# IEC 60335-2-51

Edition 5.0 2023-12
EXTENDED VERSION

# INTERNATIONAL STANDARD

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This extended version of IEC 60335-2-51:2023 includes the content of the references made to IEC 60335-1:2020

## Household and similar electrical appliances – Safety – Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations

IEC 60335-2-51:2023-12 EXV(en)

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## Household and similar electrical appliances – Safety – Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations

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# IEC 60335-1
**Edition 6.0 2020-09**

# HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

## Part 1: General requirements

## INTERPRETATION SHEET 1

This interpretation sheet has been prepared by IEC technical committee 61: Safety of household and similar electrical appliances.

The text of this Interpretation Sheet is based on the following documents:

| Draft | Report on voting |
|---|---|
| 61/5999/DISH | 61/6009/RVDISH |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

### INTRODUCTION

Edition 6 of IEC 60335-1:2020 defines and introduces requirements for a detachable power supply part of an appliance. In the document, 24.2 prohibits the use of a power supply in a flexible cord.

### QUESTION:

Does Subclause 24.2 prohibit the use of a detachable power supply part?

### ANSWER

No, a "detachable power supply part" is a defined term and is not captured by the term "power supply" as used in Subclause 24.2.

NOTE A detachable power supply part is captured by the defined term when the output of the power supply part is detachable from the class III construction part of the appliance at:

– the power supply part, or

– the class III construction part of the appliance.

However, the supply cord (if any) does not have to be detachable from the detachable power supply part.

ICS 13.120; 97.030

IEC 60335-1:2020-09/ISH1:2021-11(en)

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# HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

## Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations

## FOREWORD

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**IEC 60335-2-51:2023 EXV includes the content of IEC 60335-2-51:2023, and the references made to IEC 60335-1:2020.**

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IEC 60335-2-51 has been prepared by IEC technical committee 61: Safety of household and similar electrical appliances. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2019. This edition constitutes a technical revision.

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

a) the text has been aligned with IEC 60335-1:2020;

b) some notes have been converted to normative text (Clause 1);

c) the use of separate connectors to ease the installation and establish the supply connection has been introduced (7.12.1, 22.102, 24.1.5, 24.1.101, 25.3);

d) clarifications related to remote operation (22.40, 22.49, 22.51).

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 61/7008/FDIS | 61/7073/RVD |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 60335 series, under the general title: *Household and similar electrical appliances – Safety*, can be found on the IEC website.

This part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments unless that edition precludes it; in that case, the latest edition that does not preclude it is used. It was established on the basis of the sixth edition (2020) of that standard.

NOTE 1 When "Part 1" is mentioned in this standard, it refers to IEC 60335-1.

This part 2 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Particular requirements for stationary circulation pumps for heating and service water installations.

When a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. When this standard states "addition", "modification" or "replacement", the relevant text in Part 1 is to be adapted accordingly.

NOTE 2 The following numbering system is used:

– subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;

– unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;

– additional annexes are lettered AA, BB, etc.

NOTE 3 The following print types are used:

– requirements: in roman type;

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– 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 the associated noun are also in bold.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations can need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 12 months or later than 36 months from the date of publication.

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# INTRODUCTION

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

Guidance documents concerning the application of the safety requirements for appliances can be accessed via TC 61 supporting documents on the IEC website

https://www.iec.ch/tc61/supportingdocuments

This information is given for the convenience of users of this International Standard and does not constitute a replacement for the normative text in this standard.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice and takes into account the way in which electromagnetic phenomena can affect the safe operation of appliances.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the appliance is connected to the supply mains. However, national wiring rules can differ.

If an appliance within the scope of this standard also incorporates functions that are covered by another part 2 of IEC 60335, the relevant part 2 is applied to each function separately, as far as is reasonable. If applicable, the influence of one function on the other is taken into account.

When a part 2 standard does not include additional requirements to cover hazards dealt with in Part 1, Part 1 applies.

NOTE 1 This means that the technical committees responsible for the part 2 standards have determined that it is not necessary to specify particular requirements for the appliance in question over and above the general requirements.

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

NOTE 2 Horizontal publications, basic safety publications and group safety publications covering a hazard are not applicable since they have been taken into consideration when developing the general and particular requirements for the IEC 60335 series of standards.

An appliance that complies with the text of this standard will not necessarily be considered to comply with the safety principles of the standard if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

An appliance 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 considered to comply with the standard.

NOTE 3 Standards dealing with non-safety aspects of household appliances are:

– IEC standards published by TC 59 concerning methods of measuring performance;
– CISPR 11, CISPR 14-1 and relevant IEC 61000-3 series standards concerning electromagnetic emissions;
– CISPR 14-2 concerning electromagnetic immunity;
– IEC standards published by TC 111 concerning environmental matters.

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# HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

## Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations

## 1 Scope

This part of IEC 60335 deals with the safety of electric **stationary circulation pumps** for household and similar purposes intended for use in heating systems or in service water systems, their **rated voltage** being not more than 250 V for single-phase appliances and 480 V for other appliances including direct current (DC) supplied appliances.

NOTE 101 The hydraulic and electrical parts of the pump can be in the same enclosure, so that the water flows through the motor and serves as a coolant, or they can be separated.

Appliances not intended for normal household use, but that nevertheless can 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.

As far as is practicable, this standard deals with the common hazards presented by appliances that are encountered by all persons in and around the home. However, in general, it does not take into account

– persons (including children) whose
  - physical, sensory or mental capabilities; or
  - lack of experience and knowledge

  prevents them from using the appliance safely without supervision or instruction;
– children playing with the appliance.

Attention is drawn to the fact that

– for appliances intended to be used in vehicles or on-board ships or aircraft, additional requirements can be necessary;
– in many countries additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour and similar authorities.

This standard does not apply to

– pumps for circulating liquids other than water;
– pumps, other than circulation pumps (IEC 60335-2-41);
– circulation pumps intended exclusively for industrial purposes;
– circulation pumps intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour, or gas).

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

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IEC 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps*

IEC 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC TR 60083, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*
IEC 60112:2003/AMD1:2009[1]

IEC 60127 (all parts), *Miniature fuses*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60227-5:2011, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60238, *Edison screw lampholders*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60252-1:2010, *AC motor capacitors – Part 1: General – Performance, testing and rating – Safety requirements – Guidance for installation and operation*
IEC 60252-1:2010/AMD1:2013[2]

IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60320-1, *Appliance couplers for household and similar general purposes – Part 1: General requirements*

IEC 60320-2-3, *Appliance couplers for household and similar general purposes – Part 2-3: Appliance couplers with a degree of protection higher than IPX0*

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[1] There exists a consolidated edition 4.1:2009 that includes edition 4 and its Amendment 1.

[2] There exists a consolidated edition 2.1:2013 that includes edition 2 and its Amendment 1.

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IEC 60320-3, *Appliance couplers for household and similar general purposes – Part 3: Standard sheets and gauges*

IEC 60384-14:2013, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*
IEC 60384-14:2013/AMD1:2016[3]

IEC 60417, *Graphical symbols for use on equipment*

IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013[4]

IEC 60598-1:2014, *Luminaires – Part 1: General requirements and tests*
IEC 60598-1:2014/AMD1:2017[5]

IEC 60603-11, *Connectors for frequencies below 3 MHz for use with printed boards – Part 11: Detail specification for concentric connectors (dimensions for free connectors and fixed connectors)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60664-4:2005, *Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress*

IEC 60691, *Thermal-links – Requirements and application guide*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60695-2-13, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test*

IEC 60695-11-5:2016, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

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3 There exists a consolidated edition 4.1:2016 that includes edition 4 and its Amendment 1.

