

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Information technology equipment – Safety –
Part 1: General requirements**

**Matériels de traitement de l'information – Sécurité –
Partie 1: Exigences générales**



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**INFORMATION TECHNOLOGY EQUIPMENT –
SAFETY –****Part 1: General requirements****FOREWORD**

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The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 60950-1 has been prepared by IEC technical committee 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology.

IEC 60950-1 includes the basic requirements for the safety of information technology equipment.

Additional parts of IEC 60950-1 will cover specific safety requirements for information technology equipment having limited applications or having special features as follows:

Part 21: Remote feeding (published);

Part 22: Equipment installed outdoors (planned);

Part 23: Large data storage equipment (planned);

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In this standard, the following print types are used:

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INTRODUCTION

0 Principles of safety

The following principles have been adopted by technical committee 108 in the development of this standard.

These principles do not cover performance or functional characteristics of equipment.

Words printed in SMALL CAPITALS are terms that are defined in 1.2 of this standard.

0.1 General principles of safety

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

These principles are not an alternative to the detailed requirements of this standard, but are intended to provide designers with an appreciation of the basis of these requirements. Where the equipment involves technologies and materials or methods of construction not specifically covered, the design of the equipment should provide a level of safety not less than those described in these principles of safety.

Designers shall take into account not only normal operating conditions of the equipment but also likely fault conditions, consequential faults, foreseeable misuse and external influences such as temperature, altitude, pollution, moisture, overvoltages on the MAINS SUPPLY and overvoltages on a TELECOMMUNICATION NETWORK or a CABLE DISTRIBUTION SYSTEM. Dimensioning of insulation spacings should take account of possible reductions by manufacturing tolerances, or where deformation could occur due to handling, shock and vibration likely to be encountered during manufacture, transport and normal use.

The following priorities should be observed in determining what design measures to adopt:

- where possible, specify design criteria that will eliminate, reduce or guard against hazards;
- where the above is not practicable because the functioning of the equipment would be impaired, specify the use of protective means independent of the equipment, such as personal protective equipment (which is not specified in this standard);
- where neither of the above measures is practicable, or in addition to those measures, specify the provision of markings and instructions regarding the residual risks.

There are two types of persons whose safety needs to be considered, USERS (or OPERATORS) and SERVICE PERSONS.

USER is the term applied to all persons other than SERVICE PERSONS. Requirements for protection should assume that USERS are not trained to identify hazards, but will not intentionally create a hazardous situation. Consequently, the requirements will provide protection for cleaners and casual visitors as well as the assigned USERS. In general, USERS should not have access to hazardous parts, and to this end, such parts should only be in SERVICE ACCESS AREAS or in equipment located in RESTRICTED ACCESS LOCATIONS.

When USERS are admitted to RESTRICTED ACCESS LOCATIONS they shall be suitably instructed.

SERVICE PERSONS are expected to use their training and skill to avoid possible injury to themselves and others due to obvious hazards that exist in SERVICE ACCESS AREAS of the equipment or on equipment located in RESTRICTED ACCESS LOCATIONS. However, SERVICE PERSONS should be protected against unexpected hazards. This can be done by, for example, locating parts that need to be accessible for servicing away from electrical and mechanical

hazards, providing shields to avoid accidental contact with hazardous parts, and providing labels or instructions to warn personnel about any residual risk.

Information about potential hazards can be marked on the equipment or provided with the equipment, depending on the likelihood and severity of injury, or made available for SERVICE PERSONS. In general, USERS shall not be exposed to hazards likely to cause injury, and information provided for USERS should primarily aim at avoiding misuse and situations likely to create hazards, such as connection to the wrong power source and replacement of fuses by incorrect types.

MOVABLE EQUIPMENT is considered to present a slightly increased risk of shock, due to possible extra strain on the supply cord leading to rupture of the earthing conductor. With HAND-HELD EQUIPMENT, this risk is increased; wear on the cord is more likely, and further hazards could arise if the units were dropped. TRANSPORTABLE EQUIPMENT introduces a further factor because it can be used and carried in any orientation; if a small metallic object enters an opening in the ENCLOSURE it can move around inside the equipment, possibly creating a hazard.

0.2 Hazards

Application of a safety standard is intended to reduce the risk of injury or damage due to the following:

- electric shock;
- energy related hazards;
- fire;
- heat related hazards;
- mechanical hazards;
- radiation;
- chemical hazards.

0.2.1 Electric shock

Electric shock is due to current passing through the human body. The resulting physiological effects depend on the value and duration of the current and the path it takes through the body. The value of the current depends on the applied voltage, the impedance of the source and the impedance of the body. The body impedance depends in turn on the area of contact, moisture in the area of contact and the applied voltage and frequency. Currents of approximately half a milliampere can cause a reaction in persons in good health and may cause injury indirectly due to involuntary reaction. Higher currents can have more direct effects, such as burn or muscle tetanization leading to inability to let go or to ventricular fibrillation.

Steady state voltages up to 42,4 V peak, or 60 V d.c., are not generally regarded as hazardous under dry conditions for an area of contact equivalent to a human hand. Bare parts that have to be touched or handled should be at earth potential or properly insulated.

Some equipment will be connected to telephone and other external networks. Some TELECOMMUNICATION NETWORKS operate with signals such as voice and ringing superimposed on a steady d.c. supply voltage; the total may exceed the values given above for steady-state voltages. It is common practice for the SERVICE PERSONS of telephone companies to handle parts of such circuits bare-handed. This has not caused serious injury, because of the use of cadenced ringing and because there are limited areas of contact with bare conductors normally handled by SERVICE PERSONS. However, the area of contact of a part accessible to the USER, and the likelihood of the part being touched, should be further limited (for example, by the shape and location of the part).

It is normal to provide two levels of protection for USERS to prevent electric shock. Therefore, the operation of equipment under normal conditions and after a single fault, including any consequential faults, should not create a shock hazard. However, provision of additional protective measures, such as protective earthing or SUPPLEMENTARY INSULATION, is not considered a substitute for, or a relief from, properly designed BASIC INSULATION.

Harm may result from:

Contact with bare parts normally at HAZARDOUS VOLTAGES.

Breakdown of insulation between parts normally at HAZARDOUS VOLTAGES and accessible conductive parts.

Contact with circuits connected to TELECOMMUNICATION NETWORKS that exceed 42,4 V peak or 60 V d.c.

Breakdown of USER-accessible insulation.

TOUCH CURRENT (leakage current) flowing from parts at HAZARDOUS VOLTAGES to accessible parts, or failure of a protective earthing connection. TOUCH CURRENT may include current due to EMC filter components connected between PRIMARY CIRCUITS and accessible parts.

Examples of measures to reduce risks:

Prevent USER access to parts at HAZARDOUS VOLTAGES by fixed or locked covers, SAFETY INTERLOCKS, etc. Discharge accessible capacitors that are at HAZARDOUS VOLTAGES.

Provide BASIC INSULATION and connect the accessible conductive parts and circuits to earth so that exposure to the voltage which can develop is limited because overcurrent protection will disconnect the parts having low impedance faults within a specified time; or provide a metal screen connected to protective earth between the parts, or provide DOUBLE INSULATION or REINFORCED INSULATION between the parts, so that breakdown to the accessible part is not likely to occur.

Limit the accessibility and area of contact of such circuits, and separate them from unearthed parts to which access is not limited.

Insulation that is accessible to the USER should have adequate mechanical and electrical strength to reduce the likelihood of contact with HAZARDOUS VOLTAGES.

Limit TOUCH CURRENT to a specified value, or provide a high integrity protective earthing connection.

0.2.2 Energy related hazards

Injury or fire may result from a short-circuit between adjacent poles of high current supplies or high capacitance circuits, causing:

- burns;
- arcing;
- ejection of molten metal.

Even circuits whose voltages are safe to touch may be hazardous in this respect.

Examples of measures to reduce risks include:

- separation;
- shielding;
- provision of SAFETY INTERLOCKS.

0.2.3 Fire

Risk of fire may result from excessive temperatures either under normal operating conditions or due to overload, component failure, insulation breakdown or loose connections. Fires originating within the equipment should not spread beyond the immediate vicinity of the source of the fire, nor cause damage to the surroundings of the equipment.

Examples of measures to reduce risks include:

- providing overcurrent protection;
- using constructional materials having appropriate flammability properties for their purpose;
- selection of parts, components and consumable materials to avoid high temperature which might cause ignition;
- limiting the quantity of combustible materials used;
- shielding or separating combustible materials from likely ignition sources;
- using ENCLOSURES or barriers to limit the spread of fire within the equipment;
- using suitable materials for ENCLOSURES so as to reduce the likelihood of fire spreading from the equipment.

0.2.4 Heat related hazards

Injury may result from high temperatures under normal operating conditions, causing:

- burns due to contact with hot accessible parts;
- degradation of insulation and of safety-critical components;
- ignition of flammable liquids.

Examples of measures to reduce risks include:

- taking steps to avoid high temperature of accessible parts;
- avoiding temperatures above the ignition point of liquids;
- provision of markings to warn USERS where access to hot parts is unavoidable.

0.2.5 Mechanical hazards

Injury may result from:

- sharp edges and corners;
- moving parts that have the potential to cause injury;
- equipment instability;
- flying particles from imploding cathode ray tubes and exploding high pressure lamps.

Examples of measures to reduce risks include:

- rounding of sharp edges and corners;
- guarding;
- provision of SAFETY INTERLOCKS;
- providing sufficient stability to free-standing equipment;
- selecting cathode ray tubes and high pressure lamps that are resistant to implosion and explosion respectively;
- provision of markings to warn USERS where access is unavoidable.

0.2.6 Radiation

Injury to USERS and to SERVICE PERSONS may result from some forms of radiation emitted by equipment. Examples are sonic (acoustic), radio frequency, infra-red, ultraviolet and ionizing radiation, and high intensity visible and coherent light (lasers).

Examples of measures to reduce risks include:

- limiting the energy level of potential radiation sources;
- screening radiation sources;
- provision of SAFETY INTERLOCKS;
- provision of markings to warn USERS where exposure to the radiation hazard is unavoidable.

0.2.7 Chemical hazards

Injury may result from contact with some chemicals or from inhalation of their vapours and fumes.

Examples of measures to reduce risks include:

- avoiding the use of constructional and consumable materials likely to cause injury by contact or inhalation during intended and normal conditions of use;
- avoiding conditions likely to cause leakage or vaporization;
- provision of markings to warn USERS about the hazards.

0.3 Materials and components

Materials and components used in the construction of equipment should be so selected and arranged that they can be expected to perform in a reliable manner for the anticipated life of the equipment without creating a hazard, and would not contribute significantly to the development of a serious fire hazard. Components should be selected so that they remain within their manufacturers' ratings under normal operating conditions, and do not create a hazard under fault conditions.

INFORMATION TECHNOLOGY EQUIPMENT – SAFETY –

Part 1: General requirements

1 General

1.1 Scope

1.1.1 Equipment covered by this standard

This standard is applicable to mains-powered or battery-powered information technology equipment, including electrical business equipment and associated equipment, with a RATED VOLTAGE not exceeding 600 V.

