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REDLINE VERSION

INTERNATIONAL STANDARD

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Household and similar electrical appliances – Safety – Part 2-25: Particular requirements for microwave ovens, including combination microwave ovens

IEC 60335-2-25:2024-07 RLV(en)

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-25: Particular requirements for microwave ovens, including combination microwave ovens

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60335-2-25:2020. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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IEC 60335-2-25 has been prepared by subcommittee 61B: Safety of microwave appliances for household and commercial use, of IEC technical committee 61: Safety of household and similar electrical appliances. It is an International Standard.

This eighth edition cancels and replaces the seventh edition published in 2020. This edition constitutes a technical revision.

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

a) some subclauses have been modified for the appliance outlets and socket-outlets;
b) Subclause 7.12 has been improved in clarity;
c) Subclauses 8.1.1 and 20.2 have been modified to adopt test probe 19;
d) Subclauses 10.1 and 10.2 have been improved in clarity for inverter type microwave ovens;
e) maximum temperature rises of external accessible surfaces have been added in Subclause 11.8;
f) test criterion has been modified in Subclause 15.101;
g) Subclause 15.102 has been modified for harmonization with IEC 60335-2-6;
h) Subclauses 8.1.3, 15.103, 19.11.2, 19.13, 22.105, 22.106, 22.111 and Figure 101 have been improved in clarity;
i) Subclauses 22.103.2, 22.105 and 22.120 have been modified to adopt test probe 18;
j) Subclause 16.101 has been modified to move the content of 16.101.1, 16.101.2 directly under 16.101;
k) Subclause 22.119 has been modified to move the content of 22.119.1, 22.119.2 and 22.119.3 directly under 22.119.

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

Draft	Report on voting
61B/701/FDIS	61B/705/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 of the IEC 60335 series, under the general title: *Household and similar electrical appliances – Safety*, can be found on the IEC website.

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

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

This part 2 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Particular requirements for microwave ovens, including combination microwave ovens.

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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, or
- revised.

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

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

The following differences exist in the countries indicated below.

– 5.3: Microwave leakage is not to exceed 10 W/m^2 during the initial test (Japan and USA).

– 6.1: Microwave ovens may be class 0I if the rated voltage does not exceed more than 150 V (Japan).

– 7.12: Specific instructions exist pertaining to using and servicing **microwave ovens** with respect to the risk of exposure to microwave energy (USA).

– 7.12: It is prohibited to place the appliance in a cabinet with a door (Japan).

– Clause 18: The test is carried out on two appliances (USA).

– 19.11.2: The input voltage variation is not applied (USA).

– 19.13: Microwave leakage is measured only at the end of each test (USA).

– 21.102: The applied force is 222 N (USA).

– 21.105: Microwave leakage is not to exceed 50 W/m^2 (Japan and USA).

– 22.111: Microwave leakage is measured only at the end of the test (USA).

– 22.112: Microwave leakage is not to exceed 50 W/m^2 (Japan and USA).

– 22.115: All access to the cavity has to be prevented (USA).

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INTRODUCTION

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

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

https://www.iec.ch/tc61/supportingdocuments
https://www.iec.ch/sc61b/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~~ can differ.

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

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

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

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

NOTE 2 ~~Horizontal and generic standards~~ Horizontal publications, basic safety publications and group safety publications covering a hazard are not applicable since they have been taken into consideration when developing the general and particular requirements for the IEC 60335 series of standards. ~~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 which 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~~ can be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

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

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

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-25: Particular requirements for microwave ovens, including combination microwave ovens

1 Scope

This clause of Part 1 is replaced by the following.

This part of IEC 60335 deals with the safety of **microwave ovens** for household and similar use, their **rated voltage** being not more than 250 V including direct current (DC) supplied appliances and **battery-operated appliances**.

This standard also deals with **combination microwave ovens**, for which normative Annex AA is applicable.

This standard also deals with **microwave ovens** intended to be used on board ships, for which normative Annex BB is applicable.

Appliances not intended for normal household use but which nevertheless ~~may~~ can be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard. However, if the appliance is intended to be used professionally to process food for commercial purposes, the appliance is not considered to be for household and similar use only.

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 can be necessary;
– in many countries, additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour and similar authorities.

~~NOTE 102~~ This standard does not apply to

– commercial **microwave ovens** (IEC 60335-2-90);
– commercial microwave appliances with insertion or contacting applicators (IEC 60335-2-110);
– industrial microwave heating equipment (IEC 60519-6);
– appliances for medical purposes (IEC 60601);
– 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).

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2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60068-2-6, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

~~IEC 60335-2-5:2012, *Household and similar electrical appliances – Safety – Part 2-5: Particular requirements for dishwashers*~~

IEC 60335-2-6:~~2014~~ [1], *Household and similar electrical appliances – Safety – Part 2-6: Particular requirements for stationary cooking ranges, hobs, ovens and similar appliances*

IEC 60335-2-9, *Household and similar electrical appliances – Safety – Part 2-9: Particular requirements for grills, toasters and similar portable cooking appliances*

IEC 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1 Definitions relating to physical characteristics

3.1.7 *Addition:*

Note 101 to entry: The **rated frequency** is the input frequency.

3.1.9
normal operation

Modification:

Replace the first paragraph by the following:

operation of the appliance with 1 000 g ± 50 g of potable water at an initial temperature of 20 °C ± 2 °C in a cylindrical borosilicate glass vessel having a maximum thickness of 3 mm and an outside diameter of approximately 190 mm~~.~~, the vessel ~~is~~ being placed on the centre of the **shelf**

3.5 Definitions relating to types of appliances

3.5.101
microwave oven
appliance using electromagnetic energy in one or several of the ISM frequency bands[2] between 300 MHz and 30 GHz, for heating food and beverages in a **cavity**

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[1] Under preparation. Stage at the time of publication: IEC/FDIS 60335-2-6:2024.

[2] ~~ISM frequency bands are the electromagnetic frequencies established by the ITU and reproduced in CISPR 11.~~

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Note 1 to entry: ISM frequency bands are the electromagnetic frequencies established by the ITU and reproduced in CISPR 11.

3.5.102
combination microwave oven
microwave oven in which heat is also provided in the **cavity** by simultaneous or consecutive operation of resistive heating elements

Note 1 to entry: The resistive heating elements are used to provide radiant heat, convection heat or steam.

3.6 Definitions relating to parts of an appliance

~~3.103~~**3.6.101**
cavity
space enclosed by the inner walls and the door in which the load is placed

~~3.104~~**3.6.102**
shelf
horizontal support in the **cavity** on which the load is placed

~~3.105~~**3.6.103**
door interlock
device or system that prevents the operation of the ~~magnetron~~ microwave generator(s), unless the oven door is closed

~~3.106~~**3.6.104**
monitored door interlock
door interlock system that incorporates a supervision device

~~3.107~~**3.6.105**
temperature-sensing probe
device that is inserted into the food to measure its temperature and is a part of an oven control

3.8 Definitions relating to miscellaneous matters

3.8.101
open deck
area that is exposed to marine environment

3.8.102
dayroom
area that can be exposed to marine environment from time to time

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:*

~~NOTE 101~~ *An additional sample can be required for the test of 19.104.*

~~NOTE 102~~ *Six samples of the interlocks are required for the test of 24.1.4.*

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5.3 *Modification:*

Instead of carrying out the tests in the order of clauses, the following sequence of clauses and subclauses applies: 32.1, 22.113, 22.108, 22.115, 22.116, Clause 7 to 17, Clause 20, Clause 21 (except 21.101 to 21.105), Clause 18, Clause 19 (except 19.104), Clause 22 (except 22.108, 22.113, 22.115 and 22.116), Clause 23 to 31 and 32.2, 21.101 to 21.105 and 19.104.

5.101 ***Microwave ovens*** *are tested as* ***motor-operated appliances****.*

5.102 ***Class III temperature-sensing probes*** *are only subjected to the tests of 22.112.*

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 *Modification:*

Microwave ovens shall be **class I** or **class II**.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 *Addition:*

Appliances shall be marked with the nominal frequency in megahertz of the ISM band in which they operate.

If the removal of any cover results in microwave leakage exceeding the value specified in 32.1, the cover shall be marked with the substance of the following:

WARNING
MICROWAVE ENERGY
DO NOT REMOVE THIS COVER

~~If an appliance incorporates a socket-outlet protected by means of fuses, other than D-type fuses, it shall be marked with the rated current of the relevant fuse. When a miniature fuse-link is provided, this marking shall indicate that the fuse-link is to have a high breaking capacity.~~

When the exempted provisions of footnote b to Table 101 and/or Table 3 apply, the appliance shall be marked with the substance of "CAUTION: Hot surface", or symbol IEC 60417-5041 (2002-10).

7.6 *Addition:*

[symbol IEC 60417-5041 (2002-10)] caution, hot surface

7.12 *Addition:*

~~The instructions shall state the substance of the following:~~

~~IMPORTANT SAFETY INSTRUCTIONS~~
~~READ CAREFULLY AND KEEP FOR FUTURE REFERENCE~~

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The instructions shall include the substance of the following warnings:

– WARNING: If the door or door seals are damaged, the oven must not be operated until it has been repaired by a competent person.

– WARNING: It is hazardous for anyone other than a competent person to carry out any service or repair operation that involves the removal of a cover which gives protection against exposure to microwave energy.

