

INTERNATIONAL STANDARD



**Household and similar electrical appliances – Safety –
Part 2-106: Particular requirements for heated carpets and for heating units for
room heating installed under removable floor coverings**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.



IEC 60335-2-106

Edition 2.0 2021-11
REDLINE VERSION

INTERNATIONAL STANDARD



**Household and similar electrical appliances – Safety –
Part 2-106: Particular requirements for heated carpets and for heating units for
room heating installed under removable floor coverings**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 13.120; 97.100.10

ISBN 978-2-8322-1051-0

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	4
INTRODUCTION	2
1 Scope	8
2 Normative references	9
3 Terms and definitions	9
4 General requirement	10
5 General conditions for the tests	10
6 Classification	11
7 Marking and instructions	11
8 Protection against access to live parts	14
9 Starting of motor-operated appliances	15
10 Power input and current	15
11 Heating	15
12 Charging of metal-ion batteries	17
13 Leakage current and electric strength at operating temperature	17
14 Transient overvoltages	18
15 Moisture resistance	18
16 Leakage current and electric strength	18
17 Overload protection of transformers and associated circuits	19
18 Endurance	19
19 Abnormal operation	22
20 Stability and mechanical hazards	23
21 Mechanical strength	23
22 Construction	27
23 Internal wiring	29
24 Components	29
25 Supply connection and external flexible cords	30
26 Terminals for external conductors	30
27 Provision for earthing	31
28 Screws and connections	31
29 Clearances, creepage distances and solid insulation	31
30 Resistance to heat and fire	31
31 Resistance to rusting	33
32 Radiation, toxicity and similar hazards	34
Annexes	43
Annex B (normative) Battery-operated appliances, separable batteries and detachable batteries for battery-operated appliances	44
Bibliography	45
Figure 101 – Arrangement for testing heating units	34
Figure 102 – Arrangement for testing heating units to be used only above concrete or similar floors	35

Figure 103 – Arrangement for measuring leakage current and electric strength of the flexible part.....	36
Figure 104 – Jig for locating the contact needle	37
Figure 105 – Arrangement for the three-thickness fold test	38
Figure 106 – Equipment for flexing heating elements and internal wiring	39
Figure 107 – Equipment for the spark ignition test	40
Figure 108 – Details of the mask.....	42
 Table 101 – Maximum temperature rises.....	 17

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-106: Particular requirements for heated carpets and for heating units for room heating installed under removable floor coverings

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60335-2-106:2007. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60335-2-106 has been prepared by IEC technical committee 61: Safety of household and similar electrical appliances. It is an International Standard.

This second edition cancels and replaces the first edition published in 2007. 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, 5.2, 5.3, 5.6, 7.12.1, 7.101, 10.1, 18.101.1, 18.101.2, 18.102.5, 19.1, 19.103, 21.1, 21.104, 21.105, 30.102);
- c) requirements for portable heated carpets have been added (Clause 1, 5.2, 5.5, 6.1, 6.2, 7.1, 7.6, 7.12, 7.14, 7.101, 11.8, 15.1, 15.101, 16.1, 16.2, 16.3, 19.101, 19.102, 19.103, 21.105, 21.106, 24.1.5, 24.2, 29.3);
- d) requirements for washable portable heated carpets have been added (5.3, 7.1, 7.6, 7.12, 7.14);
- e) the test of 30.102 has been updated.

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

Draft	Report on voting
61/6369/FDIS	61/6419/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/standardsdev/publications.

A list of all parts in the IEC 60335 series, published 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 heated carpets and for heating units for room heating installed under removable floor coverings.

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 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 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.

The following differences exist in the countries indicated below.

- 6.1: Class III heating units only are allowed (Finland).

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

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 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~~ 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. ~~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.

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.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-106: Particular requirements for heated carpets and for heating units for room heating installed under removable floor coverings

1 Scope

This clause of Part 1 is replaced by the following.

This part of IEC 60335 deals with the safety of

- **portable heated carpets**;
- **heated carpets** and similar appliances;
- **heating units** to heat the room in which they are located and that are intended to be installed directly under ~~a floor covering that is itself intended to be removable~~ materials used as a removable floor covering such as carpet, cushion vinyl, or loose laid laminate,

their **rated voltage** being not more than 250 V for single-phase installations and 480 V for other installations, including direct current (DC) supplied appliances.

~~NOTE 101 Examples of materials used as removable floor coverings are carpet, cushion vinyl, or loose laid laminate.~~

~~NOTE 102~~ Attention is drawn to the fact that

- in many countries different wiring rules apply;
- for appliances intended to be used in vehicles or on board ships or aircraft, additional requirements ~~may~~ can be necessary;
- in many countries additional requirements are specified by the national authorities for fire protection, the national authorities for building regulations, the national health authorities, the national authorities responsible for the protection of labour and similar authorities.

~~NOTE 103~~ This standard does not apply to

- appliances intended exclusively for industrial purposes;
- appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas);
- blankets, pads and similar flexible heating appliances (IEC 60335-2-17);
- heated mats and foot warmers with an area not exceeding 0,5 m² (IEC 60335-2-81);
- flexible sheet heating systems permanently incorporated in the floor of the building structure (IEC 60335-2-96);
- flexible heating elements incorporated in other appliances;
- **battery-operated appliances**.

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60884-1:2002, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 60884-1:2002/AMD1:2006

IEC 60884-1:2002/AMD2:2013¹

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1 Definitions relating to physical characteristics

3.1.9 ~~Addition~~ Replacement:

operation of the appliance under the following conditions:

heating units are installed under a layer of material having a thermal resistance of approximately $0,1 \text{ m}^2 \cdot \text{K/W}$. **Heating units**, the current of which can vary depending on the length of the heating element, and those that can supply other **heating units** are loaded so that the current marked on the heating element flows through the **heating unit**.

3.5 Definitions relating to types of appliances

3.5.101

heating unit

heating element equipped with means for connection to the supply

3.5.102

modular heating unit

prefabricated assembly consisting of a **heating unit** and other materials

~~3.105~~ 3.5.103

controlled appliance

appliance incorporating means in the **flexible part** for sensing the changes in temperature when the appliance is operated under **normal operation**, thus automatically controlling the average power input

3.5.104

heated carpet

appliance having an area exceeding $0,5 \text{ m}^2$ on which the user's feet or body are placed in order to warm them

3.6 Definitions relating to parts of an appliance

~~3.103~~ 3.6.101

electrode

conductive part incorporated in a flexible sheet heating element for supplying the heating material

¹ There exists a consolidated edition 3.2:2013 that includes edition 3 and its Amendment 1 and Amendment 2.

~~3.104~~ 6.102

flexible part

all layers of material forming the permanent enclosure of the appliance together with the heating element, **thermostats** and all other current-carrying parts contained within it, which are intended to be under or part of the floor covering

Note 1 to entry: The **flexible part** may be provided with a **detachable cover**.

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:

*For laminated **heated carpets**, an additional appliance is required for the tests of 22.103.*

*For **heating units**, two additional appliances are required for the test of 18.102. For **heating units** with deposited film or printed circuit heating elements, two additional appliances are required for the test of 21.102.*

*For **heated carpets** that incorporate a wear indicator, such as a colour change, special samples with the textile layer worn or removed to expose the indicator are required for the tests of Clauses 11, 13, 18 and Subclauses 19.2, 19.101, 21.101, 21.102, 21.103 and 21.104.*

~~NOTE 101~~—*The tests of 21.101 and 21.104 may be carried out on separate appliances.*

A 15 m length of heating element or internal wiring is required for the tests of 21.105.

5.3 Addition:

~~NOTE 101~~—*The test of 21.101 may be carried out in conjunction with the conditioning in 18.102.2.*

*Washable **portable heated carpets** are laundered twice in accordance with the instructions before testing is started.*

5.5 Addition:

*If **portable heated carpets** are provided with a **detachable cover**, tests are carried out with or without this cover, whichever is the most unfavourable.*

5.6 Addition:

***Thermostats** sensitive to room air temperature or outdoor air temperature are short circuited. However, the **thermostat** is not short circuited if it can be set so that it does not cycle.*

~~NOTE 101~~—*For electronic controls, it may be necessary to render the sensing elements inoperative instead of short circuiting the **thermostat**.*

5.10 Addition:

*For **heating units** that are cut to measure, the tests are carried out after connecting the **supply leads** and protecting the edges in accordance with the instructions.*

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 Addition:

If a **heating unit** is classified, the relevant requirements apply.

Portable heated carpets shall be class II or III.

6.2 Addition:

Heating units and other floor mounted parts shall be at least IPX7.

Heated carpets, other than **portable heated carpets**, and similar appliances shall be IPX7.

~~NOTE 101~~—This **requirement** does not apply to the plug for appliances connected via a **supply cord** fitted with a plug or to wall-mounted controls.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 Modification:

Instead of the marking of **rated power input** or **rated current**, the following applies:

Heating units shall be marked with their **rated power input** and the maximum **rated current** at 20 °C. **Heating units** that can be cut to measure shall be marked with their **rated power input** per metre length.

Heating units shall be marked with their maximum current if

- the current can vary depending on the length of the **heating unit**; or
- other **heating units** can be supplied through them.