This standard is also applicable to such information technology equipment:

- designed for use as telecommunication terminal equipment and TELECOMMUNICATION NETWORK infrastructure equipment, regardless of the source of power;
- designed and intended to be connected directly to, or used as infrastructure equipment in, a CABLE DISTRIBUTION SYSTEM, regardless of the source of power;
- designed to use the AC MAINS SUPPLY as a communication transmission medium (see Clause 6, Note 4 and 7.1, Note 4).

This standard is also applicable to components and subassemblies intended for incorporation in information technology equipment. It is not expected that such components and subassemblies comply with every aspect of the standard, provided that the complete information technology equipment, incorporating such components and subassemblies, does comply.

NOTE 1 Examples of aspects with which uninstalled components and subassemblies may not comply include the marking of the power rating and access to hazardous parts.

NOTE 2 This standard may be applied to the electronic parts of equipment even if that equipment does not wholly fall within its Scope, such as large-scale air conditioning systems, fire detection systems and fire extinguishing systems. Different requirements may be necessary for some applications.

This standard specifies requirements intended to reduce risks of fire, electric shock or injury for the OPERATOR and layman who may come into contact with the equipment and, where specifically stated, for a SERVICE PERSON.

This 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.

Examples of equipment that is in the scope of this standard are:

Generic product type	Specific example of generic type
banking equipment	monetary processing machines including automated teller (cash dispensing) machines (ATM)
data and text processing machines and associated equipment	data preparation equipment, data processing equipment, data storage equipment, personal computers, plotters, printers, scanners, text processing equipment, visual display units
data network equipment	bridges, data circuit terminating equipment, data terminal equipment, routers
electrical and electronic retail equipment	cash registers, point of sale terminals including associated electronic scales
electrical and electronic office machines	calculators, copying machines, dictation equipment, document shredding machines, duplicators, erasers, micrographic office equipment, motor-operated files, paper trimmers (punchers, cutting machines, separators), paper jogging machines, pencil sharpeners, staplers, typewriters
other information technology equipment	photoprinting equipment, public information terminals, multimedia equipment
postage equipment	mail processing machines, postage machines
telecommunication network infrastructure equipment	billing equipment, multiplexers, network powering equipment, network terminating equipment, radio basestations, repeaters, transmission equipment, telecommunication switching equipment
telecommunication terminal equipment	facsimile equipment, key telephone systems, modems, PABXs, pagers, telephone answering machines, telephone sets (wired and wireless)

NOTE 3 The requirements of IEC 60065 may also be used to meet safety requirements for multimedia equipment. See IEC Guide 112, *Guide on the safety of multimedia equipment*.

This list is not intended to be comprehensive, and equipment that is not listed is not necessarily excluded from the Scope.

Equipment complying with the relevant requirements in this standard is considered suitable for use with process control equipment, automatic test equipment and similar systems requiring information processing facilities. However, this standard does not include requirements for performance or functional characteristics of equipment.

1.1.2 Additional requirements

Requirements additional to those specified in this standard may be necessary for:

- equipment intended for operation in special environments (for example, extremes of temperature; excessive dust, moisture or vibration; flammable gases; and corrosive or explosive atmospheres);
- electromedical applications with physical connections to the patient;
- equipment intended to be used in vehicles, on board ships or aircraft, in tropical countries, or at altitudes greater than 2 000 m;
- equipment intended for use where ingress of water is possible; for guidance on such requirements and on relevant testing, see Annex T.

NOTE Attention is drawn to the fact that authorities of some countries impose additional requirements.

1.1.3 Exclusions

This standard does not apply to:

- power supply systems which are not an integral part of the equipment, such as motor-generator sets, battery backup systems and transformers;
- building installation wiring;
- devices requiring no electric power.

1.2 Definitions

For the purpose of this International Standard the following definitions apply. Where the terms "voltage" and "current" are used, they imply the r.m.s. values, unless otherwise specified.

Definitions in alphabetical order of nouns

AREA, OPERATOR ACCESS	1.2.7.1
AREA, SERVICE ACCESS	1.2.7.2
BODY	1.2.7.5
CABLE, INTERCONNECTING	1.2.11.6
CABLE DISTRIBUTION SYSTEM	1.2.13.14
CHEESECLOTH	1.2.13.15
CIRCUIT, ELV	1.2.8.7
CIRCUIT, LIMITED CURRENT	1.2.8.9
CIRCUIT, PRIMARY	1.2.8.4
CIRCUIT, SECONDARY	1.2.8.5
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1.2.1 Equipment electrical ratings

1.2.1.1

RATED VOLTAGE

supply voltage (for a three-phase AC MAINS SUPPLY, the line-to-line voltage) as declared by the manufacturer

1.2.1.2

RATED VOLTAGE RANGE

supply voltage range as declared by the manufacturer, expressed by its lower and upper RATED VOLTAGES

1.2.1.3

RATED CURRENT

input current of the equipment as declared by the manufacturer

1.2.1.4

RATED FREQUENCY

supply frequency as declared by the manufacturer

1.2.1.5

RATED FREQUENCY RANGE

supply frequency range as declared by the manufacturer, expressed by its lower and upper RATED FREQUENCIES

1.2.2 Operating conditions

1.2.2.1

NORMAL LOAD

mode of operation, used for testing purposes, which represents as closely as possible the most severe conditions of normal use which can reasonably be expected

If the conditions of actual use can reasonably be expected to be more severe than the maximum load conditions recommended by the manufacturer, including RATED OPERATING TIME and RATED RESTING TIME, a mode of operation is used that represents these more severe conditions.

NOTE NORMAL LOAD conditions for some types of equipment are given in Annex L.

1.2.2.2

RATED OPERATING TIME

maximum operating time assigned to the equipment by the manufacturer

1.2.2.3

RATED RESTING TIME

minimum time, assigned by the manufacturer, during which the equipment is switched off or running idle between periods of RATED OPERATING TIME

1.2.3 Equipment mobility

1.2.3.1

MOVABLE EQUIPMENT

equipment which is either:

- 18 kg or less in mass and not fixed; or
- equipment with wheels, castors or other means to facilitate movement by the OPERATOR as required to perform its intended use

1.2.3.2**HAND-HELD EQUIPMENT**

MOVABLE EQUIPMENT, or a part of any kind of equipment, that is intended to be held in the hand during normal use

1.2.3.3**TRANSPORTABLE EQUIPMENT**

MOVABLE EQUIPMENT that is intended to be routinely carried by a USER

NOTE Examples include laptop and notebook personal computers, pen-based tablet computers, and their portable accessories such as printers and CD-ROM drives.

1.2.3.4**STATIONARY EQUIPMENT**

equipment that is not MOVABLE EQUIPMENT

1.2.3.5**EQUIPMENT FOR BUILDING-IN**

equipment intended to be installed in a prepared recess, such as in a wall, or similar situation

NOTE In general, EQUIPMENT FOR BUILDING-IN does not have an ENCLOSURE on all sides, as some of the sides will be protected after installation.

1.2.3.6**DIRECT PLUG-IN EQUIPMENT**

equipment that is intended to be used without a power supply cord; the mains plug forms an integral part of the equipment ENCLOSURE so that the weight of the equipment is taken by the socket-outlet

1.2.4 Classes of equipment – Protection against electric shock

NOTE Some information technology equipment cannot be identified as conforming to one of the following classes.

1.2.4.1**CLASS I EQUIPMENT**

equipment where protection against electric shock is achieved by

- using BASIC INSULATION and
- providing a means of connection to the PROTECTIVE EARTHING CONDUCTOR in the building wiring those conductive parts that are otherwise capable of assuming HAZARDOUS VOLTAGES if the BASIC INSULATION fails

NOTE CLASS I EQUIPMENT may have parts with DOUBLE INSULATION or REINFORCED INSULATION.

1.2.4.2**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

1.2.4.3**CLASS III EQUIPMENT**

equipment in which protection against electric shock relies upon supply from SELV CIRCUITS and in which HAZARDOUS VOLTAGES are not generated

NOTE For CLASS III EQUIPMENT, although there is no requirement for protection against electric shock, all other requirements of the standard apply.

1.2.5 Connection to the supply

1.2.5.1

PLUGGABLE EQUIPMENT TYPE A

equipment that is intended for connection to a MAINS SUPPLY via a non-industrial plug and socket-outlet or a non-industrial appliance coupler, or both

1.2.5.2

PLUGGABLE EQUIPMENT TYPE B

equipment that is intended for connection to a MAINS SUPPLY via an industrial plug and socket-outlet or an appliance coupler, or both, complying with IEC 60309 or with a comparable national standard

1.2.5.3

PLUGGABLE EQUIPMENT

equipment that is either **PLUGGABLE EQUIPMENT TYPE A** or **PLUGGABLE EQUIPMENT TYPE B**

1.2.5.4

PERMANENTLY CONNECTED EQUIPMENT

equipment that is intended for connection to the building installation wiring using screw terminals or other reliable means

1.2.5.5

DETACHABLE POWER SUPPLY CORD

flexible cord, for supply purposes, intended to be connected to the equipment by means of a suitable appliance coupler

1.2.5.6

NON-DETACHABLE POWER SUPPLY CORD

flexible cord, for supply purposes, fixed to or assembled with the equipment

Such a cord may be either:

Ordinary: a flexible cord that can be easily replaced without special preparation of the cord or special TOOLS; or

Special: a flexible cord that is specially prepared, or requires the use of specially designed TOOLS for replacement, or is such that it cannot be replaced without damage to the equipment.

The term "specially prepared" includes provision of an integral cord guard, the use of cable lugs, formation of eyelets, etc., but not the reshaping of the conductor before introduction into a terminal or the twisting of a stranded conductor to consolidate the end.

1.2.6 Enclosures

1.2.6.1

ENCLOSURE

part of the equipment providing one or more of the functions described in 1.2.6.2, 1.2.6.3 or 1.2.6.4

NOTE One type of ENCLOSURE can be inside another type (for example, an ELECTRICAL ENCLOSURE inside a FIRE ENCLOSURE or a FIRE ENCLOSURE inside an ELECTRICAL ENCLOSURE). Also, a single ENCLOSURE can provide the functions of more than one type (for example, the functions of both an ELECTRICAL ENCLOSURE and a FIRE ENCLOSURE).

1.2.6.2

FIRE ENCLOSURE

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

1.2.6.3

MECHANICAL ENCLOSURE

part of the equipment intended to reduce the risk of injury due to mechanical and other physical hazards

1.2.6.4**ELECTRICAL ENCLOSURE**

part of the equipment intended to limit access to parts that may be at HAZARDOUS VOLTAGES or HAZARDOUS ENERGY LEVELS or are in TNV CIRCUITS

1.2.6.5**DECORATIVE PART**

part of the equipment, outside the ENCLOSURE, which has no safety function

1.2.7 Accessibility**1.2.7.1****OPERATOR ACCESS AREA**

part of the equipment to which, under normal operating conditions, one of the following applies:

- access can be gained without the use of a TOOL;
- the means of access is deliberately provided to the OPERATOR;
- the OPERATOR is instructed to enter regardless of whether or not a TOOL is needed to gain access

The terms "access" and "accessible", unless qualified, relate to an OPERATOR ACCESS AREA as defined above.

