatus is connected to a supply voltage of 0.9 times or ~~1.06~~ 1.1 times of any* RATED SUPPLY VOLTAGE *for which the apparatus is designed.*

In case of doubt, tests may also be performed at the value of any RATED SUPPLY VOLTAGE*.*

For apparatus having a RATED SUPPLY VOLTAGE *range not requiring the adjustment of a voltage setting device, the apparatus is connected to a supply voltage of 0.9 times the lower limit or ~~1.06~~ 1.1 times the upper limit of any* RATED SUPPLY VOLTAGE *range; moreover, the apparatus is connected to any nominal supply voltage within the* RATED SUPPLY VOLTAGE *range marked on the apparatus.*

Any rated supply frequency marked on the apparatus is used.

For a.c./d.c. apparatus, an a.c. or d.c. supply is used.

For d.c. supply any polarity is used, unless this is prevented by the construction of the apparatus.

NOTE – In the U.S. the RATED SUPPLY VOLTAGE for single phase apparatus is assumed to be 120 V or 120/240 V.

4.2.2 *Any position of controls which are* ACCESSIBLE *to the* USER *for adjustment* BY HAND*, including* REMOTE CONTROLS*, excluding voltage setting devices complying with 14.8 and volume controls and tone controls.*

Any cable connected REMOTE CONTROL *device, detachable by a connector or a similar device, is connected or not.*

A cover, enclosing a LASER SYSTEM*, which can be opened* BY HAND*, is opened fully, opened partly or closed.*

4.2.3 *In the case of single-phase supply any earth* TERMINAL *and any* PROTECTIVE EARTH TERMINAL *may be connected to either pole of the isolated supply source used during the test.*

In the case of a supply other than single phase any earth TERMINAL *and any* PROTECTIVE EARTH TERMINAL *may be connected to the neutral or to any phase of the isolated supply source used during the test.*

4.2.4 DU *In addition, for an AUDIO AMPLIFIER:*

a) The apparatus is operated in such a way as to deliver one-eighth of the NON-CLIPPED OUTPUT POWER but not less than 0.5 W per channel to the RATED LOAD IMPEDANCE using the standard signal described in 4.1.6 with the tone controls set to their mid position.

Where the NON-CLIPPED OUTPUT POWER cannot be obtained using the standard signal, one-eighth of the maximum attainable output but not less than 0.5 W per channel is taken. As an alternative, where the amplifier function is not adversely affected, a sine wave of 1 kHz or where applicable, another frequency corresponding to the geometric mean of the upper and lower -3dB response points of the relative part of the apparatus may be used to supply each channel. If the result of a measurement performed with the sine wave does not comply with this standard, the measurement with pink noise is decisive.

If the maximum NON-CLIPPED OUTPUT POWER is less than 0.5 W, the apparatus is to be operated at the maximum NON-CLIPPED OUTPUT POWER.

When a redundant protection circuit, THERMAL CUT-OUT with automatic reset, or PTC-S THERMISTOR operates while the apparatus is delivering one-eighth of the NON-CLIPPED OUTPUT POWER to the RATED LOAD IMPEDANCE, the output power is to be reduced to the maximum power that permits continuous operation of the apparatus.

When determining whether a part or output TERMINAL contact is HAZARDOUS LIVE according to 9.1.1 and 11.1, ~~at the manufacturer's option~~ the apparatus ~~may also~~ shall be operated ~~in such a way as~~ with a sinusoidal input test signal of 1 kHz or where applicable, another frequency corresponding to the geometric mean of the upper and lower -3dB response points of the relevant amplifier part of the apparatus, sufficient in amplitude for the apparatus to deliver ~~the~~ maximum NON-CLIPPED OUTPUT POWER into ~~the~~ its RATED LOAD IMPEDANCE ~~using a sinusoidal signal of 1000 Hz or another frequency corresponding to the mid-frequency of the relevant amplifier part of the apparatus.~~ Open-circuit output voltage is determined after the load is removed.

b) The most unfavourable RATED LOAD IMPEDANCE of any output circuit is connected or not.

c) Organs or similar instruments which have a tone-generator unit are operated with any combination of two bass pedal keys, if any, and ten manual keys depressed, and all stops and tabs which can increase the output power are activated.

