

Australian/New Zealand Standard™

**Audio, video and similar electronic
apparatus—Safety requirements
(IEC 60065:2014 (ED. 8.0) MOD)**



AS/NZS 60065:2018

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee TE-001, Safety of Electronic Equipment. It was approved on behalf of the Council of Standards Australia on 8 January 2018 and by the New Zealand Standards Approval Board on 20 December 2017.
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Consumer Electronics Suppliers Association
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This Standard was issued in draft form for comment as DR AS/NZS 60065:2017.

Australian/New Zealand Standard™

Audio, video and similar electronic apparatus—Safety requirements (IEC 60065:2014 (ED. 8.0) MOD)

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TE-001 Safety of Electronic Equipment.

AS/NZS 60065:2012, *Audio, video and similar apparatus—Safety requirements* (IEC 60065, ED. 7.2 (2011) MOD) will also remain current for 2 years from the publication of AS/NZS 60065:2018, *Audio, video and similar electronic apparatus—Safety requirements (IEC 60065:2014 (ED. 8.0) MOD)*, and after this time will be superseded by AS/NZS 60065:2018. Regulatory authorities that reference these Standards in regulation may apply these requirements at a different time; users of this Standard should consult with these authorities to confirm their requirements.

The objective of this Standard is to provide Australian and New Zealand electrical and electronic industries with minimum safety requirements for electrically powered equipment intended for the reception, generation, recording or reproduction of audio, video and associated signals.

This Standard is an adoption with national modifications and has been reproduced from IEC 60065:2014 (ED.8.0), *Audio, video and similar apparatus—Safety requirements*, including Corrigendum 1 (2015), which has been added at the end of the source text. IEC Corrigendum 2 (2016) has not been included as it comprises a correction to Clause 12.7.1 that has been incorporated into Appendix ZZ. The Australian/New Zealand variations are listed in Appendix ZZ. This Standard has been varied from the IEC Standard as indicated to take account of Australian/New Zealand conditions.

This Standard is structured as follows:

- (a) Australian/New Zealand Preface.
- (b) IEC 60065:2014 (unedited from the scope to the final clause of the source document including Corrigendum 1).
- (c) Appendix ZZ—Australian/New Zealand variations to the source document.

The variations listed in Appendix ZZ address Australia/New Zealand issues including the following:

- (i) Addition of references to relevant normative Australian/New Zealand Standards.
- (ii) Alternate requirements for thermoplastic materials
- (iii) Appropriate tests of AS/NZS 3112.
- (iv) Australian/New Zealand requirements for flexible cords.
- (v) Requirements for stability of television receivers.
- (vi) Alternate resistance to fire tests.
- (vii) Change Table 21 flammability category.
- (viii) Reference to Australian Telecommunications Labelling Notice (Annex B).
- (ix) Additional requirements for batteries.
- (x) Abnormal conditions and single fault conditions output voltage test for external power supplies, docking stations and other similar devices.

The essential safety requirements in AS/NZS 3820, *Essential safety requirements for electrical equipment*, that could be applicable to electrically powered equipment intended for the reception, generation, recording or reproduction of audio, video and associated signals are covered by this Standard.

The variations described in Appendix ZZ form the Australian and New Zealand variations for the purposes of the CB scheme for recognition of testing to standards for safety of electrical equipment.

As this Standard is reproduced from an International Standard, the following applies:

(A) In the source text ‘this International Safety Standard’ should read ‘this Australian/New Zealand Standard’.

(B) A full point should be substituted for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific standards.

In cases where Australian or Australian/New Zealand Standards are modified-text adoptions of international normative reference Standards, references to those International Standards are required by Appendix ZZ to be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS	
60038	IEC standard voltages	60038	Standard voltages
		AS/NZS	
60320	Appliance couplers for household and similar general purposes (series)	60320	Appliance couplers for household and similar general purposes (series)
60335	Household and similar electrical appliances—Safety	60335	Household and similar electrical appliances—Safety
60335-1	Part 1: General requirements	60335.1	Part 1: General requirements (IEC 60335-1 Ed 5, MOD)
60950	Safety of information technology equipment—Safety	60950	Information technology equipment—Safety
60950-1	Part 1: General requirements	60950.1	Part 1: General requirements (IEC 60950-1, Ed.2.2 (2013), MOD)
61058	Switches for appliances	61058	Switches for appliances
61058-1	Part 1: General requirements	61058.1	Part 1: General requirements (IEC 61058-1, Ed.3.1 (2000), MOD)
62368	Audio/visual, information and communication technology equipment	62368	Audio/visual, information and communication technology equipment
62368-1	Part 1: Safety requirements	62368.1	Part 1: Safety requirements (IEC 62368-1:2014 (ED. 2.0), MOD)

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FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60065 has been prepared by IEC technical committee 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology. It has the status of a group safety publication in accordance with IEC Guide 104.

This eighth edition cancels and replaces the seventh edition published in 2001 including its Amendment 1 (2005) and Amendment 2 (2010). It constitutes a technical revision.

The principal changes in this edition as compared with the seventh edition are as follows:

- new requirements for wall and ceiling mounting means;
- new requirements for coin / button cell batteries;
- all notes have been reviewed to comply with the new directives;
- addition of requirements for LEDs;
- requirements for creepage distances are aligned with IEC 60950-1;
- change in optocoupler requirements.

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

FDIS	Report on voting
108/523/FDIS	108/541/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.

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

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

- requirements proper and normative annexes: in roman type;
- compliance statements and test specifications: *italic type*;
- notes/explanatory matter: in smaller roman type;
- normative conditions within tables: in smaller roman type;
- terms defined in Clause 2: SMALL CAPITALS.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the stability 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.

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;
- chemical burns (for example, as a result of the ingestion of lithium chemistry button/coin cells).

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 that 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 single 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

Contacts 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. Provide 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:

- heat;
- arcing;

caused by

- overloads;
- component failure;
- insulation breakdown;
- bad connections;
- conductor breakage.

Requirements are included that are intended to prevent fire originating 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 subassemblies;
- the prevention of excessive temperature rise that 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.

AUSTRALIAN/NEW ZEALAND STANDARD

**Audio, video and similar electronic apparatus—Safety requirements
(IEC 60065:2014 (ED. 8.0) MOD)****1 General****1.1 Scope**

1.1.1 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 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 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.

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 and overhead projectors are covered by IEC 60335-2-56.

