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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Household and similar electrical appliances – Safety – Part 2-90: Particular requirements for commercial microwave ovens

IEC 60335-2-90:2024-07 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-90: Particular requirements for commercial 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 60335-2-90:2015+AMD1:2019 CSV. 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 60335-2-90 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 fifth edition cancels and replaces the fourth edition published in 2015 including its Amendment 1:2019. This edition constitutes a technical revision.

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

a) the appliance used in area open to the public has been introduced in Clause 1, 3.8.107, 7.12, 8.1.1, 11.8, 20.2, 22.103.2, 22.105 and 22.117;
b) Subclauses 5.5, 7.12.1, 11.2, 11.7, 20.1 and 20.101 have been modified to add for stacking installation;
c) Subclauses 7.1, 11.7 and 22.61 have been modified for the appliance outlets and socket-outlets;
d) Subclause 7.12 has been improved in clarity;
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 16.101 has been modified to move the content of 16.101.1, 16.101.2 directly under 16.101.
h) Subclauses 19.11.2, 19.13, Clause 21, Subclauses 22.105, 22.111 and Annex AA have been improved in clarity;
i) Annex BB and Annex EE have been modified to add screw requirements.

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

Draft	Report on voting
61B/702/FDIS	61B/706/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 commercial microwave ovens.

When a particular subclause of Part 1 is not mentioned in 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** type 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, USA and Canada).

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

– 7.12: Some warnings have to be marked on the appliance and be visible to the user (Canada).

– 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 only measured 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 only measured at the end of the test (USA).

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

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

– 27.2: A terminal for an external equipotential conductor is not required (Japan).

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 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.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-90: Particular requirements for commercial 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** with a **cavity** door intended for commercial use, their **rated voltage** being not more than 250 V for single-phase appliances connected between one phase and neutral and 480 V for other appliances.

These appliances are not intended for household and similar purposes. They are used for commercial processing of food, also in **areas open to the public**, for example in kitchens of restaurants, canteens, hospitals and in commercial enterprises such as bakeries and butcheries;

– the safety of **combination microwave ovens** with a **cavity** door, the requirements of which are contained in normative Annex AA;

– the safety of **microwave ovens** without a **cavity** door and with **transportation means** that are intended for commercial use only, for the heating of food and beverages, the requirements of which are contained in normative Annex BB.

Microwave ovens covered by normative Annex BB have **transportation means** for moving the **load** through the **microwave oven**. Requirements for tunnel microwave ovens and several types of microwave vending machines are covered.

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

~~NOTE 101~~ In normative Annex BB, a **microwave oven** without a **cavity** door and with **transportation means** is described as a **microwave oven**. All clauses of this standard apply to these appliances unless otherwise specified in normative Annex BB.

This part of IEC 60335 also takes into account **ordinary persons** having access to the **removing area** of the vending machine.

~~NOTE 102~~ The appliance ~~may~~ can be built into a vending machine, in which case IEC 60335-2-75 ~~may~~can also be applicable.

~~NOTE 103~~ Appliances that use non-electrical energy are within the scope of this standard.

~~In general, this standard does not take into account~~

~~– the use of appliances by young children or infirm persons without supervision;~~

~~– playing with the appliance by young children.~~

As far as is practicable, this standard deals with the common hazards presented by these types of appliances.

This standard does not take into account the use of a **microwave oven** without a **cavity** door and with **transportation means** by **ordinary persons** except in the vicinity of **entrance and exit ports**.

~~NOTE 104~~ The rationales for particular microwave exposure conditions and measures related to microwave energy being confined by an open structure are given in normative Annex BB.

~~NOTE 105~~ Attention is drawn to the fact that

- for appliances intended to be used in vehicles or on trains, on board ships or board aircraft, additional requirements ~~may~~ can be necessary;
- for appliances intended to be used in tropical countries, special requirements ~~may~~ can be necessary;
- in many countries, the national health authorities, the national authorities responsible for the protection of labour and similar authorities specify additional requirements;
- in many countries, national authorities specify additional requirements to BB.22.~~119~~101.1.

~~NOTE 106~~ This standard does not apply to

- ~~household~~ **Microwave ovens** including **combination microwave ovens** for household use covered by IEC 60335-2-25 and used in the following environments by laymen:
  - staff kitchen areas in shops, offices and other working environments;
  - farm houses;
  - by clients in hotels, motels and other residential type environments;
  - bed and breakfast type environments.
- 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).

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60068-2-6, *Environmental testing – Part 2-6: 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 60335-2-36, *Household and similar electrical appliances – Safety – Part 2-36: Particular requirements for commercial electric cooking ranges, ovens, hobs and hob elements*

IEC 60335-2-42, *Household and similar electrical appliances – Safety – Part 2-42: Particular requirements for commercial electric forced convection ovens, steam cookers and steam-convection ovens*

IEC 60335-2-49, *Household and similar electrical appliances − Safety − Part 2-49: Particular requirements for commercial electric ~~hot cupboards~~ appliances for keeping food and crockery warm*

IEC 60335-2-75, *Household and similar electrical appliances – Safety – Part 2-75: Particular requirements for commercial dispensing appliances and vending machines*

IEC 60436:~~2004~~2015, *Electric dishwashers for household use – Methods for measuring the performance*
~~IEC 60436:2004/AMD 1:2009~~
~~IEC 60436:2004/AMD 2:2012~~
IEC 60436:2015/AMD1:2020

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

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

ISO 3506-1, *Fasteners – Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs with specified grades and property classes*

ISO 3506-2, *Fasteners – Mechanical properties of corrosion-resistant stainless steel fasteners – Part 2: Nuts with specified grades and property classes*

ISO 3506-3, *Mechanical properties of corrosion-resistant stainless steel fasteners – Part 3: Set screws and similar fasteners not under tensile stress*

ISO 3506-4, *Mechanical properties of corrosion-resistant stainless steel fasteners – Part 4: Tapping screws*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1 Definitions relating to physical characteristics

3.1.7

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 under the following conditions:

The appliance is operated 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 placed on the centre of the **shelf**. If the **rated microwave power output** exceeds 2 200 W, two such vessels are used and placed contiguously in the **cavity**.

~~3.102~~3.1.101
rated microwave power output
microwave power output assigned to the appliance by the manufacturer

3.5 Definitions relating to types of appliances

~~3.101~~3.5.101
microwave oven
appliance using electromagnetic energy in one or several of the ISM frequency bands[1] between 300 MHz and 30 GHz, for heating food and beverages in a **cavity**

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

~~3.127~~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

~~3.111~~3.6.106
transportation means
means to transport the **load** through the **microwave oven**

Note 1 to entry: An example of a **transportation means** is a belt, an arm or an inclined plane.

~~3.113~~3.6.107
microwave enclosure
structure that is intended to confine microwave energy to a defined region

Note 1 to entry: Barriers mounted outside the **microwave enclosure** are not considered a part of the **microwave enclosure**.

Note 2 to entry: A **microwave enclosure** ~~may~~ can consist of a **cavity**, quarter wave chokes (acting by impedance transformation), mode chokes (acting by field pattern mismatching) and microwave energy absorbers.

~~[1] ISM frequency bands are the electromagnetic frequencies established by the ITU and reproduced in CISPR 11.~~

~~3.114~~3.6.108
microwave barrier
physical barrier, which is microwave transparent, limiting access to the **microwave enclosure**, mounted outside the **microwave enclosure** and can only be removed with the aid of tools

Note 1 to entry: A **microwave barrier** ~~may~~ can be mounted between the **microwave enclosure** and the external cover of the appliance.