Appliances with **detachable controls** shall be marked with the reference number or by other means of identification of the control.

Addition:

Heating units shall be marked with the indication of orientation, unless they are symmetrical.

The marking shall be repeated at least once every 0,5 m of the heating element or on each section that can be cut to form a **heating unit**.

Heating units that can be cut to measure and have to be cut at specified places shall be marked appropriately.

Heating units intended to be installed only above a floor of concrete or similar material shall be permanently marked with the substance of the following:

In order to avoid a fire hazard, this heating unit is to be installed only above a floor of concrete or similar material.

Flexible parts of the **portable heated carpets** shall be marked with the symbol ISO 7000-3114 (2011-10) and the symbol ISO 7000-3124 (2011-10) or the substance of the following:

Do not dry clean. Do not bleach.

In addition, **portable heated carpets** not intended to be washed shall be marked with the symbol ISO 7000-3123 (2011-10) or the substance of the following:

Do not wash.

7.6 Addition:



[symbol ISO 7000-3114 (2011-10)]

Do not dry clean



[symbol ISO 7000-3123 (2011-10)]

Do not wash



[symbol ISO 7000-3124 (2011-10)]

Do not bleach

7.12 Addition:

The instructions shall contain the substance of the following:

This appliance is for indoor use only.

For **heated carpets** that incorporate a wear indicator such as a colour change, the instructions shall clearly explain the purpose of the indicator and the action to be taken when it becomes visible.

The instructions for **portable heated carpets** shall contain the substance of the following:

Portable heated carpets should not be used if there are signs of damage.

Portable heated carpets should not be used for warming animals.

The instructions for **portable heated carpets** shall give details regarding laundering or cleaning. If symbol ISO 7000-3114 (2011-10), symbol ISO 7000-3123 (2011-10) or symbol ISO 7000-3124 (2011-10) are used, their meaning shall be explained.

The instructions for **portable heated carpets** shall state that the appliance shall be repaired or replaced if the cover is worn. They shall explain how such wear can be observed.

Modification:

The instructions concerning persons (including children) with reduced physical, sensory or mental capabilities or lack of experience and knowledge and children playing with the appliance are not required.

7.12.1 Addition:

~~Instructions for installation shall include the substance of the following:~~

- ~~a) explanation of the marking, if necessary;~~
- ~~b) information for installing the heating units, in particular

 - ~~• precautions to be taken to avoid damage during installation;~~
 - ~~• dimensions and distances to be taken into account;~~
 - ~~• a statement that **heating units** have to be separated from other heat sources;~~
 - ~~• description of the fixing areas of the **heating unit**;~~
 - ~~• guidance on how to avoid damage to a **heating unit** and its terminations due to relative movement after installation;~~
 - ~~• the lowest ambient temperature at which **heating units** may be installed;~~
 - ~~• the minimum radius for bending the heating element, if applicable;~~
 - ~~• precautions to be taken to avoid creasing the heating element;~~
 - ~~• a statement that the **heating unit** is not to be installed on irregular surfaces;~~
 - ~~• a statement that the **heating unit** is to be installed with the correct orientation if applicable;~~
 - ~~• a statement that the installation is to be in accordance with the national wiring rules;~~
 - ~~• a recommendation that the **heating units** are to be supplied through a residual current device (RCD) having a rated residual operating current not exceeding 30 mA;~~
 - ~~• how to interconnect **heating units**, giving the cross-sectional area of the leads and type of leads, if applicable;~~~~
- ~~c) the maximum current allowed to flow through one **heating unit** when other **heating units** are supplied through it or when the current can vary depending on its length;~~
- ~~d) list of controls including the statement that the appliance must only be used in conjunction with these controls as they form part of the overheating protection system, unless they are incorporated into the **heating unit**;~~

~~NOTE 101 Only those controls that are necessary to ensure compliance with the standard need be listed.~~

- ~~e) specification of any adhesive to be used;~~
- ~~f) a label as detailed in 7.101 is to be fixed adjacent to the distribution board.~~

Instructions shall include the following:

- explanation of the markings, if necessary;
- a statement that **heating units** have to be separated from other heat sources;
- a statement that the **heating unit** is not to be installed on irregular surfaces;
- a statement that the **heating unit** is to be installed with the correct orientation if applicable;
- a statement that the installation is to be in accordance with the national wiring rules; and
- a recommendation that the **heating units** are to be supplied through a residual current device (RCD) having a rated residual operating current not exceeding 30 mA.

Instructions shall include the following information for installing the **heating units**:

- precautions to be taken to avoid damage during installation;

- dimensions and distances to be taken into account;
- description of the fixing areas of the **heating unit**;
- guidance on how to avoid damage to a **heating unit** and its terminations due to relative movement after installation;
- the lowest ambient temperature at which **heating units** may be installed;
- the minimum radius for bending the heating element, if applicable;
- precautions to be taken to avoid creasing the heating element;
- how to interconnect **heating units**, giving the cross-sectional area of the leads and type of leads, if applicable;
- the maximum current allowed to flow through one **heating unit** when other **heating units** are supplied through it or when the current can vary depending on its length;
- list of controls that are necessary to ensure compliance with the standard including the statement that the appliance must only be used in conjunction with these controls as they form part of the overheating protection system, unless they are incorporated into the **heating unit**; and
- specification of any adhesive to be used.

7.12.101 The instructions for **heating units** that can be cut to measure shall state that the installation work is only to be carried out by the manufacturer or its service agent in order to avoid a hazard.

7.14 *Addition:*

The height of the lettering on the **flexible part** of the **portable heated carpets** shall be at least 2,5 mm.

The height of the symbols shown in the Addition to 7.6 shall be at least 5 mm.

The height of the lettering of the marking for **heating units** intended to be installed only above a floor of concrete or similar material shall be at least 20 mm.

7.15 *Addition:*

The marking for **heating units** intended to be installed only above a floor of concrete or similar material shall be visible during installation.

7.101 A label that contains sufficient space for the locations of the **heating units** to be listed shall be provided for each installation ~~(see 7.12.1 f)~~ giving:

- the name, trade mark or identification mark of the manufacturer or responsible vendor;
- the model or type reference;
- **rated power input**; and
- where the **heating units** are installed.

It shall state the substance of the following:

- ~~— where the **heating units** are installed;~~
- ~~— not to restrict the thermal emission of the heated floor;~~

~~NOTE The specific application is to be stated on the label.~~

- ~~— not to use fixing materials other than those recommended;~~
- ~~— not to insert nails or screws.~~
- do not restrict the thermal emission of the heated floor;

- do not use fixing materials other than those recommended;
- do not insert nails or screws;
- this label is to be fixed adjacent to the distribution board.

Compliance is checked by inspection.

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.

10.1 ~~Addition~~ Modification:

NOTE 101—The requirement also applies to the **rated power input** per metre length of heating elements **of the heating units**.

10.101 The power input of appliances having **heating units** incorporating **PTC heating elements** 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.

11.1 Addition:

The tests are carried out in a room that is maintained at an ambient temperature of $20\text{ °C} \pm 2\text{ °C}$.

11.2 Replacement:

Heating units intended to be installed only above a floor of concrete or similar material are positioned in accordance with 11.2.103. Other **heating units** and **heated carpets** are installed on top of the floor and are positioned in accordance with 11.2.102.

*If a **modular heating unit** is provided with a **thermostat** having a separate floor sensor, the sensor is located on one of the adjacent **heating units***

- on the centreline, or
- as per manufacturer's instructions,

but 300 mm ± 50 mm outside the area of the thermal insulation and at least 300 mm from the edges of the test floor.

For other **heating units** provided with a **thermostat** having a separate floor sensor, the sensor is located on

- the centreline of the **heating unit**, or
- as per manufacturer's instructions,

but 300 mm ± 50 mm outside the area of the thermal insulation and at least 300 mm from the edges of the test floor.

11.2.101 Multiple **heating units** are installed in accordance with the instructions for installation. They are arranged in a matrix, the **heating unit** under test being located in the centre.

11.2.102 The appliance is placed on the test floor as shown in Figure 101 and a layer of thermal insulation having a thermal resistance of approximately $5 \text{ m}^2 \cdot \text{K/W}$ is placed beneath the surface of the test floor.

The test floor has a free space of at least 1,5 m above its upper surface.

A piece of thermal blocking insulation having a thermal resistance of approximately $1,25 \text{ m}^2 \cdot \text{K/W}$ is placed on the floor centrally across the **heating units**, as shown in Figure 101. The insulation has a length of 0,8 m and a width

- of 0,8 m, for **heated carpets**;
- equal to that of the **heating unit**, for **heating units**.

NOTE In order to measure the highest temperature rise of the floor, it ~~may~~ can be necessary to repeat the test with the covering material having the minimum thickness specified in the instructions.

11.2.103 **Heating units** intended to be installed only above a floor of concrete or similar material are placed on a test floor as shown in Figure 102. Thermal insulation having a thermal resistance of approximately $2,5 \text{ m}^2 \cdot \text{K/W}$ is located under the **heating units**. A layer of concrete at least 40 mm thick supports the thermal insulation. Instead of pouring concrete, the concrete layer may consist of concrete slabs 40 mm thick and having dimensions at least 500 mm × 500 mm, the gaps between the slabs being filled with dry sand.