For AUDIO AMPLIFIERS used in an ELECTRONIC MUSICAL INSTRUMENT which does not generate a continuous tone, the standard signal described in 4.1.6 is applied to the signal input TERMINAL or to the appropriate input stage of the AUDIO AMPLIFIER.

4.2.4 revised September 9, 2002

4.2.4.1 DR *The measured input power or current shall not exceed the marked input rating by more than 5% when the apparatus is operated to produce maximum power input under normal operating conditions.*

4.2.4.2 DU *An apparatus with multiple modes of operation, multiple signal input sources, or both, is to be operated using each mode of operation or signal input source separately, or in combination, according to the manufacturer's instructions to produce the maximum power input.*

4.2.5 *For apparatus incorporating motors, load conditions for the motor are chosen which may occur during intended use, including stalling* BY HAND *if this is possible.*

4.2.6 *An apparatus supplying power to other apparatus is loaded to give its rated power or not loaded.*

4.2.7 *A* SUPPLY APPARATUS *to be used inside apparatus for which it is intended exclusively, is tested within such apparatus after installation according to the manufacturer's instruction for use.*

4.2.8 *In addition for Citizen's Band apparatus, the* RATED LOAD IMPEDANCE *is connected or not to the antenna* TERMINAL *or, if applicable, a telescopic antenna extended to any length. The transmitting test conditions are specified in IEC 61149.*

4.2.9 Antenna positioners

4.2.9.1 *In addition for antenna positioners in combination with their control and* SUPPLY APPARATUS *:*

– *four consecutive movements from one endstop to the opposite endstop;*

– *15 min resting period.*

The movements and the resting period are repeated as many times as necessary for the relevant tests. For temperature measurements the movements and the resting periods are repeated until a steady state of temperature has been reached but not longer than 4 h.

After the last movement period, the 15 min resting period does not apply to the temperature measurements.

4.2.9.2 *In addition, for satellite antenna positioners consisting of a power supply and control unit without a motor drive system, the power supply unit shall be loaded in accordance with the marked output rating and operated with a duty cycle of 5 min on, and 15 min off.*

4.2.10 *Apparatus designed to be supplied exclusively by a* SPECIAL SUPPLY APPARATUS *specified by the manufacturer of the apparatus, shall be tested together with this* SPECIAL SUPPLY APPARATUS. *The supply voltage for the* SPECIAL SUPPLY APPARATUS *is determined in accordance with 4.2.1.*

Where a voltage setting device for the output voltage of the SPECIAL SUPPLY APPARATUS *is provided, it shall be adjusted to the* RATED SUPPLY VOLTAGE *of the apparatus under test.*

4.2.11 *Apparatus, which can be supplied by* SUPPLY APPARATUS FOR GENERAL USE, *shall be supplied by a test power supply according to table 1 corresponding to the* RATED SUPPLY VOLTAGE *of the apparatus under test. The values of no-load voltage given in table 1 are subject to the under- and over-voltage provisions specified in 4.2.1.*

4.2.12 *Apparatus intended to be used with optional detachable legs or stands supplied by the manufacturer of the apparatus are tested with or without legs or stands fitted.*

