IEC 60335-2-81

Edition 3.1 2017-10

CONSOLIDATED VERSION

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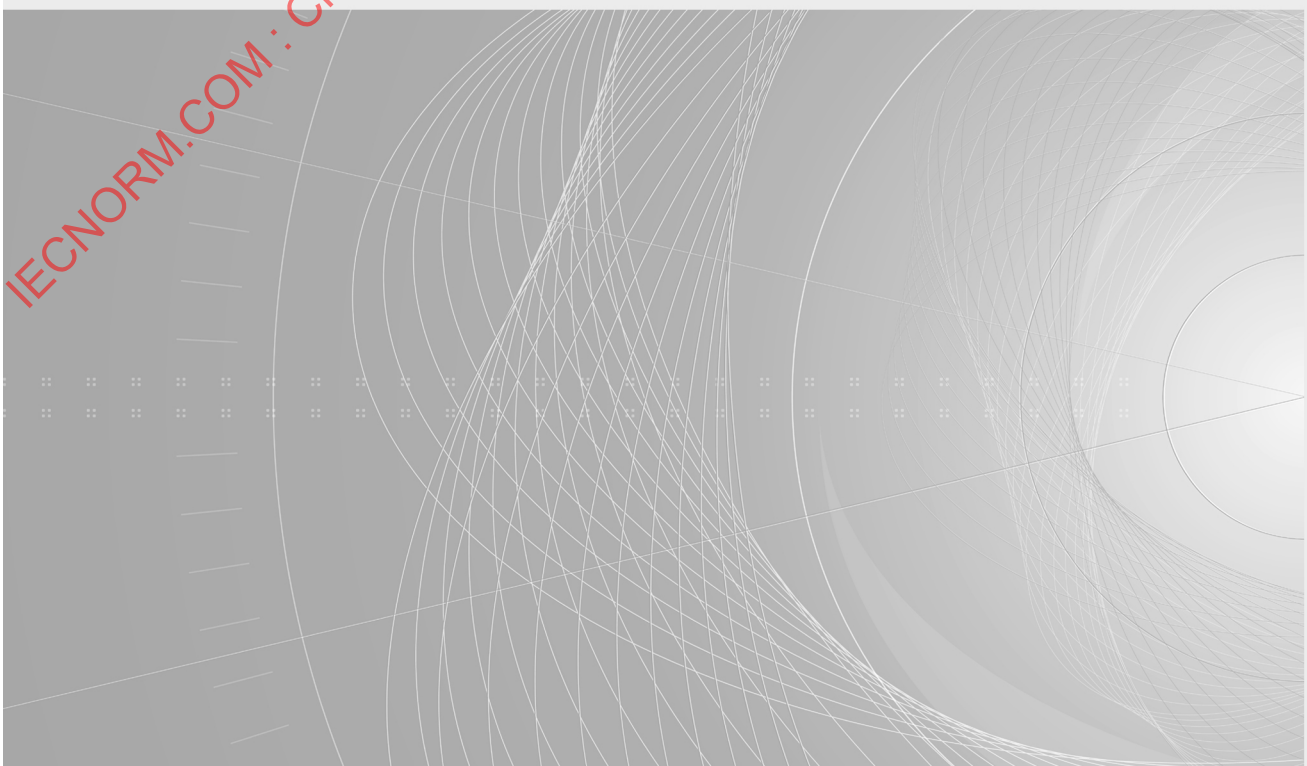
Household and similar electrical appliances – Safety – Part 2-81: Particular requirements for foot warmers and heating mats



IEC 60335-2-81:2015-04+AMD1:2017-10 CSV(en)

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Household and similar electrical appliances – Safety – Part 2-81: Particular requirements for foot warmers and heating mats

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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REDLINE VERSION

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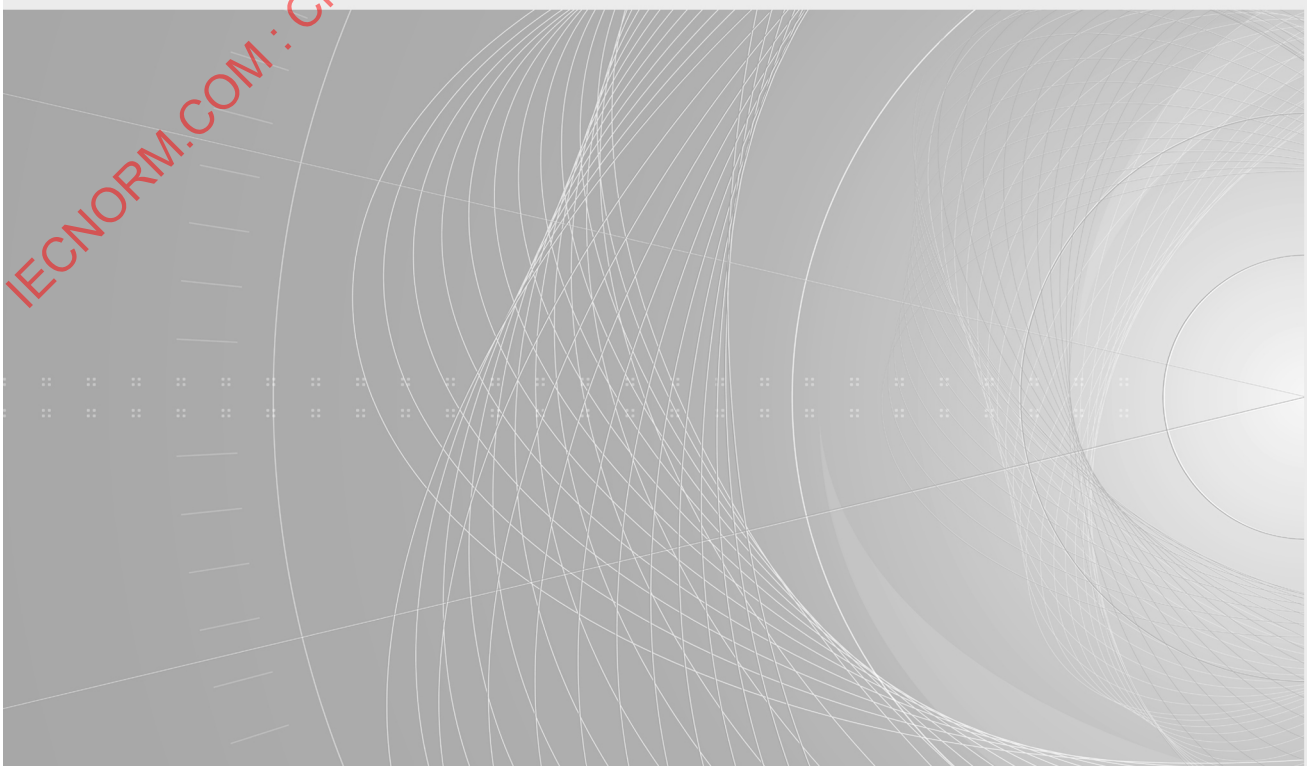

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-81: Particular requirements for foot warmers and heating mats

FOREWORD

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This Consolidated version of IEC 60335-2-81 bears the edition number 3.1. It consists of the third edition (2015-04) [documents 61/4841/FDIS and 61/4896/RVD] and its amendment 1 (2017-10) [documents 61/5292/CDV and 61/5378A/RVC]. The technical content is identical to the base edition and its amendment.

