

Australian/New Zealand Standard™

Safety of household and similar electrical appliances

Part 1: General requirements (IEC 60335-1:1991, MOD)



AS/NZS 3350.1:2002

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-002, Safety of Household and Similar Electrical Appliances and Small Power Transformers. It was approved on behalf of the Council of Standards Australia on 7 May 2002 and on behalf of the Council of Standards New Zealand on 21 March 2002.

This Standard was published on 13 May 2002.

The following are represented on Committee EL-002:

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Australian Electrical and Electronic Manufacturers Association
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Consumer Electronic Suppliers Association, Australia
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This Standard was issued in draft form for comment as DR 01966.

Australian/New Zealand Standard™

Safety of household and similar electrical appliances

Part 1: General requirements (IEC 60335-1:1991, MOD)

Originated as AS/NZS 3350.1:1994.
Second edition 2000.
Third edition 2002.
Reissued incorporating Amendment No. 1 (November 2003).
Reissued incorporating Amendment No. 2 (May 2004).
Reissued incorporating Amendment No. 3 (January 2005).
Reissued incorporating Amendment No. 4 (November 2007).

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Jointly published by Standards Australia, GPO Box 476, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 4632 2

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PREFACE

This standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-002- Safety of Household and Similar Electrical Appliances and Small Power Transformers. It will supersede AS/NZS 3350.1:2000 and its amendments on publication.

A4 This Standard incorporates Amendment No. 1 (November 2003), Amendment No. 2 (May 2004), Correcting Amendment No. 3 (January 2005) and Amendment No. 4 (November 2007). The changes introduced by the Amendments are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected. Where an application date other than immediate is applicable to an amendment the date of application (DOA) is indicated by the marginal bar against the part affected.

The objective of this Standard is to provide manufacturers, designers, regulatory authorities, testing laboratories and similar organizations with safety requirements designed to give the user protection against hazards that might occur during normal operation and abnormal operation of the appliance and that may be used as the basis for approval for sale or for connection to the electricity supply mains in Australia and New Zealand.

This Standard was revised to incorporate Amendment Nos. 1, 2, 3 and 4 and to effect changes to clauses 8.1, 24.1.5, 30.2.2, 30.2.3 and Annex R and Annex ZZ that were issued in draft form for comment as document DR 01966. It forms the third edition of AS/NZS 3350.1 *Safety of household and similar electrical appliances, Part 1: General requirements*.

This Standard is an adoption with national modifications and contains the full text of the second impression of IEC 60335-1:1991, *Safety of Household and similar electrical Part 1: General requirements*, including its amendments 1 and 2 and has been varied as indicated to take account of Australian and New Zealand conditions. It also includes the changes detailed in IEC document 61/2121/INF.

This part is to be used in conjunction with the appropriate Part 2 of AS/NZS 3350. The Parts 2 contain clauses to supplement or modify the corresponding clauses in this part to provide the relevant requirements for each type of appliance.

NOTE 1 Throughout this publication, when "Part 2" is mentioned, it refers to the relevant part of AS/NZS 3350.

NOTE 2 The following print types are used:

- requirements: in roman type;
- *test specifications: in italic type;*
- notes: in small roman type.

Words in **bold** in the text are defined in clause 3. When a definition concerns an adjective, the adjective and associated noun are also in bold.

The numbering of clauses, subclauses, notes, tables, figures and annexes follows that of IEC 60335-1:1991. To allow for the introduction of additional material by the IEC, the numbers 101 to 200 have been reserved. To allow for additional material to be introduced by Australia and New Zealand, the numbers 201 to 300 are used to number further clauses, subclauses, notes, tables and figures in part 1. Additional annexes are lettered ZA, ZB and so on.

This scheme has been introduced to reduce the likelihood of the IEC and Australia and New Zealand using the same identifier for different purposes.

The use of the word VOID indicates that the IEC text is not used in Australia or New Zealand. The use of this word also avoids the need to renumber, clauses, notes, tables and figure if an earlier clause, note, table or figure is not used.