4 There exists a consolidated edition 2.2:2013 that includes edition 2 and its Amendment 1 and Amendment 2.

5 There exists a consolidated edition 8.1:2017 that includes edition 8 and its Amendment 1.

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IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*
IEC 60730-1:2013/AMD1:2015[6]

IEC 60730-2-8:2018, *Automatic electrical controls – Part 2-8: Particular requirements for electrically operated water valves, including mechanical requirements*

IEC 60730-2-9:2015, *Automatic electrical controls – Part 2-9: Particular requirements for temperature sensing controls*
IEC 60730-2-9:2015/AMD1:2018[7]

IEC 60730-2-10, *Automatic electrical controls for household and similar use – Part 2-10: Particular requirements for motor-starting relays*

IEC 60738-1, *Thermistors – Directly heated positive temperature coefficient – Part 1: Generic specification*

IEC 60799, *Electrical accessories – Cord sets and interconnection cord sets*

IEC 60906-1, *IEC system of plugs and socket-outlets for household and similar purposes – Part 1: Plugs and socket-outlets 16 A 250 V a.c.*

IEC 60934, *Circuit-breakers for equipment (CBE)*

IEC 60990:2016, *Methods of measurement of touch current and protective conductor current*

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm$^2$ up to 35 mm$^2$ (included)*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11:2020, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

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6 There exists a consolidated edition 5.1:2015 that includes edition 5 and its Amendment 1.

7 There exists a consolidated edition 4.1:2018 that includes edition 4 and its Amendment 1.

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IEC 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*
IEC 61000-4-13:2002/AMD1:2009
IEC 61000-4-13:2002/AMD2:2015[8]

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*
IEC 61000-4-34:2005/AMD1:2009[9]

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61058-1:2016, *Switches for appliances – Part 1: General requirements*

IEC 61058-1-1:2016, *Switches for appliances – Part 1-1: Requirements for mechanical switches*

IEC 61058-1-2:2016, *Switches for appliances – Part 1-2: Requirements for electronic switches*

IEC 61180, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61210, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

IEC 61558-1:2017, *Safety of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

IEC 61558-2-6:2009, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

IEC 61558-2-16:2009, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units*
IEC 61558-2-16:2009/AMD1:2013[10]

IEC 61770, *Electric appliances connected to the water mains – Avoidance of backsiphonage and failure of hose-sets*

IEC 61984:2008, *Connectors – Safety requirements and tests*

IEC 62133-1:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 1: Nickel systems*

IEC 62133-2:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems*

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8 There exists a consolidated edition 1.2:2015 that includes edition 1 and its Amendment 1 and Amendment 2.

9 There exists a consolidated edition 1.1:2009 that includes edition 1 and its Amendment 1.

10 There exists a consolidated edition 1.1:2013 that includes edition 1 and its Amendment 1.

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IEC 62151, *Safety of equipment electrically connected to a telecommunication network*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

IEC 62477-1, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

IEC 62821 (all parts), *Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V*

ISO 178, *Plastics – Determination of flexural properties*

ISO 179-1, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 180, *Plastics – Determination of Izod impact strength*

ISO 527 (all parts), *Plastics – Determination of tensile properties*

ISO 1463, *Metallic and oxide coatings – Measurement of coating thickness – Microscopical method*

ISO 2178, *Non-magnetic coatings on magnetic substrates – Measurement of coating thickness – Magnetic method*

ISO 2768-1, *General tolerances – Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 4892-1:2016, *Plastics – Methods of exposure to laboratory light sources – Part 1: General guidance*

ISO 4892-2: 2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 7000, *Graphical symbols for use on equipment – Registered symbols*

ISO 8256, *Plastics – Determination of tensile-impact strength*

ISO 9772, *Cellular plastics – Determination of horizontal burning characteristics of small specimens subjected to a small flame*

ISO 9773, *Plastics – Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source*

## 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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When the terms "voltage" and "current" are used, they are RMS values, unless otherwise specified.

When the term "earthing" is used, it means "protective earthing", unless otherwise specified.

## 3.1 Definitions relating to physical characteristics

**3.1.1**
**rated voltage**
voltage assigned to the appliance by the manufacturer

**3.1.2**
**rated voltage range**
voltage range assigned to the appliance by the manufacturer, expressed by its lower and upper limits

**3.1.3**
**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**, with controls and switching devices positioned so as to maximize the value

Note 1 to entry: **Working voltage** takes into account resonant voltages.

Note 2 to entry: When deducing the **working voltage**, the effect of transient voltages is ignored.

**3.1.4**
**rated power input**
power input assigned to the appliance by the manufacturer

Note 1 to entry: If no power input is assigned to the appliance, the **rated power input** for **heating appliances** and **combined appliances** is the power input measured when the appliance is supplied at **rated voltage** and operated under **normal operation**.

**3.1.5**
**rated power input range**
power input range assigned to the appliance by the manufacturer, expressed by its lower and upper limits

**3.1.6**
**rated current**
current assigned to the appliance by the manufacturer

Note 1 to entry: If no current is assigned to the appliance, the **rated current** is the current measured when the appliance is supplied at **rated voltage** and operated under **normal operation.**

**3.1.7**
**rated frequency**
frequency assigned to the appliance by the manufacturer

**3.1.8**
**rated frequency range**
frequency range assigned to the appliance by the manufacturer, expressed by its lower and upper limits

**3.1.9**
**normal operation**
operation with the water pressure and flow rate adjusted within their specified limits, so that the highest power input is attained

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Appliances operated with **integral batteries** or **separable batteries** not disconnected from the appliance for charging purposes:

– the **battery** that is **fully discharged** is charged with the **battery-operated appliance** performing its intended function, if allowed by the construction of the appliance;
– the **battery** that is **fully discharged** is charged without the **battery-operated appliance** performing its intended function

Note 1 to entry: Operation of a **battery-operated appliance** to perform its intended function is considered to be **normal operation**.

**3.1.10**
**rated impulse voltage**
voltage derived from the **rated voltage** and the overvoltage category of the appliance, characterizing the specified withstand capability of its insulation against transient overvoltages

**3.1.11**
**dangerous malfunction**
unintended operation of the appliance that may impair safety

**3.1.12**
**outlet load**
load that can be connected to appliance outlets accessible to the user and socket-outlets accessible to the user

Note 1 to entry: Outlets with a voltage not exceeding **SELV** are not considered to be an appliance outlet.

## 3.2 Definitions relating to means of connection

**3.2.1**
**supply leads**
set of wires intended for connecting the appliance to fixed wiring and accommodated in a compartment within or attached to the appliance

**3.2.2**
**interconnection cord**
external flexible cord between two parts of an appliance, provided as part of a complete appliance for purposes other than connection to the supply mains

Note 1 to entry: In **battery-operated appliances**, if the **battery** is placed in a separate box, the flexible lead or flexible cord connecting the box with the appliance is considered to be an **interconnection cord**.

Note 2 to entry: The output cord from a **charging system** or a **detachable power supply part** is an **interconnection cord**.

**3.2.3**
**supply cord**
flexible cord, for supply purposes, that is fixed to the appliance

**3.2.4**
**type X attachment**
method of attachment of the **supply cord** such that it can easily be replaced

Note 1 to entry: The **supply cord** may be specially prepared and only available from the manufacturer or its service agent. A specially prepared cord may include a part of the appliance.