NOTE 101 This warning is applicable if microwave leakage exceeds the limit specified in 32.1 during the removal of any cover.

– WARNING: Liquids and other foods must not be heated in sealed containers since they are liable to explode.

– WARNING: Ensure that the cavity does not contain any items or utensils that are not suitable for the use with the microwave oven before you operate the appliance.

– WARNING: Do not use the cavity for storing combustible products, cooking utensils, or food and similar when the microwave oven is not in use.

The instructions shall include the substance of the following:

– This appliance is intended to be used in household and similar applications such as:

- staff kitchen areas in shops, offices and other working environments;
- farm houses;
- by clients in hotels, motels and other residential environments;
- bed and breakfast type environments.

If the manufacturer wishes to limit the use of the appliance to less than the above, this ~~has to~~ shall be clearly stated in the instructions.

– The minimum height of free space necessary above the top surface of the oven.

~~– Only use utensils that are suitable for use in **microwave ovens**.~~

– Metallic containers for food and beverages are not allowed during microwave cooking. This requirement is not applicable if the manufacturer specifies size and shape of metallic containers suitable for microwave cooking.

– When heating food in plastic or paper containers, keep an eye on the oven due to the possibility of ignition.

– The **microwave oven** is intended for heating food and beverages. Drying of food or clothing and heating of warming pads, slippers, sponges, damp cloth and similar ~~may~~ can lead to risk of injury, ignition or fire.

– If smoke is observed, switch off or unplug the appliance and keep the door closed in order to stifle any flames.

– Microwave heating of beverages can result in delayed eruptive boiling, therefore care must be taken when handling the container.

– The contents of feeding bottles and baby food jars shall be stirred or shaken and the temperature checked before consumption, in order to avoid burns.

– Eggs in their shell and whole hard-boiled eggs should not be heated in **microwave ovens** since they ~~may~~ can explode, even after microwave heating has ended.

– Details for cleaning door seals, **cavities** and adjacent parts.

– The oven should be cleaned regularly and any food deposits removed.

– Failure to maintain the oven in a clean condition could lead to deterioration of the surface that could adversely affect the life of the appliance and possibly result in a hazardous situation.

– Only use the temperature probe recommended for this oven (for appliances having a facility to use a **temperature-sensing probe**).

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– The instructions for use for **fixed appliances** and **built-in appliances** being used equal or higher than 900 mm above the floor and having **detachable** turntables shall state that care should be taken not to displace the turntable when removing containers from the appliance. This is not applicable for appliances with horizontal bottom hinged door.

– The appliance shall not be cleaned with a steam cleaner.

If symbol IEC 60417-5041 (2002-10) is marked on the appliance, its meaning shall be explained.

The manufacturer shall state in the instructions whether the **microwave oven** is allowed to be placed or installed less than 850 mm above the floor.

The manufacturer shall state in the instructions whether the **microwave oven** is intended to be used freestanding, built-in or in a cabinet. If the appliance can be used while placed in a cabinet,

- the minimum dimensions of the cabinet shall be given by the manufacturer, and
- the instructions shall state that the appliance must be operated with any cabinet door open.

The instructions for **microwave ovens** having an additional decorative door shall state that the appliance must be operated with the decorative door open.

The instructions for **microwave ovens** that are not tested in a cabinet shall state that the appliance must not be placed in a cabinet.

The instructions for **microwave ovens** that are not in compliance with 22.118 shall state that the appliance must not be installed equal or higher than 900 mm above the floor.

7.14 *Addition:*

The height of the lettering of the warning specified in 7.1 shall be at least 3 mm.

The height of symbol IEC 60417-5041 (2002-10) shall be at least 10 mm.

Compliance is checked by measurement.

7.15 *Addition:*

If the hot surface marking in 7.1, or symbol IEC 60417-5041 (2002-10) is marked on the appliance, it shall be visible when the appliance is operated as in normal use, including when actuating any switch, adjusting any control or opening a lid, drawer or door. It shall not be placed on surfaces that are exempted from the limits in Table 3 and Table 101.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

8.1.1 *Addition:*

~~*Test probe 18 of IEC 61032 is also applied, as specified for test probe B. However, it is only applied to parts that are accessible when the oven is operated in normal use.*~~

For part of appliances situated not more than 850 mm above the floor after installation or in normal use, in addition to the use of test probe 18, test probe 19 of IEC 61032 is also applied wherever test probe 18 is used and with the same test conditions used for test probe 18.

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8.1.3 *Addition:*

Test probe 19 of IEC 61032 is not applied.

~~**8.2** *Addition:*~~

~~*Test probe 18 of IEC 61032 is also applied, as specified for test probe B. However, it is only applied to parts that are accessible when the oven is operated in normal use.*~~

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:*

*For inverter type **microwave ovens**, if the power input varies throughout the operating cycle, the representative period is considered as specified in 11.7 without the rest periods.*

*For inverter type **microwave ovens**, if the power input does not vary throughout the operating cycle, and for non-inverter type **microwave ovens**, the power input is measured at the end of third operating cycle of 11.7.*

10.2 *Addition:*

*For inverter type **microwave ovens**, if the current varies throughout the operating cycle, the representative period is considered as specified in 11.7 without the rest periods.*

*For inverter type **microwave ovens**, if the current does not vary throughout the operating cycle, and for non-inverter type **microwave ovens**, the current is measured at the end of the third operating cycle of 11.7.*

11 Heating

This clause of Part 1 is applicable except as follows.

11.2 *Addition:*

*Appliances, other than **built-in appliances**, are positioned as specified for **heating appliances**.*

A ceiling is placed over the appliance at the minimum height stated in the instructions. The ceiling has a depth of 300 mm from the back wall of the test corner and a length at least 150 mm in excess of the width of the appliance.

Appliances that can be used when placed in a cabinet are placed in a cabinet with the minimum dimension given in the instructions by the manufacturer, the plywood specified for the test corner being used. The appliance is positioned against the rear wall and one of the side walls.

The cabinet door is in the open position.

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11.3 *Addition:*

Where the external ***accessible surfaces*** *are suitably flat and access permits, the test probe of Figure 104 is used to measure the temperature rises of external* ***accessible surfaces*** *specified in Table 101. The probe is applied with a force of 4 N ± 1 N to the surface in such a way that the best possible contact between the probe and the surface is ensured. The measurement is performed after a contact period of 30 s.*

The probe can be held in place using a laboratory stand clamp or similar device. Any measuring instrument giving the same results as the probe can be used.

11.7 *Replacement:*

Appliances are operated for three cycles with ***remote operation*** *enabled, if any. Each cycle consisting of a heating period of 10 min followed by a rest period of 1 min. The last cycle does not include a rest period of 1 min. During the rest periods, the lid, drawer or door is open, the* ***remote operation*** *enabled, if any, and the load is replaced.*

Appliance outlets accessible to the user and socket-outlets accessible to the user are loaded with a resistive load that gives the marked ***outlet load****. The current in the appliance outlets and socket-outlets on the appliance are continuously loaded.*

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

– *the* ***battery*** *that has been* ***fully discharged*** *is charged for 1 h, while the appliance is operated as specified, if allowed by the construction of the appliance;*

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

11.8 *Modification:*

Replace the first paragraph by the following text:

During the test, the temperature rises are monitored continuously and shall not exceed the values shown in Table 3 and Table 101.

Addition:

For Table 3:

– *The temperature rises of external surfaces of* ***microwave ovens*** *are only measured on the surfaces that are not placed against the wall and the floor of the test corner;*

– *There are no temperature rise limits for air-outlet grilles and for surfaces up to a distance of 25 mm from them.*

~~NOTE 101 These surfaces do not include handles.~~

– *When the required values for external enclosure of* ***motor-operated appliances*** *are not met, the maximum temperature rise shall not exceed the limit by more than 20 K to the values indicated.*

NOTE 101 The temperature rises for handles, knobs, grips and similar parts which are specified in Table 3 apply regardless of their position on the above surfaces.

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Table 101 – Maximum temperature rises of external accessible surfaces under normal operating conditions

Surface	*Temperature rise of surfaces of appliances allowed to be placed or installed less than 850 mm above the floor* [a] K	*Temperature rise of surfaces of appliances intended to be placed not less than 850 mm above the floor* [a, b] K
Bare metal	*38*	*42*
Coated metal [c]	*42*	*49*
Glass and ceramic	*51*	*56*
Plastic and plastic coating > 0,4 mm [d, e]	*58*	*62*

NOTE The temperature rise limits of handles, knobs, grips, keyboards, keypads and similar parts are specified in Table 3.

