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INTERNATIONAL STANDARD

colour inside

Safety requirements for radio transmitting equipment – General requirements and terminology

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COMMISSION

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SAFETY REQUIREMENTS FOR RADIO TRANSMITTING EQUIPMENT – GENERAL REQUIREMENTS AND TERMINOLOGY

FOREWORD

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International Standard IEC 60215 has been prepared by IEC technical committee 103: Transmitting equipment for radiocommunication.

This fourth edition cancels and replaces the third edition, published in 1987, Amendment 1:1989 and Amendment 2:1993. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- The test methods in this standard are similar to those given in IEC 60215:1987 and continue to apply only to radio transmitting equipment and equipment defined in Clause 1, operating under the responsibility of SKILLED persons.
- Reorganization and revision of the content are summarized in Annex F.

Words printed in SMALL CAPITALS are terms that are defined in Clause 3.

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

FDIS	Report on voting
103/143/FDIS	103/146/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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

SAFETY REQUIREMENTS FOR RADIO TRANSMITTING EQUIPMENT – GENERAL REQUIREMENTS AND TERMINOLOGY

1 Scope

This International Standard applies to radio transmitting equipment, operating under the responsibility of SKILLED persons. It also applies to auxiliary equipment and ancillary apparatus, including combining units and matching networks and cooling systems where these form an integral part of the transmitter system.

The requirements of IEC 60215 may also be used to meet safety requirements for cognate equipment. Examples of equipment that could be within the scope of this International Standard are shown in Table 1.

Table 1 – Examples of equipment

Generic product type	Specific example of generic type
RF amplifiers	High power RF amplifiers used for industrial, medical or scientific applications
High-voltage power supplies (HVPS)	DC HVPS based on PSM technology or any cognate technology

Table 1 is not intended to be comprehensive, and equipment that is not listed is not necessarily excluded.

When the equipment is to be manufactured and/or installed in territories that have safety standards covering the scope of this International Standard that are more stringent, then those standards apply.

Antenna systems, associated feeder lines and matching networks, not forming an integral part of the transmitter, are excluded.

This International Standard does not apply to transmitters of safety-insulated construction using DOUBLE INSULATION or REINFORCED INSULATION and without provision for protective earthing. This type of equipment is designated CLASS II EQUIPMENT and is usually marked with a symbol as shown in 3.2.2 b).

This International Standard does not apply to battery powered transmitters or to radio base stations and fixed terminal stations for wireless telecommunication, as this equipment is covered by other standards.

2 Normative references

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

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

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

IEC 60244-6, *Methods of measurement for radio transmitters – Part 6: Cabinet radiation at frequencies between 130 kHz and 1 GHz*

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

IEC 60695-1-10, *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*

IEC 60695-1-11, *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment*

IEC 60825-12, *Safety of laser products – Part 12: Safety of free space optical communication systems used for transmission of information*

IEC 62232, *Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure*

IEC 62311, *Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz)*

ISO 1999, *Acoustics – Estimation of noise-induced hearing loss*

Directive 2011/65/EU of the European Parliament and the Council of 8 June 2011 on the restriction of the use of hazardous substances in electrical and electronic equipment

3 Terms, definitions and symbols

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

3.1 Terms and definitions

3.1.1
skilled
having the necessary knowledge and practical experience of electrical and radio engineering to appreciate the various hazards that can arise from working on radio transmitters including auxiliaries, and to take appropriate precautions to ensure the safety of personnel

Note 1 to entry: Guidance on assessing the competence of personnel for designation as SKILLED is given in Annex B.

Note 2 to entry: The above definition and the guidance in Annex B detail the minimum requirements for a SKILLED PERSON. In some countries more stringent requirements for qualifications, training and experience are stipulated, with formal certification.

3.1.2
unskilled
not SKILLED

3.1.3
operator
operating company and operating personnel

3.1.4
operator area
area in which the ICNIRP occupational exposure limits apply

3.1.5
electrically safe
unable to cause a harmful electric shock or radio-frequency skin burn

3.1.6
creepage distance
shortest distance measured in air, over the surface of the insulation, between two conductive parts, or between a conductive part and the chassis of the equipment

3.1.7
clearance
shortest distance, measured in air, between two conductive parts, or between a conductive part and the chassis of the equipment

3.1.8
by hand
without the use of a tool, coin or any other object

3.1.9
accessible part
part which can be touched by either of the standard test fingers described in IEC 60529, when applied in any direction with a force not exceeding 30 N

Note 1 to entry: In addition to guarding against flashover, any part carrying a voltage is regarded as an ACCESSIBLE PART if its distance to the test finger is less than the CLEARANCE given in Annex A.

3.1.10
enclosure
space in which items of the equipment that might be dangerous are located, and access to which is prevented, for example, with locked doors or with cover plates which cannot be removed without using a tool

3.1.11
safety device
part or component provided for the purpose of protecting personnel from possible injury

3.1.12
Class II equipment
equipment 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 reliance on protective earthing

3.1.13
basic insulation
insulation that provides basic protection against electric shock

3.1.14
double insulation
insulation comprising both BASIC INSULATION and an independent insulation in order to reduce the risk of electric shock in the event of a failure of the BASIC INSULATION

3.1.15
reinforced insulation
single insulation system that provides a degree of protection against electric shock equivalent to DOUBLE INSULATION

3.2 Symbols

As far as practicable, the symbols given below conform to those given in IEC 60417.

3.2.1 General symbols

a) AC supply		IEC 60417-5032 (2002-10)
b) DC supply		IEC 60417-5031 (2002-10)
c) AC and DC supply		IEC 60417-5033 (2002-10)
d) Three-phase AC supply		IEC 60417-5032-1 (2002-10)
e) Earth		IEC 60417-5017 (2006-08)
f) Aerial; antenna		IEC 60417-5039 (2006-08)
g) Special disposal restrictions apply		

3.2.2 Symbols relating to safety

a) Safety earth		IEC 60417-5019 (2006-08)
b) Equipment of safety insulated construction (CLASS II EQUIPMENT)		IEC 60417-5172 (2003-02)
c) Dangerous voltage		IEC 60417-5036 (2002-10)
d) Ionizing radiation		ISO 7000-0907 (2004-01)
e) High temperature		IEC 60417-5041 (2002-10)

3.2.3 Symbols relating to degree of protection against moisture

IP codes (International Protection Marking) are used to indicate the degree of protection against the intrusion of solid particles or water. The first digit of the code indicates the protection against solid particles and the second digit the protection against ingress of water. Where no protection is specified for solid particles, this digit is replaced with the letter X.

The the following IP codes apply for ingress of water:

IPX0	Non-protected
IPX1	Protected against vertically falling water drops
IPX2	Protected against vertically falling water drops when enclosure tilted up to 15°
IPX3	Protected against spraying water
IPX4	Protected against splashing water
IPX5	Protected against water jets
IPX6	Protected against powerful water jets
IPX7	Protected against the effects of temporary immersion in water
IPX8	Protected against the effects of continuous immersion in water
IPX9	Protected against high pressure and temperature water jets

4 Principle of safety

4.1 General principles

It is essential that designers understand the underlying principles of safety requirements in order that they can engineer safe equipment.