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

This part of International Standard IEC 60335 has been prepared by IEC technical committee 61: Safety of household and similar electrical appliances.

This third edition constitutes a technical revision.

The principal changes in this edition as compared with the second edition of IEC 60335-2-81 are as follows (minor changes are not listed):

- Requirements for washable appliances (5.3, 7.1, 7.6, 7.12);
- Requirements for controls in flexible cords (15.1.1, 24.2);
- Requirements for appliance inlets (22.105, 24.1.5, 29.1.3).

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of the fifth edition (2010) 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: Safety requirements for foot warmers and heating mats.

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;

– *test specifications: in italic type;*

– notes: in small roman type.

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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may 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.

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.

The following differences exist in the countries indicated below.

– 3.1.9: Normal operation is different (USA)
– 6.1: Class 0 appliances are allowed if their rated voltage does not exceed 150 V (Japan)
– 6.1: Class 0 and class I appliances are allowed (USA)
– 7.6: Symbols not permitted to replace required text (USA)
– 11.8: Temperature limit is different (USA)
– 13.2: Method and limit is different (USA)
– 19.2: The test is different (USA)
– 21.101: The test is different (USA)
– 22.101: The tests are different (USA)

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

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

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.

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 may 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 and generic standards 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. For example, in the case of temperature requirements for surfaces on many appliances, generic standards, such as ISO 13732-1 for hot surfaces, are not applicable in addition to Part 1 or part 2 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.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-81: Particular requirements for foot warmers and heating mats

1 Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of electric **foot warmers** and **heating mats** for household and similar purposes, their **rated voltage** being not more than 250 V.

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

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.

NOTE 101 Attention is drawn to the fact that

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

NOTE 102 This standard does not apply to

– appliances specifically intended for use under medical supervision;
– electric blankets and pads (IEC 60335-2-17);
– electrically heated carpets (IEC 60335-2-106);
– electrical heating appliances for breeding and rearing animals (IEC 60335-2-71).

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60320-1:2001, *Appliance couplers for household and similar general purposes – Part 1: General requirements*
IEC 60320-1:2001/AMD1:2007[1]

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1 There exists a consolidated edition 2.1 (2007) that includes the second edition and its Amendment 1.

ISO 2439, *Flexible cellular polymeric materials – Determination of hardness (indentation technique)*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1.9 *Replacement:*
normal operation
operation of the appliance under the following conditions:

Foot warmers are unfilled and placed on a horizontal surface.

Heating mats are placed on a horizontal surface and covered by a piece of expanded polystyrene having dimensions approximately 300 mm × 150 mm × 50 mm.

NOTE 101 The density of the polystyrene is approximately 20 kg/m^3 ± 5 kg/m^3.

3.101
foot warmer
appliance into which the user's feet are inserted in order to warm them

3.102
heating mat
appliance having an area not exceeding 0,5 m^2, on which the user's feet are placed in order to warm them

3.103
heating element with PTC characteristics
heating element of the appliance consisting of a pair of conductors separated by conductive material that has a rapid non-linear increase in resistance when the temperature is raised through a particular range

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.2 *Addition:*

A 15 m length of heating element or internal wiring is required for the tests of 21.102.

*Twelve samples of the enclosure material of **foot warmers**, each having dimensions 200 mm × 100 mm, are required for the test of 30.101.*

5.3 *Addition:*

Washable appliances are laundered twice in accordance with the instructions before testing is started.

*The tests of Clauses 13, 15 and 16 are not carried out on **Class III appliances** having a **rated voltage** not exceeding 24 V or on **Class III constructions** having a **working voltage** not exceeding 24 V.*

5.5 *Addition:*

*If the appliance is provided with a **detachable cover**, the tests are carried out with or without this cover, whichever is more unfavourable.*

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 *Modification:*

Appliances shall be **class II** or **class III**.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 *Addition:*

Washable appliances shall be marked with symbol ISO 7000-3114 (2012-04) and with symbol ISO 7000-3124 (2012-04).

7.6 *Addition:*

[symbol ISO 7000-3114 (2012-04)] Do not dry clean

[symbol ISO 7000-3124 (2012-04)] Do not bleach

7.12 *Addition:*

The instructions shall state the substance of the following:

– the appliance is not to be used if there are signs of damage;
– the appliance is not to be used for warming animals;
– details regarding laundering or cleaning.

The instructions for **foot warmers** shall state that outdoor shoes must be removed before use.

The instructions for **heating mats** shall state that the appliance has to be repaired or replaced if the cover is worn. They shall explain how such wear can be observed.

The instructions for **foot warmers** intended to be used after preheating without supply and incorporating an appliance inlet shall state that the cord set must be disconnected from the supply after preheating.

If symbol ISO 7000-3114 (2012-04) and symbol ISO 7000-3124 (2012-04) are used, their meaning shall be explained.

8 Protection against access to live parts

This clause of Part 1 is applicable.

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is applicable except as follows.

10.101 The power input of appliances incorporating **heating elements with PTC characteristics** shall significantly decrease with an increase in temperature.

Compliance is checked by the following test.

*The appliance is supplied at **rated voltage** and operated under **normal operation**. The power input shall have decreased by at least 50 % from the initial value when steady conditions are established, any control operating during this period being short-circuited.*

11 Heating

This clause of Part 1 is applicable except as follows:

11.2 *Modification:*

Appliances are placed as near as possible to one wall of the test corner and away from the other wall.

11.3 *Addition:*

Thermocouples attached to the small blackened disks are also used for measuring the temperature rise of the surface of the appliance.

11.7 *Replacement:*

Appliances are operated until steady conditions are established.

11.8 *Modification:*

When polyvinyl chloride is used for insulating heating elements, the temperature rise of the insulation shall not exceed 80 K.

Addition:

The temperature rise of surfaces likely to be in contact with the user's feet shall not exceed 40 K.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

13.2 *Modification:*

*When testing the top surface of **heating mats**, the dimensions of the metal foil are 300 mm × 150 mm.*

NOTE 101 If the **heating mat** is reversible, each surface is tested in turn.

Addition:

***Foot warmers** are also tested with the inside surface completely covered with metal foil.*

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.1.1 *Addition:*

Appliances are subjected to the test of IEC 60529 as described in Subclause 14.2.1. However, cord sets, switches and controls in the flexible cord are not subjected to the tests.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.2 *Modification:*

*When testing the top surface of **heating mats**, the dimensions of the metal foil are 300 mm × 150 mm.*

NOTE 101 If the **heated mat** is reversible, each surface is tested in turn.

Addition:

***Foot warmers** are also tested with the inside surface completely covered with metal foil.*

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is not applicable.

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.2 *Addition:*

The appliance is covered partially or completely, whichever is more unfavourable, with a sheet of open-cell polyether approximately 36 mm thick, having the following properties:

– *cell count* $18\ ^{+2}_{0}$ *per cm;*

– *specific mass* $30\ kg/m^3 + ^{+10}_{0}\ \%$;

– *hardness* *120 N to 170 N at 40 % impression, measured according to ISO 2439.*

*If the **foot warmer** has a flexible part that covers the user's legs, this part is folded onto the foot part before covering.*

*A plywood board, having dimensions approximately 500 mm × 500 mm × 20 mm, is placed on top of the polyether sheet covering **foot warmers**.*

19.4 *Modification:*

***Heating mats** are tested without being covered by the polystyrene block.*

19.13 *Addition:*

The temperature rise of the insulation of heating elements shall not exceed 145 K.

