

Audio, video and similar electronic apparatus — Safety requirements

The European Standard EN 60065:1998 has the status of a
British Standard

ICS 33.160.01; 97.030

National foreword

This British Standard is the English language version of EN 60065:1998 including Corrigendum June 1999. It was derived by CENELEC from IEC 60065:1998. It supersedes BS EN 60065/BS 415:1994 which will be withdrawn on 2002-08-01.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by a sideline in the margin. The UK participation in its preparation was entrusted to Technical Committee EPL/92, Safety of audio, video and similar electronic equipment, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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A list of organizations represented on this committee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change-over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

Attention is drawn to the fact that CEN and CENELEC standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 103 and a back cover.

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10393 Corrigendum	December 1998	Corrections to 1.1.1 and 3.1.
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English version

Audio, video and similar electronic apparatus Safety requirements

(IEC 60065:1998, modified)

Appareils audio, vidéo et appareils
électroniques analogues
Exigences de sécurité
(CEI 60065:1998, modifiée)

Audio-, Video- und ähnliche
elektronische Geräte
Sicherheitsanforderungen
(IEC 60065:1998, modifiziert)

This European Standard was approved by CENELEC on 1998-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of document 92/60/FDIS, future edition 6 of IEC 60065, prepared by IEC TC 92, Safety of audio, video and similar electronic equipment, together with the common modifications prepared by the Technical Committee CENELEC TC 92, was submitted to the CENELEC formal vote and was approved by CENELEC as EN 60065 on 1998-08-01.

This European Standard supersedes EN 60065:1993 + corrigenda November 1993 and September 1997 + A11:1997.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1999-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2002-08-01

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex ZA and Annex ZB are normative and Annex ZC is informative.

Annex ZA, Annex ZB and Annex ZC have been added by CENELEC.

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Introduction — Principles of safety

General

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

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

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

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

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

Hazards

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

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

Electric shock

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

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

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. The insulations shall have 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.

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

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

Excessive temperatures

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

Radiation

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

Implosion

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

Mechanical hazards

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

Fire

A fire can result from:

- overloads;
- component failure;
- insulation breakdown;
- bad connections;
- arcing.

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

The following preventive measures are recommended:

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

1. General

1.1 Scope

1.1.1 This International Standard applies to electronic apparatus designed to be fed from the MAINS or from a SUPPLY APPARATUS and intended for reception, generation, recording or reproduction respectively of audio, video and associated signals. It also applies to apparatus designed to be used exclusively in combination with the above mentioned apparatus. This standard concerns only safety aspects of the above apparatus; it does not concern other matters, such as style or performance.

For above-mentioned apparatus, which are fed from a supply source other than the MAINS or from a SUPPLY APPARATUS, and which contain a LASER SYSTEM or produce an internal OPERATING VOLTAGE greater than 4 000 V (peak), this standard applies as far as applicable.

NOTE 1 This standard can be used as a guide for the testing of battery operated apparatus.

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

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

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

NOTE 2 Video and flipper games for commercial use are covered by IEC 60335-2-82 [7]¹⁾

- juke boxes;
- electronic gaming and scoring machines;

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

- teletext equipment;
- record and optical disc players;
- tape and optical disc recorders;
- antenna signal converters and amplifiers;
- antenna positioners;
- Citizen's Band apparatus;
- apparatus for IMAGERY;
- light effect apparatus;
- intercommunication apparatus, using low voltage MAINS as the transmission medium.

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.

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

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

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

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

- apparatus falling within the scope of IEC 60950;
- dictation apparatus;

¹⁾ Figures in square brackets refer to the bibliography given in Annex P.