1.2.7.2**SERVICE ACCESS AREA**

part of the equipment, other than an OPERATOR ACCESS AREA, where it is necessary for SERVICE PERSONS to have access even with the equipment switched on

1.2.7.3**RESTRICTED ACCESS LOCATION**

location for equipment where both of the following apply:

- access can only be gained by SERVICE PERSONS or by USERS who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and
- access is through the use of a TOOL or lock and key, or other means of security, and is controlled by the authority responsible for the location

NOTE The requirements for equipment intended for installation in RESTRICTED ACCESS LOCATIONS are the same as for OPERATOR ACCESS AREAS, except as given in 1.7.14, 2.1.3, 4.5.4, 4.6.2 and 5.1.7.

1.2.7.4**TOOL**

screwdriver or any other object that may be used to operate a screw, latch or similar fixing means

1.2.7.5**BODY**

all accessible conductive parts, shafts of handles, knobs, grips and the like, and metal foil in contact with all accessible surfaces of insulating material

1.2.7.6**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

1.2.8 Circuits and circuit characteristics

1.2.8.1

AC MAINS SUPPLY

a.c. power distribution system external to the equipment for supplying power to a.c. powered equipment

These power sources include public or private utilities and, unless otherwise specified in the standard (for example, 1.4.5), equivalent sources such as motor-driven generators and uninterruptible power supplies.

NOTE See Annex V for typical examples of a.c. power distribution systems.

1.2.8.2

DC MAINS SUPPLY

d.c. power distribution system, with or without batteries, external to the equipment, for supplying power to d.c. powered equipment, excluding the following:

- a d.c. supply providing power over TELECOMMUNICATION NETWORK wiring to remote equipment;
- a limited power source (see 2.5) whose open circuit voltage is less than or equal to 42,4 V d.c.;
- a d.c. supply whose open circuit voltage is greater than 42,4 V d.c. and less than or equal to 60 V d.c., and whose available power output is less than 240 VA

Circuitry connected to a DC MAINS SUPPLY is considered to be a SECONDARY CIRCUIT (for example, an SELV CIRCUIT, a TNV CIRCUIT or a HAZARDOUS VOLTAGE SECONDARY CIRCUIT) in the meaning of this standard.

NOTE See ITU-T Recommendation K.27 for bonding configurations and earthing inside a telecommunication building.

1.2.8.3

MAINS SUPPLY

power distribution system that is either an AC MAINS SUPPLY or a DC MAINS SUPPLY

1.2.8.4

PRIMARY CIRCUIT

circuit that is directly connected to the AC MAINS SUPPLY

It includes, for example, the means for connection to the AC MAINS SUPPLY, the primary windings of transformers, motors and other loading devices.

NOTE Conductive parts of an INTERCONNECTING CABLE may be part of a PRIMARY CIRCUIT as stated in 1.2.11.6.

1.2.8.5

SECONDARY CIRCUIT

circuit that has no direct connection to a PRIMARY CIRCUIT and derives its power from a transformer, converter or equivalent isolation device, or from a battery

NOTE Conductive parts of an INTERCONNECTING CABLE may be part of a SECONDARY CIRCUIT as stated in 1.2.11.6.

1.2.8.6

HAZARDOUS VOLTAGE

voltage exceeding 42,4 V peak, or 60 V d.c., existing in a circuit that does not meet the requirements for either a LIMITED CURRENT CIRCUIT or a TNV CIRCUIT

1.2.8.7

ELV CIRCUIT

SECONDARY CIRCUIT with voltages between any two conductors of the circuit, and between any one such conductor and earth (see 1.4.9), not exceeding 42,4 V peak, or 60 V d.c., under normal operating conditions, which is separated from HAZARDOUS VOLTAGE by BASIC INSULATION, and which neither meets all of the requirements for an SELV CIRCUIT nor meets all of the requirements for a LIMITED CURRENT CIRCUIT

1.2.8.8**SELV CIRCUIT**

SECONDARY CIRCUIT that is so designed and protected that under normal operating conditions and single fault conditions, its voltages do not exceed a safe value

NOTE 1 The limit values of voltages under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.2. See also Table 1A.

NOTE 2 This definition of an SELV CIRCUIT differs from the term "SELV system" as used in IEC 61140.

1.2.8.9**LIMITED CURRENT CIRCUIT**

circuit that is so designed and protected that, under both normal operating conditions and single fault conditions, the current that can be drawn is not hazardous

NOTE The limit values of currents under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.4.

1.2.8.10**HAZARDOUS ENERGY LEVEL**

available power level of 240 VA or more, having a duration of 60 s or more, or a stored energy level of 20 J or more (for example, from one or more capacitors), at a potential of 2 V or more

1.2.8.11**TNV CIRCUIT**

circuit that is in the equipment and to which the accessible area of contact is limited and that is so designed and protected that, under normal operating conditions and single fault conditions (see 1.4.14), the voltages do not exceed specified limit values

A TNV CIRCUIT is considered to be a SECONDARY CIRCUIT in the meaning of this standard.

NOTE 1 The specified limit values of voltages under normal operating conditions and single fault conditions (see 1.4.14) are given in 2.3.1. Requirements regarding accessibility of TNV CIRCUITS are given in 2.1.1.1.

NOTE 2 Conductive parts of an INTERCONNECTING CABLE may be part of a TNV CIRCUIT as stated in 1.2.11.6.

TNV CIRCUITS are classified as TNV-1 CIRCUITS, TNV-2 CIRCUITS and TNV-3 CIRCUITS as defined in 1.2.8.12, 1.2.8.13 and 1.2.8.14.

NOTE 3 The voltage relationships between SELV and TNV CIRCUITS are shown in Table 1A.

Table 1A – Voltage ranges of SELV and TNV circuits

Overvoltages from TELECOMMUNICATION NETWORKS possible?	Overvoltages from CABLE DISTRIBUTION SYSTEMS possible ?	Normal operating voltages	
		Within SELV CIRCUIT limits	Exceeding SELV CIRCUIT limits but within TNV CIRCUIT limits
Yes	Yes	TNV-1 CIRCUIT	TNV-3 CIRCUIT
No	Not applicable	SELV CIRCUIT	TNV-2 CIRCUIT

1.2.8.12**TNV-1 CIRCUIT****TNV CIRCUIT**

- whose normal operating voltages do not exceed the limits for an SELV CIRCUIT under normal operating conditions and
- on which overvoltages from TELECOMMUNICATION NETWORKS and CABLE DISTRIBUTION SYSTEMS are possible

1.2.8.13

TNV-2 CIRCUIT

TNV CIRCUIT

- whose normal operating voltages exceed the limits for an SELV CIRCUIT under normal operating conditions and
- which is not subject to overvoltages from TELECOMMUNICATION NETWORKS

1.2.8.14

TNV-3 CIRCUIT

TNV CIRCUIT

- whose normal operating voltages exceed the limits for an SELV CIRCUIT under normal operating conditions and
- on which overvoltages from TELECOMMUNICATION NETWORKS and CABLE DISTRIBUTION SYSTEMS are possible

1.2.9 Insulation

1.2.9.1

FUNCTIONAL INSULATION

insulation that is necessary only for the correct functioning of the equipment

NOTE FUNCTIONAL INSULATION by definition does not protect against electric shock. It may, however, reduce the likelihood of ignition and fire.

1.2.9.2

BASIC INSULATION

insulation to provide basic protection against electric shock

1.2.9.3

SUPPLEMENTARY INSULATION

independent insulation applied in addition to BASIC INSULATION in order to reduce the risk of electric shock in the event of a failure of the BASIC INSULATION

1.2.9.4

DOUBLE INSULATION

insulation comprising both BASIC INSULATION and SUPPLEMENTARY INSULATION

1.2.9.5

REINFORCED INSULATION

single insulation system that provides a degree of protection against electric shock equivalent to DOUBLE INSULATION under the conditions specified in this standard

NOTE The term "insulation system" does not imply that the insulation has to be in one homogeneous piece. It may comprise several layers that cannot be tested as BASIC INSULATION and SUPPLEMENTARY INSULATION.

1.2.9.6

WORKING VOLTAGE

highest voltage to which the insulation or the component under consideration is, or can be, subjected when the equipment is operating under conditions of normal use

Overvoltages that originate outside the equipment are not taken into account.

1.2.9.7

RMS WORKING VOLTAGE

r.m.s. value of a WORKING VOLTAGE, including any d.c. component

NOTE For the purpose of determining RMS WORKING VOLTAGES, the rules of 2.10.2.2 apply, and where relevant those of 1.4.8.

1.2.9.8**PEAK WORKING VOLTAGE**

peak value of a WORKING VOLTAGE, including any d.c. component and any repetitive peak impulses generated in the equipment

Where peak-to-peak ripple exceeds 10 % of the average value, the requirements related to peak or a.c. voltages are applicable.

NOTE For the purpose of determining PEAK WORKING VOLTAGES, the rules of 2.10.2.3 apply, and where relevant those of 1.4.8.

1.2.9.9**REQUIRED WITHSTAND VOLTAGE**

peak voltage that the insulation under consideration is required to withstand

1.2.9.10**MAINS TRANSIENT VOLTAGE**

highest peak voltage expected at the power input to the equipment, arising from external transients on the MAINS SUPPLY

1.2.9.11**TELECOMMUNICATION NETWORK TRANSIENT VOLTAGE**

highest peak voltage expected at the TELECOMMUNICATION NETWORK connection point of the equipment, arising from external transients on the network

NOTE The effect of transients from CABLE DISTRIBUTION SYSTEMS is not taken into account.

1.2.10 Properties of insulation**1.2.10.1****CLEARANCE**

shortest distance between two conductive parts, or between a conductive part and the BOUNDING SURFACE of the equipment, measured through air

1.2.10.2**CREEPAGE DISTANCE**

shortest path between two conductive parts, or between a conductive part and the BOUNDING SURFACE of the equipment, measured along the surface of the insulation

1.2.10.3**BOUNDING SURFACE**

outer surface of the ELECTRICAL ENCLOSURE, considered as though metal foil were pressed into contact with accessible surfaces of insulating material

1.2.10.4**SOLID INSULATION**

material that provides electrical insulation between two opposite surfaces, not along an outer surface

NOTE The required properties of SOLID INSULATION are specified either as

- the actual minimum distance through the insulation (see 2.10.5.2), or by
- other requirements and tests in this standard instead of a minimum distance.

1.2.11 Components**1.2.11.1****THERMOSTAT**

cycling temperature-sensing control intended to keep a temperature between two particular values under normal operating conditions and that may have provision for setting by the OPERATOR

1.2.11.2

TEMPERATURE LIMITER

temperature-sensing control intended to keep a temperature below or above one particular value during normal operating conditions and that may have provision for setting by the OPERATOR

NOTE A TEMPERATURE LIMITER may be of the automatic reset or of the manual reset type.

