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**Zambian Standard**

**SAFETY OF HOUSEHOLD AND SIMILAR ELECTRICAL  
APPLIANCES – Specification**

**PART 1. General requirements**

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**ZAMBIA BUREAU OF STANDARDS**

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## **ZAMBIA BUREAU OF STANDARDS**

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(See foreword)

## **FOREWORD**

This Zambian Standard is technically equivalent to the European Standard, *EN 60335 – 1: 1995 – Specification for safety of household electrical appliances: Part 1. General requirements.*

The European standard has been adopted as Zambian Standard and hence has the status of a Zambian Standard.

**COMPLIANCE WITH A ZAMBIAN STANDARD DOES NOT OF ITSELF CONFER IMMUNITY  
FROM LEGAL OBLIGATIONS**

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## INTRODUCTION

It has been assumed in the drafting of this international standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Moreover, when elaborating this standard, TC 61 took into account as far as possible the requirements given in IEC 364\* so that an appliance may be installed in accordance with these wiring rules. However national wiring rules may differ.

This standard recognizes the internationally accepted level of protection against hazards such a electrical, mechanical, thermal, fire and radiation of electrical household and similar appliances when operated as in normal use taking into account the manufacturer's instructions; it also covers abnormal situations which can be expected in practice.

A product which complies with the text of this standard will not necessarily be judged to comply with the safety principles of the standard it, when examined and tested, it is found to have other features which impair the level of safety covered by these requirements.

A product employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the safety principles of the standard.

The essential safety requirements of the following European directives, which could be applicable to household and similar appliances, are covered by this standard:

- |   |            |   |                                 |
|---|------------|---|---------------------------------|
| - | 73/23/EEC  | - | Low voltage directive;          |
| - | 89/393/EEC | - | Machinery directive;            |
| - | 89/106/EEC | - | Construction products directive |

This standard is a product-family standard dealing with the safety of household and similar electrical appliances and takes precedence over horizontal and generic standards covering the same subject.

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\*IEC 364:Electrical installations of buildings.

**SAFETY OF HOUSEHOLD AND SIMILAR ELECTRICAL  
APPLIANCES – Specification**

**PART 1. General requirements**

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**1 Scope**

This standard deals with the safety of electrical appliances for household and similar purposes, the **rated voltage** of the appliances being not more than 250 V for single-phase appliances and 480 V for other appliances.

Appliances may incorporate motors, heating elements or their combination.

Appliances not intended for normal household use but which nevertheless may be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

**NOTE:**

- 1 Examples of such appliances are catering equipment, cleaning appliances for industrial and commercial use, and appliances for hairdressers.

So far as is practicable, this standard deals with the common hazards presented by appliances, which are encountered by all persons in and around the home.

This standard does not in general take into account

- the use of appliances by young children or infirm persons without supervision;
- Playing with the appliance by young children.

**NOTES:**

- 2 Attention is drawn to the fact that
- for appliances intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary;
  - for appliances intended to be used in tropical countries, special requirements may be necessary;
  - in many countries additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour, the national water supply authorities and similar authorities.
- 3 This standard does not apply to
- appliances intended exclusively for industrial purposes;
  - appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas);
  - radio and television receivers, record players and similar equipment (IEC 65);
  - appliances for medical purposes (IEC 601);

- hand-held motor-operated electric tools (IEC 745);
- personal computers and similar equipment (IEC 950)
- blankets, pads and similar flexible heating appliances (IEC 967);
- electric fence energizers (IEC 1011);
- transportable motor-operated electric tools (IEC 1029).

## 2 Definitions

For the purpose of this standard, the following definitions apply.

2.1 Where the terms voltage and current are used they imply r.m.s. values, unless otherwise specified.

2.2.1 rated voltage: Voltage assigned to the appliance by the manufacturer.

**NOTE:**

For three-phase supply it is the voltage between phases.

2.2.2 rated voltage range: Voltage range assigned to the appliance by the manufacturer, expressed by its lower and upper limits.

2.2.3 Working voltage: Maximum voltage to which the part under consideration is subjected when the appliance is supplied at its rated voltage and operating under normal operation.

**NOTE:**

When deducing the working voltage, the effect of transient voltages is ignored.

2.2.4 rated power input: Power input assigned to the appliance by the manufacturer.

2.2.5 rated power input range: Power input range assigned to the appliance by the manufacturer expressed by its lower and upper limits.

2.2.6 Rated current: Current assigned to the appliance by the manufacturer.

**NOTE:**

If no current is assigned to the appliance, the rated current is

- for heating appliances, the current calculated from the rated power input and the rated voltage;
- for motor-operated appliances, the current measured when the appliance is rated voltage and operated under normal operation.

2.2.7 rated frequency: Frequency assigned to the appliance by the manufacturer.

2.2.8 rated frequency range: Frequency range assigned to the appliance by the manufacturer, expressed by its lower and upper limits.

2.2.8 normal operation: Conditions under which the appliance is operated in normal use when connected to the supply.

2.2.9 Normal operation: Conditions under which the appliance is operated in normal use when connected to the supply.

2.3.1 detachable cord: Flexible cord, for supply or interconnection, intended to be connected to the appliance by means of a suitable appliance coupler.

2.3.2 interconnection cord: External flexible cord provided as part of a complete appliance for purposes other than connection to the supply mains.

**NOTE:**

Remote hand-held switching device, an external interconnection between two parts of an appliance and a cord connecting an accessory to the appliance or to a separate signalling circuit are examples of interconnection cords.

2.3.3 supply cord: Flexible cord, for supply purposes, which is fixed to the appliance.

2.3.4 type X attachment: Method of attachment of the supply cord such that it can easily be replaced.

**NOTES:**

- 1 The supply cord may be specially prepared and only available from the manufacturer or its service agent.
- 2 A specially prepared cord may also include a part of the appliance.

2.3.5 type Y attachment: Method of attachment of the supply cord such that any replacement is intended to be made by the manufacturer, its service agent or similar qualified person.

**NOTE:**

Type Y attachment may be used either with an ordinary flexible cord or with a special cord.

2.3.6 type Z attachment: Method of attachment of the supply cord such that it cannot be replaced without breaking or destroying the appliance.

2.3.7 Supply leads: Set of wires intended for connecting the appliance to fixed wiring and accommodated in a compartment within or attached to the appliance.

2.4.1 basic insulation: Insulation applied to live parts to provide basic protection against electric shock.

**NOTE:**

Basic insulation does not necessarily include insulation used exclusively for functional purposes.

2.4.2 supplementary insulation: Independent insulation applied in addition to the basic insulation, in order to provide protection against electric shock in the event of a failure of the basic insulation.

2.4.3 double insulation: Insulation system comprising both basic insulation and supplementary insulation.

2.4.4 reinforced insulation: Single insulation applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in this standard.

**NOTE:**

It is not implied that the insulation is one homogeneous piece. The insulation may comprise several layers, which cannot be tested singly as supplementary insulation or basic insulation.

2.4.5 class 0 appliance: Appliance in which protection against electric shock relies upon basic insulation; this implies that there are no means for the connection of conductive accessible parts, if any, to the protective conductor in the fixed wiring of the installation, reliance in the event of a failure of the basic insulation being placed upon the environment.

**NOTE:**

Class 0 appliances have either an enclosure of insulating material which may form a part or the whole of the basic insulation, or a metal enclosure of insulating material has provision for earthing internal parts, it is considered to be a class 1 appliance or class 01 appliance

2.4.6 class 01 appliance: Appliance having at least basic insulation throughout and incorporating with an earthing terminal but with a supply cord without earthing conductor and a plug without earthing contact.

2.4.7 Class I appliance: Appliance in which protection against electric shock does not rely on basic insulation only but which includes an additional safety precaution in that conductive accessible parts are connected to the protective earthing conductor in the fixed wiring of the installation in such a way that conductive accessible parts cannot become live in the event of a failure of the basic insulation.

**NOTE:**

This provision includes a protective conductor in the supply cord.

2.4.8 class II appliance: Appliance in which protection against electric shock does not rely on basic insulation only but in which additional safety precautions, such as double insulation or reinforced insulation, are provided, there being no provision for protective earthing or reliance upon installation conditions.

**NOTES**

1 Such an appliance may be of one of the following types:

- a) an appliance having a durable and substantially continuous enclosure of insulating material which envelops all metal parts, with the exception of small parts, such as nameplates, screws and rivets, which are isolated from live parts by insulation at least equivalent to reinforced insulation; such an appliance is called an insulation-encased class II appliance;
- b) an appliance having a substantially continuous metal enclosure, in which double insulation or reinforced insulation is used throughout; such an appliance is called a metal-encased class II appliance;
- c) an appliance which is a combination of types a) and b).

2 The enclosure of an insulation-encased class II appliance may form a part or the whole of the supplementary insulation or of the reinforced insulation.

3 If an appliance with double insulation or reinforced insulation throughout has provision for earthing, it is considered to be a class I or a class 01 appliance.

4 Class II appliances may incorporate means for maintaining the continuity of protective circuits, provided that such means are within the appliance and are insulated from conductive accessible parts by supplementary insulation.

2.4.9 class II construction: Part of an appliance for which protection against electric shock relies upon double insulation or reinforced insulation.

2.4.10 class III appliance: Appliance in which protection against electric shock relies on supply at safety extra-low voltage and in which voltage higher than those of safety extra-low voltage are not generated.

NOTE - Appliances intended to be operated at safety extra-low voltage and having internal circuits which operate at a voltage other than safety extra-low voltage, are not included in the classification and are subject to additional requirements.

2.4.11 class III construction: Part of an appliance for which protection against electric shock relies upon safety extra-low voltage and in which voltages higher than those of safety extra-low voltages are not generated.

2.4.12 creepage distance: Shortest path between two conductive parts or between a conductive part and the accessible surface of the appliance, measured along the surface of the insulating material.

2.4.13 clearance: Shortest distance between two conductive parts or between a conductive part and the accessible surface of the appliance, measured through air.

2.5.1 extra-low voltage: Voltage supplied from a source within the appliance which, when the appliance is supplied at rated voltage does not exceed 50 V between conductors and between conductors and earth.

2.5.2 safety extra-low voltage: Voltage not exceeding 42 V between conductors and between conductors and earth, the no-load voltage not exceeding 50 V.

When safety extra-low voltage is obtained from the supply mains, it is to be through a safety isolating transformer or a convertor with separate windings, the insulation of which complies with double insulation or reinforced insulation requirements.

NOTE – The voltage limits specified are based on the assumption that the safety isolating transformer is supplied at its rated voltage.

2.5.3 safety isolating transformer: Transformer, the input winding of which is electrically separated from the output winding by an insulation at least equivalent to double insulation or reinforced insulation and which is intended to supply an appliance or circuit at safety extra-low voltage.

2.6.1 portable appliance: Either an appliance which is intended to be moved while in operation or an appliance, other than a fixed appliance, having a mass less than 18 kg.

2.6.2 hand-held appliance: Portable appliance intended to be held in the hand during normal use, the motor, if any, forming an integral part of the appliance.

2.6.3 stationary appliance: Either a fixed appliance or an appliance which is not portable.

2.6.4 fixed appliance: Appliance which is intended to be used while fastened to a support or otherwise secured in a specific situation.

NOTE – Adhesives are not recognized as a means for fastening a fixed appliance to a support.

2.6.5 built-in appliance: Fixed appliance intended to be installed in a cabinet, in a prepared recess in a wall or in a similar situation.

2.7.1 non-detachable part: Part which can only be removed or opened-with the aid of a tool or a part which fulfils the test of 22.11.

2.7.2 detachable part: Part which can be removed or opened without the aid of a tool, a part which is removed in accordance with the instructions for use even if a tool is needed for removal or a part which does not fulfil the test of 22.11.

NOTE Z1 – A part is not considered to be detachable if, according to the instruction, it has to be removed with the aid of a tool in order to discard batteries before scrapping the appliance.

## NOTES

1 If for installation purposes a part has to be removed, this part is not considered as detachable even if the instructions state that it is to be removed.

2 Components which can be removed without the aid of a tool are considered as detachable parts.

2.7.3 tool: Screwdriver, coin or any other object which may be used to operate a screw or similar fixing means.

2.8.1 thermostat: Temperature-sensing device, the operating temperature of which may be either fixed or adjustable and which during normal operation keeps the temperature of the controlled part between certain limits by automatically opening and closing a circuit.

2.8.2 temperature limiter: Temperature-sensing device, the operating temperature of which may be either fixed or adjustable and which during normal operation operates by opening or closing a circuit when the temperature of the controlled part reaches a pre-determined value.

NOTE – It does not make the reverse operation during the normal duty cycle of the appliance. It may or may not require manual resetting.

2.8.3 thermal cut-out: Device which during abnormal operation limits the temperature of the controlled part by automatically opening the circuit or by reducing the current and constructed so that its setting cannot be altered by the user.

2.8.4 self-resetting thermal cut-out: Thermal cut-out which automatically restores the current after the relevant part of the appliance has cooled down sufficiently.

2.8.5 non-self-resetting thermal cut-out: Thermal cut-out which requires a manual operation for resetting or replacement of a part, in order to restore the current.

NOTE – Manual operation includes disconnection of the supply.

2.8.6 protective device: Device, the operation of which prevents a hazardous situation under abnormal operation conditions.

2.8.7 thermal link: Thermal cut-out which operates only once and then requires partial or complete replacement.

2.9.1 all-pole disconnection: For single-phase appliances disconnection of both supply conductors by a single initiating action or, for three-phase appliances, disconnection of all supply conductors except the earthed (grounded) conductor, by a single initiating action.

NOTE – The protective earthing conductor is not considered to be a supply conductor.

2.9.2 off position: Stable position of a switching device in which the circuit controlled by the switch is disconnected from its supply.

NOTE – The off position does not imply an all-pole disconnection.

2.9.3 accessible part: Part or surface which can be touched by means of the test finger of figure 1, including any conductive part connected to accessible metal parts.

2.9.4 live part: Any conductor or conductive part intended to be energized in normal use, including a neutral conductor but, by convention, not a PEN conductor.

#### NOTES

1 Parts, accessible or not, complying with 8.1.4 are not considered to be live parts.

2. A PEN conductor is a protective earthed neutral conductor combining the functions of both protective conductor and neutral conductor

2.9.5 Visibly glowing heating element: Heating element which is partly or completely visible from the outside of the appliance and has a temperature of at least 650°C when the appliance has been operated under normal operation at rated power input until steady conditions have been established.

2.9.6 heating appliance: Appliance incorporating heating elements but without any motor.

2.9.7 motor-operated appliance: Appliance incorporating motors but without any heating element.

NOTE – Magnetically driven appliances are considered to be motor-operated appliances.

2.9.8 combined appliance: Appliance incorporating heating elements and motors.

2.9.9 user maintenance: Any maintenance operation stated in the instructions for use or marked on the appliance which the user is intended to perform.

2.10.1 electronic component: Part in which conduction is achieved principally by electrons moving through a vacuum, gas or semiconductor.

NOTE – Neon indicators are not considered to be electronic components.

2.10.2 electronic circuit: Circuit incorporating at least one electronic component.

2.10.3 protective impedance: Impedance connected between live parts and accessible conductive parts of class II construction such that the current, in normal use and under likely fault conditions in the appliance, is limited to a safe value.

2.10.4 PTC heating element: Element intended for heating consisting mainly of positive temperature coefficient resistors which are thermally sensitive and which have a rapid non-linear increase in resistance when the temperature is raised through a particular range.

### 3 General requirement

Appliances shall be constructed so that in normal use they function safely so as to cause no danger to persons or surroundings, even in the event of carelessness that may occur in normal use.

In general this principle is achieved by fulfilling the relevant requirements specified in this standard and compliance is checked by carrying out all the relevant tests.

#### NOTES

1 deleted

2 deleted

3 This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of electrical household and similar appliances when operated as in normal use taking into account the instructions for use; it also covers abnormal situations likely to be encountered in practice.

### 4. General conditions for the tests

4.1 Tests according to this standard are type tests.

4.2 Unless otherwise specified, the tests are made on a single appliance which shall withstand all the relevant tests. However the tests of clauses 22 to 26 and 28 may be made on separate samples.

#### NOTES

1 Additional samples may be required for example if the appliance can be supplied with different voltages.

If the test of annex C has to be made, six samples of the motor are needed.

The testing of components may require the submission of additional samples of these components.

If the tests of 24.1.3 are carried out, three switches or three additional appliances are needed.

2 The cumulative stress resulting from successive tests on electronic circuits is to be avoided. It may be necessary to replace components or to use additional samples. The number of additional samples should be kept to a minimum by an evaluation of the relevant electronic circuits.

3 If an appliance has to be dismantled in order to carry out a test, care is to be taken to insure that it is reassembled as originally supplied. In case of doubt subsequent tests may be carried out on a separate sample.

4.3 Unless otherwise specified, the tests are carried out in the order of the clauses. However, the test of 22.11 on the appliance at room temperature is made before the tests of clause 8. If it is evident from the construction of the appliance that a particular test is not applicable, the test is not made.

4.4 When testing appliances which are also supplied by other energies such as gas, the influence of their consumption has to be taken into account.

4.5 The tests are carried out with the appliance or any movable part of it placed in the most unfavourable position which may occur in normal use.

4.6 Appliances provided with controls or switching devices are tested with these controls or devices adjusted to their most unfavourable setting, if the setting can be altered by the user.

#### NOTES

1 If the adjusting means of the control is accessible without the aid of a tool, this subclause applies whether the setting can be altered by hand or with the aid of a tool. If the adjusting means is not accessible without the aid of a tool and if the setting is not intended to be altered by the user, this subclause does not apply.

2 Adequate sealing is regarded as preventing alteration of the setting by the user.

4.7 The tests are carried out in a draught free location and in general at an ambient temperature of  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .

If the temperature attained by any part is limited by a temperature sensitive device or is influenced by the temperature at which a change of state occurs, for example when water boils, the ambient temperature is maintained at  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  in case of doubt.

4.8.1 Appliances for a.c. only are tested with a.c. at rated frequency, if marked, and those for a.c./d.c. are tested at the more unfavourable supply.

Appliances which are not marked with rated frequency are tested with 50 Hz. Appliances which are marked with a frequency range of 50 Hz to 60 Hz are tested with 50 Hz or 60 Hz, whichever is the more unfavourable.

4.8.2 Appliances having more than one rated voltage are tested on the basis of the most unfavourable voltage.

When it is specified, for motor-operated appliances and combined appliances marked with a rated voltage range, that the supply voltage is equal to the rated voltage multiplied by a factor, the supply voltage is equal to

- the upper limit of the rated voltage range multiplied by this factor, if greater than 1;
- the lower limit of the rated voltage range multiplied by this factor, if smaller than 1.

When a factor is not specified, the supply voltage is the most unfavourable within the rated voltage range.

#### NOTES

1 If a heating appliance has a rated voltage range, the upper limit of the voltage range will usually be the most unfavourable voltage within the range.

2 For combined appliances and motor-operated appliances and for appliances having more than one rated voltage or rated voltage range, it may be necessary to make some of the tests at the minimum, the mean and the maximum values of the rated voltage or the rated voltage range in order to establish the most unfavourable voltage.

4.8.3 When it is specified, for heating appliances and combined appliances marked with a rated power input range, that the power input is equal to the rated power input multiplied by a factor, the power input is equal to

- the upper limit of the rated power input range multiplied by this factor, if greater than 1;
- the lower limit of the rated power input range multiplied by this factor, if smaller than 1.

When a factor is not specified, the power input is the most unfavourable within the rated power input range.

4.8.4 For appliances marked with a rated voltage range and rated power input corresponding to the mean of the rated voltage range, when it is specified that the power input is equal to rated power input multiplied by a factor, the power input is equal to:

- the calculated power input corresponding to the upper limit of the rated voltage range multiplied by this factor if greater than 1;
- the calculated power input corresponding to the lower limit of the rated voltage range multiplied by this factor if smaller than 1.

When a factor is not specified, the power input corresponds to the power input at the most unfavourable voltage within the rated voltage range.

4.9 When alternative heating elements or accessories are made available by the appliance manufacturer, the appliance is tested with those elements or accessories which give the most unfavourable results.

4.10 The tests are made on the appliance as supplied. However, an appliance constructed as a single appliance but supplied in a number of units is tested after assembly in accordance with the instructions provided with the appliance.

Unless otherwise specified, built-in appliances and fixed appliances are installed in accordance with the instructions provided with the appliance before testing.

4.11 Unless otherwise specified, appliances intended to be supplied by means of a flexible cord are tested with the appropriate flexible cord connected to the appliance.

4.12 When, for combined appliances and heating appliances, it is specified that the appliance has to operate at a power input multiplied by a factor, this applies only to heating elements without appreciable positive temperature coefficient of resistance.

For other heating elements, other than PTC heating elements, the supply voltage is determined by supplying the appliance at rated voltage until the heating element reaches its operating temperature. The supply voltage is then rapidly increased to the value necessary to give the power input required or the relevant test, this value of the supply voltage being maintained throughout the test.

NOTE – In general, the temperature coefficient is considered to be appreciable if, at rated voltage, the power input of the appliance in cold condition differs by more than 25% from the power input at operating temperature.

4.13 The tests for appliances with PTC' heating elements are made at a voltage corresponding to the specified power input. When a power input greater than the rated power input is specified, the factor for multiplying the voltage is equal to the square root of the factor for multiplying the power input.

4.14 If class 01 appliances or class 1 appliances have accessible metal parts which are not earthed and are not separated from live parts by an intermediate metal part which is earthed, such parts are checked for compliance with the appropriate requirements specified for class II construction.

If class 01 appliances or class 1 appliances have accessible non-metallic parts, such parts are checked for compliance with the appropriate requirements specified for class II construction unless these parts are separated from live parts by an intermediate metal part which is earthed.

4.15 If appliances have parts operating at safety extra-low voltage, such parts are checked for compliance with the appropriate requirements specified for class III construction.

4.16 When testing electronic circuits, the supply is to be free from perturbations from external sources that can influence the results of the tests.

5 Void

6 Classification

6.1 Appliances shall be of one of the following classes with respect to protection against electric shock:

class I, class II, class III.

Compliance is checked by inspection and by the relevant tests.

6.2 Appliances shall have the appropriate degree of protection against harmful ingress of water.

Compliance is checked by inspection and by the relevant tests.

NOTE - The degrees of protection against harmful ingress of water are given in IEC 529.

7 Marking and Instructions

7.1 Appliances shall be marked with the

- rated voltage or rated voltage range in volts;
- symbol for nature of supply, unless the rated frequency is marked;
- rated power input in watts or kilowatts or rated current in amperes;
- name, trade mark or identification mark of the manufacturer or responsible vendor;
- model or type reference;
- symbol for class II construction, for class II appliances only;
- IP number according to degree of protection against ingress of water, other than IPXO

The marking of the rated voltage or rated voltage range shall cover

- 230 V for single-phase appliances;
- 400 V for multi-phase appliances.

Compliance is checked by inspection.

#### NOTES

- 1 The first numeral of the IP number need not be marked on the appliance.
- 2 Additional markings are allowed provided they do not give rise to misunderstanding.

3 If components are marked separately, the marking of the appliance and that of the components is to be such that there can be no doubt with regard to the marking of the appliance itself.

7.2 Stationary appliances for multiple supply shall be marked with the substance of the following:

Warning: Before obtaining access to terminals, all supply circuits must be disconnected.

This warning shall be placed in the vicinity of the terminal cover.

Compliance is checked by inspection.

7.3 Appliances having a range of rated values and which can be operated without adjustment throughout the range, shall be marked with the lower and upper limits of the range separated by a hyphen.

NOTE 1 – Example: 115-230 V: The appliance is suitable for any value within the marked range (a curling iron with a PTC heating element).

Appliances having different rated values and which have to be adjusted for use at a particular value by the user or installer, shall be marked with the different values separated by an oblique stroke.

#### NOTES

2 Example: 115/230 V: The appliance is only suitable for the marked values (a shaver with a selector switch).

3 This requirement is also applicable to appliances with provision for connection to both single-phase and multi-phase supplies.

Example: 230 V/400 V: The appliance is only suitable for the voltage values indicated where 230 V is for single-phase operation and 400 V for three-phase operation (a dishwasher with terminals for both supplies).

7.4 If the appliance can be adjusted for different rated voltages, the voltage to which the appliance is adjusted shall be clearly discernible.

NOTE – For appliances where frequent changes in voltage setting are not required, this requirement is considered to be met if the rated voltage to which the appliance is to be adjusted can be determined from a wiring diagram fixed to the appliance. The wiring diagram may be on the inside of a cover which has to be removed to connect the supply conductors. It is not to be on a label loosely attached to the appliance.

Compliance is checked by inspection.

7.5 For appliances marked with more than one rated voltage or with more than one rated voltage range, the rated power input for each of these voltages or ranges shall be marked. However, if the difference between the limits of a rated voltage range does not exceed 10% of the mean value of the range, the marking for rated power input may be related to the mean value of the range.

