



# UL 60065

## STANDARD FOR SAFETY

Audio, Video and Similar Electronic Apparatus –  
Safety Requirements

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

Eighth Edition, Dated September 30, 2015

### **Summary of Topics**

***This revision of ANSI/UL 60065 dated June 29, 2020 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.***

***UL 60065 is an adoption of IEC 60065, Audio, video and similar electronic apparatus – Safety requirements (Eighth Edition, issued June 2014). Please note that the national difference document incorporates all of the U.S. national differences for UL 60065.***

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

The requirements are substantially in accordance with Proposal(s) on this subject dated April 17, 2020.

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SEPTEMBER 30, 2015  
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ANSI/UL 60065-2015 (R2020)

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## UL 60065

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

Prior to the seventh edition, the requirements for the products covered by this standard were included in the Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use, UL 6500, First and Second Editions. UL 60065, seventh edition, was a new edition of UL 6500. The standard number and edition number were changed to correspond with the equivalent IEC 60065 standard.

Seventh Edition – June, 2003

#### Eighth Edition

September 30, 2015

This ANSI/UL Standard for Safety consists of the Eighth Edition including revisions through June 29, 2020.

The most recent designation of ANSI/UL 60065 as a Reaffirmed American National Standard (ANS) occurred on June 19, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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

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## Preface (UL)

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

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

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## NATIONAL DIFFERENCES

### GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication IEC 60065, Audio, video and similar electronic apparatus – Safety requirements, copyright 2014, are indicated by notations next to the clause, sub-clause, Table, Figure or Annex number.

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

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

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

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

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

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

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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### AUDIO, VIDEO AND SIMILAR ELECTRONIC APPARATUS – SAFETY REQUIREMENTS

## 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 nongovernmental 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

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

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.

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.)

#### Prevention

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

Discharge capacitors at hazardous voltages.

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.

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.

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 sub-assemblies;
- 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.

# AUDIO, VIDEO AND SIMILAR ELECTRONIC APPARATUS – SAFETY REQUIREMENTS

## 1 General

### 1.1 Scope

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

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

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

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

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

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

NOTE 1 Film projectors, slide projectors and overhead projectors are covered by IEC 60335-2-56 UL 122

- video cameras and video monitors;
- household 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 UL 22

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

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

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

NOTE 4 Includes cameras, stop motion recorders and the like used in alarm systems. This Standard does not cover the investigation of the actual alarm system.

- intercommunication apparatus, using low voltage MAINS as the transmission medium;
- cable head-end receivers;
- professional general use amplifiers, record or disc players, tape players, recorders, and public address systems;
- professional sound/video systems;

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

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

The requirements of IEC 60950-1 UL 60950-1 or UL 62368-1 may also be used to meet the requirements for safety of multimedia apparatus (see also IEC Guide 112).

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

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

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

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

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

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

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

NOTE 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.

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

**1.1.6 DR** Audio and video apparatus with nonmetallic enclosures, intended to be installed in air-handling spaces shall additionally comply with the requirements in UL 2043.

NOTE Apparatus such as dome cameras and public address system speakers having nonmetallic enclosures that extend inside the air-handling space after installation are subject to this requirement.

**1.1.7 DU** Baby monitors shall comply with ASTM F2951.

## 1.2 DC 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.

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

ASTM F2951, Consumer Safety Specification for Baby Monitors

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 Eb: 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*

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*Amendment 1:2009*

*Amendment 2:2013*<sup>1</sup>

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UL 150 . Antenna Rotators

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UL 508 . Industrial Control Equipment

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UL 746B . Polymeric Materials – Long Term Property Evaluations

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

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UL 817 , Cord Sets and Power-Supply Cords

UL 840 , Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 873 , Temperature-Indicating and -Regulating Equipment