1.2.11.3

THERMAL CUT-OUT

temperature-sensing control intended to operate under abnormal operating conditions and that has no provision for the OPERATOR to change the temperature setting

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

1.2.11.4

THERMAL CUT-OUT, AUTOMATIC RESET

THERMAL CUT-OUT that automatically restores the current after the relevant part of the equipment has cooled down sufficiently

1.2.11.5

THERMAL CUT-OUT, MANUAL RESET

THERMAL CUT-OUT that requires resetting by hand, or replacement of a part, in order to restore the current

1.2.11.6

INTERCONNECTING CABLE

cable used to

- electrically connect an accessory to a unit of information technology equipment,
- interconnect units in a system, or
- connect a unit to a TELECOMMUNICATION NETWORK or to a CABLE DISTRIBUTION SYSTEM

Such a cable may carry any type of circuit from one unit to another.

NOTE A power supply cord for connection to the MAINS SUPPLY is not an INTERCONNECTING CABLE.

1.2.12 Flammability

1.2.12.1

FLAMMABILITY CLASSIFICATION OF MATERIALS

recognition of the burning behaviour of materials and their ability to extinguish if ignited

Materials are classified as in 1.2.12.2 to 1.2.12.14 when tested in accordance with IEC 60695-11-10, IEC 60695-11-20, ISO 9772 or ISO 9773.

NOTE 1 When applying the requirements in this standard, HF-1 CLASS FOAMED MATERIAL is regarded as better than HF-2 CLASS, and HF-2 CLASS better than HBF CLASS.

NOTE 2 Similarly, material of 5VA CLASS is regarded as better than 5VB CLASS, 5VB CLASS better than V-0 CLASS, V-0 CLASS better than V-1 CLASS, V-1 CLASS better than V-2 CLASS, V-2 CLASS better than HB40 CLASS and HB40 CLASS better than HB75 CLASS.

NOTE 3 Similarly, MATERIAL of VTM-0 CLASS is regarded as better than VTM-1 CLASS and VTM-1 CLASS better than VTM-2 CLASS.

NOTE 4 VTM-0 CLASS, VTM-1 CLASS and VTM-2 CLASS MATERIALS are considered to be equivalent to V-0 CLASS, V-1 CLASS and V-2 CLASS MATERIALS, respectively, but only for their flammability properties. Their electrical and mechanical properties are not necessarily equivalent.

NOTE 5 Certain flammability classes have replaced the classes used in earlier editions of this standard. The equivalence of the old and the new classes is shown in Table 1B.

Table 1B – Equivalence of flammability classes

Old class	New class	Equivalence
–	5VA (1.2.12.5)	5VA is not required in this standard.
5V	5VB (1.2.12.6)	Materials that pass the tests for class 5V in Clause A.9 of earlier editions of this standard are equivalent to 5VB or better.
HB	HB40 (1.2.12.10)	Samples of materials in a thickness of 3 mm that pass the tests of Clause A.8 in earlier editions of this standard (maximum burning rate 40 mm/min during test) are equivalent to HB40.
	HB75 (1.2.12.11)	Samples of materials in a thickness of less than 3 mm that pass the tests of Clause A.8 in earlier editions of this standard (maximum burning rate 75 mm/min during test) are equivalent to HB75.

1.2.12.2**V-0 CLASS MATERIAL**

material tested in the thinnest significant thickness used and classified v-0 according to IEC 60695-11-10

1.2.12.3**V-1 CLASS MATERIAL**

material tested in the thinnest significant thickness used and classified v-1 according to IEC 60695-11-10

1.2.12.4**V-2 CLASS MATERIAL**

material tested in the thinnest significant thickness used and classified v-2 according to IEC 60695-11-10

1.2.12.5**5VA CLASS MATERIAL**

material tested in the thinnest significant thickness used and classified 5VA according to IEC 60695-11-20

1.2.12.6**5VB CLASS MATERIAL**

material tested in the thinnest significant thickness used and classified 5VB according to IEC 60695-11-20

1.2.12.7**HF-1 CLASS FOAMED MATERIAL**

foamed material tested in the thinnest significant thickness used and classified HF-1 according to ISO 9772

1.2.12.8**HF-2 CLASS FOAMED MATERIAL**

foamed material tested in the thinnest significant thickness used and classified HF-2 according to ISO 9772

1.2.12.9**HBF CLASS FOAMED MATERIAL**

foamed material tested in the thinnest significant thickness used and classified HBF according to ISO 9772

1.2.12.10

HB40 CLASS MATERIAL

material tested in the thinnest significant thickness used and classified HB40 according to IEC 60695-11-10

1.2.12.11

HB75 CLASS MATERIAL

material tested in the thinnest significant thickness used and classified HB75 according to IEC 60695-11-10

1.2.12.12

VTM-0 CLASS MATERIAL

material tested in the thinnest significant thickness used and classified VTM-0 according to ISO 9773

1.2.12.13

VTM-1 CLASS MATERIAL

material tested in the thinnest significant thickness used and classified VTM-1 according to ISO 9773

1.2.12.14

VTM-2 CLASS MATERIAL

material tested in the thinnest significant thickness used and classified VTM-2 according to ISO 9773

1.2.12.15

EXPLOSION LIMIT

lowest concentration of a combustible material in a mixture containing any of the following: gases, vapours, mists or dusts, in which a flame is able to propagate after removal of the ignition source

1.2.13 Miscellaneous

1.2.13.1

TYPE TEST

test on a representative sample with the objective of determining if, as designed and manufactured, it can meet the requirements of this standard

1.2.13.2

SAMPLING TEST

test on a number of samples taken at random from a batch

1.2.13.3

ROUTINE TEST

test to which each individual sample is subjected during or after manufacture to check if the sample complies with certain criteria

1.2.13.4

DC VOLTAGE

average value of a voltage having a peak-to-peak ripple not exceeding 10 % of the average value

NOTE Where peak-to-peak ripple exceeds 10 % of the average value, the requirements related to peak voltage are applicable.

1.2.13.5

SERVICE PERSON

person having appropriate technical training and experience necessary to be aware of hazards to which that person may be exposed in performing a task and of measures to minimize the risks to that person or other persons

1.2.13.6**USER**

any person, other than a SERVICE PERSON

The term USER in this standard is the same as the term OPERATOR and the two terms can be interchanged.

1.2.13.7**OPERATOR**

see USER (1.2.13.6)

1.2.13.8**TELECOMMUNICATION NETWORK**

metallically terminated transmission medium intended for communication between equipment that may be located in separate buildings, excluding:

- the mains system for supply, transmission and distribution of electrical power, if used as a telecommunication transmission medium;
- CABLE DISTRIBUTION SYSTEMS;
- SELV CIRCUITS connecting units of information technology equipment

NOTE 1 The term TELECOMMUNICATION NETWORK is defined in terms of its functionality, not its electrical characteristics. A TELECOMMUNICATION NETWORK is not itself defined as being either an SELV CIRCUIT or a TNV CIRCUIT. Only the circuits in the equipment are so classified.

NOTE 2 A TELECOMMUNICATION NETWORK may be:

- publicly or privately owned;
- subject to transient overvoltages due to atmospheric discharges and faults in power distribution systems;
- subject to longitudinal (common mode) voltages induced from nearby power lines or electric traction lines.

NOTE 3 Examples of TELECOMMUNICATION NETWORKS are:

- a public switched telephone network;
- a public data network;
- an Integrated Services Digital Network (ISDN);
- a private network with electrical interface characteristics similar to the above.

1.2.13.9**FUNCTIONAL EARTHING**

earthing of a point in equipment or in a system, which is necessary for a purpose other than safety

1.2.13.10**PROTECTIVE EARTHING CONDUCTOR**

conductor in the building installation wiring, or in the power supply cord, connecting a main protective earthing terminal in the equipment to an earth point in the building installation

NOTE In some countries, the term "grounding conductor" is used instead of "PROTECTIVE EARTHING CONDUCTOR".

1.2.13.11**PROTECTIVE BONDING CONDUCTOR**

conductor in the equipment, or a combination of conductive parts in the equipment, connecting a main protective earthing terminal to a part of the equipment that is required to be earthed for safety purposes

1.2.13.12**TOUCH CURRENT**

electric current through a human body when it touches one or more accessible parts

NOTE TOUCH CURRENT was previously included in the term "leakage current".

1.2.13.13

PROTECTIVE CONDUCTOR CURRENT

current flowing through the PROTECTIVE EARTHING CONDUCTOR under normal operating conditions

NOTE PROTECTIVE CONDUCTOR CURRENT was previously included in the term "leakage current".

1.2.13.14

CABLE DISTRIBUTION SYSTEM

metallically terminated transmission medium using coaxial cable, mainly intended for transmission of video and/or audio signals between separate buildings or between outdoor antennas and buildings, excluding:

- the mains system for supply, transmission and distribution of electric power, if used as a communication transmission medium;
- TELECOMMUNICATION NETWORKS;
- SELV CIRCUITS connecting units of information technology equipment

NOTE 1 Examples of CABLE DISTRIBUTION SYSTEMS are:

- local area cable networks, community antenna television systems and master antenna television systems providing video and audio signal distribution;
- outdoor antennas including satellite dishes, receiving antennas, and other similar devices.

NOTE 2 CABLE DISTRIBUTION SYSTEMS may be subjected to greater transients than TELECOMMUNICATION NETWORKS (see 7.4.1).

1.2.13.15

CHEESECLOTH

bleached cotton cloth of approximately 40 g/m²

1.2.13.16

WRAPPING TISSUE

soft and strong, lightweight wrapping paper of grammage generally between 12 g/m² and 30 g/m², primarily intended for protective packaging of delicate articles and for gift wrapping

[ISO 4046-4:2002, definition 4.215]

1.2.13.17

PROTECTIVE CURRENT RATING

rating of an overcurrent protective device that is known or assumed to be in place to protect a circuit

NOTE Rules to determine the value of the PROTECTIVE CURRENT RATING are in 2.6.3.3.

1.2.13.18

(HOUSEHOLD AND HOME/OFFICE DOCUMENT/MEDIA) SHREDDER

equipment with a plug configuration associated with PLUGGABLE EQUIPMENT TYPE A, or battery operated equipment, designed to shred paper or other forms of media as instructed by the manufacturer

NOTE 1 Examples of other forms of media include but are not limited to digital video disks, compact disks, flash memory, magnetic strip cards, or magnetic disks, or the like.

NOTE 2 HOUSEHOLD AND HOME/OFFICE DOCUMENT/MEDIA SHREDDERS are typically identified as either strip-cut type or cross-cut type. A strip-cut HOUSEHOLD AND HOME/OFFICE DOCUMENT/MEDIA SHREDDER shreds the paper into long strips using a motor-based shredding mechanism. A cross-cut DOCUMENT/MEDIA SHREDDER shreds paper two or more ways into tiny particles, typically using a more powerful motor and more complex shredding mechanism.

NOTE 3 A document/media shredder is considered to be non-household or non-home/office type if the document/media shredder is provided with a plug configuration associated with PLUGGABLE EQUIPMENT TYPE B, or is PERMANENTLY CONNECTED EQUIPMENT.

1.3 General requirements

1.3.1 Application of requirements

The requirements detailed in this standard shall be applied only if safety is involved.

In order to establish whether or not safety is involved, the circuits and construction shall be carefully investigated to take into account the consequences of possible failures.

1.3.2 Equipment design and construction

Equipment shall be so designed and constructed that, under all conditions of normal use and under likely abnormal use or single fault conditions (see 1.4.14), protection is provided to reduce the risk of personal injury from electric shock and other hazards, and against spread of fire originating in the equipment.