**3.2.5**
**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

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**3.2.6**
**type Z attachment**
method of attachment of the **supply cord** such that it cannot be replaced without breaking or destroying the appliance

### 3.3 Definitions relating to protection against electric shock

**3.3.1**
**basic insulation**
insulation applied to **live parts** to provide basic protection against electric shock

**3.3.2**
**supplementary insulation**
independent insulation applied in addition to **basic insulation**, in order to provide protection against electric shock in the event of a failure of **basic insulation**

**3.3.3**
**double insulation**
insulation system comprising both **basic insulation** and **supplementary insulation**

**3.3.4**
**reinforced insulation**
single insulation applied to **live parts**, that provides a degree of protection against electric shock equivalent to **double insulation** under the conditions specified in this standard

Note 1 to entry: 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**.

**3.3.5**
**functional insulation**
insulation between conductive parts of different potential which is necessary only for the proper functioning of the appliance

**3.3.6**
**protective impedance**
impedance connected between **live parts** and **accessible conductive parts** of **class II constructions** so that the current, in normal use and under likely fault conditions in the appliance, is limited to a safe value

**3.3.7**
**class 0 appliance**
appliance in which protection against electric shock relies upon **basic insulation** only, there being 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 1 to entry: **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**.

**3.3.8**
**class 0I appliance**
appliance having at least **basic insulation** throughout and incorporating an earthing terminal but having a **supply cord** without earthing conductor and a plug without earthing contact

**3.3.9**
**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

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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 1 to entry: This provision includes a protective earthing conductor in the **supply cord**.

**3.3.10**
**class II appliance**
appliance in which protection against electric shock does not rely on **basic insulation** only but in which additional safety precautions are provided, such as **double insulation** or **reinforced insulation**, there being no provision for protective earthing or reliance upon installation conditions

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

– an appliance having a durable and substantially continuous enclosure of insulating material which envelops all metal parts, with the exception of 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**;
– 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**;
– an appliance which is a combination of an insulation-encased **class II appliance** and a metal-encased **class II appliance**.

Note 2 to entry: 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**.

Note 3 to entry: **Class II appliances** may incorporate an earth for functional purposes.

**3.3.11**
**class II construction**
part of an appliance for which protection against electric shock relies upon **double insulation** or **reinforced insulation**

**3.3.12**
**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 1 to entry: **Basic insulation** may be required in addition to supply at **SELV**. Refer to 8.1.4.

Note 2 to entry: **Class III appliances** may incorporate an earth for functional purposes.

**3.3.13**
**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 voltage** are not generated

Note 1 to entry: **Basic insulation** may be required in addition to supply at **SELV**. Refer to 8.1.4.

**3.3.14**
**clearance**
shortest distance in air between two conductive parts or between a conductive part and the **accessible surface**

**3.3.15**
**creepage distance**
shortest distance along the surface of insulation between two conductive parts or between a conductive part and the **accessible surface**

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## 3.4 Definitions relating to extra-low voltage

**3.4.1**
**extra-low voltage**
voltage supplied from a source within the appliance that does not exceed 50 V between conductors and between conductors and earth or functional earth when the appliance is supplied at **rated voltage**

**3.4.2**
**safety extra-low voltage**
voltage not exceeding 42 V between conductors and between conductors and earth or functional earth, the no-load voltage not exceeding 50 V

Note 1 to entry: 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 2 to entry: The voltage limits specified are based on the assumption that the **safety isolating transformer** is supplied at its **rated voltage**.

Note 3 to entry: **Safety extra-low voltage** is also known as **SELV**.

**3.4.3**
**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**, that is intended to supply an appliance or circuit at **safety extra-low voltage**

**3.4.4**
**protective extra-low voltage circuit**
earthed circuit operating at **extra-low voltage** that is separated from other circuits, except circuits operating at **safety extra-low voltage**, by **basic insulation** and protective screening, **double insulation** or **reinforced insulation**

Note 1 to entry: Protective screening is the separation of circuits from **live parts** by means of an earthed screen.

Note 2 to entry: A **protective extra-low voltage circuit** is also known as a **PELV circuit**.

## 3.5 Definitions relating to types of appliances

**3.5.1**
**portable appliance**
appliance that is intended to be moved while in operation or an appliance, other than a **fixed appliance,** having a mass less than 18 kg

**3.5.2**
**hand-held appliance**
**portable appliance** intended to be held in the hand during normal use

**3.5.3**
**stationary appliance**
**fixed appliance** or an appliance which is not a **portable appliance**

**3.5.4**
**fixed appliance**
appliance that is intended to be used while fastened to a support or while secured in a specific location

**3.5.5**
**built-in appliance**
**fixed appliance** intended to be installed in a cabinet, in a prepared recess in a wall or in a similar location

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**3.5.6**
**heating appliance**
appliance incorporating heating elements but without any motor

**3.5.7**
**motor-operated appliance**
appliance incorporating motors but without any heating element

Note 1 to entry: Magnetically driven appliances are considered to be **motor-operated appliances**.

**3.5.8**
**combined appliance**
appliance incorporating heating elements and motors

**3.5.9**
**battery-operated appliance**
appliance deriving its energy from **batteries** enabling the appliance to perform its intended function without a supply connection

Note 1 to entry: A **battery-operated appliance** can have a supply connection.

## 3.6 Definitions relating to parts of an appliance

**3.6.1**
**non-detachable part**
part that can only be removed or opened with the aid of a **tool** or part that fulfils the test of 22.11

**3.6.2**
**detachable part**
part that can be removed or opened without the aid of a **tool**, part that is removed or opened in accordance with the instructions for use, even if a **tool** is needed for removal, or part that does not fulfil the test of 22.11

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

Note 2 to entry: Components that can be removed without the aid of a **tool** are considered to be **detachable parts**.

Note 3 to entry: If a part has to be removed solely to discard a **battery** before scrapping the appliance, this part is not considered to be a **detachable part** even if the instructions state that it is to be removed.

**3.6.3**
**accessible part**
part or surface that can be touched by means of test probe B of IEC 61032, and if the part or surface is metal, any conductive part connected to it

Note 1 to entry: **Accessible non-metallic parts** with conductive coatings are considered to be **accessible metal parts**.

**3.6.4**
**live part**
conductor or conductive part intended to be energized in normal use, including a neutral conductor but, by convention, not a PEN conductor

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

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

Note 3 to entry: Parts, whether they are **accessible parts** or not, of **battery-operated appliances** and **batteries** not exceeding the electrical limits of B.22.3 and B.22.4, are not considered to be **live parts**.

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**3.6.5**
**tool**
screwdriver, coin or any other object that may be used to operate a screw or similar fixing means

**3.6.6**
**small part**
part, where each surface lies completely within a circle of 15 mm diameter, or part where some of the surface lies outside a 15 mm diameter circle but in such a way that it is not possible to fit a circle of 8 mm diameter on any of the surfaces

Note 1 to entry: A part that is too small to grip and at the same time to be able to apply the glow-wire tip is shown in example A in Figure 5. A part that is large enough to grip but that is too small to be able to apply the glow-wire tip is shown in example B in Figure 5. A part that is not a **small part** is shown in example C in Figure 5.

**3.6.7**
**detachable power supply part**
part of the appliance the output of which is intended to be detachable from the **class III construction** part of the appliance

Note 1 to entry: Means of detachment are a flexible cord and connector or an appliance outlet fitted to the **detachable power supply part**.