Designers shall take into account not only normal operating conditions of the equipment but also fault conditions, foreseeable misuse and external influences such as temperature, altitude, pollution, moisture and overvoltages on the mains supply. Dimensioning of insulation spacing should take account of possible reductions by manufacturing tolerances, or where deformation could occur due to handling, shock ageing and vibration likely to be encountered during manufacture, transport and normal use.

There are two types of person whose safety needs to be considered, SKILLED persons and UNSKILLED persons.

Requirements for protection should assume that UNSKILLED persons are not trained to identify hazards, but will not intentionally create a hazardous situation. Consequently, the requirements provide protection for cleaners and casual visitors and all other UNSKILLED persons. In general, UNSKILLED persons should not have access to hazardous parts, whether or not such parts are marked or barriered.

4.2 Object

This International Standard specifies requirements intended to reduce risks of

- electric shock,
- skin burns,
- high temperature and fire,
- injury from harmful radiation, and
- mechanical or any other hazard,

for the persons who may come into contact with the equipment covered by this International Standard.

This International Standard is intended to reduce such risks with respect to installed equipment, whether it consists of a system of interconnected units or independent units, subject to installing, operating and maintaining the equipment in the manner prescribed by the manufacturer.

Design and construction requirements and, where appropriate, test methods are specified covering the following:

a) the safety of SKILLED personnel when operating, carrying out routine adjustments, and as far as practicable, during fault finding and repairing the equipment;
b) the safety of personnel, including UNSKILLED personnel directed by SKILLED personnel, when the equipment is operating normally, and also when operating under certain specific fault conditions which may arise in normal use;
c) the prevention of fire and its spread.

These requirements do not necessarily ensure the safety of UNSKILLED personnel working on the equipment when it is not in normal operation.

Tests are specified, where appropriate, for checking that the equipment meets the safety requirements of this International Standard when operating normally and also under the specified fault conditions. The tests should be carried out on a representative

set of equipment in order to determine whether the design meets the requirements of this International Standard. The tests are neither mandatory nor limiting and may be modified by agreement between manufacturer and purchaser.

The use of this International Standard is not, however, intended to be restricted to type tests. It may also be used for acceptance tests after installation of the equipment, for tests after modifications to parts of the equipment, and for tests at appropriate intervals to ensure the continuing safety of the equipment throughout its life.

5 Operating conditions

5.1 General

Clause 5 sets out the range of conditions of normal use and the fault conditions under which the equipment may operate without danger to personnel, including UNSKILLED personnel directed by SKILLED personnel. The equipment shall meet the safety requirements of this International Standard when operating under the conditions of normal use given in 5.2 and also when any of the initial fault conditions detailed in 5.3 have been applied.

5.2 Conditions of normal use

The conditions of normal use are as follows.

a) The temperature and humidity conditions shall be compliant with the material specification as well as within conditions agreed between manufacturer and purchaser.

b) Temperature and humidity shall never be such as to cause condensation on the equipment.

c) Where no specific environmental condition exists, the atmospheric conditions shall be within the following range:

   – temperature: +5 °C to +45 °C;

   – relative humidity: 45 % to 75 %, without condensation;

   – air pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar).

d) The supply voltage and frequency shall be within the range for which the equipment has been designed.

e) For AC equipment, the waveform of the supply voltage shall be substantially sinusoidal.

f) For equipment which may be operated from AC or DC, either supply shall be applied separately.

g) The safety earth terminals or contacts, if any, (see 7.2.1) and any other earth terminal shall be connected to earth, unless they are designed to be tightened BY HAND, in which case they shall be left unconnected.

h) The access doors and cover plates or other protective covers, if any, shall be closed or fixed in position unless they are designed to be opened or removed BY HAND, in which case they may be left open or removed.

i) The equipment shall operate in any position for which it has been designed to be used.

j) The equipment shall be controllable at any operating state.

k) The equipment shall operate with any input signal condition and output load given in the equipment specification.

5.3 Fault conditions

Operating under fault conditions denotes that, with the equipment operating under the conditions of normal use given in 5.2, one of the faults a) to i) listed below is present, together with any associated consequential faults arising. The initial faults shall be applied separately, in turn, in any convenient order.

The faults are as follows:

a) short circuits across CREEPAGE DISTANCES, if they are less than the values given in Annex A, unless the insulation materials are resistant to tracking and non-flammable (for details see 7.6);

b) short circuits across CLEARANCES, if they are less than the values given in Annex A;

c) a potentially dangerous failure of any component as determined from inspecting the equipment and studying the circuit diagram, unless the component is known to comply with an IEC test recommendation appropriate to the conditions of use in the equipment;

d) connection of any unfavourable impedance to the radio-frequency output connection, including open circuits and short circuits;

e) failure of any cooling system;

f) continuous operation of motors, intended for intermittent operation, unless protection against this is included in the equipment;

g) locking of moving parts in rotating or linear operating devices, if these parts can be jammed by mechanical failure;

h) the loss of one or more phases on a three-phase supply;

i) the loss of the neutral conductor on a three-phases, four wire supply.

5.4 General conditions for tests

General conditions for tests shall comply with the international standards which define the methods of measurement of the equipment concerned.

Partial deviated test conditions might be mutually agreed between purchaser and supplier.

6 Components and construction

6.1 Introductory remark

The purpose of Clause 6 is to ensure that the equipment is designed and constructed to ensure safety of the personnel throughout the life of the equipment, starting from the development through the operation of entire systems and the disposal of disused equipment.

Where no test method is given, compliance shall be checked by visual inspection and where appropriate by functional test.

6.2 Components

6.2.1 General requirements

Components shall not be loaded in excess of their ratings under normal conditions nor, as far as practicable, under fault conditions. Normal and fault conditions are described in 5.2 and 5.3

Components which are known to comply with an IEC test recommendation appropriate to the conditions of use in the equipment need not be tested.

When this is not so, the components may be tested either in the equipment or externally under conditions equivalent to those applying in the equipment. The number of components to be tested shall be agreed between manufacturer and purchaser.

6.2.2 Connectors

The following requirements apply.

a) Connectors shall be designed so that they cannot be mated in a manner which might cause a hazard, for example, a connector for a circuit other than a supply circuit shall not be able to accept a mains supply connector. Mains supply connectors shall not be used for any other purpose, for example for low-voltage supplies or signal circuits.

b) Connectors shall be constructed so as to prevent a bare wire inserted into the connector from penetrating the connector and making contact with any other part.

c) Connectors and internal connections for ancillary purposes such as monitoring shall have CLEARANCE and CREEPAGE DISTANCES to other circuits at least twice those specified in Annex A.

d) Connectors with a non-detachable cord or cable shall comply with the country-specific safety standard.

6.2.3 Switches

Circuit breakers and manually-operated switches for the mains supply and other supply circuits shall have adequate making and breaking capacity under conditions of normal use. Circuit breakers shall also have adequate making and breaking capacity under fault conditions.

Switches, including circuit breakers and safety isolators, shall disconnect the equipment simultaneously from all poles of the supply source necessary to make the equipment safe.

In case of three-phase supplies using an arrangement of single phase breaker, the neutral pole shall not be protected.

An indication of the ON and OFF positions of such switches shall be provided and be clearly visible.

NOTE In some countries local regulations require that the neutral pole be isolated to render the equipment safe and in others that this not be done.