Annex A has been reformatted to indicate the Australia/New Zealand standard that is equivalent to the IEC standard or ISO standard to which normative reference is made.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown on the cover and title page only.
- (b) In the source text "this International Standard" should read "this Australian/New Zealand Standard".
- (c) A full point substitutes for a comma when referring to a decimal marker.

Variations to IEC 60335-1:1991 are indicated at the appropriate places throughout this standard. Strikethrough (~~example~~) identifies IEC tables, figures and passages of text which, for the purposes of this Australian/New Zealand standard are deleted. Where Australian/New Zealand tables, figures or passages of text are added, each is set in its proper place and identified by shading (**example**). Added figures are not themselves shaded, but are identified by a shaded border.

Variations made to IEC 60335-1:1991 form the Australian variations for the purposes of the IECEE scheme for recognition of testing to standards for safety of electrical equipment (the CB scheme). These variations have been incorporated in the body of the standard. They are listed in Annex ZZ for easy reference.

INTRODUCTION

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

The requirements in this Standard take into account, as far as possible, the requirements given in AS/NZS 3000* so that an appliance may be installed in accordance with these wiring rules.

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 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 if, 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.

Individual countries may wish to consider the application of this standard, so far as is reasonable, to appliances not mentioned in part 2 and to appliances designed on new principles.

If the functions of an appliance are covered by different parts 2 of AS/NZS 3350, the relevant part 2 is applied to each function separately, so far as is reasonable, with the influence of one function on the other being taken into account.

The essential safety requirements in AS/NZS 3820** that could be applicable to household and similar electrical appliances are covered by this standard.

Standards dealing with non-safety aspects of household appliances are:

- Standards published by EL/15 concerning methods of measuring performance;
- CISPR 11¹ and CISPR 14-1² concerning radio interference suppression;
- CISPR 14-2³ and IEC 61000 series concerning electromagnetic compatibility.

* AS/NZS 3000: *Electrical installations (known as the Australia/New Zealand Wiring Rules)*

** AS/NZS 3820: *Essential safety requirements for low voltage electrical equipment*

¹ CISPR 11: *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*

² CISPR 14-1: *Limits and methods of measurement of radio disturbance characteristics of electrical motor operated and thermal appliances for household and similar purposes, electric tools and electrical apparatus*

³ CISPR 14-2: *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 2: Immunity – Product family standard*

Australia/New Zealand Standard

Safety of household and similar electrical appliances

Part 1: General requirements (IEC 60335-1:1991, MOD)

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. However 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;~~

- for the purpose of this Standard, Australia and New Zealand are not considered to be tropical countries;

- 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 60065);
- appliances for medical purposes (IEC 60601);
- hand-held motor-operated electric tools (IEC 60745);
- personal computers and similar equipment (IEC 60950);
- transportable motor-operated electric tools (IEC 61029).

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 supplied at **rated voltage** and operated under **normal operation**;
- for **combined appliances**, the current measured when the appliance is supplied at **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.

2.2.9 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 - A 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 which is separated from **live parts** by an appropriate insulation. If an appliance with an enclosure of insulating material has provision for earthing internal parts, it is considered to be a **class I appliance** or **class 0I appliance**.

2.4.6 class 0I appliance: Appliance having at least **basic insulation** throughout and incorporating 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 0I appliance**.

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 voltages 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 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.

NOTES

- 1 If for installation purposes a part has to be removed, this part is not considered to be 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 to be detachable parts.
- 3 A part which can be opened is considered to be a part which can be removed.

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 predetermined 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 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.

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

If an intentionally weak part becomes open-circuit during the tests of clause 19, an additional appliance is needed.

If the tests of annex R are carried out, four additional transformers are needed.

- 2 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 standard.
- 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

Unless otherwise specified, the tests are carried out in accordance with this clause.