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

21.1 *Addition:*

***Foot warmers** are also subjected to the test of 21.101.*

21.2 *Addition:*

This requirement is not applicable to textiles and similar materials forming the enclosure.

21.101 *A plywood board, having dimensions approximately 300 mm × 150 mm × 20 mm with rounded edges, is placed in the leg section of the **foot warmer** as shown in Figure 101. A load of 30 kg is placed on the board, which is allowed to drop freely from a height of 200 mm above the base, so that the leg section is flexed and the appliance is compressed between the board and the supporting surface. The total mass of the board, its movable support and the load is 30 kg. If the **foot warmer** does not have a leg section, the board is allowed to fall onto the top surface.*

The test is carried out 1 000 times at a rate of six times per minute.

The test shall not result in

- *damage to the enclosure or displacement of heating elements to such an extent that compliance with the standard is impaired;*
- *open-circuiting of heating elements or controls;*
- *breakage of more than 10 % of the strands of internal wiring;*
- *failure of constructional stitching, or breakage of glued or welded joints, to such an extent that compliance with the standard is impaired.*

NOTE An example of damage to the enclosure that could impair compliance with the standard is a tear in the enclosure. Small holes in textiles that are not part of electrical insulation or do not provide protection against moisture are ignored.

21.102 The insulation of heating elements and internal wiring shall retain adequate flexibility and insulating characteristics throughout the life of the appliance.

Compliance is checked by the tests of 21.102.1 and by the tests of 21.102.2 and 21.102.3 when the insulation exceeds

- *a temperature rise of 50 K during the test of Clause 11,*

or

- *a temperature rise of 110 K during the tests of Clause 19.*

The tests are carried out on separate samples of heating element or internal wiring.

For the test of 21.102.1, one sample measuring approximately 4 m in length is required. For the tests of 21.102.2, at least 12 samples are required, each having a length of 300 mm. For the test of 21.102.3, 12 samples are required, each having a length of 300 mm.

21.102.1 *The sample of heating element or internal wiring is attached to the equipment shown in Figure 102. This equipment has a carrier with two pulleys, each having a groove with a radius of 4 mm, the diameter at the base of the groove being 25 mm. The pulleys are arranged so that the sample is horizontal where it passes between them.*

NOTE 1 For samples not having a circular cross-section, the form of the groove in the pulley is suitably modified.

The sample is stretched over the pulleys, each end being loaded with a mass of 0,25 kg. If necessary, the mass at each end is increased in steps of 0,1 kg in order to ensure that the wires leaving the pulleys are parallel to each other. Restraining clamps are positioned so that the pull is always applied by the mass in the opposite direction from which the carrier is moving.

The carrier moves over a distance of 1 m with a constant speed of approximately 0,33 m/s for 25 000 cycles.

NOTE 2 A cycle is two movements, one in each direction.

The sample shall not break during the test.

NOTE 3 A monitoring current not exceeding 50 mA can be passed through the sample during the test.

*For **heating elements with PTC characteristics**, the power input is measured before and after the test. The measurement is made with the **heating element** suspended vertically in free air and supplied at the **rated voltage** of the appliance. Both measurements are carried out at the same ambient temperature and when the power input has stabilized. The power input shall not increase during the test.*

The sample is then immersed in water containing approximately 1 % NaCl. A d.c. voltage of approximately 500 V is applied between the conductor and the saline solution.

The insulation resistance is measured 1 min after immersion and shall be at least 1 MΩ.

21.102.2 *The conductors are pulled out from 12 samples of heating element or internal wiring. If this is not possible, the insulation is slit longitudinally, the conductor is removed and the insulation allowed to close.*

Six of the samples are conditioned by suspending them vertically so that they hang freely in a heating cabinet at a temperature of 125 °C ± 2 °C for 336 h. The samples are removed from the cabinet and allowed to cool down to room temperature. When the material has stabilized, the length of the samples is measured and shall not be less than 90 % of the original length.

NOTE PVC material is considered to have stabilized by 16 h after removal from the cabinet.

The heating cabinet shall have forced air circulation in order to ensure that there is no temperature gradient over the length of the samples.

The 12 samples are placed in a tensile machine, in turn, so that the length between the clamps is at least 50 mm. The machine is operated at a uniform speed of 500 mm/min ± 50 mm/min. The force and elongation at the instant of rupture are determined.

Results obtained from any sample that ruptured at a force differing from the average value by more than 10 %, and from samples that ruptured within a distance of 15 mm from the clamp, are disregarded. Additional samples are tested in order to obtain 12 valid results.

The elongation of each of the unconditioned samples shall not be less than 100 % and their tensile strength shall not be less than 8,75 MPa.

The average value of both the elongation and tensile strength of the conditioned samples shall be not less than 75 % of the average value determined for the unconditioned samples.

21.102.3 *A 10 mm length of insulation is removed from each end of 12 samples of heating element or internal wiring.*

Six of the samples are wound in a close helix of six turns on a metal mandrel having a diameter approximately equal to the external diameter of the samples. Together with the remaining six samples, they are placed in a heating cabinet at a temperature of 125 °C ± 2 °C for 336 h. The samples are removed from the cabinet and allowed to cool down to room temperature.

When the material has stabilized, the other six samples are also wound on the mandrel in the same way.

NOTE PVC material is considered to have stabilized by 16 h after removal from the cabinet.

The heating cabinet shall have forced air circulation in order to ensure that there is no temperature gradient over the length of the samples.

*The mandrel is immersed for 1 h in water containing approximately 1 % NaCl. The samples are then subjected to a test voltage of 1 000 V for **class II appliances** and 500 V for **class III appliances**. The voltage is applied for 1 min between the conductors and the solution and there shall be no breakdown.*

The samples are unwound from the mandrel and inspection shall show that there are no visible cracks.

21.103 Heating elements with PTC characteristics shall be resistant to crushing.

Compliance is checked by the following test.

The flexible part is fully supported by a piece of plywood 20 mm thick and supplied as specified in 11.4. When steady conditions are established, the temperature of the ***heating element*** *is measured. A block having dimensions of 100 mm × 300 mm and a mass of 80 kg is applied for 5 min to the surface in the most unfavourable place. After removing the block, the appliance is again operated until steady conditions are established and the temperature of the* ***heating element*** *is measured. The temperature of the* ***heating element*** *where the block has been applied shall not have increased by more than 10 K.*

NOTE 1 The edges of the block in contact with the flexible part are rounded.

NOTE 2 The most unfavourable place to apply the block is usually at a loop in the element.

22 Construction

This clause of Part 1 is applicable except as follows.

22.101 Appliances shall be constructed so that heating elements and internal wiring are retained in their intended position. No part of the heating element shall cross over another part of the heating element.

Crossing of internal wiring shall be avoided as far as possible. When this is unavoidable, the wiring shall be secured in order to prevent any relative movement.

Compliance is checked by inspection.

22.102 There shall be no significant change in the position of the heating elements if the stitching retaining them in position is broken.

Compliance is checked by inspection after breaking the thread in the most unfavourable place.