6.2.4 Fuse links

Fuse links shall have an enclosed fuse element. Where practicable, the rating of the fuse link shall be marked on the fixed part of the assembly or adjacent to it.

Special fusing characteristics such as time delay or breaking capacity shall at least be indicated in the manual.

6.2.5 Parts subject to corrosion

The equipment shall be so constructed so that there is no danger to personnel resulting from the failure of any part due to corrosion.

Tests shall be agreed between manufacturer and purchaser.

6.2.6 Fibre optics

In order to prevent eye injury, fibre optic transmitters of laser class 1 (eye safe) shall be used to prevent fibre optics allowing powered laser light at dangerous intensity.

Equipment containing fibre optics of laser class 1M or higher and accessible to SKILLED persons or UNSKILLED persons shall be in accordance with IEC 60825-12.

6.2.7 Batteries

The following requirements apply.

a) The equipment shall not contain
   - any battery or accumulator that contains more than 0,000 5 % of mercury by weight; and
   - portable batteries or accumulators, including those incorporated into appliances that contain more than 0,002 % of cadmium by weight;

b) Batteries, accumulators and battery packs shall be appropriated marked with the symbol shown in 3.2.1 g).

c) If equipment is provided with a replaceable battery, and if replacement by an incorrect type could result in an explosion (for example, with some lithium batteries), there shall be a marking close to the battery or a statement in the operating and servicing instructions. This marking or statement shall include the following or similar text:

CAUTION: RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS

6.3 Construction

6.3.1 General

The following requirements apply.

a) The equipment shall, as far as practicable, be constructed of non-flammable materials and shall have adequate strength to ensure safety.

b) No hazardous substances according to the “Restriction of hazardous substances” (RoHS) Directive 2011/65/EU shall be used, except where the directive allows exemption.

c) Where the slackness of electrical connections could constitute a hazard, their tightness shall not be dependent upon the degree of compression applied to an insulating material.

d) Screws which serve both as electrical and mechanical connections shall be adequately locked.

e) Moving parts liable to cause personal injury shall be adequately guarded.

f) Where parts can be set in motion by remote control, suitable precautions shall be incorporated to prevent possible injury and shall have suitable labelling adjacent to the remotely controlled part.

g) Equipment shall be mechanically designed to minimize the possibility of injury to personnel from sharp edges, protruding corners, hot pipes, the release of potential energy from, for example, a spring, etc. Warnings shall be displayed where appropriate.

h) Attention shall be paid in the design of equipment to minimize the generation of acoustic noise, as exposure to excessive noise can cause damage to hearing and to the nervous system. Where noise exceeds the safe value recommended in ISO 1999, notices shall be displayed giving the safe exposure time allowed and recommending that ear protectors be worn. Such noise levels may, for example, exist in rooms housing cooling plant for large transmitters.

6.3.2 Resistance to humidity

Tests to check the resistance to humidity shall be agreed between manufacturer and purchaser and shall be made after the equipment has been subjected to the appropriate damp heat test given in IEC 60068-2-1.

6.3.3 Resistance to ingress of water

If the transmitter is specified as protected against the ingress of water (see IP codes in 0), it shall remain safe when tested under the conditions agreed between manufacturer and

purchaser. The test shall be made after the equipment has been subjected to the appropriate sealing test given in IEC 60068-2-1.

6.3.4 Housing of batteries

The arrangements for housing lead-acid and nickel-cadmium batteries shall provide adequate ventilation to remove noxious gas and vapours and ensure that leakage of electrolyte will neither cause damage to other parts nor endanger personnel.

6.4 Markings relevant to safety

The following safety marking shall be used:

a) Marking shall be indelible and remain easily legible and discernible throughout the life of the equipment. Compliance is checked by visual inspection and by the following tests:
   - it shall not be possible to remove the marking by rubbing lightly in turn with two pieces of cloth, one soaked with water, the other with petroleum spirit;
   - when exposed to sunlight, the marking shall not fade so as to become illegible.

b) Safety-markings shall, as far as practicable, be in the language appropriate to the area in which the equipment is to be used. Symbols should be used to avoid language problems.

c) Switches and isolators specifically provided to render equipment safe shall be clearly marked as such to prevent ambiguity between these switches and other switches. The marking shall be in accordance with 6.4 b).

d) Parts which serve as protection against harmful radiation, and which are intended to be removed during servicing, shall be marked with an appropriate warning.

Service instructions and safety related instructions shall be provided in the language agreed between manufacturer and customer.

7 Protection against harmful electric shock, and radio-frequency skin burns

7.1 General

The conditions for a part to be ELECTRICALLY SAFE are either

a) that the voltage between the part and earth, and also between the part and any other ACCESSIBLE PART, does not exceed 72 V peak when measured with an instrument having an internal resistance of not less than 10 kΩ/V;

   or

b) that the voltage exceeds 72 V peak, but the limits in Table 2 and Table 3 with regard to both current and capacitance apply.

Table 2 – Current limits

Frequency	Current limit [a]
DC	2 mA
< 1 kHz	0,7 mA (peak)
1 kHz to 100 kHz	(0,7 × f) mA (peak)
> 100 kHz	70 mA (peak)

[a] The current is measured in a non-inductive resistor of 2 kΩ connected between the part concerned and earth or any other ACCESSIBLE PART, and f is the frequency in kilohertz.

Table 3 – Capacitance limits

Voltage range, U (peak value) V	Capacitance limit [a] μF
72 to 450	0,1
450 to 15 000	$45/U$
> 15 000	$675\ 000/U^2$

[a] The indicated limit is the capacitance between the part and earth, or any other ACCESSIBLE PART, and the peak voltage (U) is measured in volts with an instrument having an internal resistance of not less than 10 kΩ/V.

Further information on the effects of a current passing through the human body is given in E.2.

Clause 7 specifies requirements for protection against electric shock from energized parts. It sets out the design principles to be followed for transmitters in which dangerous voltages are present.

Where no test method is given, compliance shall be checked by visual inspection and, where appropriate, by a functional test.

7.2 Earthing

7.2.1 Safety earth terminal

Accessible conductive parts shall be reliably connected to a safety earth.

In addition, the following provisions apply.

a) Equipment to be connected to fixed wiring:

A separate safety earth terminal shall be used. The terminal should be adjacent to the mains terminals, and shall be marked with the appropriate symbol. The material of the earth terminal shall be electrolytically compatible with a copper earth conductor.

It shall not be possible to loosen the earth connection BY HAND.

b) Equipment provided with a non-detachable flexible cord or cable:

The requirements of 7.2.1 a) apply. In addition, the cord or cable used for connecting the equipment to the mains supply shall include an insulated earth conductor of adequate cross-section, colour-coded in accordance with the national standard where the equipment is installed. This conductor shall be connected to the safety earth terminal of the equipment and, if a plug is provided, to the safety earth contact of the plug.

c) Equipment provided with a mains supply connector:

The mains supply connector shall incorporate a safety earth contact which shall be an integral part of the connector. The safety earth shall make contact before the supply when inserting the connector; it shall break after the supply is broken when removing the connector.

d) Misuse of safety terminals and contacts:

Safety earth terminals and safety earth contacts shall not be used for any other purpose.