- video cameras and video monitors;
- video games and flipper games;
- juke boxes;
- electronic gaming and scoring machines;

NOTE 2 Video games, flipper games and gaming machines and other amusement games for commercial use are covered by IEC 60335-2-82.

- teletext equipment;
- record and optical disc players;
- tape and optical disc recorders;
- antenna signal converters and amplifiers;
- antenna positioners;
- Citizen's Band apparatus;

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- apparatus for IMAGERY;
- electronic light effect apparatus;
- apparatus for use in alarm systems;
- intercommunication apparatus, using low voltage MAINS as the transmission medium;
- cable head-end receivers;
- professional general use amplifiers, record or disc players, tape players, recorders, and public address systems;
- professional sound/video systems;
- electronic flash apparatus for photographic purposes (see Annex L); and
- multimedia apparatus.

The requirements of IEC 60950-1 may also be used to meet the requirements for safety of multimedia apparatus (see also IEC Guide 112).

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 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, 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 1 See Table A.2 of IEC 60664-1:2007.

NOTE 2 China has special requirement in choosing multiplication factors at altitude above 2 000 m.

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.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60038:2009, *IEC standard voltages*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-31:2008, *Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens*

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

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

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

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

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

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*
Amendment 1:2009

IEC 60127 (all parts), *Miniature fuses*

IEC 60127-6, *Miniature fuses. Part 6: Fuse-holders for miniature cartridge fuse-links*

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

IEC 60216 (all parts), *Electrical insulating materials – Thermal endurance properties*

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

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

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

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

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

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

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

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

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

IEC 60384-1:2008, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60384-14:2005, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

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

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

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

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

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

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

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1:2010, *Automatic electrical controls for household and similar use – Part 1: General requirements*

IEC 60747-5-5:2007, *Semiconductor devices – Discrete devices – Part 5-5: Optoelectronic devices – Photocouplers*
Amendment 1:2013

IEC 60825-1:2007, *Safety of laser products – Part 1: Equipment classification and requirements*

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

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

IEC 60851-6:2012, *Winding wires – Test methods – Part 6: Thermal properties*

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

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*
Amendment 1:2009
Amendment 2:2013¹

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

¹ A consolidated edition (2.2) exists, that includes IEC 60950-1:2005 and its Amendments 1:2009 and 2:2013.

IEC 60998-2-2, *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, *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 60999-2, *Connecting devices – Electrical copper conductors. Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 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*
Amendment 1:2009

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

IEC/TS 61149, *Guide for safe handling and operation of mobile radio equipment*

IEC 61260, *Electroacoustics – Octave-band and fractional-octave-band filters*

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

IEC 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*
Amendment 1:2009²

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

IEC 61965, *Mechanical safety of cathode ray tubes*

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

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

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

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

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

IEC Guide 112, *Guide on the safety of multimedia equipment*

² A consolidated edition (2.1) exists, that includes IEC 61558-1:2005 and its Amendment 1:2009.

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

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

ISO 306:2004, *Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality level (AQL) for lot-by-lot inspection*

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

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

ITU-T Recommendation K.44, *Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic recommendation*

2 Terms and definitions

2.1 Definitions in alphabetical order

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

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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

Note 1 to entry: See 3.48 of IEC 60825-1:2007.

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

Note 1 to entry: See 3.41 of IEC 60825-1:2007.

Note 2 to entry: 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**PORTABLE APPARATUS**

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

2.2.11**TRANSPORTABLE APPARATUS**

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

Note 1 to entry: Examples of TRANSPORTABLE APPARATUS are musical instruments and their associated amplifiers.

2.2.12**PROFESSIONAL APPARATUS**

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

Note 1 to entry: The designation should be specified by the manufacturer.

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**WORKING 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

Note 1 to entry: 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

Note 1 to entry: See Figure 1.

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 1 to entry: 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 $2\,000\ \Omega$ 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

Note 1 to entry: A TERMINAL 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 to entry: 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 to entry: 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 to entry: 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

Note 1 to entry: A TNV CIRCUIT is considered to be a circuit which is not CONDUCTIVELY CONNECTED TO THE MAINS.

Note 2 to entry: 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 4.2.1 of IEC 62151:2001.

Note 3 to entry: 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 4 to entry: The voltage relationships between TNV CIRCUITS are shown in the Table 1.

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 1 to entry: The limiting values of voltages under normal operating and fault conditions are specified in 9.1.1.2 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

2.5 Signals, sources, loads**2.5.1****PINK NOISE**

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

2.5.2**NOISE SIGNAL**

stationary random signal having normal probability distribution of instantaneous values

Note 1 to entry: 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 1 to entry: 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 1 to entry: Examples may include a 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 1 to entry: 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 1 to entry: BASIC INSULATION may also serve as functional insulation.

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 1 to entry: 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

2.6.10**HAZARDOUS LIVE**

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

Note 1 to entry: 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 1 to entry: 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 1 to entry: 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 1 to entry: 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 1 to entry: 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

Note 1 to entry: 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 1 to entry: 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

2.7.15**COIN CELL BATTERY****BUTTON CELL BATTERY**

small, single cell battery having a diameter greater than its height

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**ACCESSIBLE**

possibility of touching by the test finger according to IEC 61032:1997, test probe B

Note 1 to entry: 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 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

2.8.6**INSTRUCTED PERSON**

person adequately advised or supervised by a SKILLED PERSON 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

Note 1 to entry: 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 1 to entry: 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

Note 1 to entry: Such a faulty contact or interruption in an electrical connection includes those which may occur in CONDUCTIVE PATTERNS on PRINTED BOARDS.

Note 2 to entry: An electronic protection circuit may be used to prevent such a fault from becoming a POTENTIAL IGNITION SOURCE.

2.8.12

PASSIVE FLAMMABILITY

flammability caused by external heating of the component

Note 1 to entry: It can be caused for example, by flames.

3 General requirements

3.1 General

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; and
- 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 Designation of classes

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

3.3 Constructions and components not specifically covered

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

3.4 Components and subassemblies that comply with IEC 62368-1

Components and subassemblies that comply with IEC 62368-1 are acceptable as part of an apparatus covered by this standard without further evaluation other than to give consideration to the appropriate use of the component or subassembly in the end-product.

4 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.

4.1.2 The sample or samples under test shall be representative of the apparatus the USER would receive, or shall be the actual apparatus 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 subassemblies 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.

The tests should be carried out in the following order:

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

NOTE In view of the amount of resources involved in testing and in order to minimize waste, all parties concerned can 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 apparatus manufacturer, specifically those dealing with proper ventilation.