Note 2 to entry: Devices such as an array of metal chains or hinged metal plates at **entrance and exit ports** intended to reduce microwave leakage are not considered **microwave barriers**.

Note 3 to entry: Construction requirements are given in BB.22.~~119~~101.

Note 4 to entry: Informative Annex DD mentions about rationale for the **microwave barrier** and associated leakage test.

~~3.115~~3.6.109
entrance and exit ports
openings in the **microwave enclosure** through which **loads** move

~~3.116~~3.6.110
loading area
area on which the **load** is placed

~~3.117~~3.6.111
means of monitored microwave interlock
means of microwave interlock that incorporates a supervision device

~~3.118~~3.6.112
protective blocking structure
movable mechanical structure located in the **removing area** limiting access to the **microwave enclosure**

~~3.119~~3.6.113
removing area
area from which the **load** is removed

~~3.120~~3.6.114
viewing opening
opening in the **cavity** through which the warm up process can be visually monitored

~~3.121~~3.6.115
fixed means of connection
all parts of the **microwave enclosure** that are permanently open with the exception of **entrance and exit ports** and **viewing openings**

Note 1 to entry: **Fixed means of connection** ~~may~~ can be used for venting and water flushing.

3.6.116
Void

~~3.123~~3.6.117
means of microwave interlock
mechanical or electrical safety devices or systems that operate when certain conditions are not fulfilled (e.g. an interlock system that prevents the operation of the microwave generator when a means of access is open)

~~3.124~~3.6.118
maintenance cover
structural feature of any part of the equipment that can be opened or removed by the use of a tool to provide access for routine maintenance, service, replacement of expendable parts, etc. in microwave containing areas

~~3.125~~3.6.119
cleaning cover
part of the **microwave enclosure** that can be opened or removed, only with the aid of a tool, for frequent cleaning purposes, during operation

~~3.126~~3.6.120
reference surface
surface in the vicinity of entrance and exits ports defined depending on the leading of microwave leakage of ~~Clause BB.32~~ 32.1 of normative Annex BB

Note 1 to entry: If the leakage reading is less or equal to 50 W/m^2, the **reference surface** is the surface of the geometric opening of the **microwave enclosure** without **microwave barrier**.

Note 2 to entry: If the leakage reading exceeds 50 W/m^2, the **reference surface** is an artificial surface located 50 mm away from the locations where the sensor of the instrument measures leakage readings of 50 W/m^2 straight inwards towards the appliance.

Note 3 to entry: For further explanation, refer to ~~Clause BB.32~~ 32.1 of normative Annex BB.

3.8 Definitions relating to miscellaneous matters

~~3.108~~3.8.101
instructed person
person who is sufficiently instructed and monitored to know how to avoid any danger caused by the operation of **microwave ovens**

~~3.109~~3.8.102
skilled person
person with suitable professional education, knowledge and experience to discern and to avoid any danger caused by the operation of **microwave ovens**

~~3.110~~3.8.103
ordinary person
person who is neither a **skilled person** nor an **instructed person**

~~3.112~~3.8.104
load
food and beverages that can be heated up in a **microwave oven**

3.8.105
area open to the public
area in which the general public, including children, can have access

Note 1 to entry: Examples include customer areas in:

– grocery stores;
– canteens;
– train stations;
– self-service restaurants.

3.8.106
open deck
area that is exposed to marine environment

3.8.107
dayroom
area that can be exposed to marine environment from time to time

~~**3.122**~~
~~**detachable means of access**~~
~~all parts of the **microwave enclosure** that can be opened or removed without the aid of tools to get access to the inside for maintenance, with the exception of **entrance and exit ports** and **viewing openings**~~

~~Note 1 to entry: Examples of **detachable means of access** are tunnels that are opened by drop down or sliding action and cavity lamp covers.~~

~~**3.128**~~
~~**hot functional surface**~~
~~surface that is intentionally heated by an internal heat source and that has to be hot to carry out the intended function of the appliance~~

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 ~~may~~ can be required for the test of 19.104.*

Six samples of the interlocks are required for the test of 24.1.4.

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, 22.116, Clause 7 to Clause 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 and 22.116), Clause 23 to Clause 31 and 32.2, 21.101 to 21.105 and 19.104.

5.5 *Addition:*

The tests are carried out with the appliances in any stacked combination or any movable part of it placed in the most unfavourable condition that can occur in normal use.

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**.

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.~~

If appliances have external enclosures, other than working surfaces, that cannot meet the limit in Table 3 specified for external enclosures of **motor-operated appliances**, they shall be marked with symbol IEC 60417-5041 (2002-10) or with the substance of the following:

CAUTION: Hot surface.

If appliances have external **accessible surfaces**, for which temperature rise limits are specified in Table 101 and Table 102 and for which the provisions of footnote b to Table 101 and Table 102 apply, then the appliance shall be marked with symbol IEC 60417-5041 (2002-10) or with the substance of the following:

CAUTION: Hot surface

7.6 *Addition:*

	[symbol IEC 60417-5021 (2002-10)]	equipotentiality
	[symbol IEC 60417-5041 (2002-10)]	caution, hot surface

7.12 *Addition:*

The instructions shall include the substance of the following:

– 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 any 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 or other foods must not be heated in sealed containers since they are liable to explode.

– WARNING: Microwave heating of beverages can result in delayed eruptive boiling, therefore care must be taken when handling the container.
– WARNING: The contents of feeding bottles and baby food jars must be stirred or shaken and the temperature checked before consumption, in order to avoid burns.
– 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**.
– When heating food in plastic or paper containers, keep an eye on the oven due to the possibility of ignition.
– If smoke is observed, switch off or unplug the appliance and keep the door closed in order to stifle any flames.
– Eggs in their shell and whole hard-boiled eggs should not be heated in **microwave ovens** since they may 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**).
– The appliance should not be cleaned with a water jet (for appliances intended to stand on the floor and which are not at least IPX5).
– Statement on usage on commercial road vehicles (for appliances intended to be used on commercial road vehicles).
– The appliance must not be cleaned with a steam cleaner (for appliances which are not at least IPX5).

~~NOTE 101 If the oven is incorporated in a vending machine, these warnings and instructions may not be relevant and therefore not required.~~

NOTE 102 If the oven is incorporated in a vending machine, no warnings and instructions can be required.

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

The manufacturer shall declare that the appliance is also intended to be used in an **area open to the public**. For this case, it shall be stated whether this appliance is allowed to be placed or installed less than 850 mm above the floor.

If the appliance is not suitable for use in an **area open to the public**, the instruction shall include the substance of the following warning:

WARNING: This appliance shall not be placed or installed where the public has access.

7.12.1 *Addition:*

If the installation instructions state that a **microwave oven** can be placed on top of another **microwave oven**, they shall state model or type reference of the suitable **microwave ovens**. Instructions shall be given for the stacking way of the **microwave ovens**. The instructions shall state how to use the fixing attachments, if any, in a correct way. The instructions shall also state the maximum number of stacked **microwave ovens**.

7.14 *Addition:*

The warning specified in 7.1 shall be in lettering at least 3 mm high.

The warning specified in 7.101 shall be in lettering at least 5 mm high.

The height of the triangle used with symbol IEC 60417-5041 (2002-10) shall be at least 12 mm.

7.15 *Addition:*

~~The marking specified for hot surfaces shall be visible when the appliance is operated as in normal use, including when actuating any switch, adjusting any control or opening a lid or door. It shall not be placed on a **hot functional surface**.~~

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 or door. It shall not be placed on surfaces that are exempted from the limits in Table 3, Table 101 and Table 102.