22.103 The insulation of heating elements and internal wiring, except in **class III appliances**, shall be integral with the conductor.

Compliance is checked by inspection.

22.104 **Heating mats** shall be constructed so that exposure of insulation of heating element and internal wiring shall be readily observed.

Compliance is checked by inspection after removing other materials such as carpet pile. The colours of the insulation shall be different from the colours of the other materials.

22.105 The appliance inlet in **foot warmers** shall be positioned so that the connector is not in contact with the floor.

Compliance is checked by inspection.

23 Internal wiring

This clause of Part 1 is applicable.

24 Components

This clause of Part 1 is applicable except as follows.

24.1.3 *Modification:*

Switches are tested for 6 000 cycles of operation.

24.1.4 *Modification:*

***Thermostats** are operated for 100 000 cycles of operation and **self-resetting thermal cut-outs** for 10 000 cycles of operation.*

24.1.5 *Addition:*

All parts of IEC 60320-1 are applicable except for those that make reference to the connectors in the standard sheets of IEC 60320-1.

24.2 *Modification:*

Appliances may be fitted with switches and controls in flexible cords.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.5 *Addition:*

Type Z attachment is allowed.

25.14 *Addition:*

The test is applicable to appliances fitted with a non-detachable flexible cord. It also applies to switches and controls fitted in the flexible cord.

25.15 *Modification:*

The pull force is increased to 60 N.

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable except as follows.

29.1.3 *Addition:*

*The **clearance** between the engagement face and contact tubes of appliance couplers used for supplying the flexible part shall be at least 3,5 mm.*

29.2 *Addition:*

The microenvironment is pollution degree 3 unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution during normal use of the appliance.

29.3 *Addition:*

The requirement does not apply to the part containing heating elements.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.1 *Addition:*

The test is not applied to enclosures that are likely to be flexed in normal use.

Modification:

Parts of resilient plastic material are subjected to the pressure test of 24.1.3 of IEC 60320-1:2001 instead of the ball pressure test of IEC 60695-10-2.

NOTE 101 An example of a part of resilient plastic material is a connection block.

30.2 *Modification:*

*The test is not carried out on textiles and similar materials forming the enclosure of **foot warmers**.*

30.2.2 Not applicable.

30.2.3.2 *Addition:*

The needle-flame test is not carried out on textile materials.

30.101 Textiles and similar materials forming the enclosure of **foot warmers** shall be adequately resistant to ignition.

Compliance is checked by a spark ignition test that is carried out on six samples of the material. Each sample has dimensions approximately 200 mm × 100 mm. Any pieces of heating element and trimming are removed from the samples.

The test fixture, as shown in Figure 103, has two brass electrodes 3 mm in diameter that are supported by brass pillars mounted on a base plate of insulating material so that their axes are aligned. The base plate also supports a platform of insulating material, having dimensions

of 100 mm × 100 mm, and located centrally between the brass pillars. Provision is made for the height of the platform to be adjusted.

One of the electrodes is fixed in position while the other electrode is movable, thus allowing the sample to be inserted. The tip of the fixed electrode has an angle of 45°. The electrode is positioned so that the point furthest from the brass pillar is at the top and at a distance of approximately 3 mm from the centre of the platform. The movable electrode has a flat end.

The lower member of a two-part hardwood mask, as shown in detail A of Figure 103, is placed on the adjustable platform in the position indicated.

The test fixture, including the upper member of the mask as shown in detail B of Figure 103, is placed in a heating cabinet having a door with an inspection window, air being circulated by natural convection. The electrodes are connected in series with an adjustable non-inductive resistor to a supply having a sinusoidal output voltage of 10 kV and a characteristic such that the output voltage does not decrease by more than 100 V when a current of 1 mA is flowing.

The temperature of the heating cabinet is raised to 65 °C ± 2 °C. The electrodes are then short-circuited and the resistor adjusted so that a current of 1 mA flows. The supply is then disconnected and the samples are placed in the cabinet for a period of 3 h.

Without removing the fixture from the heating cabinet, the movable electrode is withdrawn and one sample is pulled over the fixed electrode so that the electrode is situated centrally in the space normally occupied by the heating element. The sample is adjusted so that its end is approximately level with the edge of the adjustable platform. The movable electrode is then inserted into the other end of the element space and is fixed so that the distance between the electrodes is 6,0 mm ± 0,1 mm. The sample is smoothed out and the upper member of the mask is placed in position. The door of the heating cabinet is then closed for a further period of 5 min in order to stabilise the temperature.

The supply is switched on and sparks are allowed to pass between the electrodes for a period of 2 min. If the sample ignites, the time from the instant of switching on until the flame reaches the inner edge of the mask is recorded, any ignition of surface fibres that last no more than 3 s being ignored. If the sample does not ignite, a time of 120 s is recorded.

The sample is then removed and repositioned between the electrodes with the other surface uppermost and so that the opposite end is subjected to the test.

The test is repeated on the other five samples.

If any time recorded is less than 30 s, the complete test is repeated on a second set of six samples. In this case, no sample shall have a recorded time less than 30 s.

The average of the 12 values recorded is calculated and shall not be less than 80 s. All values differing by more than 30 s from the average are ignored and, if necessary, the average of the remaining values is recalculated.

30.102 The insulation of **heating elements** and internal wiring shall be sufficiently resistant to heat and fire.

Compliance is checked by the following test.

*A sample of the **heating element** or internal wiring at least 150 mm long is supported by a grid inclined at 45°. The grid is formed from parallel wires 0,6 mm in diameter and spaced 20 mm apart. The sample is positioned perpendicular to the horizontal wires and centrally between the other wires. A second grid of similar dimensions is placed on top of the sample*

so that its horizontal wires are displaced by 10 mm from the horizontal wires of the first grid. The wires of both grids that are parallel to the sample are aligned with each other.

The grid is mounted at the centre of a three-sided metal screen in a substantially draught-free location. The screen is approximately 900 mm high, 450 mm wide and 300 mm deep, of rectangular plan with open front and closed top.

A needle flame, as specified in IEC 60695-11-5, is applied to the sample and is maintained until the insulation ceases to burn.

The length of the sample damaged by fire shall not exceed 65 mm, measured from the point where the flame is applied.

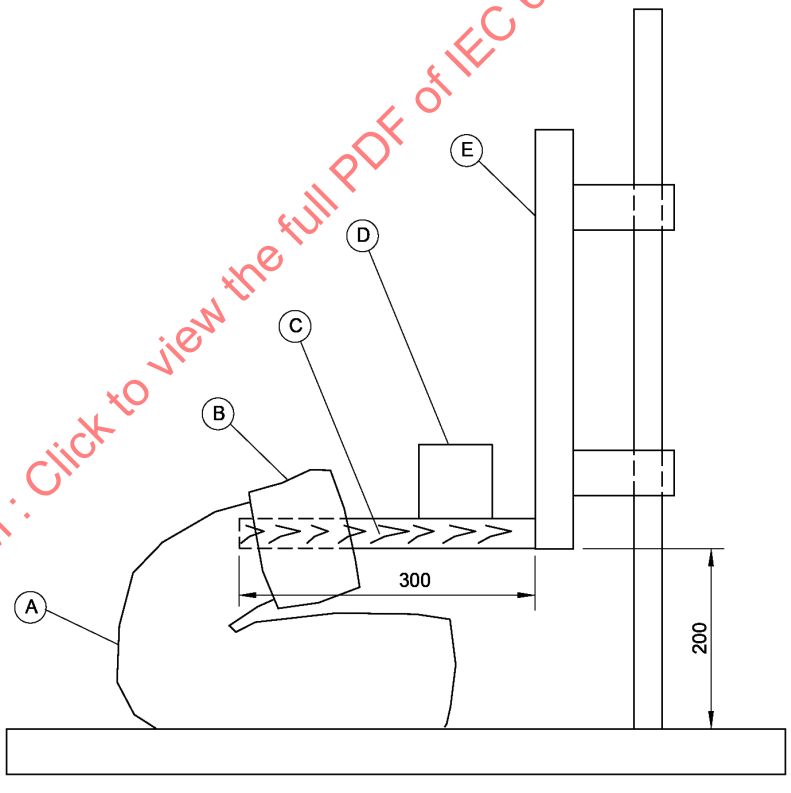
31 Resistance to rusting

This clause of Part 1 is applicable.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.