Compliance is checked by inspection and by the relevant tests.

1.3.3 Supply voltage

Equipment shall be designed to be safe at any supply voltage to which it is intended to be connected.

Compliance is checked by inspection and by carrying out the relevant tests of this standard using a supply voltage as specified in the corresponding subclause. If the subclause does not specify the supply voltage (explicitly or by reference to 1.4.5), then the value of the RATED VOLTAGE or any value in the RATED VOLTAGE RANGE shall be used.

1.3.4 Constructions not specifically covered

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

NOTE The need for additional detailed requirements to cope with a new situation should be brought promptly to the attention of the appropriate committee.

1.3.5 Equivalent materials

Where the standard specifies a particular grade of insulation, the use of a better grade of insulation is permitted. Similarly, where the standard requires material of a particular FLAMMABILITY CLASS, the use of a better class is permitted.

1.3.6 Orientation during transport and use

Where it is clear that the orientation of the equipment is likely to have a significant effect on the application of the requirements or the results of tests, all orientations of use permitted in the installation or operating instructions shall be taken into account. For TRANSPORTABLE EQUIPMENT, all orientations of transport and use shall be taken into account.

NOTE The above may apply to 4.1, 4.2, 4.3.8, 4.5, 4.6 and 5.3.

1.3.7 Choice of criteria

Where the standard permits a choice between different criteria for compliance, or between different methods or conditions of test, the choice is specified by the manufacturer.

1.3.8 Examples mentioned in the standard

Where examples of equipment, parts, methods of construction, design techniques and faults are given in the standard, prefaced by "for example" or "such as", other examples, situations and solutions are not excluded.

1.3.9 Conductive liquids

For the electrical requirements of this standard, conductive liquids shall be treated as conductive parts.

1.4 General conditions for tests

1.4.1 Application of tests

The tests detailed in this standard shall be conducted only if safety is involved.

If it is evident from the design and construction of the equipment that a particular test is not applicable, the test is not made.

Unless otherwise stated, upon conclusion of the tests, the equipment need not be operational.

1.4.2 Type tests

Except where otherwise stated, the tests specified in this standard are TYPE TESTS.

1.4.3 Test samples

Unless otherwise specified, the sample or samples under test shall be representative of the equipment 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 equipment, tests may be conducted separately on circuits, components or subassemblies outside the equipment, provided that inspection of the equipment and circuit arrangements indicates that the results of such testing will be representative of the results of testing the assembled equipment. If any such test indicates a likelihood of non-conformance in the complete equipment, the test shall be repeated in the equipment.

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

NOTE 1 The tests should be conducted in the following order:

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

NOTE 2 In view of the 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.

1.4.4 Operating parameters for tests

Except where specific test conditions are stated elsewhere in the standard and where it is clear that there is a significant impact on the results of the test, the tests shall be conducted

under the most unfavourable combination within the manufacturer's operating specifications of the following parameters:

- supply voltage (see 1.4.5);
- supply frequency (see 1.4.6);
- operating temperature (see 1.4.12);
- physical location of equipment and position of movable parts;
- operating mode;
- adjustment of THERMOSTATS, regulating devices or similar controls in OPERATOR ACCESS AREAS, which are:
 - adjustable without the use of a TOOL; or
 - adjustable using a means, such as a key or a TOOL, deliberately provided for the OPERATOR.

1.4.5 Supply voltage for tests

In determining the most unfavourable voltage for the power to energize the equipment under test (EUT), the following variables shall be taken into account:

- multiple RATED VOLTAGES;
- tolerances on RATED VOLTAGE as specified below;
- extremes of RATED VOLTAGE RANGES.

If the equipment is intended for direct connection to an AC MAINS SUPPLY, the tolerances on RATED VOLTAGE shall be taken as +6 % and –10 %, unless:

- the RATED VOLTAGE is 230 V single-phase or 400 V three-phase, in which case the tolerance shall be taken as +10 % and –10 %; or
- a wider tolerance is declared by the manufacturer, in which case the tolerance shall be taken as this wider value.

If the equipment is intended only for connection to an a.c. mains equivalent source, such as a motor-driven generator or an uninterruptible power supply (see 1.2.8.1), or a source other than a MAINS SUPPLY, the tolerances on RATED VOLTAGE shall be declared by the manufacturer.

If equipment is intended for connection to a DC MAINS SUPPLY, the tolerance shall be taken as +20 % and –15 %, unless declared otherwise by the manufacturer.

When testing equipment designed for d.c. only, the possible influence of polarity shall be taken into account.

1.4.6 Supply frequency for tests

In determining the most unfavourable frequency for the power to energize the EUT, different RATED FREQUENCIES within the RATED FREQUENCY RANGE shall be taken into account (for example, 50 Hz and 60 Hz) but consideration of the tolerance on a RATED FREQUENCY (for example, 50 Hz ± 0,5 Hz) is not normally necessary.

1.4.7 Electrical measuring instruments

Electrical measuring instruments shall have adequate bandwidth to provide accurate readings, taking into account all components (d.c., AC MAINS SUPPLY frequency, high frequency and harmonic content) of the parameter being measured. If the r.m.s. value is measured, care shall be taken that measuring instruments give true r.m.s. readings of non sinusoidal waveforms as well as sinusoidal waveforms.

1.4.8 Normal operating voltages

For the purposes of:

- determining WORKING VOLTAGES (see 1.2.9.6); and
- classifying circuits in the equipment as ELV CIRCUITS, SELV CIRCUITS, TNV-1 CIRCUITS, TNV-2 CIRCUITS, TNV-3 CIRCUITS, or HAZARDOUS VOLTAGE circuits;

the following voltages shall be considered:

- normal operating voltages generated in the equipment, including repetitive peak voltages such as those associated with switch mode power supplies;
- normal operating voltages generated outside the equipment, including ringing signals received from TELECOMMUNICATION NETWORKS.

For these purposes, unwanted, externally generated, non-repetitive transient voltages (for example, MAINS TRANSIENT VOLTAGES and TELECOMMUNICATION NETWORK TRANSIENT VOLTAGES) induced by power distribution system switching and lightning surges, shall not be considered:

- when determining WORKING VOLTAGES, because such transients have been taken into account in the procedures for determining minimum CLEARANCES (see 2.10.3 and Annex G);
- when classifying circuits in the equipment, except when distinguishing between SELV CIRCUITS and TNV-1 CIRCUITS and between TNV-2 CIRCUITS and TNV-3 CIRCUITS (see 1.2.8.11, Table 1A).

NOTE 1 The effects of unwanted steady-state voltages generated outside the equipment (for example, earth potential differences and voltages induced on TELECOMMUNICATION NETWORKS by electric train systems) are controlled by installation practices or by appropriate isolation in the equipment. Such measures are application dependent and are not dealt with by this standard.

NOTE 2 In Canada and the United States, additional requirements apply for protection against overvoltages (see Clause 6 Note 5).

1.4.9 Measurement of voltage to earth

Where the standard specifies a voltage between a conductive part and earth, all of the following earthed parts are considered:

- the main protective earthing terminal (if any); and
- any other conductive part required to be connected to protective earth (for examples see 2.6.1); and
- any conductive part that is earthed within the equipment for functional reasons.

Parts that will be earthed in the application by connection to other equipment, but are unearthed in the equipment as tested, shall be connected to earth at the point by which the highest voltage is obtained. When measuring a voltage between earth and a conductor in a circuit that will not be earthed in the intended application of the equipment, a non-inductive resistor of $5\,000\ \Omega \pm 10\%$ shall be connected across the voltage measuring instrument.

Voltage drop in the PROTECTIVE EARTHING CONDUCTOR of the power supply cord, or in an earthed conductor in other external wiring, is not included in the measurements.

1.4.10 Loading configuration of the EUT

In determining the input current (see 1.6.2), and where other test results could be affected, the following variables shall be considered and adjusted to give the most unfavourable results:

- loads due to optional features, offered or provided by the manufacturer for inclusion in or with the EUT;
- loads due to other units of equipment intended by the manufacturer to draw power from the EUT;
- loads that could be connected to any standard supply outlets in OPERATOR ACCESS AREAS on the equipment, up to the value indicated in the marking required by 1.7.5.

It is permitted to use artificial loads to simulate such loads during testing.

1.4.11 Power from a telecommunication network

For the purpose of this standard, the power available from a TELECOMMUNICATION NETWORK is considered to be limited to 15 VA.

1.4.12 Temperature measurement conditions

1.4.12.1 General

Temperatures measured on the EUT shall conform to 1.4.12.2 or 1.4.12.3, as applicable, all temperatures being in degrees Celsius ($^{\circ}\text{C}$); where

- T is the temperature of the given part measured under the prescribed test conditions;
- T_{max} is the maximum temperature specified for compliance with the test;
- T_{amb} is the ambient temperature during test;
- T_{ma} is the maximum ambient temperature permitted by the manufacturer's specification, or 25°C , whichever is greater.

1.4.12.2 Temperature dependent equipment

For equipment where the amount of heating or cooling is designed to be dependent on temperature (for example, the equipment contains a fan that has a higher speed at a higher temperature), the temperature measurement is made at the least favourable ambient temperature within the manufacturer's specified operating range. In this case:

T shall not exceed T_{max} .

NOTE 1 In order to find the highest value of T for each component, it may be necessary to conduct several tests at different values of T_{amb} .

NOTE 2 The least favourable value of T_{amb} may be different for different components.

1.4.12.3 Non-temperature dependent equipment

For equipment where the amount of heating or cooling is not designed to be dependent on ambient temperature, it is permitted to use the method in 1.4.12.2. Alternatively, the test is performed at any value of T_{amb} within the manufacturer's specified operating range. In this case:

T shall not exceed $(T_{\text{max}} + T_{\text{amb}} - T_{\text{ma}})$.

During the test, T_{amb} should not exceed T_{ma} unless agreed by all parties involved.

1.4.13 Temperature measurement methods

Unless a particular method is specified, the temperatures of windings shall be determined either by the thermocouple method or by the resistance method (see Annex E). The temperatures of parts other than windings shall be determined by the thermocouple method.

Any other suitable method of temperature measurement which does not noticeably influence the thermal balance and which achieves an accuracy sufficient to show compliance is also permitted. The choice of and position of temperature sensors shall be made so that they have minimum effect on the temperature of the part under test.

1.4.14 Simulated faults and abnormal conditions

Where it is required to apply simulated faults or abnormal operating conditions, these shall be applied in turn and one at a time. Faults that are the direct consequence of a simulated fault or abnormal operating condition are considered to be part of that simulated fault or abnormal operating condition.

When applying simulated faults or abnormal operating conditions, parts, supplies, consumable materials, media and recording materials shall be in place if they are likely to have an effect on the outcome of the test.

Where there is a specific reference to a single fault, the single fault consists of a single failure of any insulation (excluding DOUBLE INSULATION or REINFORCED INSULATION) or a single failure of any component (excluding components with DOUBLE INSULATION or REINFORCED INSULATION). The failure of FUNCTIONAL INSULATION is simulated only when required by 5.3.4 c).