7.101 A label shall be provided, together with instructions for fixing it in a conspicuous place close to the appliance. The label shall state the substance of the following.

– WARNING: Liquids or other foods must not be heated in sealed containers since they are liable to explode;
– WARNING: Microwave heating of beverages can result in delayed eruptive boiling, therefore care must be taken when handling the container;
– WARNING: The contents of feeding bottles and baby food jars must be stirred or shaken and the temperature checked before consumption, in order to avoid burns.

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

8.1.1 *Addition:*

*For appliances intended to be used in the **area open to the public**, test probe 18 of IEC 61032 is applied.*

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.

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 intended to be fixed to the floor, **microwave ovens** intended to be stacked onto other **microwave ovens** ~~and~~or appliances with a mass greater than 40 kg and not provided with rollers, castors or similar means, are installed in accordance with the installation instructions. If no instructions are supplied, these appliances are placed on the floor as near as possible to the walls of the test corner.*

11.3 *Addition:*

*Where the external **accessible surfaces** are suitably flat and access permits, the test probe of Figure 102 is used to measure the temperature rises of external **accessible surfaces** specified in Table 101 and Table 102. 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 in cycles, each cycle consisting of a heating period of 4 min followed by a rest period of 1 min until steady conditions are established. The last cycle does not include a rest period of 1 min. Boiling water is added to the water **load** when half of the water **load** has evaporated.*

*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 **microwave ovens** intended to be stacked onto other **microwave ovens**, the tests shall be also conducted under the most unfavourable stacking conditions in accordance with the instructions. In this case, all **microwave ovens** are operated simultaneously under normal use and supplied by the same voltage.*

11.8 *Modification:*

Replace the first paragraph by the following text:

*For appliances intended to be used in **areas open to the public**, the temperature rises are monitored continuously and shall not exceed the values shown in Table 3 and Table 102.*

For other appliances, the temperature rise shall not exceed the values shown in Table 3 and Table 101.

Addition:

For Table 3:

- *The temperature rises of external surfaces are only measured on the surfaces that are not placed against the wall and the floor of the test corner.*
- *There are no temperature limits for air-outlet grilles and for surfaces up to a distance of 25 mm from them.*
- *When the required values for external enclosures of **motor-operated appliances** are not met, the maximum temperature rise shall not ~~be higher~~ exceed the limit by more than ~~two times~~ 25 K to the values indicated.*

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

Surface [a]	*Temperature rise of external accessible surfaces* *K* [b]
Bare metal	*48*
Coated metal [c]	*59*
Glass and ceramic	*65*
Plastic and plastic coating > 0,4 mm [d, e]	*74*

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 103):*

- ***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 which, according to the installation conditions of Subclause 11.2, shall be against the walls and where these surfaces are inaccessible to a 75 mm diameter probe having a hemispherical end;*
- *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 exceed the limit by more than 25 K to 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.*

Table 102 – Maximum temperature rises of external accessible surfaces for appliances intended to be used in areas open to the public under normal operating conditions

Surface [a]	*Temperature rise of external accessible surfaces* K	
	Appliances and parts situated not more than 850 mm above the floor after installation	*Appliances and parts situated more than 850 mm above the floor after installation* [b]
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 103):*
- ***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 which, according to the installation condition of Subclause 11.2, shall be against the walls and where these surfaces are inaccessible to a 75 mm diameter probe having a hemispherical end;*
- *surfaces on the oven door within 10 mm from the left, right and lower edge of the oven door, or 25 mm from the upper edge of the oven door (Zone 1). For* ***built-in appliances****, the edges shall be considered between the oven door and decorative trims, if any;*
- *surfaces around the oven door within 10 mm from the left, right or lower edge of the oven door, or 25 mm from the upper edge of the oven door (Zone 2). For* ***built-in appliances****, the edges shall be considered between the 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 exceed the limit by more than 25 K to the values indicated.*

[c] *Metal is considered coated when a coating having a minimum thickness of 90 µm made by enamel, powder 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.*

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.

15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.1.1 *Addition:*

In addition, appliances which are intended to be situated not more than 850 mm above the floor, except those marked IPX5 or IPX6, are subjected for 5 min to the following splash test.

The apparatus shown in Figure BB.201 *is used. The appliance is placed in normal position of use and adjustable feet shall be set in accordance with the instructions for use to the most unfavourable height.*

For appliances normally used on the floor, the bowl is placed on the floor and is moved around in such a way as to splash the appliance from all directions. During the test, the water pressure is so regulated that the water splashes up 150 mm above the bottom of the bowl. The bowl is not positioned underneath the appliance.

For all other appliances, the bowl is placed on the same plane where the appliance is placed and is moved around in such a way as to splash the appliance from all directions. During the test, the water pressure is so regulated that the water splashes up 100 mm above the bottom of the bowl. The bowl is not positioned underneath the appliance.

Care is taken that the appliance is not hit by the direct jet.

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 test of 16.2~~ electric strength test of 16.3.

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.

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~~ 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 transformers, 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.

Addition:

The tests are not carried out on the power transformer that supplies the magnetron and its associated circuits, these are 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 100 000 cycles of operation with the appliance supplied at ***rated voltage*** *and containing an appropriate microwave-absorbing* ***load****. It is then subjected to 100 000 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 six 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 ~~may~~ 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, ~~may~~ can be replaced in order to complete the test.

NOTE 103 Bricks or additional water of maximum 1 000 g ~~may~~ 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 19.104, 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:*

During the tests, the temperature of windings shall not exceed the values shown in Table 8. Only appliances that allow a preselected 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.*

19.101 *Appliances are operated with controls set at the most unfavourable position and without a **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 exceeds 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;

– 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 potatoes placed on the **shelf** in the position where they are most likely to ignite and propagate flames to other combustible material.*

Each potato has an approximately ellipsoidal shape and a mass between 125 g and 150 g. The length of the shorter principal axis is at least 40 mm. The length of the longer 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 longer axis of the potato, is inserted along this axis of at least one of the potatoes. The number of potatoes to be used is stated in ~~Table 101~~ Table 103.

*If the potatoes do not ignite, the test is repeated with the **load** reduced by one potato. If a single potato does not ignite, it is ignited artificially.*

Table ~~101~~ 103 – Number of potatoes

Rated microwave power output *W*	***Volume of the cavity*** *l*	***Number of potatoes***
<600	*≥14 and <28*	*2*
≥600 and <1 000	*≥28 and <42*	*4*
≥1 000 and <2 000	*≥42 and <56*	*6*
≥2 000	*≥56*	*6 + N* [a]
NOTE The **rated microwave power output** or the volume of the **cavity** applies, whichever results in the higher number of potatoes.		
[a] *N is 2 for each 500 W increase in power output or for each 14 l increase in volume.*		

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 ~~may~~ can have resulted from the cumulative effects of previous tests.

20 Stability and mechanical hazards

This clause of part 1 is applicable except as follows.