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

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

- IEC 60027 (all parts), *Letter symbols to be used in electrical technology*.
- IEC 60038:1983, *IEC standard voltages*.
- IEC 60068-2-3:1969, *Environmental testing — Part 2: Tests — Test Ca: Damp heat, steady state*.
- IEC 60068-2-6:1995, *Environmental testing — Part 2: Tests — Test Fc: Vibration (sinusoidal)*.
- IEC 60068-2-32:1975, *Environmental testing — Part 2: Tests — Test Ed: Free fall (Procedure 1)*.
- IEC 60068-2-75:1997, *Environmental testing — Part 2-75: Tests — Test Eh: Hammer tests*.
- IEC 60085:1984, *Thermal evaluation and classification of electrical insulation*.
- IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*.
- IEC 60127 (all parts), *Miniature fuses*.
- IEC 60167:1964, *Methods of test for the determination of the insulation resistance of solid insulating materials*.
- IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*.
- IEC 60245 (all parts), *Rubber insulated cables — Rated voltages up to and including 450/750 V*.
- IEC 60249-2 (all specifications), *Base materials for printed circuits — Part 2: Specifications*.
- IEC 60268-1:1985, *Sound system equipment — Part 1: General*.
- IEC 60317 (all parts), *Specifications for particular types of winding wires*.
- IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*.
- IEC 60335-1:1991, *Safety of household and similar electrical appliances — Part 1: General requirements*.
- IEC 60384-1:1982, *Fixed capacitors for use in electronic equipment — Part 1: Generic specification*.
- IEC 60384-14:1993, *Fixed capacitors for use in electronic equipment — Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*. Amendment 1 (1995)
- IEC 60417 (all parts), *Graphical symbols for use on equipment. Index, survey and compilation of single sheets*.
- IEC 60454 (all parts), *Specifications for pressure-sensitive adhesive tapes for electrical purposes*.
- IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*.
- IEC 60536:1976, *Classification of electrical and electronic equipment with regard to protection against electric shock*.
- IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests*.
- IEC 60664-3:1992, *Insulation coordination for equipment within low-voltage systems — Part 3: Use of coatings to achieve insulation coordination of printed board assemblies*.
- IEC 60691:1993, *Thermal links — Requirements and application guide*.
- IEC 60695-2-2:1991, *Fire hazard testing — Part 2: Test methods — Section 2: Needle-flame test*.
- IEC 60707:1981, *Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source*.
- IEC 60730 (all parts), *Automatic electrical controls for household and similar use*.
- IEC 60738 (all parts), *Directly heated positive step-function temperature coefficient thermistors*.

- IEC 60825-1:1993, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide.*
- IEC 60884 (all parts), *Plugs and socket-outlets for household and similar purposes.*
- IEC 60885-1:1987, *Electrical test methods for electric cables — Part 1: Electrical tests for cables, cords and wires for voltages up to and including 450/750 V.*
- IEC 60906 (all parts), *IEC system of plugs and socket-outlets for household and similar purposes.*
- IEC 60950:1991, *Safety of information technology equipment.*
- IEC 60990:1990, *Methods of measurement of touch-current and protective conductor current.*
- IEC 60998-2-2:1991, *Connecting devices for low-voltage circuits for household and similar purposes — Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units.*
- IEC 60999:1990, *Connecting devices — Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors.*
- IEC 61032:1990, *Test probes to verify protection by enclosures.*
- IEC 61058-1:1996, *Switches for appliances — Part 1: General requirements.*
- IEC 61149:1995, *Guide for safe handling and operation of mobile radio equipment.*
- IEC 61260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters.*
- IEC 61293:1994, *Marking of electrical equipment with ratings related to electrical supply — Safety requirements.*
- ISO 261:1973, *ISO general purpose metric screw threads — General plan.*
- ISO 262:1973, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts.*
- ISO 306:1994, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST).*
- ISO 7000:1989, *Graphical symbols for use on equipment — Index and synopsis.*

2 Definitions

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

2.1 Definitions in alphabetical order

	Subclause
ACCESSIBLE	2.8.3
ALL-POLE MAINS SWITCH	2.7.11
AUDIO AMPLIFIER	2.2.1
AVAILABLE POWER	2.3.7
BASIC INSULATION	2.6.3
BY HAND	2.8.4
CLASS I	2.6.1
CLASS II	2.6.2
CLEARANCE	2.6.11
CONDUCTIVELY CONNECTED TO THE MAINS	2.4.4
CONDUCTIVE PATTERN	2.7.13
CREEPAGE DISTANCE	2.6.12
DIRECTLY CONNECTED TO THE MAINS	2.4.3
DOUBLE INSULATION	2.6.4
ELECTRONIC MUSICAL INSTRUMENT	2.2.2
FIRE ENCLOSURE	2.8.10
HAZARDOUS LIVE	2.6.10
IMAGERY	2.2.8
INSTRUCTED PERSON	2.8.6
ISOLATING TRANSFORMER	2.7.1