[a] *The following surfaces or elements shall not be taken into consideration (see Figure 105):*
- ***cavity*** *(surface temperatures are only measured when the door is closed);*
- *handles or control knobs including keypads, keyboards and the like: part of the equipment that a user needs to touch to operate or adjust the equipment. The equipment shall be installed according to the manufacturer's instructions;*
- *surfaces within 5 mm of touch controls regardless of their shape;*
- *external surfaces of appliances inaccessible to a 75 mm diameter probe having a hemispherical end, when the appliance is installed according to the installation condition of 11.2.*
- *surfaces on the* ***microwave oven*** *door within 10 mm from the left, right and lower edge of the* ***microwave oven*** *door, or 25 mm from the upper edge of the* ***microwave oven*** *door (Zone 1). For built-in appliances, the edges shall be considered between the* ***microwave oven*** *door and decorative trims, if any;*
- *surfaces around the* ***microwave oven*** *door within 10 mm from the left, right or lower edge of the* ***microwave oven*** *door, or 25 mm from the upper edge of the* ***microwave oven*** *door (Zone 2). For built-in appliances, the edges shall be considered between the* ***microwave oven*** *door and decorative trims, if any;*
- *surfaces within 25 mm of vents such as air-outlet grilles (Zone 3).*

[b] *When the required values are not met, the maximum temperature rise shall not be higher than 20 K in excess of the values indicated.*

[c] *Metal is considered coated when a coating having a minimum thickness of 90 µm made by enamel, powder coating or non-substantially plastic coating is used.*

[d] *The temperature rise limit of plastic also applies for plastic material having a metal finish of thickness less than 0,1 mm.*

[e] *When the thickness of the plastic coating does not exceed 0,4 mm, the temperature rise limits of the coated metal or of glass and ceramic material apply.*

[f] *The area that is adjacent to the handle that could be touched whilst using the handle shall comply with 22.13.*

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

This clause of Part 1 is applicable.

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable.

14 Transient overvoltages

This clause of Part 1 is applicable.

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15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.2 *Addition:*

*A quantity of 0,5 l of the same spillage solution is poured steadily over the **shelf** over a period of 1 min. If the **shelf** can collect spilled liquid, it is filled with the solution and a further 0,5 l is then added over a period of 1 min.*

15.101 Temperature-sensing probes shall be constructed so that their insulation is not affected by water.

Compliance is checked by the following test.

The probe is completely immersed in water containing approximately 1 % NaCl and having a temperature of 20 °C ± 5 °C. The solution is heated to the boiling point in approximately 15 min. The probe is then removed from the boiling solution and immersed in the solution having a temperature of 20 °C ± 5 °C for 30 min.

This procedure is carried out five times, after which the probe is removed from the solution. All traces of liquid are then removed from the surface.

The probe shall then withstand the ~~leakage current~~ electric strength test of 16.~~2~~3.

NOTE **Detachable temperature-sensing probes** are not connected to the appliance for this test. **Non-detachable temperature-sensing probes** are tested in the **cavity**, the probe being immersed as much as possible.

15.102 ~~**Microwave ovens** intended to be built-in as underbench installation and therefore subject to spillage of liquid from containers onto working surfaces shall be constructed so that such spillage does not affect their electrical insulation.~~

~~*Compliance is checked by the following test (see Figure 102).*~~

~~*The **microwave oven** is built-in as underbench installation as specified by the manufacturer. The test cabinet including the working surface is tilted to an angle of 2° in the most unfavourable direction. 500 ml of water containing approximately 1 % NaCl and approximately 0,6 % acid rinsing agent is poured steadily over a period of 20 s through a funnel onto the complete width of the working surface above the **microwave oven**. The funnel has an outlet diameter of approximately 8 mm and the lower edge of its outlet is positioned 20 mm above the working surface. The centre of the funnel is positioned 15 mm inwards from the leading edge of the working surface.*~~

~~*The leading edge of the working surface shall be rounded with a radius of 25 mm and the working surface shall be 50 mm in thickness and free of any drain slots, drain edges, tearing edges and similar.*~~

~~*Immediately after the test, the appliance shall 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.*~~

~~*The composition of the water containing approximately 1 % NaCl and approximately 0,6 % acid rinsing agent is described in Annex AA of IEC 60335-2-5:2012.*~~

Built-in microwave ovens that are intended for use installed under work surfaces shall be constructed so that such spillage does not affect their electrical insulation.

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Compliance is checked by the following test.

*They shall be subjected to a spillage test with 0,5 l of the spillage solution specified in 15.2. They shall be installed according to the manufacturer's instructions except that the front surface of the **microwave oven** (excluding control knobs, handles) shall align with front edge of a 30 mm thick wooden work surface with a square front edge, see Figure 106. The spillage solution shall be poured on the work surface at the area which gives the most unfavourable conditions representing the pouring likely to occur, so that the spillage solution flows down the front surface of the **microwave oven** over controls, joints, vents and similar openings. If necessary, the test is repeated until all different controls or gaps are covered by the spillage test. The appliance is dried between each test.*

The test is performed as follows:

A bottle with a shape similar to the one in Figure 108 and a cap is filled with 0,5 l of the spillage solution.

The cap of the bottle shall have a hole 8 mm diameter, placed off-centre according to Figure 107. The bottle shall also have a hole 8 mm diameter near the bottle base (see Figure 108) to equalize the liquid pressure.

Other suitable containers may be used provided the spillage solution amount is poured over the appliance under test in the same manner.

*The hole in the cap of the bottle is put on the horizontal work surface at approximately 80 mm horizontal distance with respect to the front of the **microwave oven**. The inclination of the bottle shall be higher than 30° and lower than 45°. The lower part of the bottle hole in the cap shall be in contact with the work surface, with the hole in the cap placed down closest to the surface. See Figure 109.*

NOTE 1 The intention of the inclination and distance is avoiding the spillage "jumping" over the front of the **microwave oven**.

NOTE 2 When using holes of 8 mm diameter, the specified solution amount is spilled in about 15 s.

When the 0,5 l of spillage solution has been poured, the remaining solution on the work surface is pushed towards the front so that the remaining solution spills homogeneously over the front with a suitably flat means.

*Immediately after the test, the appliance shall 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.*

15.103 Microwave ovens intended to be built-in in cabinets underneath other **built-in appliances** and therefore subject to spillage of liquid from filled containers which are handled during usage of these other appliances shall be constructed so that such spillage does not affect their electrical insulation.

Compliance is checked by the following test (see Figure 103).

*The **microwave oven** is built-in as specified by the manufacturer. The test cabinet is tilted to an angle of 2° in the most unfavourable direction. 200 ml of ~~water containing approximately 1 % NaCl and approximately 0,6 % acid rinsing agent~~ the spillage solution specified in 15.2 is poured steadily over a period of 8 s through a funnel onto the complete width of the separation board above the **microwave oven**. The funnel has an outlet diameter of approximately 8 mm and the lower edge of its outlet is positioned 20 mm above the separation board. The centre of the funnel is positioned 15 mm inwards from the leading edge of the separation board.*

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*If the manufacturer states in the installation instructions that a separation board above the **microwave oven** is not required, the test shall be repeated while pouring the ~~water containing approximately 1 % NaCl and approximately 0,6 % acid rinsing agent~~ spillage solution directly onto the complete width of the top surface of the **microwave oven**. The lower edge of the funnel outlet is positioned 20 mm above the top surface of the **microwave oven** and its centre is positioned 15 mm inwards from the leading edge of the **microwave oven**.*

*Immediately after the test, the appliance shall 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.*

~~*The composition of the water containing approximately 1 % NaCl and approximately 0,6 % acid rinsing agent is described in Annex AA of IEC 60335-2-5:2012.*~~

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.101 The windings of the power transformer that supplies the magnetron shall have adequate insulation.

~~*Compliance is checked by the test of 16.101.1 for switch-mode power supplies and by the test of 16.101.2 for other power transformers.*~~

Compliance is checked by one of the following tests.

~~**16.101.1**~~

– *For switch-mode power suppliers, the insulation between the primary and secondary windings of switch-mode power supply transformers is subjected for 1 min to a voltage of substantially sinusoidal waveform and having a frequency of 50 Hz or 60 Hz. The value of the voltage is 1,414 times the peak value of the secondary **working voltage** plus 750 V, with a minimum of 1 250 V.*

There shall be no breakdown between windings or between adjacent turns of the same winding.

~~**16.101.2**~~

– *For other power transformer, twice the **working voltage** is induced in the secondary winding of the transformer by applying a sinusoidal voltage having a frequency higher than **rated frequency** to the primary terminals.*

The duration of the test is

- *60 s, for frequencies up to twice the **rated frequency**, or*
- $120 \times \frac{\textbf{rated frequency}}{\text{test frequency}}$ *s, with a minimum of 15 s, for higher frequencies.*

NOTE The frequency of the test voltage is higher than the **rated frequency** to avoid excessive excitation current.

A maximum of one-third of the test voltage is applied and is then rapidly increased without creating transients. At the end of the test, the voltage is decreased in a similar manner to approximately one-third of its full value before switching off.

There shall be no breakdown between windings or between adjacent turns of the same winding.

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable except as follows.

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Addition:

The tests are not carried out on the power transformer that supplies the magnetron and its associated circuits, these being checked during the tests of Clause 19.

18 Endurance

This clause of Part 1 is replaced by the following.

The door system, including hinges, microwave seals and other associated parts, shall be constructed to withstand wear that ~~may~~ can be expected in normal use.

Compliance is checked by the following test.

*The door system is subjected to 50 000 cycles of operation with the appliance supplied at **rated voltage** and containing an appropriate microwave-absorbing load. It is then subjected to 50 000 cycles of operation without microwave generation.*

The door is opened and closed as in normal use. It is opened from the closed position to a position approximately 10° before fully open. The rate of operation is 6 cycles per minute. With the agreement of the manufacturer, the rate of operation without microwave generation can be increased to 12 cycles per minute.