20.1 *Modification:*

Replace the first paragraph of the compliance criterion by the following:

For stacked appliances intended to be placed on the floor, the appliances, not connected to the supply mains, are placed in any normal position of use on a plane inclined at an angle of 15° to the horizontal, the ***supply cord*** *resting on the inclined plane in the most unfavourable position. However, if part of any appliance comes into contact with the horizontal supporting surface when the stacked appliances are tilted through an angle of 15°, the stacked appliances are placed on a horizontal support and tilted in the most unfavourable direction through an angle of 15°.*

For other than stacked appliances intended to be placed on the floor, the appliances, not connected to the supply mains, are placed in any normal position of use on a plane inclined at an angle of 10° to the horizontal, the ***supply cord*** *resting on the inclined plane in the most unfavourable position. However, if part of any appliance comes into contact with the horizontal supporting surface when the appliances are tilted through an angle of 10°, the appliances are placed on a horizontal support and tilted in the most unfavourable direction through an angle of 10°.*

20.2 *Addition:*

For appliances intend to be used in ***areas open to the public****, test probe 18 of IEC 61032 is applied.*

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.

For appliances ~~normally~~ intended to be used on the floor, the mass is

- *23 kg for* ***cavity*** *doors, or the mass that can be placed in the oven in accordance with the instructions, if this is higher;*
- *7 kg for other doors.*

For appliances ~~normally~~ intended to be used on a table, the mass is

- *7 kg for* ***stationary appliances****;*
- *3,5 kg for* ***portable appliances****.*

The appliance shall not tilt.

NOTE 1 A sandbag can be used for the **load**.

~~NOTE 2 For appliances having more than one door, the tests are made on each door separately.~~

*For **microwave ovens** intended to be stacked onto other **microwave ovens**, the test is repeated under the stacking conditions in accordance with the instructions. Each door of **microwave ovens** in stacked condition is tested one at a time.*

If the appliance has more than one door, the test is conducted on each door, one at a time, during the above tests.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

~~**21.2**~~ *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 25 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 25 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 50 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 10 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 furthest from the door hinge. An attempt is made to close the door with a force of 90 N applied at the other corner furthest 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 furthest 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 140 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.

22.101 **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 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** ~~may~~ 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. Additionally, for appliances intended to be used in **areas open to the public**, test probe 18 is also used. 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.

Compliance is checked by inspection.

22.105 At least one of the **door interlocks** shall be concealed and not 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 ~~of IEC 61032~~ and, for appliances intended to be installed in an **area open to the public**, then test probe 18, to all openings. The test is repeated with a rod, as shown in Figure 101, to any openings of the **door interlock** mechanism. ~~Only one rod shall be used at a time.~~ The test probes and rod shall be applied 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 interlocks*** *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, the rod and the magnet, each applied separately. For appliances intended to be used in* ***areas open to the public****, test probe 18 is additionally applied separately.*

The concealed ***door interlocks*** *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.*

~~NOTE 1~~ *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 2~~ *The supervision device is replaced for subsequent tests if it fails in the closed circuit position.*

~~NOTE 3~~ *It ~~may be~~ is necessary to render other* ***door interlocks*** *inoperative in order to perform this test.*

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.

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

~~NOTE 5 Switches are replaced each time the internal fuse ruptures if this is stated in the instructions for servicing.~~

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 ~~may~~ 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 10 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.

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 of 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 Appliances shall be constructed so that **shelves** do not fall out of their supports when subjected to a **load**. **Shelves** intended to be partially withdrawn in use shall not tip when they have partially been removed from the oven.

Compliance is checked by the following test.

*A vessel filled with sand or shot is placed on the **shelf**. The total mass in kilograms is equal to 30 kg/m^2 of the **shelf** area. The **shelf**, with the vessel placed centrally on it, is inserted into the oven and moved as close as possible to one of the side walls. It is left in this position for 1 min and then withdrawn. It is then reinserted, moved as close as possible to the other side wall and left for one minute.*

*During the test, the **shelf** shall not fall away from its support.*

*For **shelves** intended to be partially withdrawn in use, the test is repeated with the **shelf** pulled out by 50 % of its depth. An additional force of 10 N is applied vertically downwards on the centre of the exposed front edge of the **shelf**.*

*During the test, the **shelf** shall not tip.*

NOTE A small angle of deflection is ~~allowed~~ ignored.

22.115 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.

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

Compliance is checked by inspection and the following test.

*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**.*

22.117 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, for appliances intended to be used in an **area open to the public**, in addition test probe 18, one at a time.*

22.118 Lights, switches or push-buttons for the indication of danger, alarm or similar situations shall ~~only~~ be coloured red.

Compliance is checked by inspection.

22.119 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.

22.120 Appliances for installing in commercial road vehicles, coaches, busses, food stalls 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, Clause 29 and 32.1, and connections shall not have worked loose.

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*

– *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[2] is not applicable to power transformers that supply the magnetron.

24.1.4 ~~*Addition*~~ *Modification:*

*The number of cycles of operation for **thermostats** is increased to 30 000.*

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.

~~**24.101** Socket-outlets incorporated in 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 may be accessible.~~

2 Withdrawn.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Modification:*

Appliances shall not be provided with an appliance inlet.

25.3 *Addition:*

Fixed appliances and appliances with a mass greater than 40 kg and not provided with rollers, castors or similar means shall be constructed so that the **supply cord** can be connected after the appliance has been installed in accordance with the installation instructions.

Terminals for the permanent connection of cables to fixed wiring may also be suitable for a **supply cord** of **type X attachment**. In this case, a cord anchorage complying with 25.16 shall be fitted to the appliance.

25.7 *Modification:*

Instead of the types of **supply cords** specified, the following applies:

Supply cords shall be oil-resistant and shall not be lighter than ordinary polychloroprene sheathed flexible cord (code designation 60245 IEC 57) or equivalent synthetic elastomer sheathed cord.

25.14 *Addition:*

*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.

27.2 *Addition:*

Stationary appliances shall be provided with a terminal for the connection of an external equipotential bonding conductor. This terminal shall be in effective electrical contact with all fixed exposed metal parts and shall allow the connection of a conductor having a nominal cross-sectional area up to 10 mm^2. It shall be located in a position convenient for the connection of the conductor after installation of the appliance.

NOTE 101 Small fixed exposed metal parts, for example nameplates, are not required to be in electrical contact with the terminal.

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 and those with a keep-warm function, 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.*

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**.

Dimensions in millimetres

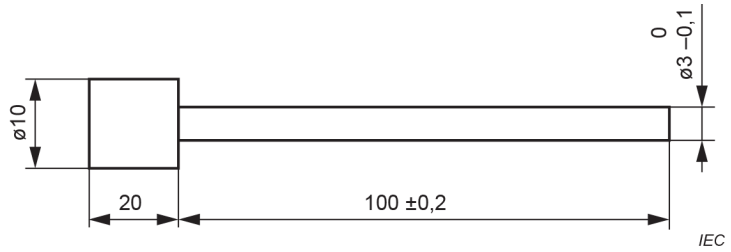
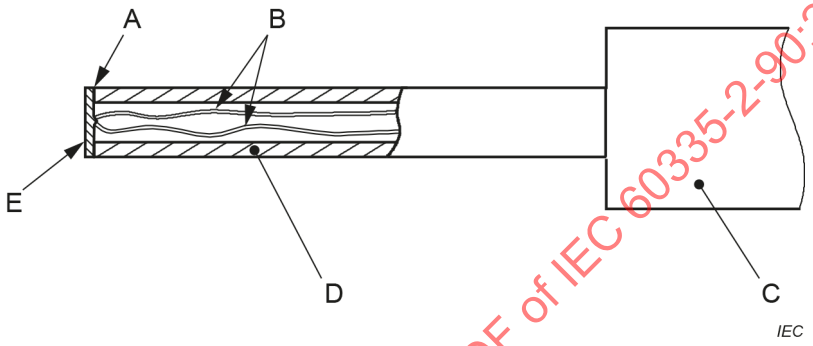