Dimensions in millimetres

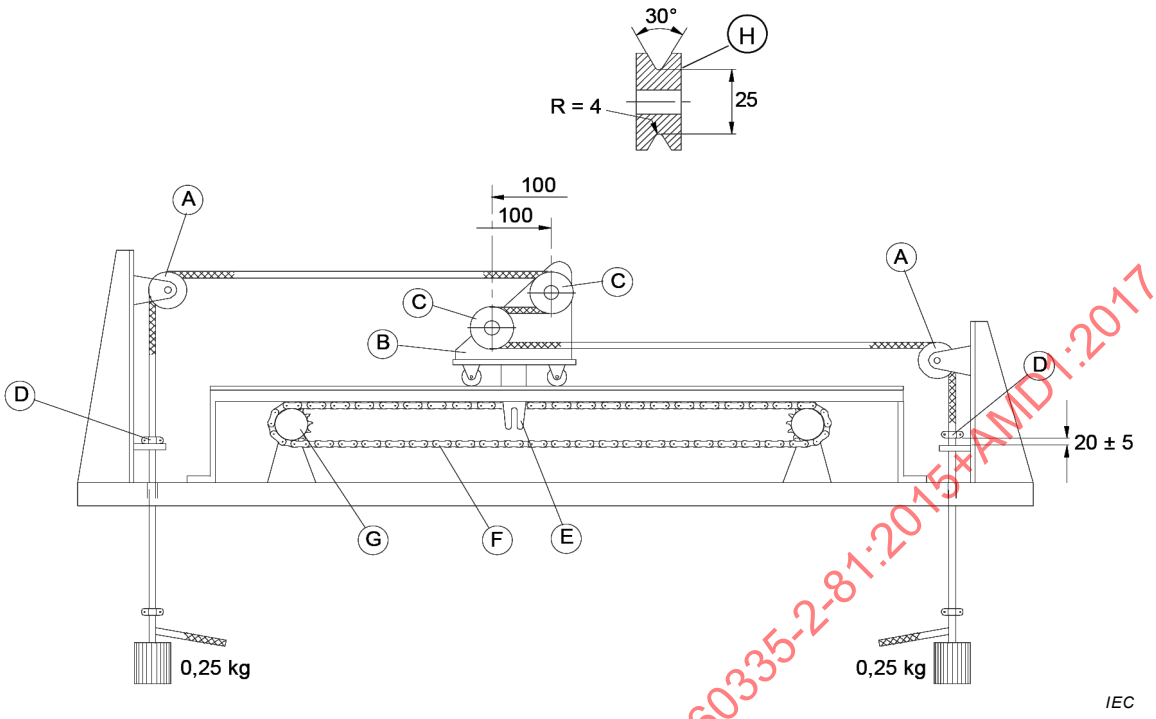


Key

A foot warmer
B leg section
C plywood board, 150 mm wide
D load
E movable support

Figure 101 – Equipment for the flexing test for foot warmers

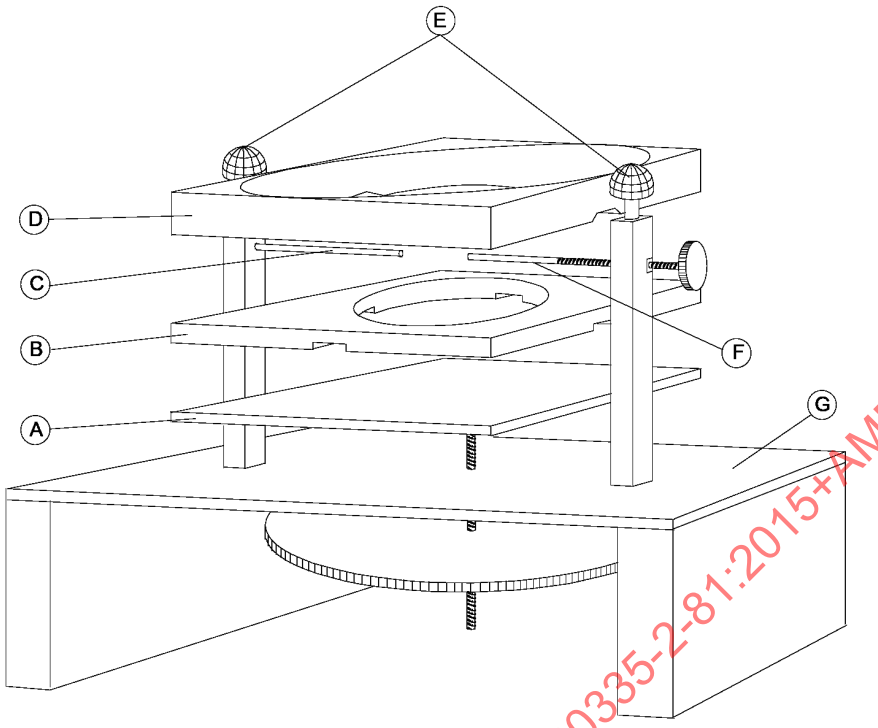
Dimensions in millimetres



Key

A pulley having a diameter > 50 mm
B carrier
C grooved pulley
D restraining clamp
E engagement pin
F chain having a pitch of 12,7 mm
G sprocket having 20 teeth with a pitch circle diameter of 88,9 mm
H details of pulleys C

Figure 102 – Equipment for flexing heating elements and internal wiring

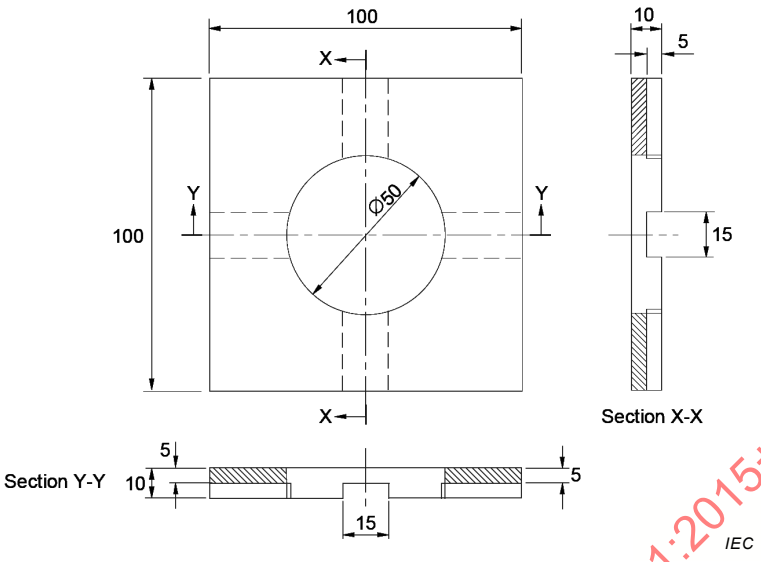


Key

A adjustable platform
B lower part of mask (see detail A of Figure 104)
C fixed electrode
D upper part of mask (see detail B of Figure 104)
E terminals
F movable electrode
G base plate