4.1 Tests according to this standard are type tests.

4.2 *The tests are made on a single appliance which shall withstand all the relevant tests. However the tests of clauses 20, 22 (except 22.11 and 22.18) to 26, 28, 30 and 31 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.
If an intentionally weak part becomes open-circuit during the tests of clause 19, an additional appliance is needed.
If the tests of annex R are carried out, four additional transformers 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 *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 °C ± 5 °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 $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ 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 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.~~

4.8.1 Appliances for a.c. only are tested with a.c. at 50 Hz and those for a.c./d.c. are tested at a.c. 50 Hz or d.c., whichever is the more unfavourable supply.

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.

Built-in appliances and fixed appliances are installed in accordance with the instructions provided with the appliance before testing.

4.11 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 for 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 0I appliances** or **class I 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 0I appliances** or **class I 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.

4.17 Appliances powered by rechargeable batteries are tested according to Annex B.

4.201 For Australia the following applies:

For appliances, other than **class III appliances**, that are intended for connection to the supply mains and that are not marked with

- a **rated voltage** of at least 240 V for single-phase appliances and at least 415 V for three-phase appliances, or

- a **rated voltage range** that includes 240 V for single-phase appliances and 415 V for three-phase appliances,

the **rated voltage** is equal to 240 V for single-phase appliances and 415 V for three-phase appliances, and the upper limit of the **rated voltage range** is equal to 240 V for single-phase appliances and 415 V for three-phase appliances. In addition, the **rated current** or **rated power input** is equal to the calculated value corresponding to 240 V for single-phase appliances and 415 V for three-phase appliances as appropriate.

NOTE 1 - Example of calculation

If the appliance is marked with a **rated voltage** of 230 V and a **rated current** "A" or a **rated power input** "P", it will be tested as if it is marked with a **rated voltage** of 240 V and a **rated current** of $A \times (240/230)$ or a **rated power input** of $P \times (240/230)^2$.

NOTE 2 - This general test condition does not apply in New Zealand.

5 Void

6 Classification

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

~~class 0, class 0I, class I, class II, class III.~~

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 60529.

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 IPX0.

Appliances other than **class III appliances** intended for connection to the supply mains shall be marked with

- a **rated voltage** of at least:

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

or

– a **rated voltage range** that includes:

- 230 V for single phase appliances;
- 400 V for polyphase 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).

Compliance is checked by inspection.

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
== or d.c.	.....	direct current
~ or a.c.	.....	alternating current
2 ~	.....	two-phase alternating current
2N ~	.....	two-phase alternating current with neutral
3 ~	.....	three-phase alternating current
3N ~	.....	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 60127
	.....	protective earth
	.....	class II appliance
IPXX	.....	IP number
	.....	[Symbol No. 1641 of ISO 7000] read the instructions
	.....	[Symbol No. 0434 of ISO 7000] caution

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 60417 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, for example, 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.

NOTE - An indication of + and – is sufficient.

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

These instructions shall contain the substance of the following:

- the appliance is not intended for use by young children or infirm persons without supervision;
- young children should be supervised to ensure that they do not play with the appliance.

Compliance is checked by inspection.

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

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 means for disconnection must be incorporated in the fixed wiring according to the wiring rules.~~

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 an air gap contact separation in all active (phase) conductors, the instructions shall state that such means for disconnection shall be incorporated in the fixed wiring according to the wiring rules.

Compliance is checked by inspection.

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.~~

NOTE - VOID.

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;
- minimum dimensions of ventilating openings and their correct arrangement;
- 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.~~

7.13 Instructions and other texts required by this Standard shall be written in English.

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.

NOTE 201 - "without appreciable force" is considered to be a force not exceeding 1 N.

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.

The test pin is also applied to openings in earthed metal enclosures having a non-conductive coating such as enamel or lacquer.

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

NOTE – 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 of which can be disconnected by a single switching action. It is also applied to parts 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:
 - for a.c., the peak value of the voltage does not exceed 42,4 V;
 - for 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 μF ;
- for voltages having a peak value over 450 V up to and including 15 kV, the discharge shall not exceed 45 μC .