The apparatus shall also comply with Table 3 when tested on an open bench.

4.1.5 *The characteristics of the supply source, except those specified in 4.2.2, 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 Figure C.1 in Annex C.*

NOTE If appropriate, the standard signal can 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

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

4.2.2 *The apparatus, except battery-operated apparatus, is connected to a supply voltage of 0,9 times or 1,1 times of any RATED SUPPLY VOLTAGE for which the apparatus is designed.*

For battery-operated apparatus a fully charged rechargeable battery or dry batteries in a fresh condition are used.

RATED CURRENT CONSUMPTION and RATED POWER CONSUMPTION are measured at the RATED SUPPLY VOLTAGE. For RATED CURRENT CONSUMPTION or RATED POWER CONSUMPTION measurements of television sets, the following settings shall apply:

- the ‘three vertical bar signal’ shall be used as defined in 3.2.1.3 of IEC 60107-1:1997; and*
- USER ACCESSIBLE picture controls shall be adjusted so as to obtain the maximum power consumption; and*
- sound settings shall be as defined in 4.2.5 a) of this standard.*

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 1,1 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.

Any type of supply for which the apparatus is designed to be used.

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

4.2.3 *Any position of controls which are ACCESSIBLE to the USER for adjustment BY HAND, including REMOTE CONTROLS, excluding voltage setting devices complying with 14.9 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.

4.2.4 *In the case of single-phase supply, any earth TERMINAL and any PROTECTIVE EARTHING 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 EARTHING TERMINAL may be connected to the neutral or to any phase of the isolated supply source used during the test.

4.2.5 *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 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 power 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 –3 dB response points of the relevant part of the apparatus may be used to supply each channel.

If the result of a measurement performed with a sine wave does not comply with this standard, the measurement with PINK NOISE is decisive.

When determining whether a part or output TERMINAL contact is HAZARDOUS LIVE according to 9.1.1.2 and 11.1, the apparatus shall be operated with a sinusoidal input test signal of 1 kHz or where applicable, another frequency corresponding to the geometric mean of the upper and lower –3 dB response points of the relevant amplifier part of the apparatus, sufficient in amplitude for the apparatus to deliver the NON-CLIPPED OUTPUT POWER into its RATED LOAD IMPEDANCE. Open-circuit output voltage is determined after the load is removed.

- b) *The most unfavourable RATED LOAD IMPEDANCE of any output circuit is connected.*
- 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.

- d) *Where the intended amplifier function depends on phase difference between two channels, there shall be a phase difference of 90° between the signals applied to the two channels.*
- e) *For equipment containing multi-channel amplifiers, where each channel can be operated independently, each channel shall be operated using the RATED LOAD IMPEDANCE at the output power level that corresponds to 1/8 of the NON-CLIPPED OUTPUT POWER. Where some channels cannot be operated independently, those channels shall be operated using the RATED LOAD IMPEDANCE at the output power level that corresponds, by design, to 1/8 of the NON-CLIPPED OUTPUT POWER of the adjustable amplifier channel(s).*

4.2.6 *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.*

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

4.2.8 *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.*

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

4.2.10 *Antenna positioners shall comply with all of the following requirements:*

4.2.10.1 *For antenna positioners in combination with their control and SUPPLY APPARATUS:*

- *four consecutive movements from one endstop to the opposite endstop;*
- *followed by a 15 min resting period.*

The movements and the resting periods 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.

4.2.10.2 *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.*

4.2.11 *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 4.2.2.

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.

4.2.12 *Apparatus which can be supplied by SUPPLY APPARATUS FOR GENERAL USE shall be supplied by a test power supply with a sufficient current capacity according to Table 2 corresponding to the RATED SUPPLY VOLTAGE of the apparatus under test. The values of no-load voltage given in Table 2 are subject to the under- and over-voltage provisions specified in 4.2.2.*

Table 2 – Test power supply

RATED SUPPLY VOLTAGE V d.c.	Nominal no-load voltage V d.c.	Internal resistance Ω
1,5	2,25	0,75
3,0	4,50	1,50
4,5	6,75	2,25
6,0	9,00	3,00
7,5	11,25	3,75
9,0	13,50	4,50
12,0	18,00	6,00

The test power supply voltage and current parameters are not limited to those provided in this table. The parameters in the table are representative for supply apparatus having output voltage(s) < 12 V d.c. and rated output current < 1 A.

4.2.13 *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.*

4.3 Fault conditions

4.3.1 For operation under fault conditions, in addition to the normal operating conditions mentioned in 4.2, each of the following conditions is applied one at a time 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.

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 that are likely to create a hazard and that are to be applied. These are applied in sequence, in the order that is most convenient.

The examination of the apparatus and circuit diagrams indicate the operating conditions under which simulated faults are applied in order to produce the most unfavourable effects. In most cases, the effects of a simulated fault are most unfavourable if the simulated fault is applied while the apparatus is in full operation.

However, for some parts, the most unfavourable effects can occur if the simulated fault is applied before switching on the apparatus. It is also possible that the most unfavourable effects could occur when a simulated fault is applied when the apparatus is in a STAND-BY condition.

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 no installation instructions are provided and there is a possibility that the test box 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.

4.3.2 *Short-circuit across CLEARANCES and CREEPAGE DISTANCES, if they are less than the values specified in Clause 13 for BASIC and SUPPLEMENTARY INSULATION, with the exception of insulation between parts of different polarity DIRECTLY CONNECTED TO THE MAINS.*

NOTE For CLEARANCES between parts of different polarity DIRECTLY CONNECTED TO THE MAINS, reference is made to 13.1.

4.3.3 *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 10.4.*

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

4.3.4 *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; and*
- *semiconductor devices, one lead at a time interrupted or any two leads connected together one pair at a time (but see 4.3.5 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.

4.3.5 *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 14.2 and, as far as applicable, of 11.2;*
- b) *PTC THERMISTORS complying with Clauses 15, 17, J.15 and J.17 of IEC 60730-1:2010;*
- c) *capacitors and RC-units complying with the requirements of 14.3, 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 14.12;*
- e) *windings and the insulation of transformers and other windings mentioned in 14.4 complying with the requirements of that subclause; and*
- f) *surge suppression varistors complying with the requirements of 14.13.*

4.3.6 *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.*

4.3.7 *Motors are stalled.*

4.3.8 *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.*

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

4.3.10 *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. MAINS socket outlets shall be loaded with 1,1 times the highest load possible based on over-current protection and the outlet configuration except where the wiring to the socket outlet has the same cross-sectional area as the MAINS cord.*

4.3.11 *The top, sides and the back of an apparatus, if such surfaces have ventilation openings, shall be covered one at a time with a piece of card of 200 g/m² density with dimensions not less than each tested surface, covering all openings.*

Openings on different surfaces on top of the apparatus (if any) are covered simultaneously by separate pieces of card.