UL 935 , Fluorescent-Lamp Ballasts

UL 1054 , Special-Use Switches

UL 1069 , Hospital Signaling and Nurse-Call Equipment

UL 1310 , Class 2 Power Units

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

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

UL 1419 , Professional Video and Audio Equipment

UL 1434 , Thermistor-Type Devices

UL 1441 , Coated Electrical Sleeving

UL 1446 , Systems of Insulating Materials – General

UL 1449 , Surge Protective Devices

UL 1577 , Optical Isolators

UL 1598 , Luminaires

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

## 2 Terms and definitions

### 2.1 DU Definitions in alphabetical order

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

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<u>ACCESSORY</u>	<u>2.8.14</u>
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AVAILABLE POWER	2.3.7
BASIC INSULATION	2.6.3
BY HAND	2.8.4
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<u>COMMERCIAL APPARATUS</u>	<u>2.2.12</u>
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<u>MAJOR ENCLOSURE PART</u>	<u>2.8.13</u>
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MICRO-DISCONNECTION	2.7.7
NOISE SIGNAL	2.5.2
NON-CLIPPED OUTPUT POWER	2.3.4
PERMANENTLY CONNECTED APPARATUS	2.4.2
PINK NOISE	2.5.1

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POTENTIAL IGNITION SOURCE	2.8.11
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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

#### 2.2.10.1 DU

STATIONARY APPARATUS

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

### 2.2.11

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 DU

PROFESSIONAL APPARATUS COMMERCIAL APPARATUS

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

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

### 2.2.13 DU

PROFESSIONAL APPARATUS

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

## 2.3 Ratings and electrical values

### 2.3.1

RATED SUPPLY VOLTAGE

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

### 2.3.2

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

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## 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 ( $\Delta W/\Delta f$ ) 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

**2.6.13 DU**FUNCTIONAL INSULATION

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

## 2.7 Components

### 2.7.1

ISOLATING TRANSFORMER

transformer with PROTECTIVE SEPARATION between the input and output windings

### 2.7.2

SEPARATING TRANSFORMER

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

Note 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 DU

ACCESSIBLE

possibility of touching by the test finger according to IEC 61032:1997, test probe B the articulated finger probe as shown in Figure 18

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.

### 2.8.13 DU

#### MAJOR ENCLOSURE PART

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

### 2.8.14 DU

#### ACCESSORY

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

## 3 General requirements

### 3.1 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 DU Components and subassemblies that comply with IEC 62368-1 UL 62368-1

Components and subassemblies that comply with IEC 62368-1 UL 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 DE 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 DU** 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.

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

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 DU** In addition, for an AUDIO AMPLIFIER:

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

Where the NON-CLIPPED OUTPUT POWER cannot be obtained using the standard signal, one-eighth of the maximum attainable output power but not less than 0.5 W per channel is taken.

As an alternative, where the amplifier function is not adversely affected, a sine wave of 1 kHz or where applicable, another frequency corresponding to the geometric mean of the upper and lower -3 dB response points of the relevant part of the apparatus may be used to supply each channel.

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

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).

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

**4.2.6** *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 DU – Test power supply

RATED SUPPLY VOLTAGE V d.c	Nominal no-load voltage V d.c	Internal resistance $\Omega$
1,5	2,25 <u>1.60</u>	0,75 <u>0.003</u>
3,0	4,50 <u>3.19</u>	1,50 <u>0.006</u>
4,5	6,75 <u>4.79</u>	2,25 <u>0.010</u>
6,0	9,00 <u>6.39</u>	3,00 <u>0.013</u>
7,5	11,25 <u>7.98</u>	3,75 <u>0.016</u>
9,0	13,50 <u>9.57</u>	4,50 <u>0.019</u>
12,0	18,00 <u>12.77</u>	6,00 <u>0.026</u>

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 of a 30 A minimum supply source with 6 percent regulation.

**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.

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

*These fault conditions do not apply to*

- a) *resistors complying with the requirements of 14.2 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, or UL 1434;*
- 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/m<sup>2</sup> 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 DU 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, Clause 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 *k*<sub>auri</sub>-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).