Table 1 DU – Test power supply

RATED SUPPLY VOLTAGE V ~~d.c~~	Nominal no-load voltage V ~~d.c~~	Internal resistance Ω
1.5	~~2.25~~ 1.60	~~0.75~~ 0.003
3.0	~~4.50~~ 3.19	~~1.50~~ 0.006
4.5	~~6.75~~ 4.79	~~2.25~~ 0.010
6.0	~~9.00~~ 6.39	~~3.00~~ 0.013
7.5	~~11.25~~ 7.98	~~3.75~~ 0.016
9.0	~~13.50~~ 9.57	~~4.50~~ 0.019
12.0	~~18.00~~ 12.77	~~6.00~~ 0.026
NOTE – Table 1 provides a standardized set of supply parameters intended to represent ~~those found in SUPPLY APPARATUS FOR GENERAL USE in the range 1.5 V to 12 V and with a rated output current of 1 A~~ a 30 A minimum supply source with 6 percent regulation. ~~Supply parameters for voltages >12 V and output currents >1 A are under consideration.~~		

4.3 Fault conditions

For operation under fault conditions, in addition to the normal operating conditions mentioned in 4.2, each of the following conditions is applied in turn and, associated with it, those other fault conditions which are a logical consequence.

NOTE 1 – The logical consequences of a fault condition are those which occur when a fault is applied

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Circuits, or parts of a circuit supplied with an open circuit voltage not exceeding 35 V (peak) a.c. or d.c. and not generating voltages above that value, are not considered to present a fire hazard if the current which may be drawn from the supplying circuit for more than 2 min at any load, including short-circuit, is limited to not more than 0.2 A. Such supplied circuits are not subject to fault conditions testing.

An example of a test circuit to measure the voltage and the current is given in figure 1.

NOTE 2 – Examination of the apparatus and all its circuit diagrams, excluding the internal circuit diagrams of integrated circuits, generally shows the fault conditions which are likely to create a hazard and which need to be applied. These are applied in sequence, in the order which is most convenient.

NOTE 3 – When carrying out the examination in note 2, the operating characteristics of integrated circuits are taken into consideration.

NOTE 4 – The fault tests are only to be made in the wooden test box mentioned in 4.1.4, if there is a possibility that this will influence the results.

When a specified fault condition test is carried out, it can cause consequential faults which either interrupt or short circuit a component. In case of doubt, the fault condition test shall be repeated up to two more times with replacement components in order to check that the same result is always obtained. Should this not be the case, the most unfavourable consequential fault, whether interruption or short circuit, shall be applied together with the specified fault condition.

4.3.1 *Short-circuit across CLEARANCES and CREEPAGE DISTANCES if they are less than the values specified in clause 13 for BASIC and SUPPLEMENTARY INSULATION.*

4.3.2 *Short-circuit across parts of insulating material, the short-circuiting of which might cause an infringement of the requirements regarding protection against electric shock hazard or overheating, with the exception of insulating parts which comply with the requirements of 10.3.*

NOTE – This subclause does not imply a need to short-circuit the insulation between turns of coils.

4.3.3 *Short-circuit, or if applicable, interruption of:*

– *heaters of electronic tubes;*

– *insulation between heaters and cathodes of electronic tubes;*

– *spacings in electronic tubes, excluding picture tubes;*

– *semiconductor devices, one lead at a time interrupted or any two leads connected together in turn (but see 4.3.4 d)).*

NOTE – If electronic tubes are so constructed that a short circuit between certain electrodes is highly improbable or even impossible, the electrodes concerned need not be short-circuited.

4.3.4 DC *Short-circuit or disconnection, whichever is more unfavourable, of resistors, capacitors, windings (for example transformers, degaussing coils), loudspeakers, optocouplers, varistors or non-linear passive components, the short-circuiting or disconnection of which might cause an infringement of the requirements regarding protection against electric shock or overheating.*

These fault conditions do not apply to:

a) resistors complying with the requirements of 14.1 and, as far as applicable, of 11.2;

b) PTC-S THERMISTORS complying with ~~IEC 60738~~ UL 1434;

c) capacitors and RC-units complying with the requirements of 14.2, provided that the voltage at their terminations does not exceed their rated voltage and that their application is in accordance with 8.5 or 8.6;

d) the insulation between the input and output terminations of optocouplers complying with the requirements of 14.11;

e) windings and the insulation of transformers and other windings mentioned in 14.3 complying with the requirements of that subclause.