7.2.2 Safety earth connections

The following shall be observed.

a) Means used for assembling the various metal parts of an ENCLOSURE are considered sufficient for ensuring continuity of earthing if the precautions taken guarantee permanent good conductivity and a suitably low impedance to the safety earth, so that ACCESSIBLE

PARTS are ELECTRICALLY SAFE, both under normal conditions of use and under fault conditions. For cover plates, unequipped panels, other protective covers, etc. the usual metal screwed connections or low impedance plug contacts are considered sufficient to ensure continuity, provided that no electrical equipment is attached to them and that there is some part of the panel that has metal-to-metal contact with the frame. If electrical parts are attached to such items, then separate conductors providing suitably low impedance shall be used.

b) Safety earth conductors shall not be used for any other purpose.

7.3 Enclosures

7.3.1 General

The requirements for SAFETY DEVICES preventing access to ENCLOSURES whilst dangerous voltages are present are given in 7.3.2 below.

Permissible voltages remaining on the equipment after the ENCLOSURES have been opened are given in 7.3.3. Some additional safety provisions are given in 7.3.4.

7.3.2 Safety devices relating to enclosures

The following steps shall be followed:

a) It shall not be possible to open access doors, or to remove cover plates or other protective covers which are designed to be removed BY HAND, before all dangerous voltages have been removed and ACCESSIBLE PARTS have been made ELECTRICALLY SAFE. In addition, all parts subject to peak voltages in excess of 1 000 V with respect to earth should be earthed by means of a safety earthing switch before such removal or opening is possible.

b) The protection shall be accomplished by SAFETY DEVICES forming part of the equipment. The design of the safety system shall be such that the safety of personnel is not dependent solely upon the satisfactory operation of relays, contactors, circuit breakers, etc., which are electrically or magnetically operated or employ hydraulic or pneumatic arrangements. For additional mechanical considerations concerning SAFETY DEVICES, refer to 7.4.

c) The coupling between the safety mechanism and the locking of the means of access shall be effected in such a way that it will not be possible to gain access to an ENCLOSURE without the SAFETY DEVICES having operated correctly. To achieve this, a mechanical system shall be used.

d) The reapplication of dangerous voltages shall not be possible until the earth connection established by the safety earthing switch, if any, has been disconnected, and any cover plates have been replaced and access doors closed.

e) The safety system for equipment with access doors for ENCLOSURES shall include an arrangement to enable any person entering the ENCLOSURE to prevent the doors being closed and dangerous voltages being reapplied while the person is inside.

7.3.3 Voltages remaining on the equipment

Parts becoming accessible after access doors have been opened, or cover plates or other protective covers designed to be removed BY HAND have been removed, shall be ELECTRICALLY SAFE in accordance with 7.1.

In addition to the voltages which are allowed under 7.1 a), it is permitted to have voltages on the equipment which do not comply with the requirements of 7.1 b), provided that these voltages are not accessible and are less than 358 V peak with respect to earth under normal operation, or under foreseeable fault condition as measured with an instrument having an internal resistance of not less than 10 k Ω/V. Access shall be prevented by means of separate protective covers which cannot be removed BY HAND. These covers shall carry an appropriate warning in accordance with 6.4 b).

7.3.4 Additional provisions

As far as practicable, earthing wands shall be provided as an additional safety measure. Such wands shall consist of an insulated handle, appropriate for the voltage encountered in the equipment, with a rigid conducting hook at one end. A flexible conductor of adequate cross-sectional area shall connect the conducting hook visibly to earth. If insulation is used on the conductor, it shall be transparent and loosely fitting over the conductor. The earth connection of the wire to the hook shall be bolted and visible at all times

The design of the equipment shall be such that it is impossible to receive an electric shock by touching insulating material surfaces on the exterior, such as windows for viewing instruments, decorative features, etc., which are not earthed.

Compliance is checked by a voltage test in accordance with 7.1.

7.4 Mechanical considerations concerning safety devices

The following requirements apply.

a) SAFETY DEVICES shall be designed in accordance with the "fail-safe" principle. They shall remain in or go to a condition which provides protection to personnel in the event of a fault within the device.

b) There shall be no possibility of a false indication of safety.

c) The operation of SAFETY DEVICES shall be such that transition from the "safe" position to the "unsafe" position cannot be carried out without deliberate action, nor shall there be ambiguity between the "safe" position and the "unsafe" position.

d) It shall not be possible to disable a SAFETY DEVICE BY HAND.

e) SAFETY DEVICES shall be designed to withstand such mishandling as may be expected in practice and continue to remain effective throughout the life of the equipment.

f) Safety earthing switches shall be so constructed and mounted that the closing of the contacts is directly visible from a safe location.

g) Handles, knobs, etc., forming part of the safety system shall be reliably fixed to their shafts. Mechanical drives shall be such as to prevent the possibility of slip or incorrect registration. This shall be ensured by positive means such as keys, fully-secured pins, etc.

h) All parts of the safety system, including mechanical couplings, bearings, taper pins, etc., shall be reasonably accessible for inspection and maintenance.

7.5 Wiring and termination

The following requirements apply.

a) All conductors and cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal condition of service.

b) Conductors within the equipment which are intended for monitoring, keying, control or modulating purposes, and which are connected to external circuits shall be protected from possible contact with the other conductors within the equipment by adequate insulation, and preferably by physical separation, or by the use of an earthed screen.

c) The terminating arrangement for flexible cables shall ensure that the electrical connections are free from mechanical strain and that the cables are protected from abrasion.

d) Self-tapping (thread-cutting or thread-forming) screws shall not be used for the electrical connection of current-carrying parts, unless they generate a full form standard machine screw thread.

7.6 Insulation

Where CREEPAGE DISTANCE is smaller than the values specified in Annex A, the insulating material shall be non-tracking and non-flammable.

For material other than ceramic, the comparative tracking index shall be determined by the test method given in IEC 60112. The insulating material will be considered to be non-tracking if the comparative tracking index is equal to or greater than 175. Flammability shall be checked by the appropriate test given in IEC 60695-1-10 and IEC 60695-1-11.

Smaller CREEPAGE DISTANCES are allowed inside vibrators and tubes, on tube bases and sockets, relays, plugs and sockets, transistors, micro-modules and similar devices, provided that they comply with their own specification.

7.7 Voltages at the radio-frequency output connection

Transmitter radio-frequency output connections which are not ELECTRICALLY SAFE, especially those for open wire feeders, are permitted if personnel cannot unintentionally approach a position where danger might exist. Guards or screens shall be provided where necessary.

As far as practicable the radio-frequency output connection shall be arranged to drain off to earth any charges due to, for example, the accumulation of static charges which may give rise to dangerous voltages. Attention is drawn to the fact that high voltages may exist at the transmitter output terminals due to coupling from other transmitters operating on the same site, and in such cases means shall be provided for making the parts affected ELECTRICALLY SAFE.

8 High temperature, fire and miscellaneous hazards

8.1 Introductory remark

The purpose of Clause 8 is to ensure that personnel are not liable to injury from parts becoming excessively hot during normal operation and also that high temperature conditions do not arise which could cause fire or other hazards. Clause 8 also covers a number of additional hazards which the equipment shall be designed to avoid. When no test method is given, compliance shall be checked by visual inspection and, where appropriate, by functional test.