The upper and lower limits of the rated power input shall be marked on the appliance so that the relation between input and voltage is clear.

Compliance is checked by inspection.

7.6 When symbols are used, they shall be as follows:

V	volts
A	amperes
Hz	hertz
W	watts
F	farads
l	litres
G	grammes
Pa	pascals
bar	bars (see note 4)
h	hours
min	minutes
s	seconds
	direct current
	alternating current
	two-phase alternating current
	two-phase alternating current with neutral
	three-phase alternating current
	three-phase alternating current with neutral
	rated current of the appropriate fuse-link in amperes
	time-lag miniature fuse-link where X is the symbol for the time/current characteristic as given in IEC 127
	protective earth
	class II appliance
	IP number

If the first numeral for the IP numbering is omitted, the omitted numeral shall be replaced by the letter X, for example IPX3.

The symbol for nature of supply shall be placed next to the marking for rated voltage.

The dimensions for the symbol for class II appliances shall be such that the length of the sides of the outer square is about twice the length of the sides of inner square.

The symbol for class II appliances shall be placed so that it will be obvious that it is a part of the technical information and is unlikely to be confused with any other marking.

When other units are used the units and their symbols shall be those of the international standardized system.

Compliance is checked by inspection and by measurement.

#### NOTES

- 1 Multiple or submultiple units are also allowed.
- 2 Additional symbols are allowed provided they do not give rise to misunderstanding.
- 3 Symbols specified in IEC 417 may be used.
- 4 Bars may be used but only together with pascals and placed in brackets.

7.7 Appliances to be connected to more than two supply conductors and appliances for multiple supply shall have a connection diagram fixed to them, unless the correct mode of connection is obvious.

Compliance is checked by inspection.

#### NOTES

1 The correct mode of connection is considered to be obvious if for three-phase appliances the terminals for the supply conductors are indicated by arrows pointing towards the terminals. The earthing conductor is not a supply conductor.

2 Marking in words is an acceptable means of indicating the correct mode of connection.

3 The connection diagram may be the wiring diagram referred to in 7.4.

7.8 Except for type Z attachment, terminals used for connection to the supply mains shall be indicated as follows:

- terminals intended exclusively for the neutral conductor shall be indicated by the letter N;
- protective earthing terminals shall be indicated by the symbol

These indications shall not be placed on screws, removable washers or other parts which can be removed when conductors are being connected.

If, for single-phase class I appliances intended to be permanently connected to fixed wiring, a single-pole protective device is inserted in the phase conductor inside the appliance, the corresponding terminal shall be clearly indicated.

Compliance is checked by inspection.

7.9 Unless it is obviously unnecessary, switches which may give rise to a hazard when operated shall be marked or placed so as to indicate clearly which part of the appliance they control.

Indications used for this purpose shall, wherever practicable, be comprehensible without a knowledge of languages or national standards.

Compliance is checked by inspection.

7.10 The different positions of switches on stationary appliances and the different positions of controls on all appliances shall be indicated by figures, letters or other visual means.

NOTE 1 – This requirement also applies to switches which are part of a control.

If figures are used for indicating the different positions, the off position shall be indicated by the figure 0 and the position for a greater output, input, speed, cooling effect, etc., shall be indicated by a higher figure.

The figure 0 shall not be used for any other indication, unless it is positioned and associated with other numbers so that it does not give rise to confusion with the indication of the off position.

Compliance is checked by inspection.

NOTE 2 – The figure 0 may, for example, also be used on a digital programming keyboard.

7.11 Controls intended to be adjusted during installation or in normal use shall be provided with an indication for the direction of adjustment.

Compliance is checked by inspection.

7.12 Instructions for use shall be provided with the appliance so that the appliance can be used safely.

Compliance is checked by inspection.

NOTE – Instructions for use may be marked on the appliance as long as they are visible in normal use.

The instructions for appliances incorporating batteries which contain materials which are hazardous to the environment, shall state that the batteries must be removed from the appliance before it is scrapped and that

they are disposed of safely. The instructions shall state that the appliance must be disconnected from the supply and give details how to remove the batteries.

NOTE Z1 – Refer to annex ZA.

7.12.1 If it is necessary to take special precautions for installation or user maintenance, details of these shall be supplied.

Compliance is checked by inspection.

7.12.2 If a stationary appliance is not provided with a supply cord and a plug or with other means for disconnection from the supply having a contact separation of at least 3 mm in all poles, the instructions shall state that such means for disconnection must be incorporated in the fixed wiring.

Compliance is checked by inspection.

If a stationary appliance is provided with a supply cord and a plug, the instructions shall state that the appliance must be positioned so that the plug is accessible.

NOTE Z1 - this requirement does not apply if the appliance incorporates other means for disconnection from the supply.

7.12.3 If the insulation of the supply wires of an appliance intended to be permanently connected to fixed wiring can come into contact with parts which have a temperature rise exceeding 50 K during the test of clause 11, the instructions shall state that the appliance must be connected by means of wires having an appropriate temperature rating (T-marking).

Compliance is checked by inspection and during the test of clause 11.

NOTE – This requirement will become applicable as soon as there is an IEC standard for high temperature cords and wires.

7.12.4 The instructions for built-in appliances shall include clear information with regard to the following:

- dimensions of the space to be provided for the appliance;
- dimensions and position of the means for supporting and fixing the appliance within this space;
- minimum distances between the various parts of the appliance and the surrounding parts of the fitment;
- connection of the appliance to the supply and the interconnection of any separate components;
- necessity to have the plug accessible after installation, unless the appliance is provided with a switch complying with 24.3.

Compliance is checked by inspection.

7.12.5 The instructions shall contain the substance of the following:

- for appliances with type X attachment having a specially prepared cord:
  - If the supply cord is damaged, it must be replaced by a special cord or assembly available from the manufacturer or its service agent;
- for appliances with type Y attachment:

If the supply cord is damaged, it must be replaced by the manufacturer or its service agent or a similarly qualified person in order to avoid a hazard;

- for appliances with type Z attachment:

The supply cord cannot be replaced. If the cord is damaged the appliance should be scrapped.

Compliance is checked by inspection.

- 7.13 Instructions and other texts required by this standard shall be written in the official language of the country in which the appliance is to be sold.

Compliance is checked by inspection.

- 7.14 The markings required by the standard shall be clearly legible and durable.

Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

After all the tests of this standard, the marking shall be clearly legible, it shall not be easily possible to remove marking plates and they shall show no curling.

#### NOTES

1 In considering the durability of the marking, the effect of normal use is taken into account. For example, marking by means of paint or enamel, other than vitreous enamel, on containers that are likely to be cleaned frequently, is not considered to be durable.

2 The petroleum spirit to be used for the test is aliphatic solvent hexane having a maximum aromatics content of 0,1% by volume, a kauri-butanol value of 29, an initial boiling point of approximately 65° C, a dry point of approximately 69° C and a specific mass of approximately 0,66 kg/l

- 7.15 The markings specified in 7.1 to 7.5 shall be on a main part of the appliance.

Markings on the appliance shall be clearly discernible from the outside of the appliance but if necessary after removal of a cover. For portable appliances it shall be possible to remove or open this cover without the aid of a tool.

For stationary appliances at least the name or trade mark or identification mark of the manufacturer or responsible vendor and the model or type reference shall be visible when the appliance is installed as in normal use. These markings may be beneath a detachable cover. Other markings may be beneath a cover only if they are near to the terminals.

For fixed appliances, this requirement applies after the appliance has been installed according to the instructions provided with the appliance.

Indications for switches and controls shall be placed on or near these components. They shall not be placed on parts which can be positioned or repositioned in such a way that the marking is misleading.

Compliance is checked by inspection.

- 7.16 If compliance with this standard depends upon the operation of a replaceable thermal link or fuse link, the reference number or other means for identifying the link shall be marked at such a place that it is clearly visible when the appliance has been dismantled to the extent necessary for replacing the link.

NOTE - Marking on the link is allowed as long as the marking is legible after the link has functioned.

This requirement does not apply to links which can only be replaced together with a part of the appliance.

Compliance is checked by inspection.

## 8. Protection against access to live parts

8.1 Appliances shall be constructed and enclosed so that there is adequate protection against accidental contact with live parts.

Compliance is checked by inspection and by the tests of 8.1.1 to 8.1.3 as applicable, taking into account 8.1.4 and 8.1.5.

8.1.1 The requirement of 8.1 applies for all positions of the appliance when it is operated as in normal use, even after opening lids and doors and removal of detachable parts.

NOTE – This excludes the use of screw-type fuses and screw-type miniature circuit breakers which are accessible without the aid of a tool.

Lamps located behind a detachable cover are not removed, provided the appliance can be isolated from the supply by means of a plug or an all-pole switch. However, during insertion or removal of lamps which are located behind a detachable cover, protection against contact with live parts of the lamp cap shall be ensured.

The test finger of figure 1 is applied without appreciable force, the appliance being in every possible position except that appliances normally used on the floor and having a mass exceeding 40 kg are not tilted. Through openings, the test finger is applied to any depth that the finger will permit and is rotated or angled before, during and after insertion to any position. If the opening does not allow the entry of the finger, the force on the finger in the straight position is increased to 20 N. If the finger then enters the opening, the test is repeated with the finger in the angled position.

It shall not be possible to touch live parts or live parts protected only by lacquer, enamel, ordinary paper, cotton, oxide film, beads or sealing compound except self-hardening resins, with the test finger.

8.1.2 The test pin of figure 2 is applied without appreciable force through openings in class 0 appliances, class II appliances or class II constructions, except for those giving access to lamp caps and live parts in socket-outlets.

It shall not be possible to touch live parts with the test pin.

NOTE Z2 - Appliance outlets are not considered to be socket-outlets.

8.1.3 Instead of the test finger and the test pin, for appliances other than those of class II, the test probe of figure 3 is applied without appreciable force to live parts of visibly glowing heating elements, all poles supporting such elements, provided that it is obvious from the outside of the appliance, without removing covers and similar parts, that these supporting parts are in contact with the element.

It shall not be possible to touch these live parts.

NOTE - For appliances provided with a supply cord and without a switching device in their supply circuit, the withdrawal of the plug from a socket-outlet is considered to be a single switching action.

8.1.4 An accessible part is not considered to be live if

- the part is supplied at safety extra-low voltage provided that:
  - r a.c., the peak value of the voltage does not exceed 42,4 V;
  - r d.c., the voltage does not exceed 42,4 V;

or

- the part is separated from live parts by protective impedance.

In the case of protective impedance, the current between the part and the supply source shall not exceed 2 mA for d.c. and its peak value shall not exceed 0,7 mA for a.c. and moreover:

- for voltages having a peak value over 42,4 V up to and including 450 V, the capacitance shall not exceed 0,1  $\mu$ F;
- for voltages having a peak value over 450 V up to and including 15 kV, the discharge shall not exceed 45  $\mu$ C.

Compliance is checked by measurement with the appliance supplied at rated voltage.

Voltages and currents are measured between the relevant parts and each pole of the supply source. Discharges are measured immediately after the interruption of the supply.

NOTE - Details of a suitable measuring circuit for leakage current are given in annex G.

8.1.5 Live parts of built-in appliances, fixed appliances and appliances delivered in separate units, shall be protected at least by basic insulation before installation or assembly.

Compliance is checked by inspection and by the test of 8.1.1.

8.2 Class II appliances and class II constructions shall be constructed and enclosed so that there is adequate protection against accidental contact with basic insulation and metal parts separated from live parts by basic insulation only.

It shall only be possible to touch parts which are separated from live parts by double insulation or reinforced insulation.

Compliance is checked by inspection and by applying the test finger of figure 1, as described in 8.1.1.

#### NOTES

- 1 This requirement applies for all positions of the appliance when it is operated as in normal use, even after opening lids and doors and removal of detachable parts.
- 2 Built-in appliances and fixed appliances are tested after installation.

Appliances having batteries which, according to the instructions for use, may be replaced by the user need only have basic insulation between live parts and the inner surface of the battery compartment. If the appliance can be operated without the batteries, double insulation or reinforced insulation is required.

9. Starting of motor-operated appliances

Requirements and tests are specified in part 2 when necessary.

10 Power input and current

10.1 The power input of the appliance at rated voltage and at normal operating temperature shall not deviate from the rated power input by more than the deviation shown in table 1.

**Table 1 - Power input deviation**

Type of appliance	Rated power input W	Deviation
All appliances	$\leq 25$	+20 %
<b>Heating appliances and combined appliances</b>	$>25$ and $\leq 200$	$\pm 10$ %
	$>200$	+5% or 20 W (whichever is the greater) -10%
<b>Motor-operated appliances</b>	$>25$ and $\leq 300$	+ 20%
	$>300$	+15% or 60 W (whichever is the greater)

The deviation for motor-operated appliances applies for combined appliances if the power input of the motors is more than 50% of the total rated power input.

NOTE 1 - In case of doubt the power input of motors is measured separately.

Compliance is checked by measurement when the power input has stabilized:

- all circuits which can operate simultaneously being in operation;
- the appliance being supplied at rated voltage;
- the appliance being operated under normal operation.

If the power input varies throughout the operating cycle, the power input is determined as the mean value of the power input occurring during a representative period.

#### NOTES

2 The test is made at both the upper and lower limits of the ranges for appliances marked with one or more rated voltage ranges, unless the marking of the rated power input is related to the mean value of the relevant voltage range, in which case the test is made at a voltage equal to the mean value of that range.

3 The permissible deviations apply for both limits of the range for appliances marked with a rated voltage range having limits differing by more than 10% of the mean value of the range.

4 The negative deviation is not limited for motor-operated appliances and for all appliances having a rated power input of 25 W or less.

10.2 If an appliance is marked with rated current, the current at normal operating temperature shall not deviate from rated current by more than the corresponding deviation shown in table 2.

Table 2 – Current deviation

Type of appliance	Rated power input W	Deviation
-------------------	------------------------	-----------

All appliances	$\leq 0,2$	+20 %
<b>Heating appliances and combined appliances</b>	$> 0,2$ and $\leq 1,0$	$\pm 10$ %
	$> 1,0$	+5% or 0,10 A (whichever is the greater) -10%
<b>Motor-operated appliances</b>	$> 0,2$ and $\leq 1,5$	+ 20%
	$> 1,5$	+15% or 0,30 A (whichever is the greater)

Compliance is checked by measurement when the current has stabilized:

- all circuits which can operate simultaneously being in operation;
- the appliance being supplied at rated voltage;
- the appliance being operated under normal operation.

If the current varies throughout the operating cycle, the current is determined as the mean value of the current occurring during a representative period.

#### NOTES

- 1 The test is made at both the upper and lower limits of the ranges for appliances marked with one or more rated voltage ranges, unless the marking of the rated current is related to the mean value of the relevant voltage range, in which case the tests are made at a voltage equal to the mean value of that range.
- 2 The permissible deviations apply for both limits of the range for appliances marked with a rated voltage range having limits differing by more than 10% of the mean value of the range.
- 3 The negative deviation is not limited for motor-operated appliances and for all appliances having a rated current of 0,2 A or less.

#### 11 Heating

11.1 Appliances and their surroundings shall not attain excessive temperatures in normal use.

Compliance is checked by determining the temperature rise of the various parts under the conditions specified in 11.2 to 11.7 but if the temperature rise of the motor winding exceeds the value specified in table 3 or if there is doubt with regard to the classification of the insulation system employed in a motor, by the tests of annex C.

11.2 Hand-held appliances are held in their normal position of use.

Built-in appliances are installed in accordance with the instructions for installation.

Other heating appliances and other combined appliances are placed in a test corner as follows:

- appliances normally placed on a floor or table in use, are placed on the floor as near to the walls as possible;
- appliances normally fixed to a wall are fixed on one of the walls, as near to the other wall and to the floor or ceiling as is likely to occur in normal use, unless otherwise stated in the instructions for installation;
- appliances normally fixed to a ceiling are fixed to the ceiling as near to the walls as is likely to occur in normal use, unless otherwise stated in the instructions for installation.

Other motor-operated appliances are positioned as follows:

- appliances normally placed on a floor or table in use, are placed on a horizontal support;
- appliances normally fixed to a wall are fixed to a vertical support;
- appliances normally fixed to a ceiling are fixed underneath a horizontal support.

Dull black-painted plywood approximately 20 mm thick is used for the test corner, the supports and for the installation of built-in appliances.

For appliances provided with an automatic cord reel, one-third of the total length of the cord is unreel. The temperature rise of the cord sheath is determined as near as possible to the hub of the reel and also between the two outermost layers of the cord on the reel.

For cord storage devices other than automatic cord reels, which are intended to accommodate the supply cord partially while the appliance is in operation, 50 cm of the cord is unwound. The temperature rise of the stored part of the cord is determined at the most unfavourable place.

11.3 Temperature rises other than those of windings are determined by means of fine-wire thermocouples positioned so that they have minimum effect on the temperature of the part under test.

NOTE 1 - Thermocouples having wires with a diameter not exceeding 0,3 mm are considered to be fine-wire thermocouples.

Thermocouples used for determining the temperature rise of the surface of walls, ceiling and floor are attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick. The front of the disk is flush with the surface of the board.

So far as is possible, the appliance is positioned so that the thermocouples detect the highest temperatures.

The temperature rise of electrical insulation, other than that of windings, is determined on the surface of the insulation, at places where failure could cause a short circuit, contact between live parts and accessible metal parts, bridging of insulation or reduction of creepage distances or clearances below the values specified in 29.1.

Temperature rises of windings are determined by the resistance method unless the windings are non-uniform or if it is difficult to make the necessary connections, in which case the temperature rise is determined by means of thermocouples.

#### NOTES

- 2 If it is necessary to dismantle the appliance to position thermocouples, care is taken to ensure that the appliance has been correctly reassembled and the power input is measured again.
- 3 The point of separation of the cores of a multicore cord and the point where insulated wires enter lampholders, are examples of places where thermocouples are positioned.

11.4 Heating appliances are operated under normal operation, at 1,15 times the rated power input.

11.5 Motor-operated appliances are operated under normal operation, supplied with the most unfavourable voltage between 0,94 times and 1,06 times the rated voltage.

11.6 Combined appliances are operated under normal operation, supplied with the most unfavourable voltage between 0,94 times and 1,06 times the rated voltage.

11.7 The appliance is operated for a duration corresponding to the most unfavourable conditions of normal use.

NOTE - The duration of the test may consist of more than one cycle of operation.

11.8 During the test the temperature rises are monitored continuously and shall not exceed the values shown in table 3, protective devices shall not operate and sealing compound shall not flow out.

**Table 3 - Maximum normal temperature rises**

Part	Temperature rise K
------	-----------------------

Windings <sup>1)</sup> , if the winding insulation according to IEC 85 is:	
- class A	75 (65)
- class E	90 (80)
- class B	95 (85)
- class F	115
- class H	140
- class 200	160
- class 220	180
- class 250	210
Pins of appliance inlets:	
- for very hot conditions	130
- for hot conditions	95
- for cold conditions	40
Terminals, including earthing terminals, for external conductors of stationary appliances, unless they are provided with a supply cord	60
Ambient of switches, thermostats and temperature limiters <sup>2)</sup>	
- without T-marking	30
- with T-marking	T25
Rubber or polyvinyl chloride insulation of internal and external wiring including supply cords:	
- without temperature rating <sup>3)</sup>	50
- with temperature rating (T)	T25
Cord sheaths used as supplementary insulation	35
Sliding contacts of cord reels	65
Rubber, other than synthetic, used for gaskets or other parts, the Deterioration of which could affect safety:	
- when used as supplementary insulation or as reinforced insulation	40
- in other cases	50
Lampholders B22, E26 and E27:	
- metal or ceramic type	130
- insulated type, other than ceramic	90
- with T-marking	T25

(See notes on p. )

Table 3 (continued)

(Continued on p. )

Part	Temperature rise K
------	-----------------------

Lampholders E14 and B15:	
- metal or ceramic type	130
- insulated type, other than ceramic	90
- with T-marking	T25
Material used as insulation other than that specified for wires and windings <sup>4)</sup>	
- impregnated or varnished textile, paper or press board	70
- laminates bonded with:	
- melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins	85 (175)
- urea-formaldehyde resin	65 (150)
- printed circuit boards bonded with epoxy resin	120
- moulding of:	
- phenol-formaldehyde with cellulose fillers	85 (175)
- phenol-formaldehyde with mineral fillers	100 (200)
- melamine-formaldehyde	75 (150)
- urea-formaldehyde	65 (150)
- polyester with glass-fibre reinforcement	110
- silicone rubber	145
- polytetrafluoroethylene	265
- pure mica and tightly sintered ceramic material when such materials are used as supplementary insulation or reinforced insulation	400
- thermoplastic material <sup>5)</sup>	-
Wood, in general <sup>6)</sup>	65
- Wooden supports, walls, ceiling and floor of the test corner and wooden cabinets:	
- stationary appliances liable to be operated continuously for long periods	60
- other appliances	65
Outer surface of capacitors <sup>7)</sup>	
- with marking of maximum operating temperature (T) <sup>8)</sup>	T25
- without marking of maximum operating temperature:	
- small ceramic capacitors for radio and television interference suppression	50
- capacitors complying with IEC 384-14 or subclause 14.2 of IEC 65	50
- Other capacitors	20
External enclosure of motor-operated appliances, except handles held in normal use.	60

(See notes on p. )

(Continued on p. )

Table 3 (continued)

Part	Temperature rise K
------	-----------------------

Handles, knobs, grips and similar parts which are continuously held in normal use (e.g. soldering irons):	
- of metal	30
- of porcelain or vitreous material	40
- of moulded material, rubber or wood	50
Handles, knobs, grips and similar parts which are held for short periods only in normal use (e.g. switches):	
- of metal	35
- of porcelain or vitreous material	45
- of moulded material, rubber or wood	60
Parts in contact with oil having a flash-point of t°C	t-50
Any point where the insulation of wires can come into contact with parts of a terminal block or compartment for fixed wiring of a stationary appliance not provided with a supply cord:	
- when the instructions require the use of supply wires with temperature rating (T)	T25
- in other cases <sup>3)</sup>	50

(See notes on p. )

(Continued on p. )

Table 3 (concluded)

Notes to table 3

1) To allow for the fact that the average temperature of windings of universal motors, relays, solenoids

and similar components, is usually above the temperature at the points on the windings where thermocouples are placed, the figures without parentheses apply when the resistance method is used and those within parentheses apply when thermocouples are used. For windings of vibrator coils and a.c. motors, the figures without parentheses apply in both cases.

For motors constructed so that the circulation of air between the inside and the outside of the case is prevented but which are not necessarily sufficiently enclosed to be considered airtight, the temperature rise limits may be increased by 5 K.

2) T means the maximum ambient temperature in which the component or its switch head can operate.

The ambient is the temperature of the air at the hottest point at a distance of 5 mm from the surface of the component concerned.

For the purpose of this test, switches and thermostats marked with individual ratings may be considered as having no marking for the maximum operating temperature, if requested by the appliance manufacturer.

3) This limit applies to cords and wires complying with the relevant IEC standards; for others it may be different.

4) The values in parentheses apply if the material is used for handles, knobs, grips and similar parts and is in contact with hot metal.

5) There is no specific limit for thermoplastic material. However the temperature rise has to be determined in order that the tests of 30.1 can be carried out.

6) The limit specified concerns the deterioration of wood and it does not take into account deterioration of surface finishes.

7) There is no limit for the temperature rise of capacitors which are short-circuited in 19.11.

8) Temperature marking for capacitors mounted on printed circuit boards may be given in the technical sheet.

If these or other materials are used, they shall not be subjected to temperatures in excess of the thermal capabilities as determined by ageing tests made on the materials themselves.

## NOTES

1 The values in the table are based on an ambient temperature not normally exceeding 25°C but occasionally reaching 35°C. However, the temperature rise values specified are based on 25°C.

2 The temperature rise of a winding is calculated from the formula:

$$\Delta t = \frac{R_2 - R_1}{R_1} (k + t_1) - (t_2 - t_1)$$

Where

$\Delta t$  is the temperature rise of the winding;

$R_1$  is the resistance at the beginning of the test;

$R_2$  is the resistance at the end of the test;

$k$  is equal to 234,5 for copper windings and 225 for aluminium windings;

$t_1$  is the room temperature at the beginning of the test;

$t_2$  is the room temperature at the end of the test.

At the beginning of the test, the windings are to be at room temperature. It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

Z1 The temperature rise limit for metal applies to parts having a metal coating at least 0.1 mm thick and to metal parts

12 Void

13 Leakage current and electric strength at operating temperature

13.1 At operating temperature, the leakage current of the appliance shall not be excessive and its electric strength shall be adequate.

Compliance is checked by the tests of 13.2 and 13.3.

The appliance is operated under normal operation for the duration specified in 11.7.

Heating appliances are operated at 1,15 times the rated power input.

Motor-operated appliances and combined appliances are supplied at 1,06 times the rated voltage.