Figure 101 – Test rod for door interlock concealment



Key

A adhesive

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

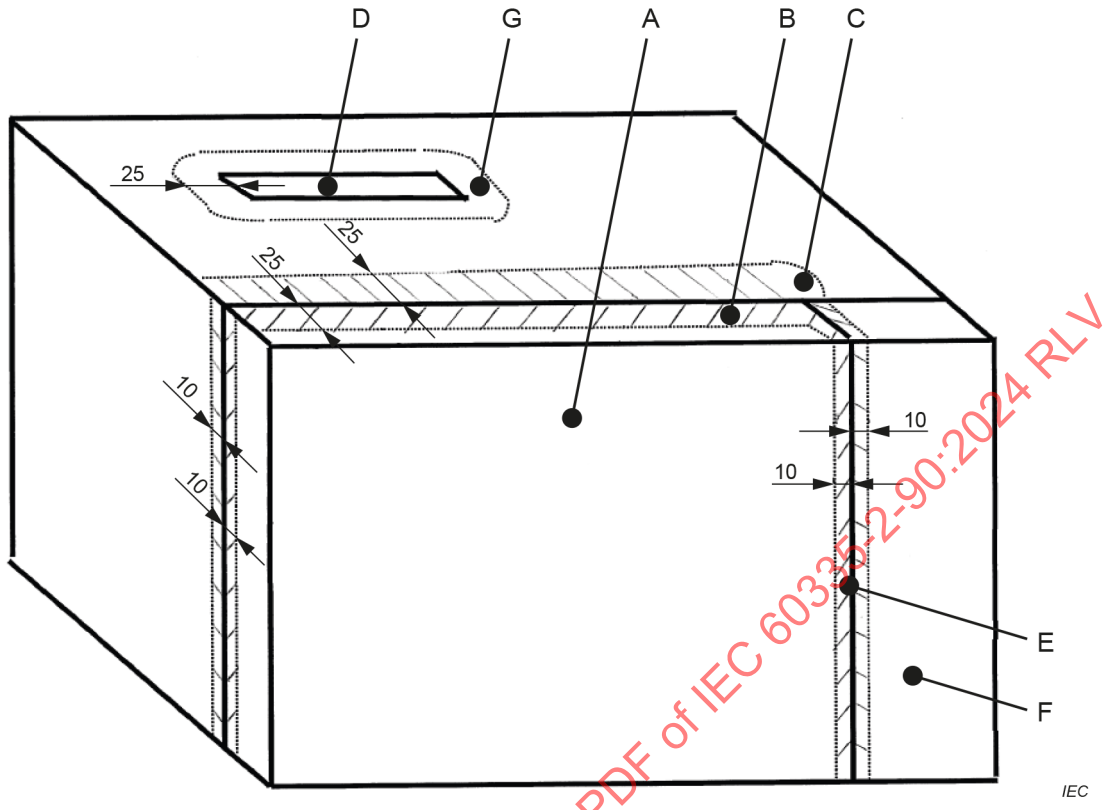
C handle arrangement permitting a contact force of 4 N ± 1 N

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 102 – Probe for measuring surface temperatures

Dimensions in millimetres



Key

A oven door
B excluded area on the oven door (Zone 1)
C excluded area around the oven door (Zone 2)
D vent
E door gap
F oven front surface
G excluded area around vents (Zone 3)

Figure 103 – Front view of appliance with identification of excluded areas

Annexes

The annexes of Part 1 are applicable except as follows.

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 dealt with in 7.1 are checked to ensure that they are marked with the warnings concerning microwave energy.

The presence of the warning sign and warning text dealt with in BB.22.~~119~~201.6 is checked.

The appliance is checked to ensure that the corresponding labels, instructions and manuals 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

A.103.1 *The **microwave oven** is supplied at **rated voltage** and operated with the microwave power control adjusted to the highest setting. The energy flux density of microwave leakage is measured at any point approximately 50 mm from the*

– *external surface of the appliance for **microwave ovens** not covered by normative Annex BB, or*
– ***reference surface** for **microwave ovens** covered by normative Annex BB.*

A.103.2 *For **microwave ovens***

– *not covered by normative Annex BB, an appropriate **load** may be used, or*
– *covered by normative Annex BB, a **load** as specified in ~~BB.3.1.9~~ 3.1.9 of normative Annex BB shall be used.*

A.103.3 *The measuring instrument is moved*

– *over the external surface of the appliance for **microwave ovens** not covered by normative Annex BB, or*
– *over the external surface of the appliance and any **microwave barrier** for **microwave ovens** covered by normative Annex BB*

and the microwave leakage is measured.

A.103.4 *The microwave leakage shall not exceed*

– *50 W/m^2 for **microwave ovens** not covered by normative Annex BB, or*

– *50 W/m^2, averaged over the most onerous 20 s interval and 500 W/m^2 measured as peak value for **microwave ovens** covered by normative Annex BB,*

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 to 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 the measurements specified in A.104.~~2~~3, the minimum resolution of the instrument under test (IUT) shall be 1 W/m^2.*

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 readings 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.*

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.

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.

~~For **combination microwave ovens**, IEC 60335-2-36 is also applicable, for **combination microwave ovens** with convection or steam function, IEC 60335-2-42 is also applicable, for **combination microwave ovens** with the function of keeping food and crockery warm, IEC 60335-2-49 is also applicable and for **combination microwave ovens** in conjunction with dispensing appliances or vending machines, IEC 60335-2-75 is also applicable.~~

1 Scope

AA.1.201 For **combination microwave ovens** with commercial electric forced convection ovens, steam cookers and steam-convection ovens, IEC 60335-2-42 is also applicable.

AA.1.202 For **combination microwave ovens** with commercial electric cooking ranges, ovens, hobs and hob element, IEC 60335-2-36 is also applicable.

AA.1.203 For **combination microwave ovens** with commercial electric appliances for keeping food and crockery warm, IEC 60335-2-49 is also applicable.

AA.1.204 For **combination microwave ovens** with commercial dispensing appliances or vending machines, IEC 60335-2-75 is also applicable.

NOTE If a **combination microwave oven** has a mode of operation independent of microwave generation, then this mode ~~has to be~~ is tested only according to the requirements in the relevant standard (see Clause 2 of this 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.

~~AA.~~3 Terms and definitions

~~AA.~~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.

~~AA.~~5 General conditions for the tests

~~*Addition:*~~

5.3

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

~~AA.~~5.101

Replace as follows.

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

~~AA.~~11 Heating

AA.11.7.~~101~~201 ***Combination microwave ovens*** *incorporating resistive heating elements where simultaneous operation is intended, are operated with the resistive heating elements switched on as specified in the manufacturer's instructions under the conditions of Clause 11 of the relevant standard but using the* ***load*** *specified in 3.1.9, the microwave power output being approximately 50 %.*

If no instructions are provided, the appliance is operated until steady conditions are established.

~~AA.~~18 Endurance

Addition:

Before measuring the microwave leakage, the following additional conditioning is carried out.

– *resistive heating elements for radiant heating are operated for 30 min;*
– *resistive heating elements for convection heating are operated for 60 min.*

~~AA.~~19 Abnormal operation

~~AA.~~19.1 ~~*Addition:*~~

Modify as follows.

The test of 19.102 is carried out with the appliance supplied at 1,06 times ***rated voltage***.

~~AA.~~29 Clearances, creepage distances and solid insulation

Replace as follows.

This clause of Part 1 is applicable except as follows.