The test floor has a free space of at least 1,5 m above its upper surface.

A piece of thermal blocking insulation having a thermal resistance of approximately $1,25 \text{ m}^2 \cdot \text{K/W}$ is placed on the floor centrally across the **heating units**, as shown in Figure 102. The insulation has a length of 0,8 m and a width equal to that of the **heating unit**.

11.3 Addition:

The temperature on top of the simulated carpet is measured by thermocouples attached to the back of a blackened plate of copper or brass, 65 mm × 65 mm × 0,5 mm.

11.4 Addition:

Controlled 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 Replacement:

Appliances are operated until steady conditions are established.

11.8 Addition:

Temperature rises are also measured at the points indicated in Table 101 and shall not exceed the values specified. The temperature rises at points away from the thermal blocking insulation shall be measured at least 100 mm from the edges of the thermal blocking insulation.

Table 101 – Maximum temperature rises

Part	Temperature rise K
<i>Top surface of the 0,1 m² · K/W thermal insulation layer or heated carpet</i>	22 (60)
<i>Wood of the test framework</i>	60 (60)
NOTE The temperature rise limits under the thermal blocking insulation are in brackets.	

*For **portable heated carpets**, when polyvinyl chloride is used for insulating heating elements, the temperature rise of the insulation shall not exceed 80 K.*

12 ~~Void~~ Charging of metal-ion batteries

This clause of Part 1 is not applicable.

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

13.1 Addition:

Appliances are installed as specified in 11.2.

*Two sheets of metal foil of sufficient size to cover the heated area are inserted, one above the 0,1 m² · K/W thermal insulation layer or **heated carpet** and one below the appliance, these sheets being electrically connected together. A uniformly distributed load of approximately 35 kg/m² is placed on the top of the 0,1 m² · K/W thermal insulation layer.*

The arrangement is shown in Figure 103.

13.2 Addition:

The leakage current is measured between any pole of the supply and the sheets of metal foil. Screens and other earthing means are disconnected from earth.

Instead of the values specified, the leakage current shall not exceed 1 mA/m².

NOTE 101 If the total leakage current is above 10 mA, special installation in accordance with national wiring rules ~~may~~ can be required.

NOTE 102 The major part of the leakage current with these appliances is usually capacitive leakage.

13.3 Modification:

*For the **flexible part**, the test voltage is applied between **live parts** and the 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 Addition:

*The test is carried out directly on a **heating unit**.*

***Portable heated carpets** are also subjected to the test of 15.101.*

15.1.1 Addition:

*IPX7 **heating units** are immersed for 72 h.*

15.101 Addition:

*The **flexible part** of the **portable heated carpet** is immersed for 1 h in water containing approximately 1 % NaCl at a temperature of 20 °C ± 5 °C after removing **detachable parts**.*

*All of the **flexible part** is immersed except:*

- appliance inlets;*
- the connections of the heating element or internal wiring to the appliance inlet.*

*The appliance shall then withstand the electric strength test of 16.3 and inspection shall show that there is no trace of water on insulation that could result in a reduction of **clearances** or **creepage distances** below the values specified in Clause 29.*

16 Leakage current and electric strength

This clause of **Part 1** is applicable except as follows:

16.1 Addition:

*The tests are not applicable to **class III portable heated carpets**.*

16.2 Addition:

*The **flexible part** of **portable heated carpets** is tested with the voltage applied between **live parts** and an electrode immersed in the saline solutions.*

16.3 Modification:

*The **flexible part** of **portable heated carpets** is tested with the voltage applied between **live parts** and an electrode immersed in the saline solutions. However, when the test is carried out on **portable heated carpets** without first carrying out the tests of Clause 15, the **flexible part** is covered with metal foil instead.*

Addition:

*After the test, the **flexible part of portable heated carpets** is thoroughly rinsed in water and then allowed to dry for at least 24 h at a temperature between 20 °C and 40 °C. During the drying period, the appliance is stretched in an attempt to regain the original dimensions.*

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is replaced by the following.

18.101 The connections from the heating element to the **supply leads** and to interconnection leads shall be reliable.

Compliance is checked by the tests of 18.101.1 or 18.101.2 as applicable.

18.101.1 For **heating units** with deposited film or printed circuit heating elements, the **heating unit** is placed in a heating cabinet at a temperature of $20\text{ °C} \pm 2\text{ °C}$ and is supplied with a voltage so that the current is equal to the value marked on the **heating unit** or to the **rated current**, as applicable. The voltage drop at each connection is measured.

~~NOTE 1~~—The length of the **heating unit** should be as short as possible but not less than 0,5 m.

~~NOTE 2~~—The **heating unit** is not moved after it has been placed in the cabinet.

~~NOTE 3~~—If the connections are made by using crimp connectors, the measurement is carried out between the **supply lead** and the connector and also between the connector and the heating element. The measuring points are as close as possible to the connections.

The **heating unit** is heated in cycles. Each cycle has a duration of 1 h and comprises

- a period of 30 min, during which
 - the **heating unit** is supplied with the voltage that was applied when the voltage drop was measured;
 - for the first 20 min, the temperature of the heating cabinet is raised to 85 °C or to the temperature of the heating element determined during the test of Clause 11, whichever is lower;
 - for the last 10 min, the temperature of the heating cabinet is maintained within $\pm 5\text{ K}$ of this temperature;
- a period of 20 min, during which the temperature is lowered to approximately 30 °C;
- a stabilization period of 10 min.

~~NOTE 4~~—The temperature in the heating cabinet is measured at a distance of at least 50 mm from the **heating unit**.

~~NOTE 5~~ Forced cooling ~~may~~ can be used.

The test is carried out for 400 cycles. The temperature of the heating cabinet is then reduced to $20\text{ °C} \pm 2\text{ °C}$ and the voltage drop at each connection is measured again.

The voltage drop shall not exceed 22,5 mV or 1,5 times the first value measured, whichever is lower.

18.101.2 *Portable heated carpets with any detachable cover removed are driven backwards and forwards over a smooth horizontal roller having a diameter of 25 mm. The appliance is arranged so that one end hangs vertically over the roller while the full length of the other end is clamped to the driving means, which moves in a horizontal plane.*

A clamp is attached to the end of the vertical part of the appliance over its full length. A mass of 0,5 kg or equivalent to 3 g/mm of the length of the attached end, whichever is greater, is attached to the clamp.

The stroke of the driving means is such that the greatest possible area is subjected to flexing.

The driving means is operated at a rate of approximately 125 mm/s for 1 000 cycles. The appliance is then turned through 90° and subjected to a further 1 000 cycles.

NOTE 1—*The test is carried out with the same face of the carpet adjacent to the roller.*

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

After the test, inspection shall show no damage to the extent that compliance with this standard is impaired.

18.102 *The electrical connections between the resistance material and electrodes of heating units with deposited film or printed circuit heating elements shall be reliable.*

Compliance is checked by tests that are carried out on two heating units, each having a length exceeding 1 m.

One heating unit is subjected to the test of 18.102.2 after which it is subjected to the test of 18.102.5. The other heating unit is subjected to the tests of 18.102.1 to 18.102.5.

After the tests, the voltage drop of the second heating unit, determined at the location where bending is applied during the tests of 18.102.2, shall not exceed 1,5 times the voltage drop that was determined on the first heating unit. In addition, the average voltage drop determined at the other locations of the second heating unit shall not exceed 1,5 times the average voltage drop of the first heating unit.

Inspection shall show no contact degradation such as pitting under the electrodes or damage adjacent to the electrodes.

The endurance test is carried out under the conditions of Clause 11 for 1 000 h.

18.102.1 *The heating unit is wound on a cylindrical mandrel having a diameter equal to twice the minimum radius for bending specified in the instructions for installation and then unwound. This is repeated with the other face of the heating unit against the mandrel.*

The test is carried out three times.

If the instructions for installation state that the heating unit is only to be wound in one direction, the test is carried out six times in this direction.

18.102.2 *Part of the heating unit is held between two hardwood boards 100 mm thick and of sufficient size to fully cover the width of the heating element. The edges of the boards are rounded with a radius of 50 mm.*

The assembly is placed in an ambient of –5 °C or the lowest ambient temperature specified for installation, whichever is lower. When the heating element has reached this temperature, its

free end is bent over the rounded edges of the boards. It is bent through an angle of 180° and back to its normal position, in both directions. This bending operation is carried out three times.

18.102.3 The **heating unit** is placed in a humidity cabinet having a relative humidity of 93 % ± 3 % and a temperature of 40 °C ± 2 °C. It is supplied at **rated voltage** and operated for 1 h after which the supply is switched off for 1 h.

The test is carried out for 1 000 cycles.

18.102.4 The **heating unit** is subjected to the test of 18.101.1 which is carried out for 2 000 cycles. However, the voltage drop and inspection for damage is not determined.

18.102.5 The **heating unit** is placed on a horizontal surface and supplied at **rated voltage**. A needle is inserted into the resistance material of the heating element at an angle of 45° and at a distance of 5 mm from the inside edge of the **electrode**.