After the test, the microwave leakage shall not exceed the limit specified in 32.1 and the door system shall still function.

NOTE 101 Controls can be rendered inoperative in order to carry out the test.

NOTE 102 Components, the deterioration of which does not impair compliance with this standard, can be replaced in order to complete the test.

NOTE 103 Bricks or additional water of maximum 500 g can be added if necessary to avoid stopping of the test due to overheating.

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.1 *Modification:*

*Instead of subjecting the appliance to the tests of 19.2 to 19.10, compliance is checked by the tests of 19.101 to 19.105, the appliance being supplied at **rated voltage**.*

19.11.2 *Addition:*

*The cathode-to-anode circuit of the magnetron is open-circuited and short-circuited ~~in turn~~ one at a time. If one of these fault conditions results in an input current that increases with decreasing voltage, the test is carried out with the appliance supplied at 0,94 times **rated voltage**. However, if the input current increases more than proportionally with voltage, the appliance is supplied at 1,06 times **rated voltage**.*

The filament of the magnetron is not short-circuited.

19.13 *Addition:*

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During the tests, the temperature of windings shall not exceed the values shown in Table 8. Only appliances that allow a pre-selected start time and those operating with a keep-warm function are considered to be appliances operated until steady conditions are established.

However, during the tests of 19.11.3, Table 8 only applies to the windings of the transformer of the power supply of the microwave generator(s), if any.

During the tests, the microwave leakage shall not exceed 100 W/m^2 measured in accordance with 32.1 but with the load as specified for each subclause. The appliance shall comply with 32.1 if it can be operated after the tests.

Modification:

Replace the last paragraph by the following:

In an appliance containing lids, drawer and doors that are controlled by one or more interlocks, one of the interlocks may be released provided that both of the following conditions are fulfilled:

- *the lid, drawer or door does not move automatically to an open position when the interlock is released;*
- *the appliance will not restart after the cycle in which the interlock was released.*

19.101 *Appliances are operated with controls set at the most unfavourable position and without load in the **cavity**.*

The period of operation is the maximum time allowed by the timer or until steady conditions are established, whichever is shorter.

If microwave leakage exceeds 100 W/m^2, the following alternative measurement method shall be applied, which modifies the microwave leakage limit of 19.13.

In order to identify and mark all spots where peak values of microwave leakage exceed 100 W/m^2, the instrument antenna is moved again over the external surface of the appliance, particular attention being given to the door and its seals.

NOTE 1 A peak hold function of the measurement instrument, if any, can be activated for identification of spots where peak values of microwave leakage exceed 100 W/m^2.

The leakage values of each such spot shall be recorded and the averaged leakage value of any spot over the most onerous 20 s shall not exceed 100 W/m^2. Furthermore, the peak value shall not exceed 500 W/m^2.

NOTE 2 Since the stirrer and/or turntable revolution time and the number of microwave stirrer blades determine the frequency and duration of actual peak leakage values, instruments with appropriate specifications (like minimum sampling time, capability to measure peak values of power flux density, capability to average these values) can be used.

19.102 *Appliances are operated under **normal operation** with the timer or other controls that operate in normal use short-circuited. If the appliance is provided with more than one control, these are short-circuited in turn. These short-circuits are applied one at a time.*

19.103 *Appliances are operated under **normal operation** and with any single fault condition simulated that is likely to occur. The controls are adjusted to their most unfavourable setting and the appliance is operated for the maximum time allowed by the timer or 90 min, whichever is shorter.*

NOTE Examples of fault conditions are

- blocking of air openings in the same plane. This fault condition is not applied if the appliance is a **built-in appliance**;

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– locking the rotor of motors if the locked rotor torque is smaller than the full load torque;

– locking moving parts liable to be jammed.

19.104 *The appliance is operated with the controls adjusted to their most unfavourable setting and with a potato placed on the **shelf** in the position where it is most likely to ignite and propagate flames to other combustible material.*

The potato has an approximately ellipsoidal shape and a mass between 125 g and 150 g. The length of the shortest principal axis is at least 40 mm. The length of the longest principal axis is not more than 140 mm and may be symmetrically reduced in order to obtain the specified mass. A steel wire, having a diameter of 1,5 mm ± 0,5 mm and approximately the same length as the longest axis of the potato, is inserted along this axis.

*The test is terminated 15 min after the microwave generation has ceased or a fire in the **cavity** has extinguished.*

*During the test, any fire in the **cavity** shall be contained within the appliance.*

NOTE 1 Subclause 19.13 does not apply during the test.

*After the test, if the appliance is still operable, any damaged **detachable shelf** is replaced and 19.13 applies. If the appliance does not comply, the test is repeated on a new appliance.*

NOTE 2 Non-compliance can have resulted from the cumulative effects of previous tests.

19.105 ***Built-in appliances** having an additional decorative door and appliances to be used in a cabinet are operated under **normal operation** but with the decorative door or cabinet door closed.*

The period of operation is the maximum time allowed by the timer or until steady conditions are established, whichever is shorter.

20 Stability and mechanical hazards

This clause of Part 1 is applicable except as follows.

20.2 *Addition:*

For part of appliances situated not more than 850 mm above the floor after installation or in normal use, in addition to the use of test probe 18, test probe 19 of IEC 61032 is also applied wherever test probe 18 is used and with the same test conditions used for test probe 18. During the tests with test probe 19, the appliance is fully assembled as in normal use with any door closed.

20.101 Appliances having doors with a horizontal hinge at their lower edge and on which a load is likely to be placed shall have adequate stability.

Compliance is checked by the following test.

The appliance is placed on a horizontal surface with the door open and a mass is gently placed on the geometric centre of the door.

The mass is

– *7 kg for **stationary appliances**;*

– *3,5 kg for **portable appliances**.*

NOTE A sandbag can be used for the load.

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The appliance shall not tilt.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is also checked by the tests of 21.101 to 21.105. During these tests, the appliance is rigidly supported, except for 21.102.

21.101 *Hinged doors are positioned approximately 30° before the fully open position. Sliding doors are positioned so that they are approximately two-thirds open. A force of 35 N is applied to the inside surface of a hinged door at a point 25 mm from its free edge or to the handle of a sliding door.*

The force is applied by means of a spring balance having a spring constant of 1,05 N/mm. It is initially applied with an opposing force applied to the other side of the door or handle. The opposing force is then removed to allow the door to complete its travel to the fully open position.

The test is carried out five times.

The test is repeated on doors of ***stationary appliances*** *and* ***built-in appliances*** *except that*

– *the door is initially placed midway between the fully open and closed positions*;
– *the applied force is 1,5 times the force required to open the door or 65 N, whichever is greater. However, if the force cannot be measured or if the door is opened indirectly, the 65 N force is applied.*

The test is carried out five times.

Doors are placed midway between the fully open and closed positions. A closing force of 90 N is applied to the outside surface of a hinged door at a point 25 mm from the free edge or to the handle of a sliding door, initially with the opposing force as described above.

This test is carried out ten times.

The appliance shall then comply with 32.1.

21.102 *Side-hinged doors are placed in the fully open position. A downward force of 140 N or the maximum force that can be applied in any door position without tilting the appliance, whichever is smaller, is then applied to the free edge of the door and the door is closed. The door is fully opened again with the force still applied.*

This test is carried out five times.

Bottom-hinged doors are opened. A force of 140 N or the maximum force that can be applied without tilting the appliance, whichever is smaller, is applied to the inside surface of the door at the most unfavourable position 25 mm from the free edge.

The force is applied for 15 min.

The appliance shall then comply with 32.1.

21.103 *A cube of wood having a side dimension of 20 mm is attached to an inside corner farthest from the door hinge. An attempt is made to close the door with a force of 90 N applied*

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at the other corner farthest from the hinge in the direction perpendicular to the surface of the door.

The force is maintained for 5 s.

The cube is then removed. The door is slowly closed until microwave generation becomes possible. The door and its opening means are then manipulated in order to determine the position resulting in the highest microwave leakage.

The appliance shall then comply with 32.1.

The test is repeated with the wooden cube attached to the other corner farthest from the hinge.

NOTE The test is not applicable to sliding doors.

21.104 *The door is closed and its outside surface subjected to three impacts, each having an energy of 3 J. These impacts are applied to the central part of the door and may be at the same point.*

The impact is applied by means of a steel ball having a diameter of 50 mm and a mass of approximately 0,5 kg. The ball is suspended by a suitable cord that is held in the plane of the door. The ball is allowed to fall as a pendulum through the distance required to strike the surface with the specified impact energy.

The door is then opened and its mating surface on the oven is subjected to three similar impacts.

The inside surface of a hinged door is subjected to three impacts as before, the test being made with the door in the fully open position. The impacts are applied to the central part of the door and may be at the same point. However, if a bottom-hinged door is horizontal when in the fully open position, the impacts are applied by allowing the steel ball to fall freely through a distance such that the specified impact energy is obtained.

A bottom-hinged door is further tested by subjecting its seal to three similar impacts. The impacts are made at three different locations.

The appliance shall then comply with 32.1.

21.105 *A bottom-hinged door is opened and a hardwood dowel having a diameter of 10 mm and a length of 300 mm is placed along the bottom hinge. The dowel is positioned such that one end is flush with an outside edge of the door. A closing force of 90 N is applied to the centre of the handle in a direction perpendicular to the surface of the door. The force is maintained for 5 s.*

The test is repeated with the end of the dowel flush with the other outside edge and then with the dowel positioned centrally within the door hinge.