Openings on top of the apparatus, on a surface inclined at an angle greater than 30° and smaller than 60° to the horizontal, from which an obstruction is free to slide, are excluded.

On the back and the sides of the apparatus, the card is attached to the upper edge and allowed to hang freely.

NOTE There is no test for the bottom surface.

4.3.12 *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.

4.3.13 *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/TS 61149.*

4.3.14 For 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.

4.3.15 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, 4.2.2 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.

4.3.16 Apparatus which can be supplied by SUPPLY APPARATUS FOR GENERAL USE shall be tested by using a test power supply as specified in Table 2 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 2.

During this test, 4.2.2 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.

4.3.17 For apparatus with a charging circuit, recharge a fully discharged SPECIAL BATTERY with one cell short-circuited.

NOTE See also 11.2 and 14.11.3.

5 Marking and instructions

5.1 General requirements

NOTE Additional requirements for marking and instructions are contained in 4.1.4, 4.2.8, 8.18, 9.1.5, 14.4.2, 14.6.2.4, 14.6.3.2, 14.6.5, Cause 19 and Annex B.

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. As an alternative, it is permitted to use a reagent grade hexane with a minimum of 85 % as n-hexane.

NOTE The designation "n-hexane" is chemical nomenclature for a "normal" or straight chain hydrocarbon. This petroleum spirit is further identified as a certified ACS (American Chemical Society) reagent grade hexane (CAS# 110-54-3).

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.

Compliance is checked by inspection.

5.2 Identification and supply ratings

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 for apparatus without functional earth: , IEC 60417-5172 (2003-02)
for CLASS II apparatus with functional earth: , IEC 60417-6092 (2011-10)
- d) nature of supply:
 - a.c. only with the symbol: , IEC 60417-5032 (2002-10)
 - d.c. only with the symbol: , IEC 60417-5031 (2002-10)
 - a.c. or d.c. with the symbol: , IEC 60417-5033 (2002-10)
 - for three-phase systems, reference is made to IEC 61293;
- e) 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";
- f) rated MAINS frequency (or range of frequencies) in hertz, if safety is dependent on the use of the correct MAINS frequency;
- g) 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.
The measured consumption at RATED SUPPLY VOLTAGE shall not exceed the marked value by more than 10 %;
- h) RATED CURRENT CONSUMPTION or RATED POWER CONSUMPTION for apparatus intended for connection to an a.c. MAINS supply.
The measured consumption at RATED SUPPLY VOLTAGE shall not exceed the marked value by more than 10 %.

If an appliance coupler for Class I is used for Class II equipment with functional earth connection, the requirements of Clause 15 and Clause 16 related to Class I construction shall be applied up to the connecting point of the protective (earthing) conductor to the functional earth.

Graphical symbols placed on the apparatus, whether required by this standard or not, shall be in accordance with IEC 60417 or ISO 3864-2 or ISO 7000, if available. In the absence of suitable symbols, the manufacturer may design specific graphical symbols.

Care shall be taken so that additional markings and instructions not required by this standard do not contradict the markings and instructions required by this standard.

Symbols placed on the equipment shall be explained in the user manual.

Compliance is checked by inspection.

5.3 TERMINALS

TERMINALS shall be marked as follows:

- a) The wiring TERMINAL intended for connection of the protective earthing conductor associated with the supply wiring:



, IEC 60417-5019 (2006-08)

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:



, IEC 60417-5036 (2002-10)

- c) Unless the TERMINALS are marked with the type references of the apparatus that are permitted to be connected, output TERMINALS provided for supply of other apparatus except MAINS supply shall be marked with

- the nominal output voltage; and
- the maximum output current or power, if with the most unfavourable load, temperature rises higher than those allowed in Table 3 for normal operating conditions can occur.

Socket-outlets providing MAINS power to other apparatus shall be marked with the power and 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 5.1.

Compliance is checked by inspection.

5.4 Caution marking

The following markings shall be included as applicable:

- a) 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 (2004-01)

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

This symbol shall not be placed on components.

- b) Where a loudspeaker grille, removable from the outside by the use of a tool, coin or other object, is relied on as protective cover (see 9.2), the following marking, or equivalent, shall be visible on the enclosure after removal of the grille:

CAUTION

To prevent electric shock hazard, do not connect to mains power supply while grille is removed.

Alternatively, the symbol , IEC 60417-5036 (2002-10) shall be visible after removal of the grille and the caution wording above shall appear in the user instructions, accompanied by the symbol.

- c) If an apparatus contains a USER-replaceable COIN / BUTTON CELL BATTERY, the following:



, ISO 7000-0434 (2004-01), or



combination of ISO 7000-0434 (2004-01) and ISO 7000-1641 (2004-01).

This marking is not required where these batteries are not intended to be replaced or are only ACCESSIBLE after damaging the apparatus.

Compliance is checked by inspection.

NOTE In Finland, Norway and Sweden, CLASS I apparatus which is intended for connection to the building installation wiring via a plug or an appliance coupler, or both, and in addition is intended for connection to other apparatus or a network shall, if safety relies on connection to protective earth or if surge suppressors are connected between the network TERMINALS and ACCESSIBLE parts, have a marking stating that the apparatus must be connected to an earthed MAINS socket-outlet.

5.5 Instructions

5.5.1 When information with regard to safety is required according to this standard, this information shall be given in an instruction for installation or 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.

NOTE Reference is made to ISO/IEC Guide 37.

If safety relevant, the following information should be 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.

5.5.2 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.
- b) A warning that TERMINALS marked with the symbol according to 5.3 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) A warning that an apparatus with CLASS I construction shall be connected to a MAINS socket outlet with a protective earthing connection.
- e) Instructions to ensure correct and safe installation and interconnection of the apparatus in multimedia systems.
- f) If the apparatus is not tested to the stability requirements of 19.2, 19.3 or 19.4 due to fastening in place, the following or similar text shall be marked on or provided with the apparatus:

WARNING

To prevent injury, this apparatus must be securely attached to the floor/wall in accordance with the installation instructions.