Three-phase appliances which, according to the instructions for installation, are also suitable for single-phase supply are tested as single-phase appliances with the three circuits connected in parallel.

Protective impedance and radio interference filters are disconnected before carrying out the tests.

13.2 The leakage current is measured by means of the circuit described in annex G, between any pole of the supply and accessible metal parts connected to metal foil having an area not exceeding 20 cm x 10 cm which is in contact with accessible surfaces of insulating materials.

For single-phase appliances, the measuring circuit is shown in the following figures:

- if of class II, figure 4;
- if other than class II, figure 5.

The leakage current is measured with the selector switch in each of the positions 1 and 2.

For three-phase appliances, the measuring circuit is shown in the following figures:

- if of class II, figure 6;
- if other than class II, figure 7.

For three-phase appliances, the leakage current is measured with the switches a, b and c in the closed position. The measurements are then repeated with each of the switches a, b and c open in turn, the other two switches remaining closed. For appliances intended to be connected in star connection only, the neutral is not connected.

After the appliance has been operated for a duration as specified in 11.7, the leakage current shall not exceed the following values:

- for class 0, class 01 and class III appliances 0,5 mA
- for portable class I appliances 0,75 mA

- for stationary class I motor-operated appliances 3,5 mA
- for stationary class I heating appliances 0,75 mA or 0,75 mA per kW  
rated power input of the  
appliance, whichever is the  
greater, with a maximum of 5 mA
- for class II appliances 0,25 mA

For combined appliances the total leakage current may be within the limits specified for heating appliances or for motor-operated appliances, whichever is the greater, but the two limits are not added.

If the appliance incorporates capacitors and is provided with a single-pole switch, the measurements are repeated with the switch in the off position.

If the appliance incorporates a thermal control which operates during the test of clause 11, the leakage current is measured immediately before the control opens the circuit.

#### NOTES

1 The test with the switch in the off position is made to verify that capacitors connected behind a single-pole switch do not cause an excessive leakage current.

2 It is recommended that the appliance is supplied through an isolating transformer; otherwise it is to be insulated from earth.

3 The metal foil has the largest area possible on the surface under test without exceeding the dimensions specified. If its area is smaller than the surface under test, it is moved to test all parts of the surface.

13.3 The insulation is subjected for 1 min to a voltage of substantially sinusoidal waveform having a frequency of 50 Hz or 60 Hz. For single-phase appliances, the connections are shown in figure 8. Motors and three-phase appliances are tested immediately after the appliance has been disconnected from the supply.

The test voltage is applied between live parts and accessible parts, non-metallic parts being covered with metal foil. For class II constructions having intermediate metal between live parts and accessible parts, the voltage is applied across the basic insulation and the supplementary insulation.

The value of the test voltage is

- 500 V for basic insulation subjected in normal use to safety extra-low voltage;
- 1 000 V for other basic insulation;
- 2 750 V for supplementary insulation;
- 3 750 for reinforced insulation.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No breakdown shall occur during the test.

#### NOTES

1 Glow discharges without drop in voltage are neglected.

2 The high-voltage source used for the test is to be capable of supplying a short circuit current is between the output terminals after the output voltage has been adjusted to the

appropriate test voltage U. The overload release of the circuit is not to operate for any current below the tripping current I<sub>r</sub>. The voltmeter used to measure the r.m.s. value of the test voltage is to be at least of class 2.5 according to IEC 51-2. The values of I<sub>s</sub> and I<sub>r</sub> are given in table 4 for various high voltage sources.

Test voltage U V	Minimum current mA	
	I <sub>s</sub>	I <sub>r</sub>
U < 4 000	200	100
4 000 ≤ U < 10 000	80	40
10 000 ≤ U ≤ 20 000	40	20

1) The currents are calculated on the basis of the short circuit and release energies of 800 VA and 400 VA respectively at the upper end of the voltage ranges.

2) The measurement uncertainty of the high voltage shall not exceed ± 3% of the measured voltage for a leakage current up to 50% of I<sub>r</sub>.

3 If the secondary winding of the isolating transformer is not provided with a tap at the midpoint, the output winding of the high-voltage transformer can be connected to the midpoint of a potentiometer having a total resistance not exceeding 2 000 Ω and connected across the output winding of the isolating transformer.

4. Care should be taken to avoid overstressing the components of electronic circuits.

14 Void

15 Moisture

15.1 The enclosure of the appliance shall provide the degree of protection against moisture in accordance with the classification of the appliance.

Compliance is checked as specified in 15.1.1 taking into account 15.1.2, the appliance not being connected to the supply.

The appliance shall then withstand the electric strength test of 16.3 and inspection shall show that there is no trace of water on insulation which could result in a reduction of creepage distances and clearances below the values specified in 29.1.

NOTE Z1 - Before inspection, the enclosure of the appliance is dried and care has to be taken when dismantling to avoid displacing any water.

15.1.1 Appliances other than IPX0, are subjected to the tests of IEC 529 as follows:

- IPX1 appliances as described in subclause 14.2.1;
- IPX2 appliances as described in subclause 14.2.2;
- IPX3 appliances as described in subclause 14.2.3
- IPX4 appliances as described in subclause 14.2.4;
- IPX5 appliances as described in subclause 14.2.5;
- IPX6 appliances as described in subclause 14.2.6;
- IPX7 appliances as described in subclause 14.2.7.

For this test the appliance is immersed in water containing 1% NaCl.

15.1.2 Hand-held appliances are turned continuously through the most unfavourable positions during the test.

Built-in appliances are installed in accordance with the instructions.

Appliances normally used on the floor or table are placed on a horizontal unperforated support having a diameter of twice the oscillating tube radius minus 15 cm.

Appliances normally fixed to a wall are mounted as in normal use in the centre of a wooden board having dimensions which are  $15\text{ cm} \pm 5\text{ cm}$  in excess of those of the orthogonal projection of the appliance on the board. The wooden board is placed at the centre of the oscillating tube.

For IPX3, the base of wall-mounted appliances is placed at the same level as the pivot axis of the oscillating tube.

For IPX4, the horizontal centre line of the appliance is aligned with the pivot axis of the oscillating tube, except that for appliances normally used on the floor or standing on the floor or table, the support is placed at the level of the pivot axis of the oscillating tube. The movement is limited to two times  $90^\circ$  from the vertical for a period of 5 min.

If, for wall-mounted appliances, the instructions for installation state that the appliance is to be placed close to the floor level and specifies a distance, a board is placed under the appliance at that distance. The dimensions of the board are 15 cm more than the horizontal projection of the appliance.

Appliances with type X attachment, except those having a specially prepared cord, are fitted with the lightest permissible type of flexible cord of the smallest cross-sectional area specified in table 11.

Detachable parts are removed and subjected, if necessary, to the relevant treatment with the main part.

15.2 Appliances subject to spillage of liquid in normal use shall be constructed so that such spillage does not affect their electrical insulation.

Compliance is checked by the following test.

Appliances with type X attachment, except those having a specially prepared cord, are fitted with the lightest permissible type of flexible cord of the smallest cross-sectional area specified in table 11.

Appliances incorporating an appliance inlet are tested with or without an appropriate connector in position, whichever is most unfavourable.

Detachable parts are removed.

The liquid container of the appliance is completely filled with water containing approximately 1% NaCl and a further quantity, equal to 15% of the capacity of the container or 0,25 l, whichever is the greater, is poured in steadily over a period of 1 min.

The appliance shall then withstand the electric strength test of 16.3 and inspection shall show that there is no trace of water on insulation which could result in a reduction of creepage distances and clearances below the values specified in 29.1.

15.3 Appliances shall be proof against humid conditions which may occur in normal use.

Compliance is checked by the following humidity test.

Appliances subjected to the tests of 15.1 or 15.2 are kept in a test room having a normal atmosphere for 24 h before being subjected to the test.

Cable entries, if any, are left open; if knock-outs are provided, one of them is opened.

Detachable parts are removed and subjected, if necessary, to the humidity test with the main part.

The humidity test is carried out for 48 h in a humidity cabinet containing air with a relative humidity of  $(93 \pm 2)\%$ . The temperature of the air is maintained within 1 K of any convenient value  $t$  between 20 °C and 30 °C. Before being placed in the humidity cabinet, the appliance is brought to a temperature of  $t^{+4}$  °C.

The appliance shall then withstand the tests of clause 16 in the humidity cabinet or in the room in which the appliance was brought to the prescribed temperature after reassembly of those parts which may have been removed.

#### NOTES

1 In most cases, the appliance may be brought to the specified temperature by keeping it at this temperature for at least 4 h before the humidity test.

2 A relative humidity of  $(93 \pm 2)\%$  can be obtained by placing, in the humidity cabinet, a saturated solution of  $\text{Na}_2\text{SO}_4$  or  $\text{KNO}_3$  in water, the container having a sufficiently large contact surface with the air.

3 The specified conditions may be achieved by ensuring a constant circulation of the air within a thermally insulated cabinet.

16 Leakage current and electric strength

16.1 The leakage current of the appliance shall not be excessive and its electric strength shall be adequate.

Compliance is checked by the tests of 16.2 and 16.3.

Protective impedance is disconnected from live parts before carrying out the tests.

The tests are made on the appliance at room temperature and not connected to the supply.

16.2 An a.c. test voltage is applied to items 1 and 3 specified in table 5, the metal foil having a size not exceeding 20 cm x 10 cm and being moved, if necessary, so that all parts of the surface are tested.

The test voltage is

- 1,06 times rated voltage for single-phase appliances,
- 1,06 times rated voltage, divided by 3, for three-phase appliances.

The leakage current is measured within 5 s after the application of the test voltage.

The leakage current shall not exceed the following values:

- for class 0, class 01 and class III appliances 0,5 mA
- for portable class 1 appliances 0,75 mA
- for stationary class 1 motor-operated appliances 3,5 mA
- for stationary class 1 heating appliances 0,75 mA or 0,75 mA per kW rated power input of the appliance, whichever is the greater, with a maximum of 5 mA
- for class II appliances 0,25 mA

The values specified above are doubled if all controls have an off position in all poles.  
They are also doubled if

- the appliance has no control other than a thermal cut-out or
- all thermostats, temperature limiters and energy regulators do not have an off position or
- the appliance has radio interference filters. In this case the leakage current with the filter disconnected shall not exceed the limits specified.

For combined appliances, the total leakage current may be within the limits specified for heating appliances or for motor-operated appliances, whichever is the greater, but the two limits are not added.

16.3 Immediately after the test of 16.2 the insulation is subjected for 1 min to a voltage of substantially sinusoidal waveform and having a frequency of 50 Hz or 60 Hz. The value of the test voltage and the points of application are shown in table 5.

Accessible parts of insulated material are covered with metal foil.

Table 5 – Test voltages

Points of application	Test voltage V		
	Class III Appliances And class III Constructions	Class II Appliances And class II constructions	Other appliances
1. Between live parts and accessible parts separated from live parts by <ul style="list-style-type: none"> <li>- basic insulation only</li> <li>- reinforced insulation</li> </ul>	500 -	- 3 750	1 250 3 750
2. For parts with double insulation between metal parts separated from live parts by basic insulation only and <ul style="list-style-type: none"> <li>- live parts</li> <li>- accessible parts</li> </ul>	- -	1 250 2 500	1 250 2 500

3. Between metal enclosures or covers lined with insulating material and metal foil in contact with the inner surface of the lining, if the distance between live parts and these metal enclosures or covers, measured through the lining, is less than the appropriate clearance as specified in 29.1	-	2 500	1 250
4. Between metal foil in contact with handles, knobs, grips and similar parts and their shafts, if these shafts can become live in the event of an insulation fault <sup>1)</sup>	-	2 500	2 500 (1250)
5. Between accessible parts and the supply cord wrapped with metal foil, where the cord is fitted in inlet bushings of insulating material, cord guards, cord anchorages and similar parts <sup>2), 3)</sup>	-	2 500	1 250
6. Between the point where a winding and a capacitor are connected together, if a resonance voltage U occurs between this point and any terminal for external conductors, and	-	-	2 U + 1 000 <sup>4)</sup>
- accessible parts		2 U + 1 000	
- metal parts separated from live parts by basic insulation only <sup>4)</sup>			

1) The value in parentheses applies to class 0 appliances.

2) The outer surface of the cord guard is not wrapped with the metal foil.

3) The torque applied to clamping screws of the cord anchorages is 2/3 of the torque specified in 28.1.

4) The test between the point where a winding and a capacitor are connected together and accessible parts or metal parts is only made where the insulation is subjected to the resonance voltage under normal operation. Other parts are disconnected and the capacitor is short-circuited.

The value of 1 250 V is reduced to 1 000 V for appliances with a rated voltage not exceeding 130 V.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No breakdown shall occur during the test.

#### NOTES

1 Care is taken that the metal foil is placed so that no flashover occurs at the edges of the insulation.

2 The high-voltage source used for the test is described in note 2 of 13.3.

3 For class II construction incorporating both reinforced insulation and double insulation, care is taken that the voltage applied to the reinforced insulation does not overstress the basic insulation or the supplementary insulation.

4 In constructions where basic insulation and supplementary insulation cannot be tested separately, the insulation provided is subjected to the test voltages specified for reinforced insulation.

5 When testing insulating coatings, the metal foil may be pressed against the insulation by means of a sandbag so that the pressure is approximately 5 kPa. The test may be limited to places where the insulation is likely to be weak, for example where there are sharp metal edges under the insulation.

6 If practicable, insulating linings are tested separately.

7 Care is taken to avoid overstressing the components of electronic circuits.

## 17 Overload protection of transformers and associated circuits

Appliances incorporating circuits supplied from a transformer shall be constructed so that in the event of short circuits which are likely to occur in normal use, excessive temperatures do not occur in the transformer or in the circuits associated with the transformer.

Compliance is checked by applying the most unfavourable short circuit or overload which is likely to occur in normal use, the appliance being supplied with 1,06 times or 0,94 times rated voltage, whichever is the more favourable.

The temperature rise of the insulation of the conductors of safety extra-low voltage circuits shall not exceed the relevant value specified in table 3 by more than 15 K.

The temperature of the winding shall not exceed the value specified in table 6. Transformers complying with IEC 742 are not tested.

### NOTES

- 1 Examples of short circuits which are likely to occur in normal use are the short-circuiting of bare or inadequately insulated conductors of safety extra-low voltage circuits which are accessible.
- 2 Failure of basic insulation is not considered likely to occur in normal use.
- 3 Protection of transformer windings may be obtained by the inherent impedance of the winding or by means of fuses, automatic controls, thermal cut-outs or similar devices incorporated in the transformer or located inside the appliance, provided these devices are only accessible with the aid of a tool.

## 18 Endurance

Requirements and tests are specified in part 2 when necessary.

## 19 Abnormal operation

19.1 Appliances shall be constructed so that the risk of fire, mechanical damage impairing safety or protection against electric shock as a result of abnormal or careless operation, is obviated as far as is practicable.

Electronic circuits shall be designed and applied so that a fault condition will not render the appliance unsafe with regard to electric shock, fire hazard, mechanical hazard or dangerous malfunction.

Appliances incorporating heating elements are subjected to the tests of 19.2 and 19.3. In addition, such appliances provided with a control limiting the temperature during clause 11 are subjected to the tests of 19.4 and where applicable to the test of 19.5. Appliances incorporating PTC heating elements are also subjected to the test of 19.6

Appliances incorporating motors are subjected to the tests of 19.7 to 19.10 as applicable.

Appliances incorporating electronic circuits are also subjected to the tests of 19.11 and 19.12 as applicable.

Unless otherwise specified, the tests are continued until a non-self-resetting thermal cut-out operates or until steady conditions are established. If a heating element or an intentionally weak part becomes permanently open-circuited, the relevant test is repeated on a second sample. This second test shall be terminated in the same mode unless the test is otherwise satisfactorily completed.

Only one abnormal condition is simulated each time.

Unless otherwise specified, compliance with the tests of this clause is checked as described in 19.13.

#### NOTES

1 An intentionally weak part is a part intended to rupture under conditions of abnormal operation to prevent the occurrence of a condition which could impair compliance with this standard. Such a part may be a replaceable component, such as a resistor or a capacitor or a part of a component to be replaced, such as an inaccessible thermal link incorporated in a motor.

2 Fuses, thermal cut-outs, overcurrent protection devices or similar devices incorporated in the appliance, may be used to provide the necessary protection. The protective device in the fixed wiring does not provide the necessary protection.

3 If more than one of the tests are applicable to the same appliance, these tests are made consecutively after the appliance has cooled down to room temperature.

4 For combined appliances, the tests are carried out with motors and heating elements operating simultaneously under conditions of normal operation, the appropriate tests being applied one at a time to each motor and heating element.

19.2 Appliances with heating elements are tested under the conditions specified in clause 11 but with restricted heat dissipation. The supply voltage, determined prior to the test, is that required to provide a power input of 0,85 times rated power input under normal operation when the power input has stabilized. This voltage is maintained throughout the test.

19.3 The test of 19.2 is repeated but with a supply voltage, determined prior to the test, equal to that required to provide a power input of 1,24 times rated power input under normal operation when the power input has stabilized. This voltage is maintained throughout the test.

19.4 The appliance is tested under the conditions specified in clause 11, the power input being 1,15 times rated power input. Any control which limits the temperature during the test of clause 11 is short-circuited.

NOTE - If the appliance is provided with more than one control, these are short-circuited in turn.

19.5 The test of 19.4 is repeated on class 01 appliances and class I appliances incorporating tubular sheathed or embedded heating elements. However, controls are not short-circuited but one end of the element is connected to the sheath of the heating element.

This test is repeated with the polarity of the supply to the appliance reversed and with the other end of the element connected to the sheath.

The test is not carried out on appliances intended to be permanently connected to fixed wiring and on appliances where an all-pole disconnection occurs during the test of 19.4.

#### NOTES

1 Appliances with a neutral are tested with the neutral connected to the sheath.

2 For embedded heating elements, the metal enclosure is considered to be the sheath.

Z1 Refer to annex ZA.

19.6 Appliances with PTC heating elements are supplied at rated voltage until steady conditions with regard to power input and temperature are established.

The voltage is then increased by 5% and the appliance is operated until steady conditions are again established. This test is repeated until 1,5 times rated voltage is reached or until the heating element ruptures, whichever occurs first.

19.7 The appliance is operated under stalled conditions by

- locking the rotor if the locked rotor torque is smaller than the full load torque;
- locking moving parts of other appliances.

NOTE

1 If an appliance has more than one motor, the test is made for each motor separately.

Appliances incorporating motors and having capacitors in the circuit of an auxiliary winding, are operated with the rotor locked, the capacitors being open-circuited one at a time. The test is repeated with the capacitors short-circuited one at a time unless they comply with IEC 252.

NOTE 3 - This test is made with the rotor locked because certain motors with capacitors may or may not start so that variable results could be obtained.

For each of the tests, appliances provided with a timer or programmer are supplied at rated voltage for a period equal to the maximum period allowed by the timer or programmer.

Other appliances are supplied at rated voltage for a period

- of 30 s for:
  - hand-held appliances;
  - appliances which have to be kept switched on by hand or foot;
  - appliances which are continuously loaded by hand;
- of 5 min for other appliances operated while attended;
- until steady conditions are established for the other appliances.

NOTE 4 - Appliances which are tested for 5 min are indicated in the relevant part 2.

During the test, the temperature of the windings shall not exceed the values shown in table 6.

Table 6 – Maximum winding temperature

Type of appliance	Temperature °C							
	Class A	Class E	Class B	Class F	Class H	Class 200	Class 220	Class 250
Appliances other than those operated until steady conditions are established	200	215	225	240	260	280	300	330

Appliances operated until steady conditions are established								
- if impedance protected	150	165	175	190	210	230	250	280
- if protected by protective devices								
- during the first hour, maximum value	200	215	225	240	260	280	300	330
- after first hour, maximum value	175	190	200	215	235	255	275	305
- after first hour, arithmetic average	150	165	175	190	210	230	250	280

19.8 One phase of appliances incorporating three-phase motors is disconnected. The appliance is then operated under normal operation and supplied at rated voltage for the period specified in 19.7.

19.9 A running overload test is made on appliances incorporating motors which are either intended to be remotely or automatically controlled or liable to be operated continuously.

The appliance is operated under normal operation and supplied at rated voltage until steady conditions are established. The load is then increased so that the current through the motor windings is raised by 10% and the appliance is operated again until steady conditions are established, the supply voltage being maintained at its original value. The load is again increased and the test is repeated until the protective device operates or the motor stalls.

During the test the winding temperature shall not exceed

- 140°C for class A;
- 155°C for class E;
- 165°C for class B;
- 180°C for class F;
- 200°C for class H;
- 220°C for class 200;
- 240°C for class 220;
- 270°C for class 250

NOTE

- 1 If the load cannot be increased in appropriate steps, the motor is removed from the appliance and tested separately.

19.10 Appliances incorporating series motors are operated with the lowest possible load and supplied at 1,3 times rated voltage for 1 min.

During the test, parts shall not be ejected from the appliance.

19.11 Compliance for electronic circuits is checked by evaluation of the fault conditions specified in 19.11.2 for all circuits or parts of circuits, unless they comply with the conditions specified in 19.11.1.

If the safety of the appliance under any of the fault conditions depends on the operation of a miniature fuse-link complying with IEC 127, the test of 19.12 is made.

During and after each test, the temperature of the windings shall not exceed the values specified in table 6 and the appliance shall comply with the conditions specified in 19.13. In particular, live parts shall not be accessible to the test finger or the test pin, as specified in clause 8. Any current flowing through protective impedance shall not exceed the limits specified in 8.1.4.

If a conductor of a printed circuit board becomes open-circuited, the appliance is considered to have withstood the particular test, provided all three of the following conditions are met:

- the material of the printed circuit board withstands the burning test of subclause 20.1 of IEC 65;
- any loosened conductor does not reduce the creepage distances or clearances between live parts and accessible metal parts below the values specified in clause 29;
- the appliance withstands the tests of 19.11.2 with the open-circuited conductor bridged.

#### NOTES

1 Unless it is necessary to replace components after any of the tests, the electric strength test of 19.13 need only be carried out after the final test on the electronic circuit.

2 In general, examination of the appliance and its circuit diagram will reveal the fault conditions which have to be simulated, so that testing can be limited to those cases which may be expected to give the most unfavourable results.

3 In general, the tests take into account any failure which may arise from perturbations on the mains supply. However, where more than one component may be affected simultaneously, it may be necessary to carry out additional tests which are under consideration.

19.11.1 Fault conditions a) to f) specified in 19.11.2 are not applied to circuits or parts of circuits where both of the following conditions are met:

- the electronic circuit is a low-power circuit as described below;
- the protection against electric shock, fire hazard, mechanical hazard or dangerous malfunction in other parts of the appliance does not rely on the correct functioning of the electronic circuit.

A low-power circuit is determined as follows; an example is shown in figure 9.

The appliance is supplied at rated voltage and a variable resistor adjusted to its maximum resistance is connected between the point to be investigated and the opposite pole of the supply source.

The resistance is then decreased until the power consumed by the resistor reaches a maximum. Points closest to the supply at which the maximum power delivered to this resistor does not exceed 15 W at the end of 5 s are called low-power points. The part of the circuit farther from the supply source than a low-power point is considered to be a low-power circuit.

#### NOTES

1 The measurements are made from only pole of the supply source, preferably the one that gives the fewest low-power points.

2 When determining the low-power points, it is recommended to start with points close to the supply source.

3 The power consumed by the variable resistor is measured by a wattmeter.

19.11.2 The following fault conditions are considered and, if necessary, applied one at a time. Consequential faults are taken into consideration.

- a) Short circuit of creepage distances and clearances between live parts of different potential, if these distances are less than the values specified in 29.1, unless the relevant part is adequately encapsulated.
- b) Open circuit at the terminals of any component.
- c) Short circuit of capacitors, unless they comply with IEC 384-14 or subclause 14.2 of IEC 65.
- d) Short circuit of any two terminals of an electronic component, other than integrated circuits. This fault condition is not applied between the two circuits of an optocoupler.
- e) Failure of triacs in the diode mode.
- f) Failure of an integrated circuit. In this case the possible hazardous situations of the appliance are assessed to ensure that safety does not rely on the correct functioning of such a component.

All possible output signals are considered under fault conditions within the integrated circuit. If it can be shown that a particular output signal is unlikely to occur, then the relevant fault is not considered.

#### NOTES

- 1 Components such as thyristors and triacs are not subjected to fault condition f).
- 2 Microprocessors are tested as integrated circuits.
- Z1 Refer to annex ZA.

In addition, each low-power circuit is short-circuited by connecting the low-power point to the pole of the supply from which the measurements were made.

For simulation of the fault conditions, the appliance is operated under the conditions specified in clause 11 but supplied at rated voltage.

When any of the fault conditions are simulated, the duration of the test is

- as specified in 11.7 but only for one operating cycle and only if the fault cannot be recognized by the user, for example, change in temperature;
- as specified in 19.7, if the fault can be recognized by the user, for example, when the motor of a kitchen machine stops;
- Until steady conditions are established, for circuits continuously connected to the supply mains, for example, stand-by circuits.