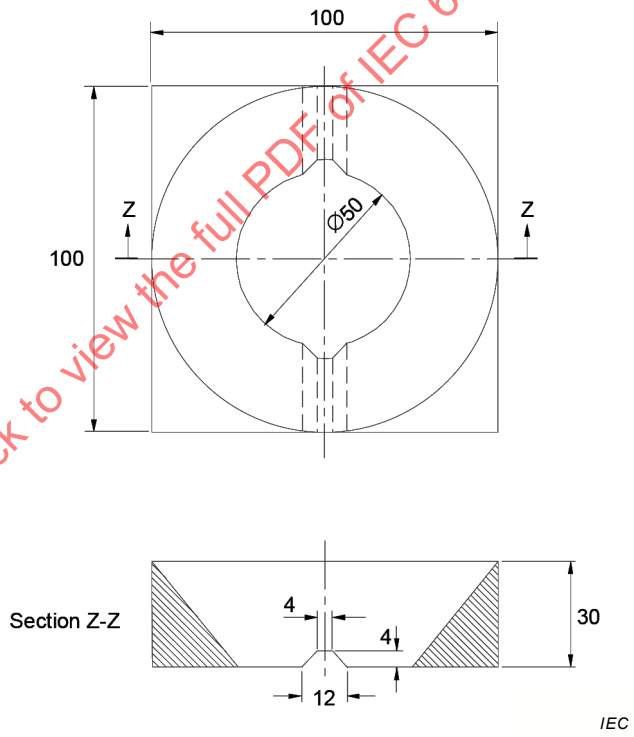
Figure 103 – Equipment for the spark ignition test

Dimensions in millimetres



a) Detail A – Lower part of mask

Dimensions in millimetres



b) Detail B – Upper part of mask

NOTE The mass of the upper part of the mask is approximately 100 g, which is achieved by modifying its thickness.

Figure 104 – Details of the mask

Annexes

The annexes of Part 1 are applicable.

Bibliography

The bibliography in Part 1 is applicable except as follows.

Addition:

IEC 60335-2-17, *Household and similar electrical appliances – Safety – Part 2-17: Particular requirements for blankets, pads, clothing and similar flexible heating appliances*

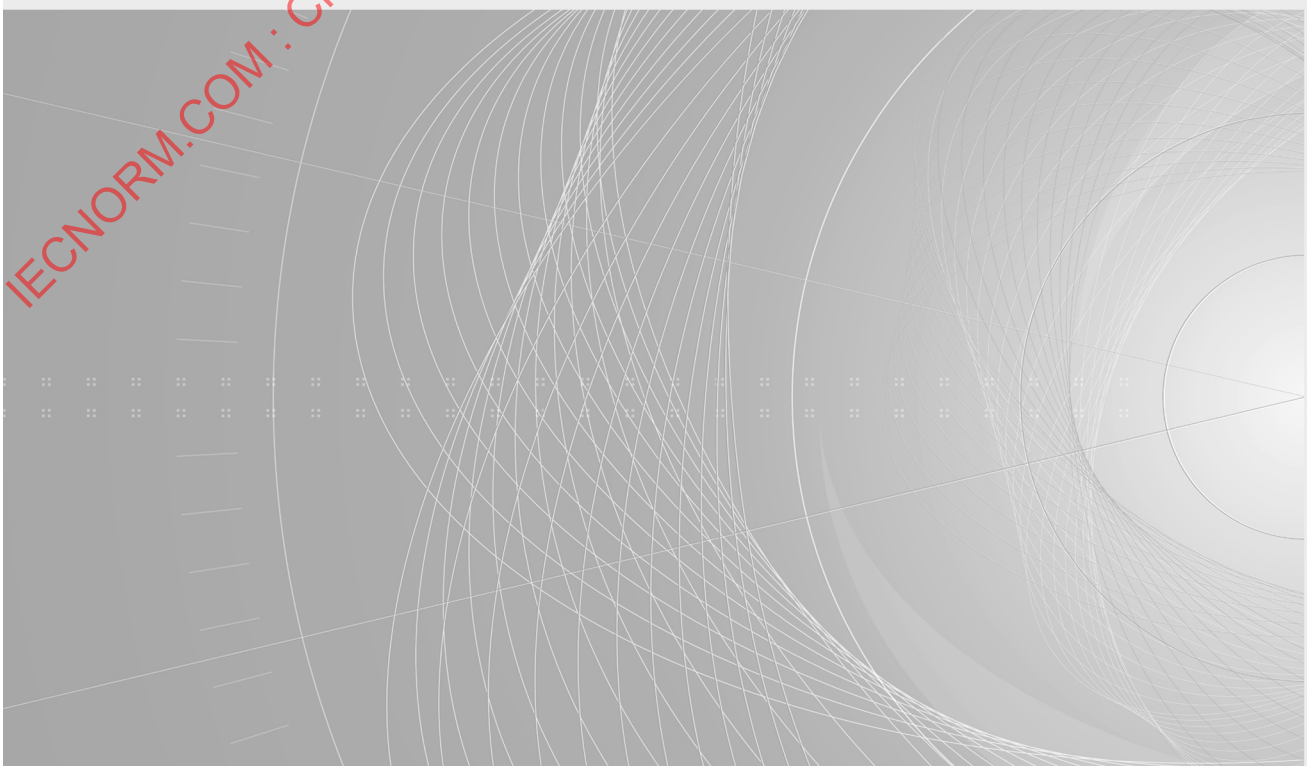
IEC 60335-2-71, *Household and similar electrical appliances – Safety – Part 2-71: Particular requirements for electrical heating appliances for breeding and rearing animals*

IEC 60335-2-81

Edition 3.1 2017-10

FINAL VERSION

Household and similar electrical appliances – Safety – Part 2-81: Particular requirements for foot warmers and heating mats



IEC 60335-2-81:2015-04+AMD1:2017-10 CSV(en)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-81: Particular requirements for foot warmers and heating mats

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

This Consolidated version of IEC 60335-2-81 bears the edition number 3.1. It consists of the third edition (2015-04) [documents 61/4841/FDIS and 61/4896/RVD] and its amendment 1 (2017-10) [documents 61/5292/CDV and 61/5378A/RVC]. The technical content is identical to the base edition and its amendment.

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

This part of International Standard IEC 60335 has been prepared by IEC technical committee 61: Safety of household and similar electrical appliances.

This third edition constitutes a technical revision.

The principal changes in this edition as compared with the second edition of IEC 60335-2-81 are as follows (minor changes are not listed):

- Requirements for washable appliances (5.3, 7.1, 7.6, 7.12);
- Requirements for controls in flexible cords (15.1.1, 24.2);
- Requirements for appliance inlets (22.105, 24.1.5, 29.1.3).