8.2 High temperatures

8.2.1 Permissible temperature rise under conditions of normal use

No ACCESSIBLE PART of the equipment shall attain temperatures which might cause injury to personnel and no part shall attain temperatures which might cause deterioration of electrical insulation or impairment of mechanical strength.

Maximum touch temperature limits are specified in Annex E.

Other factors such as OPERATOR comfort and the need to provide reasonable working conditions may, however, often dictate a lower allowable temperature rise.

8.2.2 Temperature rise under fault conditions

Under the specific fault conditions (see 5.3), no part of the equipment shall reach a temperature giving rise to danger or fire or the release of flammable or toxic gases.

Compliance with this requirement shall be checked by the following test.

- If the temperature rise is limited by the operation of a thermal trip, overload trip or fuse, the temperatures shall be measured 2 min after the operation of the device.
- If no such device is fitted, the temperatures shall be measured when the maximum temperature is attained, but for no longer than 6 h of operation of the equipment.
- The temperatures shall be compared with the maximum safe working temperatures for the components and materials used. The maximum values of temperature rise under fault conditions indicated in IEC 60065 may be used as a guide.

8.3 Fire

Equipment shall be so constructed that possibility of fire and its spread is minimized.

The use of flammable materials, for example, non-fire-retardant plastics, should be avoided wherever reasonably practicable. See also 7.6 and 8.2.2.

Where it is not possible to avoid the use of components containing flammable fluids, measures shall be taken to contain any fluid leakage and to prevent it coming into contact with components that might reach temperatures near to the ignition point of the fluid, or whose insulation may be damaged by it.

8.4 Implosion and explosion

8.4.1 General requirements

Components which are liable to implosion or explosion shall be so protected that personnel will not be exposed to danger.

8.4.2 Implosion

Cathode-ray tubes or picture tubes of measuring or monitoring equipment with a maximum face dimension exceeding 16 cm shall either be intrinsically safe or the ENCLOSURE shall provide adequate protection against the effects of an implosion.

A non-intrinsically-safe tube shall be provided with a protective screen which cannot be removed BY HAND. If a separate screen of glass is used, it shall not be in contact with the surface of the tube. If the screen is removable, it shall have a clearly visible warning in letters not less than 3 mm in height. The warning shall require that the screen be in position before the equipment is made available for use.

Compliance shall be checked by visual inspection.

8.4.3 Explosion

Components which may cause danger by exploding shall be equipped with a safety valve or have a clearly marked “weak spot” in their structure to prevent the development of excessive pressures.

The safety valve or “weak spot” shall be so situated that there will be no danger to personnel in the event of operating.

8.5 Harmful radiation

8.5.1 Non-ionizing radiation, including electromagnetic fields

The transmitter shall be so constructed that there is no danger to personnel from any stray or cabinet non-ionizing radiation at radio frequencies.

The electric or magnetic components of any stray electric and magnetic fields produced by the transmitting equipment shall not exceed the values given in Annex D in the OPERATOR AREAS. Warning signs shall be placed where higher limits may occur.

Radio base station equipment with integrated antennas is excluded from assessments if the manufacturer has assessed compliance using other relevant standards, such as IEC 62232, EN 50383, EN 50384 and EN 50385, and provides installation instructions ensuring compliance with the exposure limits.

Compliance shall be checked under normal operating conditions using appropriate measuring instruments and antennas according IEC 60244-6, or IEC 62311 or IEC 62232.

8.5.2 Ionizing radiation

The equipment shall be so constructed that there is no danger to personnel due to harmful ionizing radiation.

Compliance shall be checked by measuring the amount of ionizing radiation at any readily accessible point 10 cm from the outer surface of the ENCLOSURE.

The value shall be less than 1 μSv/h (0,1 mR/h) measured under normal operating conditions.

NOTE This value is consistent with ICRP 103.

The method of measurement to be used shall be such that the whole spectrum of ionizing radiation is included.

8.5.3 General requirements concerning radioactive materials

A warning notice shall be affixed to equipment using tubes or any other items in which radioactive materials have been deliberately incorporated.

Full instructions for the handling, storage and disposal of such devices shall be given in the equipment handbook, together with a note explaining the hazards associated with the materials.

NOTE National regulations exist governing the use of radioactive material. Some countries have regulations concerning the registration, storage and disposal of devices containing radioactive material.

8.5.4 General requirements concerning lasers

If an item of equipment contains lasers, a laser notice shall be affixed to the equipment. Classification of lasers shall follow IEC 60825:

- lasers of class 2 and above require hazard labelling;
- lasers of classes 3 or 4 shall have suitable protection incorporated within the equipment to prevent eye damage; this may include interlocking.

8.6 Dangerous materials

Any dangerous materials incorporated in the equipment shall be listed in the equipment handbook which shall contain full instructions for the safe handling, storage and disposal of the materials, together with a note explaining the hazards associated with the materials contained in the components.

NOTE Some countries have additional regulations governing the storage and disposal of dangerous materials.

8.7 Dangerous short-circuiting of low-voltage supplies

Conductors and terminations in equipment containing high-current/low-voltage parts such as tube filament supplies and high-capacity batteries, although ELECTRICALLY SAFE as defined in 3.1.5, are liable to give rise to severe arcing or overheating if accidentally short-circuited, with the possibility of injury to personnel and the risk of fire.

Equipment containing such high-current/low-voltage parts shall be designed and constructed so as to minimize the possibility of dangerous short-circuiting.

Annex A
(normative)

Clearance and creepage distances

The CLEARANCES and CREEPAGE DISTANCES between parts shall be adequate to avoid failure under such conditions as a deposit of dust or moisture.

The CLEARANCES and CREEPAGE DISTANCES given in Table A.1 below are the minimum actual separation, taking into account tolerances in assemblies and piece-parts.

Table A.1 – Clearances and creepage distances

DC or peak voltage (U)[a] V	**RMS voltage ($U/\sqrt{2}$)** V	**CLEARANCE** mm	**CREEPAGE DISTANCE** mm
72 to 354	50 to 250	3	3
354 to 500	250 to 360	3	4
500 to 1 400	360 to 1 000	$2 + U/500$	$2 + U/250$
>1 400	>1 000		
		Unless another criterion is agreed between manufacturer and purchaser, distances shall be such that no brush discharge can occur when the relevant parts are subjected to a voltage test with $2U$ V	

[a] U is the DC voltage or peak AC voltage (up to a frequency of 1 000 Hz) under conditions of normal use, i.e. normal working + 10 %.

NOTE If an insulating part contains a groove and /or ridge of less than 1 mm width, the CREEPAGE DISTANCE is not measured over the surface of the groove and/or ridge, but only across its width.

If a CLEARANCE consists of two or more air gaps in series separated by conductive parts, any gap of less than 1 mm width is ignored in computing the total distance.

Annex B
(normative)

Guidance on assigning the competence of personnel for designation as skilled

The definition of SKILLED in 3.1.1 is intended to ensure that personnel are considered to be SKILLED only if they are competent to take responsibility both for their own safety and for that of UNSKILLED personnel under their immediate supervision, when working on the transmitter.