In each case, the test is ended if interruption of the supply occurs within the appliance.

If the appliance incorporates an electronic circuit which operates to ensure compliance with clause 19, the relevant test is repeated with a single fault simulated, as indicated in a) to f) above.

Fault condition f) is applied to encapsulated and similar components if the circuit cannot be assessed by other methods.

Positive temperature coefficient resistors (PTC's), negative temperature coefficient resistors (NTC's) and voltage dependent resistors (VDR's) are not short-circuited if they are used within their manufacturer's declared specification.

19.12 If, for any of the fault conditions specified in 19.11.2, the safety of the appliance depends on the operation of a miniature fuse-link complying with IEC 127, the test is repeated but with the miniature fuse-link replaced by an ammeter.

If the current measured does not exceed 2,1 times the rated current of the fuse-link, the circuit is not considered to be adequately protected and the test is carried out with the fuse-link short-circuited.

If the current measured is at least 2,75 times the rated current of the fuse-link, the circuit is considered to be adequately protected.

If the current measured exceeds 2,1 times the rated current of the fuse-link but does not exceed 2,75 times the rated current, the fuse link is short-circuited and the test is carried out

- for quick acting fuse-links, for the relevant period or for 30 min, whichever is the shorter;
- for time lag fuse-links, for the relevant period or for 2 min, whichever is the shorter.

#### NOTES

1 In case of doubt, the maximum resistance of the fuse-link has to be taken into account when determining the current.

2 The verification whether the fuse-link acts as a protective device is based on the fusing characteristics specified in IEC 127, which also gives the information necessary to calculate the maximum resistance of the fuse-link.

3 Other fuses are considered to be intentionally weak parts in accordance with 19.1.

19.13 During the tests the appliance shall not emit flames, molten metal, poisonous or ignitable gas in hazardous amounts and temperature rises shall not exceed the values shown in table 7.

After the tests and when the appliance has cooled to approximately room temperature, enclosures shall not have deformed to such an extent that compliance with clause 8 is impaired and, if the appliance can still be operated, it shall comply with 20.2.

**Table 7 – Maximum abnormal temperature rise**

Part	Temperature rise K
Walls, ceiling and floor of the test corner <sup>1)</sup>	150
Insulation of the supply cord <sup>1)</sup>	150
Supplementary insulation and reinforced insulation other than thermoplastic materials <sup>3)</sup>	1,5 times the relevant value specified in table 3 <sup>2)</sup>
Notes to table 7	
1) For motor-operated appliances these temperature rises are not determined.	
2) This value is under consideration.	
3) There is no specific limit for supplementary insulation and reinforced insulation of thermoplastic material. However, the temperature rise has to be determined so that the test of 30.1 can be carried out.	

After the tests, the insulation other than that of class III appliances, then it has cooled down to approximately room temperature, shall withstand the electric strength test in 16.3, the test voltage however being

- 1 000 V for basic insulation;
- 2 750 V for supplementary insulation;
- 3 750 V for reinforced insulation.

For appliances which are immersed in or filled with conducting liquid in normal use, the appliance is immersed in or filled with water for 24 h before the electric strength test is made.

NOTE - The humidity treatment of 15.3 is not applied before this electric strength test.

## 20 Stability and mechanical hazards

20.1 Appliances, other than fixed appliances and hand-held appliances, intended to be used on a surface such as the floor or a table shall have adequate stability.

Compliance is checked by the following test, appliances incorporating an appliance inlet being fitted with an appropriate connector and flexible cord.

The appliance is placed in any normal position of use on a plane inclined at an angle of 10° to the horizontal, the supply cord resting on the inclined plane in the most unfavourable position. If, however, the appliance is such that, if it were to be tilted through an angle of 10° when standing on a horizontal plane, a part of it not normally in contact with the supporting surface would touch the horizontal plane, the appliance is placed on a horizontal support and tilted in the most unfavourable direction through an angle of 10°.

### NOTES

- 1 The appliance is not connected to the supply.
- 2 The test on the horizontal plane may be necessary for appliances provided with rollers, castors or feet.

Appliances provided with doors are tested with the doors open or closed, whichever is the more unfavourable.

Appliances intended to be filled with liquid by the user in normal use are tested empty or filled with the most unfavourable quantity of water up to the capacity indicated in the instructions for use.

The appliance shall not overturn.

The test is repeated on appliances with heating elements with the angle of inclination increased to 15°. If the appliance overturns in one or more positions, it is subjected to the tests of clause 11 in each of these overturned positions.

During this test, temperature rises shall not exceed the values shown in table 7.

NOTE 3 - Castors or wheels are blocked to prevent the appliance from rolling.

20.2 Moving parts of appliances shall, as far as is compatible with the use and working of the appliance, be positioned or enclosed to provide adequate protection against personal injury in normal use.

Protective enclosures, guards and similar parts shall be non-detachable parts and shall have adequate mechanical strength.

The unexpected reclosure of self-resetting thermal cut-outs and overcurrent protective devices shall not cause a hazard.

Compliance is checked by inspection, by the tests of clause 21 and by applying a force not exceeding 5 N by means of a test finger similar to that shown in figure 1 but having a circular stop plate with a diameter of 50 mm, instead of the non-circular plate.

For appliances provided with movable devices such as those intended of varying the tension of belts, the test with the test finger is made with these devices adjusted to the most unfavourable position within their range of adjustment; if necessary, belts are removed.

It shall not be possible to touch dangerous moving parts with this test finger.

#### NOTES

1 For some appliances complete protection is impracticable, for example sewing machines, food mixers and electric knives.

2 Examples of appliances in which self-resetting thermal cut-outs and overcurrent protective devices could cause a hazard are food mixers and wringers.

#### 21 Mechanical strength

Appliances shall have adequate mechanical strength and be constructed to withstand such rough handling that may be expected in normal use.

Compliance is checked by applying blows to the appliance by means of the spring-operated impact-test apparatus described in IEC 68-2-63.

The appliance is rigidly supported and three blows are applied to every point of the enclosure that is likely to be weak with an impact energy of  $0,5 \text{ J} \pm 0,04 \text{ J}$ .

If necessary, the blows are also applied to handles, levers, knobs and similar parts and to signal lamps and their covers but only if the lamps or covers protrude from the enclosure by more than 10 mm or if their surface area exceeds  $4 \text{ cm}^2$ . Lamps within the appliance and their covers are only tested if they are likely to be damaged in normal use.

After the test, the appliance shall show no damage which could impair compliance with this standard; in particular, compliance with 8.1, 15.1 and 29.1 shall not be impaired. In case of doubt, supplementary insulation or reinforced insulation is subjected to the electric strength test of 16.3.

If there is doubt as to whether a defect has occurred by the application of the preceding blows, this defect is neglected and the group of three blows is applied to the same place on a new sample which shall then withstand the test.

#### NOTES

1 When applying the release come to the guard of a visibly glowing heating element, care is to be taken that the hammer head passing through the guard does not strike the heating element.

2 Damage to the finish, small dents which do not reduce creepage distances and clearances below the values specified in 29.1 and small chips which do not adversely affect protection against access to live parts or moisture are neglected.

3 Cracks not visible to the naked eye and surface cracks in fibre-reinforced mouldings and similar materials are ignored.

4 If a decorative cover is backed by an inner cover, fracture of the decorative cover is neglected if the inner cover withstands the test after removal of the decorative cover.

5 To ensure that the appliance is rigidly supported, it may be necessary to place it against a solid wall of brick, concrete or similar material, covered by a sheet of polyamide which is tightly fixed to the wall, care being taken that there is no appreciable air gap between the sheet and the wall. The sheet has a Rockwell hardness of HR 100, a thickness of at least 8 mm and a surface area such that no part of the appliance is mechanically overstressed due to insufficient supporting area.

## 22 Construction

22.1 If the appliance is marked with the first numeral of the IP system, the relevant requirements of IEC 529 shall be fulfilled.

Compliance is checked by the relevant tests.

22.2 For stationary appliances means shall be provided to ensure all-pole disconnection from the supply. Such means shall be one of the following:

- a supply cord fitted with a plug;
- a switch complying with 24.3;
- a statement in the instructions for installation that a disconnection incorporated in the fixed wiring is to be provided;
- an appliance coupler.

If a single-phase class I appliance with heating elements, which is intended to be permanently connected to fixed wiring, incorporates single-pole switches or single-pole protective devices intended to disconnect the heating element from the supply, these shall be connected in the phase conductor.

NOTE Z1 - refer to annex ZA.

Compliance is checked by inspection.

22.3 Appliances with pins for insertion into socket-outlets shall not impose undue strain on these socket-outlets.

Compliance is checked by inserting the pins of the appliance, as in normal use, into a socket-outlet without earthing contact. The socket-outlet has a horizontal pivot at a distance of 8 mm behind the engagement face of the socket-outlet and in the plane of the contact tubes.

The torque which has to be applied to maintain the engagement face of the socket-outlet in the vertical plane shall not exceed 0,25 N.

NOTE - The torque which has to be applied to the socket-outlet without the appliance is not included in this value.

22.4 Appliances for heating liquids and appliances causing undue vibration shall not be provided with pins for insertion into socket-outlets.

Compliance is checked by inspection.

22.5 Appliances intended to be connected to the supply by means of a plug shall be constructed so that in normal use there is no risk of electric shock from charged capacitors when touching the pins of the plug.

Compliance is checked by the following test, which is made 10 times.

The appliance is supplied at rated voltage. Any switch is then placed in the off position and the appliance is disconnected from the supply. One second after disconnection, the voltage between the pins of the plug is measured with an instrument which does not appreciably affect the value to be measured.

The voltage shall not exceed 34 V.

NOTE - Capacitors having a rated capacitance less than or equal to 0,1  $\mu$ F are not considered to entail a risk of electric shock.

22.6 Appliances shall be constructed so that their electrical insulation cannot be affected by water which could condense on cold surfaces or by liquid which could leak from containers, hoses, couplings and similar parts of the appliance. Moreover, the electrical insulation of class II appliances and class II constructions shall not be affected, if a hose ruptures or a seal leaks.

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

Drops of coloured water solution are applied by means of a syringe to those parts inside the appliance where leakage of a liquid could occur and affect the electrical insulation. The appliance is in operation or at rest, whichever is the most unfavourable.

After this test, inspection shall show that there is no trace of liquid on windings or insulation which could result in a reduction of creepage distances below the values specified in 29.1.

22.7 Appliances containing liquid or gases in normal use or provided with steam-producing devices, shall incorporate adequate safeguards against the risk of excessive pressure.

Compliance is checked by inspection and, if necessary, by an appropriate test.

22.8 For appliances having compartments to which access can be gained without the aid of a tool and which are likely to be cleaned in normal use, the electrical connections shall be arranged so that they are not subject to pulling during cleaning.

Compliance is checked by inspection and by manual test.

22.9 Appliances shall be constructed so that parts such as insulation, internal wiring, windings, commutators and slip rings are not exposed to oil, grease or similar substances.

However, if the construction is such that insulation is exposed to substances such as oil or grease, the substance shall have adequate insulating properties so that compliance with the standard is not impaired.

Compliance is checked by inspection and by the tests of this standard.

22.10 Reset buttons of non-self-resetting controls shall be located or protected so that their accidental resetting is unlikely to occur if this could result in a hazard.

Compliance is checked by inspection.

NOTE - For example, this requirement precludes reset buttons on the back of an appliance so that they can be reset by pushing the appliance against a wall.

22.11 Non-detachable parts which provide the necessary degree of protection against access to live parts, moisture or contact with moving parts, shall be fixed in a reliable manner and shall withstand the mechanical stress occurring in normal use.

Snap-in devices used for fixing such parts shall have an obvious locked position. The fixing properties of snap-in devices used in parts which are likely to be removed during installation or servicing shall not deteriorate.

Compliance is checked by the following test.

Parts which are likely to be removed for installation or during servicing are disassembled and assembled 10 times before the test is carried out.

NOTE - Servicing includes replacement of the supply cord.

The appliance is at room temperature. However, in cases where compliance may be affected by temperature, the test is also carried out immediately after the appliance has been operated under the conditions specified in clause 11.

The test is applied to all parts which are likely to be detachable whether or not they are fixed by screws, rivets or similar parts.

A force is applied for 10 s in the most unfavourable direction without jerks to those areas of the cover or part which are likely to be weak. The force is as follows:

- Push force 50 N
- Pull force
  - a) If the shape of the part is such that the fingertips cannot easily slip off 50 N
  - b) If the projection of the part which is gripped is less Than 10 mm in the direction of removal 30 N

The push force is applied by means of a rigid test finger similar in dimensions to the test finger of figure 1.

The pull force is applied by a suitable means such as a suction cup, so that the test results are not affected.

While the pull test of a) and b) is being applied, the test fingernail of figure 10 is inserted in any aperture or joint with a force of 10 N. The fingernail is then slid sideways with a force of 10 N; it is not twisted or used as a lever.

If the shape of the part is such that an axial pull is unlikely, no pull force is applied but the test fingernail of figure 10 is inserted in any aperture or joint with a force of 10 N and is then pulled for 10 s by means of the loop with a force of 30 N in the direction of removal.

If the cover or part is likely to be subjected to a twisting force, a torque as detailed below is applied at the same time as the pull or push force:

- for major dimensions up to and including 50 mm 2 Nm;
- for major dimensions over 50 mm 4 Nm.

This torque is also applied when the test finger nail is pulled by means of the loop.

If the projection of the part which is gripped is less than 10 mm, the above torque is reduced to 50% of the value.

Parts shall not become detached and they shall remain in the locked position.

22.12 Handles, knobs, grips, levers and similar parts shall be fixed in a reliable manner so that they will not work loose in normal use if loosening could result in a hazard.

If handles, knobs and similar parts are used to indicate the position of switches or similar components, it shall not be possible to fix them in a wrong position if this could result in a hazard.

Compliance is checked by inspection, by manual test and by trying to remove the handle, knob, grip or lever by applying, for 1 min, an axial force as follows:

- If the shape of these parts is such that an axial pull is unlikely to be applied in normal use, the force is 15 N;
- If the shape is such that an axial pull is likely to be applied, the force is 30 N.

NOTE - Sealing compound and similar materials, other than self-hardening resins, are not considered to be adequate to prevent loosening.

22.13 Handles shall be constructed so that, when gripped as in normal use, contact between the operator's hand and parts having a temperature rise exceeding the value specified for handles which are held for short periods only in normal use, is unlikely.

Compliance is checked by inspection and, if necessary, by determining the temperature rise.

22.14 Appliances shall have no ragged or sharp edges, other than those necessary for the function of the appliance or accessory, that could create a hazard for the user in normal use or during user maintenance.

There shall be no exposed pointed ends of self-tapping screws or other fasteners that are liable to be touched by the user in normal use or during user maintenance.

Compliance is checked by inspection.

22.15 Storage hooks and similar devices for flexible cords shall be smooth and well-rounded.

Compliance is checked by inspection.

22.16 Automatic cord reels shall be constructed so that they cause

- no undue abrasion or damage to the sheath of the flexible cord;
- no breakage of conductor strands;
- no undue wear of contacts.

Compliance is checked by the following test, which is made without passing current through the flexible cord.

Two-thirds of the total length of the cord is unreeled. An additional length of 75 cm of the cord is then unreeled and allowed to be recoiled by the reel 6 000 times at a rate of approximately 30 times per min. or at the maximum rate permitted by the construction of the cord reel if this is less.

The cord is pulled in a direction such that the greatest abrasion occurs to the sheath, taking into account the normal position of use of the appliance. Where the cord leaves the appliance, the angle between the axis of the cord during the test and the axis of the cord when it is unreeled without substantial resistance, is to be approximately 60°.

#### NOTES

- 1 If the cord does not recoil at the angle of 60°, this angle is adjusted to the maximum that will allow recoil.

2 It may be necessary to interrupt the test to allow the cord to cool.

If the total withdrawable length of the cord is less than 225 cm, the cord is initially unreeled to such an extent that a length of 75 cm remains on the reel. This length is then tested as specified.

After this test, the cord and cord reel are inspected. In case of doubt the cord is subjected to the electric strength test of 16.3, a test voltage of 1 000 V being applied between the conductors of the cord connected together and metal foil wrapped around the cord.

22.17 Spacers intended to prevent the appliance from overheating walls shall be fixed so that it is not possible to remove them from the outside of the appliance by hand or by means of a screwdriver or a spanner.

Compliance is checked by inspection and by manual test.

22.18 Current-carrying parts and other metal parts, the corrosion of which could result in a hazard, shall be resistant to corrosion under normal conditions of use.

Compliance is checked by verifying that after the tests of clause 19, the relevant parts show no sign of corrosion.

#### NOTES

1 Attention is to be paid to the compatibility of the materials of terminals and to the effect of heating.

2 Stainless steel and similar corrosion-resistant alloys and plated steel are considered to be satisfactory for the purpose of this requirement.

22.19 Driving belts shall not be relied upon to provide the required level of insulation.

This requirement does not apply if the appliance incorporates a belt, the design of which prevents inappropriate replacement.

Compliance is checked by inspection.

22.20 Direct contact between live parts and thermal insulation shall be effectively prevented, unless such material is non-corrosive, non-hygroscopic and non-combustible.

Compliance is checked by inspection, by the tests of clauses 15 and 16 and, if necessary, by chemical tests or flammability tests.

#### NOTES

1 Glass-wool is an example of thermal insulation which is satisfactory for the purpose of this requirement.

2 Non-impregnated slag-wool is an example of corrosive thermal insulation.

22.21 Wood, cotton, silk, ordinary paper and similar fibrous or hygroscopic material shall not be used as insulation, unless impregnated.

NOTE - Insulating material is considered to be impregnated if the interstices between the fibres of the material are substantially filled with a suitable insulant.

Compliance is checked by inspection.

22.22 Asbestos shall not be used in the construction of appliances, unless the liberation of dust of impregnated asbestos or of asbestos fibres into the surrounding air is adequately prevented.

Compliance is checked by inspection.

NOTE - The intention of this requirement is to avoid the risk associated with the inhalation of asbestos fibre or dust.

22.23 Oils containing polychlorinated biphenyl (PCB) shall not be used in appliances.

Compliance is checked by inspection

22.24 Bare heating elements shall be supported so that, if they rupture, the heating conductor is unlikely to come into contact with earthed metal parts or accessible metal parts.

Compliance is checked by inspection, after cutting the heating conductor in the most unfavourable place.

#### NOTES

- 1 No force is applied to the conductor after it has been cut.
- 2 This test is made after the tests of clause 29.

22.25 Appliances other than those of class III shall be constructed so that sagging heating conductors cannot come into contact with accessible metal parts.

Compliance is checked by inspection.

NOTE - This requirement may be met by providing supplementary insulation or a core which effectively prevents the heating conductor from sagging.

22.26 Class II appliances having parts of class III construction shall be constructed so that the insulation between parts operating at safety extra-low voltage and other live parts complies with the requirements for double insulation or reinforced insulation.

Compliance is checked by the tests specified for double insulation or reinforced insulation.

22.27 Parts connected by protective impedance shall be separated by double insulation or reinforced insulation.

Compliance is checked by the tests specified for double insulation or reinforced insulation.

22.28 For class II appliances connected in normal use to the gas mains or to the water mains, metal parts conductively connected to the gas pipes or in contact with the water shall be separated from live parts by double insulation or reinforced insulation.

Compliance is checked by inspection.

22.29 Class II appliances intended to be permanently connected to fixed wiring shall be constructed so that the required degree of access to live parts is maintained after installation of the appliance.

Compliance is checked by inspection.

NOTE - The protection against access to live parts may be affected for example, by the installation of metal conduits or cables provided with a metal sheath.

22.30 Parts of class II construction which serve as supplementary insulation or reinforced insulation and which could be omitted during reassembly after servicing, shall

- be fixed so that they cannot be removed without being seriously damaged,
- or
- be constructed so that they cannot be replaced in an incorrect position and so that if they are omitted, the appliance is rendered inoperable or manifestly incomplete.

Compliance is checked by inspection and by manual test.

NOTE - Servicing includes replacement of components such as supply cords and switches.

22.31 Creepage distances and clearances over supplementary insulation and reinforced insulation shall not be reduced below the values specified in 29.1 as a result of wear. If any wire, screw, nut, washer, spring or similar part becomes loose or falls out of position, creepage distances and clearances over supplementary insulation or reinforced insulation shall not be reduced to less than 50% of the value specified in 29.1.

Compliance is checked by inspection, by measurement and by manual test.

NOTE - For the purpose of this requirement:

- only the normal position of use of the appliance is taken into account;
- it is not to be expected that two independent fixings will become loose at the same time;
- parts fixed by means of screws or nuts provided with locking washers are regarded as not liable to become loose, provided these screws or nuts are not required to be removed during the replacement of the supply cord or other servicing;
- wires connected by soldering are not considered to be adequately fixed, unless they are held in place near the terminals, independently of the solder;
- wires connected to terminals are not considered to be adequately secured, unless an additional fixing is provided near to the terminal, so that in the case of stranded conductors, this fixing clamps both the insulation and the conductor;
- short rigid wires are not regarded as liable to come away from a terminal if they remain in position when the terminal screw is loosened.

22.32 Supplementary insulation and reinforced insulation shall be designed or protected so that the deposition of dirt or the dust resulting from wear of parts within the appliance, does not reduce creepage distances or clearances below the values specified in 29.1

Ceramic material which is not tightly sintered, similar materials or beads alone shall not be used as supplementary insulation or reinforced insulation.

Parts of natural or synthetic rubber used as supplementary insulation shall be resistant to ageing or be arranged and dimensioned so that creepage distances are not reduced below the values specified in 29.1 even if cracks occur.

NOTE - Insulating material in which heating conductors are embedded is considered to be basic insulation and not reinforced insulation

Compliance is checked by inspection, by measurement and, for rubber, by the following test.

Parts of rubber are aged in an atmosphere of oxygen under pressure. The samples are suspended freely in an oxygen bomb, the effective capacity of the bomb being at least ten times the volume of the samples. The bomb is filled with commercial oxygen not less than 97% pure, to a pressure of 2,1 Mpa  $\pm$  0,07 Mpa.

The samples are kept in the bomb at a temperature of 70°C  $\pm$  1°C for 96 h. Immediately afterwards they are removed from the bomb and left at room temperature, avoiding direct sunlight, for at least 16 h.

After the test, the samples are examined and shall show no crack visible to the naked eye.

#### NOTES

- 1 In case of doubt with regard to materials other than rubber, other tests may be made.
  - 2 The use of the oxygen bomb presents some danger unless handled with care. Precautions should be taken to avoid the risk of explosion due to sudden oxidation.
- Z1 Refer to the footnote\*

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\* The following interpretation has been published by the IEC and accepted by CENELEC:

NOTE – In case of doubt the following test is carried out to determine if ceramic material is tightly Sintered.

The ceramic material is broken into pieces which are immersed in a solution containing 1 g of fuchsin in each 100 g of methylated spirit. The solution is maintained at a pressure not less than 15 Mpa for a period so that the product of the test duration in hours and the test pressure in Mpa is not less than 180.

The pieces are removed from the solution, rinsed, dried and broken into smaller pieces.

The freshly broken surfaces are examined and are not to show any trace of dye.

22.33 Conductive liquids which are or may become accessible in normal use shall not be in direct contact with live parts.

For class II construction, such liquids shall not be in direct contact with basic insulation or reinforced insulation.

Compliance is checked by inspection.

22.34 Shafts of operating knobs, handles, levers and similar parts shall not be live unless the shaft is not accessible when the part is removed.

Compliance is checked by inspection and by applying the test finger as specified in 8.1 after removal of the part even with the aid of a too.

22.35 For constructions other than those of class III, handles, levers and knobs which are held or actuated in normal use shall not become live in the event of an insulation fault. If these handles, levers or knobs are of metal and if their shafts or fixings are likely to become live in the event of an insulation fault, they shall either be adequately covered by insulating material or their accessible parts shall be separated from their shafts or fixings by supplementary insulation.

NOTE - The insulation material is considered to be adequate if it complies with the test of 16.3, table 5, item 4.

For stationary appliances this requirement does not apply to handles, levers and knobs, other than those of electrical components, provided they are either reliably connected to an earthing terminal or earthing contact or separated from live parts by earthed metal.

Compliance is checked by inspection and if necessary by the relevant tests.

22.36 For appliances other than those of class III, handles which are continuously held in the hand in normal use shall be constructed so that when gripped as in normal use, the operator's hand is not likely to touch metal parts unless they are separated from live parts by double insulation or reinforced insulation.

Compliance is checked by inspection.

22.37 For class II appliances, capacitors shall not be connected to accessible metal parts and their casings, if of metal, shall be separated from accessible metal parts by supplementary insulation.

This requirement does not apply to capacitors complying with the requirements for protective impedance specified in 22.42.

Compliance is checked by inspection and by the relevant tests.