NOTE 1—Any conductive material between the **electrode** and the resistance material is considered to be part of the **electrode**.

NOTE 2 1 A jig such as that shown in Figure 104 ~~may~~ can be used to locate the needle.

*The voltage (U_m) between the needle and the supply connection to the **electrode** is measured.*

NOTE 3 2 Compensation for the voltage drop in the **electrode** itself is allowed.

The voltage drop (ΔU) at the contact is determined from the following formula:

$$\Delta U = U_m - \frac{5 U_r}{d}$$

where

U_r is the **rated voltage** of the **heating unit**;

d is the distance, in millimetres, between the inside edges of the **electrodes**. If the conductive path is not perpendicular to the **electrodes**, the distance is measured along the centreline of the path.

The voltage drop is determined at the location where bending is applied during the test of 18.102.2. It is also determined at not less than six other locations and the average value is calculated.

NOTE 4 3 The location of the test points ~~may~~ can be selected with the aid of thermal imaging equipment.

18.103 The resistance of the **heating unit** shall not decrease significantly during use.

Compliance is checked by the following test.

*The **heating unit** is placed in a heating cabinet having a temperature 5 K higher than the temperature on the surface of the heating element determined during the test of Clause 11.*

*After a period of 2 h, the resistance of the **heating unit** is measured. The resistance is measured again at intervals not exceeding 72 h. The **heating unit** is left in the heating cabinet for 3 000 h. During the test, the resistance of the **heating unit** shall not decrease by more than 5 % below the value measured after the initial period of 2 h.*

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.1 Addition:

Portable heated carpets are subjected to the test of 19.101.

Appliances incorporating a fuse-link or intentionally weak part which ruptures due to a short circuit during the test of 19.101 are also subjected to the test of 19.102.

NOTE 101—Fuse-links which are incorporated in an appliance for compliance with 19.101 and 19.102 are not subjected to the tests of 19.12.

Modification:

Unless otherwise specified, the appliance is supplied with a voltage

- between 0,9 times and 1,1 times the **rated voltage**, for **controlled appliances**;
- resulting in a power input between 0,85 times and 1,24 times the **rated power input**, for other appliances.

19.2 Addition:

The thermal resistance of the thermal blocking insulation placed on the floor is increased to approximately $2,9 \text{ m}^2 \cdot \text{K/W}$ and it is placed in the most unfavourable position.

19.6 Not applicable.

19.13 ~~Addition~~ Modification:

Add to Table 9:

Part	Temperature rise K
Top surface of the $0,1 \text{ m}^2 \cdot \text{K/W}$ thermal insulation layer or heated carpet , under the thermal blocking insulation	60
Wood of the test framework	120

19.101 Portable heated carpets are folded at the most unfavourable place with a three-thickness fold. The fold is 40 mm wide, 400 mm long and is fanned out at the ends, as shown in Figure 105. The upper sheet of thermal insulation as defined in 3.1.9 and having dimensions $300 \text{ mm} \times 450 \text{ mm} \times 36 \text{ mm}$ is placed on the folded **heating unit** at the most unfavourable location.

The temperature rise of the **flexible part** in contact with the thermal insulation shall not exceed 130 K. For **controlled appliances** and for other appliances, the temperature rise shall not exceed 130 K. The temperature rise of the insulation of heating elements shall not exceed 145 K.

19.102 If compliance with 19.101 depends on the rupturing of a fuse-link or intentionally weak part, the test is repeated with the **flexible part** arranged as specified but with the point of maximum impedance of the protection circuit included in the most unfavourable part of the fold. The appliance is supplied with a voltage at the lower limit of the range specified in 19.1.

19.103 Portable heated carpets incorporating heating elements or internal wiring consisting of stranded conductors shall not attain excessive temperatures in normal use if one or more strands are broken.

NOTE—Any unsheathed core of a flexible cord within the **flexible part** and which extends more than 100 mm from the cord anchorage is considered to be internal wiring.

Compliance is checked by the tests of 19.103.1 to 19.103.3 as appropriate or by assessment of the protection system.

19.103.1 *If internal wiring or heating elements do not have integral insulation and have individual strands which are not electrically insulated from each other, the enclosure of the **flexible part** is opened at the most unfavourable place and a short length of the bare conductor is exposed. All but one of the strands are cut and folded back to leave a gap of approximately 15 mm. The enclosure is then closed and the appliance operated under **normal operation** for 4 h.*

If the single strand ruptures before any damage occurs, the test is repeated with the number of uncut strands increased to the minimum necessary to prevent rupturing.

After the test, there shall be no scorching of the enclosure or of any material in contact with the uncut strands.

19.103.2 *If internal wiring or heating elements have integral insulation and individual strands which are not electrically insulated from each other, the enclosure of the **flexible part** is opened at the most unfavourable place and a short length of the insulated conductor is exposed. A single identical strand 100 mm long is wrapped for one complete turn around the insulation of the conductor, the ends of the turn being spaced 1 mm apart.*

*The strand is connected in series with the conductor, the enclosure is then closed and the appliance operated under **normal operation** for 4 h.*

If the single strand ruptures before any damage occurs, the test is repeated with the number of strands increased to the minimum necessary to prevent rupturing.

*After the test, there shall be no damage to the insulation of the conductor or to other material of the **flexible part**.*

NOTE A slight indentation of the insulation of the conductor is neglected.

19.103.3 *If internal wiring or heating elements have individual strands which are electrically insulated from each other, the wiring or heating element is disconnected from its terminals. A DC voltage of approximately 500 V is applied for 1 min between any two strands.*

The insulation resistance is measured and shall not be less than

- 0,1 MΩ, for **class III** appliances;
- 1 MΩ, for other appliances.

20 Stability and mechanical hazards

This clause of Part 1 is not applicable.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

21.1 Addition:

NOTE 101—Normal use includes transportation and installation.

The blows are only applied to rigid parts of the appliance.

Heating units are subjected to the tests of 21.101 and 21.102.

Heating units incorporating insulated wires are also subjected to the tests of 21.103, and 21.104 ~~and 21.105~~.

Heated carpets, other than portable heated carpets, incorporating insulated wires are also subjected to the tests of 21.104 ~~and 21.105~~.

21.101 Part of the heating element is held between two hardwood boards 100 mm thick and of sufficient size to fully cover the width of the heating element. The edge of the boards are rounded with a radius of 50 mm.

The assembly is placed in an ambient of $-5\text{ }^{\circ}\text{C}$ or the lowest ambient temperature specified for installation, whichever is lower. When the heating element has reached this temperature, its free end is bent over the rounded edges of the boards. It is bent through an angle of 180° and back to its normal position, in both directions. This bending operation is carried out three times.

*The **heating unit** shall then withstand the electric strength test of 16.3 and shall not be damaged to such an extent that compliance with this standard is impaired.*

21.102 Two samples of **heating units** incorporating deposited film or printed circuit heating elements are subjected to the following test.

*The **heating unit** is placed on a horizontal steel plate having a smooth surface and the surface of the heating element is scratched by means of a hardened steel pin, the end of which has the form of a cone with an angle of 40° . Its tip is rounded with a radius of $0,25\text{ mm} \pm 0,02\text{ mm}$. The pin is loaded so that the force exerted along its axis is $10\text{ N} \pm 0,5\text{ N}$ for applications in concrete and similar floors and $5\text{ N} \pm 0,5\text{ N}$ for applications in other floors. The scratches are made by drawing the pin along the surface at a speed of approximately 20 mm/s. The pin is held at an angle of 5° to 10° from the vertical in the direction of movement.*

*Three scratches, at least 50 mm apart, are made on both sides of one heating element. They are made parallel with the length of the **heating unit** and at least 10 mm from one of the edges. The length of the scratches is approximately equal to the width of the **heating unit**. If the heating element incorporates **electrodes**, one of the scratches is made along one of the **electrodes**.*

Two similar scratches are made across the full width on both sides of the other heating element.

*The **heating unit** shall then withstand the electric strength test of 16.3.*

21.103 A part of the **heating unit** is placed on a rigid steel plate. A steel rod, 6 mm in diameter and 20 mm in length with an end radius of 3 mm, is placed across the **heating unit** so that it is only in contact in one location.

A force is applied to the rod for 30 s and has a value of 1 000 N.

The force is applied to five different locations at least 50 mm apart.

*The **heating unit** shall then withstand the electric strength test of 16.3. If the insulated heating wire contains more than one conductor, the test for **basic insulation** is also carried out between*

the conductors and shall not be damaged to such an extent that compliance with this standard is impaired.

21.104 *The **heating unit** is placed on a fixed hardwood square edge tongue and groove floor (100 mm × 25 mm) on 600 mm centre supports. The floor boards shall have gaps of 3 mm between boards. Boards are replaced before the start of each test. If the **heating unit** is designed to be installed with underlay, then it shall be installed in accordance with the manufacturer's instructions. The heating elements are installed at right angle to the floor groove. The **heating unit** is assembled and supported in accordance with the manufacturer's instructions and is operated under conditions of **normal operation**.*

*A canvas sheet of cotton having a weight of 0,24 kg/m², with 24 × 24 picks per centimetre is placed on top of the **heating units**.*

*A five-castor chair with the chair and castor mechanism locked with respect to rotation in the horizontal plane is used to submit the **heating unit** to 2 500 cycles of rotation.*

The pitch circle diameter of the castor circle is approximately 260 mm. The diameter of the castors is approximately 50 mm, their width is approximately 20 mm and their crank distance is approximately 32 mm.