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.

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	≤ 25	+20%
Heating appliances and combined appliances	> 25 and ≤ 200	± 10%
	> 200	+5% or 20 W (whichever is the greater) -10%
Motor-operated appliances	> 25 and ≤ 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 current A	Deviation
All appliances	$\leq 0,2$	+20%
Heating appliances and combined appliances	$> 0,2$ and $\leq 1,0$	$\pm 10\%$
	$> 1,0$	+5% or 0,10 A (whichever is the greater) -10%
Motor-operated appliances	$> 0,2$ 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 unreeled. 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.

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Table 3 – Maximum normal temperature rises

Part	Temperature rise K
<i>Windings</i> ¹⁾ , if the winding insulation according to IEC 60085 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
<i>Pins of appliance inlets:</i>	
- for very hot conditions	130
- for hot conditions	95
- for cold conditions	45
Insulated pins of appliances with pins for insertion into socket-outlets	45
<i>Terminals, including earthing terminals, for external conductors of stationary appliances, unless they are provided with a supply cord</i>	60
<i>Ambient of switches, thermostats and temperature limiters</i> ²⁾ :	
- without T-marking	30
- with T-marking	T-25
<i>Rubber or polyvinyl chloride insulation of internal and external wiring including supply cords:</i>	
- without temperature rating ³⁾	50
- with temperature rating (T)	T-25
<i>Cord sheaths used as supplementary insulation</i>	35

continued

Table 3 – Maximum normal temperature rises (continued)

<i>Sliding contacts of cord reels</i>	65	
<i>Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:</i>		
- when used as supplementary insulation or as reinforced insulation	40	
- in other cases	50	
<i>Lampholders with T-marking⁹⁾</i>		
- B15 and B22 marked T1	140	
- B15 and B22 marked T2	185	
- other lampholders	T-25	
<i>Lampholders without T-marking⁹⁾:</i>		
- E14 and B15	110	
- B22, E26 and E27	140	
- other lampholders and starter holders for fluorescent lamps	55	
<i>Material used as insulation other than that specified for wires and windings⁴⁾</i>		
- 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 ⁵⁾	-	
<i>Wood, in general⁶⁾</i>	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	
<i>Outer surface of capacitors⁷⁾</i>		
- with marking of maximum operating temperature (T) ⁸⁾	T-25	
- without marking of maximum operating temperature		
• small ceramic capacitors for radio and television interference suppression	50	
• capacitors complying with IEC 60384-14	50	
• other capacitors	20	
<i>External enclosure of motor-operated appliances, except handles held in normal use</i>	60	

continued

Table 3 – Maximum normal temperature rises (continued)

<i>Handles, knobs, grips and similar parts which are continuously held in normal use (e.g. soldering irons):</i>	
- of metal	30
- of porcelain or vitreous material	40
- of moulded material, rubber or wood	50
<i>Handles, knobs, grips and similar parts which are held for short periods only in normal use (e.g. switches):</i>	
- of metal	35
- of porcelain or vitreous material	45
- of moulded material, rubber or wood	60
<i>Parts in contact with oil having a flash-point of t °C</i>	t-50
<i>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:</i>	
- when the instructions require the use of supply wires with temperature rating (T)	T-25
- in other cases ³⁾	50
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. However, if a thermostat or a temperature limiter is mounted on a heat-conducting part, the declared temperature limit of the mounting surface (Ts) is also applicable. Therefore, the temperature rise of the mounting surface has to be measured. 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. 9) Locations for measuring the temperature rises are specified in table 12.1 of IEC 60598-1. If these or other materials is used, they shall not be subjected to temperature in excess of the thermal capabilities as determined by ageing tests made on the materials themselves.	

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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

- Δt 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.

- 3 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.
- 4 The temperature of the terminals of switches is measured if the switch is tested in accordance with annex S.