4.3.5 *For apparatus containing an AUDIO AMPLIFIER, using the standard signal described in 4.1.6 so as to deliver the most unfavourable output power from zero up to the maximum attainable output power to the RATED LOAD IMPEDANCE or, if applicable, to the most unfavourable load impedance connected to the output TERMINALS including short-circuit and open circuit.*

4.3.6 **DU** *Motors are stalled if this is possible during the use of the apparatus by internal or external influences.*

Solenoids shall be tested with the plunger blocked in the de-energized (at-rest) state.

4.3.7 *Motors, relay coils or the like, intended for short-time or intermittent operation, are operated continuously if this can occur during operation of the apparatus.*

4.3.8 *The apparatus is connected simultaneously to alternative types of supply unless this is prevented by the construction.*

4.3.9 **DU** *Output TERMINALS of apparatus supplying power to other apparatus, except MAINS socket-outlets DIRECTLY CONNECTED TO THE MAINS, are connected to the most unfavourable load impedance, including short circuit.*

External MAINS socket-outlets are separately overloaded to 110% of the current rating for the socket outlet configuration.

4.3.10 *Each group of ventilation openings that are likely to be covered simultaneously, shall be covered in turn and tested separately.*

Ventilating openings that are likely to be covered simultaneously are:

– openings on top of the apparatus, for example by a newspaper; or

– openings on the sides and the back, excluding the front, for example when pushed into a hanging curtain.

4.3.11 *If it is possible to insert USER replaceable batteries with reversed polarity, the apparatus is tested with one or more batteries with both intended and reversed polarity.*

NOTE – CAUTION, there is a danger of explosion when this test is applied.

4.3.12 *For Citizen's Band apparatus, the most unfavourable load impedance including short circuit is connected to the antenna* TERMINAL *or to the antenna itself, for example a telescopic antenna, when no antenna* TERMINAL *is provided. The transmitting test conditions are specified in IEC 61149.*

4.3.13 DU *For ~~PORTABLE APPARATUS~~ apparatus to be supplied from an a.c.* MAINS *and provided with a voltage setting device to be set by the* USER*, connection to a supply voltage of 250 V a.c., with the* MAINS *voltage setting device at the most unfavourable position.*

4.3.14 *Apparatus designed to be supplied by a* SPECIAL SUPPLY APPARATUS *with a voltage setting device for the output voltage, specified by the manufacturer of the apparatus, shall be tested by adjusting this voltage setting device to any output voltage.*

During this test, 4.2.1 is applied, except that the SPECIAL SUPPLY APPARATUS *is fed by its* RATED SUPPLY VOLTAGE*.*

The test need not be made if the current consumption of the apparatus under test cannot exceed 0.2 A for more than 2 min, for example by the operation of a fuse.

4.3.15 *Apparatus which can be supplied by* SUPPLY APPARATUS FOR GENERAL USE *shall be tested by using a test power supply as specified in table 1 step by step upwards, starting with the value one step above the value specified for the* RATED SUPPLY VOLTAGE *of the apparatus under test.*

This test is not applied to apparatus having a RATED SUPPLY VOLTAGE *equal to or higher than the maximum* RATED SUPPLY VOLTAGE *in table 1.*

During this test, 4.2.1 is applied, except that the no-load voltages have their nominal values.

The test need not be made if the current consumption of the apparatus under test cannot exceed 0.2 A for more than 2 min, for example by the operation of a fuse.

4.3.16 DU *The battery-supply cord of an apparatus that is intended to be connected to an external battery is to be short-circuited at any point on the load side of the overcurrent protective device in the cord while the cord is connected to the battery supplied with the apparatus or while the cord is connected to a power supply as identified in table 1 with the output voltage equivalent to the battery voltage.*

5 Markings and instructions

Markings shall be permanent, comprehensible and easily discernible on the apparatus when ready for use.