	Subclause
LASER	2.2.7
LASER SYSTEM	2.2.6
LOAD TRANSDUCER	2.5.4
MAINS	2.4.1
MANUALLY OPERATED MECHANICAL SWITCH	2.7.10
MICRO-DISCONNECTION	2.7.7
NOISE SIGNAL	2.5.2
NON-CLIPPED OUTPUT POWER	2.3.4
OPERATING VOLTAGE	2.3.2
PERMANENTLY CONNECTED APPARATUS	2.4.2
PINK NOISE	2.5.1
PORTABLE APPARATUS	2.2.10
POTENTIAL IGNITION SOURCE	2.8.11
PRINTED BOARD	2.7.12
PROTECTIVE EARTH TERMINAL	2.4.6
PROTECTIVE SCREENING	2.6.8
PROTECTIVE SEPARATION	2.6.7
PTC-S THERMISTOR	2.7.8
RATED CURRENT CONSUMPTION	2.3.6
RATED LOAD IMPEDANCE	2.3.5
RATED SUPPLY VOLTAGE	2.3.1
REINFORCED INSULATION	2.6.6
REMOTE CONTROL	2.2.9
RIPPLE FREE	2.3.3
ROUTINE TEST	2.8.2
SAFETY INTERLOCK	2.7.9
SEPARATING TRANSFORMER	2.7.2
SKILLED PERSON	2.8.5
SOURCE TRANSDUCER	2.5.3
SPECIAL SUPPLY APPARATUS	2.2.5
STAND-BY	2.8.8
SUPPLEMENTARY INSULATION	2.6.5
SUPPLY APPARATUS	2.2.3
SUPPLY APPARATUS FOR GENERAL USE	2.2.4
TELECOMMUNICATION NETWORK	2.4.7
TERMINAL	2.4.5
THERMAL CUT-OUT	2.7.4
THERMAL LINK	2.7.5
THERMAL RELEASE	2.7.3
TOUCH CURRENT	2.6.9
TRANSPORTABLE APPARATUS	2.2.11
TRIP-FREE	2.7.6
TYPE TEST	2.8.1
USER	2.8.7
WOOD-BASED MATERIAL	2.8.9

2.2 Types of apparatus

2.2.1

AUDIO AMPLIFIER

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

2.2.2

ELECTRONIC MUSICAL INSTRUMENT

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

2.2.3

SUPPLY APPARATUS

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

2.2.4

SUPPLY APPARATUS FOR GENERAL USE

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

2.2.5

SPECIAL SUPPLY APPARATUS

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

2.2.6

LASER SYSTEM

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

2.2.7

LASER

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

2.2.8

IMAGERY

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

2.2.9

REMOTE CONTROL

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

2.2.10

PORTABLE APPARATUS

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

2.2.11

TRANSPORTABLE APPARATUS

apparatus specifically designed to be moved frequently from place to place

2.3 Ratings and electrical values

2.3.1

RATED SUPPLY VOLTAGE

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

2.3.2**OPERATING VOLTAGE**

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

2.3.3**RIPPLE FREE**

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

2.3.4**NON-CLIPPED OUTPUT POWER**

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

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

2.3.5**RATED LOAD IMPEDANCE**

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

2.3.6**RATED CURRENT CONSUMPTION**

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

2.3.7**AVAILABLE POWER**

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

2.4 Supply and external connections**2.4.1****MAINS**

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

2.4.2**PERMANENTLY CONNECTED APPARATUS**

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

2.4.3**DIRECTLY CONNECTED TO THE MAINS**

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

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

2.4.4**CONDUCTIVELY CONNECTED TO THE MAINS**

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

2.4.5**TERMINAL**

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

2.4.6**PROTECTIVE EARTH TERMINAL**

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

2.4.7**TELECOMMUNICATION NETWORK**

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

NOTE It is assumed that adequate measures according to ITU-T Recommendation **K.11** have been taken to reduce the risk that over-voltages presented to apparatus exceed 1,5 kV (peak).

excluded are:

- MAINS systems for supply, transmission and distribution of electrical power, used as telecommunication transmission medium;
- TV distribution systems using cable;
- public or private mobile radio systems;
- radio paging systems.

2.5 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. Unless otherwise stated, the mean value is zero

2.5.3**SOURCE TRANSDUCER**

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

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

2.5.4**LOAD TRANSDUCER**

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

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

2.6 Protection against electric shock, insulations**2.6.1****CLASS I**

design in which protection against electric shock does not rely on BASIC INSULATION only, but which includes an additional safety precaution in such a way that means are provided for the connection of ACCESSIBLE conductive parts to the protective (earthing) conductor in the fixed wiring of the installation, in such a way that ACCESSIBLE conductive parts cannot become HAZARDOUS LIVE in the event of a failure of the BASIC INSULATION (see **3.2** of IEC 60536)

NOTE Such a design may have parts of CLASS II.