22.38 Capacitors shall not be connected between the contacts of a thermal cut-out.

Compliance is checked by inspection.

22.39 Lampholders shall be used only for the connection of lamps.

Compliance is checked by inspection.

22.40 Motor-operated appliances and combined appliances which are intended to be moved while in operation or which have accessible moving parts, shall be fitted with a switch to control the motor. The actuating member of this switch shall be easily visible and accessible.

Compliance is checked by inspection.

22.41 Mercury switches shall be mounted so that the mercury capsule cannot fall out of position or be damaged by the clamping means and they shall be arranged so that, should the capsule break, liquid or vaporous mercury cannot be released so as to contaminate the surroundings.

Compliance is checked by inspection and by measurement.

22.42 Protective impedance shall consist of at least two separate components whose impedance is unlikely to change significantly during the lifetime of the appliance. If any one of the components is short-circuited or open-circuited the values specified in 8.1.4 shall not be exceeded.

Compliance is checked by inspection and by measurement.

NOTE - Resistors complying with subclause 14.1 and capacitors complying with subclause 14.2 of IEC 65 are considered to be appropriate components..

22.43 Appliances which can be adjusted for different voltages shall be constructed so that accidental changing of the setting is unlikely to occur.

Compliance is checked by manual test.

22.Z1 Appliances are not allowed to have an enclosure which is shaped and decorated so that the appliance is likely to be treated as a toy by children.

Compliance is checked by inspection

NOTE - Examples are enclosures representing animals or persons or resembling scale models.

22.Z2 Fully halogenated chlorofluorocarbons (CFC's) shall not be used.

Compliance is checked by inspection.

23 Internal wiring

23.1 Wireways shall be smooth and free from sharp edges.

Wires shall be protected so that they do not come into contact with burrs, cooling fins or similar edges which may cause damage to their insulation.

Holes in metal through which insulated wires pass shall have smooth well-rounded surfaces or be provided with bushings.

Wiring shall be effectively prevented from coming into contact with moving parts.

Compliance is checked by inspection.

23.2 Beads and similar ceramic insulators on live wires shall be fixed or supported so that they cannot change their position; they shall not rest on sharp edges or sharp corners. If beads are inside flexible metal conduits, they shall be contained within an insulating sleeve, unless the conduit cannot move in normal use.

Compliance is checked by inspection and by manual test.

23.3 Different parts of an appliance which can move in normal use or during user maintenance relative to each other, shall not cause undue stress to electrical connections and internal conductors, including those providing earthing continuity. Flexible metallic tubes shall not cause damage to the insulation of the conductors contained within them.

Open-coil springs shall not be used to protect conductors. If a coiled spring, the turns of which touch one another, is used for this purpose, an adequate insulating lining shall be provided in addition to the insulation of the conductors.

Compliance is checked by inspection and by the following test.

If flexing occurs in normal use, the appliance is placed in the normal position of use and is supplied at rated voltage under normal operation.

The movable part is moved backwards and forwards, so that the conductor is flexed through the largest angle permitted by the construction. The number of flexings for conductors flexed in normal use is 10 000 and the rate of flexing 30 per min; for conductors flexed during user maintenance the number is 100 with the same rate of flexing.

The appliance shall not be damaged to the extent that compliance with this standard is impaired and it shall be fit for further use. In particular, the wiring and its connections shall withstand the electric strength test of 16.3, the test voltage being however reduced to 1 000 V and applied between live parts and other metal parts only.

#### NOTES

1 A flexing is one movement, either backwards or forwards.

2 The sheath of a flexible cord complying with IEC 227 or IEC 245 is regarded as an adequate insulating lining.

23.4 Bare internal wiring shall be rigid and fixed so that, in normal use, creepage distances and clearances cannot be reduced below the values specified in 29.1.

Compliance is checked during the test of 29.1

23.5 The insulation of internal wiring shall withstand the electrical stress likely to occur in normal use.

Compliance is checked as follows:

The basic insulation shall be electrically equivalent to the basic insulation of cords complying with IEC 227 or IEC 245 or comply with the following electric strength test:

A voltage of 2 000 V is applied for 15 min between the conductor and metal foil wrapped around the insulation. There shall be no breakdown.

#### NOTES

1 If the insulation of the conductor does not fulfil one of these conditions, the conductor is considered to be bare.

2 The test is only applied to wiring subjected to the supply mains voltage.

Z1 For class II constructions, the requirements for supplementary insulation and reinforced insulation apply except that the sheath of a cord complying with IEC 227 or IEC 245 may provide supplementary insulation.

23.6 When sleeving is used as supplementary insulation on internal wiring it shall be retained in position by positive means.

Compliance is checked by inspection and by manual test.

NOTE - A sleeve is considered to be fixed by positive means if it can only be removed by breaking or cutting or if it is clamped at both ends.

23.7 Conductors identified by the colour combination green/yellow shall only be used for earthing conductors.

Compliance is checked by inspection.

23.8 Aluminium wires shall not be used for internal wiring.

Compliance is checked by inspection.

NOTE - Windings are not considered as internal wiring.

23.9 Stranded conductors shall not be consolidated by lead-tin soldering where they are subjected to contact pressure, unless the clamping means is constructed so that there is no risk of bad contact due to cold flow of the solder.

Compliance is checked by inspection.

#### NOTES

1 The requirements may be met by using spring terminals. Securing the clamping screws alone is not considered adequate.

2 Soldering of the tip of a stranded conductor is allowed.

## 24 Components

24.1 Components shall comply with the safety requirements specified in the relevant IEC standards as far as they reasonably apply.

Compliance is checked by inspection and by the tests of 24.1.1 to 24.1.5.

NOTE - Compliance with the IEC standard for the relevant component does not necessarily ensure compliance with the requirements of this standard.

NOTE Z1 – Unless otherwise specified, the requirements of clause 29 apply between live parts of components and accessible parts of the appliance.

24.1.1 Capacitors likely to be permanently subjected to the supply mains voltage and used for radio interference suppression or for voltage dividing, shall comply with annex ZC.

**Small lampholders similar to E10 lampholders shall comply with the requirements for E10 lampholders; they need not accept a lamp with E10 cap complying with the current edition of Standard Sheet 7004-22 of IEC 61-1.**

**Safety isolating transformers** shall comply with IEC 742, unless they are tested with the appliance in which case they shall comply with annex ZD.

**Appliance couplers for IPXO appliances shall comply with IEC 320. Other appliance couplers shall comply with IEC 309.**

**Automatic controls shall comply with IEC 730 unless they are tested with the appliance.**

Switches shall comply with IEC 1058 unless they are tested with the appliance.

**24.1.2 Automatic controls which have not been separately tested and found to comply with IEC 730 shall be tested according to this standard and according to subclauses 11.3.5 to 11.3.8 and clause 17 of IEC 730 as type 1 controls.**

The tests according to IEC 730 are carried out under the conditions occurring in the appliance.

For the tests of clause 17 of IEC 730 the number of cycles of operation are

- thermostats	10 000
- temperature limiters	1 000
- self-resetting thermal cut-outs	300
- non-self-resetting thermal cut-outs	30
- energy regulators	3 000
- timers	10 000

## NOTES

1 The tests of clauses 12,13 and 14 are not carried out before making the test of clause 17 of IEC 730.

2 The tests of clause 17 of IEC 730 are not carried out on automatic controls which operate during clause 11, if the appliance meets the requirements of this standard when they are short-circuited.

3 Automatic controls may be tested separately from the appliance.

24.1.3 For switches, the test of subclause 17.2.7 of IEC 1058-1 is carried out for 10 000 cycles of operation.

Switches which have not been separately tested and found to comply with IEC 1058-1 under conditions covering those occurring in the appliance, shall comply with annex ZE.

Switches intended for operation under no load and which can be operated only with the aid of a tool are not subjected to the tests of clause 17 of IEC 1058-1. This applies also for such switches operated by hand which are interlocked so that they cannot be operated under load but switches without this interlock are subjected to the test of subclause 17.2.7 for 100 cycles of operation.

NOTE - The test of subclause 17.2.7 of IEC 1058-1 is only carried out on switches required by this standard.

24.1.4 If components are marked with their operating characteristics, the conditions under which they are used in the appliance shall be in accordance with these markings, unless otherwise specified.

NOTE - For automatic controls, the term “marking” includes documentation and declaration as specified in clause 7 of IEC 730.

The testing of components which have to comply with other standards is, in general, carried out separately, according to the relevant standard.

If the component is used within the limits of its marking, it is tested in accordance with the conditions occurring in the appliance, the number of samples being that required by the relevant standard.

When no IEC standard exists for the relevant component, when the component is not marked or is not used in accordance with its marking, it is tested under the conditions occurring in the appliance. The number of samples is, in general, that required by a similar specification.

Components not mentioned in table 3 are tested as a part of the appliance, their T-marking, if any, being taken into account.

24.1.5 For capacitors connected in series with a motor winding, it is verified that, when the appliance is supplied at 1,1 times rated voltage and under minimum load, the voltage across the capacitor does not exceed 1,1 times its rated voltage.

NOTE - Capacitors in auxiliary windings of motors are to be marked with their rated voltage and their rated capacitance.

24.2 Appliances shall not be fitted with

- switches or automatic controls in flexible cords;
- devices which cause the protective device in the fixed wiring to operate in the event of a fault in the appliance;
- thermal cut-outs which can be reset by a soldering operation.

Compliance is checked by inspection.

24.3 Switches intended to ensure all-pole disconnection of stationary appliances, as required in 22.2, shall be directly connected to the supply terminals and shall have a contact separation of at least 3 mm in each pole.

Compliance is checked by inspection and by measurement.

24.4 Plugs and socket-outlets used as terminal devices for heating elements and plugs and socket-outlets for extra-low voltage circuits, shall not be interchangeable with plugs and socket-outlets listed in IEC 83 or with connectors and appliance inlets complying with the standard sheets of IEC 320.

Compliance is checked by inspection.

24.5 Plugs and socket-outlets and other connecting devices of interconnection cords shall not be interchangeable with plugs and socket-outlets listed in IEC 83 or with connectors and appliance inlets complying with the standard sheets of IEC 320, if direct supply to these parts from the supply mains could give rise to a hazard.

Compliance is checked by inspection and by manual test.

24.6 Motors connected to the supply mains and having basic insulation which is inadequate for the rated voltage of the appliance, shall comply with the requirements of annex F.

Compliance is checked by the tests of annex F.

## 25 Supply connection and external flexible cords

25.1 Appliances, other than those intended to be permanently connected to fixed wiring, shall be provided with one of the following means for connection to the supply:

- supply cord fitted with a plug;
- an appliance inlet having at least the same degree of protection against moisture as required for the appliance;
- pins for insertion into socket-outlets.

Compliance is checked by inspection.

25.2 Appliances other than stationary appliances for multiple supply shall not be provided with more than one means of connection to the supply. Stationary appliances for multiple supply may be provided with more than one means of connection provided the relevant circuits are adequately insulated from each other.

Compliance is checked by inspection and by the following test.

A voltage of 1 250 V of substantially sinusoidal waveform and having a frequency of 50 Hz or 60 Hz is applied for 1 min between each means of connection to the supply, any switches being in the most unfavourable position.

During this test, no breakdown shall occur.

### NOTES

- 1 A multiple supply is, for example, required for day and night supply at different tariffs.
- 2 This test may be combined with that of 16.3.

25.3 Appliances intended to be permanently connected to fixed wiring shall allow the connection of the supply wires after the appliance has been fixed to its support and shall be provided with one of the following means for connection to the supply:

- a set of terminals allowing the connection of cables of fixed wiring having the nominal cross-sectional areas specified in 26.2;
- a set of terminals allowing the connection of a flexible cord;

NOTE 1 - In this case it is allowed to connect the supply cord before the appliance is fixed to its support. The appliance may be provided with a flexible cord.

- a set of terminals and cable entries, conduit entries, knock-outs or glands, which allow the connection of the appropriate types of cable or conduit.

NOTE 2 - If a fixed appliance is constructed so that parts can be removed to facilitate easy installation, the requirement is considered to be met if it is possible to connect the supply wires without difficulty after a part of the appliance has been fixed to its support. In this case removable parts are to be constructed to be easily reassembled to the part which has been fixed in position, without risk of incorrect assembly or damage to the wiring and without exposing the wiring to stress which may cause damage to the terminals or to the insulation of the wires.

Compliance is checked by inspection and if necessary by making the appropriate connections.

25.4 For appliances having a rated current not exceeding 16 A, cable and conduit entries shall be suitable for cables or conduits having a maximum overall diameter shown in table 8.

**Table 8 - Diameter of cables and conduits**

Number of conductors Including earthing conductors	Maximum overall diameter Mm	
	Cable	Conduit
2	13.0	16.0
3	14.0	16.0
4	14.5	20.0
5	15.5	20.0

Conduit entries, cable entries and knock-outs shall be constructed or located so that the introduction of the conduit or cable does not affect the protection against access to live parts or reduce creepage distances and clearances below the value specified in 29.1.

Compliance is checked by inspection and by measurement.

25.5 Supply cords shall be assembled to the appliance by one of the following methods:

- type X attachment;
- type Y attachment;
- type Z attachment, if allowed in part 2.

Type X attachments other than those with a specially prepared cord, shall not be used for flat twin tinsel cords.

Compliance is checked by inspection

25.6 Plugs shall not be fitted with more than one flexible cord.

Supply cords of single-phase portable appliances having a rated current not exceeding 16 A shall be provided with a plug complying with the following standard sheets of IEC 83:

- for class I appliances                      standard sheet C2b, C3b or C4;
- for class II appliances                      standard sheet C5 or C6.

NOTE Z1 - Refer to annex ZA

Compliance is checked by inspection.

25.7 Supply cords shall not be lighter than

- braided cord (code designation 245 IEC 51);
- ordinary tough rubber sheathed cord (code designation 245 IEC 53);
- ordinary polychloroprene sheathed flexible cord (code designation 245 IEC 57);
- flat twin tinsel cord (code designation 227 IEC 41);
- light polyvinyl chloride sheathed cord (code designation 227 IEC 53), for appliances having a mass exceeding 3 kg.

NOTES

- 1 Braided cords and flat twin tinsel cords may only be used if allowed in part 2.
- 2 A lower number in the code designation of the cord in IEC 227 or IEC 245 indicates a lighter type.

Z1 The harmonized code designations corresponding to the IEC cord types are given in annex ZF.

Polyvinyl chloride insulated cords shall not be used for appliances where the temperature rise of external metal parts exceeds 75 K during the test of clause 11. However they may be used if

- the appliance is constructed so that the supply cord is not likely to touch such metal parts in normal use;
- the supply cord is appropriate for higher temperatures. In this case, type Y attachment or type Z attachment shall be used.

Compliance is checked by inspection and by measurement.

25.8 Conductors of supply cords shall have a nominal cross-sectional area not less than that shown in table 9.

Table 9 - Minimum cross-sectional area of conductors

Rated current of appliance A	Nominal cross-sectional area mm <sup>2</sup>
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$\leq$ 0.2 > 0,2 and $\leq$ 3 > 3 and $\leq$ 6 > 6 and $\leq$ 10 > 10 and $\leq$ 16 > 16 and $\leq$ 25 > 25 and $\leq$ 32 > 32 and $\leq$ 40 > 40 and $\leq$ 63	Tinsel cord <sup>1)</sup> 0,5 <sup>1)</sup> 0,75 1 1,5 2,5 4 6 10
1) These cords may only be used if their length does not exceed 2 m between the point where the cord or cord guard enters the appliance and the entry to the plug.	

NOTE Z1 - Refer to annex ZA.

Compliance is checked by inspection

25.8 Supply cords shall not be in contact with sharp points or edges of the appliance.

Compliance is checked by inspection.

25.9 The supply cord of class I appliances shall have a green/yellow core which is connected to the earthing terminal of the appliance and to the earthing contact of the plug.

Compliance is checked by inspection.

25.10 The supply cord of class I appliances shall have a green/yellow core which is connected to the earthing terminal of the appliance and to the earthing contact of the plug.

Compliance is checked by inspection.

25.11 Conductors of supply cords shall not be consolidated by lead-tin soldering where they are subject to contact pressure, unless the clamping means is constructed so that there is no risk of a bad contact due to cold flow of the solder.

Compliance is checked by inspection.

#### NOTES

1 The requirement may be met by using spring terminals. Securing the clamping screws alone is not considered adequate.

2 Soldering of the tip of a stranded conductor is allowed.

25.12 The insulation of the supply cord shall not be damaged when moulding the cord to part of the enclosure.

Compliance is checked by inspection.

25.13 Inlet openings shall be provided with a bushing or shall be constructed so that the sheath of the supply cord can be introduced without risk of damage.

Compliance is checked by inspection and by manual test.

#### 25.13.1 Inlet bushings shall

- be shaped to prevent damage to the supply cord;
- not be detachable parts.

Compliance is checked by inspection and by manual test.

25.13.2 At inlet openings, the insulation between the conductor of a supply cord and the enclosure of the appliance shall consist of the insulation of the conductor and in addition

- for class 0 appliances, at least one separate insulation;
- for other appliances, at least two separate insulations.

Only one separate insulation is required if the enclosure at the inlet opening is of insulating material.

A separate insulation shall consist of

- the sheath of a supply cord at least equivalent to that of a cord complying with IEC 227 or IEC 245;
- a lining or bushing of insulating material complying with the requirements of 29.2 for supplementary insulation.

Compliance is checked by inspection.

25.14 Appliances provided with a supply cord which are moved while in operation, shall be constructed so that the cord is adequately protected against excessive flexing where it enters the appliance.

NOTE 1 - This does not apply to appliances with automatic cord reels which are tested by 22.16 instead.

Compliance is checked by the following test which is made on an apparatus having an oscillating member as shown in figure 11.

The part of appliance comprising the cord entry, the cord guard if any and the supply cord, is fixed to the oscillating members so that, when the latter is at the middle of its travel, the axis of the cord where it enters the cord guard or inlet is vertical and passes through the axis of oscillation. The major axis of the section of flat cords shall be parallel to the axis of oscillation.

The cord is loaded so that the force applied is

- 10 N for cords having a nominal cross-sectional area exceeding 0,75 mm<sup>2</sup>;
- 5 N for other cords.

The distance A, as shown in figure 11, between the axis of oscillation and the point where the cord or cord guard enters the appliance, is adjusted so that when the oscillating member moves over its full range, the cord and load make the minimum lateral movement.

The oscillating member is moved through an angle of 90° (45° on either side of the vertical), the number of flexings for type Z attachments being 20 000 and for other attachments 10 000. The rate of flexing is 60 per min.

NOTE 2 - a FLEXING IS ONE MOVEMENT OF 90°.

The cord and its associated parts are turned through an angle of 90° after half the number of flexings, unless a flat cord is fitted.

During the test, the conductors are loaded with the rated current of the appliance at rated voltage.

NOTE 3 - Current is not passed through the earthing conductor.

The test shall not result in

- short circuit between the conductors;
- breakage of more than 10% of the strands of any conductor;
- separation of the conductor from its terminal;
- loosening of any cord guard;
- damage to the cord or cord guard which could impair compliance with this standard;
- broken strands piercing the insulation and becoming accessible.

#### NOTES

4 Conductors include earthing conductors.

5 A short circuit between conductors of the cord is considered to occur if the current exceeds a value equal to twice the rated current of the appliance.

25.15 Appliances provided with a supply cord shall have cord anchorages such that the conductors are relieved from strain, including twisting, where they are connected within the appliance and that the insulation of the conductors is protected from abrasion. This requirement also applies to appliances intended to be permanently connected to the fixed wiring by a flexible cord.

It shall not be possible to push the cord into the appliance to such an extent that the cord or internal parts of the appliance could be damaged.

Compliance is checked by inspection, by manual test and by the following test.

A mark is made on the cord while it is subjected to the pull force shown in table 10, at a distance of approximately 2 cm from the cord anchorage or other suitable point.

The cord is then pulled 25 times with the force specified. The pulls are applied in the most unfavourable direction without jerks, each time for 1 s.

The cord, other than that of an automatic cord reel, is then immediately subjected to a torque which is applied as close as possible to the appliance. The torque as specified in table 10 is applied for 1 min.

**Table 10 - Pull force and torque**

Mass of appliance kg	Pull force N	Torque Nm
≤ 1	30	0,1
> 1 and ≤ 4	60	0,25
> 4	100	0,35

During the tests the cord shall not be damaged.

After the tests the cord shall not be longitudinally displaced by more than 2 mm and the conductors shall not have moved over a distance of more than 1 mm in the terminals. There shall be no appreciable strain at the connection and creepage distances and clearances shall not be reduced below the values specified in 29.1.

NOTE - The displacement of the mark on the cord in relation to the cord anchorage or other point is measured while the cord is subjected to the pull.

25.16 Cord anchorages for type X attachments shall be constructed and located so that

- replacement of the cord is easily possible;
- it is clear how the relief from strain and the prevention of twisting are obtained;
- they are suitable for the different types of cord which may be connected, unless the cord is specially prepared;
- the cord cannot touch the clamping screws of the cord anchorage if these screws are accessible, unless they are separated from accessible metal parts by supplementary insulation;
- the cord is not clamped by a metal screw which bears directly on the cord;
- at least one part of the cord anchorage is securely fixed to the appliance unless it is part of a specially prepared cord;
- screws which have to be operated when replacing the cord do not fix any other component. However this does not apply if
  - the screws are omitted or components are incorrectly positioned and the appliance becomes inoperative or is obviously incomplete;
  - the parts intended to be fastened by them cannot be removed without the aid of a tool during the replacement of the cord.
- If labyrinths can be bypassed the test of 25.15 is nevertheless withstood;
- For class 0, class 0I and class I appliances, they are of insulating material or are provided with an insulating lining, unless a failure of the insulation of the cord does not make accessible metal parts live;
- For class II appliances, they are of insulating material or if of metal, they are insulated from accessible metal parts by supplementary insulation.

#### NOTES

1 If the cord anchorage for type X attachment comprises one or more clamping members to which pressure is applied by means of nuts engaging with studs which are securely attached to the appliance, the cord anchorage is considered to have one part securely fixed to the appliance, even if the clamping member can be removed from the studs.

2 If the pressure on the clamping members is applied by means of one or more screws engaging with separate nuts or with a thread in a part which is integral with the appliance, the cord anchorage is not considered to have one part securely fixed to the appliance. This does not apply if one of the clamping members is fixed to the appliance or the surface of the appliance is of insulating material and shaped so that it is obvious that this surface is one of the clamping members.

3 Examples of acceptable and unacceptable constructions of cord anchorages are shown in figure 13.

Compliance is checked by inspection and by the test of 25.15 under the following conditions.

The tests are made with the lightest permissible type of cord of the smallest cross-sectional area specified in table 11 and then with the next heavier type cord having the largest cross-sectional area specified. However, if the appliance is fitted with a specially prepared cord, the test is carried out with this cord.

The conductors are placed in the terminals and any terminal screws tightened just sufficiently to prevent the conductors from easily changing their position. The clamping screws of the cord anchorage are tightened with two-thirds of the torque specified in 28.1.

Screws of insulating material bearing directly on the cord are fastened with two-thirds of the torque specified in column 1 of table 12, the length of the slot in the screw head being taken as the nominal diameter of the screw.

25.17 For type Y attachment and type Z attachment, cord anchorages shall be adequate.

Compliance is checked by the test of 25.15.

NOTE - The test is carried out on the cord supplied with the appliance.

25.18 Cord anchorages shall be arranged so that they are only accessible with the aid of a tool or be constructed so that the cord can only be fitted with the aid of a tool.

Compliance is checked by inspection.

25.19 For type X attachment, glands shall not be used as cord anchorages in portable appliances. Tying the cord into a knot or tying the cord with string is not allowed.

Compliance is checked by inspection.

25.20 The insulated conductors of the supply cord for type Y attachment and type Z attachment shall be additionally insulated from accessible metal parts by basic insulation for class 0, class 0I and class I appliances, and by supplementary insulation for class II appliances. This insulation may be provided by the sheath of the supply cord or by other means.

Compliance is checked by inspection and by the relevant tests.

25.21 The space for connection of the supply cables for fixed wiring or for the connection of the supply cord provided for type X attachment shall be constructed.

- to permit checking that the supply conductors are correctly positioned and connected before fitting any cover;
- so that any covers can be fitted without risk of damage to the conductors or their insulation;
- for portable appliances, so that the uninsulated end of a conductor, should it become free from the terminal, cannot come into contact with accessible metal parts, unless the end of the cord is such that the conductors are unlikely to slip free.

Compliance is checked by inspection and by an installation test with cables or flexible cords of the largest cross-sectional area specified in table 11.

Portable appliances are subjected to the following additional test.

For pillar terminals where the supply cord is not clamped at a distance of 30 mm or less from the terminal and for other terminals with screw clamping, the clamping screws or nuts are loosened in turn. A force of 2 N is then applied to the conductor in any direction at a position adjacent to the terminal. The uninsulated end of the conductor shall not come into contact with accessible metal parts.