Competence, in the current context, necessitates adequate technical knowledge, adequate practical experience, and adequate detailed knowledge of the particular transmitter installation to avoid danger to personnel.

Training requirements for a SKILLED person should not be confined solely to technical matters and, preferably, should include first-aid treatment, especially methods of artificial resuscitation, respiration and external cardiac compression (heart massage).

In practice it is not possible to give precise details of the technical knowledge, training and experience necessary for a SKILLED person because this depends on the type of transmitter and the duties concerned, which range from normal operation of a simple transmitter to the maintenance of a sophisticated transmitter containing high voltage as described in Annex C.

Annex C
(normative)

Guidance on safety precautions to be observed by personnel working on radio transmitting equipment

C.1 Introductory remark

To ensure the safety of personnel working on radio transmitters and associated equipment, a full appreciation of the various hazards involved is required.

The factors covered with respect to such work are as follows:

– general precautions to be taken when using voltages exceeding 72 V peak;
– special precautions to be taken when using high radio-frequency voltages, often much higher than the voltages indicated above;
– the effects of electromagnetic fields existing in the vicinity of antennas and antenna leads which may introduce fire hazards, danger of electric shock, burns to personnel and other harmful physiological effects;
– explosion hazards where flammable gases are present;
– the risk, run by personnel working on structures or buildings, of falls which may be complicated by shock through accidental contact with live conductors.

C.2 Dangerous voltages and currents

Fundamentally, current rather than voltage is the criterion of shock intensity. The passage of even a very small current through a vital part of the human body can cause death. The voltage necessary to produce the fatal current is dependent upon the resistance of the body, the contact conditions, the path through the body, etc.

Detailed information on the effect of electric shock is given in IEC 60479.

C.3 Electric shock: first-aid treatment

Electric shock may result in interruption of natural breathing. Immediate action is necessary to restore the breathing and it is therefore essential that personnel are familiar with the various methods of artificial respiration and heart massage.

Defibrillators are a useful addition to first aid treatment equipment.

In the case of high-voltage accidents urgent medical aid is needed to treat the effects of poisonous products in the body caused by severe burns.

In all cases, medical assistance shall be called.

It is necessary to check all personnel engaged in the operation and maintenance of transmitting equipment in which dangerous voltages may be present, for their ability to apply artificial resuscitation and to make arrangements for additional first-aid training of such personnel whenever needed.

C.4 Operation of transmitting equipment

The following apply.

a) The equipment shall be kept constantly in such condition as to comply with the relevant safety requirements.

b) At regular intervals, the condition of the equipment and the correct functioning of protective and SAFETY DEVICES shall be checked by a SKILLED person approved by the appropriate authority for this duty.

   Functional checks shall be carried out on interlocking systems of doors, mechanical interlocks, isolating switches, earthing switches, parallel resistances and protective devices against overvoltages and overcurrents.

   The above checks shall also be carried out after the protective and SAFETY DEVICES have operated under fault conditions.

   The SAFETY DEVICES shall not be altered or disconnected except for replacement, nor shall the safety circuit be modified without specific approval of the appropriate authority in each case.

c) All covers giving protection against accidental contact with dangerous voltages shall be kept closed under conditions of normal operation. They shall only be opened for maintenance or repair, when approved by the SKILLED person responsible. Covers which are designed for removal by tool shall not be modified to be operated BY HAND.

d) All metal ENCLOSURES and covers of electrical and electronic equipment shall be effectively earthed, and care shall be taken to maintain these protective earth connections. For fix screwed cover plates, the usual metal screwed connections or low impedance plug contacts are considered sufficient to ensure continuity, provided that no electrical equipment is attached to them and that there is some part of the panel that has metal-to-metal contact with the frame. If electrical parts are attached to such items, then separate conductors providing suitably low impedance shall be used.

e) The room occupied by equipment of open construction is to be considered as an ENCLOSURE, within the meaning of 3.1.10.

f) When energizing a radio transmitter, the SKILLED person responsible shall satisfy himself that there is no-one at work on the equipment or its associated antenna system, that any work which may have been in progress is sufficiently completed to permit transmission, that no tools, test equipment or hand lamps are left in or on the equipment, and that all test or ancillary apparatus connected for the purpose of testing has been removed.

C.5 Procedure for establishing the absence of voltage

The following procedure applies.

a) Before starting work on the equipment, it shall be isolated from the mains supply. This disconnection shall always be checked by visual inspection. Further precautions shall be taken to ensure that the mains supply cannot be restored whilst work is being carried out (see also 7.3.2).

   After the mains supply has been disconnected, all other lines such as control and interlocking shall be disconnected if they carry dangerous voltages. Moreover, the antenna or the antenna transmission line shall be disconnected from the antenna terminal device to prevent the introduction of dangerous voltages due to antenna pick-up. When disconnection of the antenna or antenna transmission line is not possible, other suitable precautions shall be taken, for example, earthing, when necessary at several places, to establish absence of voltage. These earthing connections shall be very short compared with the wavelength.

b) Capacitors which are connected to a circuit isolated from its supply shall be discharged and have their terminals permanently short-circuited and the casing earthed during the whole period of the work.

c) The electrical charge retained by electrical machinery when stopped may, in certain cases, be sufficient to cause a severe shock. This shall be taken into account when making connections to an apparently "dead" machine. Therefore all machinery shall be discharged and earthed using an adequately insulated lead for this purpose. The discharge operation shall be repeated several times.

d) Before any maintenance work is carried out on automatic or remote controlled equipment, the remote or automatic switching circuits shall be made inoperative. Precautions shall be taken to ensure that the remote or automatic switching cannot be restored whilst work is being carried out. If appropriate, locking keys should be in the possession of the person carrying out the work.

C.6 Procedure for determination of the absence of voltage

After the equipment has been isolated according to C.5, the absence of voltage shall be determined at the work place. This may be done by the use of voltage indicators, measuring instruments, glow-discharge lamps for indicating radio-frequency voltages or other suitable means. High-voltage exposed parts shall be earthed through attaching an earthing wand, but this should only be carried out after determination of the absence of voltage by other means.

C.7 Working on live circuits

Work on live circuits with voltages exceeding the limits laid down in 7.1 0 or work in proximity to such circuits shall be restricted to a minimum. Such work may be performed only if the following conditions are met.

– The work shall be carried out by an authorized person, SKILLED in electrical engineering, watched by at least one other person who has been instructed and is able to switch off voltage without delay and, moreover, has been trained to render first aid by means of artificial respiration and cardiac massage.

– There should be no possibility of hazardous ionizing or non-ionizing radiation.

– The work shall be performed in such a manner that there is no danger from arcing or currents flowing through the body.

– Suitable equipment, test facilities and tools shall be used for the work to be carried out safely.

– Suitable measures shall be taken to indicate the areas of danger.

– The work shall be performed only for compelling reasons; for example, because in the absence of live voltages it would be impossible to do the work or to localize the fault.

NOTE In some countries more stringent rules and/or regulations apply.

C.8 Other hazards

C.8.1 Radio-frequency radiation hazards

The following requirements apply.

a) The maximum levels of power density in the microwave range and/or the electric and magnetic components of field strength at lower radio frequencies to which personnel may be exposed shall not exceed the national limits of the country concerned. For countries which have not yet adopted a national standard for permissible non-ionizing radiation levels, guidance may be obtained from the ICNIRP (International Commission on Non-ionizing Radiation Protection) *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)* (see Annex D).

b) Personnel shall never make a direct visual examination of any microwave radiator, reflector, waveguide, horn or any concentrated beam radiating system during periods of operation.