The information should preferably be on the exterior of the apparatus, excluding the bottom. It is, however, permissible to have it in an area that is easily ACCESSIBLE BY HAND, for example under a lid, or on the exterior of the bottom of a PORTABLE APPARATUS or an apparatus with a mass not exceeding 7 kg, provided that the location of the marking is given in the instructions for use.

Compliance is checked by inspection and by rubbing the marking BY HAND *for 15 s with a piece of cloth soaked with water and, at a different place or on a second sample, for 15 s with a piece of cloth soaked with petroleum spirit. After this the marking shall be legible; it shall not be easily possible to remove marking plates and they shall show no curling.*

Petroleum spirit, to be used for reference purposes is defined as follows:

The petroleum spirit is an aliphatic solvent hexane having a maximum aromatics content of 0.1% by volume, a kauri-butanol value of 29, an initial boiling point of approximately 65°C, a dry-point of approximately 69°C and a specific mass of approximately 0.7 kg/l.

Letter symbols for quantities and units shall be in accordance with IEC 60027.

Graphical symbols shall be in accordance with IEC 60417 and ISO 7000 as appropriate.

The on-position, and where relevant, the off-position of switches shall be indicated in accordance with 14.6.3.

Compliance is checked by inspection.

5.1 DR DU Identification and supply ratings

5.1 revised September 9, 2002

Power supplies and adapters complying with the construction and test requirements of UL 1310, UL 1950, Third Edition, or UL 60950 are considered to fulfill the marking requirements of items a through i of this subclause.

The apparatus shall be marked with the following:

a) maker's or responsible vendor's name, trade mark or identification mark;

b) model number or type reference;

c) the symbol for CLASS II, if applicable: ⧈ (60417-2-IEC-5172)

d) NOTE – Marking for apparatus designed for use in tropical climates is under consideration.

e) Nature of supply:

– a.c. only with the symbol: ∿ (60417-2-IEC-5032)

– d.c. only with the symbol: ⎓ (60417-2-IEC-5031)

– a.c. or d.c. with the symbol: ≂ (60417-2-IEC-5033)

– for three-phase systems, reference shall be made to IEC 61293.

f) RATED SUPPLY VOLTAGE or range of the RATED SUPPLY VOLTAGES which can be applied without operating a voltage setting device.

Apparatus which can be set to different RATED SUPPLY VOLTAGES or ranges of RATED SUPPLY VOLTAGES shall be so constructed that the indication of the voltage or range of voltages to which the apparatus is set, is discernible on the apparatus when ready for use;

A solidus shall be used for USER selectable ratings, for example ″110/230 V″ and a hyphen shall be used for a rating range, for example ″110-230 V″;

g) Rated MAINS frequency (or range of frequencies) in hertz. ~~if safety is dependent on the use of the correct MAINS frequency.~~

h) RATED CURRENT CONSUMPTION or rated power consumption of apparatus. ~~which can be supplied by SUPPLY APPARATUS FOR GENERAL USE. As an alternative the information may be given in the instruction manual.~~

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i) Power consumption marking for apparatus intended for connection to an a.c. MAINS supply other than single phase.

NOTE – Details for the measurement of the power consumption are under consideration.

j) The date or a dating code not exceeding any three consecutive months of manufacture. The dating code shall be in an established alphanumeric code affirmed by the manufacturer. The coding system shall have a minimum 10 year repetition cycle.

k) A distinctive identification to identify the factory of origin, when the same apparatus is produced at more than one factory.

l) When the enclosure of an apparatus provides the user with a means for access to parts which involve the risk of electric shock, the combination of the two graphical symbols and the supplemental marking – ″CAUTION – RISK OF ELECTRIC SHOCK – DO NOT OPEN″ – depicted in figure 15 shall be provided on at least one surface of the apparatus enclosure through which the USER gains access to the interior.