**3.6.8**
**cell**
basic functional unit, consisting of an assembly of electrodes, electrolyte, container, terminals, and usually separators that is a source of electric energy obtained by direct conversion of chemical energy

[SOURCE: IEC 60050-482:2004, 482-01-01]

**3.6.9**
**battery**
assembly of one or more **cells** ready for use as a source of electrical energy, characterised by its voltage, size, terminal arrangement, capacity and rate capability

Note 1 to entry: A **detachable battery** and **separable battery** have an enclosure that is equivalent in properties to that of the appliance itself, but **integral batteries** may have no enclosure or an enclosure less substantial than that of the appliance, as they are protected by the enclosure of the appliance.

**3.6.10**
**detachable battery**
rechargeable **battery** in an enclosure separate from the **battery-operated appliance**, intended for use with specific appliances and intended to be removed from the appliance for charging purposes

Note 1 to entry: A standard automotive **battery** is not considered a **detachable battery**.

Note 2 to entry: A **detachable battery** is not considered a **battery** that is replaceable.

**3.6.11**
**separable battery**
**battery** contained in an enclosure separate from the **battery-operated appliance,** intended for use with specific appliances and connected to the appliance by a cord external to the enclosure of the appliance

Note 1 to entry: A standard automotive **battery** is not considered a **separable battery**.

Note 2 to entry: A **separable battery** is not considered a **battery** that is replaceable.

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**3.6.12**
**integral battery**
**battery** contained within the **battery-operated appliance** and not removed from the appliance for charging purposes

Note 1 to entry: A **battery** that is only to be removed from the **battery-operated appliance** for disposal or recycling is still considered to be an **integral battery**.

## 3.7 Definitions relating to safety components

**3.7.1**
**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

**3.7.2**
**temperature limiter**
temperature-sensing device, the operating temperature of which may be either fixed or adjustable and which during **normal operation** operates by opening or closing a circuit when the temperature of the controlled part reaches a pre-determined value

Note 1 to entry: A **temperature limiter** does not make the reverse operation during the normal duty cycle of the appliance. It may or may not require manual resetting.

**3.7.3**
**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 is constructed so that its setting cannot be altered by the user

**3.7.4**
**self-resetting thermal cut-out**
**thermal cut-out** that automatically restores the current after the relevant part of the appliance has cooled down sufficiently

**3.7.5**
**non-self-resetting thermal cut-out**
**thermal cut-out** that requires a manual operation for resetting, or replacement of a part, in order to restore the current

Note 1 to entry: Manual operation includes disconnection of the appliance from the supply mains.

**3.7.6**
**protective device**
device, the operation of which prevents a hazardous situation under abnormal operation conditions

**3.7.7**
**thermal link**
**thermal cut-out** which operates only once and requires partial or complete replacement

**3.7.8**
**intentionally weak part**
part intended to rupture under conditions of abnormal operation to prevent the occurrence of a condition which could impair compliance with this standard

Note 1 to entry: 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 a **thermal link** that is not an **accessible part** incorporated in a motor.

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## 3.8 Definitions relating to miscellaneous matters

**3.8.1**
**all-pole disconnection**
disconnection of both supply conductors by a single initiating action or, for multi-phase appliances, disconnection of all supply conductors by a single initiating action

Note 1 to entry: For multi-phase appliances, the neutral conductor is not considered to be a supply conductor.

**3.8.2**
**off position**
stable position of a switching device in which the circuit controlled by the switch is disconnected from its supply or, for electronic disconnection, the circuit is de-energized

Note 1 to entry: The **off position** does not imply an **all-pole disconnection**.

**3.8.3**
**visibly glowing heating element**
heating element that 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

**3.8.4**
**PTC heating element**
element intended for heating consisting mainly of positive temperature coefficient resistors that are thermally sensitive and have a rapid non-linear increase in resistance when the temperature is raised through a particular range

**3.8.5**
**user maintenance**
any maintenance operation stated in the instructions for use, or marked on the appliance, that the user is intended to perform

**3.8.6**
**room temperature**
ambient temperature specified in the general conditions for the tests

Note 1 to entry: The ambient temperature is specified in 5.7.

## 3.9 Definitions relating to electronic circuits

**3.9.1**
**electronic component**
part in which conduction is achieved principally by electrons moving through a vacuum, gas or semiconductor

Note 1 to entry: Neon indicators are not considered to be **electronic components**.

**3.9.2**
**electronic circuit**
circuit incorporating at least one **electronic component**

**3.9.3**
**protective electronic circuit**
**electronic circuit** that prevents a hazardous situation under abnormal operating conditions

Note 1 to entry: Parts of the circuit may also be used for functional purposes.

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## 3.10 Definitions relating to battery charging and discharging

**3.10.1**
**battery system**
system that includes a **battery**, **charging system** and the **battery-operated appliance**

Note 1 to entry: The **battery system**, including interfaces, may contain more than one **battery** and **charging system.**

**3.10.2**
**charging system**
circuitry that charges and maintains the state of charge of the **battery**

Note 1 to entry: Parts of the **charging system** may perform other functions such as charge balancing and may be separately enclosed.

**3.10.3**
**specified operating region for charging**
region during charging in which a **cell** operates within its voltage and current range as specified by the **cell** manufacturer

Note 1 to entry: An example of a specified operating region of a lithium-ion **cell** during charging is shown in Figure 14.

**3.10.4**
**upper limit charging voltage**
highest charging voltage in the **specified operating region for charging**

**3.10.5**
**venting**
condition intended by design that occurs when a **cell** provides a controlled release of excessive internal pressure without expulsion of major components of the **cell**

**3.10.6**
**fully charged**
at the maximum state of charge

Note 1 to entry: For **cells** and **batteries** that are rechargeable, this is the maximum state of charge permitted by the **charging system**.

Note 2 to entry: The maximum state of charge for **non-rechargeable batteries** and **batteries** that are rechargeable is specified in the artificial source characteristics of Table B.1.

**3.10.7**
**fully discharged**
discharged at a steady rate of current to attain, at 5 h of steady discharge ($C_5$ rate), or the fastest discharge rate allowed by the **cell** manufacturer or **battery** manufacturer if it is slower than the $C_5$ rate, until

– discharge terminates due to operation of discharge termination circuitry; or

– the **battery** (or **cell**) reaches a total voltage with an average voltage per **cell** equal to the end-of-discharge voltage for the **cell** chemistry being used, unless a different end of discharge voltage is specified by the **cell** manufacturer

Note 1 to entry: Examples of the end-of-discharge voltages for **fully discharged** common **cell** chemistries are typically

– 0,9 V/**cell** for nickel cadmium;
– 0,9 V/**cell** for nickel metal-hydride;
– 1,75 V/**cell** for lead-acid;
– 2,5 V/**cell** for lithium iron-phosphate;

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– 3,0 V/**cell** for lithium cobalt-oxide.

## 3.11 Definitions relating to remote functionality

**3.11.1**
**entity**
person, device, appliance, product, or service that interacts with an appliance

**3.11.2**
**message**
data which is transmitted from a sender (data source) to one or more receivers (data sink)

**3.11.3**
**public network**
network carrying digital data or analogue signals or both where access to the data and signals is not restricted by the physical space within the household or similar use environment of the appliance

Note 1 to entry: Determination of confinement to the physical space includes consideration of the network's range of communication, configuration, or construction.

For the purposes of this standard, examples of **public networks** include but are not limited to:

– PAN (personal area network);
– LAN (local area network) connected devices which may or may not be connected to a gateway,
– PLC (power line communication);
– SRD (short range devices);
– WAN (wide area network);

For the purposes of this standard, examples of networks which are not considered as being **public networks** include but are not limited to:

– NFC (near field communication);
– optical communication with line of sight (infra-red rays or visual rays);
– hardwired configurations constructed of physical media;

without connection to a **public network**.