C.8.2 Eye protection

Personnel shall never make a direct visual examination of any fibre optic or laser source system during periods of operation.

Annex D
(normative)

Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)

Reference levels for exposure to time-varying electrical and magnetic fields are given in Tables D.1 and D.2. They are an extract from the ICNIRP (International Commission on Non-Ionizing Radiation Protection) *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)* (1998).

Table D.1 – Reference levels for occupational exposure to time-varying electrical and magnetic fields (unperturbed r.m.s. values)

Frequency range	E-field strength V/m	H-field strength A/m	B-field strength μT	Equivalent plane wave power density, S_{eq} W/m^2
Up to 1 Hz	–	$1{,}63 \times 10^5$	2×10^5	–
1 Hz to 8 Hz	20 000	$1{,}63 \times 10^5/f^2$	$2 \times 10^5/f^2$	–
8 Hz to 25 Hz	20 000	$2 \times 10^4/f$	$2{,}5 \times 10^4/f$	–
0,025 kHz to 0,82 kHz	$500/f$	$20/f$	$25/f$	–
0,82 kHz to 65 kHz	610	24,4	30,7	–
0,065 MHz to 1 MHz	610	$1{,}6/f$	$2{,}0/f$	–
1 MHz to 10 MHz	$610/f$	$1{,}6/f$	$2{,}0/f$	–
10 MHz to 400 MHz	61	0,16	0,2	10
400 MHz to 2 000 MHz	$3\sqrt{f}$	$0{,}008\sqrt{f}$	$0{,}01\sqrt{f}$	f/40
2 GHz to 300 GHz	137	0,36	0,45	50
NOTE f is the frequency as indicated in the frequency range column.				

Table D.2 – Reference levels for general public exposure to time-varying electrical and magnetic fields (unperturbed r.m.s. values)

Frequency range	E-field strength V/m	H-field strength A/m	B-field strength μT	Equivalent plane wave power density, S_{eq} W/m^2
Up to 1 Hz	–	$3{,}2 \times 10^4$	4×10^4	–
1 Hz to 8 Hz	10 000	$3{,}2 \times 10^4/f^2$	$4 \times 10^4/f^2$	–
8 Hz to 25 Hz	10 000	$4\,000/f$	$5\,000/f$	–
0,025 kHz to 0,8 kHz	$250/f$	$4/f$	$5/f$	–
0,8 kHz to 3 kHz	$250/f$	5	6,25	–
3 kHz to 150 kHz	87	5	6,25	–
0,15 MHz to 1 MHz	87	$0{,}73/f$	$0{,}92/f$	–
1 MHz to 10 MHz	$87/\sqrt{f}$	$0{,}73/f$	$0{,}92/f$	–
10 MHz to 400 MHz	28	0,073	0,092	2
400 MHz to 2 000 MHz	$1{,}375\sqrt{f}$	$0{,}003\,7\sqrt{f}$	$0{,}004\,6\sqrt{f}$	f/200
2 GHz to 300 GHz	61	0,16	0,2	10
NOTE f is the frequency as indicated in the frequency range column.				

Figures D.1 and D.2 show a comparison of the reference levels given in Tables D.1 and D.2.

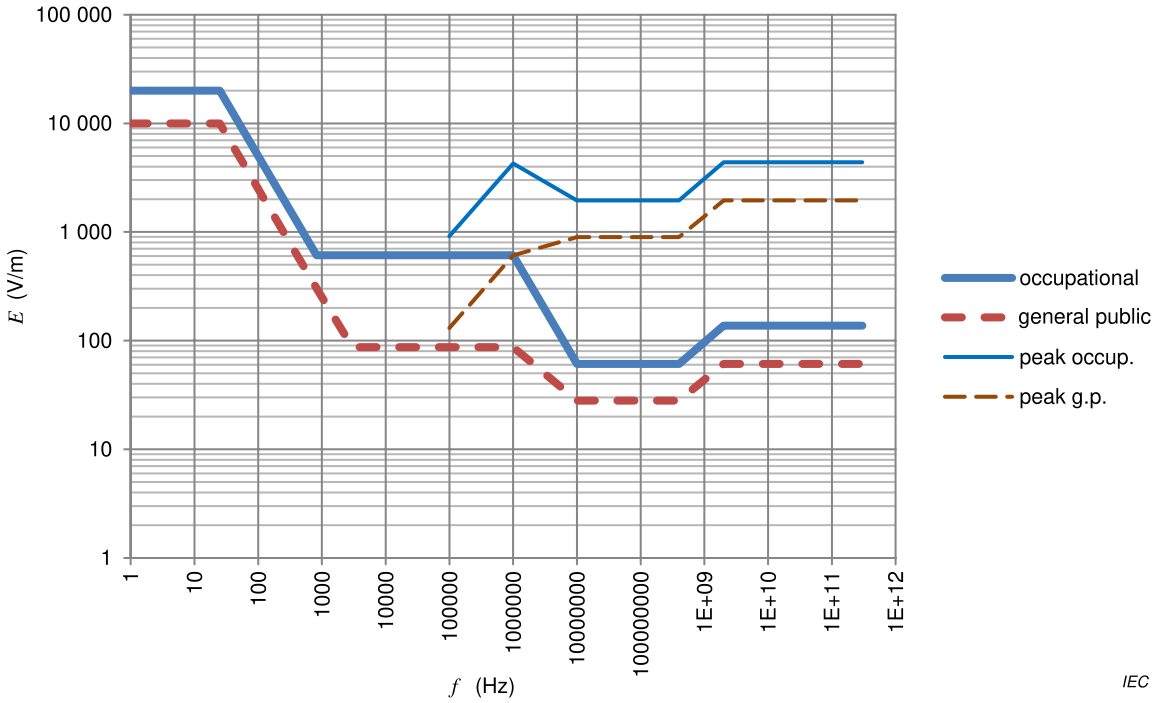

Figure D.1 – Reference levels for exposure to time-varying electrical fields comparing Tables D.1 and D.2