2.6.2**CLASS II**

design in which protection against electric shock does not rely on BASIC INSULATION only, but in which additional safety precautions, such as DOUBLE INSULATION or REINFORCED INSULATION, are provided, there being no provision for protective earthing or reliance upon installation conditions (see **3.3** of IEC 60536)

2.6.3**BASIC INSULATION**

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

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

2.6.4**DOUBLE INSULATION**

insulation comprising both BASIC INSULATION and SUPPLEMENTARY INSULATION (see **2.3** of IEC 60536)

2.6.5**SUPPLEMENTARY INSULATION**

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

2.6.6**REINFORCED INSULATION**

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

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

2.6.7**PROTECTIVE SEPARATION**

separation between circuits by means of basic and supplementary protection (BASIC INSULATION plus SUPPLEMENTARY INSULATION or plus PROTECTIVE SCREENING) or by an equivalent protective provision, for example REINFORCED INSULATION (see **2.9** of IEC 60536-2)

2.6.8**PROTECTIVE SCREENING**

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

2.6.9**TOUCH CURRENT**

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

2.6.10**HAZARDOUS LIVE**

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

2.6.11**CLEARANCE**

shortest distance in air between two conductive parts

2.6.12**CREEPAGE DISTANCE**

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

2.7 Components**2.7.1****ISOLATING TRANSFORMER**

transformer with PROTECTIVE SEPARATION between the input and output windings

2.7.2**SEPARATING TRANSFORMER**

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

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

2.7.3**THERMAL RELEASE**

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

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

2.7.4**THERMAL CUT-OUT**

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

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

2.7.5**THERMAL LINK**

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

2.7.6**TRIP-FREE**

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

2.7.7**MICRO-DISCONNECTION**

adequate contact separation so as to ensure functional security

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

2.7.8**PTC-S THERMISTOR**

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

2.7.9**SAFETY INTERLOCK**

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

2.7.10**MANUALLY OPERATED MECHANICAL SWITCH**

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

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

2.7.11**ALL-POLE MAINS SWITCH**

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

2.7.12**PRINTED BOARD**

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

2.7.13**CONDUCTIVE PATTERN**

configuration formed by electrically conductive material of a PRINTED BOARD

2.8 Miscellaneous**2.8.1****TYPE TEST**

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

2.8.2**ROUTINE TEST**

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

2.8.3**ACCESSIBLE**

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

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

2.8.4**BY HAND**

operation 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 SKILLED PERSONS to enable him or her to avoid dangers and to prevent risks which electricity may create

2.8.7**USER**

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

2.8.8**STAND-BY**

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

2.8.9**WOOD-BASED MATERIAL**

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

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

2.8.10**FIRE ENCLOSURE**

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

2.8.11**POTENTIAL IGNITION SOURCE**

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

3 General requirements

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

- hazardous currents passing through the human body (electric shock);
- excessive temperatures;
- hazardous radiations;
- effects of implosion and explosion;
- mechanical instability;

- injury by mechanical parts;
- start and spread of fire;
- exposure to excessive sound pressures from headphones or earphones.

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

NOTE A new method is under consideration by CENELEC/TC 206.

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

4 General test conditions

4.1 Conduct of tests

4.1.1 Tests according to this standard are TYPE TESTS.

NOTE For ROUTINE TEST, recommendations are given in Annex N.

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

As an alternative to carrying out tests on the complete apparatus, tests may be carried out separately on circuits, components or 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.

NOTE 1 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 2 In view of the amount of resources involved in testing and in order to minimize waste, it is recommended that all parties concerned jointly consider the test programme, the test samples and the test sequence.

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

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

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

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

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

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

Examples of such characteristics are source impedance and waveform.

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

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

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

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

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

4.2 Normal operating conditions

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

4.2.1 *The apparatus is connected to a supply voltage of 0,9 times or 1,06 times of any RATED SUPPLY VOLTAGE for which the apparatus is designed.*

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

For apparatus having a RATED SUPPLY VOLTAGE range not requiring the adjustment of a voltage setting device, the apparatus is connected to a supply voltage of 0,9 times the lower limit or 1,06 times the upper limit of any RATED SUPPLY VOLTAGE range; moreover, the apparatus is connected to any nominal supply voltage within the RATED SUPPLY VOLTAGE range marked on the apparatus.

Any rated supply frequency marked on the apparatus is used.

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

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

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

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

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

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

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

4.2.4 *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.

When determining whether a part or TERMINAL contact is HAZARDOUS LIVE according to 9.1.1 and 11.1, at the manufacturer's option the apparatus may also be operated in such a way as to deliver the NON-CLIPPED OUTPUT POWER to the RATED LOAD IMPEDANCE using a sinusoidal signal of 1 000 Hz or another frequency corresponding to the mid-frequency of the relevant amplifier part of the apparatus.

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

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

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

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

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

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

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

4.2.9 Antenna positioners

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

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

The movements and the resting 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.