The microwave leakage is measured under the conditions specified in 32.1 and shall not exceed 100 W/m^2.

22 Construction

This clause of Part 1 is applicable except as follows.

22.40 *Modification:*

Replace the second paragraph and the NOTE by the following:

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Appliances for **remote operation** shall be fitted with a switch for stopping the operation of the appliance. The actuating member of this switch shall be easily visible and accessible.

22.49 *Replacement:*

For **remote operation**, the duration of operation shall be set before the appliance can be started unless the appliance switches off automatically at the end of a cycle.

Compliance is checked by inspection.

22.51 *Replacement:*

A control on the appliance shall be manually adjusted to the setting for **remote operation** before the appliance can be operated in this mode. There shall be a visual indication on the appliance showing that the appliance is adjusted for **remote operation**.

Compliance is checked by inspection and by manual test.

22.101 **Built-in appliances** shall only be vented through the front, unless provisions are made for venting through a duct.

Compliance is checked by inspection.

22.102 **Microwave oven** vents shall be constructed so that any moisture or grease discharged through them cannot affect **clearances** and **creepage distances** between **live parts** and other parts of the appliance.

Compliance is checked by inspection.

22.103 The appliances shall be constructed in compliance with either 22.103.1 or 22.103.2.

22.103.1 Appliances shall incorporate at least two **door interlocks** that are operated by opening the door, one being a **monitored door interlock**. At least one of the **door interlocks** shall be concealed and not operable by manipulation.

Compliance is checked by inspection and concealment is checked by 22.105.

NOTE The two **door interlocks** can be incorporated in the system of the **monitored door interlock**.

22.103.2 Appliances shall incorporate two independent **monitored door interlocks** that are operated by opening the door. In this case, 22.105 is not applicable.

NOTE None of the **door interlocks** ~~have~~ need to be concealed because there are two independent **monitored door interlocks** incorporating supervision devices.

Compliance is checked by inspection and the following test.

The door is slowly opened and, simultaneously, an attempt is made to manually defeat any ***accessible door interlock*** *with test probe B and test probe 18. Each probe is applied one at a time.*

During the tests, the operation of the ~~*magnetron*~~ *microwave generator(s) shall not be possible.*

22.104 At least one **door interlock** of 22.103.1 and both **monitored door interlocks** of 22.103.2 shall incorporate a switch that disconnects the microwave generator(s) or its supply main circuit.

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Compliance is checked by inspection.

22.105 At least one of the **door interlocks** shall be concealed and shall not be operable by manipulation. This **door interlock** shall operate before any **accessible door interlock** can be defeated.

Compliance is checked by the following test.

*The door is placed in ~~the open or closed~~ any position and an attempt is made to operate the concealed **door interlock** by applying test probe B and then probe 18 of IEC 61032 to all openings. The test is repeated with a rod, as shown in Figure 101, to any openings of the **door interlock** mechanism. Only test probe B, test probe 18, or one rod shall be used one at a time.*

***Door interlocks** that operate magnetically are also evaluated by applying a magnet to the enclosure over the **door interlock** switch. The magnet has a similar configuration and magnetic orientation to the magnets that operate the **door interlock**. It shall be capable of exerting a force of 50 N ± 5 N when applied to a mild steel armature having dimensions of 80 mm × 50 mm × 8 mm. In addition, the magnet shall be capable of applying a force of 5 N ± 0,5 N at a distance of 10 mm from the armature.*

*It shall not be possible to operate the concealed **door interlock(s)** during the tests.*

*The door is slowly opened and, simultaneously, an attempt is made to manually defeat any **accessible door interlock** with test probe B, test probe 18, the rod and the magnet; each apply separately.*

~~*It shall not be possible to operate The concealed **door interlock** during the tests.*~~

*The concealed **door interlock(s)** shall operate before any **accessible door interlock** can be defeated.*

22.106 The supervision device of each **monitored door interlock** shall render the appliance inoperable if its switching part fails to control the microwave generator(s).

Compliance is checked by the following test.

*The switching part of the **monitored door interlock** is rendered inoperative. The appliance is supplied at **rated voltage** from a supply source having a short-circuit capacity of at least 1,5 kA for appliances having a **rated voltage** over 150 V and 1,0 kA for other appliances.*

*Appliances having a **rated voltage** less than 150 V and a **rated current** over 20 A are supplied at **rated voltage** from a supply source having a short-circuit capacity of at least 5,0 kA.*

*The appliance is operated with the door closed and an attempt is then made to gain access to the **cavity** in the normal way. It shall not be possible to open the door, unless the microwave generator(s) cease(s) to function and remains inoperable. The supervision device shall not fail in the open-circuit position.*

~~NOTE 1~~ *The supervision device is replaced for subsequent tests if it fails in the closed-circuit position.*

~~NOTE 2~~ *It ~~can be~~ is necessary to render other **door interlocks** inoperative in order to perform this test in some cases.*

If an internal fuse in the circuit supplying the microwave generator(s) rupture(s), the fuse is replaced and the test is carried out two more times. The internal fuse shall rupture each time.

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The test is carried out three more times but with an impedance of (0,4 + j 0,25) Ω in series with the supply source. The internal fuse shall rupture each time.

~~NOTE 3~~ *For appliances having a **rated voltage** under 150 V and those with a **rated current** over ~~16~~ 20 A, the test with the series impedance is not carried out.*

NOTE In case of internal fuse ruptures, the switches, filters and wiring can be replaced each time, if this is stated in the instructions of professional servicing.

22.107 The failure of any single electrical or mechanical component that affects the operation of a **door interlock** shall not cause any other **door interlock**, or the supervision device of the **monitored door interlock** to become inoperative, unless the appliance is rendered inoperable.

Compliance is checked by inspection and, if necessary, by simulating component failure and operating the appliance as in normal use.

NOTE This requirement does not apply to components of the supervision device that comply with the test of 22.106.

22.108 The **door interlocks** incorporated to comply with 22.103 shall operate before undue microwave leakage occurs.

Compliance is checked by the following test.

*All **door interlocks** except one are rendered inoperative. The appliance is supplied at **rated voltage** and operated with the load specified in 32.1. The door opening sequence is carried out in small increments during which the microwave leakage is measured.*

The appliance shall comply with 32.1.

*The test is repeated on each **door interlock** in turn.*

NOTE 1 **Door interlocks** are only tested if they are necessary for compliance with 22.103.

NOTE 2 It can be ~~necessary~~ applicable to render the supervision device of the **monitored door interlock** inoperative when carrying out the test.

22.109 There shall be no undue microwave leakage if thin material is introduced between the door and its mating surface.

Compliance is checked by closing the door on a strip of paper having a width of 60 mm ± 5 mm and a thickness of 0,15 mm ± 0,05 mm, the paper being placed between the door and its mating surface.

The appliance shall then comply with 32.1.

The test is carried out ten times with the paper in different locations.

22.110 There shall be no undue microwave leakage if the door seals become contaminated by food residues.

Compliance is checked by the following test.

The door seal is coated with cooking oil. If the seal has an open choke, the trough is filled with oil.

The appliance shall then comply with 32.1.

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22.111 There shall be no undue microwave leakage when the door corners are subjected to distortion.

Compliance is checked by the following test.

*The appliance is supplied at **rated voltage** and operated with the load specified in 32.1. The door and its opening means are manipulated until the largest door gap permitting microwave generation is obtained. A pull force is applied perpendicular to the surface of the door to each corner ~~in turn~~ one at a time. The force is slowly increased to 40 N.*

During the test, the microwave leakage is measured under the conditions specified in 32.1 and shall not exceed 100 W/m^2.

After the test, the appliance shall comply with 32.1.

22.112 There shall be no undue microwave leakage, and the **temperature-sensing probe** shall not become damaged when a probe or its cord is trapped by the door.

Compliance is checked by the following test.

*The probe is connected as in normal use, the sensing part or cord being allowed to rest in the most unfavourable position likely to occur. The door is closed against the sensing part or the cord with a force of 90 N applied for 5 s in the most unfavourable place. The force is then released and, if the oven can be operated with the **temperature-sensing probe** still being placed in the trapped position, the microwave leakage is measured under the conditions specified in 32.1 and shall not exceed 100 W/m^2.*

*After the test, the appliance shall comply with 32.1 and the **temperature-sensing probe** shall comply with 8.1, 15.101 and Clause 29.*

22.113 There shall be no undue microwave leakage when **detachable parts** are removed.

Compliance is checked by the following test.

***Detachable parts** are removed, except **shelves**, unless a horizontal surface greater than 85 mm in diameter is made available when they are removed.*

*The appliance shall then comply with 32.1, the load being placed on the horizontal surface as close as possible to the centre of the **cavity**.*

NOTE In order to avoid detecting non-radiating standing waves, the tip of the instrument probe is not inserted into an opening resulting from the removal of a **detachable part**.

22.114 A single fault such as failure of **basic insulation** or a loose wire bridging the insulation system shall not allow operation of the microwave generator(s) with the door open.