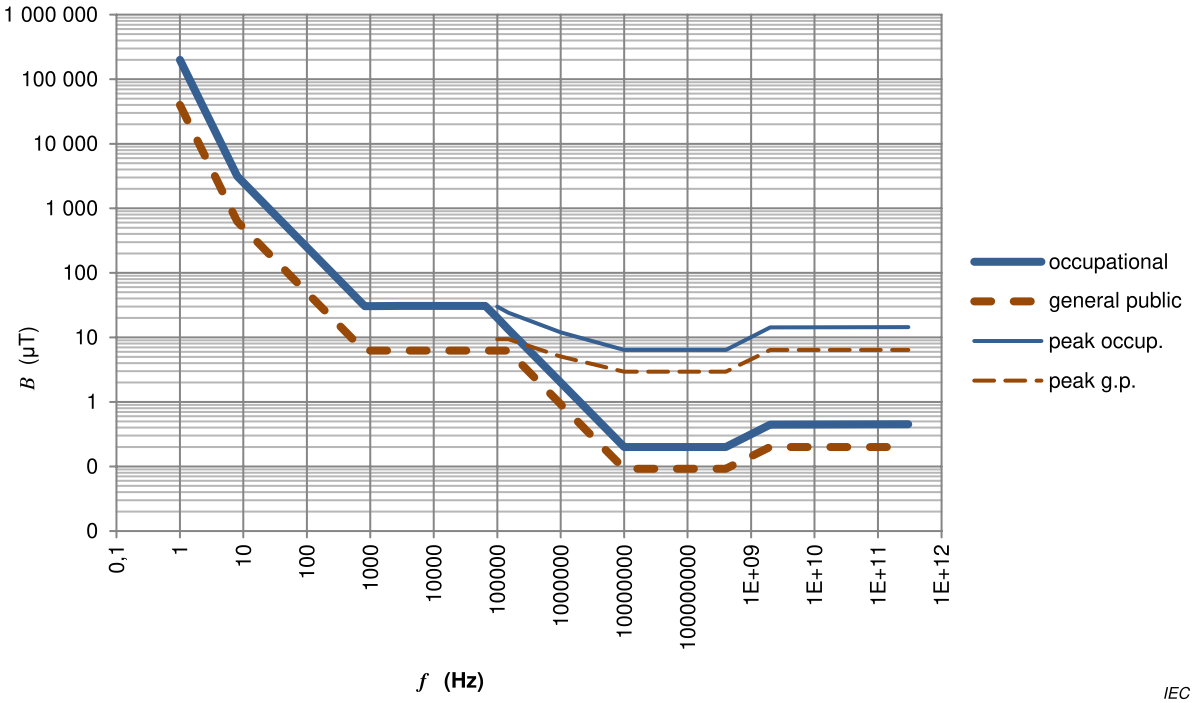

Figure D.2 – Reference levels for exposure to time-varying magnetic fields comparing Tables D.1 and D.2

Annex E
(normative)

Touch temperature limits

The temperatures of ACCESSIBLE PARTS shall not exceed the values shown in Table E.1.

Table E.1 – Touch temperature limits

Parts in OPERATOR access areas	Maximum temperature, T_{max} °C		
	Metal	Glass, porcelain and vitreous material	Plastic and rubber [b]
Handles, knobs, grips, etc., held or touched for short periods only	60	70	85
Handles, knobs, grips, etc., continuously held in normal use	55	65	75
External surfaces of equipment that may be touched [a]	70	80	95
Parts inside the equipment that may be touched [c]	80	80	95

[a] Temperatures up to 100 °C are permitted on the following parts:

- areas on the external surface of equipment that have no dimension exceeding 50 mm, and that are not likely to be touched in normal use; and
- a part of equipment requiring heat for the intended function (for example, an electronic tube), provided that this condition is obvious to the OPERATOR. A warning shall be marked on the equipment in a prominent position adjacent to the hot part.

  The warning shall be either the symbol IEC 60417-5041 (see 3.2.2 e) or the following or similar wording:

WARNING
HOT SURFACE
DO NOT TOUCH

[b] For each material, account shall be taken of the data for that material to determine the appropriate maximum temperature.

[c] Temperatures exceeding the limits are permitted provided that the following conditions are met:

- unintentional contact with such a part is unlikely; and
- the part has a marking indicating that this part is hot. It is permitted to use the symbol IEC 60417-5041 to provide this information.

For equipment intended for installation in a restricted access location, the temperature limits in Table E.1 apply, except that for external metal parts that are evidently designed as heat sinks or that have a visible warning, a temperature of 90 °C is permitted.

Annex F
(informative)

Changes in the fourth edition

Table F.1 summarizes the reorganization and revision of IEC 60215 between the third and fourth editions.

Table F.1 – Reorganization and revision of content between the third and fourth editions of IEC 60215

Third Edition	Action	Fourth Edition
Introduction	Included in Foreword	Foreword
1	Revised	1
Appendix A	Integrated in main document	2
2	Revised and renumbered	4.2
SECTION ONE	Title deleted	
3	Revised and renumbered	3.1
3.1	Revised and renumbered	3.1.1
	New	3.1.2
	New	3.1.3
	New	3.1.4
3.2	Renumbered	3.1.5
3.3	Revised and renumbered	3.1.6
3.4	Revised and renumbered	3.1.7
3.5	Renumbered	3.1.8
3.6	Revised and renumbered	3.1.9
3.7	Revised and renumbered	3.1.10
3.8	Renumbered	3.1.11
	New	3.1.12
	New	3.1.13
	New	3.1.14
	New	3.1.15
Appendix C	Symbols integrated in main document	3.2
SECTION TWO	Title deleted	
4	New title and renumbered	5.1
5	Revised and renumbered	5.2
6	Renumbered	5.3
	New	5.4
SECTION THREE	Renumbered	6
7	Revised and renumbered	6.1
8	Renumbered	6.2
8.1	Renumbered	6.2.1
8.2	Renumbered and item d) revised	6.2.2
8.3	Revised and renumbered	6.2.3
8.4	Revised and renumbered	6.2.4
8.5	Revised and renumbered	6.2.5
8.6	Deleted	
8.7	Deleted	
8.8	Revised and renumbered	6.2.6
	New	6.2.7
9	Renumbered	6.3
9.1	Revised and renumbered	6.3.1
9.2	Renumbered	6.3.2
9.3	Renumbered	6.3.3
9.4	Revised and renumbered	6.3.4
10	Revised and renumbered	6.4
SECTION FOUR	Renumbered	7
11	Revised and renumbered	7.1
12	Renumbered	7.2
12.1	Renumbered and Amendment 2, 12.1 integrated	7.2.1
12.2	Renumbered and Amendment 2, 12.2 integrated	7.2.2
13	Renumbered	7.3.1
13.1	Renumbered and item b) revised	7.3.2
13.2	Revised and renumbered	7.3.3
13.3	Revised and renumbered	7.3.4
14	Renumbered	7.4
15	Revised and renumbered	7.5
16	Revised and renumbered	7.6
17	Renumbered	7.7
SECTION FIVE	Renumbered	8
18	Renumbered	8.1
19	Renumbered	8.2

Third Edition	Action	Fourth Edition
19.1	Revised and renumbered	8.2.1
19.2	Renumbered	8.2.2
20	Renumbered	8.3
21	Renumbered	8.4
21.1	Renumbered	8.4.1
21.2	Revised and renumbered	8.4.2
21.3	Renumbered	8.4.3
22	Renumbered	8.5
22.1	Revised and renumbered	8.5.1
22.2	Revised and renumbered	8.5.2
22.3	Renumbered	8.5.3
	New	8.5.4
23	Renumbered	8.6
24	Renumbered	8.7

Third Edition	Action	Fourth Edition
Appendix A	Revised / new reference / integrated in main document (Clause 2)	2
Appendix B		Annex A
Appendix C	Revised and integrated in main document	3.2
Appendix D		Annex B
Appendix E	Annex partly revised	Annex C
E.7	E.7 from Amendment 2 integrated	C.7
E.8.1	Revised	C.8.1
	New	C. 8.2
	New	Annex D
	New	Annex E
	New	Annex F

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EN 50384, *Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz – 40 GHz) – Occupational*

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