**3.11.4**
**remote communication**
transmission of data between the appliance and an **entity** that can be initiated out of sight of the appliance, using communication means such as radio wave modulation, sound wave modulation or bus systems

Note 1 to entry: Examples of transmission of data includes but are not limited to remote monitoring, software downloading or control parameter modifications.

Note 2 to entry: Transmission of data can be one-way (simplex) or two-way (duplex).

**3.11.5**
**remote operation**
control of an appliance by **remote communication**

Note 1 to entry: **Remote communication** that results in a change of appliance operation, such as change of rotational speed, temperature, spatial movement, start/stop of the intended function, is considered **remote operation**. It is possible to have **remote communication** that does not lead to **remote operation.**

Note 2 to entry: A line of sight infra-red signal by itself is not considered one used for **remote operation**.

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## 4 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.*

## 5 General conditions for the tests

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

**5.1** *Tests according to this standard are type tests*.

NOTE Routine tests are described in informative Annex A.

**5.2** *The tests are carried out on a single appliance that shall withstand all the relevant tests. However, the tests of Clauses 12, 20, 22 (except 22.10, 22.11 and 22.18) to 26, 28, 30 and 31 may be carried out on separate appliances. The test of 22.3 is carried out on a new appliance.*

*If an **intentionally weak part** becomes open circuit during the tests of Clause 19, an additional appliance may be needed.*

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

*If the test of normative Annex C has to be carried out, six samples of the motor are needed.*

*If the test of normative Annex D has to be carried out, an additional appliance may be used.*

*If the tests of normative Annex G are carried out, four additional transformers are needed.*

*If the tests of normative Annex H are carried out, three switches or three additional appliances are needed.*

NOTE Additional samples can be required if the appliance has to be tested under different conditions, for example if it can be supplied with different voltages.

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

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

**5.3** *The tests are carried out in the order of the clauses. However, the test of 22.11 on the appliance at **room temperature** is carried out before the tests of Clause 8. The tests of Clause 14, 21.2 and 22.24 are carried out after the tests of Clause 29. The test of 19.14 is carried out before the tests of 19.11.*

*If it is evident from the construction of the appliance that a particular test is not applicable, the test is not carried out.*

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

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

**5.6** *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.*

*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.*

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

*For appliances fitted with a voltage selector switch, the tests are carried out with the switch in the position corresponding to the* ***rated voltage*** *value used for the tests.*

**5.7** *The tests are carried out in a draught-free location 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 °C ± 2 °C in case of doubt.*

*The water temperature at the inlet is maintained between 0 °C and –5 °C of the value corresponding to the TF class of the pump.*

*For circulation pumps intended to be located within the enclosure of a boiler, the tests of Clauses 10, 11 and 13 are carried out at an ambient temperature of 55 °C or at the temperature specified in the instructions, whichever is higher.*

### 5.8 Test conditions relating to frequency and voltage

**5.8.1** *Appliances for alternating current (AC) only are tested with AC at* ***rated frequency****, and those for AC and DC are tested at the more unfavourable supply.*

*Appliances for AC that are not marked with* ***rated frequency*** *or are marked with a* ***rated frequency range*** *of 50 Hz to 60 Hz are tested with either 50 Hz or 60 Hz, whichever is the more unfavourable.*

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

*For* ***motor-operated appliances****, and* ***combined appliances****, marked with a* ***rated voltage range****, when it is specified that the supply voltage is equal to the* ***rated voltage*** *multiplied by a factor, the appliance is supplied at*

– *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****.*

*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. For* ***motor-operated appliances***

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***combined appliances*** *and 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.*

**5.8.3** *For* ***heating appliances****, and* ***combined appliances****, marked with a* ***rated power input range****, when it is specified that the power input is equal to the* ***rated power input*** *multiplied by a factor, the appliance is operated at*

– *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****.*

**5.8.4** *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 appliance is operated at:*

– *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****.*

**5.9** *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.*

**5.10** *The tests are carried out 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.*

*A* ***class III construction*** *part of the appliance is tested connected to its* ***detachable power supply part*** *taking into account 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.*

*If* ***batteries*** *intended for use with the appliance use metal-ion chemistry, the manufacturer or responsible agent shall provide the following information for each type of* ***battery***

– *end-of-discharge voltage;*
– ***upper limit charging voltage****, for* ***batteries*** *comprising series connected* ***cells****;*
– *rated capacity of the* ***battery*** *($C_5$ Ah).*

*If* ***cells*** *intended for use with the appliance use metal-ion chemistry, the manufacturer or responsible agent shall provide the* ***specified operating region for charging*** *for each type of* ***cell****.*

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**5.11** *Appliances intended to be connected to fixed wiring by means of a flexible cord are tested with the appropriate flexible cord connected to the appliance.*

**5.12** *For **heating appliances** and **combined appliances**, when 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 heating elements with appreciable positive temperature coefficient of resistance, 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.

**5.13** *The tests for appliances with **PTC heating elements** and for **heating appliances** and **combined appliances** where the heating elements are supplied via a switch mode power supply are carried out 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.*

**5.14** *If **class 0I appliances** or **class I appliances** have **accessible metal parts** that are not earthed and are not separated from **live parts** by an intermediate metal part that 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 that is earthed.*

NOTE Guidance is given in informative Annex P for enhanced requirements that can be used to ensure an acceptable level of protection against electrical and thermal hazards for particular types of appliances used in an installation without a protective earthing conductor in countries that have tropical climates.

**5.15** *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**.*

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

**5.17** ***Battery-operated appliances** and remote controls containing **batteries** are tested in accordance with normative Annex B.*

***Battery-operated appliances** having a functional earth connection or a supply connection are tested in accordance with the relevant clauses of the main part of this standard and normative Annex B.*

NOTE A supply connection can include a mains connection.

***Battery-operated appliances** having a supply connection are considered dual supply appliances. Dual supply appliances are regarded as **battery-operated appliances** when deriving their energy from **batteries**.*

***Separable batteries** and **detachable batteries** for **battery-operated appliances** are tested in accordance with normative Annex B.*

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**5.18** *To condition **batteries** that are rechargeable, the **batteries** shall be **fully discharged** and then **fully charged** in accordance with the appliance manufacturer's instructions. The sequence shall be repeated at least 2 h after the **battery** was charged.*

*For **batteries** where there is a series arrangement of parallel clusters of **cells**, the cluster shall be treated as a single **cell** for those tests that require altering the amount of charge on a single **cell** prior to conducting the test.*

**5.19** *Measurements of **cell** voltages or **battery** voltages shall be made using a single pole resistive-capacitive low pass filter with a –3 dB roll off frequency of 5 kHz ± 0,5 kHz. To determine if the **upper limit charging voltage** has been exceeded, the peak value of the filtered voltage shall be measured with a tolerance of ±1 %.*

*When measuring **cell** voltages or **battery** voltages, the peak value of any superimposed ripple exceeding 10 % of the average value shall be included. Transient voltages are ignored, such as a temporary increase of voltage, for example, after the **battery** is removed from the **charging system**.*

**5.20** *If linear and angular dimensions are specified without a tolerance, ISO 2768-1 is applicable.*

**5.21** *Probes are applied with a force not exceeding 1 N.*

**5.22** *If a component or part of the appliance has both a **self-resetting feature** and a **non-self-resetting feature** and if the **non-self-resetting feature** is not required in order to comply with this standard, then appliances incorporating such a component or part shall be tested with the **non-self-resetting feature** rendered inoperative.*

**5.101** *Circulation pumps having a three-phase motor that does not incorporate a **protective device** are installed with an appropriate device, in accordance with the instructions.*

## 6 Classification

**6.1** Circulation pumps shall be **class I**, **class II** or **class III.**

If an appliance consists of a part of **class III construction** and a **detachable power supply part**, the complete appliance is classified as a **class I appliance** or **class II appliance** in accordance with the classification applicable to its **detachable power supply part**.