The equipment, circuit diagrams and component specifications are examined to determine those fault conditions that might reasonably be expected to occur. Examples include:

- short-circuits and open circuits of semiconductor devices and capacitors;
- faults causing continuous dissipation in resistors designed for intermittent dissipation;
- internal faults in integrated circuits causing excessive dissipation;
- failure of BASIC INSULATION between current-carrying parts of the PRIMARY CIRCUIT and
 - accessible conductive parts;
 - earthed conductive screens (see Clause C.2);
 - parts of SELV CIRCUITS;
 - parts of LIMITED CURRENT CIRCUITS.

1.4.15 Compliance by inspection of relevant data

Where in this standard compliance of materials, components or subassemblies is checked by inspection or by testing of properties, it is permitted to confirm compliance by reviewing any relevant data or previous test results that are available instead of carrying out the specified TYPE TESTS.

1.5 Components

1.5.1 General

Where safety is involved, components shall comply either with the requirements of this standard or with the safety aspects of the relevant IEC component standards.

NOTE 1 An IEC component standard is considered relevant only if the component in question clearly falls within its Scope.

NOTE 2 In Sweden, switches containing mercury are not permitted.

NOTE 3 In Switzerland, switches containing mercury such as THERMOSTATS, relays and level controllers are not allowed.

1.5.2 Evaluation and testing of components

Evaluation and testing of components shall be conducted as follows:

- *a component that has been demonstrated to comply with a standard harmonized with the relevant IEC component standard shall be checked for correct application and use in accordance with its rating. It shall be subjected to the applicable tests of this standard as part of the equipment with the exception of those tests which are part of the relevant IEC component standard;*
- *a component that has not been demonstrated to comply with a relevant standard as above shall be checked for correct application and use in accordance with its specified rating. It shall be subjected to the applicable tests of this standard, as part of the equipment, and to the applicable tests of the component standard, under the conditions occurring in the equipment;*

NOTE The applicable test for compliance with a component standard is, in general, conducted separately.

- *where no relevant IEC component standard exists, or where components are used in circuits not in accordance with their specified ratings, the components shall be tested under the conditions occurring in the equipment. The number of samples required for test is, in general, the same as required by an equivalent standard.*

1.5.3 Thermal controls

Thermal controls shall be tested in accordance with Annex K.

1.5.4 Transformers

Transformers shall comply with the relevant requirements of this standard, including those of Annex C.

1.5.5 Interconnecting cables

INTERCONNECTING CABLES provided as part of the equipment shall comply with the relevant requirements of this standard and shall not present a hazard in the meaning of this standard whether they are detachable or non-detachable.

For INTERCONNECTING CABLES supplied alone (for example, printer cables), it is permitted to apply the requirements of this subclause at the option of the manufacturer.

It is permitted to treat cables, or those parts of cables that are within an equipment ENCLOSURE, either as INTERCONNECTING CABLES or as internal wiring.

1.5.6 Capacitors bridging insulation

A capacitor connected between two line conductors in a PRIMARY CIRCUIT, or between one line conductor and the neutral conductor or between the PRIMARY CIRCUIT and protective earth shall comply with one of the subclasses of IEC 60384-14 and shall be used in accordance with its rating. This requirement also applies to a capacitor bridging DOUBLE INSULATION or REINFORCED INSULATION elsewhere in the equipment. The details of the damp heat, steady state test as specified in 4.12 of IEC 60384-14 shall be as follows:

- Temperature: $40\text{ °C} \pm 2\text{ °C}$;
- Humidity: $93\% \pm 3\%$ relative humidity;
- Test duration: 21 days.

NOTE 1 Capacitors that have been subjected to a test duration longer than 21 days are considered to have met the test duration criteria.

The above requirement does not apply to a capacitor connected between a HAZARDOUS VOLTAGE SECONDARY CIRCUIT and protective earth, where only BASIC INSULATION is required.

NOTE 2 The test of 5.2.2 still applies between the HAZARDOUS VOLTAGE SECONDARY CIRCUIT and protective earth.

The appropriate capacitor subclass shall be selected from those listed in Table 1C according to the rules of application in the table.

Table 1C – Capacitor ratings according to IEC 60384-14

Capacitor subclass according to IEC 60384-14	RATED VOLTAGE of the capacitor V r.m.s.	TYPE TEST voltage of the capacitor kV peak
Y1	Up to and including 500	8
Y2	Over 150 up to and including 300	5
Y4	Up to and including 150	2,5
X1	-	4 ^a
X2	-	2,5 ^a

Rules for the application of Table 1C

1 Capacitors used to bridge BASIC INSULATION, SUPPLEMENTARY INSULATION or REINFORCED INSULATION shall be class Y except that it is permitted to bridge BASIC INSULATION in a SECONDARY CIRCUIT by a class X capacitor.

2 The voltage rating of the capacitor shall be at least equal to the RMS WORKING VOLTAGE across the insulation being bridged, determined according to 2.10.2.2.

~~3 For a single capacitor bridging FUNCTIONAL INSULATION, BASIC INSULATION or SUPPLEMENTARY INSULATION, the peak test voltage of the capacitor shall be at least equal to the REQUIRED WITHSTAND VOLTAGE.~~

3 For a single capacitor bridging FUNCTIONAL INSULATION, BASIC INSULATION or SUPPLEMENTARY INSULATION, the peak test voltage of the capacitor shall be at least equal to the peak value of the test voltage (not the r.m.s. voltage) of Table 5B, or the peak value of the test voltage of Table 5C, as applicable, and the r.m.s. test voltage shall be not less than the required r.m.s. test voltage of Table 5B, or the equivalent r.m.s. test voltage (not the peak voltage) of Table 5C, as applicable.

~~4 For a single capacitor bridging DOUBLE INSULATION or REINFORCED INSULATION, the peak test voltage of the capacitor shall be at least equal to twice the REQUIRED WITHSTAND VOLTAGE.~~

4 For a single capacitor bridging DOUBLE INSULATION or REINFORCED INSULATION, the peak test voltage of the capacitor shall be not less than the peak value of the test voltage (not the r.m.s. voltage) of Table 5B, or the peak value of the test voltage of Table 5C, as applicable; and the r.m.s. test voltage shall be not less than the required r.m.s. test voltage of Table 5B, or the equivalent r.m.s. test voltage (not the peak voltage) of Table 5C, as applicable.

5 It is permitted to use a higher grade capacitor than the one specified, as follows:

- subclass Y1 if subclass Y2 is specified;
- subclass Y1 or Y2 if subclass Y4 is specified;
- subclass Y1 or Y2 if subclass X1 is specified;
- subclass X1, Y1 or Y2 if subclass X2 is specified.

6 It is permitted to use two or more capacitors in series in place of the single capacitor specified, as follows:

- subclass Y1 or Y2 if subclass Y1 is specified;
- subclass Y2 or Y4 if subclass Y2 is specified;
- subclass X1 or X2 if subclass X1 is specified.

~~7 If two or more capacitors are used in series, they shall~~

- ~~- all have the same nominal capacitance value;~~
- ~~- each be rated for the total RMS WORKING VOLTAGE across the insulation; and~~
- ~~- comply with the other rules above.~~

7 If two or more capacitors are used in series, all of the following apply:

- under single fault conditions, the voltage on each of the remaining individual capacitors shall not exceed the voltage rating of the relevant individual capacitor;
- for BASIC INSULATION or SUPPLEMENTARY INSULATION, the sum of the peak impulse test voltages of all capacitors shall be not less than the peak value of the test voltage (not the r.m.s. voltage) of Table 5B, or the peak value of the test voltage of Table 5C, as applicable;
- for BASIC INSULATION or SUPPLEMENTARY INSULATION, the sum of the r.m.s. test voltages of all capacitors shall be not less than the required r.m.s. test voltage of Table 5B, or the equivalent r.m.s. test voltage (not the peak voltage) of Table 5C, as applicable;
- for REINFORCED INSULATION, the sum of the peak impulse test voltages of all capacitors shall be not less than the peak value of the test voltage (not the r.m.s. voltage) of Table 5B, or the peak value of the test voltage of Table 5C, as applicable;
- for REINFORCED INSULATION, the sum of the r.m.s. test voltages of all capacitors shall be not less than the required r.m.s. test voltage of Table 5B, or the equivalent r.m.s. test voltage (not the peak voltage) of Table 5C, as applicable;
- they shall comply with the other rules above.

^a For capacitance values of more than 1 µF, this test voltage is reduced by a factor equal to $\sqrt{C}$, where C is the capacitance value in µF.

Table 1D gives a number of informative examples of the application of capacitors selected in accordance with Table 1C. Other examples are possible.

Table 1D – Informative examples of application of capacitors

AC MAINS SUPPLY VOLTAGE up to and including V r.m.s.	Overvoltage Category	MAINS TRANSIENT VOLTAGE kV	Bridged insulation	Capacitor type	Number of capacitors
150	II	1,5	B or S	Y4	1
	II	1,5	D or R	Y2	1
	II	1,5	D or R	Y4	2
	III	2,5	F	X2	1
	III	2,5	B or S	Y4	1
	III	2,5	D or R	Y1	1
	IV	4,0	F	X1	1
	IV	4,0	B or S	Y2	1
	IV	4,0	D or R	Y1	1
250	II	2,5	F	X2	1
300	II	2,5	B or S	Y2	1
	II	2,5	D or R	Y1	1
	II	2,5	D or R	Y2	2
250	III	4,0	F	X1	1
300	III	4,0	D or R	Y1	1
	III	4,0	D or R	Y2	2
	IV	6,0	B or S	Y1	1
	IV	6,0	D or R	Y1	2
500	II	4,0	B or S	Y1	1
	II	4,0	D or R	Y1	1
	III	6,0	B or S	Y1	1
	III	6,0	D or R	Y1	2
	IV	8,0	B or S	Y1	1
	IV	8,0	D or R	Y1	2
The values in the table apply to FUNCTIONAL INSULATION (F), BASIC INSULATION (B), SUPPLEMENTARY INSULATION (S), DOUBLE INSULATION (D) and REINFORCED INSULATION (R).					

AC MAINS SUPPLY voltage up to and including V r.m.s.	Overvoltage Category	MAINS TRANSIENT VOLTAGE kV	Bridged insulation	Capacitor type	Number of capacitors	
					Using Table 5B	Using Table 5C
150	II	1,5	B or S	Y2	1	1
	II	1,5	D or R	Y2	2	2
	II	1,5	D or R	Y1	1	1
	II	1,5	F	X2	1	1
	III	2,5	F	X2	1	1
	III	2,5	B or S	Y2	-	2
	III	2,5	D or R	Y1	-	1
	IV	4,0	F	X1	-	1
	IV	4,0	B or S	Y1	-	1
	IV	4,0	B or S	Y2	-	2
	IV	4,0	D or R	Y1	-	2
250	II	2,5	F	X2	1	1
	III	4,0	F	X1	1	1
300	II	2,5	B or S	Y2	1	2
	II	2,5	D or R	Y1	1	1
	II	2,5	D or R	Y2	2	3
	III	4,0	B or S	Y1	-	1
	III	4,0	B or S	Y2	-	2
	III	4,0	D or R	Y1	-	2
	III	4,0	D or R	Y2	-	4
	IV	6,0	F	X1	-	2
	IV	6,0	B or S	Y1	-	2
	IV	6,0	D or R	Y1	-	3
500	II	4,0	F	X1	1	1
	II	4,0	B or S	Y1	1	1
	II	4,0	D or R	Y1	1	2
	III	6,0	F	X1	-	2
	III	6,0	B or S	Y1	-	2
	III	6,0	D or R	Y1	-	3
	IV	8,0	F	X1	-	2
	IV	8,0	B or S	Y1	-	2
	IV	8,0	D or R	Y1	-	3
The values in the table apply to FUNCTIONAL INSULATION (F), BASIC INSULATION (B), SUPPLEMENTARY INSULATION (S), DOUBLE INSULATION (D) and REINFORCED INSULATION (R).						
NOTE Table 5B is used for Overvoltage Categories I and II only.						