*Compliance is checked by inspection and if, necessary, by simulating relevant faults. Wires that ~~may~~ can become loose are disconnected and allowed to fall out of position but are not otherwise manipulated. They shall not come into contact with other **live parts** or earthed parts if this results in all **door interlocks** becoming inoperative.*

NOTE 1 Failure of **reinforced insulation** or **double insulation** is considered to be two faults.

NOTE 2 Wires secured by two independent fixings are not considered likely to become loose.

22.115 There shall be no access to the **cavity** through the viewing screen.

Compliance is checked by inspection and the following test.

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*A straight steel rod having a diameter of 1 mm and a flat end is pressed perpendicularly against the viewing screen with a force of 2 N. The rod shall not enter the **cavity**.*

22.116 Appliances for installing in road vehicles, caravans and similar vehicles shall withstand the vibrations to which they ~~may~~ can be subjected.

Compliance is checked by carrying out the vibration tests specified in IEC 60068-2-6 under the following conditions.

The appliance is fastened in its normal position of use to a vibration-generator by means of straps around the enclosure. The type of vibration is sinusoidal, and the severity is as follows:

- *the direction of vibration is vertical;*
- *the amplitude of vibration is 0,35 mm;*
- *the sweep frequency range is 10 Hz to 55 Hz;*
- *the duration of the test is 30 min.*

The appliance shall show no damage that could impair compliance with 8.1, 16.3 and Clauses 29 and 32, and connections shall not have worked loose.

22.117 If **electronic circuits** are used to provide protection against microwave leakage, they shall be designed so that a fault condition will not affect protection against microwave leakage.

Compliance is checked by applying the tests in Clause 19 in conjunction with the requirements and test specifications in 22.105, 22.106, 22.107 and 22.108.

22.118 Inadvertent operations during handling of the container during normal use of **fixed appliances** and **built-in appliances** being used equal or higher than 900 mm above the floor having **detachable** turntables shall not lead to a hazardous situation due to falling down turntables. This is not applicable for appliances with horizontal bottom hinged door.

Compliance is checked by inspection and the following test.

*The bearing of the **detachable** turntable of **microwave ovens** shall be placed in the most unfavourable position. A force which will be increased from 0 N up to the maximum of 10 N is applied vertically downwards to the front edge of the turntable.*

*During the test, the turntable shall not slide out of the **cavity** and fall down.*

*A cylindrical container of borosilicate glass with a maximum thickness of 3 mm, an external diameter of approximately 190 mm, a height of approximately 90 mm and an outer bottom curvature of approximately 5 mm is filled with 1 000 g ± 50 g cold water and placed on the turntable. With a horizontal force applied at the top of the container which will be increased from 0 N up to the maximum of 10 N, an attempt is made to pull the container out of the **cavity** without any lifting from the turntable.*

*During the test, the turntable shall not slide out of the **cavity** and fall down.*

NOTE During the test, it is possible that the container falls out of the **cavity**.

22.119 Outer glass panels of **microwave oven** doors which break during the test of 21.104 and with an area having any two orthogonal dimensions exceeding 75 mm shall be made from one of the following glasses.

- ~~glass that breaks into small pieces when it fractures in accordance with 22.119.1; or~~
- ~~glass that is not released or dropped from its normal position when broken in accordance with 22.119.2; or~~

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~~– glass with enhanced mechanical strength in accordance with 22.119.3.~~

~~22.119.1~~ – Glass that breaks into small pieces when it fractures.

Compliance is checked by the following test which is performed on two samples.

Frames or other parts attached to the glass panel to be tested are removed and the glass is placed on a rigid horizontal flat surface.

NOTE 1 The edges of the sample to be tested are contained within a frame of adhesive tape in such a manner that the broken pieces remain in place after breakage but without hindering expansion of the sample.

The sample under test is broken by means of a test punch having a head with a mass of 75 g ± 5 g and a conical tungsten carbide tip with an angle of 60° ± 2°. The punch shall be positioned approximately 13 mm in from the longest edge of the glass at the midpoint of that edge. The punch is then hit by a hammer so that the glass breaks.

A transparent mask of 50 mm × 50 mm is placed on the fractured glass except within a peripheral margin of 25 mm from the edge of the sample.

The assessment shall be undertaken on at least two areas of the sample, and the areas chosen shall contain the largest particles.

The number of crack free particles within the mask is counted and for each assessment shall not be less than 40. The particle count shall be made within 5 min of the fracture. Each particle wholly contained within the area of the mask shall be counted as one particle and each particle that is partially within the mask shall be counted as a half particle.

NOTE 2 In the case of curved glass, plane pieces of the same material can be used for the test.

~~22.119.2~~ – Glass that is not released or dropped from its normal position when broken.

Compliance is checked by breaking the glass when mounted in its normal position in the appliance by means of a test punch having a head with a mass of 75 g ± 5 g and a conical tungsten carbide tip with an angle of 60° ± 2°. The punch shall be positioned approximately 13 mm in from the longest edge of the glass at the midpoint of that edge. The punch is then hit by a hammer so that the glass breaks.

At the conclusion of this test, the glass shall not be broken or cracked such that pieces are released or dropped from their normal position. Glass that is released within the immediate vicinity of the punch tip as a result of the punch impacting the sample under test is ignored.

~~22.119.3~~ – Glass with enhanced mechanical strength.

Compliance is checked by the pendulum hammer test Eha of IEC 60068-2-75.

For the test, the glass panels are supported according to their method of incorporation in the appliance.

The test is performed with three blows applied at the most critical point on two samples, the impact energy of each blow shall be 5 J.

At the conclusion of the tests, the glass shall not be broken or cracked.

22.120 Where interlocks other than **door interlocks** are required to comply with this standard and are operated by **detachable parts**, they shall be guarded so that accidental operation is prevented.

Compliance is checked by inspection and by manual test with test probe B and test probe 18 one at a time.

22.121 For appliances that are controlled by programmable **electronic circuits** that limit the number of heating elements and motors from being energised at the same time, simultaneous activation of any combination of heating elements and motors shall not render the appliance unsafe.

Compliance is checked as follows:

– *the fault/error conditions specified in Table R.1 are applied and evaluated in accordance with the relevant requirements of normative Annex R; or*

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– *the appliance is operated under conditions of Clause 11 while being supplied at **rated voltage**, the programmable **electronic circuits** being modified to allow simultaneous activation of all heaters and motors under their control. Under these conditions, compliance with 19.13 shall be fulfilled.*

23 Internal wiring

This clause of Part 1 is applicable.

24 Components

This clause of Part 1 is applicable except as follows.

24.1

NOTE 101 IEC 60989[3] is not applicable to power transformers that supply the magnetron.

24.1.4 *Addition:*

Interlocks are subjected to the following test which is carried out on six samples.

*The interlocks are connected to a load that simulates the conditions occurring in the appliance when it is supplied at **rated voltage**. They are operated at a rate of approximately six cycles per minute. The number of cycles is:*

– ***door interlocks*** *50 000;*

– *interlocks only operated during **user maintenance*** *5 000.*

After the test, the interlocks shall not be damaged to such an extent that their further use is impaired in this standard.

~~**24.101** Socket-outlets incorporated in **class I appliances** shall be single-phase, incorporate an earthing contact and have a rated current not exceeding 16 A. Both poles shall be protected by fuses or miniature circuit-breakers placed behind a **non-detachable cover** and having a rated current not exceeding~~

~~– 20 A, for appliances having a **rated voltage** up to 130 V;~~

~~– 10 A, for other appliances.~~

~~If the appliance is intended to be permanently connected to fixed wiring, or is fitted with a polarized plug, the neutral pole need not be protected.~~

~~*Compliance is checked by inspection.*~~

~~NOTE The actuating member of miniature circuit-breakers can be **accessible**.~~

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.14 *Addition:*

[3] Withdrawn.

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*For **temperature-sensing probes**, the total number of flexings is 5 000. Probes with circular-section cords are turned through 90° after 2 500 flexings.*

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable except as follows.

27.1

NOTE 101 For **class I appliances**, one pole of the output of power supply of microwave generator(s), if any, is earthed for functional purposes.

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.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2 *Addition:*

*For appliances that allow a preselected start time, appliances with a keep-warm function and appliances with **remote operation**, 30.2.3 is applicable. For other appliances, 30.2.2 is applicable.*

31 Resistance to rusting

This clause of Part 1 is applicable.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable except as follows.

32.1 *Addition:*

Compliance for microwave leakage is checked by the following test.

*A load of 275 g ± 15 g of potable water having a temperature of 20 °C ± 2 °C, in a thin-wall borosilicate glass vessel having an inside diameter of approximately 85 mm, is placed on the centre of the **shelf**. The appliance is supplied at **rated voltage** and operated with the microwave power control at the highest setting.*

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Microwave leakage is determined by measuring the microwave flux density using an instrument that reaches 90 % of its steady reading in 2 s to 3 s when subjected to a stepped input signal. The instrument antenna is moved over the external surface of the appliance to locate the highest microwave leakage, particular attention being given to the door and its seals.

The microwave leakage at any point 50 mm or more from the external surface of the appliance shall not exceed 50 W/m^2.

NOTE 101 If compliance with the test is in doubt due to a high water temperature, the test is repeated with a fresh load.