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

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

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

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

Table 1 — 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

NOTE Table 1 provides a standardized set of supply parameters intended to represent those found in SUPPLY APPARATUS FOR GENERAL USE in the range 1,5 V to 12 V and with a rated output current of 1 A. Supply parameters for voltages > 12 V and output currents > 1 A are under consideration.

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

4.3 Fault conditions

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

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

Circuits, or parts of a circuit supplied with an open circuit voltage not exceeding 35 V (peak) a.c. or d.c. and not generating voltages above that value, are not considered to present a fire hazard if the current which may be drawn from the supplying circuit for more than 2 min at any load, including short-circuit, is limited to not more than 0,2 A. Such supplied circuits are not subject to fault conditions testing.

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

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

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

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

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

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

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

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

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

- heaters of electronic tubes;
- insulation between heaters and cathodes of electronic tubes;
- spacings in electronic tubes, excluding picture tubes;
- semiconductor devices, one lead at a time interrupted or any two leads connected together in turn [but see 4.3.4 d)].

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

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

These fault conditions do not apply to:

- a) *resistors complying with the requirements of 14.1 and, as far as applicable, of 11.2;*
- b) *PTC-S THERMISTORS complying with IEC 60738;*
- c) *capacitors and RC-units complying with the requirements of 14.2, provided that the voltage at their terminations does not exceed their rated voltage and that their application is in accordance with 8.5 or 8.6;*
- d) *the insulation between the input and output terminations of optocouplers complying with the requirements of 14.11;*
- e) *windings and the insulation of transformers and other windings mentioned in 14.3 complying with the requirements of that subclause.*

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

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

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

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

4.3.9 *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.*

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

Ventilating openings that are likely to be covered simultaneously are:

- openings on top of the apparatus, for example by a newspaper; or
- openings on the sides and the back, excluding the front, for example when pushed into a hanging curtain.

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

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

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

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

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

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

The test need not be made if the current consumption of the apparatus under test cannot exceed 0,2 A for more than 2 min, for example by the operation of a fuse.

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

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

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

The test need not be made if the current consumption of the apparatus under test cannot exceed 0,2 A for more than 2 min, for example by the operation of a fuse.

5 Marking and instructions

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

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

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

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

The petroleum spirit is an aliphatic solvent hexane having a maximum aromatics content of 0,1 % by volume, a kauri-butanol value of 29, an initial boiling point of approximately 65 °C, a dry-point of approximately 69 °C and a specific mass of approximately 0,7 kg/l.

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

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

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

Compliance is checked by inspection.

5.1 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, if applicable: 

(60417-2-IEC-5172)

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

e) Nature of supply:

- a.c. only with the symbol:  (60417-2-IEC-5032)
- d.c. only with the symbol:  (60417-2-IEC-5031)
- a.c. or d.c. with the symbol:  (60417-2-IEC-5033)
- for three-phase systems, reference shall be made to IEC 61293;

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

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

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

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

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

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

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

Compliance is checked by inspection.

5.2 TERMINALS

TERMINALS shall be marked as follows:

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



(60417-2-IEC-5019)

This symbol shall not be used for other earthing TERMINALS.

b) TERMINALS which are HAZARDOUS LIVE under normal operating conditions, except TERMINALS for MAINS supply:



(60417-2-IEC-5036)

c) Output TERMINALS provided for supply of other apparatus except MAINS supply shall be marked with the nominal output voltage and, in addition, the maximum output current, if with the most unfavourable load higher temperature rises than allowed in Table 2 can occur, unless the TERMINALS are marked with the type references of the apparatus which are permitted to be connected.

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

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

Compliance is checked by inspection.

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



(ISO 7000-0434)

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

This symbol shall not be placed on components.

Compliance is checked by inspection.

5.4 Instructions

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

NOTE 2 The following information with regard to safety are recommended to 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.

5.4.1 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 5.2 b) are HAZARDOUS LIVE and that the external wiring connected to these TERMINALS requires installation by an INSTRUCTED PERSON or the use of ready-made leads or cords.
- c) If an apparatus is provided with a replaceable lithium battery, the following applies:
 - if the battery is intended to be replaced by the USER, there shall be a warning close to the battery or in both the instructions for use and the service instructions;
 - if the battery is not intended to be replaced by the USER, there shall be a warning close to the battery or in the service instructions.

This warning shall include the following or similar text:

CAUTION

Danger of explosion if battery is incorrectly replaced.

Replace only with the same or equivalent type.

- d) Information as required according to 14.6.3.

Compliance is checked by inspection.