Each cycle comprises rotation of the chair for 3 min in one direction followed by rotation for 3 min of the chair in the reverse direction. During the test the chair is loaded with a mass so as to give a total mass, including that of the chair, of 90 kg ± 1 kg and the chair/castor combination is rotated at a rate of 15 r/min ± 1 r/min.

NOTE—*For **heating units**, other than those supplied with a **supply cord** and a plug, the cord connection is part of the **heating unit**.*

*The test is also applicable to **heated carpets**, other than **portable heated carpets**, but without the addition of the canvas sheet.*

The tested appliance shall then withstand the electric strength test of 16.3 and shall not be damaged to such an extent that compliance with this standard is impaired.

21.105 *The insulation of heating elements, earthing conductors and insulated wires of the **portable heated carpets** shall retain adequate flexibility and insulating characteristics throughout the life of the appliance.*

Compliance is checked by the tests of 21.105.1 and by the tests of 21.105.2 and 21.105.3 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 the heating element, earthing conductors or insulated wires.

For the test of 21.105.1, one sample measuring approximately 4 m in length is required. For the tests of 21.105.2, at least 12 samples are required, each having a length of 300 mm. For the tests of 21.105.3, at least 12 samples are required, each having a length of 300 mm.

21.105.1 *A sample of the heating element, earthing conductor or ~~internal wiring~~ insulated wire is attached to the equipment shown in Figure 106. 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 in order to accommodate the larger axis of the sample within it.

NOTE 2—For conductors such as laminated foils, a 10 mm wide strip cut from the laminate is used.

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 to which the carrier is moving.

The carrier is moved by a means of a chain over a distance of 1 m at a constant speed of approximately 0,33 m/s for 1 000 cycles.

NOTE 3—A cycle is two movements, one in each direction.

The sample shall not break during the test.

NOTE 4 A monitoring current not exceeding 50 mA ~~may~~ can be passed through the sample during the test.

For **heating units** incorporating **PTC heating elements**, 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 DC 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.

21.105.2 The conductors are pulled out from 12 samples of the heating element, earthing conductor or insulated wire. 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 $125\text{ °C} \pm 2\text{ °C}$ 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 $\pm$ 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.

21.105.3 A 10 mm length of insulation is removed from each end of 12 samples of the heating element, earthing conductor or insulated wire.

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 $125\text{ °C} \pm 2\text{ °C}$ 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.

21.106 Heating elements with PTC characteristics of **portable heated carpets** 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. The edges of the block in contact with the **flexible part** are rounded.

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 The most unfavourable place to apply the block can be at a loop in the element.

22 Construction

This clause of Part 1 is applicable except as follows.

22.101 For other than **class III appliances**, **heating units** shall be of **class II construction** and may be provided with a protective earth.

Compliance is checked by inspection and the tests for **class II constructions**.

22.102 The insulation and any adhesive covering the connections and the edges of the heating element shall not affect the material or insulation properties of the heating element.

Compliance is checked by the following test.

The **heating unit** is placed in a cabinet at a temperature of 80 °C or 45 °C plus the temperature rise determined during the test of Clause 11, whichever is higher. The test is carried out for 336 h.

After the **heating unit** has cooled down to approximately **room temperature**, it shall withstand the electric strength test of 16.3.

22.103 The sheets of laminated **heated carpets** used to locate the heating element shall be reliably bonded together.

Compliance is checked by the following test.

Six samples having dimensions approximately 100 mm × 130 mm are cut from the laminated part of a new heating element. The samples for each set are taken from the edge and from the heating surface both perpendicular and parallel to the heating element runs.

From the ends measuring 100 mm, a strip of the material retaining the heating element in position and having a width of 25 mm is cut away from one face at one end of each sample. Another similar strip is removed from the opposite face and at the opposite end of the sample. Any heating element situated under the removed strips is also cut away.

NOTE It ~~may~~ can be necessary to cut away more than one layer in order to test the bonding of the layers retaining the heating element.

Clamps are attached to the full length of the remaining layers of material at both ends of the sample.

The sample is then suspended by one of the clamps and subjected to a total load of 1,25 kg by means of the other clamp. The test is carried out for 1 h at a temperature of 20 °C, and then for 1 h at a temperature of 80 °C.

The layers retaining the heating element in position shall not separate.

This test is repeated on samples taken from an appliance that has been subjected to the tests of Clauses 11 and 19.

22.104 Connecting devices fitted to **supply leads** and to interconnection leads shall be of **class II construction**. It shall not be possible to separate them without the aid of a **tool**.

Compliance is checked by inspection.

22.105 Appliances, other than those containing heating elements operating at **safety extra-low voltage**, shall incorporate

- a protection circuit that disconnects both poles of the supply within one cycle of the supply frequency when the heating element insulation is penetrated, or
- an earthed metal screen that encloses the heating element insulation.

For appliances that incorporate a protection circuit, the protection circuit shall not automatically reset or automatically reconnect the supply when the penetrating object is removed.

Compliance is checked by the test of

- 22.105.1 for appliances that incorporate a protection circuit;
- 22.105.2 and 27.5 for appliances that incorporate an earthed metal screen that encloses the heating element insulation.

22.105.1 The appliance is supplied at **rated voltage** and an attempt is made to insert test probe D of IEC 61032 into the appliance in order to touch the heating element insulation. The probe is applied using a force of ~~approximately~~ 10 N. If contact with the insulation is made, a protection circuit shall operate to give **all pole disconnection** of the heating elements within one cycle of the supply frequency.

When the probe is removed from contact with the appliance, a manual operation shall be required to re-energize the heating elements.

If the protection circuit does not rely on a connection to the supply system protective earth to cause its operation,

- the voltage on the probe prior to and during detection shall not be greater than 24 V, and
- the maximum current through the probe ~~must~~ shall not exceed 5 mA,

when measured to earth or any of the **supply conductors**.

If the protection system relies on contact with a conductive layer, such as metal braiding or metal foil, to cause its operation and if the conductive layer does not comply with the requirements for **accessible earthed metal** of 27.5, then the conductive layer shall be insulated from **live parts** by **reinforced insulation** or **double insulation** and be covered by a sheath complying with the requirements for **basic insulation**.

22.105.2 An attempt is made to insert test probe D of IEC 61032 into the appliance in order to touch the heating element insulation. The probe is applied using a force of ~~approximately~~ 10 N. The probe shall not touch the heating element insulation without also touching the screen.

22.106 For appliances that incorporate protection circuits that rely on a connection to the supply system protective earth, it shall not be possible to energize the heating elements unless connection to the protective earth is of a sufficiently low value.

Compliance is checked by the following test.

A 10 Ω resistor is placed in series between the protection circuit and its connection to the supply system protective earth. When the appliance is supplied at **rated voltage**, the heating elements shall not become energized.

22.107 When the heating element is incorporated directly into the textile section of a **heated carpet**, a wear indicator, such as a colour change, shall be incorporated in the carpet above the heating element so that the indicator becomes visible before the heating element insulation system is exposed.

Compliance is checked by inspection after removing the top sections (pile/tread layer) of the **heated carpet** enclosure.

23 Internal wiring

This clause of Part 1 is applicable.

24 Components

This clause of Part 1 is applicable except as follows.

24.1.5 Addition:

For **portable heated carpets**, all parts of IEC 60320 are applicable except for those that make reference to the connectors in the standard sheets of IEC 60320-3.

24.2 Modification:

Portable heated carpets may be fitted with switches and controls in flexible cords.

24.101 Thermal cut-outs that are necessary for compliance with Clause 19 shall be non-self-resetting with a trip-free mechanism.

Compliance is checked by inspection.

24.102 Controls and other components necessary for the appliance to comply with this standard shall be supplied with the appliance.

Compliance is checked by inspection.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 Modification:

Portable heated carpets shall be supplied with a **supply cord** with a minimum length of 2,3 m.

Compliance is checked by inspection and measurement.

25.3 Replacement:

Fixed heating units shall incorporate one of the following means for permanent connection to fixed wiring:

- a set of **supply leads**;
- a **supply cord**.

The minimum length is 3 m.

Compliance is checked by inspection and measurement.

25.5 Replacement:

Supply cords shall be assembled to the appliance using a **type Y attachment** or **type Z attachment**.

Compliance is checked by inspection.

25.15 Modification:

The force irrespective of the mass of the unit is 100 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 Modification:

Portable heated carpets are in overvoltage category II. Other appliances are in overvoltage category III.

29.3 Modification:

There are no dimensional requirements for the insulation of the **flexible part** of the **heating unit** and for the heating element of the **portable heated carpets**.