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Dimensions in millimetres

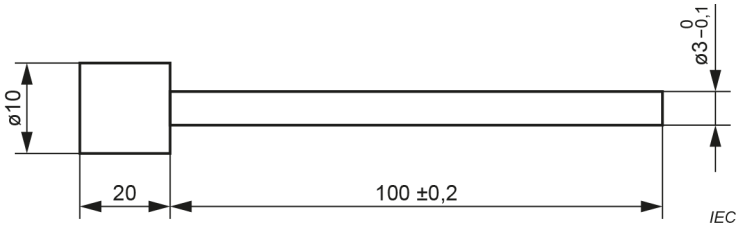
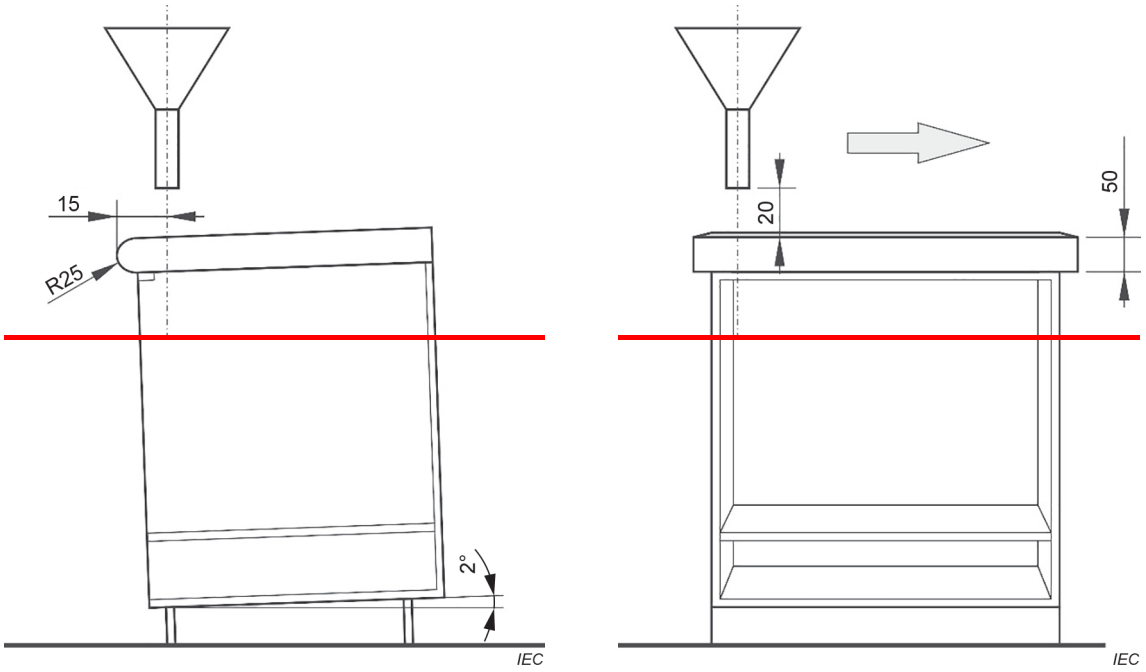


Figure 101 – Test rod for door interlock concealment

~~Dimensions in millimetres~~



~~a) Side view~~ ~~b) Front view~~

~~**Figure 102 – Test cabinet including working surface, position of funnel and example for direction of tilt**~~

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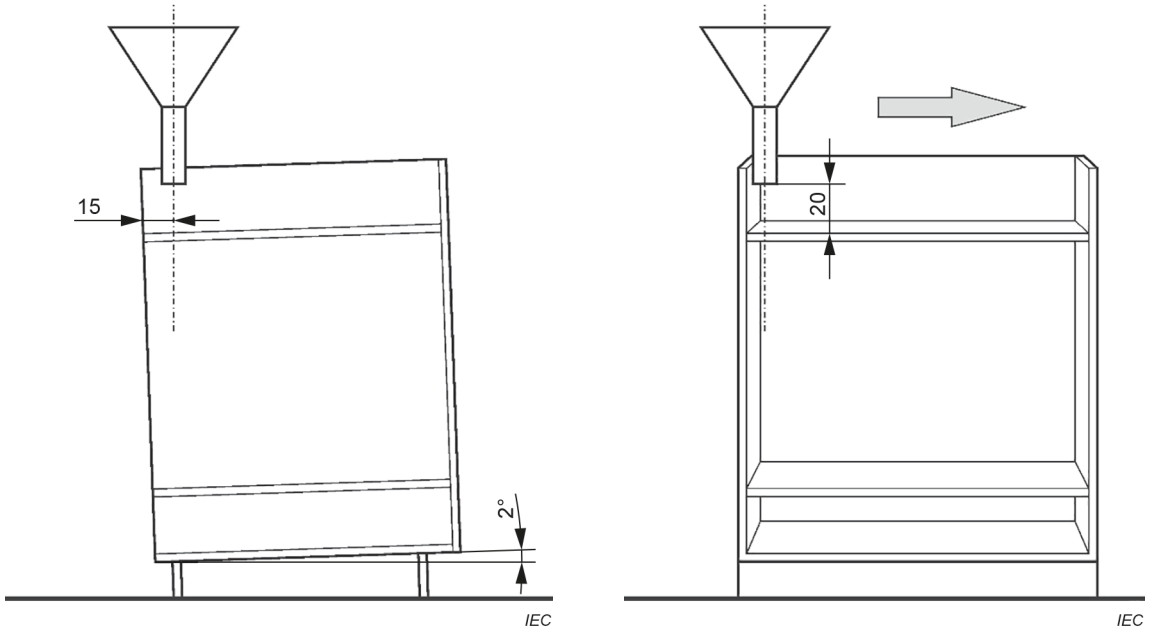
Figure 102 – Void

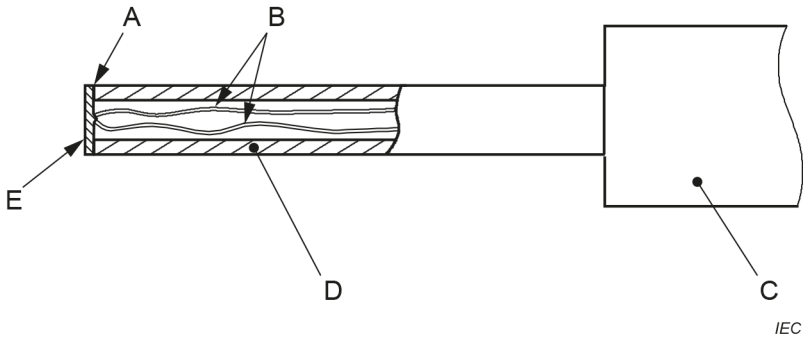
Dimensions in millimetres



a) Side view

b) Front view

Figure 103 – Test cabinet including separation board, position of funnel and example for direction of tilt



Key

A adhesive

B thermocouple wires 0,3 mm diameter to IEC 60584-1 Type K

C handle arrangement permitting a contact force of 4 N ± 1 N

D polycarbonate tube: inside diameter 3 mm, outside diameter 5 mm

E tinned copper disc: 5 mm diameter, 0,5 mm thick with flat contact face

Figure 104 – Probe for measuring surface temperatures

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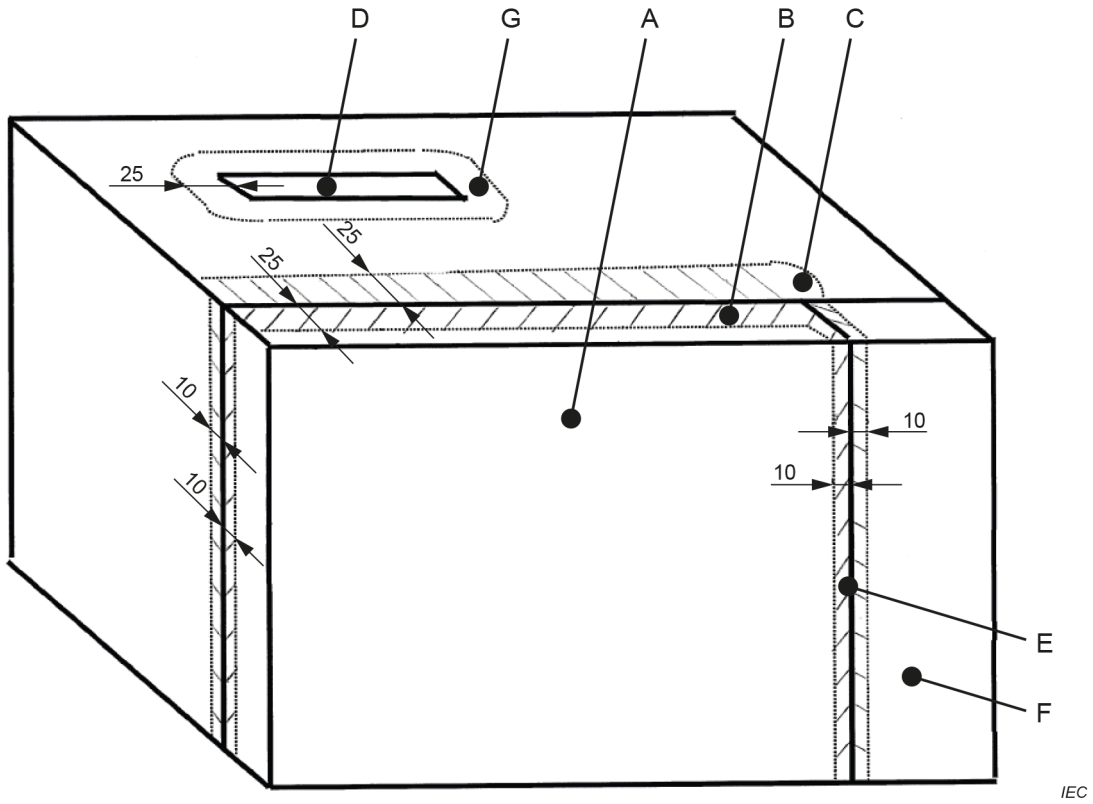
Dimensions in millimetres