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

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).

NOTE 2 The value is according to ICRP 15, clause 289 [16].

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;*
- *not more than one flash-over 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 this subclause if:

- classification by the manufacturer according to IEC 60825-1, 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 Information about the measuring equipment is given in IEC 61040 [8].

NOTE 2 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, IEC 60825-1, clause 5 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 3 Soldered joints and paint locking are examples of adequate locking.

The laser radiation emitted by redirection as mentioned in IEC 60825-1, 3.32 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:

6.2.1

- a) The apparatus shall meet under normal operating conditions, the approachable emission limits of class 1 as specified in IEC 60825-1, Table 1. Time basis of the classification is 100 s.

Compliance is checked by performing the relevant measurements as specified in IEC 60825-1, 8.2.

- 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.

6.2.2

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 3A 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 3A limits are as specified in IEC 60825-1, Table 3.

Compliance is checked by performing the relevant measurements as specified in IEC 60825-1, 8.2

b) If the apparatus incorporates a LASER SYSTEM which meets, under fault conditions, the approachable emission limits given in 6.2.2 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 6.2.2 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.

7 Heating under normal operating conditions

7.1 General

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;*

NOTE 2 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.

— *in other cases, by any suitable method.*

Temperature rises shall not exceed the values specified in 7.1.1 to 7.1.5 inclusive.

Protective devices, except THERMAL CUT-OUTS with automatic reset and PTC-S THERMISTORS, affecting the safety of the apparatus shall not operate during the test.

7.1.1 ACCESSIBLE parts

The temperature rise of ACCESSIBLE parts shall not exceed the values given in Table 2, item a), “normal operating conditions”.

7.1.2 Parts, other than windings, providing electrical insulation

The temperature rise of insulating parts, other than windings, providing BASIC, SUPPLEMENTARY, 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 2, item b) “normal operating conditions”, taking into account note 4 of Table 2.

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 clauses 8 and 11 is checked.

7.1.3 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 2, item c) “normal operating conditions”.

7.1.4 Windings

The temperature rise of windings comprising insulation providing protection against electric shock or fire hazard shall not exceed the values given in Table 2, 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 clauses 8 and 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.

7.1.5 Parts not subject to a limit under 7.1.1 to 7.1.4 inclusive

According to the nature of the material, the temperature rise of the part shall not exceed the values given in Table 2, item e) “normal operating conditions”.

Table 2 — Permissible temperature rise of parts of the apparatus

Parts of the apparatus	Normal operating conditions K	Fault conditions K
a) <i>ACCESSIBLE parts</i> Knobs, handles, etc. if — metallic — non-metallic (note 3) Enclosures if — metallic (note 2) — non-metallic (notes 2 and 3)	30 50 40 60	65 65 65 65
b) <i>Parts providing electrical insulation (note 4)</i> Supply cords and wiring insulation with — polyvinyl chloride or synthetic rubber — not under mechanical stress — under mechanical stress — natural rubber Other insulations of: — thermoplastic materials (note 5) — non-impregnated paper — non-impregnated cardboard — impregnated cotton, silk, paper and textile — laminates based on cellulose or textile, bonded with — phenol-formaldehyde, melamine-formaldehyde, phenol-furfural or polyester — epoxy — mouldings of — phenol-formaldehyde or phenol-furfural, melamine and melamine phenolic compounds with — cellulose fillers — mineral fillers — thermosetting polyester with mineral fillers — alkyd with mineral fillers — composite materials of — polyester with glass-fibre reinforcement — epoxy with glass-fibre reinforcement — silicone rubber	60 45 45 (note 6) 55 60 70 85 120 100 110 95 95 95 100 145	100 100 100 (note 6) 70 80 90 110 150 130 150 150 150 150 190
c) <i>Parts acting as a support or a mechanical barrier including the inside of enclosures (note 4)</i> Wood and WOOD-BASED MATERIALS Thermoplastic materials (note 5)	60 (note 6)	90 (note 6)
d) <i>Winding wires (note 4)</i> — insulated with — non-impregnated silk, cotton, etc. — impregnated silk, cotton, etc. — oleoresinous materials	55 70 70	75 100 135

Table 2 — Permissible temperature rise of parts of the apparatus

Parts of the apparatus	Normal operating conditions K	Fault conditions K
— 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	50
All other parts, except resistors and parts of metal, glass, ceramic.	200	300

NOTE 1 General conditions applicable to Table 2:
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.

NOTE 2 For areas having no dimension exceeding 5 cm and for heat sinks or metallic parts directly covering heat sinks, without a dimensional restriction, which are not likely to be touched during intended use, temperature rises up to 65 K are allowed under normal operating conditions.