All other enclosure surfaces that provide a means for access to the interior of the apparatus for servicing purposes shall be marked either as indicated in figure 15, or with the graphical symbol depicted in figure 16 adjacent to one of the enclosure fasteners on that surface.

m) An audio and/or video system consisting of an equipment rack and one or more audio or video components shall be marked to identify the individual audio and video component type(s) and model number(s) which have been evaluated as part of the system. The marking shall be provided on a tag that is permanently attached to the rack. The tag shall be of substantial material such as cardboard, cloth, plastic or the equivalent to provide mechanical strength and to discourage removal. The tag shall have a hole and be secured to the rack by a plastic strap or the equivalent, or be provided with adhesive backing and secured to the rack as a flag. The tag shall be factory applied and not installed by the user.

n) Apparatus having leakage current levels greater than 0.75 MIU and equal to or less than 1.5 MIU, as permitted in 9.1.1, shall be provided with the word ″CAUTION″ and the following marking or equivalent: ″TO REDUCE THE RISK OF ELECTRIC SHOCK, GROUNDING OF THE CENTER PIN OF THIS PLUG MUST BE MAINTAINED.″ The marking shall be on a tag which shall be of substantial material such as cardboard, cloth, plastic or the equivalent to provide mechanical strength and to discourage removal. The tag shall have a hole and be secured to the cord by a plastic strap or the equivalent.

Compliance is checked by inspection.

5.2 DR DU TERMINALS

5.2 revised December 19, 2000

TERMINALS shall be marked as follows:

a) The wiring TERMINAL intended for connection of the protective earthing conductor associated with the supply wiring: ⏚ (60417-2-IEC-5019)

This symbol shall not be used for other earthing TERMINALS.

b) TERMINALS which are HAZARDOUS LIVE under normal operating conditions, except TERMINALS for MAINS supply: ϟ (60417-2-IEC-5036)

c) Output TERMINALS provided for supply of other apparatus except MAINS supply shall be marked with the nominal output voltage and frequency, and, in addition, the maximum output current ~~if with the most unfavourable load higher temperature rises than allowed in table 2 can occur~~, or power, unless the TERMINALS are marked with the type references of the apparatus which are permitted to be connected. When intended to be installed or interconnected in the field by a SKILLED PERSON, the Class of wiring shall be marked adjacent to the TERMINALS.

Socket-outlets providing MAINS power to other apparatus shall be marked with the power or current which may be drawn.

If there is only one TERMINAL provided for supply of other apparatus, the marking may be put on the apparatus at any place, taking into account the first paragraphs of clause 5.

d) Speaker TERMINALS on apparatus, other than PORTABLE APPARATUS, that is not provided with speakers and associated wiring shall be provided with a marking adjacent to the TERMINALS as identified below:

– "Class 1 Wiring" for TERMINALS with a measured open-circuit voltage exceeding 300 V rms when delivering NON-CLIPPED OUTPUT POWER, or

– "Class 3 Wiring" for TERMINALS with a measured open-circuit voltage exceeding 120 V rms but not exceeding 300 V rms when delivering NON-CLIPPED OUTPUT POWER, or

– "Class 2 Wiring" for all other terminals provided the audio output power exceeds 10 W per channel under normal operating conditions or the apparatus is intended to be installed or interconnected in the field by a SKILLED PERSON

The operation manual shall discuss the risks involved, precautions to be taken as well as the reason for them, and instructions as to the proper connecting and insulating techniques to be used when connecting a speaker.

Compliance is checked by inspection.

5.3 DU When an apparatus is provided with safety related graphical symbols, the instructions shall include an illustration of the graphical symbols and an explanation of their meaning. Those symbols that are visible only after removal of a servicing cover by a SKILLED PERSON are only required to be explained in the service instructions. Explanations of required symbols in the operating manual shall precede any operating instructions.

Where in a manufacturer's service documentation, for example in circuit diagrams or lists of components, a symbol is used to indicate that a specific component shall be replaced only by the component specified in that documentation for safety reasons, the following symbol shall be used: ⚠ (ISO 7000-0434).