For **class II heating units**, there shall be two layers of insulation on the **heating unit** and each of these layers shall withstand the electric strength test of 16.3 for **reinforced insulation**. However, if the layers are inseparable, the combination shall withstand the electric strength test of 16.3 for **reinforced insulation**.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.1 Addition:

*The test is not applicable to **heating units** or **heated carpets**.*

*The tests of 25.1 and 25.4 of IEC 60884-1:2002 including IEC 60884-1:2002/AMD1:2006 and IEC 60884-1:2002/AMD2:2013 are applicable to the **flexible parts** of connecting devices.*

30.2 Addition:

*The enclosure of the **flexible part** is not tested.*

30.2.2 Not applicable.

30.2.3.2 Addition:

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

30.101 The enclosure of the **flexible part** shall be resistant to ignition, unless the appliance incorporates means to prevent overheating resulting from the arcing of conductors.

Compliance is checked by the test of

- 30.101.1, for assessing the resistance to ignition of the **flexible part**, or
- 30.101.2, for appliances incorporating means to prevent overheating resulting from the arcing of conductors.

30.101.1 Six samples, having dimensions of 100 mm × 200 mm, are cut from the enclosure so that their shorter sides are parallel with the runs of the heating element. They are selected from parts of the enclosure so that no two samples contain the same warp thread or the same weft thread. If this is not possible, the samples are selected so that the same threads do not appear in more than two samples. Any pieces of heating element and trimming are removed from the samples.

The test equipment, as shown in Figure 107, has two brass electrodes 3 mm in diameter that are supported by brass pillars mounted on a base of insulating material so that their axes are aligned. The base 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 part of a hardwood mask, as shown in detail A of Figure 108, is placed on the adjustable platform in the position indicated.

The test equipment, including the upper part of the mask as shown in detail B of Figure 108, is placed in a heating cabinet having a door with an inspection window and air 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 equipment 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 part 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 stabilize 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 which lasts 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.

30.101.2 A suitable length of the conductor is exposed and the insulation of the conductor is removed over a length of 25 mm. This part of the conductor is bent in a radius of 75 mm and immersed in a non-conductive liquid having a temperature of $230\text{ °C} \pm 2\text{ °C}$, the appliance being supplied at **rated voltage**. Within 30 s the protection system shall operate so that the power input of the **flexible part** does not exceed 1 W.

The conductor is withdrawn from the liquid when the protection system has operated. If the power input of the **flexible part** subsequently increases above 1 W, the test is carried out 100 times or until the power input is permanently reduced below 1 W, whichever occurs first.

30.102 The insulation of heating elements, internal wiring and connections within the **flexible part** shall be sufficiently resistant to abnormal heat and to fire.

~~NOTE This requirement also applies to material used to insulate connections.~~

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, spaced 20 mm apart, and it is large enough to fully support the sample. 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 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.~~

The wires of both grids that are parallel to the sample are aligned with each other.

The two grids are placed centrally within the laboratory fumehood/chamber as specified in IEC 60695-11-5 and are held in position so that there is no movement during the test.

~~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.~~

A needle flame, as specified in Figure 2a of IEC 60695-11-5:2016, is applied to the sample at a point mid-way between the wires, so that the tip of the flame is in contact with the surface of the sample and near its lower end. The flame is maintained until the test specimen ceases to burn.

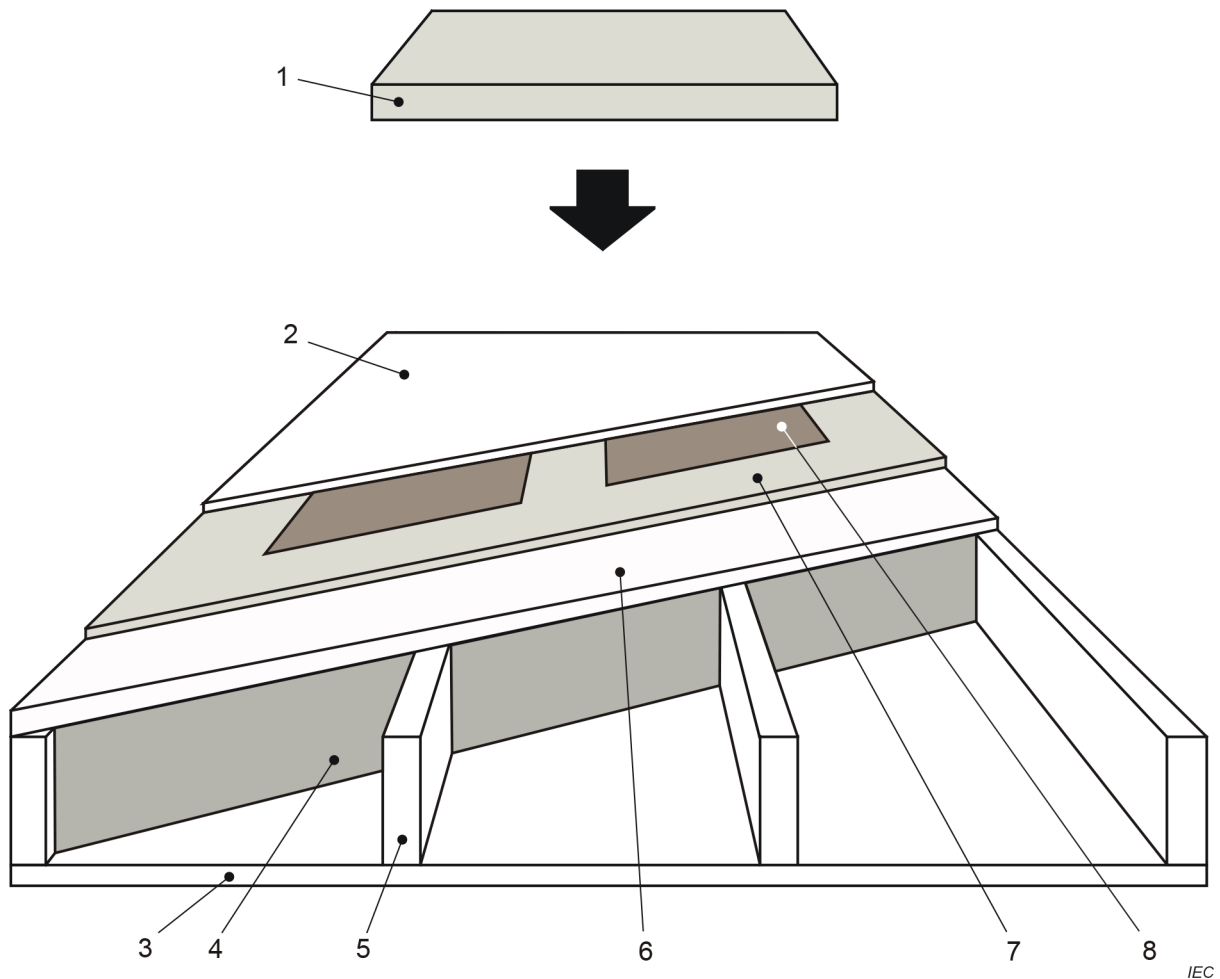
The test is repeated on two additional samples.

31 Resistance to rusting

This clause of Part 1 is applicable.

32 Radiation, toxicity and similar hazards

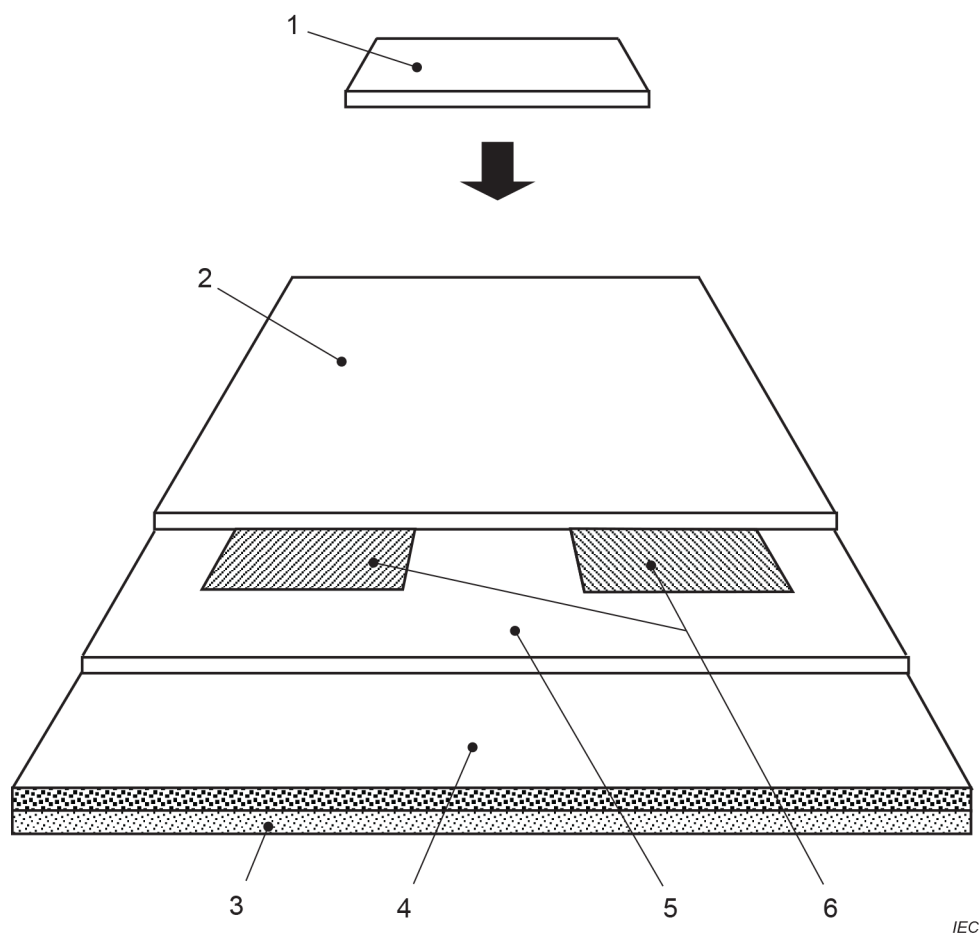
This clause of Part 1 is applicable.