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.

NOTE 3 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.

NOTE 4 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 should not exceed those which have been proved to be satisfactory, for example in accordance with IEC 60085.

NOTE 5 Natural rubber and synthetic rubbers are not considered as being thermoplastic materials.

NOTE 6 Due to their wide variety, it is not possible to specify permissible temperature rises for thermoplastic materials.

While the matter is under consideration, the following method shall be used:

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

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

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

- under normal operating conditions, a temperature of 10 K below the softening temperature as obtained under item a);
- under fault conditions, the softening temperature itself.

If the required softening temperature exceeds 120 °C, note 3 shall be taken into account.

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 2 under item a) of note 6.

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 operation BY HAND, like

- changing the setting for the voltage or nature of supply;
- replacing fuse-links and indicator lights;
- 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 IEC 60167, clause 9, is subjected to a temperature of $(40 \pm 2) ^\circ\text{C}$, 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 10.3 without the humidity treatment according to 10.2.

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 5.2 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 shall comply with the requirements as specified in 14.1 a).

NOTE 2 Parts of the apparatus which have DOUBLE or REINFORCED INSULATION (CLASS II construction) may be bridged by a resistor in compliance with the requirements as specified in 14.1 a).

A capacitor or RC-unit bridging BASIC INSULATION between a HAZARDOUS LIVE part and an ACCESSIBLE conductive part connected to the PROTECTIVE EARTH TERMINAL, shall comply with the requirements of 14.2.1 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 EARTH TERMINAL or contact to which the protective earth 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 EARTH TERMINAL.

NOTE 3 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.

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 component complying with the requirements of 14.1 a) or 14.3, except components according to 14.3.4.3, may bridge BASIC, SUPPLEMENTARY, DOUBLE or REINFORCED INSULATION.

Components according to 14.3.4.3 may bridge BASIC INSULATION only.

BASIC and SUPPLEMENTARY INSULATIONS may each be bridged by a capacitor or RC-unit, having the same rated values, complying with the requirements of 14.2.1 a).

DOUBLE or REINFORCED INSULATION may be bridged by two capacitors or RC-units in series, having the same rated values, each complying with the requirements of 14.2.1 a).

Alternatively DOUBLE or REINFORCED INSULATION may be bridged by a single capacitor or RC-unit complying with the requirements of 14.2.1 b).

NOTE 2 For external insulation, bridging DOUBLE or REINFORCED INSULATION, also see 8.8.

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

Compliance is checked by inspection.

a) If ACCESSIBLE parts are separated from HAZARDOUS LIVE parts by BASIC and SUPPLEMENTARY INSULATION, the following shall apply:

Each of these insulations shall comply with the insulation requirements as specified in clause 10 and with the requirements for CLEARANCES and CREEPAGE DISTANCES specified in clause 13.

Enclosures of wood not complying with the requirements of 8.3 are permitted as SUPPLEMENTARY INSULATION if they withstand the dielectric strength test of 10.3.

Compliance is checked by inspection and/or measurement.

b) If ACCESSIBLE parts are separated from HAZARDOUS LIVE parts by REINFORCED INSULATION the following shall apply:

The insulation shall comply with the insulation requirements specified in clause 10. Moreover, it shall comply with the requirements for CLEARANCES and CREEPAGE DISTANCES specified in clause 13.

NOTE 3 An example of assessment of REINFORCED INSULATION is given in Figure 2.

Compliance is checked by inspection and/or measurement.

8.7 For voltages above 35 V (peak) up to and including 71 V (peak) a.c. or above 60 V d.c. up to and including 120 V d.c. (RIPPLE FREE), measured at the RATED SUPPLY VOLTAGE under normal operating conditions and under fault conditions, in deviation from 8.5 or 8.6 respectively, BASIC INSULATION meeting the requirements of clause 10 and clause 13 is sufficient, between circuits with the voltages above and ACCESSIBLE parts or parts connected to ACCESSIBLE conductive parts.

Circuits with the voltages above shall be separated from HAZARDOUS LIVE parts with higher voltages by DOUBLE or REINFORCED INSULATION according to 8.6 or by an ISOLATING TRANSFORMER according to 14.3.2 (CLASS II construction) or by a conductive part connected to the PROTECTIVE EARTH TERMINAL according to 8.5 or by a transformer according to 14.3.3 (CLASS I construction).

Compliance is checked by inspection.

8.8 BASIC, SUPPLEMENTARY and REINFORCED INSULATION shall each withstand the dielectric strength test as specified in 10.3.