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of the fifth edition (2010) 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: Safety requirements for foot warmers and heating mats.

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

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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may 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.

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.

The following differences exist in the countries indicated below.

– 3.1.9: Normal operation is different (USA)
– 6.1: Class 0 appliances are allowed if their rated voltage does not exceed 150 V (Japan)
– 6.1: Class 0 and class I appliances are allowed (USA)
– 7.6: Symbols not permitted to replace required text (USA)
– 11.8: Temperature limit is different (USA)
– 13.2: Method and limit is different (USA)
– 19.2: The test is different (USA)
– 21.101: The test is different (USA)
– 22.101: The tests are different (USA)

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

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.

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 may 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 and generic standards 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. For example, in the case of temperature requirements for surfaces on many appliances, generic standards, such as ISO 13732-1 for hot surfaces, are not applicable in addition to Part 1 or part 2 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.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-81: Particular requirements for foot warmers and heating mats

1 Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of electric **foot warmers** and **heating mats** for household and similar purposes, their **rated voltage** being not more than 250 V.

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

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.

NOTE 101 Attention is drawn to the fact that

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

NOTE 102 This standard does not apply to

– appliances specifically intended for use under medical supervision;
– electric blankets and pads (IEC 60335-2-17);
– electrically heated carpets (IEC 60335-2-106);
– electrical heating appliances for breeding and rearing animals (IEC 60335-2-71).

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60320-1:2001, *Appliance couplers for household and similar general purposes – Part 1: General requirements*
IEC 60320-1:2001/AMD1:2007[1]

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1 There exists a consolidated edition 2.1 (2007) that includes the second edition and its Amendment 1.

ISO 2439, *Flexible cellular polymeric materials – Determination of hardness (indentation technique)*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1.9 *Replacement:*
normal operation
operation of the appliance under the following conditions:

Foot warmers are unfilled and placed on a horizontal surface.

Heating mats are placed on a horizontal surface and covered by a piece of expanded polystyrene having dimensions approximately 300 mm × 150 mm × 50 mm.

NOTE 101 The density of the polystyrene is approximately 20 kg/m^3 ± 5 kg/m^3.

3.101
foot warmer
appliance into which the user's feet are inserted in order to warm them

3.102
heating mat
appliance having an area not exceeding 0,5 m^2, on which the user's feet are placed in order to warm them

3.103
heating element with PTC characteristics
heating element of the appliance consisting of a pair of conductors separated by conductive material that has a rapid non-linear increase in resistance when the temperature is raised through a particular range

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.2 *Addition:*

A 15 m length of heating element or internal wiring is required for the tests of 21.102.

*Twelve samples of the enclosure material of **foot warmers**, each having dimensions 200 mm × 100 mm, are required for the test of 30.101.*

5.3 *Addition:*

Washable appliances are laundered twice in accordance with the instructions before testing is started.

*The tests of Clauses 13, 15 and 16 are not carried out on **Class III appliances** having a **rated voltage** not exceeding 24 V or on **Class III constructions** having a **working voltage** not exceeding 24 V.*

5.5 *Addition:*

*If the appliance is provided with a **detachable cover**, the tests are carried out with or without this cover, whichever is more unfavourable.*

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 *Modification:*

Appliances shall be **class II** or **class III**.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 *Addition:*

Washable appliances shall be marked with symbol ISO 7000-3114 (2012-04) and with symbol ISO 7000-3124 (2012-04).

7.6 *Addition:*

[symbol ISO 7000-3114 (2012-04)] Do not dry clean

[symbol ISO 7000-3124 (2012-04)] Do not bleach

7.12 *Addition:*

The instructions shall state the substance of the following:

– the appliance is not to be used if there are signs of damage;
– the appliance is not to be used for warming animals;
– details regarding laundering or cleaning.

The instructions for **foot warmers** shall state that outdoor shoes must be removed before use.

The instructions for **heating mats** shall state that the appliance has to be repaired or replaced if the cover is worn. They shall explain how such wear can be observed.

The instructions for **foot warmers** intended to be used after preheating without supply and incorporating an appliance inlet shall state that the cord set must be disconnected from the supply after preheating.

If symbol ISO 7000-3114 (2012-04) and symbol ISO 7000-3124 (2012-04) are used, their meaning shall be explained.

8 Protection against access to live parts

This clause of Part 1 is applicable.

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is applicable except as follows.

10.101 The power input of appliances incorporating **heating elements with PTC characteristics** shall significantly decrease with an increase in temperature.

Compliance is checked by the following test.

*The appliance is supplied at **rated voltage** and operated under **normal operation**. The power input shall have decreased by at least 50 % from the initial value when steady conditions are established, any control operating during this period being short-circuited.*

11 Heating

This clause of Part 1 is applicable except as follows:

11.2 *Modification:*

Appliances are placed as near as possible to one wall of the test corner and away from the other wall.

11.3 *Addition:*

Thermocouples attached to the small blackened disks are also used for measuring the temperature rise of the surface of the appliance.

11.7 *Replacement:*

Appliances are operated until steady conditions are established.

11.8 *Modification:*

When polyvinyl chloride is used for insulating heating elements, the temperature rise of the insulation shall not exceed 80 K.

Addition:

The temperature rise of surfaces likely to be in contact with the user's feet shall not exceed 40 K.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

13.2 *Modification:*

*When testing the top surface of **heating mats**, the dimensions of the metal foil are 300 mm × 150 mm.*

NOTE 101 If the **heating mat** is reversible, each surface is tested in turn.

Addition:

***Foot warmers** are also tested with the inside surface completely covered with metal foil.*

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.1.1 *Addition:*

Appliances are subjected to the test of IEC 60529 as described in Subclause 14.2.1. However, cord sets, switches and controls in the flexible cord are not subjected to the tests.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.2 *Modification:*

*When testing the top surface of **heating mats**, the dimensions of the metal foil are 300 mm × 150 mm.*

NOTE 101 If the **heated mat** is reversible, each surface is tested in turn.

Addition:

***Foot warmers** are also tested with the inside surface completely covered with metal foil.*

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is not applicable.

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.2 *Addition:*

The appliance is covered partially or completely, whichever is more unfavourable, with a sheet of open-cell polyether approximately 36 mm thick, having the following properties:

– *cell count* $18\ ^{+2}_{0}$ *per cm;*

– *specific mass* $30\ kg/m^3 + ^{+10}_{0}\ \%$;

– *hardness* *120 N to 170 N at 40 % impression, measured according to ISO 2439.*

*If the **foot warmer** has a flexible part that covers the user's legs, this part is folded onto the foot part before covering.*

*A plywood board, having dimensions approximately 500 mm × 500 mm × 20 mm, is placed on top of the polyether sheet covering **foot warmers**.*

19.4 *Modification:*

***Heating mats** are tested without being covered by the polystyrene block.*

19.13 *Addition:*

The temperature rise of the insulation of heating elements shall not exceed 145 K.

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

21.1 *Addition:*

***Foot warmers** are also subjected to the test of 21.101.*

21.2 *Addition:*

This requirement is not applicable to textiles and similar materials forming the enclosure.