~~AA.~~**29.2** *Modification:*

Replace the second paragraph by the following:

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

~~AA.~~29.3 *Addition:*

There are no thickness requirements for sheaths of **visibly glowing heating elements** if the **door interlocks** provide **all-pole disconnection**.

Annex BB
(normative)

Requirements for commercial microwave ovens without a cavity door and with conveyor-type means

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.

Annex BB modifies the corresponding clauses and subclauses of the main part of this standard or, where this is not applicable, of Part 1 of IEC 60335, to indicate requirements for commercial microwave ovens without a **cavity** door and with conveyor-type means. Where it is unclear whether a clause or subclause of this annex is intended to modify the corresponding text of the main part of this standard or that of Part 1, this is specified.

~~BB.~~3 Terms and definitions

NOTE 201 For more details, see ~~Figure BB.3~~ Figure BB.203.

~~BB.~~3.1.9
normal operation

Replacement:

operation of the appliance under the following conditions:

The **microwave oven** without a **cavity** door and with conveyor-type means is operated according to the manufacturer's instructions. If no instructions are provided, the appliance is operated under the following conditions.

a) Tunnel type appliances are operated under the following conditions:
   1) if the **entrance and exit port** heights are adjustable, the largest height is used;
   2) the highest generator power settings are used.

b) The **load** to be heated up consists of *N* cylindrical containers of borosilicate glass with a maximum thickness of 3 mm and an external diameter of approximately 190 mm, filled with (1 000 ± 50) g potable water having an initial temperature of (20 ± 2) °C. These containers are placed so that all containers are inside the **cavity** and as many as possible microwave generators are operating at the same time.

   The number *N* results from the following formula:

$$N = P/1\ 100\ \text{W}$$ (*P* = **rated microwave power output** [W])

   The result of *N* shall be rounded off to the nearest integer.

   If is not possible to use these containers, containers of the same material and thickness and with a water mass of not less than 275 g ± 15 g shall be used.

   An excess number of containers are prepared, so that the whole length and width of the **transportation means** inside the **microwave enclosure** is loaded.

   The conveyor speed is set to the lowest reasonable value that will not bring the **loads** to boiling.

   Loads are taken out and are replaced with new cold **loads** on the **loading area** as they come out on the **removing area**.

c) Single special **load** vending type appliances are operated with their intended **load**. Other vending type appliances are operated under the following conditions.

1) Sealed plastic bags with potable water are used, with a water mass corresponding to the weight of typical **loads** for which the appliance is intended.

The appliance is operated for consecutive cycles, the duration of each cycle is determined by the following formula:

$$t = m \times 4{,}187 \times \Delta T / P$$

where

t is the duration of each cycle (s);

m is the mass of the water (g);

ΔT is the required temperature rise of 55 K, and

P is the **rated microwave power output** (W).

The initial temperature should be 20 °C ± 5 °C.

2) New **loads** are supplied with the shortest possible pauses between runs.

Note ~~101~~201 to entry: Care should be taken when handling the **load**.

~~**BB.3.103**~~

3.6.101

Replace as follows.

cavity
space within the **microwave enclosure** where the **load** is heated with high microwave energy

Note 1 to entry: Waveguides between the microwave generator and **cavity** are included since they also contain high microwave energy.

~~BB.~~7 Marking and instructions

~~BB.~~7.1 *Addition to the first list of items:*

– water pressure or pressure areas in kilopascals (kPa) for the appliances that are determined for the connection to the water supply, or this is fixed in the instructions for use.

~~*Modification*~~ *Replacement of the 5th dashed item of the first list:*

– model or type reference and serial number of the appliance. If the generator(s) is separate from the **cavity** part of the appliance, this information shall also appear on the generator(s);

~~BB.~~7.12 *Add the following 3 dashed items:*

– WARNING: Do not programme excessive heating times. Overheating can result in contamination or fire.

– Details for necessary cleaning required for hygienic reasons (e.g. **cavity**, **transportation means**) and also for functional reasons (e.g. **means of microwave interlock**, sensor).

– Information necessary for dispatch, positioning, installation and operation, including details of weight, dimensions and required minimum distances.

~~*Modification*~~ *Replace the ninth dashed item by the following:*

– If smoke is observed, follow the instructions supplied by the manufacturer in order to contain the fire~~;~~.

~~*Addition:*~~

BB.7.~~101~~201.1

A label shall be provided, together with instructions for fixing it in a conspicuous place close to the exit port. The label shall state the substance of the following, if applicable.

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

– WARNING: Microwaved food and beverages can be very hot, handle with care.

Compliance is checked by inspection.

BB.7.~~101~~201.2 The instructions for the operator shall include the substance of the following warnings.

– WARNING: If parts of **entrance ports and exit ports**, means of access, **viewing openings**, **microwave barriers**, covers, the **microwave enclosure** or any other means named by the manufacturer are damaged, the appliance shall not be operated until it is repaired by a **skilled person**. Until repairs are carried out, the appliance shall be set in a permanent non-operational condition (e.g. with key switch, code-card or similar devices). Further details shall be included in the instructions for use.

– WARNING: Only **instructed persons** shall operate the **microwave oven**. The **instructed persons** shall regularly, but at a minimum of once a year, be instructed by a **skilled person**. A record of the instruction provided shall be recorded.

BB.7.~~101~~201.3 The service or repair manual shall include the substance of the following:

– WARNING: The **microwave oven** shall comply with requirements of 32.1 after every repair and according to the instructions of the manufacturer.

Attention: Persons shall not be exposed to excessive emitted microwave energy from the microwave generator. All connections, waveguides, flanges, seals etc. of the **microwave enclosure** and **microwave barriers** shall be safely constructed so that the microwave leakage does not exceed the allowed limit. The operation of the appliance without a microwave absorbing **load** is to be avoided. The appliance shall be regularly maintained and kept in a good condition to ensure that microwave leakage does not exceed the allowed limit.

The **microwave oven** shall only be maintained by **skilled persons**.

The manufacturer shall supply detailed recommendations on the prevention of **cavity** fires together with guidance on how fires should be handled, should they occur. Guidance should also be provided on dealing with low water content foods, metal objects and containers with metal.

~~BB.~~8 Protection against accessibility to live parts

~~BB.~~8.1.1 *Addition:*

Test probe B of IEC 61032 is applied into openings of less than 75 mm that the probe will permit, to any depth and to a distance of 5 times the minor dimension of openings that are greater than 75 mm, up to a maximum of 850 mm. The probe is rotated or angled to all possible positions, during and after insertion.

~~BB.~~9 Starting of motor-operated appliances

BB.9.~~1~~201 Motors that drive the **transportation means** shall start under all voltage conditions that ~~may~~ can occur in use.

*Compliance is checked by starting the motor three times at a voltage equal to 0,85 times **rated voltage**, the motor being at room temperature at the beginning of the test.*

*The motor is started each time under the conditions occurring at the beginning of **normal operation** or, for automatic appliances, at the beginning of the normal cycle of operation. The motor shall be allowed to stop between successive starts. For appliances provided with motors having other than centrifugal starting switches, the test is repeated at a voltage equal to 1,06 times **rated voltage**.*

*In all cases, the motor shall start and it shall function in such a way that safety is not affected and overload **protection devices** of the motor shall not operate.*

NOTE Prior to commencing the test, appliances with conveyor means ~~shall be~~ are loaded with the heaviest **load** as specified by the manufacturer. If no instructions are provided, the conditions of ~~BB.3.1.9~~ 3.1.9 of normative Annex BB apply.