- g) A warning that batteries (battery pack or batteries installed) shall not be exposed to excessive heat such as sunshine, fire or the like.
- h) If the apparatus is provided with a CRT with protective film attached to the faceplate as part of the safety implosion protection system in accordance to IEC 61965, the following warning, or wording with a similar meaning, shall be given in the instructions:

WARNING

The CRT in this apparatus employs a protective film on the face.
This film must not be removed as it serves a safety function and removal will increase the risk of serious injury.

- i) The instructions for installation or use provided with non-floor standing televisions likely to be used in the home and weighing over 7 kg shall contain the following information or equivalent:

WARNING

Never place a television set in an unstable location. A television set may fall, causing serious personal injury or death. Many injuries, particularly to children, can be avoided by taking simple precautions such as:

- Using cabinets or stands recommended by the manufacturer of the television set.
- Only using furniture that can safely support the television set.
- Ensuring the television set is not overhanging the edge of the supporting furniture.
- Not placing the television set on tall furniture (for example, cupboards or bookcases) without anchoring both the furniture and the television set to a suitable support.
- Not placing the television set on cloth or other materials that may be located between the television set and supporting furniture.
- Educating children about the dangers of climbing on furniture to reach the television set or its controls.

If your existing television set is being retained and relocated, the same considerations as above should be applied.

Compliance is checked by inspection.

NOTE 1 In China, the protective earthing of the building installation needs to be isolated from the screen of a cable distribution system. An isolator providing electrical insulation shall comply with insulation resistance of Clause 10.4 for BASIC INSULATION, and the antenna coaxial socket incorporating this isolator should comply with mechanical stress tests in 12.5. It is, however, accepted to provide the insulation external to the equipment, the user manual shall then have the following or similar information in Chinese:

Equipment connected to the protective earthing of the building installation through the MAINS connection or through other equipment with a connection to protective earthing – and to a cable distribution system using coaxial cable, may in some circumstances create a fire hazard. Connection to a cable distribution system has therefore to be provided through a device providing electrical isolation which can withstand insulation resistance for BASIC INSULATION.

NOTE 2 In Norway and Sweden, the screen of the coaxial cable of the television distribution system is normally not earthed at the entrance of the building and there is normally no equipotential bonding system within the building. Therefore the protective earthing of the building installation needs to be isolated from the screen of a coaxial cable based television distribution system.

It is, however, acceptable to provide the insulation external to the apparatus by an adapter or an interconnection cable with galvanic isolator, which may be provided by a retailer, for example.

The user manual shall then have the following or similar information in Norwegian and Swedish language respectively, depending on in what country the apparatus is intended to be used:

“Apparatus connected to the protective earthing of the building installation through the MAINS connection or through other apparatus with a connection to protective earthing – and to a television distribution system using coaxial cable, may in some circumstances create a fire hazard. Connection to a television distribution system therefore has to be provided through a device providing electrical isolation below a certain frequency range (galvanic isolator, see IEC 60728-11)”.

In Norway, due to regulation for CATV-installations, and in Sweden, a galvanic isolator shall provide electrical insulation below 5 MHz. The insulation shall withstand a dielectric strength of 1,5 kV r.m.s., 50 Hz or 60 Hz, for 1 min.

Translation to Norwegian (the Swedish text will also be accepted in Norway): “Apparater som er koplet til beskyttelsesjord via nettplugg og/eller via annet jordtilkoplet utstyr – og er tilkoplet et koaksialbasert kabel-TV nett, kan forårsake brannfare. For å unngå dette skal det ved tilkopling av apparater til kabel-TV nett installeres en galvanisk isolator mellom apparatet og kabel-TV nettet.”

Translation to Swedish: “Apparater som är kopplade till skyddsjord via jordat vägguttag och/eller via annan utrustning och samtidigt är kopplad till kabel-TV nät kan i vissa fall medföra risk för brand. För att undvika detta skall vid anslutning av apparaten till kabel-TV nät galvanisk isolator finnas mellan apparaten och kabel-TV nätet.”

- j) For apparatus containing a USER-replaceable COIN / BUTTON CELL BATTERY, the following text or equivalent:

WARNING

Do not ingest the battery, Chemical Burn Hazard

(The remote control supplied with) This product contains a coin/button cell battery. If the coin/button cell battery is swallowed, it can cause severe internal burns in just 2 hours and can lead to death.

Keep new and used batteries away from children.

If the battery compartment does not close securely, stop using the product and keep it away from children.

If you think batteries might have been swallowed or placed inside any part of the body, seek immediate medical attention.

NOTE The part between the brackets can be deleted if the battery is located in the apparatus instead of the remote control.

This warning is not required where these batteries are not intended to be replaced or are only ACCESSIBLE after damaging the apparatus.

5.5.3 With regard to devices for disconnection from the MAINS, instructions shall state that:

- a) where the MAINS plug or an appliance coupler is used as the disconnect device, the disconnect device shall remain readily operable;
- b) where an all-pole MAINS SWITCH is used as the disconnect device, the location on the apparatus and the function of the switch shall be described, and the switch shall remain readily operable; and
- c) for PERMANENTLY CONNECTED APPARATUS provided neither with an all-pole MAINS SWITCH nor an all-pole circuit breaker, the installation shall be carried out in accordance with all applicable installation rules.

Marking of the off-position by the relevant symbol according to IEC 60417-5008 (2002-10) or according to IEC 60417-5010 (2002-10) is permitted only for an all-pole MAINS SWITCH which interrupts all poles of the MAINS supply except the protective earthing conductor.

Where marking, signal lamps or similar means might give the impression that the apparatus is completely disconnected from the MAINS, information that states clearly the correct situation shall be included in the instructions. If symbols are used, their meaning shall also be explained in the instructions.

Compliance is checked by inspection.

6 Hazardous radiations

6.1 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.

Compliance is checked by measurement under the following conditions.

In addition to the normal operating conditions, all controls adjustable from the outside BY HAND, by any object such as a tool or a coin, and those internal adjustments or pre-sets which are not locked in a reliable manner, are adjusted so as to give maximum radiation whilst maintaining an intelligible picture for 1 h, at the end of which the measurement is made.

NOTE 1 Soldered joints and paint lockings are examples of adequate locking.

The exposure rate at any point outside the apparatus is determined by means of a radiation monitor with an effective area of 10 cm², at a distance of 5 cm from the outer surface of the apparatus.