A label of conductive material secured in place by an adhesive shall withstand the oven and humidity conditions described in 12.8 when the label is capable of acting as a bridging agent and resulting in a risk of fire or electric shock when dislodged.

Six samples are to be tested, each secured to its intended mounting surface. Three samples are to be subjected to the air-circulating oven conditioning, and three samples are to be subjected to the humidity conditioning.

Each label shall withstand a minimum peel force of 5.0 N/30 mm width both before and after conditioning.

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 DR DU Identification and supply ratings

Power supplies and adapters complying with the construction and test requirements of UL 1310, UL 60950-1 or UL 62368-1 are considered to fulfill the marking requirements of items a through i of this subclause.

The apparatus shall be marked with the following:

- a) maker's or responsible vendor's name, trade mark or identification mark;
- b) model number or type reference;
- c) the symbol for CLASS II 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 %.

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

j) A distinctive identification to identify the factory of origin, when the same apparatus is produced at more than one factory. Rubbing compliance is not required.

k) When the enclosure of an apparatus provides the user with a means for access to parts which involve the risk of electric shock, the combination of the two graphical symbols and the supplemental marking – "CAUTION – RISK OF ELECTRIC SHOCK – DO NOT OPEN" – depicted in Figure 19 shall be provided on at least one surface of the apparatus enclosure through which the USER gains access to the interior.

All other enclosure surfaces that provide a means for access to the interior of the apparatus for servicing purposes shall be marked either as indicated in Figure 19, or with the graphical symbol depicted in Figure 20 adjacent to one of the enclosure fasteners on that surface.

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

m) CLASS I apparatus having touch current levels greater than 0.75 MIU and equal to or less than 3.5 MIU, as permitted in 9.1.1.1, shall be provided with the word "CAUTION" and the following marking or equivalent: "TO REDUCE THE RISK OF ELECTRIC SHOCK, GROUNDING OF THE CENTER PIN OF THIS PLUG MUST BE MAINTAINED." The marking shall be on a tag which shall be of substantial material such as cardboard, cloth, plastic or the equivalent to provide mechanical strength and to discourage removal. The tag shall have a hole and be secured to the cord by a plastic strap or the equivalent.

n) The grille/ventilation areas of the top surface of an apparatus that are limited in temperature rise in accordance with condition b of Table 3 are marked with the word "CAUTION" and the following or equivalent "HOT SURFACE". Alternately, one of the symbols shown in Figure 25 may be used.

o) Audio and video apparatus intended for installation in air handling spaces shall be marked, "Suitable for Air Handling Spaces" or "Suitable for Use in Other Environmental Air Spaces in Accordance with Section 300.22(C) of the National Electrical Code".

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 DR DU 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 frequency; 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.

When intended to be installed or interconnected in the field by a SKILLED PERSON, the Class of wiring shall be marked adjacent to the TERMINALS.

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

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

– "Class 1 Wiring" for TERMINALS with a measured open-circuit voltage exceeding 300 V r.m.s. when delivering NON-CLIPPED OUTPUT POWER, OR

– "Class 3 Wiring" for TERMINALS with a measured open-circuit voltage exceeding 120 V r.m.s. but not exceeding 300 V r.m.s. when delivering NON-CLIPPED OUTPUT POWER, OR

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

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

*Compliance is checked by inspection.*

#### 5.4 DU Caution marking

The following markings shall be included as applicable:

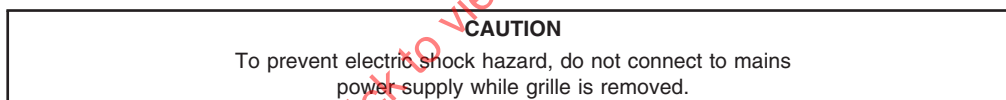
a) Where in a manufacturer’s service documentation, for example in circuit diagrams or lists of components, a symbol is used to indicate that a specific component shall be replaced only by the component specified in that documentation for safety reasons, the following symbol shall be used:

▲, 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:



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.

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

*Compliance is checked by inspection.*