NOTES

1 This test is not carried out on appliances with pillar terminals where the supply cord is clamped at a distance of 30 mm or less from the terminal.

2 The supply cord may be clamped by a cord anchorage.

#### 25.22 Appliance inlets shall

- be located or enclosed so that live parts are not accessible during insertion or removal of the connector;
- be located so that the connector can be inserted without difficulty;
- be located so that, after insertion of the connector, the appliance is not supported by the connector when it is placed in any position of normal use on a flat surface;
- not be an appliance inlet for cold conditions if the temperature rise of external metal parts of the appliance exceeds 75 K during the test of clause 11, unless the appliance is such that the supply cord is not likely to touch such metal parts in normal use.

Compliance is checked by inspection.

NOTE - Appliances provided with appliance inlets complying with IEC 320, are considered to comply with the first requirement.

#### 25.23 Interconnection cords shall comply with the requirements for the supply cord, except that

- the cross-sectional area of the conductors of the Interconnection cord is determined on the basis of the maximum current carried by the conductor during the test of clause 11 and not by the rated current of the appliance;
- the thickness of the insulation of the conductor may be reduced if the voltage of the conductor is less than the rated voltage.

Compliance is checked by inspection, by measurement and if necessary by tests, such as the electric strength test of 16.3.

25.24 Detachable interconnection cords shall not be provided with a means for connection such that accessible metal parts are live when the connection is disconnected due to the disengagement of one of the connecting means.

Compliance is checked by inspection and if necessary by means of the test finger of figure 1.

25.25 Interconnection cords shall not be detachable without the aid of a tool if compliance with this standard is impaired when they are disconnected.

Compliance is checked by inspection and if necessary by appropriate tests.

#### 26 Terminals for external conductors

26.1.1 Appliances with type X attachment and appliances for connection to fixed wiring shall be provided with terminals in which connection is made by means of screws, nuts or equally effective devices, This requirement does not apply to appliances provided with supply leads or provided with a type X attachment having a specially prepared cord.

Screws and nuts shall not serve to fix any other component, except that they may also clamp internal conductors if these are arranged so that they are unlikely to be displaced when fitting the supply conductors.

Compliance is checked by inspection.

NOTES

- 1 Safety requirements for screw type and screwless type clamping units for electrical copper conductors are under consideration. Screwless type clamping units according to subclause 2.10 of IEC 999 provided with an actuating element are regarded as equally effective devices.
- 2 Requirements for screwless terminals are given in IEC 685-2-1.

26.1.2 For appliances with type X attachment, soldered connections may be used for the connection of external conductors, provided that the conductor is positioned or fixed so that reliance is not placed upon the soldering alone to maintain the conductor in position. However soldering alone may be used if barriers are provided so that creepage distances and clearances between live parts and other metal parts cannot be reduced to less than 50% of the values specified in 29.1 if the conductor becomes free at the soldered joint.

For appliances with type Y attachment or type Z attachment, soldered, welded, crimped and similar connections may be used for the connection of external conductors. For class II appliances, the conductor shall be positioned or fixed so that reliance is not placed upon the soldering, crimping or welding alone to maintain the conductor in position. However soldering, welding or crimping alone may be used if barriers are provided so that creepage distances and clearances between live parts and other metal parts cannot be reduced to less than 50% of the values specified in 29.1 if the conductor becomes free at the soldered or welded joint or slips out of the crimped connection.

Compliance is checked by inspection and by measurement.

NOTES

- 1 It is not to be expected that two independent fixings will become loose at the same time.
- 2 Conductors connected by soldering alone are not considered to be adequately fixed, unless they are held in place near the terminal. However, “hooking in” before soldering is considered to be a suitable means for maintaining the conductors in position, other than those of a tinsel cord, provided the hole through which the conductor is passed is not unduly large.
- 3 Conductors connected to terminals by other means are not considered to be adequately fixed, unless an additional fixing is provided near to the terminal. This additional fixing is to clamp both the insulation and the conductor of flexible cord.
- 4 The terminals of a component such as a switch may be used as terminals for external conductors if they comply with the requirements of this clause.

26.2 Terminals for type X attachment and for connection to fixed wiring shall allow the connection of conductors having nominal cross-sectional areas shown in table 11. However if a specially prepared cord is used, the terminals need only be suitable for the connection of that cord.

Table 11 - Nominal cross-sectional area of conductors

Rated current of appliance A	Nominal cross-sectional area mm <sup>2</sup>	
	Flexible cords	Cables for fixed wiring
≤ 3	0,5 and 0,75	1 to 2,5
> 3 and ≤ 6	0,75 and 1	1 to 2,5

> 6 and ≤ 10	1 and 1,5	1 to 2,5
> 10 and ≤ 16	1,5 and 2,5	1,5 to 4
> 16 and ≤ 25	2,5 and 4	2,5 to 6
> 25 and ≤ 32	4 and 6	4 to 10
> 32 and ≤ 40	6 and 10	6 to 16
> 40 and ≤ 64	10 and 16	10 to 25

Compliance is checked by inspection, by measurement and by fitting cables or cords of the smallest and largest cross-sectional areas specified.

26.3 Terminals for the supply cord shall be suitable for their purpose. Terminals with screw clamping and screwless terminals shall not be used for the connection of the conductors of flat twin tinsel cords unless the ends of the conductors are fitted with a device suitable for use with screw terminals.

Compliance is checked by inspection and by applying a pull of 5 N to the connection.

After the test, the connection shall show no damage which could impair compliance with this standard.

26.4 Terminals for type X attachment and those for connection to fixed wiring shall be fixed so that when the clamping means is tightened or loosened.

- the terminal does not loosen;
- internal wiring is not subjected to stress;
- creepage distances and clearances are not reduced below the values specified in 29.1.

Compliance is checked by inspection and by the test of subclause 8.6 of IEC 999, the torque applied being equal to two-thirds of the torque specified.

#### NOTES

1 Terminals may be prevented from loosening by fixing with two screws, by fixing with one screw in a recess such that there is no appreciable movement or by other suitable means.

2 Covering with sealing compound without other means of locking is not considered to be sufficient. However self-hardening resins may be used to lock terminals which are not subject to torsion in normal use.

26.5 Terminals for type X attachment and for connection to fixed wiring shall be constructed so that they clamp the conductor between metal surfaces with sufficient contact pressure and without damaging the conductor.

Compliance is checked by inspection of the terminals and of the conductors, after the test of 26.4.

26.6 Terminals for type X attachment, except those connected to a specially prepared cord, and terminals for connection to fixed wiring, shall not require special preparation of the conductor. They shall be constructed or placed so that the conductor cannot slip out when clamping screws or nuts are tightened.

Compliance is checked by inspection of the terminals and of the conductors after the test of 26.4.

#### NOTES

1 The term "special preparation of the conductor" covers soldering of the strands, the use of cable lugs, eyelets or similar devices, but not the reshaping of the conductor before its introduction into the terminal or the twisting of a stranded conductor to consolidate the end.

2 Conductors are considered to be damaged if they show deep or sharp indentations.

26.7 Terminals of the pillar type shall be constructed and located so that the end of a conductor introduced into the hole is visible or can pass beyond the threaded hole for a distance at least equal to half the nominal diameter of the screw or 2,5 mm, whichever is the greater.

Compliance is checked by inspection and by measurement.

26.8 Terminals, including the earthing terminal, for the connection to fixed wiring shall be located close to each other.

Compliance is checked by inspection.

26.9 Terminals for type X attachment shall be accessible after removal of a cover or part of the enclosure.

Compliance is checked by inspection.

26.10 Terminals shall not be accessible without the aid of a tool, even if their live parts are not accessible.

Compliance is checked by inspection and by manual test.

26.11 Terminals for type X attachment shall be located or shielded so that if a wire of a stranded conductor escapes when the conductors are fitted, there is no risk of accidental connection between live parts and accessible metal parts and for class II construction, between live parts and metal parts separated from accessible metal parts by supplementary insulation only.

Compliance is checked by inspection and by the following test.

A 8 mm length of insulation is removed from the end of a flexible conductor having a nominal cross-sectional area as specified in table 9.

One wire of the stranded conductor is left free and the other wires are fully inserted and clamped in the terminal.

The free wire is bent, without tearing the insulation back, in every possible direction but without making sharp bends around barriers.

27 Provision for earthing

27.1 Accessible metal parts of class 0I and class I appliances which may become live in the event of an insulation fault, shall be permanently and reliably connected to an earthing terminal within the appliance or to the earthing contact of the appliance inlet.

Earthing terminals and earthing contacts shall not be connected to the neutral terminal.

Class 0, class II and class III appliances shall have no provision for earthing.

Compliance is checked by inspection.

## NOTES

1 If accessible metal parts are screened from live parts by metal parts which are connected to the earthing terminal or to the earthing contact, they are not regarded as likely to become live in the event of an insulation fault.

2 Metal part behind a decorative cover which does not withstand the test of clause 21 are considered to be accessible metal parts.

27.2 Terminals with screw clamping shall comply with the relevant requirements of clause 26. Screwless terminals shall comply with IEC 998-2-2.

Terminals for the connection of external equipotential bonding conductors shall allow the connection of conductors having nominal cross-sectional areas of 2,5 mm<sup>2</sup> to 6 mm<sup>2</sup> and shall not be used to provide earthing continuity between different parts of the appliance. It shall not be possible to loosen the conductors without the aid of a tool.

The clamping means of earthing terminals shall be adequately secured against accidental loosening.

Compliance is checked by inspection, by manual test and for screwless terminals by the tests specified in IEC 998-2-2.

#### NOTES

1 The earthing conductor in a supply cord is not considered to be an equipotential bonding conductor.

2 In general, the constructions commonly used for current-carrying terminals, other than some terminals of the pillar type, provide sufficient resiliency to comply with the latter requirement. For other constructions, special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

27.3 If a detachable part is plugged into another part of the appliance and has an earth connection, this connection shall be made before the current-carrying connections are established when placing the part in position and the current-carrying connections shall be separated before the earth connection is broken when removing the part.

For appliances with supply cords, the arrangement of the terminals or the length of the conductors between the cord anchorage and the terminals, shall be such that the current-carrying conductors become taut before the earthing conductor if the cord slips out of the cord anchorage.

Compliance is checked by inspection and by manual test.

27.4 All parts of the earthing terminal intended for the connection of external conductors shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor or any other metal in contact with these parts.

Parts providing earthing continuity, other than parts of a metal frame or enclosure shall be of coated or uncoated metal having adequate resistance to corrosion. If such parts are of steel, they shall be provided at the essential areas with an electroplated coating having a thickness of at least 5 µm.

Parts of coated or uncoated steel which are only intended to provide or to transmit contact pressure shall be adequately protected against rusting.

If the body of the earthing terminal is a part of a frame or enclosure of aluminium or aluminium alloy, precautions shall be taken to avoid the risk of corrosion resulting from contact between copper and aluminium or its alloys.

Compliance is checked by inspection and by measurement.

#### NOTES

1 Parts of copper or copper alloys containing at least 58% copper for parts that are worked cold and at least 50% copper for other parts and parts of stainless steel containing at least 13% chrome, are considered to be sufficiently resistant to corrosion.

2 Parts subjected to a treatment such as chromate conversion coating are in general not considered to be adequately protected against corrosion, but they may be used to provide or to transmit contact pressure.

3 Examples of parts providing earthing continuity and parts which are only intended to provide or to transmit contact pressure are shown in figure 14.

4 The essential areas of steel parts are, in particular, those transmitting current. In evaluating such areas, the thickness of the coating in relation to the shape of the part has to be taken into account. In case of doubt, the thickness of the coating is measured as described in ISO 2178 or in ISO 1463.

27.5 The connection between the earthing terminal or earthing contact and earthed metal parts shall have low resistance.

Compliance is checked by the following test.

A current derived from a source having a non-load voltage not exceeding 12 V (a.c. or d.c.) and equal to 1,5 times rated current of the appliance or 25 A, whichever is the greater, is passed between the earthing terminal or earthing contact and each of the accessible metal parts in turn.

The voltage drop between the earthing terminal of the appliance or the earthing contact of the appliance inlet and the accessible metal part is measured. The resistance calculated from the current and this voltage drop shall not exceed 0,1  $\Omega$ .

#### NOTES

1 In case of doubt, the test is carried out until steady conditions have been established.

2 The resistance of the supply cord is not included in the measurement.

3 Care is taken that the contact resistance between the tip of the measuring probe and the metal part under test does not influence the test results.

27.Z1 The printed conductors of printed circuit boards shall not be used to provide earthing continuity in hand-held appliances. They may be used to provide earthing continuity in other appliances if

- at least two tracks are used with independent soldering points and the appliance complies with the requirement of 27.5 for each circuit;
- the material of the printed circuit board complies with IEC 249-2-4 or IEC 249-2-5.

Compliance is checked by inspection and by the relevant tests.

28 Screws and connections

28.1 Fixings, the failure of which may impair compliance with this standard and electrical connections shall withstand the mechanical stresses occurring in normal use.

Screws used for these purposes shall not be of metal which is soft or liable to creep, such as zinc or aluminium. If they are of insulating material they shall have a nominal diameter of at least 3 mm and they shall not be used for any electrical connection.

Screws transmitting electrical contact pressure shall screw into metal.

Screws shall not be of insulating material if their replacement by a metal screw could impair supplementary insulation or reinforced insulation. Screws which may be removed when replacing a supply cord having a type X attachment or when undertaking user maintenance shall not be of insulating material if their replacement by a metal screw could impair basic insulation.

NOTE 1 - Electrical connections include earthing connections.

Compliance is checked by inspection.

The test is not carried out on screws and nuts transmitting contact pressure for earthing continuity provided at least two screws or nuts are used.

Screws and nuts transmitting contact pressure or which are likely to be tightened during user maintenance or installation are tested as follows.

The screws or nuts are tightened and loosened without jerking:

- 10 times for screws in engagement with a thread of insulating material;
- 5 times for nuts and other screws.

Screws in engagement with a thread of insulating material are completely removed and reinserted each time.

When testing terminal screws and nuts, a cable or flexible cord of the largest cross-sectional area specified in table 11 is placed in the terminal. It is repositioned before each tightening.

The test is made by means of a suitable screwdriver, spanner or key and by applying a torque as shown in table 12.

Column I is applicable for metal screws without heads if the screw does not protrude from the hole when tightened.

Column II is applicable

- for other metal screws and for nuts;
- for screws of insulating material
  - having a hexagonal head with the dimension across flats exceeding the overall thread diameter;
  - with a cylindrical head and a socket for a key, the socket having a cross-corner dimension exceeding the overall thread diameter;
  - with a head having a slot or cross slots, the length of which exceeds 1,5 times the overall thread diameter.

Column III is applicable for other screws of insulating material.

**Table 12 - Torque for testing screws and nuts**

Nominal diameter of screw (outer thread diameter) mm	Torque Nm		
	I	II	III
$\leq 2,8$	0,2	0,4	0,4
> 2,8 and $\leq 3,0$	0,25	0,5	0,5
> 3,0 and $\leq 3,2$	0,3	0,6	0,5
> 3,2 and $\leq 3,6$	0,4	0,8	0,6
> 3,6 and $\leq 4,1$	0,7	1,2	0,6
> 4,1 and $\leq 4,7$	0,8	1,8	0,9
> 4,7 and $\leq 5,3$	0,8	2,0	1,0
> 5,3	-	2,5	1,25

No damage impairing the further use of the fixings or electrical connections shall occur.

NOTES

1 Space-threaded (sheet metal) screws having a nominal diameter of 2,9 mm are considered to be equivalent to screws having a metric ISO thread of 3 mm diameter.

2 The shape of the blade of the screwdriver is to fit the head of the screw.

28.2 Electrical connections shall be constructed so that contact pressure is not transmitted through insulating material which is liable to shrink or to distort unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or distortion of the insulating material.

Compliance is checked by inspection.

NOTE - Ceramic material is not liable to shrink or to distort.

28.3 Space-threaded (sheet metal) screws shall not be used for the connection of current-carrying parts, unless they clamp these parts directly in contact with each other.

Thread-cutting (self-tapping) screws shall not be used for the electrical connection of current-carrying parts, unless they generate a full form standard machine screw thread. Such screws shall not be used if they are likely to be operated by the user or installer unless the thread is formed by a swaging action.

Thread-cutting and space-threaded screws may be used to provide earthing continuity, provided that it is not necessary to disturb the connection in normal use and that at least two screws are used for each connection.

This requirement does not apply to electrical connections in circuits carrying a current not exceeding 0,5 A.

Compliance is checked by inspection.

28.4 Screws and nuts which make a mechanical connection between different parts of the appliance shall be secured against loosening if they also make electrical connections or provide earthing continuity.

NOTES

- 1 This requirement does not apply to screws in the earthing circuit if at least two screws are used for the connection or if an alternative earthing circuit is provided.
- 2 Spring washers, lock washers and crown type locks as part of the screw head are means which may provide satisfactory security.
- 3 Sealing compound which softens on heating provides satisfactory security only for screw connections not subject to torsion in normal use.

Rivets used for electrical connections shall be secured against loosening if these connections are subject to torsion in normal use.

#### NOTES

- 4 This requirement does not imply that more than one rivet is necessary for providing earthing continuity.
- 5 A non-circular shank or an appropriate notch may be sufficient.

Compliance is checked by inspection and by manual test.

29 Creepage distances, clearances and distances through insulation

29.1 Creepage distances and clearances shall not be less than the values in millimetres shown in table 13.

If a resonant voltage occurs between the point where a winding and a capacitor are connected together and metal parts separated from live parts by basic Insulation only, creepage distances and clearances shall not be less than the values specified for the value of the voltage produced by the resonance, these values being increased by increased by 4 mm in the case of reinforced insulation.

Compliance is checked by measurement.

For appliances provided with an appliance inlet, the measurements are made with an appropriate connector inserted. For appliances with type X attachment other than those having a specially prepared cord, they are made with supply conductors of the largest cross-sectional area specified in table 11 and also without conductors. For other appliances, they are made on the appliance as delivered.

For appliances provided with belts, the measurements are made with the belts in place and any device intended for varying the belt tension adjusted to the most unfavourable position within its range of adjustment and also with the belts removed.

Movable parts are placed in the most unfavourable position. Nuts and screws with non-circular heads are assumed to be tightened in the most unfavourable position.

The clearances between terminals and accessible metal parts are also measured with the screws or nuts unscrewed as far as possible but the clearances shall then be not less than 50% of the values shown in table 13.

Distances through slots or openings in external parts of insulating material are measured to metal foil in contact with the accessible surface. The foil is pushed into corners and similar locations by means of the test finger of figure 1 but it is not pressed into openings.

If necessary, a force is applied to any point on bare conductors, other than those of heating elements, to any point on uninsulated metal capillary tubes of thermostats and similar devices and to the outside of metal enclosures, in an endeavour to reduce the creepage distances and clearances while taking the measurements.

The force is applied by means of the test finger of figure 1 and has a value of

- 2 N for bare conductors, uninsulated capillary tubes of thermostats, conductive hoses, metal foil within the appliance and similar parts.
- 30 N for enclosures.

#### NOTES

- 1 Methods of measuring creepage distances and clearances are indicated in annex E.
  - 2 For clearances are measured over barriers. If the barrier is in two parts which are not cemented together, creepage distances and clearances are measured through the joint.
  - 3 For appliances having parts with double insulation where there is no metal between basic insulation and supplementary insulation, the measurements are made as though there is metal foil between the two insulations.
  - 4 When assessing creepage distances and clearances, the effect of insulating linings of metal enclosures or covers is taken into consideration.
  - 5 Means provided for fixing the appliance to a support are considered to be accessible.
  - 6 The values specified in the table do not apply to cross-over points of motor windings.
- Z1 The values specified in the table do not apply to creepage distances and clearances over reinforced insulation of appliance outlets, provided that the distance is at least 5,7 mm.
- Z2 - Refer to the footnote\*.

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\*The following interpretation has been published by the IEC and accepted by CENELEC:

Notes to table 13; add the following text to notes 4 and 5:

The distance of 1,0 mm is allowed if the following two conditions are met:

- the insulating material at the end of the tubular sheathed element is track resistant (CTI > 250). This material could be the magnesium oxide powder or sealing material;
- the environment at the end of the tubular sheathed element is protected against the deposition of dirt by a cover. This cover is to be close to the end of the element but not necessarily in contact with it.
  - In general the enclosure of the appliance does not provide sufficient protection.
  - If a cap or a plug of ceramic or silicon rubber is fitted to the end of the element, the normal creepage distances and clearances apply to the outer surface of the cap or plug.

**Table 13 - Minimum creepage distances and clearances (in millimetres)**

Distances	Class III appliances and constructions		Other appliances					
			Working voltage $\leq 130$ V		Working voltage $> 130$ V and $\leq 250$ V		Working voltage $> 250$ V and $\leq 480$ V	
	Creepage distance	Clearance	Creepage distance	Clearance	Creepage distance	Clearance	Creepage distance	Clearance
Between live parts of different potential <sup>1)</sup>								
- if protected against deposition of dirt <sup>2)</sup>	1,0	1,0	1,0	1,0	2,0	2,0	2,0	2,0
- if not protected against deposition of dirt	2,0	1,5	2,0	1,5	3,0	2,5	4,0	3,0
- if lacquered or enamelled windings	1,0	1,0	1,5	1,5	2,0	2,0	3,0	3,0
- for positive temperature coefficient (PTC) resistors including their connecting res, if protected against position of moisture or dirt <sup>2)</sup>	-	-	1,0	1,0	1,0	1,0	-	-
Between live parts and other metal parts over basic insulation:								
- if protected against deposition of dirt <sup>2)</sup>						2,5 <sup>3)</sup>		
- if of ceramic, pure mica and similar materials	1,0	1,0	1,0	1,0	2,5 <sup>3)</sup>	2,5 <sup>3)</sup>	-	-
- if of other material	1,5	1,0	1,5	1,0	3,0	3,0	-	-
- if not protected against deposition of dirt	2,0	1,5	2,0	1,5	4,0	2,0	-	-
- if the live parts are lacquered or enamelled windings	1,0	1,0	1,5	1,5	2,0	2,0	-	-
- at the end of tubular sheathed heating elements	-	-	1,0	1,0	1,0 <sup>5)</sup>	1,0 <sup>4)</sup>	-	-
Between live parts and other metal parts over reinforced insulation:								
- if the live parts are lacquered or enamelled windings						6,0		
- for other live parts	-	-	6,0	6,0	6,0	8,0	-	-
Between metal parts separated by supplementary insulation	-	-	8,0	8,0	8,0	-	-	-
Between live parts in						-4,0		

recesses in the mounting face of the appliance and the surface to which it is fixed	-	-	4,0	4,0	-4,0	6,0	-	-
	2,0	2,0	6,0	6,0	6,0		-	-

Notes to table 13

- 1) The clearances specified do not apply to the air gap between the contacts of automatic controls, switches of micro-gap construction and similar devices or to the air gap between the current-carrying members of such devices where the clearance varies with the movement of the contacts.
- 2) In general, the interior of an appliance having a reasonably dust-proof enclosure is considered to be protected against deposition of dirt, provided the appliance does not generate dust within itself; hermetic sealing is not required.
- 3) If the parts are rigid and located by mouldings or if the construction is such that there is no likelihood of the distance being reduced by distortion or movement of the parts, this value may be reduced to 2,0 mm.
- 4) If protected against deposition of dirt.
- 5) If over ceramic, pure mica and similar materials, protected against deposition of dirt.

For conductive patterns on printed circuit boards, except at their edges, the values in the table between parts of different potential may be reduced as long as the peak value of the voltage stress does not exceed

- 150 V per mm with a minimum distance of 0,2 mm, if protected against the deposition of dirt;
- 100 V per mm with a minimum distance of 0,5 mm, if not protected against the deposition of dirt.

For peak voltages exceeding 50 V, the reduced creepage distances only apply if the proof tracking index (PTI) of the printed circuit board is greater than 175 when measured in accordance with annex N.

These distances may be reduced further provided that the appliance complies with the requirements of clause 19 when the distances are short-circuited in turn.

NOTE 7 - When the limits specified above lead to higher values than those of the table, the values of the table apply.

Creepage distances and clearances within optocouplers are not measured.

For live parts of different potential separated by basic insulation only, creepage distances and clearances smaller than those specified in the table are allowed provided the requirements of clause 19 are met if these creepage distances and clearances are short-circuited in turn.

29.2 The distance through insulation between metal parts for working voltages up to and including 250 V shall not be less than 1,0 mm if they are separated by reinforced insulation.

Compliance is checked by inspection and by measurement.

## NOTES

1 This does not imply that the distance has to be through solid insulation only. The insulation may consist of solid material plus one or more air layers.

2 For appliances having parts with double insulation where there is no metal between basic insulation and supplementary insulation, the measurements are made as though there is a metal foil between the two insulations.