*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.

Circulation pumps shall be at least IPX2.

*Compliance is checked by inspection and by the relevant tests.*

NOTE The degrees of protection against harmful ingress of water are given in IEC 60529:1989 including IEC 60529:1989/AMD1:1999 and IEC 60529:1989/AMD2:2013.

**6.101** Circulation pumps shall be of one of the classes shown in Table 101.

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**Table 101 – Temperature classification of circulation pumps**

| Class | Maximum temperature of the circulating water<br>°C |
|---|---|
| TF 60 | 60 |
| TF 95 | 95 |
| TF 110 | 110 |
| NOTE TF means Temperature of the Fluid. | |

*Compliance is checked by inspection.*

## 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 **rated current** in amperes;
– name, trade mark or identification mark of the manufacturer or responsible vendor;
– model or type reference;
– symbol IEC 60417-5172 (2003-02) for **class II appliances** only;
– IP number according to degree of protection against ingress of water, other than IPX0;
– symbol IEC 60417-5180 (2003-02), for **class III appliances**. This marking is not necessary for appliances operated only by **batteries** (primary **batteries** or secondary **batteries** recharged outside of the appliance) or appliances powered by **rechargeable batteries** recharged in the appliance.

NOTE If the appliance is marked with rated pressure, the units used can be bars but only together with pascals and placed in brackets.

Appliance outlets accessible to the user and socket-outlets accessible to the user:

– that are incorporated in appliances connected to the supply mains; and
– that operate at **rated voltage**

shall be marked with their **outlet load** in watts or amperes.

Appliances intended to be supplied from a **detachable power supply part** for the purposes of recharging the **battery** shall be marked with symbol ISO 7000-0790 (2004-01). They shall also be marked with symbol IEC 60417-6181 (2016-01) and the model or type reference of the **detachable power supply part** or with the substance of the following:

Use only with <model or type reference> supply unit

**Class II appliances** and **class III appliances** incorporating a functional earth shall be marked with the symbol IEC 60417-5018 (2011-07).

The enclosure of electrically-operated water valves incorporated in external hose-sets for connection of an appliance to the water mains shall be marked with symbol IEC 60417-5036 (2002-10) if their **working voltage** exceeds **extra-low voltage**.

Circulation pumps shall be marked with

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- the TF class;
- the direction of the water flow;
- the direction of rotation (for pumps having three-phase motors);
- the **rated current** (for pumps having three-phase motors if a **protective device** has to be installed in the fixed wiring).

*Compliance is checked by inspection.*

**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 V – 230 V: The appliance is suitable for any value within the marked range (a curling iron with a **PTC heating element** or an appliance incorporating an input switch mode power supply).

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

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

NOTE 3 Example: 230 V ∼/400 V 3N∼: The appliance is only suitable for the voltage values indicated, 230 V∼ being for single-phase, AC operation and 400 V 3N∼ for three-phase, AC with neutral operation (an appliance with terminals for both supplies).

*Compliance is checked by inspection.*

**7.4** If the appliance can be adjusted for different **rated voltages** or **rated frequencies**, the voltage or the frequency to which the appliance is adjusted shall be clearly discernible. If frequent changes in voltage setting or frequency setting are not required, this requirement is considered to be met if the **rated voltage** or **rated frequency** 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 that has to be removed to connect the supply conductors. It shall not 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 one or more **rated voltage ranges**, the **rated power input** or **rated current** 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 arithmetic mean value of the range, the marking for **rated power input** or **rated current** may be related to the arithmetic mean value of the range.

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

*Compliance is checked by inspection.*

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

| | | |
|---|---|---|
| ⎓ | [symbol IEC 60417-5031 (2002-10)] | direct current |
| ∼ | [symbol IEC 60417-5032 (2002-10)] | alternating current |
| 3 ∼ | [symbol IEC 60417-5032-1 (2002-10)] | three-phase alternating current |
| 3N ∼ | [symbol IEC 60417-5032-2 (2002-10)] | three-phase alternating current with neutral |
| | [symbol IEC 60417-5016 (2002-10)] | fuse-link |

NOTE 1 The current rating of the fuse link can be indicated in association with this symbol.

| | | |
|---|---|---|
| x | | time-lag miniature fuse-link where X is the symbol for the time/current characteristic as given in IEC 60127 |
| | [symbol IEC 60417-5019 (2006-08)] | protective earth |
| | [symbol IEC 60417-5018 (2011-07)] | functional earthing |
| | [symbol IEC 60417-5172 (2003-02)] | **class II equipment** |
| | [symbol IEC 60417-5012 (2002-10)] | Lamp |

NOTE 2 The rated wattage of the lamp can be indicated in association with this symbol.

| | | |
|---|---|---|
| | [symbol ISO 7000-0434A (2004-01)] | Caution |
| | [symbol ISO 7000-0790 (2004-01)] | read operator's manual |
| | [symbol IEC 60417-5021 (2002-10)] | Equipotentiality |
| | [symbol IEC 60417-5036 (2002-10)] | dangerous voltage |
| III | [symbol IEC 60417-5180 (2003-02)] | **Class III appliance** |

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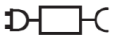

[symbol IEC 60417-6181 (2016-01)] **detachable power supply part**

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

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.

Units of physical quantities and their symbols shall be those of the international standardized system.

Additional symbols are allowed provided that they do not give rise to misunderstanding.

Symbols specified in IEC 60417 and ISO 7000 may be used.

*Compliance is checked by inspection.*

**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.

The correct mode of connection for multi-phase appliances is considered to be obvious if the terminals for the supply conductors are

– indicated by arrows pointing towards the terminals; or
– marked in words.

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

*Compliance is checked by inspection.*

**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 symbol IEC 60417-5019 (2006-08);
– functional earthing terminals shall be indicated by symbol IEC 60417-5018 (2011-07).

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

*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.*

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**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. 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 higher value, such as output, input, speed or cooling effect, 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**. The figure 0 may be used on a digital programming keyboard.

*Compliance is checked by inspection.*

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

NOTE An indication of + and – is considered to be sufficient.

*Compliance is checked by inspection.*

**7.12** The instruction concerning persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge is not applicable.

The instruction regarding supervision of children is not applicable.

**7.12.1** If it is necessary to take precautions during installation of the appliance, appropriate details shall be given.

If an appliance is intended to be permanently connected to the water mains and not connected by a hose-set, this shall be stated.

For appliances marked with different **rated voltages** or different **rated frequencies** (separated by a /), instructions shall be included to indicate to the user or installer what action must be taken to adjust the appliance for operation at the required **rated voltage** or **rated frequency**.

The installation instructions shall include the following:

– the maximum flow rate or total head;
– the maximum ambient temperature at which the pump is to be used;
– the maximum system pressure, which shall not be less than:
  - 0,6 MPa for pumps for heating systems;
  - 1,0 MPa for pumps for service water systems;
– the intended orientation of the pump;
– for pumps having a three-phase motor not incorporating a **protective device**, the substance of the following:

  A protective device is to be installed in the fixed wiring and its characteristics are to be specified.