Key

- 1 1,25 m² · K/W thermal blocking insulation
- 2 0,1 m² · K/W thermal insulation layer (for **heating units** only)
- 3 support for thermal insulation
- 4 thermal insulation
- 5 50 mm × 200 mm timber frame
- 6 plywood floor
- 7 underlay (if specified by the manufacturer)
- 8 **heating unit** or **heated carpet**

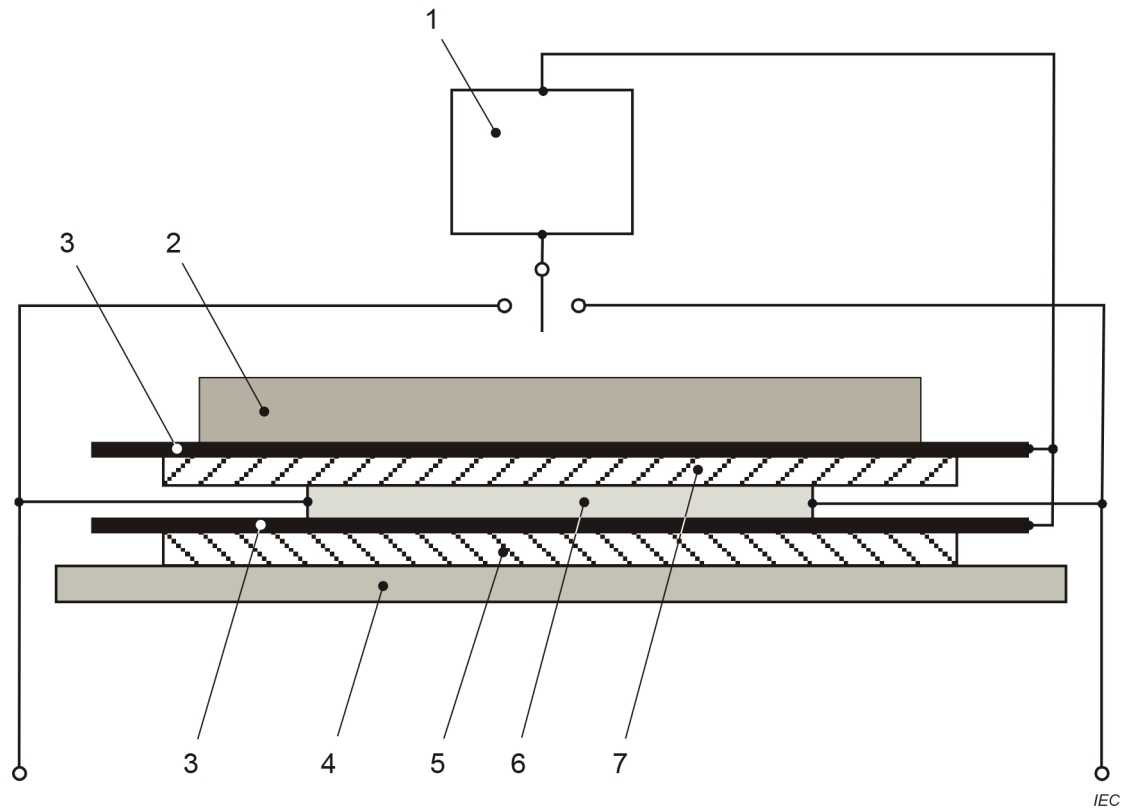
Figure 101 – Arrangement for testing heating units



Key

- 1 1,25 m² · K/W thermal blocking insulation
- 2 0,1 m² · K/W thermal insulation layer
- 3 2,5 m² · K/W thermal insulation
- 4 40 mm thick concrete base (or slabs)
- 5 underlay (if specified by the manufacturer)
- 6 **heating unit**

**Figure 102 – Arrangement for testing heating units
to be used only above concrete or similar floors**

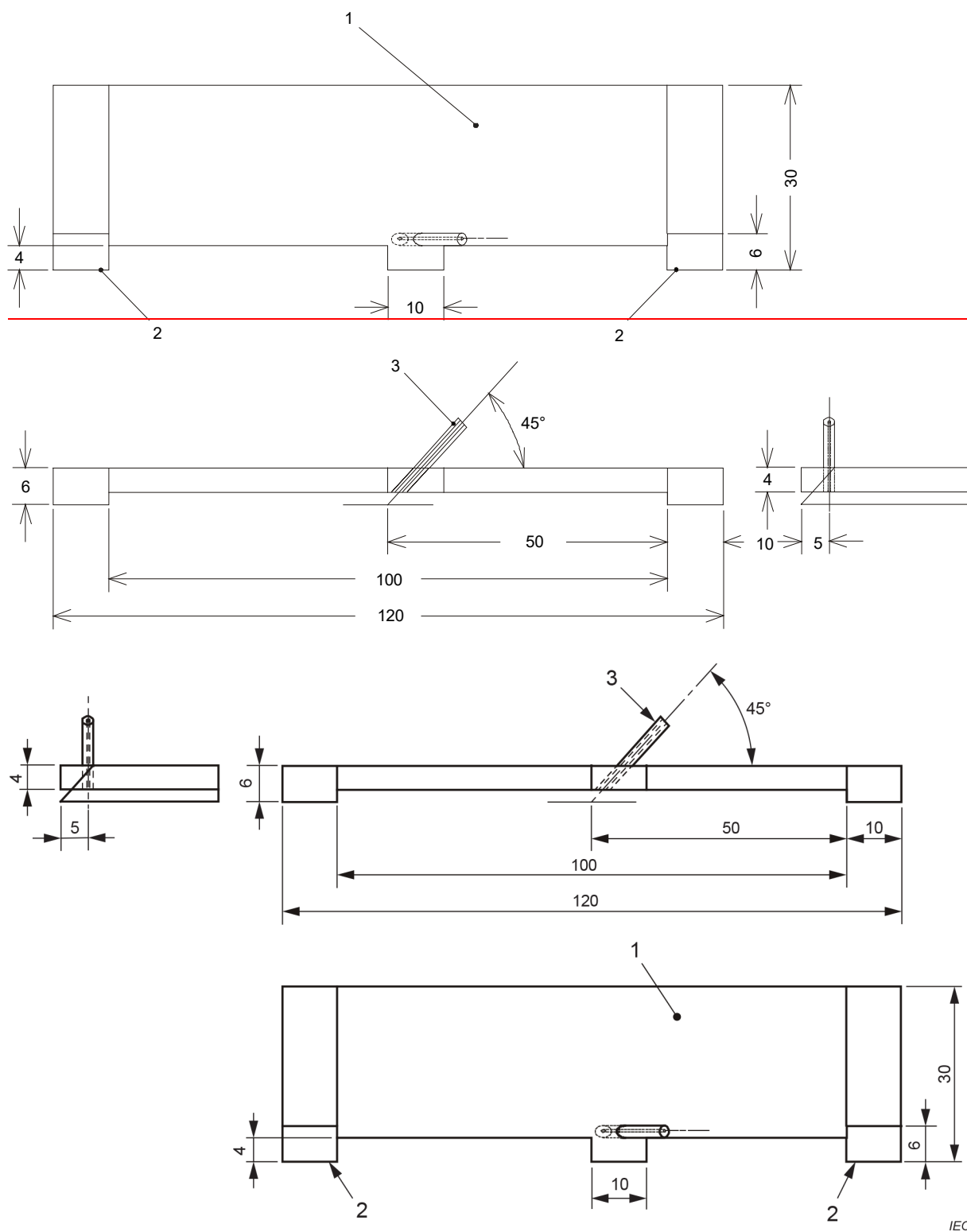


Key

- 1 circuit of Figure 4 of IEC 60990:2016
- 2 uniformly distributed load
- 3 sheets of aluminium foil
- 4 plywood floor
- 5 underlay (if specified by the manufacturer)
- 6 **heating unit** or **heated carpet**
- 7 $0,1 \text{ m}^2 \cdot \text{K/W}$ thermal insulation layer (for **heating units** only)

Figure 103 – Arrangement for measuring leakage current and electric strength of the flexible part