29.2.1 This requirement does not apply if the insulation is applied in thin sheet form, other than mica or similar scaly material and

- for supplementary insulation, consists of at least two layers, provided that each of the layers withstands the electric strength test of 16,3 for supplementary insulation;
- for reinforced insulation, consists of at least three layers, provided that any two layers together withstand the electric strength test of 16,3 for reinforced insulation.

Compliance is checked by inspection.

29.2.2 This requirement also does not apply if the supplementary insulation or the reinforced insulation is inaccessible and meets one of the following conditions:

- the maximum temperature rise determined during the tests of clause 19 does not exceed the value specified in 11.8;
- the insulation, after having been conditioned 168 h in an oven maintained at a temperature equal to 50 K in excess of the maximum temperature rise determined during the tests of clause 19, withstands the electric strength test of 116,3, this test being made on the insulation both at the temperature occurring in the oven and after cooling to approximately room temperature.

Compliance is checked by inspection and by test.

For optocouplers the conditioning procedure is carried out at a temperature of 50 K in excess of the maximum temperature rise measured on the optocoupler during the tests of clauses 11 or 19, the optocoupler being operated under the most unfavourable conditions which occur during these tests.

30 Resistance to heat, fire and tracking

NOTE - appendix H shows the selection and sequence of the tests of this clause.

30.1 External parts of non-metallic material, parts of insulating material supporting live parts including connections and parts of thermoplastic material providing supplementary insulation or reinforced insulation, the deterioration of which might cause the appliance to fail to comply with this standard, shall be sufficiently resistant to heat.

Compliance is checked by subjecting the relevant part to the ball-pressure test made by means of the apparatus shown in figure 12.

Before starting the test, the part is maintained for 24 h in an atmosphere having a temperature between 15°C and 35°C and a relative humidity between 45% and 75%.

The part is supported so that its upper surface is horizontal and the spherical part of the apparatus is pressed against this surface with a force of 20 N. The thickness of the part under test shall be at least 2,5 mm.

NOTE 1 - If necessary, the required thickness may be obtained by using two or more sections of the part.

The test is made in a heating cabinet at a temperature of  $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$  plus the maximum temperature rise determined during the test of clause 11, but it shall be at least:

- for external parts  $75^{\circ}\text{C} \pm 2^{\circ}\text{C}$
- for parts supporting live parts  $125^{\circ}\text{C} \pm 2^{\circ}\text{C}$

However, for parts of thermoplastic material providing supplementary insulation or reinforced insulation, the test is made at a temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  plus the maximum temperature rise determined during the tests of clause 19, if this is higher. The temperature rises of 19.4 are not taken into account provided the test of 19.4 is terminated by the operation of a non-self-resetting protective device and it is necessary to remove a cover or to use a tool to reset it.

Before the test is started, the test apparatus is brought to the temperature determined above.

After 1 h the apparatus is removed and the part is immediately immersed in cold water so that it is cooled to approximately room temperature within 10 s. The diameter of the impression shall not exceed 2 mm.

#### NOTES

- 2 For coil formers, only those part which support or retain terminals in position are subjected to the test.
- 3 The test is not made on parts of ceramic material.

30.2 Parts of non-metallic material shall be resistant to ignition and spread of fire.

This requirement does not apply to decorative trims, knobs and other parts not likely to be ignited or to propagate flames originating from inside the appliance.

Compliance is checked by the tests of 30.2.1, 30.2.4 and either 30.2.2 or 30.2.3 as applicable.

30.2.1 Separately moulded samples of the relevant parts are subjected to the burning test of annex J. However, instead of the burning test, the glow-wire test of annex K is made at a temperature of  $550^{\circ}\text{C}$  on corresponding parts of the appliance if

- separately moulded samples are not available;
- there is no evidence that the material withstands the burning test;
- the separately moulded samples do not withstand the burning test.

30.2.2 For appliances which are operated while attended, parts of insulating material supporting connections which carry a current exceeding 0,5 A during normal operation, are subjected to the glow-wire test of annex K, the test being made at a temperature of  $650^{\circ}\text{C}$ . This test is also carried out on parts in contact with, or in close proximity to, such connections.

This test is not made on hand-held appliances, on appliances which have to be kept switched on by hand or foot and on appliances which are continuously loaded by hand.

#### NOTES

- 1 The test is not carried out on parts supporting welded connections.
- 2 "In close proximity" is considered to be a distance not exceeding 3 mm.

30.2.3 For other appliances, connections supported by parts of insulating material and which carry a current exceeding 0,5 A during normal operation, are subjected to the bad-connection test of annex L. If

this test cannot be made due to the design of the connection, the parts of insulating material supporting the connection are subjected to the glow-wire test of annex K, the test being made at a temperature of 850°C. In this case, the test is also carried out on parts in contact with, or in close proximity to, the connection.

#### NOTES

1 The test is not carried out on parts supporting welded connections.

2 “In close proximity” is considered to be a distance not exceeding 3 mm.

NOTE 3 - Parts likely to be impinged upon by the flame are considered to be those within the envelope of a vertical cylinder having a radius of 10 mm and a height equal to the height of the flame, positioned above the point of application of the glow-wire.

30.2.4 If the parts do not withstand the test of 30.2.2 or 30.2.3, the needle-flame test of annex M is made on all other parts of non-metallic material which are within a distance of 50 mm. However, parts shielded by a separate barrier which meets the needle-flame test are not tested.

The needle-flame test is not carried out on parts which are made of material classified as FV-0 or FV-1 according to IEC 707. The sample of material submitted to the test of IEC 707 shall be no thicker than the relevant part.

30.3 Insulating material across which a tracking path may occur shall have adequate resistance to tracking, taking into account the severity of the duty conditions.

A tracking path is liable to occur

- between live parts of different potential;
- between live parts and earthed metal parts;
- across insulating material of commutators and brush-caps.

Compliance is checked by the proof tracking test of annex N.

Parts of insulating material used under normal duty conditions and parts of ceramic material are not tested.

The test voltage is 175 V for parts of insulating material used under severe duty conditions. If the material does not withstand this test and there is no hazard other than fire, surrounding parts are subjected to the needle-flame test of annex M.

The test voltage is 250 V for parts of insulating material used under extra-severe duty conditions. If the material does not withstand this test, but withstands the test with a test voltage of 175 V and there is no hazard other than fire, the surrounding parts are subjected to the needle-flame test of annex M.

The needle-flame test is not carried out on parts which are made of material classified as FV-0 or FV-1 according to IEC 707. The sample of material submitted to the test of IEC 707 shall be no thicker than the relevant part.

#### NOTES

1 The needle-flame test is made on parts of non-metallic material within a distance of 50 mm from any place where a tracking path could occur. However parts shielded by a separate barrier which meets the needle-flame test are not tested.

2 The severity of the duty conditions of insulating material is given in annex P.

31 Resistance to rusting

Ferrous parts, the rusting of which might cause the appliance to fail to comply with this standard, shall be adequately protected against rusting.

NOTE - Tests are specified in part 2 when necessary.

32 Radiation, toxicity and similar hazards

Appliance shall not emit harmful radiation or present a toxic or similar hazard.

NOTE - Tests are specified in part 2 when necessary.

## **Annex A**

### **Normative references**

#### **International publication with their relevant European publication**

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<b>IEC standard</b>	<b>Year</b>	<b>Title</b>	<b>EN/HD</b>	<b>Year</b>
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15-2	1984	Direct acting indicating analogue electrical measuring instruments and their accessories Part 2: Special requirements for ammeters And voltmeters	EN 60051-2	1989
61-1 (mod)	1969	Lamp caps and holders together with gauges for the control of interchangeability and safety Part 1: Lamp caps	EN 60061-1 <sup>1)</sup>	1993
65 (mod)	1985	Safety requirements for mains operated electronic and related apparatus for household and similar general use	EN 60065 <sup>2)</sup>	1993
68-2-63	1991	Environmental testing – Part 2: Test methods Test Eg: Impact, spring hammer	EN 60068-2-63	1994
83	1975	Plugs and socket-outlets for domestic and similar general use – Standards	-	-
85	1994	Thermal evaluation and classification of electrical insulation	HD 566 S1	1990
112	1979	Method for determining the comparative and proof tracking indices of solid insulating materials under moist conditions	HD 214 S2	1980
127	Series	Cartridge fuse-links for miniature fuses	EN 60127	Series
227 (mod)	Series	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V	HD 21	Series
245 (mod)	Series	Rubber insulated cables of rated voltage up to and including 450/750 V	HD 22	Series
249-2-4	1987	Base materials for printed circuits Part 2: Specifications Specification No. 4: Epoxide woven glass fabric copper-clad laminated sheet, general purpose grade	EN 60249-2-4 <sup>3)</sup>	1994
249-2-5	1987	Specification No. 5: Epoxide woven glass fabric copper-clad laminated sheet of defined flammability (vertical burning test)	EN 60249-2-5 <sup>4)</sup>	1994

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1) EN 60061-1 includes supplements A: 1970 to N: 1992 to IEC 61-1.

2) EN 60065 includes A1: 1989 + A2: 1989 + A3: 1992 to IEC 65.

3) EN 60249-2-4 includes A2: 1992 to IEC 249-2-4.

4) EN 60249-2-5 includes A2: 1992 to IEC 249-2-5.

## **Annex C (normative)**

### Ageing test on motors

This test may be carried out when there is doubt with regard to the classification of the insulating system of a motor winding, for example:

- when well-known insulating materials are used in an unconventional way;
- where combinations of materials of different temperature classes are used at a temperature higher than that allowed for the lowest class used;
- when materials are used for which sufficient experience is not available, for instance in motors having integral core insulation.

This test is made on 6 samples of the motor.

The rotor of each motor is locked and a current is passed individually through the rotor winding and stator winding, this current being such that the temperature of the relevant winding is equal to the maximum

temperature rise measured during the test of clause 11 increased by 25 K. This temperature is further increased by one of the values chosen from the following table. The corresponding total time during which the current is passed is indicated in the table.

Temperature increase K	Total time H
0 ± 3	p <sup>1)</sup>
10 ± 3	0,5 p
20 ± 3	0,25p
30 ± 3	0,125p
<sup>1)</sup> p is 8 000 unless otherwise specified in the part 2.	

NOTE 1 - The temperature increase chosen is to be agreed by the manufacturer.

The total time is divided into four equal periods, each of them being followed by a period of 48 h during which the motor is subjected to the humidity test of 15.3. After the final humidity test, the insulation shall withstand the electric strength test of 16.3, the test voltage being, however, reduced to 50% of the value specified in item 1 of table 5.

After each of the four periods and before the subsequent humidity test, the leakage current of the insulating system is measured as specified in 13.2, any component not forming part of the insulation system under test being disconnected before the measurement is made.

The leakage current shall not exceed 0,5 mA.

Failure of only one of the six motors during the first of the four periods of the test is ignored.

If one of the six motors fails during the second, third or fourth period of the test, the remaining five motors are subjected to a fifth period followed by the humidity test and the electric strength test.

The remaining five motors shall complete the test.

NOTE 2 - In order to verify that the insulation system is within the temperature class claimed by the manufacturer, the winding temperature for the test is to be equal to the temperature limit for the class of insulation, increased by the temperature increase chosen from the table.

## **Annex D**

- **Void** -

## **Annex E** (normative)

### Measurement of creepage distances and clearances

The methods of measuring creepage distances and clearances which are specified in 29.1 are indicated in cases 1 to 10.

These cases do not differentiate between gaps and grooves or between types of insulation.

The following assumptions are made:

- a groove may have parallel, converging or diverging sides;
- any groove having diverging sides, a minimum width exceeding 0,25 mm, a depth exceeding 1,5 mm and a width at the bottom equal to or greater than 1 mm, is regarded as an air gap, the creepage path following the contour of the groove (case 8);
- any corner including an angle less than 80° is assumed to be bridged with an insulating link of 1 mm width (0,25 mm for when protection against deposition of dirt is provided) moved into the most unfavourable position (case 3);
- where the distance over the top of a groove is 1 mm (0,25 mm when protection against deposition of dirt is provided) or more, the creepage path follows the contour of the groove (case 2);
- creepage distance and clearances measured between parts moving relative to each other are measured when these parts are placed in their most unfavourable stationary positions;
- any air gap less than 1 mm wide (0,25 mm when protection against deposition of dirt is provided) is ignored in computing the total creepage distance.

## Annex F (normative)

Motor not isolated from the supply mains and having basic insulation not designed for the rated voltage of the appliance

### F.1 Scope

This annex applies to motors having a working voltage not exceeding 42 V and not isolated from the supply mains and having basic insulation not designed for the rated voltage of the appliance.

All clauses of this standard apply to these motors, unless otherwise specified in this annex.

### F.8 Protection against access to live parts

F.8.1 NOTE – Metal parts of the motor are considered to be bare live parts.

### F.11 Heating

F.11.3 The temperature rise of the body of the motor is determined instead of the temperature rise of the windings.

F.11.8 The temperature rise of the body of the motor, where it is in contact with insulating material, shall not exceed the values shown in table 3 for the relevant insulating material.

F.16 Leakage current and electric strength

F.16.3 The insulation between live parts of the motor and its other metal parts is not subjected to this test.

F.19 Abnormal operation

F.19.1 The tests of 19.7 to 19.9 are not made.

Appliances are also subjected to the test of F.19.101.

F.19.101 The appliance is operated at rated voltage with each of the following defects:

- short circuit of the terminals of the motor, including any capacitor incorporated in the motor circuit;
- open circuit of the supply to the motor;
- open circuit of any shunt resistor during operation of the motor.

Only one defect is simulated at a time, the tests being made consecutively.

F.22 Construction

F.22.101 For class I appliances incorporating a motor supplied by a rectifier circuit, the d.c. circuit shall be insulated from accessible parts of the appliance by double insulation or reinforced insulation.

Compliance is checked by the tests specified for double insulation and reinforced insulation.

F.29 Creepage distances, clearances and distances through insulation

F.29.1 NOTE – The values specified in table 13 do not apply to distances between live parts of the motor and its other metal parts.

Annex G  
(normative)

Circuit for measuring leakage currents

A suitable circuit for measuring leakage currents is shown in figure G.1.

The circuit comprises a rectifier with germanium diodes D and a moving-coil meter M, resistors and a capacitor C for adjusting the characteristics of the circuit, and a “make-before-break” switch S for adjusting the current range of the instrument.

The measuring circuit has a total resistance of  $1\,750\ \Omega \pm 250\ \Omega$  and is shunted by a capacitor such that the time constant of the circuit is  $225\ \mu\text{s} \pm 15\ \mu\text{s}$ .

The most sensitive range of the complete instrument is not to exceed 1,0 mA, higher ranges being obtained by shunting the coil of the meter by non-inductive resistors  $R_s$  and simultaneously adjusting the series resistors  $R_v$  so as to maintain the total resistance  $R_1 + R_v + R_m$  of the circuit at the value specified.

The basic calibration points, at a sinusoidal frequency of 50 Hz or 60 Hz, are 0,25 mA, 0,5 mA and 0,75 mA.

#### NOTES

- 1 The circuit may be protected against overcurrents but the method chosen is not to affect the characteristics of the circuit.
- 2 The resistance  $R_m$  is calculated from the voltage drop measured across the rectifier arrangement at 0,5 mA, the resistance  $R_v$  being then adjusted to give the total resistance of the circuit for each range.
- 3 Germanium diodes are used since they have a lower voltage drop than other types of diode, resulting in a more linear scale, preference being given to gold bonded types. The rating of the diodes has to be chosen to suit the desired maximum range of the complete instrument. However, this range must not exceed 25 mA since diodes suitable for higher currents have a high voltage drop.
- 4 It is recommended that the switch is arranged so that it automatically returns to the position giving the highest current range, in order to prevent inadvertent damage to the instrument.
- 5 The capacitor may be constructed by selecting capacitors having preferred values and using a series/parallel arrangement.

**Annex J**  
(normative)

**Burning test**

The burning test is made in accordance with IEC 707.

For the purpose of this standard, method FH: Flame-Horizontal specimen, is used.

For the evaluation of the test results, category FH3 applies, the maximum burning rate being 40 mm/min.

If more than one specimen does not withstand the test, the test is repeated on another set of five specimens, all of which shall then withstand the test.

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**Annex K**  
(normative)

**Glow-wire test**

The glow-wire test is made in accordance with IEC 695-2-1.

For the purpose of this standard, the following applies.

4 Description of test apparatus

The last paragraph before the note is replaced by:

In cases where burning or glowing particles might fall from the specimen onto an external surface underneath the appliance, the test is made with a piece of white pine-wood board, approximately 10 mm thick and covered with a single layer of tissue paper, positioned at a distance of  $200 \text{ mm} \pm 5 \text{ mm}$  below the place where the tip of the glow-wire is applied to the specimen. If the appliance as a whole is tested, it is placed in its normal position of use above the pine-wood board which is covered with a single layer of tissue paper. Before starting the test, the board is conditioned as described in clause 7 for the specimen.

5 Severities

The duration of application of the tip of the glow-wire to the specimen is  $30 \text{ s} \pm 1 \text{ s}$ .

9 Observations and measurements

Item c) does not apply.

**Annex L**  
(normative)

### Bad-connection test with heaters

The bad-connection test with heaters is made in accordance with IEC 695-2-3.

For the purpose of this standard, the following applies.

#### 3 General description of the test

Add the following:

Crimped connection are not subjected to the test if

- a bad connection cannot give rise to a fire hazard;
- the continuous current is less than 0,5 A;
- the conductors are chosen in accordance with the following table and are used together with the current matching connector:

Continuous current A	Cross-sectional area mm <sup>2</sup>	
	a	b
≥ 0,5 and ≤ 4,0	-	0,5
> 4,0 and ≤ 6,0	0,75	1,0
> 6,0 and ≤ 10,0	1,0	1,5
> 10,0 and ≤ 16,0	1,5	2,5
> 16,0 and ≤ 25,0	2,5	4,0
Column a applies to tinned stranded connectors Column b applies to other stranded connectors		

Crimped connections are not considered to give rise to a fire hazard if the insulation which retains the connections withstands the glow-wire test of annex K at the test temperatures specified in 30.2.2 or 30.2.3 as applicable

Sleeves on the ends of stranded conductors intended for insertion into screw terminals are not regarded as crimped connections.

When establishing the value of the continuous current, in –rush currents are disregarded.

#### 4 Description of test apparatus

The last paragraph concerning the evaluation of the possibility of spread of fire including the three dashed paragraphs and the first paragraph of the note are replaced by:

In cases where burning or glowing particles might fall from the specimen onto an external surface underneath the appliance, the test is made with a piece of white pine-wood board, approximately 10 mm thick and covered with a single layer of tissue paper, positioned at a distance of  $200 \text{ mm} \pm 5 \text{ mm}$  below the place where the test heater is applied to the specimen. If the appliance as a whole is tested, it is placed in its normal position of use above the pine-wood board which is covered with a single layer of tissue paper. Before starting the test, the board is conditioned as described in clause 6 for the specimen.

5 Severities

The duration of application of the test power is  $30 \text{ min} \pm 1 \text{ min}$ .

8 Test procedure

Replace subclause 8.6 by:

The test is made on one specimen. If the specimen does not withstand the test, the test is repeated on two further specimens, both of which shall then withstand the test.

10 Information to be given in the relevant specification

The first dashed paragraph under item h) does not apply.

---

Annex M  
(normative)

**Needle-flame test**

The needle-flame test is made in accordance with IEC 695-2-2.

For the purpose of this standard, the following applies.

4 Description of the apparatus

The sixth paragraph is replaced by:

In cases where burning or glowing particles might fall from the specimen onto an external surface underneath the appliance, the test is made with a piece of white pine-wood board, approximately 10 mm thick and covered with a single layer of tissue paper, positioned at a distance of  $200 \text{ mm} \pm 5 \text{ mm}$  below the place where the test flame is applied to the specimen. If the appliance as a whole is tested it is placed in its normal position of use above the pine-wood board which is covered with a single layer of tissue paper. Before starting the test, the board is conditioned as described in clause 6 for the specimen.

5 Severities

The duration of application of the test flame is  $30 \text{ s} \pm 1 \text{ s}$ .

8 Test procedure

8.4 In the first paragraph the words “or from any source of ignition accidentally applied” do not apply.

Replace the last two paragraphs by:

At the beginning of the test, the test flame is applied in such a way that at least the tip of the flame is in contact with the surface of the specimen.

During the application of the test flame the burner is not to be moved. The test flame is removed immediately after the specified period has elapsed. For examples of test positions, see figure 1.

Replace subclause 8.5 by:

The test is made on one specimen. If the specimen does not withstand the test, the test is repeated on two further specimens, both of which shall then withstand the test.

10 Evaluation of test results

Add:

When a layer of tissue paper is used, there is to be no ignition of the tissue paper or scorching of the white pine-wood board, a slight discoloration of the white pine-wood board being neglected.

---

**Annex N**  
(normative)

**Proof tracking test**

The proof tracking test is made in accordance with IEC 112.

For the purpose of this standard, the following applies.

**3** Test specimen

The last sentence of the first paragraph does not apply.

**5** Test apparatus

The note in subclause 5.3 does not apply and the test solution A described in subclause 5.4 is used.

**6** Procedure

The voltage referred to in subclause 6.1 is adjusted to 175 V or 250 V as appropriate.

Subclause 6.2 does not apply and the proof tracking test of subclause 6.3 is made five times. For the latter test, notes 2 and 3 of clause 3 also apply.

---

**Annex P**  
(normative)

**Severity of duty conditions of insulating material  
with respect to the risk of tracking**

The severity of the duty conditions of insulating material with respect to the risk of tracking depends upon the rate of accumulation of any conductive deposit and upon the period of time during which the insulating material is subjected to electrical stress.

For the purpose of the requirement, the following duty conditions are recognized.

1. Normal duty conditions: there is virtually no deposition of conductive material and a long period of electrical stress or a light deposition of conductive material and a short period of electrical stress.

The insulating materials used in motors which produce carbon dust or in switching devices which are subject to deposition of conductive material.

The insulating materials used in motors which produce carbon dust or in switching devices which are subject to deposition of conductive material but withstand the relevant electric strength test after an appropriate endurance test, are considered to be subject to a light deposition of conductive material.

Insulating materials having a proof tracking index below 175 are considered to be adequate for use under normal duty conditions.

2 Severe duty conditions: there is a light deposition of conductive material and a long period of electrical stress or a heavy deposition of conductive material and a short period of electrical stress.

The insulating materials used in heating appliances where air from household premises is caused to blow over these materials, for example in fan heaters, are considered to be subject to a light deposition of conductive material and a long period of electrical stress.

3. Extra-severe duty conditions: there is a heavy deposition of conductive material and a long period of electrical stress or an extra-heavy deposition of conductive material and a short period of electrical stress.

Examples of insulating materials used under extra-severe duty conditions are:

- insulating materials used for those parts of a refrigerator which are subject to condensation or to heavy deposition of conductive material, the refrigerator being on circuit continuously for a very long period;
- insulating materials used for those parts of a washing machine or a dishwasher which are subject to pollution by detergents and to a short period of electrical stress.

NOTE - A long period of electrical stress is considered to exist between live parts of different potential and between live parts and earthed metal parts in the case of:

- appliances intended for continuous operation;
- the input side of the supply switch of appliances not intended for continuous operation;
- appliances provided with a single-pole switch or similar device and connected to the supply by a non-polarized plug.

If there is no single-pole switch, it is assumed that appliances not intended for continuous operation are disconnected in all poles from the supply by means of a switch in the fixed wiring or a plug and therefore a long period of electric stress will not occur.

---

Annex ZA (normative)

**Special national conditions**

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions. If it affects harmonization, it forms part of the European Standard.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

Clause      Special national condition

7.12Denmark

Supply cords of class I appliances, which are supplied without a plug, shall be provided with a visible tag containing the following text:

Important!

The conductor having green/yellow insulation shall only be connected to a terminal marked                      or

If it is essential for the safety of the appliance, the tag shall be provided either with a wiring diagram showing the connection of the other conductors or with the following text:

For the connection of the other conductors, see the enclosed instructions for installation.

19.5 Norway

The test is also applicable to appliances intended to be permanently connected to fixed wiring.

SPECIAL NATIONAL CONDITIONS (continued)

19.11.2 Austria

An appliance having circuits which may cause, under fault conditions, an earth-leakage current having a d.c. component exceeding 5 mA and exceeding 20% of the total earth-leakage current shall be

- constructed so that this current can arise only when an insulation fault equivalent to failure of double insulation or reinforced insulation occurs, or
- provided with instructions giving the necessary information with regard to the required type of residual current device.

22.2 France and Norway

The second paragraph of this subclause dealing with single-phase class I appliances with heating elements is not applicable due to the supply system.