If an accessible conductive part or circuit is separated from another part by DOUBLE INSULATION or REINFORCED INSULATION that is bridged by a capacitor or capacitors, the accessible part or circuit shall comply with the requirements for a LIMITED CURRENT CIRCUIT in 2.4. This requirement applies after electric strength testing of the insulation with the bridging capacitor or capacitors in place.

NOTE 3 A circuit is a LIMITED CURRENT CIRCUIT if the current through the bridging components complies with 2.4 and other requirements of 2.4 are met.

Compliance is checked by inspection and measurement.

1.5.7 Resistors bridging insulation

1.5.7.1 Resistors bridging functional insulation, basic insulation or supplementary insulation

There are no special requirements for resistors bridging FUNCTIONAL INSULATION, BASIC INSULATION or SUPPLEMENTARY INSULATION, but the relevant requirements of 2.10.3 (or Annex G) and 2.10.4 apply, and in some cases those of 2.4.

NOTE In Finland, Norway and Sweden resistors bridging BASIC INSULATION in CLASS I PLUGGABLE EQUIPMENT TYPE A must comply with ~~the requirements in 1.5.7.2~~ 1.5.7.1. In addition when a single resistor is used, the resistor must withstand the resistor test in 1.5.7.2.

1.5.7.2 Resistors bridging double insulation or reinforced insulation between the a.c. mains supply and other circuits

It is permitted to bridge DOUBLE INSULATION or REINFORCED INSULATION by one resistor or by a group of two or more resistors in series under the following conditions. For conditions applicable to circuits connected to an antenna or coaxial cable, see 1.5.7.3.

The resistor or group of resistors shall comply with the minimum CLEARANCES of 2.10.3 or Annex G and the minimum CREEPAGE DISTANCES of 2.10.4 for REINFORCED INSULATION for the total WORKING VOLTAGE across the resistor or group of resistors. For a group of resistors, see also Figure F.13.

If a single resistor is used, it shall pass the resistor test below.

If a group of resistors is used, the CLEARANCE and CREEPAGE DISTANCES are assessed as if each resistor were short-circuited in turn, unless the group passes the resistor test below.

If an accessible conductive part or circuit is separated from another part by DOUBLE INSULATION or REINFORCED INSULATION that is bridged by a resistor or group of resistors, the accessible part or circuit shall comply with the requirements for a LIMITED CURRENT CIRCUIT in 2.4 ~~between the accessible conductive part or circuit and earth~~. If a group of resistors is used, the current measurement in 2.4.2 is made with each resistor short-circuited in turn, unless the group passes the resistor test below. ~~This current is measured after electric strength testing of the insulation with the bridging resistor or group of resistors in place.~~ When measuring the LIMITED CURRENT CIRCUIT, the ammeter is placed between the load side of the bridging components and any USER accessible part, including earth.

Compliance is checked by inspection and measurement and, if specified above, by the following resistor test on ten samples. A sample is a single resistor if used alone, or a group of resistors in series.

Resistor Test

Before the test, the resistance of each sample is measured.

The samples are subjected to the damp heat test according to IEC 60068-2-78, with the following details:

- *Temperature: 40 °C ± 2 °C;*
- *Humidity: 93 % ± 3 % relative humidity;*
- *Test duration: 21 days.*

NOTE Resistors that have been subjected to a test duration longer than 21 days are considered to have met the test duration criteria.

Each sample is then subjected to ten impulses of alternating polarity, using the impulse test generator reference 2 of Table N.1. The interval between successive impulses is 60 s, and U_c is equal to the applicable REQUIRED WITHSTAND VOLTAGE.

After the test, the resistance of each sample shall not have changed by more than 10 %.

No failure is permitted.

1.5.7.3 Resistors bridging double insulation or reinforced insulation between the a.c. mains supply and circuits connected to an antenna or coaxial cable

The requirements and tests of 1.5.7.2 apply except the impulse test generator is as specified in reference 3 of Table N.1 if the circuit is connected to an antenna or reference 1 of Table N.1 if the circuit is connected to a coaxial cable.

After the test, the resistance of each sample shall not have changed by more than 20 % and no failure is permitted.

NOTE If a resistor or a group of resistors is connected between the PRIMARY CIRCUIT and a CABLE DISTRIBUTION SYSTEM, 7.4 also applies.

1.5.8 Components in equipment for IT power distribution systems

For equipment to be connected to IT power distribution systems, components connected between line and earth shall be capable of withstanding the stress due to the line-to-line voltage. However, capacitors rated for the applicable line-to-neutral voltage are permitted in such applications if they comply with subclass Y1, Y2 or Y4 of IEC 60384-14.

NOTE 1 The above capacitors are endurance tested at 170 % of the voltage rating of the capacitor.

NOTE 2 In Norway, due to the IT power distribution system used (see Annex V, Figure V.7), capacitors are required to be rated for the applicable line-to-line voltage (230 V).

Compliance is checked by inspection.

1.5.9 Surge suppressors

1.5.9.1 General

It is permitted to use any type of surge suppressor, including a voltage dependent resistor (VDR), in a SECONDARY CIRCUIT.

If a surge suppressor is used in a PRIMARY CIRCUIT, it shall be a VDR and it shall comply with Annex Q.

NOTE 1 A VDR is sometimes referred to as a varistor or a metal oxide varistor (MOV). Devices such as gas discharge tubes, carbon blocks and semiconductor devices with non-linear voltage/current characteristics are not considered as VDRs in this standard.

NOTE 2 It is not a requirement of this standard to comply with any particular component standard for surge suppressors used in SECONDARY CIRCUITS. However, attention is drawn to the IEC 61643 series of standards, in particular:

- IEC 61643-21 (surge suppressors in telecommunications application)
- IEC 61643-311 (gas discharge tubes)
- IEC 61643-321 (avalanche breakdown diodes)
- IEC 61643-331 (metal oxide varistors).

Compliance is checked by inspection and application of Annex Q as appropriate.

1.5.9.2 Protection of VDRs

For protection against

- temporary overvoltages above the maximum continuous voltage,
- thermal overload due to leakage current within the VDR, and
- burning and bursting of the VDR in the event of a short-circuit fault,

an interrupting means having an adequate breaking capacity shall be connected in series with the VDR. This requirement does not apply to a VDR in a LIMITED CURRENT CIRCUIT.

NOTE 1 For temporary overvoltages from the AC MAINS SUPPLY, see IEC 60664-1.

NOTE 2 During the lifetime of a VDR the leakage current increases with the number of switching cycles in the VDR. This leakage current causes a permanent and continuously increasing temperature stress, which can cause the VDR to burn or burst.

Compliance is checked by inspection.

1.5.9.3 Bridging of functional insulation by a VDR

It is permitted to bridge FUNCTIONAL INSULATION by a VDR.

Compliance is checked by inspection.

1.5.9.4 Bridging of basic insulation by a VDR

It is permitted to bridge BASIC INSULATION by a VDR provided that one side of the VDR is earthed in accordance with 2.6.1 a).

Equipment with such a VDR bridging BASIC INSULATION shall be one of the following:

- PLUGGABLE EQUIPMENT TYPE B; or
- PERMANENTLY CONNECTED EQUIPMENT; or
- equipment that has provision for a permanently connected PROTECTIVE EARTHING CONDUCTOR and is provided with instructions for the installation of that conductor.

NOTE In Finland, Norway and Sweden, the third dashed item is applicable only to equipment as defined in the Note to 6.1.2.2.

It is permitted to use a gas discharge tube (GDT) in series with a VDR that bridges BASIC INSULATION in accordance with the conditions in this subclause if the GDT complies with the requirements for FUNCTIONAL INSULATION.

Compliance is checked by inspection.

1.5.9.5 Bridging of supplementary, double or reinforced insulation by a VDR

It is not permitted to bridge SUPPLEMENTARY INSULATION, DOUBLE INSULATION or REINFORCED INSULATION by a VDR.

Compliance is checked by inspection.

1.6 Power interface

1.6.1 AC power distribution systems

AC power distribution systems are classified as TN-C, TN-C-S, TN-S, TT or IT (see Annex V).

1.6.2 Input current

The steady state input current of the equipment shall not exceed the RATED CURRENT by more than 10 % under NORMAL LOAD.

NOTE See also 1.4.10.

Compliance is checked by measuring the input current of the equipment at NORMAL LOAD under the following conditions:

- *where an equipment has more than one RATED VOLTAGE, the input current is measured at each RATED VOLTAGE;*
- *where an equipment has one or more RATED VOLTAGE RANGES, the input current is measured at each end of each RATED VOLTAGE RANGE. Where a single value of RATED CURRENT is marked (see 1.7.1), it is compared with the higher value of input current measured in the associated voltage range. Where two values of RATED CURRENT are marked, separated by a hyphen, they are compared with the two values measured in the associated voltage range.*

In each case, the readings are taken when the input current has stabilized. If the current varies during the normal operating cycle, the steady-state current is taken as the mean indication of the value, measured on a recording r.m.s. ammeter, during a representative period.

1.6.3 Voltage limit of hand-held equipment

The RATED VOLTAGE of HAND-HELD EQUIPMENT shall not exceed 250 V.

Compliance is checked by inspection.

1.6.4 Neutral conductor

The neutral conductor, if any, shall be insulated from earth and from the BODY throughout the equipment as if it were a line conductor. Components connected between neutral and earth shall be rated for the line-to-neutral voltage (however, see also 1.5.8).

Compliance is checked by inspection.