Moreover, the measurement shall be made under fault conditions causing an increase of the high-voltage, provided an intelligible picture is maintained for 1 h, at the end of which the measurement is made.

The exposure rate shall not exceed 36 pA/kg (0,5 mR/h or 5 µSv/h).

NOTE 2 The value is according to ICRP 15, Clause 289.

NOTE 3 In the member countries of CENELEC, the amount of ionizing radiation is regulated by European Council Directive 96/29/Euratom of 13 May 1996. This directive requires that at any point 10 cm from the outer surface of the apparatus, the dose-rate should not exceed 1 µSv/h (0,1 mR/h) taking account of the background level.

A picture is considered to be intelligible if the following conditions are met:

- *a scanning amplitude of at least 70 % of the usable screen width;*
- *a minimum luminance of 50 cd/m² with locked blank raster provided by a test generator;*
- *a horizontal resolution corresponding to at least 1,5 MHz in the centre, with a similar vertical degradation; and*
- *not more than one flashover per 5 min.*

6.2 Laser radiation

An apparatus containing a LASER SYSTEM shall be so constructed that personal protection against laser radiation is provided under normal operating conditions and under fault conditions.

An apparatus containing a LASER SYSTEM is exempt from all further requirements of 6.2 if:

- classification by the manufacturer according to IEC 60825-1:2007, Clauses 3, 8 and 9 shows that the approachable emission level does not exceed class 1 under all conditions of operation, maintenance, service and failure, and
- it does not contain an embedded LASER according to IEC 60825-1.

NOTE 1 The term "approachable emission level" denotes "accessible emission limit (AEL)" in the sense of IEC 60825-1.

Apparatus shall be classified and labelled in accordance with the approachable emission level measured under fault conditions, except that for apparatus not exceeding class 1, 5.2 of IEC 60825-1:2007, does not apply.

All controls adjustable from the outside BY HAND or any object such as a tool or a coin, and those internal adjustments or pre-sets which are not locked in a reliable manner, are adjusted so as to give maximum radiation.

NOTE 2 Soldered joints and paint locking are examples of adequate locking.

The laser radiation emitted by redirection as mentioned in IEC 60825-1:2007, 3.37 b), shall not be measured for a LASER SYSTEM of class 1.

Compliance is met by satisfying the relevant requirements as specified in IEC 60825-1 with the following modifications and additions:

Normal operating conditions:

- a) *The apparatus shall meet under normal operating conditions, the approachable emission limits of class 1 as specified in IEC 60825-1:2007, Tables 4 and 5. Time basis of the classification is 100 s.*

Compliance is checked by performing the relevant measurements as specified in Clause 9 of IEC 60825-1:2007.

- b) *If the apparatus incorporates a LASER SYSTEM which meets, under normal operating conditions, the approachable emission limits of class 1, the requirements mentioned under c) and d) do not apply.*

- c) *Adequate measures shall be taken to prevent the opening of any cover BY HAND giving access to laser radiation in excess of class 1 limits.*

Compliance is checked by inspection and measurement.

- d) *Where safety is dependent on the proper functioning of a mechanical SAFETY INTERLOCK, this interlock shall be fail-safe (in the failure mode the apparatus is rendered inoperative or non-hazardous), or shall withstand a switching test of 50 000 cycles of operation with current and voltage applied as under normal operating conditions.*

Compliance is checked by inspection or test.

Single fault conditions:

- a) *When the apparatus is operated under fault conditions as specified in 4.3, the approachable emission level from the apparatus shall be not higher than class 3R outside the wavelength range of 400 nm to 700 nm and not higher than five times the limit for class 1 within the wavelength range of 400 nm to 700 nm.*

NOTE The class 3R limits are as specified in IEC 60825-1, Tables 7 and 8.

Compliance is checked by performing the relevant measurements as specified in Clause 9 of IEC 60825-1:2007.

- b) *If the apparatus incorporates a LASER SYSTEM which meets, under fault conditions, the approachable emission limits given in a), the requirements mentioned under c) and d) do not apply.*

- c) Adequate measures shall be taken to prevent the opening of any cover BY HAND giving access to laser radiation in excess of the limits given in a).

Compliance is checked by inspection and measurement.

- d) Where safety is dependent on the proper functioning of a mechanical SAFETY INTERLOCK, this interlock shall be fail-safe (in the failure mode the apparatus is rendered inoperative or non-hazardous), or shall withstand a switching test of 50 000 cycles of operation with current and voltage applied as under normal operating conditions.

Compliance is checked by inspection or test.

6.3 Light emitting diodes (LEDs)

Equipment containing LEDs that produce optical radiation within the Risk Group 3 limits specified in IEC 62471 in a wavelength range 200 nm to 3 000 nm, as specified by the lamp manufacturer, shall be provided with means (such as an interlock, barriers, guards or the equivalent) to reduce the likelihood of the Risk Group 3 optical radiation from appearing in USER ACCESSIBLE areas. Low power applications of LEDs need not comply with IEC 62471.

NOTE 1 Some examples of low power applications of LEDs that will normally comply are those used as:

- indicating lights;
- infra-red devices such as are used in home entertainment devices;
- infra-red devices for data transmission, such as are used between computers and computer peripherals;
- optocouplers; and
- other similar low power devices.

Compliance is checked by evaluation of available data sheets, by inspection and, if necessary, by measurement.

NOTE 2 For guidance on measuring techniques, see IEC 62471.

NOTE 3 If optical radiation is broadband visible and IR-A radiation and the luminance of the source does not exceed 10^4 cd/m², it is expected that the radiation does not exceed the exposure limits given in 4.3 of IEC 62471:2006 (see 4.1 of IEC 62471:2006).

7 Heating under normal operating conditions

7.1 General

7.1.1 Requirements

During intended use, no part of the apparatus shall attain an excessive temperature.

Compliance is checked by measuring the temperature rises under normal operating conditions when a steady state has been attained.

NOTE 1 In general, a steady state is assumed to be attained after 4 h of operation.

Temperature rises are determined:

- in the case of winding wires, by the change in resistance method or any other method giving the average temperature of the winding wires. Care should be taken to ensure that during the measurement of the resistance of winding wires, the influence of circuits or loads connected to these winding wires is negligible; and
- in other cases, by any suitable method.

Temperature rises shall not exceed the values specified in 7.1.2 to 7.1.6 inclusive.