~~BB.~~11 Heating

~~BB.~~11.7 *Modification:*

The **microwave oven** is operated as specified in ~~BB.3.1.9~~ 3.1.9 of normative Annex BB until steady conditions are established.

~~BB.13 Leakage current and electric strength at operating temperature~~

~~**BB.13.2** *Modification of Part 1:*~~

~~*The last sentence of the fourth paragraph is void.*~~

~~NOTE An electronic power converter with a supply of more than one phase can be damaged in most cases.~~

~~BB.~~15 Moisture resistance

~~BB.~~15.1.1 *Addition:*

Microwave ovens classified as IPX0, IPX1, IPX2, IPX3 and IPX4, which are intended for placing on the floor, shall be subjected for a period of 5 min to the following splash test.

*The apparatus shown in ~~Figure BB.1~~ Figure BB.201 is used for the test. During the test, the water pressure is regulated so that the water splashes up 150 mm above the bottom of the bowl. The bowl is placed on the floor for **microwave ovens** normally used on the floor. The bowl is moved around in such a way as to splash the **microwave oven** from all directions. Care shall be taken to ensure that the **microwave oven** is not hit directly by the jet.*

~~BB.~~15.2 *Addition:*

*A quantity of 0,5 l of water containing approximately 1 % NaCl is poured steadily over the most unfavourable parts but excluding the **microwave enclosure**, over a period of 15 s.*

*The quantity of 0,5 l of water containing approximately 1 % NaCl, for each kW **rated microwave power output**, is poured steadily at a rate of 0,5 l per 15 s into the **microwave enclosure**.*

BB.15.~~102~~201 Microwave ovens that are provided with a tap intended for filling or cleaning shall be constructed so that the water from the tap cannot come into contact with live parts.

Compliance is checked by the following test.

*The tap is fully opened for 1 min with the **microwave oven** connected to a water supply having the maximum water pressure specified by the manufacturer. Movable parts are placed in the least favourable position. Swivelling outlets on water taps are positioned so that water is directed on to those parts that will give the least favourable test result. Immediately following this treatment, the **microwave oven** shall withstand an electric strength test specified in 16.3.*

~~BB.~~18 Endurance

Addition:

The means of access and covers shall be opened and then closed as in normal use. The number of operations is 6 cycles per 1 min or the maximum quantity that is given for the construction.

The following means of access are subjected to the following cycles of operation:

– Means of access and **cleaning covers** that can be opened by **instructed persons** for the purpose of venting, flushing lamp covers, cleaning, etc.	*10 000 cycles*
– Maintenance covers that can be opened by skilled persons	*300 cycles*
– Protective blocking structures which protect ordinary persons	*200 000 cycles*

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

NOTE It ~~may~~ can be ~~necessary~~ applicable to render some supervision and system control devices inoperable when carrying out this test.

~~BB.~~19 Abnormal operation

~~BB.~~19.8 *Addition:*

***Microwave ovens** intended to be star-connected are operated with the neutral conductor being disconnected. Subclause 19.13 shall be applied after the test.*

~~BB.~~19.13

Modify as follows.

The microwave leakage shall not exceed 50 W/m^2.

~~BB.~~19.104

Add as follows.

*The most onerous condition, i.e. stopping the belt, shall be selected. During the test, any fire in the **cavity** shall be contained within the appliance.*

Table 101 *Replacement of the Note:*

NOTE The **rated microwave power output** or the volume of the **cavity** applies, whichever results in the higher number of potatoes. The number of potatoes is increased if the oven does not start.

BB.19.~~105~~201

Appliances are operated with the same **load** items as in **normal operation** but with **load** on the **transportation means** only in the **cavity**. The number of **load** items is the lowest allowing operation of at least one microwave generator at maximum power. The period of operation is the longest allowed by the belt speed setting or similar.

~~BB.~~20 Stability and mechanical hazards

~~BB.~~20.1 *Addition:*

***Maintenance covers** on vending appliances that can be opened and accessories shall be placed in the most unfavourable position.*

~~BB.~~20.2 *Addition after the first paragraph of Part 1:*

This is also to be applied on operating elements i.e. handles or hand wheels.

Addition:

*If fans of the **microwave oven** can be operated when the means of access is open, rotating and moving parts of motors and fans shall be located or protected in such a way as to provide adequate protection against injury, when the **microwave oven** is used or when cleaned as intended. It shall not be possible to touch the moving or rotating parts of the fans. To fulfil this requirement, it shall be possible to set the **microwave oven** in a permanent non-operational condition (e.g. with key switch, code-card or similar devices).*

Compliance is checked according to the requirements in ~~BB.8.1.1~~ 8.1.1 of normative Annex BB.

~~BB.~~20.101

Add as follows.

***Transportation means** shall withstand weights according to the instructions of the manufacturer.*

Where no instructions are provided, compliance is checked by the following test.

*For appliances with a conveyor belt including **loading areas** and/or **removing areas**, the **transportation means** is stopped and a weight of 23 kg is placed on the **loading area** and **removing area**, in turn. The appliance shall not tilt and there shall be no damage to the **loading area** and **removing area**.*

*For vending-type appliances, the same test is made on the **removing area**, if possible. However, a weight of 8 kg is used.*

NOTE A sandbag ~~may~~ can be used for the **load**. The dimensions of the weight ~~shall~~ accord to the dimensions of the **entrance and exit ports** and to the working area of the **transportation means**.

~~*Addition:*~~

BB.20.~~102~~201

Protective enclosures according to ~~BB.20.2~~ 20.2 of normative Annex BB shall not be detachable except where

– *an appropriate interlock prevents operation of motors or fans without protective enclosures;*
– *protective enclosures are a solid part of the housing of the appliance.*

Compliance is checked by inspection.

~~BB.~~22 Construction

Modify as follows.

Subclause **22.103** to Subclause **22.115** are applicable only for **cavity** doors that are opened by the user for access to the **load**. Such doors are not a means of access.

NOTE 201 These types of doors ~~may~~ can be found in vending machines.

~~BB.~~22.116 *Replacement:*

This subclause is not applicable.

The following additional subclauses are applicable for these appliances.

BB.22.~~119~~201 Protection against accessibility to microwave-containing regions

BB.22.~~119~~201.1 General

Subclause BB.22.~~119~~201 deals with **entrance and exit ports**, means of access and **viewing openings**. Only **instructed persons** may be close to these ports, means and openings, except that **ordinary persons** may be in the vicinity of **entrance and exit ports** under certain conditions. The particular requirements relating to **ordinary persons** are given in BB.22.~~119~~201.4.

NOTE 1 In some countries, **instructed persons** are not allowed to have access to the **loading area**. In this case the requirements for **ordinary persons** of this standard ~~may~~ can be applied for **instructed persons**.

The microwave leakage and leakage extraction method in ~~Clause BB.32~~ 32.1 of normative Annex BB shall be used for the determination of a **reference surface**. This, together with the type of ports, means and openings and their dimensions determine the specification for **microwave barriers** of the appliance and any separate barrier installations.

NOTE 2 The **microwave barrier** requirements are given in BB.22.~~119~~201.2 and Table BB.~~101~~201.

NOTE 3 Requirements on warning signs are also contained in BB.22.~~119.3~~201.6.

BB.22.~~119~~201.2 Microwave enclosure opening and microwave barrier specifications

The dimensions of **viewing openings** and fixed means of access for ventilation, liquid evacuation or similar shall be less than 20 mm × 50 mm.

*A **microwave barrier** shall withstand the tests in 21.102 and 21.104. Furthermore, it should not be possible to insert test probe B of IEC 61032 through any holes in the barrier, with the exception of the accessible end opening.*

Compliance is checked by inspection.