21.101 *A plywood board, having dimensions approximately 300 mm × 150 mm × 20 mm with rounded edges, is placed in the leg section of the **foot warmer** as shown in Figure 101. A load of 30 kg is placed on the board, which is allowed to drop freely from a height of 200 mm above the base, so that the leg section is flexed and the appliance is compressed between the board and the supporting surface. The total mass of the board, its movable support and the load is 30 kg. If the **foot warmer** does not have a leg section, the board is allowed to fall onto the top surface.*

The test is carried out 1 000 times at a rate of six times per minute.

The test shall not result in

- *damage to the enclosure or displacement of heating elements to such an extent that compliance with the standard is impaired;*
- *open-circuiting of heating elements or controls;*
- *breakage of more than 10 % of the strands of internal wiring;*
- *failure of constructional stitching, or breakage of glued or welded joints, to such an extent that compliance with the standard is impaired.*

NOTE An example of damage to the enclosure that could impair compliance with the standard is a tear in the enclosure. Small holes in textiles that are not part of electrical insulation or do not provide protection against moisture are ignored.

21.102 The insulation of heating elements and internal wiring shall retain adequate flexibility and insulating characteristics throughout the life of the appliance.

Compliance is checked by the tests of 21.102.1 and by the tests of 21.102.2 and 21.102.3 when the insulation exceeds

- *a temperature rise of 50 K during the test of Clause 11,*

or

- *a temperature rise of 110 K during the tests of Clause 19.*

The tests are carried out on separate samples of heating element or internal wiring.

For the test of 21.102.1, one sample measuring approximately 4 m in length is required. For the tests of 21.102.2, at least 12 samples are required, each having a length of 300 mm. For the test of 21.102.3, 12 samples are required, each having a length of 300 mm.

21.102.1 *The sample of heating element or internal wiring is attached to the equipment shown in Figure 102. This equipment has a carrier with two pulleys, each having a groove with a radius of 4 mm, the diameter at the base of the groove being 25 mm. The pulleys are arranged so that the sample is horizontal where it passes between them.*

NOTE 1 For samples not having a circular cross-section, the form of the groove in the pulley is suitably modified.

The sample is stretched over the pulleys, each end being loaded with a mass of 0,25 kg. If necessary, the mass at each end is increased in steps of 0,1 kg in order to ensure that the wires leaving the pulleys are parallel to each other. Restraining clamps are positioned so that the pull is always applied by the mass in the opposite direction from which the carrier is moving.

The carrier moves over a distance of 1 m with a constant speed of approximately 0,33 m/s for 25 000 cycles.

NOTE 2 A cycle is two movements, one in each direction.

The sample shall not break during the test.

NOTE 3 A monitoring current not exceeding 50 mA can be passed through the sample during the test.

*For **heating elements with PTC characteristics**, the power input is measured before and after the test. The measurement is made with the **heating element** suspended vertically in free air and supplied at the **rated voltage** of the appliance. Both measurements are carried out at the same ambient temperature and when the power input has stabilized. The power input shall not increase during the test.*

The sample is then immersed in water containing approximately 1 % NaCl. A d.c. voltage of approximately 500 V is applied between the conductor and the saline solution.

The insulation resistance is measured 1 min after immersion and shall be at least 1 MΩ.

21.102.2 *The conductors are pulled out from 12 samples of heating element or internal wiring. If this is not possible, the insulation is slit longitudinally, the conductor is removed and the insulation allowed to close.*

Six of the samples are conditioned by suspending them vertically so that they hang freely in a heating cabinet at a temperature of 125 °C ± 2 °C for 336 h. The samples are removed from the cabinet and allowed to cool down to room temperature. When the material has stabilized, the length of the samples is measured and shall not be less than 90 % of the original length.

NOTE PVC material is considered to have stabilized by 16 h after removal from the cabinet.

The heating cabinet shall have forced air circulation in order to ensure that there is no temperature gradient over the length of the samples.

The 12 samples are placed in a tensile machine, in turn, so that the length between the clamps is at least 50 mm. The machine is operated at a uniform speed of 500 mm/min ± 50 mm/min. The force and elongation at the instant of rupture are determined.

Results obtained from any sample that ruptured at a force differing from the average value by more than 10 %, and from samples that ruptured within a distance of 15 mm from the clamp, are disregarded. Additional samples are tested in order to obtain 12 valid results.

The elongation of each of the unconditioned samples shall not be less than 100 % and their tensile strength shall not be less than 8,75 MPa.

The average value of both the elongation and tensile strength of the conditioned samples shall be not less than 75 % of the average value determined for the unconditioned samples.

21.102.3 *A 10 mm length of insulation is removed from each end of 12 samples of heating element or internal wiring.*

Six of the samples are wound in a close helix of six turns on a metal mandrel having a diameter approximately equal to the external diameter of the samples. Together with the remaining six samples, they are placed in a heating cabinet at a temperature of 125 °C ± 2 °C for 336 h. The samples are removed from the cabinet and allowed to cool down to room temperature.

When the material has stabilized, the other six samples are also wound on the mandrel in the same way.

NOTE PVC material is considered to have stabilized by 16 h after removal from the cabinet.

The heating cabinet shall have forced air circulation in order to ensure that there is no temperature gradient over the length of the samples.

*The mandrel is immersed for 1 h in water containing approximately 1 % NaCl. The samples are then subjected to a test voltage of 1 000 V for **class II appliances** and 500 V for **class III appliances**. The voltage is applied for 1 min between the conductors and the solution and there shall be no breakdown.*

The samples are unwound from the mandrel and inspection shall show that there are no visible cracks.

21.103 Heating elements with PTC characteristics shall be resistant to crushing.

Compliance is checked by the following test.

The flexible part is fully supported by a piece of plywood 20 mm thick and supplied as specified in 11.4. When steady conditions are established, the temperature of the ***heating element*** *is measured. A block having dimensions of 100 mm × 300 mm and a mass of 80 kg is applied for 5 min to the surface in the most unfavourable place. After removing the block, the appliance is again operated until steady conditions are established and the temperature of the* ***heating element*** *is measured. The temperature of the* ***heating element*** *where the block has been applied shall not have increased by more than 10 K.*

NOTE 1 The edges of the block in contact with the flexible part are rounded.

NOTE 2 The most unfavourable place to apply the block is usually at a loop in the element.

22 Construction

This clause of Part 1 is applicable except as follows.

22.101 Appliances shall be constructed so that heating elements and internal wiring are retained in their intended position. No part of the heating element shall cross over another part of the heating element.

Crossing of internal wiring shall be avoided as far as possible. When this is unavoidable, the wiring shall be secured in order to prevent any relative movement.

Compliance is checked by inspection.

22.102 There shall be no significant change in the position of the heating elements if the stitching retaining them in position is broken.

Compliance is checked by inspection after breaking the thread in the most unfavourable place.

22.103 The insulation of heating elements and internal wiring, except in **class III appliances**, shall be integral with the conductor.

Compliance is checked by inspection.

22.104 **Heating mats** shall be constructed so that exposure of insulation of heating element and internal wiring shall be readily observed.

Compliance is checked by inspection after removing other materials such as carpet pile. The colours of the insulation shall be different from the colours of the other materials.

22.105 The appliance inlet in **foot warmers** shall be positioned so that the connector is not in contact with the floor.

Compliance is checked by inspection.

23 Internal wiring

This clause of Part 1 is applicable.