This symbol may also be put adjacent to the relevant component.

This symbol shall not be placed on components.

Compliance is checked by inspection.

5.4 DU Instructions

Revised 5.4 effective July 1, 2004

~~When~~ Information with regard to safety is required according to this standard. This information shall be given in a separate booklet or sheet, or be located before any operating instructions in an instruction for installation for use and supplied with the apparatus. This information shall be given in a language acceptable to the country where the apparatus is intended to be used.

The important safety instructions shall be entitled "Important Safety Instructions". The following safety instructions shall be included where applicable, and, when used, shall be verbatim as follows. Additional safety information may be included by adding statements after the end of the following safety instruction list. At the manufacturer's option, a picture or drawing that illustrates the intent of a specific safety instruction may be placed immediately adjacent to that safety instruction.

1) Read these instructions.

No Text on This Page

2) Keep these instructions.

3) Heed all warnings.

4) Follow all instructions.

5) Do not use this apparatus near water.

6) Clean only with dry cloth.

7) Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.

8) Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.

9) Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.

10) Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.

11) Only use attachments/accessories specified by the manufacturer.

12) Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.

13) Unplug this apparatus during lightning storms or when unused for long periods of time.

14) Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

The symbol in figure 17 shall be shown adjacent to the text of item 12 above.

~~NOTE 1 – Reference is made to ISO/IEC Guide 37 [12].~~

~~NOTE 2 – The following information with regard to safety which are recommended to included as far as applicable:~~

~~– minimum distances around the apparatus for sufficient ventilation;~~

~~– the ventilation should not be impeded by covering the ventilation openings with items, such as newspapers, table-cloths, curtains, etc.;~~

~~– no naked flame sources, such as lighted candles, should be placed on the apparatus;~~

~~– attention should be drawn to the environmental aspects of battery disposal;~~

~~– the use of apparatus in tropical and/or moderate climates.~~

5.4.1 DU In addition, the instructions shall include the following as far as applicable.

a) For MAINS powered apparatus and for apparatus producing internal voltages greater than 35 V (peak) a.c. or d.c., having no protection against ~~splashing~~ water according to annex A, the instructions for use shall state ~~that the apparatus shall not be exposed to dripping or splashing and that no objects filled with liquids, such as vases, shall be placed on the apparatus.~~ ″WARNING″ and the following or equivalent, ″To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.″

b) A warning that TERMINALS marked with the symbol according to 5.2 b) are HAZARDOUS LIVE and that the external wiring connected to these TERMINALS requires installation by an INSTRUCTED PERSON or the use of ready-made leads or cords.

c) If an apparatus is provided with a replaceable lithium battery, the following applies:

– if the battery is intended to be replaced by the USER, there shall be a warning close to the battery or in both the instructions for use and the service instructions;

– if the battery is not intended to be replaced by the USER, there shall be a warning close to the battery or in the service instructions.

This warning shall include the following or similar text:

CAUTION

Danger of explosion if battery is incorrectly replaced.

Replace only with the same or equivalent type.

d) Information as required according to 14.6.3.

Compliance is checked by inspection.

5.4.2 If a PERMANENTLY CONNECTED APPARATUS is not provided with an ALL-POLE MAINS SWITCH according to 14.6.1, the instructions shall state that an ALL-POLE MAINS SWITCH with a contact separation of at least 3 mm in each pole shall be incorporated in the electrical installation of the building.

5.4.3 DU When apparatus operation and installation instructions contain instructions for use by service personnel, such instructions shall be separate in format from other instructions and preceded by the word ″CAUTION″ and the following or the equivalent. ″These servicing instructions are for use by qualified service personnel only. To reduce the risk of electric shock do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.″

6 Hazardous radiations

6.1 DR Ionizing radiation

Apparatus including a potential source of ionizing radiation shall be so constructed that personal protection against ionizing radiation is provided under normal operating conditions and under fault conditions.