For DOUBLE INSULATION either the BASIC or the SUPPLEMENTARY INSULATION shall have a thickness of at least 0,4 mm.

REINFORCED INSULATION shall have a minimum thickness of 0,4 mm when not subject to any mechanical stress which, at the temperatures during normal operating conditions and under fault conditions, would be likely to lead to deformation or deterioration of the insulating material.

NOTE Under mechanical stress conditions the thickness may have to be increased to comply with the insulation requirements as specified in clause 10 and the mechanical strength requirements as specified in clause 12.

The above requirements are not applicable to insulation in thin sheet materials irrespective of their thickness provided that:

- it is used within the enclosure of the apparatus, and
- BASIC or SUPPLEMENTARY INSULATION comprises at least two layers of material, each of which will pass the dielectric strength test specified in **10.3** for BASIC or SUPPLEMENTARY INSULATION, or
- BASIC or SUPPLEMENTARY INSULATION comprises three layers of material for which all combinations of two layers together pass the dielectric strength test specified in **10.3** for BASIC or SUPPLEMENTARY INSULATION, or
- REINFORCED INSULATION comprises at least two layers of material, each of which will pass the dielectric strength test specified in **10.3** for REINFORCED INSULATION, or
- REINFORCED INSULATION comprises three layers of insulation material for which all combinations of two layers together pass the dielectric strength test specified in **10.3** for REINFORCED INSULATION.

There is no requirement for all layers of insulation to be of the same insulating material.

Compliance is checked by inspection and measurement.

8.9 The insulation of internal wiring between HAZARDOUS LIVE conductors in wires or cables and ACCESSIBLE parts, or between HAZARDOUS LIVE parts and conductors in wires or cables connected to ACCESSIBLE conductive parts, shall have a thickness of at least 0,4 mm if made of polyvinyl chloride. Other materials are allowed provided that they withstand the dielectric strength test specified in **10.3** and that their thickness ensures an equivalent mechanical strength, where the construction so requires.

NOTE For example a polytetrafluoroethylene (PTFE) insulation having a thickness of at least 0,24 mm is considered to fulfil this requirement.

Compliance is checked by inspection and measurement.

8.10 In CLASS II apparatus DOUBLE INSULATION shall be provided between

- ACCESSIBLE parts and conductors in wires or cables CONDUCTIVELY CONNECTED TO THE MAINS and
- conductors in wires or cables connected to ACCESSIBLE conductive parts and parts CONDUCTIVELY CONNECTED TO THE MAINS.

Either the BASIC or the SUPPLEMENTARY INSULATION shall comply with the requirements of **8.9**. The other insulation shall withstand the dielectric strength test specified in **10.3** for BASIC or SUPPLEMENTARY INSULATION.

If DOUBLE INSULATION consists of two layers which cannot be tested separately, it shall withstand the dielectric strength test specified in **10.3** for REINFORCED INSULATION.

The test voltage of **10.3** is applied between the conductor and metal foil wrapped tightly around the insulation of the wire over a length of 10 cm.

In the case of insulating sleeves, the test voltage of **10.3** is applied between a tight-fitting metal rod inserted into the sleeve and a metal foil wrapped tightly around the sleeve over a length of 10 cm.

Compliance is checked by inspection and measurement.

8.11 The construction of the apparatus shall be such that, should any wire become detached, the CLEARANCES and CREEPAGE DISTANCES are not reduced below the values specified in clause **13** by the natural movement of a detached wire. This requirement does not apply if there is no risk of a wire becoming detached.

NOTE 1 It is assumed that not more than one connection will become detached at the same time.

Compliance is checked by inspection and measurement.

NOTE 2 Examples of methods deemed to prevent a wire from becoming detached are:

- a) the conductor of the wire is anchored to the tag before soldering, unless breakage close to the soldering place is likely to occur as a result of vibration;
- b) wires are twisted together in a reliable manner;
- c) wires are fastened together reliably by cable ties, adhesive tapes with thermosetting adhesives according to IEC 60454, sleeves or the like;
- d) the conductor of the wire is inserted into a hole in a PRINTED BOARD before soldering, the hole having a diameter slightly greater than that of the conductor, unless breakage close to the PRINTED BOARD is likely to occur as a result of vibration;
- e) the conductor of the wire and its insulation, if any, are securely wrapped around the termination by means of a special tool;
- f) the conductor of the wire and its insulation, if any, are crimped to the termination by means of a special tool.

The methods under items a) up to and including f) apply to internal wires and the methods under items a) up to and including c) to external flexible cords.

*In case of doubt, the vibration test of **12.1.2** is carried out to verify compliance.*