Any single protective device or component of a protective circuit operating during the test shall be defeated, except for:

- a) *THERMAL CUT-OUTS with automatic reset complying with 14.6.2; and*
- b) *PTC THERMISTORS complying with 14.6.4.*

Consequently, if continuous operation of an AUDIO AMPLIFIER is not possible, the amplifier shall also be operated at the maximum possible signal level permitting continuous operation.

7.1.2 ACCESSIBLE parts

The temperature rise of ACCESSIBLE parts shall not exceed the values given in Table 3, item a), "Normal operating conditions".

7.1.3 Parts, other than windings, providing electrical insulation

The temperature rise of insulating parts, other than windings, providing BASIC INSULATION, SUPPLEMENTARY INSULATION, or REINFORCED INSULATION, and of insulating parts, the failure of which would cause an infringement of the requirements of 9.1.1 or a fire hazard, shall not exceed the values given in Table 3, item b) "Normal operating conditions", taking into account condition d) of Table 3.

If an insulating part is used to establish a CLEARANCE or to contribute to a CREEPAGE DISTANCE and its permissible temperature rise is exceeded, then the relevant area of the insulating part is disregarded when compliance with Clause 8 and Clause 11 is checked.

7.1.4 Parts acting as a support or a mechanical barrier

The temperature rise of parts, a mechanical failure of which would cause an infringement of the requirements of 9.1.1, shall not exceed the value given in Table 3, item c) "Normal operating conditions".

7.1.5 Windings

The temperature rise of windings comprising insulation providing protection against electric shock or fire hazard shall not exceed the values given in Table 3, items b) and d) "Normal operating conditions".

If an insulating part is used to establish a CLEARANCE or to contribute to a CREEPAGE DISTANCE and its permissible temperature rise is exceeded, then the relevant area of the insulating part is disregarded when compliance with Clause 8 and Clause 11 is checked.

NOTE If the insulation is incorporated in a winding in such a way that its temperature rise cannot be measured directly, the temperature is assumed to be the same as that of the winding wire.

7.1.6 Parts not subject to a limit under 7.1.2 to 7.1.5 inclusive

According to the nature of the material, the temperature rise of the part shall not exceed the values given in Table 3, item e), "Normal operating conditions".

Table 3 – Permissible temperature rise of parts of the apparatus (1 of 2)

Parts of the apparatus	Normal operating conditions ^a K	Fault conditions ^a K
a) <i>ACCESSIBLE parts</i> Knobs, handles, etc. if		
– metallic	30	65
– non-metallic ^c	50	65
Enclosures if		
– metallic ^b	40	65
– non-metallic ^{b, c}	60	65
b) <i>Parts providing electrical insulation</i> ^d Supply cords and wiring insulation with		
– polyvinyl chloride or synthetic rubber		
• not under mechanical stress	60	100
• under mechanical stress	45	100
– natural rubber	45	100
Other insulations of:		
– thermoplastic materials ^e	f	f
– non-impregnated paper	55	70
– non-impregnated cardboard	60	80
– impregnated cotton, silk, paper and textile	70	90
– laminates based on cellulose or textile, bonded with		
• phenol-formaldehyde, melamine-formaldehyde, phenol-furfural or polyester	85	110
• epoxy	120	150
– mouldings of		
• phenol-formaldehyde or phenol-furfural, melamine and melamine phenolic compounds with		
– cellulose fillers	100	130
– mineral fillers	110	150
• thermosetting polyester with mineral fillers	95	150
• alkyd with mineral fillers	95	150
– composite materials of		
• polyester with glass-fibre reinforcement	95	150
• epoxy with glass-fibre reinforcement	100	150
– silicone rubber	145	190
c) <i>Parts acting as a support or a mechanical barrier including the inside of enclosures</i> ^d Wood and WOOD-BASED MATERIALS	60	90
Thermoplastic materials ^e	f	f
Other materials	d	d
d) <i>Winding wires</i> ^{d, g} – insulated with		
• non-impregnated silk, cotton, etc.	55	75
• impregnated silk, cotton, etc.	70	100
• oleoresinous materials	70	135
• polyvinyl-formaldehyde or polyurethane resins	85	150
• polyester resins	120	155
• polyesterimide resins	145	180
e) <i>Other parts</i> These temperature rises apply to parts not covered by items a), b), c) and d):		
Parts of wood and WOOD-BASED MATERIAL	60	140
Lithium batteries	40 ^h	50 ⁱ
Resistors and parts of metal, glass, ceramic, etc.	No limit	No limit
All other parts	200	300

For conditions, see the following page.

Table 3 (2 of 2)

Conditions applicable to Table 3

- ^a For tropical climates, permissible temperature rises of 10 K less than those specified in this table are required.

The values of the temperature rises are based on a maximum ambient temperature of 35 °C for moderate climates and of 45 °C for tropical climates.

Where the temperatures are thermostatically limited by a THERMAL CUT-OUT with automatic reset or a PTC THERMISTOR, the measured temperature on the part shall not exceed 35 °C plus the permitted rise of Table 3.

- ^b For parts not likely to be touched during intended use, temperature rises up to 65 K are allowed under normal operating conditions. The wooden test box of 4.1.4 shall not be used when evaluating access to parts likely to be touched. The following parts are considered not likely to be touched:

- the rear and bottom panels, except those incorporating switches or controls handled during normal use,
- the external heatsinks and metallic parts directly covering external heatsinks, except those on surfaces incorporating switches or controls handled during normal use, and
- the parts of the top surface which are more than 30 mm below the general plane of the top surface.

For outside parts of metal which are covered with plastic material, the thickness of which is at least 0,3 mm, a temperature rise which corresponds to the permissible temperature rise of the insulating material is allowed.

The 65 K rise limit may be applied to the enclosure covering an internal heatsink, if:

- the symbol (IEC 60417-5041 (2002-10)) is marked on or adjacent to the heated area of the surface of the enclosure, and
- the minimum distance over the surface of the product between this area and any control intended to be operated during use is 150 mm or greater, and
- the instruction manual gives information regarding the heated area.

- ^c If these temperature rises are higher than those allowed by the class of the relevant insulating material, the nature of the material is the governing factor.

- ^d For the purpose of this standard, the permissible temperature rises are based on service experience in relation to the thermal stability of the materials. The materials quoted are examples. For materials for which higher temperature limits are claimed, and for materials other than those listed, the maximum temperatures shall not exceed those which have been proved to be satisfactory, for example in accordance with IEC 60085.

- ^e Natural rubber and synthetic rubbers are not considered as being thermoplastic materials.