– for the thermal insulation of circulation pumps in heating systems, the substance of the following:

  Only the supplied kit or a kit made available by the manufacturer shall be used. It shall be ensured that the drain openings are not sealed after installation of the thermal insulation.

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For circulation pumps intended for permanent connection to fixed wiring, delivered with a separate connector to ease the installation and establish the supply connection, the instructions shall state the substance of the following:

Only use the supplied connector when installing the circulation pump.

*Compliance is checked by inspection.*

**7.12.2** If a **stationary appliance** is not fitted with a **supply cord** and a plug, or with other means for disconnection from the supply mains having a contact separation in all poles that provide full disconnection under overvoltage category III conditions, the instructions shall state that means for disconnection must be incorporated in the fixed wiring in accordance with the wiring rules.

*Compliance is checked by inspection.*

**7.12.3** If the insulation of the fixed wiring supplying an appliance for permanent connection to the supply mains can come into contact with parts having temperature rise exceeding 50 K during the test of Clause 11, the instructions shall state that the fixed wiring insulation must be protected, for example, by insulating sleeving having an appropriate temperature rating.

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

**7.12.4** The instructions for **built-in appliances** shall include 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 structure;
– minimum dimensions of ventilating openings and their correct arrangement;
– connection of the appliance to the supply mains and the interconnection of any separate components;
– necessity to allow disconnection of the appliance from the supply after installation, unless the appliance incorporates a switch complying with 24.3. The disconnection may be achieved by having the plug accessible or by incorporating a switch in the fixed wiring in accordance with the wiring rules.

*Compliance is checked by inspection.*

**7.12.5** For appliances with **type X attachment** having a specially prepared cord, the instructions shall contain the substance of the following:

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**, the instructions shall contain the substance of the following:

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

For appliances with **type Z attachment**, the instructions shall contain the substance of the following:

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

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If a cord set is required to be provided with the appliance according to Subclause 22.58, the instructions shall contain the substance of the following:

> If the cord set is damaged, it must be replaced by a special cord set available from the manufacturer or its service agent.

*Compliance is checked by inspection.*

**7.12.6** If a **non-self-resetting thermal cut-out** is required in order to comply with this standard, then the instructions for appliances incorporating a **non-self-resetting thermal cut-out** that is reset by disconnection of the supply mains shall contain the substance of the following:

> CAUTION: In order to avoid a hazard due to inadvertent resetting of the thermal cut-out, this appliance must not be supplied through an external switching device, such as a timer, or connected to a circuit that is regularly switched on and off by the utility.

*Compliance is checked by inspection.*

**7.12.7** The instructions for **fixed appliances** shall state how the appliance is to be fixed to its support. The method of fixing stated is not to depend on the use of adhesives since they are not considered to be a reliable fixing means.

*Compliance is checked by inspection.*

**7.12.8** The instructions for appliances connected to the water mains shall state:

– the maximum inlet water pressure, in pascals;
– the minimum inlet water pressure, in pascals, if this is necessary for the correct operation of the appliance.

The instructions for appliances connected to the water mains by **detachable hose-sets** shall state that the new hose-sets supplied with the appliance are to be used and that old hose-sets should not be reused.

*Compliance is checked by inspection.*

**7.12.9** For each language, the instructions specified in 7.12 and from 7.12.1 to 7.12.8 shall be in hard copy form and shall appear together before any other instructions supplied with the appliance. Alternatively, these instructions may be supplied with the appliance separately from any functional use booklet. They may follow the description of the appliance that identifies parts, or follow the drawings/sketches common to the languages of the instructions.

In addition, instructions shall also be available in an alternative format such as on a website or on request from the user in a format such as a DVD.

*Compliance is checked by inspection.*

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

*Compliance is checked by inspection.*

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**7.14** The markings required by this standard shall be clearly legible.

The signal words WARNING, CAUTION, DANGER if in the Latin alphabet shall be in uppercase having a height not less than:

– 3,5 mm for appliances normally used on the floor;

– 2,0 mm for **portable appliances** with a printable surface of less than 10 $cm^2$; and

– 3,0 mm for other appliances.

NOTE A height of 3,5 mm is similar to Arial 14 pt, 3,0 mm is similar to 12 pt Arial and 2,0 mm is similar to 8 pt Arial. Other typefaces might differ in the pt value.

Uppercase letter of the text explaining the signal word shall be no smaller than 1,6 mm, with other letters according to the font size of the uppercase letter.

Countries that do not use the Latin alphabet need to specify the minimum size of the script to be used taking into account what is specified for the Latin alphabet.

Unless contrasting colours are used, moulded in, engraved, or stamped markings shall be either raised above or have a depth below the surface of at least 0,25 mm.

The markings required by this standard shall be durable. On containers that are likely to be cleaned frequently, the markings shall not be by means of paint or enamel, other than vitreous enamel.

*Compliance is checked by inspection, by measurement 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. The petroleum spirit to be used for the test is aliphatic solvent hexane.*

*After all the tests of this standard, the marking shall be clearly legible. It shall not be easily possible to remove marking plates nor shall they show curling.*

**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 trademark 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.

The symbol IEC 60417-5018 (2011-07) shall be placed next to the symbol IEC 60417-5172 (2003-02) or the symbol IEC 60417-5180 (2003-02) as appropriate.

The type reference of the **detachable power supply part** shall be placed next to symbol IEC 60417-6181 (2016-01).

The marking of the **outlet load** shall be on the appliance close to the appliance outlet or socket-outlet.

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*Compliance is checked by inspection.*

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

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

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

*Compliance is checked by inspection.*

## 8 Protection against access to live parts

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

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

**8.1.1** *The requirement of 8.1 applies for all positions of the appliance when it is operated as in normal use, and after the removal of **detachable parts**, unless otherwise specified.*

*Test probe B and test probe 18 of IEC 61032 are applied with a force not exceeding 1 N, 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 probe is applied to any depth that the probe 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 probe, the force on the probe in the straight position is increased to 20 N when probe B is used or 10 N when probe 18 is used. If the probe then enters the opening, the test is repeated with the probe in the angled position.*

*During the tests with test probe B, all **detachable parts** are removed except lamps located behind a **detachable cover** are not removed, provided that the appliance can be isolated from the supply mains 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.*

*During the tests with test probe 18, the appliance shall be fully assembled as in normal use without any parts removed.*

*Test probe 18 is not applied to appliances for commercial use unless they are intended to be installed in an area open to the public.*

*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 probe.*

**8.1.2** *Test probe 13 of IEC 61032 is applied with a force not exceeding 1 N through openings in **class 0 appliances**, **class II appliances** and **class II constructions**, except for those giving access to lamp caps and **live parts** in socket-outlets.*

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

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

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

**8.1.3** *Instead of test probe B, test probe 18 and test probe 13, for appliances other than those of **class II**, test probe 41 of IEC 61032 is applied with a force not exceeding 1 N 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**.*

*If a single switching action is obtained by a switching device, the switching device shall provide full disconnection and the **clearances** for full disconnection specified in 20.3.3 of IEC 61058-1:2016 shall be obtained from Table 12 of IEC 61058-1:2016 using the next higher step for rated impulse withstand voltage.*

*For appliances provided with a **supply cord** and without a switching device in their supply circuit, a single switching action may be obtained by the withdrawal of the plug from a socket-outlet.*

*Compliance is checked by inspection and by manual test.*

**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 AC, the peak value of the voltage does not exceed 42,4 V;
  - for DC, the voltage does not exceed 42,4 V;

or

– the part is separated from **live parts** by **protective impedance**.