25.6 Plugs according to standard sheet C 2b are not allowed in Belgium, France, Greece and the United Kingdom.

Plugs according to standard sheet C 3b are not allowed in Austria, Finland, Germany, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Denmark

Replace the common modification by the following:

Supply cords of single-phase portable appliances having a rated current not exceeding 10 A shall be provided with a plug according to the following:

- Class I appliances ..... Section 107-2-D1,  
Standard Sheet  
DK 2-1a

For appliances covered by a part 2 of EN 60335, it is also allowed until further notice, and unless otherwise specified, to use plugs in accordance with IEC 83, Standard Sheet C 2b, C 3b or C 4 (See also the table).

- Class II appliances ..... IEC 83,  
Standard Sheet  
C 5 or C 6

If stationary single-phase appliances having a rated current not exceeding 10 A are provided with a supply cord and a plug, the plug shall be in accordance with the requirement specified above.

SPECIAL NATIONAL CONDITIONS (end)

If multi-phase appliances and single-phase appliances having a rated current exceeding 10 A are provided with a supply cord and a plug, the plug shall comply with the following table:

Class	Plug**	
	Section 107-2-D1 Standard sheet	EN 60309-2 Standard sheet
I	DK 6-1a	2-II, 2-IV
II	DK 6-1a*	2-II, 2-IV*

\* Earthing contact not connected  
 \*\* These plugs are also allowed for appliances having a rated current equal to or less than 10 A

#### Ireland

Only plugs according to standard sheets B1 (15 A), B2 and C2b are allowed.

#### Spain

For appliances having a rated current not exceeding 6A, plugs complying with standard UNE 20 315 are allowed, the figures to be applied being

- for class I appliances, figure 7C;
- for class II appliances, figure 15A.

For class I appliances having a rated current not exceeding 16 A, plugs complying with standard UNE 20 315 figure 7B are allowed.

#### Switzerland

Supply cords of single-phase portable appliances having a rated current not exceeding 10 A, shall be provided with a plug complying with SEV/ASE 1011.

#### United Kingdom

Only plugs according to standard sheets B2 and C5 are allowed (refer to annex ZB)

#### 25.8 Ireland and United Kingdom

Replace in the table the line with “> 10 and ≤ 16 1,5” by:

- > 10 and ≤ 13 1,25
- > 13 and ≤ 16 1,5.

Annex ZB (informative)

#### A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC member.

This European Standard falls under Directive 73/23/EEC.

NOTE (from CEN/CENELEC IR Part 2, 3.1.9): Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ No C 59, 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with

A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

<u>Clause</u>	<u>Deviation</u>						
3	<p>Switzerland (Ordinance relating to Environmentally Hazardous Substances, SR 814.013 of 1986-06-09, Annex 4.10)</p> <p>Carbon-zinc batteries shall not be imported as commercial goods or supplied by a manufacturer unless they contain no more cadmium and mercury than is necessary in accordance with the state of the art, but not exceeding a total of 250 mg per kilogram of battery.</p> <p>Alkali-manganese batteries shall not be imported as commercial goods or supplied by a manufacturer unless they contain no more mercury than is necessary in accordance with the state of the art, but not exceeding 10 g per kilogram zinc.</p>						
7.1	<p>Italy (Statutory Instruments No. 105 of 1949)</p> <p>The voltage is 220 V/380 V.</p> <p>Spain (Low voltage electrotechnical regulation, Decree 2413/1973-09-20)</p> <p>The voltages are 127 V/220 V and 220 V/380 V.</p> <p style="text-align: center;">A-DEVIATIONS (end)</p> <p>Sweden (Governmental ordinance, SFS 1989:874)</p> <p>Appliances provided with built-in batteries not replaceable by the user shall be marked with the following symbol if the batteries have a content of mercury or cadmium, exceeding 0,025% by mass.</p>						
7.12	<p>Ireland (Statutory Instrument No. 222 of 1969)</p> <p>All class I appliances suitable for domestic use that are fitted with a supply cord containing three cores, one of which is an earthing conductor, shall have attached to that cord a label with the following wording:</p> <p><b>IMPORTANT</b> The wires in this mains lead are coloured in accordance with the following code:</p> <table><tbody><tr><td>Green and Yellow</td><td>-Earth,</td></tr><tr><td>Blue</td><td>-Neutral</td></tr><tr><td>Brown</td><td>-Live.</td></tr></tbody></table>	Green and Yellow	-Earth,	Blue	-Neutral	Brown	-Live.
Green and Yellow	-Earth,						
Blue	-Neutral						
Brown	-Live.						
22.22	<p>Germany (Verordnung Vom 1993-03-25 zum 17 des Chemikaliengesetzes)</p> <p>Asbestos shall not exceed 0,1% of the mass of material containing asbestos</p> <p>Finland (Decision of the Council of State No 852/92)</p> <p>Certain types of asbestos shall not be used.</p>						

- 24 Sweden (Ordinance 1991:1290)  
Components containing mercury such as thermostats, relays and level controllers are not allowed.
- 25.6 United Kingdom (Statutory Instrument 1994 No 1768)  
These regulations apply to all plugs for domestic use at a voltage of not less than 200 V and in general allows only plugs to BS 1363 to be fitted to domestic appliances. It also allows plugs to BS 4573 and standard sheet C5 to be fitted to shavers and toothbrushes.

#### **Annex ZC (normative)**

#### **Capacitors**

The following clauses and subclauses of IEC 384-14 apply to capacitors likely to be permanently subjected to the supply mains voltage and used for radio interference suppression or for voltage dividing, with the following modifications.

#### **SECTION ONE - GENERAL**

- 4 Terminology
- 4.3 This subclause is applicable.  
Capacitors of Class X are tested as capacitors of Class X2.
- 4.4 This subclause is applicable.

#### **SECTION TWO – PREFERRED RATINGS AND CHARACTERISTICS**

- 6 Marking
- 6.1 Items a) and b) of this subclause are applicable.

#### **SECTION THREE - REQUIREMENTS**

- 8 Schedules for qualification approval tests
- 8.1 Table II, group 0, group 2 and group 3 are applicable as follows:
- group 0: subclauses 10.1, 10.2, 11.1 and 11.3
  - group 2: subclauses 12.10
  - group 3: subclauses 12.11
- 10 Visual examination and check of dimensions
- 10.1 This subclause is applicable.
- 10.2 This subclause is applicable for the marking required by 6.1 a) and b).
- 11 Electrical tests

11.1 This subclause is applicable.

11.2 In this subclause only “Table VI” applies and the climatic category is ----/----/21. The values for test A apply. However for capacitors in heating appliances the values for test B and C apply.

12 Environmental test

12.10 This subclause is applicable.

NOTE: Only insulation resistance and voltage proof are checked (see table X).

12.11 This subclause is applicable together with its subclauses 12.11.2 and 12.11.6 modified as follows:

Add before the first paragraph:

Capacitors are subjected to an impulse voltage test if they are incorporated:

- in appliances liable to be operated while unattended;
- in other appliances where they are liable to remain under electric stress while the on-off switch or control is in the off position, irrespective of the position of the plug in the socket outlet.

The wave form of the impulse is 1,2/50 with a peak value of 2,5 kV. Alternatively, the test may be carried out with an impulse voltage having any front time but with a time to half value not exceeding 100 µs.

The peak value of the impulse voltage is adjusted by a suitable means such as an impulse proof capacitor of low inductance and having a capacitance similar to that of the capacitor under test.

The impulse voltage is applied 3 times with at least 1 s between the impulses.

There shall be no flash-over and no visible damage

NOTE: When capacitors are used for voltage dividing purposes, the impulse voltage is applied to the terminals of the appliance.

12.11.6 Add:

NOTE: Only insulation resistance and voltage proof are checked (see table XI) together with a visual examination to ensure that there is no visible damage.

## Annex ZD (normative)

### **Safety isolating transformers**

Safety isolating transformers which are tested with the appliance shall comply with this standard and the following additional requirements.

7. Marking and instructions

7.1 Transformers for specific use shall be marked with:

- name, trademark or identification mark of the manufacturer or responsible vendor;;
- model or type reference

NOTE: The definition of transformers for specific use is given in EN 60742

17 Overload protection of transformers and associated equipment

The temperature limits specified for the windings do not apply to fail-safe transformers. However, such transformers shall comply with subclause 14.5 of EN60742.

NOTE: The definition of fail-safe transformers is given in EN 60742.

23 Construction

22.501 Subclause 8.6 of EN 60742 is applicable.

29 Creepage distances, clearances and distances through insulation

29.1 The distances specified in table XV of EN 60742 items 1a, 1c and 2 apply.

NOTE: The values stated for normal pollution are applicable.

## Annex ZE (normative)

### Switches

Switches which are tested with the appliance shall comply with this standard and with the following clauses of IEC 1058-1, as modified:

The tests of IEC 1058-1 are carried out under the conditions occurring in the appliance. Unless otherwise specified, the tests are carried out on the switch incorporated in the appliance.

Before being tested in the appliance, switches are operated 20 times without load.

8 Marking and documentation

Switches are not required to be marked except that incorporated switches shall be marked with the manufacturer's name or trade mark and the type reference.

NOTE - An incorporated switch is a switch which can be tested separately from the appliance.

13 Mechanism

This clause is applicable.

NOTE - The tests may be carried out on a separate sample.

15 Insulation resistance and dielectric strength

15.1 and 15.2 are not applicable.

15.3 is applicable for full disconnection and micro-disconnection.

NOTE - This test is carried out immediately after the humidity test of 15.3 of EN 60335-1.

17 Endurance

This clause is applicable.

Compliance is checked on three separate appliances or switches.

At the end of the tests, the temperature rise of the terminals shall not have increased by more than 30 K.

NOTE - The text of the second dashed item of 17.3 is deleted.

**20 Clearances, creepage distances and distances through insulation**

This clause is applicable for creepage distances and clearances for live parts of different potential only, as stated in table 18 for operational insulation and across full disconnection and micro-disconnection.

**Annex ZF (informative)**

**IEC and CENELEC code designations for flexible cords**

This annex gives CENELEC code designations for flexible cord equivalent to that of IEC. This code designation refers to HD 21 for polyvinyl chloride insulated cords and to HD 22 for rubber insulated cords.

Type of flexible cord	Code designations	
	IEC	CENELEC
PVC insulated cords		
Flat twin tinsel cord	227 IEC 41	H03VH-Y
Flat twin flexible cord	227 IEC 42	H03VH-H
Light polyvinyl chloride sheathed flexible cord	227 IEC 52	H03VV-F, H03VVH2-F
Ordinary polyvinyl chloride sheathed flexible cord	227 IEC 53	H05VV-F, H05VVH2-F
Rubber insulated cords		
Ordinary tough rubber sheathed flexible cord	245 IEC 53	H05RR-F
Braided cord	245 IEC 51	H03RT-F
Ordinary polychloroprene sheathed flexible cord	245 IEC 57	H05RN-F
Heavy polychloroprene sheathed flexible cord	245 IEC 66	H07RN-F

**National annex NA (informative)**

**Original IEC text prior to amendment by CENELEC common modification**

This annex is provided to give the original IEC text prior to amendment or deletion by the CENELEC common modifications. In the body of the standard these modifications are indicated by a side line in the margin.

The Foreword has been deleted. The text pointing out national differences reads as follows:

- 2.5.2: The safety extra-low voltage shall not exceed 30 V (42,4 V peak)
- 2.8.5: A disconnection of the supply is not considered as being a manual operation (Australia, New Zealand)
- 4.7: The ambient testing temperature is  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  (China, Japan and U.S.A.).
- 4.14: Accessible metal parts that are not liable to become energized (such as a metal nameplate or decorative part on a plastic enclosure) do not need to be earthed. Accessible non-metallic parts need only provide basic insulation (U.S.A.).
- 6.1: Class 0 and class 01 appliances are not allowed (Australia, Austria, Czechoslovakia, Finland, France, Germany, Hungary, Israel, Ireland, Italy Netherlands, New Zealand, Norway, Poland, Singapore, Sweden, United Kingdom, Yugoslavia).
- 6.2: Protection against harmful ingress of water is determined by methods other than those given in IEC 529 (U.S.A.).
- 7.1: The IP number is not required to be marked (U.S.A.).
- 7.6: Some of thee symbols are not used (U.S.A.).
- 7.8 Additional methods are permitted for identifying earthing terminals and terminals for neutral conductors (U.S.A.).
- 7.12.2 The 3 mm contact separation does not apply (Australia, Japan, New Zealand, U.S.A.).
- 7.14 Different tests are used (U.S.A.).
- 8.1.1 The test is not necessarily repeated with the 20 N force (U.S.A.).
- 8.1.1 Protection against contact with live parts of the lamp cap is not required (U.S.A.).
- 8.1.2 and 8.1.3: The test pin and test probe are not used (U.S.A.).
- 8.1.5 Built-in appliances, fixed appliances and appliances delivered in separate units are not required to be protected by at least basic insulation before installation (U.S.A.).
- 9: The ability of a motor to start without blowing a quick-acting fuse is required (U.S.A.).
- 10.1 and 10.2: Positive limits of 5% for heating appliances and 10% for motor-operated appliances are required and in general there are no negative deviations (U.S.A.).
- 11.4, 11.5 and 11.6: Heating appliances and heater circuits of combined appliances are operated at rated power input or rated voltage, whichever is the more severe; all other appliances and circuits are operated at rated voltage (U.S.A.).
- 11.8, table 3: Temperature rise limits for certain materials are different (U.S.A.).
- 13.2: The test circuit and some leakage current limits are different (U.S.A.).
- 13.3: The values of certain test voltages are different depending on the rated voltage (U.S.A.).
- 13.3: A 500 VA test transformer is used (U.S.A.).
- 15.1.1 and 15.1.2: The IP system is not used and the tests are different (U.S.A.).

- 15.3: The test is conducted with a relative humidity of  $(88 \pm 2) \%$  at a temperature of  $32^{\circ}\text{C} \pm 2^{\circ}\text{C}$  (U.S.A.).
- 16.2: The test is conducted at nominal supply voltage and some of the leakage current values are different (U.S.A.).
- 16.3: Some test voltages and methods are different (U.S.A.).
- 19.1: The circuit protection device is permitted to provide necessary protection (U.S.A.).
- 19.2 to 19.4: Generally the tests are conducted at nominal supply voltage or rated power input (U.S.A.).
- 19.13: The temperature rise limits of table 7 are not applicable (U.S.A.).
- 20.1: A stability test at 15 degrees is not conducted and an appliance tested in an overturned position is judged under abnormal test criteria (U.S.A.).
- 21: Impact force is applied with a falling steel ball instead of the spring operated impact test apparatus (U.S.A.).
- 22.1: The IP system is not used and test are not the same as specified in IEC 529 (U.S.A.).
- 22.2: The second paragraph of this subclause dealing with single-phase class I appliances with heating elements cannot be complied with because of the supply system (France and Norway).
- Double-pole switches or protective devices are required (Norway).
- Disconnection of the neutral is not necessary for all stationary appliances (U.S.A.).
- 22.2: The supply cord is not required to be fitted with a plug (Ireland).
- 22.6: This test is not conducted (U.S.A.).
- 22.11: Different criteria for snap-on constructions are required (U.S.A.).
- 22.12: Positive forms of securement are required (U.S.A.).
- 22.14: Sharp edges are evaluated by means of a sharp edge testing device (U. S.A.).
- 22.35 and 22.36: Metal parts are generally not required to be separated by double or reinforced insulation (U.S.A.).
- 23.5: Requirements for insulated internal wiring are different (U.S.A.).
- 23.7: Green wiring may be used instead of green/yellow wiring (New Zealand and U.S.A.).
- 23.7: The requirement only applies to wiring that is accessible when making supply connections (U.S.A.).
- 24.1.2: A different number of cycles is required and note 2 does not apply (U.S.A.).
- 24.1.3: The note does not apply (U.S.A.).
- 24.3: The requirement for 3 mm contact separation does not apply (U.S.A.).

- 25.8: Conductor cross-sectional areas are different (Australia, New Zealand and U.S.A.).
- 25.8: 0,5 mm<sup>2</sup> supply cords are not allowed for class I appliances (Australia and New Zealand).
- 25.10: Green insulation is also permitted (U.S.A.).
- 25.14.2: No more than one separate insulation is required (U.S.A.).
- 25.16: Fully removable cold anchorages are allowable (Australia).
- 25.16: A pull of 35 lbs is applied except for small appliances and generally the torque test is not used (U.S.A.).
- 26.2: Cross-sectional areas are specified according to American Wire Gauge (AWG) (U.S.A.).
- 26.4 and 26.5: The tests only apply to terminals for connection to fixed wiring (U.S.A.).
- 27.2: The requirements for screwless terminals are different, as IEC 685-2-1 is not used (U.S.A.).
- 28.1: Generally, tests of this type are not required (U.S.A.).
- 29.1: Different creepage distances and clearances may be applicable (U.S.A.).
- 30.1: The minimum value for the ball-pressure test for parts retaining live parts is 95°C or 40 K higher than the clause 11 temperature rise. For enclosures, the minimum value is 75°C or a mould-stress test is conducted at 10 K above the clause 11 temperature (U.S.A.).
- 30.2.1: An ignition test cannot be used to assure a slow burning rate (U.S.A.).
- 30.2.4: Printed circuits boards operated at mains voltage are required to be FV-0 or FV-1 or to meet the needle-flame test (Australia).
- F.1.1: The annex applies to motors having a working voltage not exceeding 30 V (U.S.A.).

#### Introduction

The last paragraph has been deleted. It reads as follows:

Standards dealing with non-safety aspects of household appliances are:

- IEC standards published by TC 59 concerning methods of measuring performance;
- CISPR 118 and CISPR 14\* concerning radio interference suppression;
- IEC 555\* concerning electromagnetic compatibility.

The corresponding footnotes have been deleted. They read as follows:

IEC 555: Disturbances in supply systems caused by household appliances and similar electrical equipment.

CISPR 11: 1990, Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.

CISPR 14: 1993, Limits and methods of measurement of radio disturbance characteristics of electrical motor operated and thermal appliances for household and similar purposes, electrical tools and electrical apparatus.

The following addition has been made:

The essential safety requirements of the following European directives, which could be applicable to household and similar appliances, are covered by this standard:

- 73/23/EEC - Low voltage directive;
- 89/392/EEC - Machinery directive;
- 89/106/EEC - Construction products directive.

This standard is a product-family standard dealing with the safety of household and similar electrical appliances and takes precedence over horizontal and generic standards covering the same subject.

## 2. Definitions

The following note has been added to 2.7.2:

Z1 A part is not considered to be detachable if, according to the instructions, it has to be removed with the aid of a tool in order to discard batteries before scrapping the appliances.

## 3. General requirement

Notes 1 and 2 have been deleted. They read as follows:

### NOTES

1 A product which complies with the text of this standard will not necessarily be judged to comply with the safety principles of the standard if, when examined and tested, it is found to have other features which impair the level of safety covered by these requirements.

2 A product employing materials of having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the standard.

## 4. General conditions for the tests

### 4.2 The following addition has been made to Note 1:

If the tests of 24.1.3 are carried out, three switches or three additional appliances are needed.

### 4.8.1 The second paragraph, which read as follows:

Appliances for a.c. which are not marked with rated frequency or marked with a frequency range of 50 Hz to 60 Hz are tested with either 50 Hz or 60 Hz, whichever is the more unfavourable.

Has been replaced by:

Appliances which are not marked with rated frequency are tested with 50 Hz. Appliances which are marked with a frequency range of 50 Hz to 60 Hz are tested with 50 Hz or 60 Hz, whichever is more unfavourable.

6. Classification

Class 0 and 01 have been deleted.

7 Marking and instructions

7.1 The following text has been added to the requirement:

The marking of the rated voltage or rated voltage range shall cover

- 230 V for single-phase appliances;
- 400 V for multi-phase appliances.

7.12 The following addition has been made:

The instructions for appliances incorporating batteries which contain materials which are hazardous to the environment, shall state that the batteries must be removed from the appliance before it is scrapped and that they are disposed of safely. The instructions shall state that the appliance must be disconnected from the supply and give details how to remove the batteries.

NOTE Z1 - Refer to annex ZA.

7.12.2 The following addition has been made:

If a stationary appliance is provided with a supply cord and a plug, the instructions shall state that the appliance must be positioned so that the plug is accessible.

NOTE Z1 - This requirement does not apply if the appliance incorporates other means for disconnection from the supply.

8. Protection against access to live parts

8.1.2 The following note has been added:

NOTE Z1 - Appliance outlets are not considered to be socket-outlets.

8.1.5 'and by the test of 8.1.1' has been added to the test specification.

8.2 The following text has been added:

Appliances having batteries which, according to the instructions for use, may be replaced by the user need only have basic insulation between live parts and the inner surface of the battery compartment. If the appliance can be operated without the batteries, double insulation or reinforced insulation is required.

11. Heating

11.8 A third note has been added after the table:

Z1 The temperature rise limit for metal applies to parts having a metal coating at least 0,1 mm thick and to metal parts having a plastic coating less than 0,3 mm thick.

15. Moisture resistance

15.1 The following note has been added:

NOTE Z1 - Before inspection, the enclosure of the appliance is dried and care has to be taken when dismantling to avoid displacing any water.

19. Abnormal operation

19.5 The following note has been added:

Z1 Refer to annex ZA.

19.7 Note 2 has been deleted. It read as follows:

2 Alternative tests for protected motor units are given in annex D.

19.9 2 Alternative tests for protected motor units are given in annex D.

19.10 The second paragraph, which read as follows:

After this test, the safety of the appliance shall not have been impaired, in particular windings and connections shall not have worked loose.

has been replaced by:

During the test, parts shall not be ejected from the appliance.

19.11.2 The following note has been added:

NOTE Z1 - Refer to annex ZA.

22. Construction

22.2 The following note has been added:

NOTE Z1 - Refer to annex ZA.

22.32 The following note has been added:

Z1 Refer to the footnote\*.

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\*The following interpretation has been published by the IEC and accepted by CENELEC:

NOTE - In case of doubt the following test is carried out to determine if ceramic material is tightly sintered.

The ceramic material is broken into pieces which are immersed in a solution containing 1 g of fuchsin in each 100 g of methylated spirit. The solution is maintained at a pressure not less than 15 Mpa for a period so that the product of the test duration in hours and the test pressure in Mpa is not less than 180.

The pieces are removed from the solution, rinsed, dried and broken into smaller pieces.

The freshly broken surfaces are examined and are not to show any trace of dye.

22.40

The requirement which read as follows:

22.40 Motor-operated appliances and combined appliances, which are intended to be moved while in operation, shall be fitted with a switch to control the motor.

Has been replaced by:

Motor-operated appliances and combined appliances which are intended to be moved while in operation or which have accessible moving parts, shall be fitted with a switch to control the motor. The actuating member of this switch shall be easily visible and accessible.

The following clauses have been added:

22.Z1 Appliances are not allowed to have an enclosure which is shaped and decorated so that the appliance is likely to be treated as a toy by children.

Compliance is checked by inspection.

NOTE - Examples are enclosures representing animals or persons or resembling scale models.

22.Z2 Fully halogenated chlorofluorocarbons (CFC's) shall not be used.

Compliance is checked by inspection.

23. Internal wiring

23.5 In the first paragraph of the test specification 'insulation' has been replaced by 'basic insulation' (in two places).

The following note has been added:

Z1 For Class II constructions, the requirements for supplementary insulation and reinforced insulation apply except that the sheath of a cord complying with IEC 227 or IEC 245 may provide supplementary insulation.

24. Components

24.1 The following note has been added:

NOTE Z1 - Unless otherwise specified, the requirements of clause 29 apply between live parts of components and accessible parts of the appliance.

The requirement which read as follows:

24.1.1 Fixed capacitors for radio interference suppression shall comply with IEC 384-14.

Has been replaced by:

Capacitors likely to be permanently subjected to the supply mains voltage and used for radio interference suppression or for voltage dividing, shall comply with annex ZC.

The third paragraph which read as follows:

Isolating transformers and safety isolating transformers shall comply with IEC 742.

Has been replaced by:

Safety isolating transformers shall comply with IEC 742, unless they are tested with the appliance in which case they shall comply with annex ZD.

In the sixth paragraph, IEC 328 has been replaced by IEC 1058.

24.1.2 The following items have been added to the list of controls:

- energy regulators 3 000
- timers 10 000

24.1.3 The following text has been deleted:

24.1.4 Switches which have not been separately tested and found to comply with IEC 328 and switches complying with IEC 328 but not used in accordance with their marking, are tested under the conditions occurring in the appliance.

The current and corresponding power factor are measured during switching-on and during normal operation of the appliance.

The switch may then be tested separately according to IEC 328, for 10 000 cycles of operation. The switching-on current and corresponding power factor are used for the breaking capacity test specified in clause 15 of IEC 328. The current and corresponding power factor measured during normal operation are used for the normal operation test specified in clauses 16 of IEC 328.

Switches intended for operation under no load and which can be operated only with the aid of a tool, are not subjected to the tests of clauses 15 and 16 of IEC 328. This applies also for such switches operated by hand which are interlocked so that they cannot be operated under load but switches without this interlock are subjected to the test of clause 16 for 100 cycles of operation.

NOTE -

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