- ^f Due to their wide variety, it is not possible to specify a generic permissible temperature rise for thermoplastic materials. In order to determine the softening temperature of a specific thermoplastic material, the Vicat softening temperature data from the material manufacturer, or, as determined by the test B50 of ISO 306 shall be used. If the material is not known or if the actual temperature of the parts exceeds the softening temperature, the test described under 1) shall be used.

- 1) the softening temperature of the material is determined on a separate specimen, under the conditions specified in ISO 306 with a heating rate of 50 °C/h and modified as follows:

- the depth of penetration is 0,1 mm; and
- the total thrust of 10 N is applied before the dial gauge is set to zero or its initial reading noted.

- 2) the temperature limits to be considered for determining the temperature rises are:

- for normal operating conditions, a temperature of 10 K below the softening temperature; and
- for fault conditions, the softening temperature itself.

If the required softening temperature exceeds 120 °C, condition ^c shall be taken into account.

- ^g For switch mode transformers temperature rises may be measured with a thermocouple placed as close as practicable to the winding. The permitted temperature rise shall be 10 K less than that given in Table 3.

- ^h Lithium batteries shall meet the permissible temperature rise, unless such batteries comply with the applicable electrical tests of IEC 60086-4.

- ⁱ Lithium batteries shall meet the permissible temperature rise, unless such batteries comply with all electrical tests of IEC 60086-4.

7.2 Heat resistance of insulating material

Insulating material supporting parts CONDUCTIVELY CONNECTED TO THE MAINS shall be resistant to heat if, during intended use, these parts carry a steady-state current exceeding 0,2 A and can generate substantial heat due to imperfect contact.

Compliance is checked by subjecting the insulating material to the test specified in Table 3, condition f or by a review of data from the material manufacturer.

The softening temperature of the insulating material shall be at least 150 °C.

In those cases where two groups of conductors, each supported by insulating parts, can be rigidly connected or joined together, for example by plug and socket, only one of the insulating parts need meet the test. Where one of the insulating parts is fixed in the apparatus, this part shall meet the test.

NOTE 1 Examples of parts which can generate substantial heat during intended use are contacts of switches and of voltage setting devices, screw TERMINALS and fuse holders.

NOTE 2 This test need not be performed on parts which are in accordance with a relevant IEC standard.

8 Constructional requirements with regard to the protection against electric shock

8.1 Conductive parts, covered only by lacquer, solvent-based enamel, ordinary paper, untreated textile, oxide films or beads are considered to be bare.

Compliance is checked by inspection.

8.2 The apparatus shall be designed and constructed so that operations BY HAND, such as

- changing the setting for the voltage or nature of supply;
- replacing fuses and indicator lights; and
- handling of drawers etc.,

does not involve a risk of electric shock.

Compliance is checked by application of the tests of 9.1.1.

8.3 The insulation of HAZARDOUS LIVE parts shall not be provided by hygroscopic materials.

Compliance is checked by inspection and, in case of doubt, by the following test.

A specimen of the material, as specified in Clause 9 of IEC 60167:1964, is subjected to a temperature of (40 ± 2) °C, and a relative humidity of 90 % to 95 %, the conditioning period being:

- 7 days (168 h) for apparatus to be used under tropical conditions;
- 4 days (96 h) for other apparatus.

Within 1 min after this preconditioning, the specimen shall withstand the tests of 10.4 without the humidity treatment according to 10.3.

8.4 The apparatus shall be so constructed that there is no risk of an electric shock from ACCESSIBLE parts or from those parts rendered ACCESSIBLE following the removal BY HAND of a cover.

This requirement applies also to internal parts of battery compartments which become ACCESSIBLE by the removal of a cover when replacing the batteries.

This requirement does not apply to battery compartments inside the apparatus, where the replacement of their batteries by the USER is not intended, for example batteries for memories.

Compliance is met by satisfying the requirements of 8.5 or 8.6.

NOTE Inaccessible contacts of TERMINALS are regarded as ACCESSIBLE parts, unless marked with the symbol according to 5.3 b) or intended to connect the apparatus to the MAINS or to provide MAINS power to other apparatus.

8.5 For CLASS I apparatus, the ACCESSIBLE conductive parts, except for those parts of the apparatus which have DOUBLE or REINFORCED INSULATION (CLASS II construction), shall be separated from HAZARDOUS LIVE parts by BASIC INSULATION meeting the insulation requirements as specified in Clause 10 and the requirements for CLEARANCES and CREEPAGE DISTANCES as specified in Clause 13.

This requirement does not apply to insulations whose short-circuiting does not cause any electric shock hazard.

NOTE 1 For example, if one end of a secondary winding of a SEPARATING TRANSFORMER is connected to an ACCESSIBLE conductive part, the other end need not meet any special insulation requirement with regard to the same ACCESSIBLE conductive part.

A resistor bridging BASIC INSULATION, DOUBLE INSULATION or REINFORCED INSULATION shall comply with the requirements as specified in 14.2 a).

A capacitor or RC-unit bridging BASIC INSULATION between a HAZARDOUS LIVE part and an ACCESSIBLE conductive part connected to the PROTECTIVE EARTHING TERMINAL, shall comply with the requirements of 14.3.2 a).

Such resistors, capacitors or RC-units shall be positioned inside the enclosure of the apparatus.

CLASS I apparatus shall be provided with a PROTECTIVE EARTHING TERMINAL or contact to which the protective earthing contacts of socket-outlets, if any, and ACCESSIBLE conductive parts shall be reliably connected. Such connection is not necessary for those ACCESSIBLE conductive parts which are insulated from HAZARDOUS LIVE parts by DOUBLE or REINFORCED INSULATION (CLASS II construction) or those which are protected from becoming HAZARDOUS LIVE by a conductive part reliably connected to the PROTECTIVE EARTHING TERMINAL.

NOTE 2 Examples of such a conductive part are a metal screen in a transformer between the primary and the secondary windings, a metal chassis, etc.

Compliance is checked by inspection.

8.6 For CLASS II apparatus, the ACCESSIBLE parts shall be separated from HAZARDOUS LIVE parts either by DOUBLE INSULATION specified under item a) or by REINFORCED INSULATION specified under item b).

This requirement does not apply to insulations whose short-circuiting does not cause any electric shock hazard.

EXAMPLE If one end of a secondary winding of a SEPARATING TRANSFORMER is connected to an ACCESSIBLE conductive part, the other end need not meet any special insulation requirement with regard to the same ACCESSIBLE conductive part.