If **protective impedance** is used, the current between the part and the supply source shall not exceed 2 mA for DC, its peak value shall not exceed 0,7 mA for AC and

– 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;
– for voltages having a peak value over 15 kV, the energy in the discharge shall not exceed 350 mJ.

*Compliance is checked by measurement, the appliance being 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. The quantity of electricity and energy in the discharge is measured using a resistor having a nominal non-inductive resistance of 2 000 Ω.*

*The quantity of electricity is calculated from the sum of all areas recorded on the voltage/time graph without taking voltage polarity into account. Details of a suitable circuit for measuring the current are given in Figure 4 of IEC 60990:2016.*

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**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 applying test probe B of IEC 61032 as specified in 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 probes specified in 8.1.1 in accordance with the conditions specified in 8.1.1.*

**8.3** For a **battery-operated appliance** where the **battery** circuit has a functional earth connection or a supply connection, it shall only be possible to touch parts within a **battery** compartment where:

– in **class I appliances**, **class 0I appliances** and **class II appliances**, they are separated from **live parts** by **double insulation** or **reinforced insulation**;
– in **class 0 appliances**, they are separated from **live parts** by **basic insulation**;
– the **battery** compartment is of **class III construction**. However, if the limits in 8.1.4 are exceeded, then **basic insulation** is required in addition to supply at **SELV**.

*Compliance is checked by inspection and by applying the test probes specified in 8.1.1 in accordance with the conditions specified in 8.1.1.*

## 9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

## 10 Power input and current

**10.1** If an appliance is marked with **rated power input**, the power input 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<br>W | Deviation |
|---|---|---|
| All appliances | ≤25 | +20 % |
| **Heating appliances** and **combined appliances** | >25 and ≤200 | ±10 % |
| | >200 | +5 % or 20 W (whichever is the greater)<br>–10 % |
| **Motor-operated appliances** | >25 and ≤300 | +20 % |
| | >300 | +15 % or 60 W (whichever is the greater) |

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The deviation for **motor-operated appliances** applies for **combined appliances** if the power input of the motors is more than 50 % of the **rated power input**. 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 arithmetic mean value of the range.

In case of doubt, the power input of the motors may be measured separately.

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

– *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 and its maximum value exceeds twice its arithmetic mean value occurring during a representative period, then the power input is the maximum value of the power input that is exceeded for more than 10 % of the representative period if this value is greater than the arithmetic mean value. Otherwise the power input is taken as the arithmetic mean value.*

NOTE *Guidance on the measurement of power input concerning a representative period is given in informative Annex S.*

*The test is carried out 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 arithmetic mean value of the relevant voltage range, in which case the test is carried out at a voltage equal to the arithmetic mean value of that range.*

*Appliance outlets accessible to the user and socket-outlets accessible to the user that:*

– *are incorporated in appliances connected to the supply mains; and*
– *operate at **rated voltage***

*are not loaded during the test; however, their contribution to the power input is considered to be the marked **outlet load** per appliance outlet or socket-outlet.*

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

**Table 2 – Current deviation**

| Type of appliance | Rated current<br>A | Deviation |
|---|---|---|
| All appliances | ≤0,2 | +20 % |
| **Heating appliances** and **combined appliances** | >0,2 and ≤1,0 | ±10 % |
| | >1,0 | +5 % or 0,10 A (whichever is the greater)<br>–10 % |
| **Motor-operated appliances** | >0,2 and ≤1,5 | +20 % |
| | >1,5 | +15 % or 0,30 A (whichever is the greater) |

The deviation for **motor-operated appliances** applies for **combined appliances** if the current of the motors is more than 50 % of the **rated current**. 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 arithmetic mean value of the range.

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In case of doubt, the current of the motors may be measured separately.

*Compliance is checked by measurement when the current has stabilized with:*

- *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 and its maximum value exceeds twice its arithmetic mean value occurring during a representative period, then the current is the maximum value of the current that is exceeded for more than 10 % of the representative period if this value is greater than the arithmetic mean value. Otherwise the current is taken as the arithmetic mean value.*

NOTE *Guidance on the measurement of current concerning a representative period is given in informative Annex S.*

*The test is carried out 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 arithmetic mean value of the relevant voltage range, in which case the test is carried out at a voltage equal to the arithmetic mean value of that range.*

*Appliance outlets accessible to the user and socket-outlets accessible to the user that:*

- *are incorporated in appliances connected to the supply mains; and*
- *operate at **rated voltage***

*are not loaded during the test; however, their contribution to the current is considered to be the marked **outlet load** per appliance outlet or socket-outlet.*

## 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.*

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

*Appliances with pins for insertion into socket-outlets are plugged into an appropriate wall-mounted socket-outlet.*

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

*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 to one of the walls, as near to the other wall and floor or ceiling as is likely to occur, taking into account the instructions;*
- *appliances normally fixed to a ceiling are fixed to the ceiling as near to the walls as is likely to occur, taking into account in the instructions.*

*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;*

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– *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.*

*Circulation pumps that are only fixed by the water pipes are positioned against one wall of the test corner and away from the other.*

**11.3** *Temperature rises, other than those of windings, are determined by means of thermocouples having a diameter not exceeding 0,3 mm positioned so that they have minimum effect on the temperature of the part under test.*

*Thermocouples used for determining the temperature rise of the surface of walls, ceiling and floor of the test corner 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.*

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

*If it is necessary to dismantle the appliance to position thermocouples, verify that the appliance has been correctly reassembled. In case of doubt, remeasure the power input or input current as appropriate.*

*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;*
– *a reduction of* ***clearances*** *or* ***creepage distances*** *below the values specified in Clause 29.*

NOTE 1 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.

*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. At the beginning of the test, the windings are to be at* ***room temperature****.*

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

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

*where*

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

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

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

*k is equal to*

- *225 for aluminium windings and copper/aluminium windings with an aluminium content ≥ 85 %,*
- *229,75 for copper/aluminium windings with an copper content > 15 % to < 85 %,*
- *234,5 for copper windings and copper/aluminium windings with an copper content ≥ 85 %;*

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

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

NOTE 2 The resistance of windings at the end of the test can 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.

*The temperatures $t_1$ and $t_2$ are the ambient temperatures of the environment in which the pump is installed, for instance inside the enclosure of a boiler.*

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

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

**11.7** *Circulation pumps are operated until steady conditions are established.*

*Appliance outlets accessible to the user and socket-outlets accessible to the user are loaded with a resistive load that gives the marked **outlet load**.*

*For appliances incorporating **integral batteries** or **separable batteries** not disconnected from the appliance for charging purposes:*

– *the **battery** that has been **fully discharged** is charged for 1 h, while the appliance is operated continuously performing its intended function, if allowed by the construction of the appliance;*
– *the **battery** that has been **fully discharged** is charged, for a duration of 24 h or until it is **fully charged** whichever is shorter, without the **battery-operated appliance** performing its intended function.*

NOTE The duration of the test can 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.*

*If the temperature rise of the motor winding exceeds the value specified in Table 3 or if there is doubt with regard to the temperature classification of the insulation of the motor, the tests of normative Annex C are carried out.*

***Protective devices** shall not operate and sealing compound shall not flow out. However, components in **protective electronic circuits** are allowed to operate provided they are tested for the number of cycles of operation specified in 24.1.4.*

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