Key

A **microwave oven** door

B excluded area on the **microwave oven** door (Zone 1)

C excluded area around the **microwave oven** door (Zone 2)

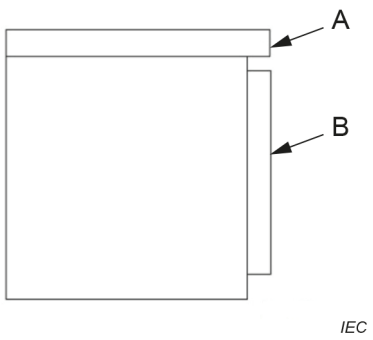
D vent

E door gap

F **microwave oven** front surface

G excluded area around vents (Zone 3)

Figure 105 – Front view of appliance with identification of excluded areas



Key

A work surface

B built-in **microwave oven**

Figure 106 – Arrangement of work surface for spillage test on built-in microwave oven

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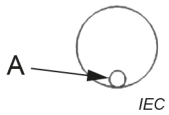
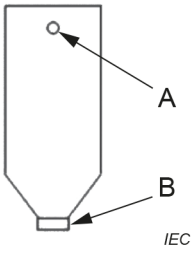


Key

A bottle cap hole – diameter 8 mm

Figure 107 – Detail of bottle cap and position of hole



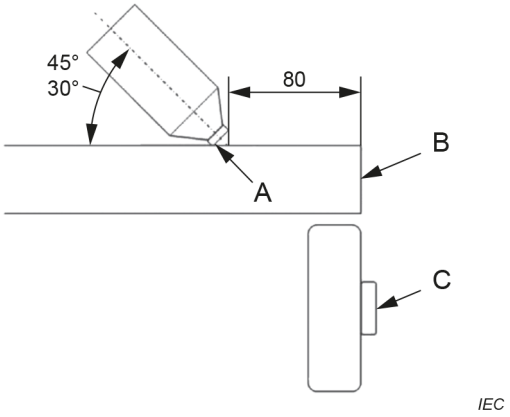
Key

A bottle hole with diameter 8 mm

B bottle cap

Figure 108 – Spillage solution bottle

Dimensions in millimetres



Key

A bottle cap hole position

B edge of work surface

C front of **microwave oven**

Figure 109 – Bottle position for the spillage test

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Annexes

The annexes of Part 1 are applicable except as follows.

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Annex A
(informative)

Routine tests

This annex of Part 1 is applicable except as follows.

A.2 ~~Electric strength~~ Earth continuity test

Modification:

The current in the test circuit may be increased up to 100 mA.

A.101 Marking and instructions

The covers are checked to ensure that they are marked with the warnings concerning microwave energy.

The appliance is checked to ensure that the corresponding instructions are provided with it.

A.102 Construction

*The operation of the **door interlock** system is checked to ensure that microwave generation ceases when the door is opened.*

A.103 Microwave leakage

*The **microwave oven** is supplied at **rated voltage** and operated with the microwave power control adjusted to the highest setting. A load as specified in 32.1 or a load with equal dielectric and thermal properties shall be used. The energy flux density of microwave leakage is measured at any point approximately 50 mm between the field sensor and the external surface of the appliance. The measuring instrument is moved over the external surface of the oven and the microwave leakage is measured.*

The microwave leakage shall not exceed 50 W/m^2, as recorded with an instrument fulfilling at least the specifications in Clause A.104 regarding its proper function.

A.104 Microwave leakage instrument minimum specifications

A.104.1 *The following specification applies only for routine tests and may also apply for checks of **microwave ovens** after repair or servicing. Instruments for type testing shall fulfil more stringent requirements, which are obtained from National bodies responsible for protection against non-ionising radiation.*

A.104.~~1~~2 *Instruments shall be subjected regular checks by carrying out the following tests, to ensure their proper function is maintained. The tests for instrument compliance are made at room temperature. For carrying out the tests, the position of the field sensor shall be known and preferably be marked. In order to allow measurements specified in A.104.~~2~~3, the minimum resolution of the instrument under test (IUT) shall be 1 W/m^2.*

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A.104.~~2~~3 *The checks are carried out either using a generator set-up in an anechoic chamber or using a reference instrument in substitution mode. The far field shall be linearly polarized. The field sensor of the instrument under test (IUT) shall be placed at the position of the reference field, where the flux density is 10 W/m^2 or 50 W/m^2, depending on the task. The range selector, if any, shall be set to the most appropriate range to measure a flux density of 10 W/m^2 or 50 W/m^2, depending on the task and with a tolerance from −40 % to ± 60 %. By slowly rotating the IUT field sensor for 360° around its axis which is aligned to the propagation direction of the far field and directed towards the radiation source, the minimum and maximum reading shall be found and recorded. If the deviation of minimum and maximum readings is less than or equal to ± 2 dB (i.e. from −37 % to +58 %) related to the reference field, it is assumed that the IUT complies with this standard.*

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Annex B
(normative)

Battery-operated appliances, separable batteries and detachable batteries for battery-operated appliances

This annex of Part 1 is applicable except as follows.

B.11.1 *Modification:*

*For appliances operated with **detachable batteries** or **separable batteries** that are disconnected from the appliance for charging purposes, the appliance is operated as specified in 11.7 or AA 11.7 until it completes that duration of the test as specified or it no longer operates due to depletion of the **battery**. If the battery is depleted before the appliance completes the duration of the test, the depleted **battery** is immediately replaced with another **battery** that is **fully charged**, the **battery** being the model or type reference of the **battery** provided or indicated in the instructions. The test is continued until the appliance completes the duration of the test as specified or it no longer operates due to depletion of the **battery**.*

*For appliances incorporating **integral batteries** or **separable batteries** not disconnected from the appliance for charging purposes, and that cannot perform their intended function while the **batteries** are being charged, the appliance is operated as specified in 11.7 and AA.11.7 until it cannot perform its intended function due to the depletion of the **batteries**.*

*For appliances operated with **batteries** that are replaceable, including **integral batteries** that are replaceable, or **non-rechargeable batteries**, the appliance is operated until the minimum capacity of the **battery** as specified in Table B.1 has been delivered or the appliance competes the duration of the test as specified in 11.7 and AA.11.7, whichever occurs first.*

B.22.3 *Addition:*

For parts of appliances situated not more than 850 mm above the floor after installation or in normal use, in addition to the use of test probe 18, test probe 19 of IEC 61032 is also applied wherever test probe 18 is used and with the same test conditions used for test probe 18.

B.22.4 *Addition:*

For parts of appliances situated not more than 850 mm above the floor after installation or in normal use, in addition to the use of test probe 18, test probe 19 of IEC 61032 is also applied wherever test probe 18 is used and with the same test conditions used for test probe 18.

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Annex R
(normative)

Software evaluation

This annex of Part 1 is applicable except as follows.

R.2.2.5 *Modification:*

For programmable **electronic circuits** with functions requiring software incorporating measures to control the fault/error conditions specified in Table R.1 or Table R.2, detection of a fault/error shall occur before compliance with Clause 19 or 22.121 is impaired.

R.2.2.9 *Modification:*

The software and safety-related hardware under its control shall be initialized and shall terminate before compliance with Clause 19 or 22.121 is impaired.

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Annex AA
(normative)

Combination microwave ovens

The following modifications to this standard are applicable for **combination microwave ovens**.

The clause numbers in this annex refer to the clause numbers in the main part of this standard. Clauses that are additional to the clauses in the main part of this standard are identified by adding the annex letter with the numbering starting at 201.

1 Scope

AA.1.201 For **stationary combination microwave ovens**, IEC 60335-2-6 is also applicable. For **portable combination microwave ovens**, IEC 60335-2-9 is also applicable. However, the requirements of these standards do not take precedence over this standard.

NOTE If a **combination microwave oven** has a mode of operation independent of microwave generation, then this mode is tested only according to the requirements in the relevant standard. If a **combination microwave oven** has a mode of operation without the use of resistive heating elements, it is tested to comply with the relevant requirements of this standard.

3 Terms and definitions

3.1.9
normal operation

Addition:

The appliance is operated with the controls adjusted to the most unfavourable setting in accordance with the instructions for the intended mode of operation.

5 General conditions for the tests

5.3 ~~*Addition:*~~

NOTE ~~101~~201 When testing the different modes of operation, only those tests having the most unfavourable conditions are carried out.

5.101 ~~*Addition:*~~

Replace as follows.

Combination microwave ovens *are tested as* ***combined appliances***.

7 Marking and instructions

7.12 *Addition:*

The instructions for use shall also include the substance of the following.

WARNING: When the appliance is operated in the combination mode, children should only use the oven under adult supervision due to the temperatures generated.

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