1.7 Markings and instructions

NOTE Additional requirements for markings and instructions are contained in the following subclauses:

2.1.1.2	Battery compartments	4.3.3	Adjustable controls
2.1.1.8	Energy hazards	4.3.5	Plugs and sockets
2.3.2.3	Protection by earthing	4.3.13.4	UV radiation
2.6.1	Unearthed parts	4.3.13.5	Lasers
2.6.2	FUNCTIONAL EARTHING	4.4.2	Hazardous moving parts
2.6.3.4 c)	Bonding conductors	4.4.5.2	Fan protection for USERS
2.6.5.1	Bonding conductors	4.4.5.3	Fan protection for service persons
2.7.1	External protective devices	4.5.3 4.5.4 Table 4C	Marking of hot parts
2.7.6	Neutral fusing	4.5.4	Touch temperatures
2.10.3.2	Overvoltage Categories	4.6.2	Equipment on non-combustible floors



3.2.1.2	DC MAINS SUPPLY	4.6.3	Removable doors and covers
3.3.7	Grouping of wiring terminals	5.1.7.1	TOUCH CURRENT exceeding 3,5 mA
3.4.3	Disconnect devices	5.1.8.2	Summation of TOUCH CURRENTS
3.4.6	Two-pole disconnect devices	6.1.1 and 6.1.2.2	Earthing for a TELECOMMUNICATION NETWORK
3.4.7	Four-pole disconnect devices	7.2 and 7.4.1	Earthing for a CABLE DISTRIBUTION SYSTEM
3.4.9	Plugs as disconnect devices	G.2.1	Equipment in Overvoltage Categories III and IV
3.4.10	Interconnected equipment	DD.2	Maximum shelf load
3.4.11	Multiple power sources	EE.2	Shredder warning
4.1	Equipment stability	EE.4	Shredder power disconnection
4.2.5	Impact test		

Compliance with each subclause of 1.7 is checked by inspection unless otherwise specified (see 1.7.11).

1.7.1 Power rating and identification markings

~~Equipment shall be provided with a power rating marking, the purpose of which is to specify a supply of correct voltage and frequency, and of adequate current-carrying capacity.~~

~~If a unit is not provided with a means for direct connection to a MAINS SUPPLY, it need not be marked with any electrical rating, such as its RATED VOLTAGE, RATED CURRENT or RATED FREQUENCY.~~

~~For equipment intended to be installed by an OPERATOR, the marking shall be readily visible in an OPERATOR ACCESS AREA, including any area that is directly visible only after an OPERATOR has opened a door or cover. If a manual voltage selector is not OPERATOR-accessible, the marking shall indicate the RATED VOLTAGE for which the equipment is set during manufacture; a temporary marker is permitted for this purpose. Marking is permitted on any outer surface of the equipment, except the bottom of equipment having a mass exceeding 18 kg. Additionally, on STATIONARY EQUIPMENT, the marking shall be visible after the equipment has been installed as in normal use.~~

~~For equipment intended to be installed by a SERVICE PERSON, and if the marking is in a SERVICE ACCESS AREA, the location of the permanent marking shall be indicated in the installation instructions or on a readily visible marker on the equipment. It is permitted to use a temporary marker for this purpose.~~

~~The marking shall include the following:~~

~~— RATED VOLTAGE(S) or RATED VOLTAGE RANGE(S), in volts;~~

- ~~• the voltage range shall have a hyphen (-) between the minimum and maximum RATED VOLTAGES and when multiple RATED VOLTAGES or RATED VOLTAGE RANGES are given, they shall be separated by a solidus (/);~~

~~NOTE 1— Some examples of RATED VOLTAGE markings are:~~

~~— RATED VOLTAGE RANGE: 220-240 V. This means that the equipment is designed to be connected to an AC MAINS SUPPLY having any voltage between 220 V and 240 V.~~

~~— Multiple RATED VOLTAGE: 120/230/240 V. This means that the equipment is designed to be connected to an AC MAINS SUPPLY having a voltage of 120 V or 230 V or 240 V, usually after internal adjustment.~~

- ~~• if equipment is to be connected to both of the line conductors and to the neutral conductor of a single phase, three wire power distribution system, the marking shall give the line-to-neutral voltage and the line-to-line voltage, separated by a solidus (/), with the added notation "Three wires plus protective earth", "3W + PE" or equivalent.~~

NOTE 2—Some examples of the above system rating markings are:

120/240 V; 3 wire + PE

120/240 V; 3W +  (60417-IEC-5019)

100/200 V; 2W + N + PE

—symbol for nature of supply, for d.c. only;

—RATED FREQUENCY or RATED FREQUENCY RANGE, in hertz, unless the equipment is designed for d.c. only;

—RATED CURRENT, in milliamperes or amperes;

- for equipment with multiple RATED VOLTAGES, the corresponding RATED CURRENTS shall be marked such that the different current ratings are separated by a solidus (/) and the relation between RATED VOLTAGE and associated RATED CURRENT appears distinctly;
- equipment with a RATED VOLTAGE RANGE shall be marked with either the maximum RATED CURRENT or with the current range;
- the marking for RATED CURRENT of a group of units having a single supply connection shall be placed on the unit which is directly connected to a MAINS SUPPLY. The RATED CURRENT marked on that unit shall be the total maximum current that can be on circuit at the same time and shall include the combined currents to all units in the group that can be supplied simultaneously through the unit and that can be operated simultaneously.

NOTE 3—Some examples of RATED CURRENT markings are:

—for equipment with multiple RATED VOLTAGES:

—120/240 V; 2,4/1,2 A

—for equipment with a RATED VOLTAGE RANGE:

—100-240 V; 2,8 A

—100-240 V; 2,8-1,4 A

—100-120 V; 2,8 A

—200-240 V; 1,4 A

It is recognized that in some regions it is customary to use a point (.) as a decimal marker instead of a comma.

—manufacturer's name or trade mark or identification mark;

—manufacturer's model identification or type reference;

—symbol  (IEC 60417-5172 (DB:2003-02)), for CLASS II EQUIPMENT only, except where this is forbidden by 2.6.2.

Additional markings are permitted, provided that they do not give rise to misunderstanding.

Where symbols are used, they shall conform to ISO 7000 or IEC 60417 where appropriate symbols exist.

1.7.1.1 Power rating markings

Equipment shall be provided with a power rating marking, the purpose of which is to specify a supply of correct voltage and frequency, and of adequate current-carrying capacity.

If the equipment is not provided with a means for direct connection to a MAINS SUPPLY, it need not be marked with any electrical rating, such as its RATED VOLTAGE, RATED CURRENT or RATED FREQUENCY. If the equipment, or a system, has multiple MAINS SUPPLY connections, each individual MAINS SUPPLY electrical rating must be marked, but the overall equipment or system electrical rating need not be marked.

For equipment intended to be installed by an OPERATOR, the power rating marking, if required, shall be readily visible in any OPERATOR ACCESS AREA. If a manual voltage selector is not OPERATOR-accessible, the power rating marking shall indicate the RATED VOLTAGE for which

the equipment is set during manufacture; a temporary marker is permitted for this purpose. The power rating marking is permitted on any outer surface of the equipment, except the bottom of equipment having a mass exceeding 18 kg.

For STATIONARY EQUIPMENT, the power rating marking shall be visible after the equipment has been installed as in normal use.

For equipment intended to be installed by a SERVICE PERSON, and if the power rating marking is in a SERVICE ACCESS AREA, the location of the permanent marking shall be indicated in the installation instructions or on a readily visible marker on the equipment. It is permitted to use a temporary marker for this purpose.

The power rating marking shall include the following:

- RATED VOLTAGE(S) or RATED VOLTAGE RANGE(S), in volts;
 - the voltage range shall have a hyphen (-) between the minimum and maximum RATED VOLTAGES and when multiple RATED VOLTAGES or RATED VOLTAGE RANGES are given, they shall be separated by a solidus (/);

NOTE 1 Some examples of RATED VOLTAGE markings are:

- RATED VOLTAGE RANGE: 220-240 V. This means that the equipment is designed to be connected to an AC MAINS SUPPLY having any voltage between 220 V and 240 V.
- multiple RATED VOLTAGE: 120/230/240 V. This means that the equipment is designed to be connected to an AC MAINS SUPPLY having a voltage of 120 V or 230 V or 240 V, usually after internal adjustment.
- if equipment is to be connected to both line conductors and to the neutral conductor of a single-phase, three-wire power distribution system, the power rating marking shall give the line-to-neutral voltage and the line-to-line voltage, separated by a solidus (/), with the added notation "Three wires plus protective earth", "3W + PE" or equivalent;

NOTE 2 Some examples of the above system rating markings are:

120/240 V; 3 wire + PE;

120/240 V; 3W +  (60417-IEC-5019);

100/200 V; 2W + N + PE;

100-120/200-240 V; 2W + N + PE.

- symbol for nature of supply, for d.c. only;
- RATED FREQUENCY or RATED FREQUENCY RANGE, in hertz, unless the equipment is designed for d.c. only;
- RATED CURRENT, in milliamperes or amperes;
 - for equipment with multiple RATED VOLTAGES, the corresponding RATED CURRENTS shall be marked such that the different current ratings are separated by a solidus (/) and the relation between RATED VOLTAGE and associated RATED CURRENT appears distinctly;
 - equipment with a RATED VOLTAGE RANGE shall be marked with either the maximum RATED CURRENT or with the current range;
 - the power rating marking for RATED CURRENT of a group of units having a single supply connection shall be placed on the unit which is directly connected to a MAINS SUPPLY. The RATED CURRENT marked on that unit shall be the total maximum current that can be on circuit at the same time and shall include the combined currents to all units in the group that can be supplied simultaneously through the unit and that can be operated simultaneously.

NOTE 3 Some examples of RATED CURRENT markings are:

- for equipment with multiple RATED VOLTAGES:
120/240 V; 2,4/1,2 A;
100-120/200-240 V; 2,4/1,2 A;
- for equipment with a RATED VOLTAGE RANGE:
100-240 V; 2,8 A or the peak value of the test voltage of Table 5C;
100-240 V; 2,8-1,4 A;
100-120 V; 2,8 A;
200-240 V; 1,4 A.

It is recognized that in some regions it is customary to use a point (·) as a decimal marker instead of a comma.

Additional markings are permitted, provided that they do not give rise to misunderstanding.

Where symbols are used, they shall conform to ISO 7000 or IEC 60417 where appropriate symbols exist.

1.7.1.2 Identification markings

Equipment shall be provided by the following identification markings:

- manufacturer's name or trade-mark or identification mark;
- manufacturer's model identification or type reference;
- symbol , IEC 60417-5172 (DB:2003-02), for the identification of CLASS II EQUIPMENT only, except where this is forbidden by 2.6.2.

Additional identification markings are permitted, provided that they do not give rise to misunderstanding.

These identification markings shall be readily visible in any OPERATOR ACCESS AREA, except that they shall not be located on the bottom of equipment having a mass exceeding 18 kg. For STATIONARY EQUIPMENT, the identification markings shall be visible after the equipment has been installed as in normal use.

1.7.2 Safety instructions and marking

1.7.2.1 General

Sufficient information shall be provided to the USER concerning any condition necessary to ensure that, when used as prescribed by the manufacturer, the equipment is unlikely to present a hazard within the meaning of this standard.

If it is necessary to take special precautions to avoid the introduction of hazards when operating, installing, servicing, transporting or storing equipment, the necessary instructions shall be made available.

NOTE 1 Special precautions may be necessary, for example, for connection of the equipment to the supply and for the interconnection of separate units, if any.

NOTE 2 Where appropriate, installation instructions should include reference to national wiring rules.

NOTE 3 In many countries, instructions and equipment marking related to safety are required to be in a language that is acceptable in the country in which the equipment is to be installed. Servicing instructions are normally made available only to SERVICE PERSONS and are generally acceptable in the English language only.

NOTE 4 In Germany, safety-related information, even for SERVICE PERSONS, has to be in the German language.

NOTE 5 In Canada, the instructions and markings should be in French and English.