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 0I 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.

The heat dissipation of the appliance is not to be affected by the metal foil.

~~**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.~~

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. Single-phase appliances are tested before the

appliance has been disconnected from the supply using the connections shown in Figure 8, or immediately after the appliance has been disconnected from the supply. 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 V for **reinforced insulation**.

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

NOTE – 'Raised gradually' is considered to be at a rate of approximately 1 000 V/s.

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 I_s 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_r . 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 60051-2. The values of I_s and I_r are given in table 4 for various high voltage sources.

Table 4 – Characteristics of high-voltage sources

Test voltage U V	Minimum current mA	
	I_s	I_r
$U < 4\,000$	200	100
$4\,000 \leq U < 10\,000$	80	40
$10\,000 \leq U \leq 20\,000$	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 $\pm 3\%$ of the measured voltage for a leakage current up to 50% of I_r .		

- 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 resistance

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 – The external enclosure is carefully wiped to remove any surplus water before inspection. Care has to be taken when dismantling to avoid displacing any water within the appliance.

15.1.1 Appliances other than IPX0, are subjected to the tests of IEC 60529 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 14.2.3a;
- IPX4 appliances, as described in subclause 14.2.4a;
- 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 approximately 1% NaCl.

NOTE – The hand-held spray nozzle may be used for testing appliances which cannot be placed under the oscillating tube specified in IEC 60529.

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 cm $\pm$ 5 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. However, for appliances normally used on the floor or table, the movement is limited to two times 90° from the vertical for a period of 5 min, the support being placed at the level of the pivot axis of the oscillating tube.

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. However, if the instructions state that a part has to be removed for **user maintenance** and a **tool** is needed, this part is not removed.

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 $(93 \pm 3)\%$. 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}_0 °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 $(93 \pm 3)\%$ can be obtained by placing, in the humidity cabinet, a saturated solution of Na₂SO₄ or KNO₃ 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 $\sqrt{3}$, 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 0I 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 |

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 insulating material are covered with metal foil.

Table 5 – Test voltages

Points of application	Test voltage V		
	<i>Class III appliances and class III constructions</i>	<i>Class II appliances and class II constructions</i>	<i>Other appliances</i>
1. Between live parts and accessible parts separated from live parts by			
- basic insulation only	500	-	1 250
- reinforced insulation	-	3 750	3 750
2. For parts with double insulation , between metal parts separated from live parts by basic insulation only and			
- live parts	-	1 250	1 250
- accessible parts	-	2 500	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 ¹⁾	-	2 500	2 500 (1 250)
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 ^{2), 3)}	-	2 500	1 250
6. Between the point where a winding and a capacitor are connected together, if a resonance voltage <i>U</i> occurs between this point and any terminal for external conductors, and			
- accessible parts	-	-	2 <i>U</i> + 1 000
- metal parts separated from live parts by basic insulation only ⁴⁾		2 <i>U</i> + 1 000	
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 gradually to the full value.

NOTE – 'Raised gradually' is considered to be at a rate of approximately 1 000 V/s.

No breakdown shall occur during the test.

NOTE

- 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 unfavourable.*

*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 windings shall not exceed the values specified in table 6. However, these limits do not apply to fail-safe transformers complying with subclause 15.5 of IEC 61558-1.

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.
- 5 When it is stated that a control is short-circuited, it may be rendered inoperative instead.

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 0I 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.

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 **working voltage** of the **PTC heating element** is increased by 5 % and the appliance is operated until steady conditions are re-established. The voltage is then increased in similar steps until 1,5 times **working voltage** is reached or until the **PTC 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.*

NOTES

- 1 If an appliance has more than one motor, the test is made for each motor separately.
- 2 ~~Alternative tests for protected motor units are given in annex D.~~

2 Void

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 are of class P2 of IEC 60252.

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.

NOTES

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

2 ~~Alternative tests for protected motor units are given in annex D.~~

2 Void