Dimensions in millimetres

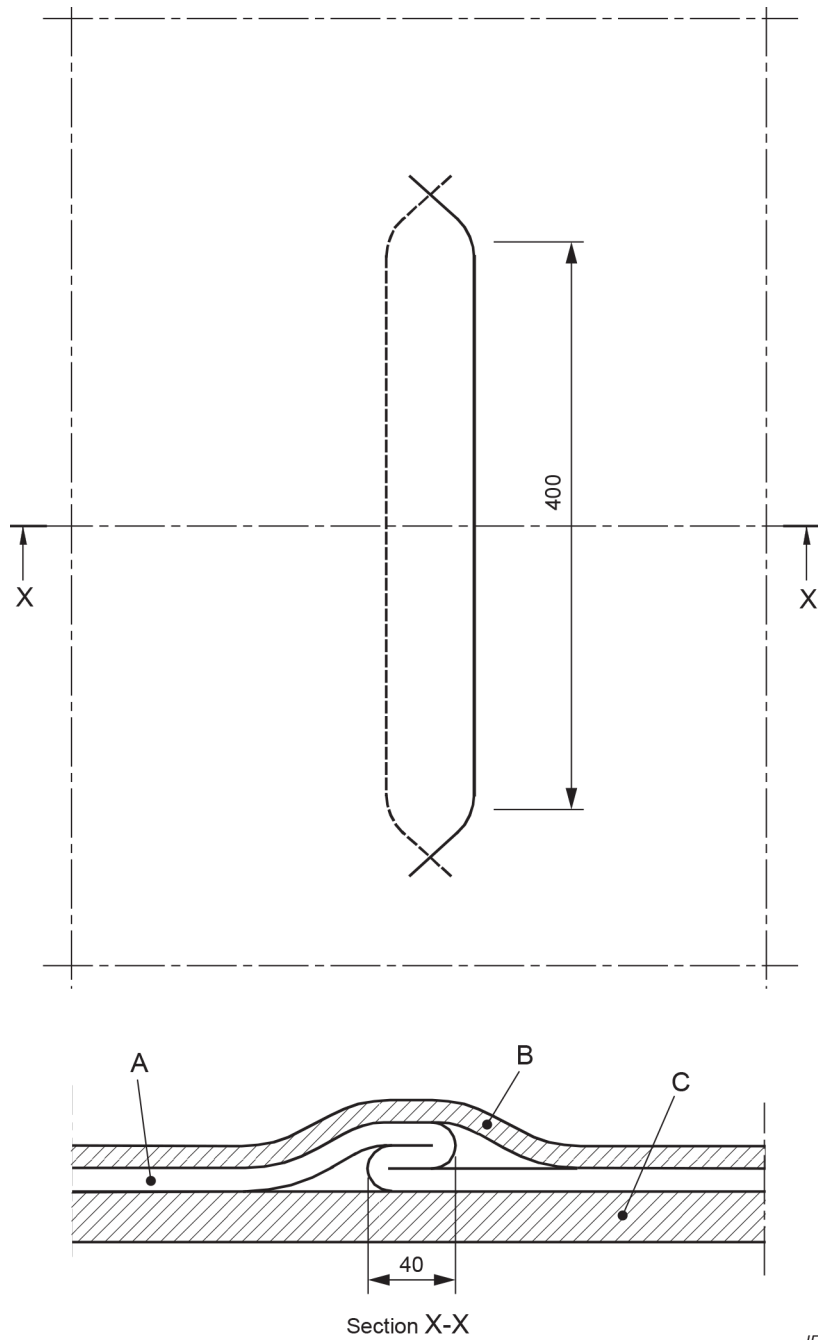
**Key**

- 1 jig body
- 2 reference edge
- 3 needle guide

NOTE The jig body is made from insulating material.

Figure 104 – Jig for locating the contact needle

Dimensions in millimetres



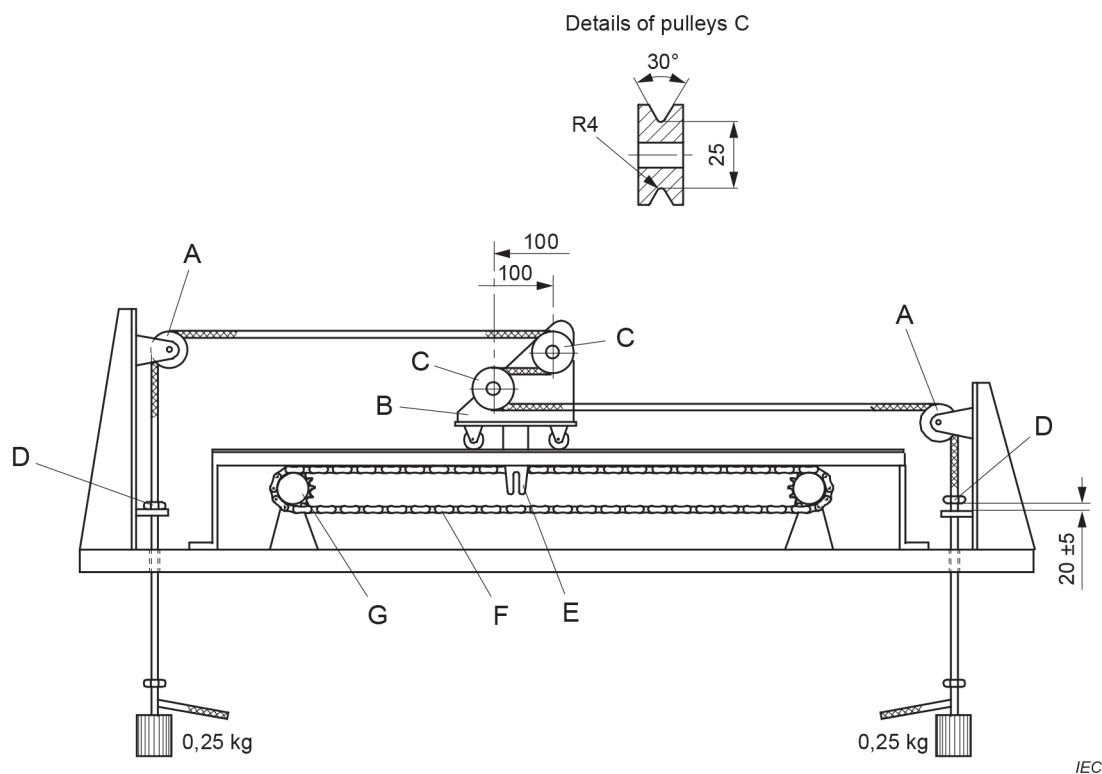
IEC

Key

- A flexible part
- B upper sheet of thermal insulation
- C underlay

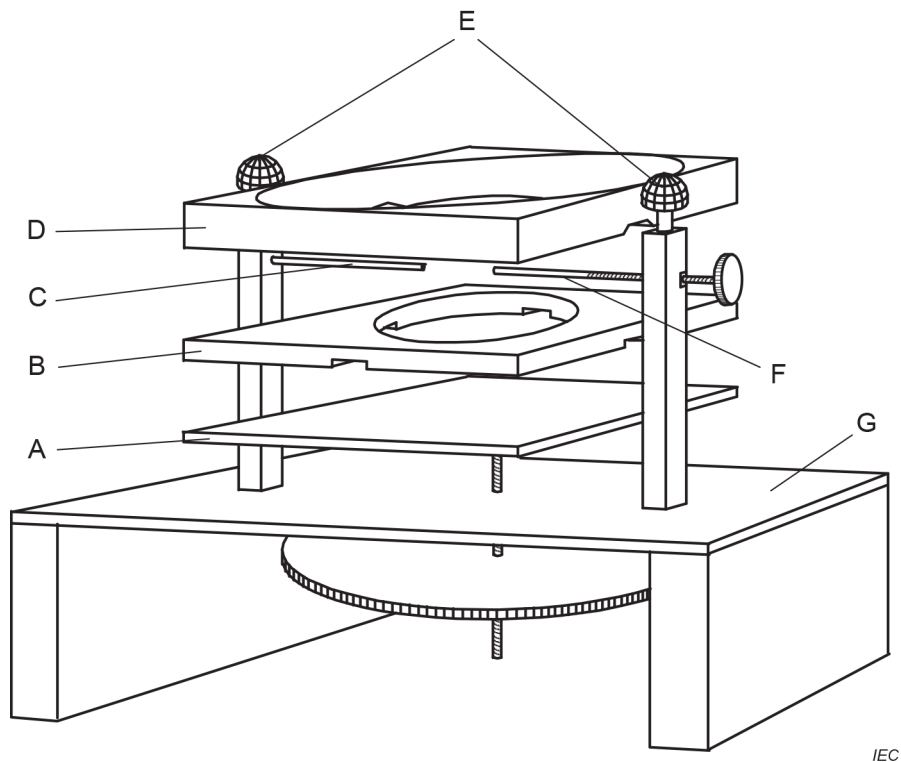
Figure 105 – Arrangement for the three-thickness fold test

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

Figure 106 – Equipment for flexing heating elements and internal wiring



Key

- A adjustable platform
- B lower part of mask (see detail A of Figure 108)
- C fixed electrode
- D upper part of mask (see detail B of Figure 108)
- E terminals
- F movable electrode
- G base plate

Figure 107 – Equipment for the spark ignition test