BB.22.~~119~~201.3 Additionally, the **microwave barrier** shall not be constructed of metal or microwave absorbing material in such a way that it can guide or absorb microwaves, and their accessible openings shall not be larger than the openings which they protect.

The **microwave barrier** shall be removable only with the aid of a tool.

NOTE The function of the **microwave barrier** is to act solely as a mechanical barrier.

Compliance is checked by inspection.

The dimensional and microwave leakage measurement requirements on **microwave barriers** in relation to the dimension and type of opening are given in ~~Table BB.101~~ Table BB.201. The length of the barrier is calculated from the **reference surface**, obtained by the measurements in ~~Clause BB.32~~ 32.1 of normative Annex BB. The barrier shall extend all the way to the opening of the **microwave enclosure**.

Table BB.~~101~~.201 – Specifications for microwave barriers

Opening dimension	Allowed use	Required barrier extent	Microwave leakage measurement	Remarks
Allows Ø75 mm	Only **entrance and exit ports**	See remark	With and without 100 mm rod. 20 s time of integration	The required barrier length is 5 × the opening minor dimension, up to 850 mm
Ø75 mm to 20 mm × 50 mm	Only **entrance and exit ports**	180 mm from **reference surface**	With and without 100 mm rod. 20 s time of integration	
20 mm × 50 mm to Ø12 mm	Any purpose	80 mm from **reference surface**	With and without 100 mm rod in **entrance and exit ports** and **viewing openings**. 20 s time of integration	The 100 mm rod is not inserted into permanently open means of access
Ø12 mm to Ø3 mm	Any purpose	None	Only without rod. 20 s time of integration	Ø12 mm holes in **cavity** walls will need protection against leakage
< Ø3 mm and narrow slots in metal surfaces	Any purpose	None	Only without rod. The leakage measurement integration time is that of the instrument (2 s to 3 s) for narrow slots	See Note 3

Compliance is checked by inspection and the tests in ~~Clause BB.32~~ 32.1 of normative Annex BB.

NOTE 1 A method for testing the microwave properties of the **microwave barrier** is by a heating test of a part of it in a laboratory **microwave oven**, for about 30 s at 800 W to 1 000 W power setting. Appropriate material does not become hot and in particular it does not show any hot spots.

NOTE 2 The mechanical strength test in 21.102 also applies to visually transparent protective devices over or inside **viewing openings**.

NOTE 3 At 2 450 MHz, narrow slots in the **cavity** can radiate significant microwave energy if their length approaches a half wavelength. A contacting part of the body can then be subjected to a very local but high power absorption even when there is a small leakage measured 50 mm away. However, the heated volume is only some few mm^3 and heat conduction will limit the temperature rise to a safe level. A shorter integration time is therefore not needed. There ~~may~~ can be no leakage from slots less than 3 mm wide in TE_{10} mode, along a wide side longitudinal centreline or in the short side in the plane of a transverse cross section.

BB.22.~~119~~201.4 For conveyor type appliances, there shall be a barrier installation in all **loading areas** and **removing areas** where **ordinary persons** place or remove the **load**.

– If the **loading areas** or **removing area** for **loads** is 800 mm above floor level, the barrier shall be at least 1 200 mm high.

– If the **loading areas** or **removing area** for **loads** is 1 000 mm above floor level, the barrier shall be at least 1 400 mm high.

– The requirements for other heights shall be in proportion to the above requirements.

– The distance from any part of the **entrance and exit port** to any periphery of the barrier shall be a minimum of 850 mm from the **reference surface** defined and determined in ~~BB.32~~ 32.1 of normative Annex BB.

– It shall not be possible to insert test probe B of IEC 61032 through the barriers.

Compliance is checked by inspection.

NOTE 1 There ~~may~~ can be additional barrier type devices that are removable with the aid of a tool.

NOTE 2 The mechanical stability requirements on barrier installations are under consideration.

BB.22.~~119~~201.5 Vending machines with an exit port shall have either a **protective blocking structure** or a **transportation means**.

In appliances with a **protective blocking structure**, the surface of the structure shall be outside the **reference surface** described in ~~Clause 32~~ 32.1 of normative Annex BB, when the **load** is being removed.

Appliances without a **protective blocking structure** shall comply with the requirements in 8.1.1 but in relation to the **reference surface**.

BB.22.~~119~~201.6 A microwave warning sign ~~(IEC 60417-5140 (2003-04))~~ (IEC 60417-6166 (2012-07)) of a size specified in IEC 60417 shall be placed in areas where the **entrance and exit ports** are visible through the barrier, or near the opening in the **microwave barrier** through which the **load** is transported.

The warning text shall include the substance of the following.

MICROWAVE ENERGY

DO NOT INSERT THE HAND OR FOREIGN OBJECTS

The same warning sign shall be placed at **viewing openings** with holes larger than Ø 12 mm and which are not protected by visually transparent protective devices.

~~BB.~~27 Provision for earthing

~~*Addition:*~~

BB.27.~~101~~201 Any external interconnection cable(s) between a separate main power supply (supplies) in a separate enclosure, and the **cavity** portion in a separate enclosure or installation shall include an additional earthing wire for high voltage circuits. The insulation of the wire shall comply with the requirements for insulation for operating high voltage.

BB.27.~~102~~202 Any secondary (high voltage) circuit earthing of magnetrons by a separate wire shall be connected to its waveguide in such a way that the wire does not come loose during service or repair.

28 Screws and connections

28.1 *Addition*

Screws made of carbon steel and alloy steel shall be made in accordance with ISO 898-1.

Screws made of corrosion-resistant stainless-steel shall be made in accordance with ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4.

28.4 *Addition*

Screws that make mechanical connections and electrical connections shall be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts during operational stress and contact corrosion.

Screws that make mechanical connections and provide earthing continuity shall

– be one of types specified in Table BB.202 and be made in accordance with ISO 898-1 or ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4, and
– have a minimum outer thread diameter of 2,8 mm, and
– be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts due to operational stress and contact corrosion. They shall be designed so that a minimum contact pressure remains.

Compliance is checked by inspection and by measuring the assembling torques for screwed connections providing earthing continuity by applying a torque as specified in Table BB.202 to turn the screw in the fastening direction. The screw shall not turn.

The screw shall not have been unfastened prior to performing this test.

Table BB.202 – Assembling torques for screwed connections providing earthing continuity

Outer thread diameter of the screw *mm*	***Assembling torque*** *Nm*	
	Screwed connections for the mechanical strength of the screws A2-70 according to ISO 3506-1, or ISO 3506-2, or ISO 3506-3, or ISO 3506-4 and 5.8 according to ISO 898-1	***Screwed connections for the mechanical strength of the screws > 8.8 according to ISO 898-1***
> 2,8 and ≤ 3,6	*0,8*	*1,3*
> 3,6 and ≤ 4,2	*1,9*	*3,0*
> 4,2 and ≤ 5,3	*3,7*	*6,0*
> 5,3 and ≤ 6,3	*6,5*	*10,0*
M8	*15,0*	*25,0*
M10	*31,0*	*50,0*

~~BB.~~30 Resistance to heat and fire

~~BB.~~30.2

Add as follows.

Microwave ovens intended to be fed automatically shall be tested according to 30.2.3.

~~BB.~~32 Radiation, toxicity and similar hazards

~~BB.~~32.1

Replace as follows:

Compliance for microwave leakage is checked by the following two test series.

*The **load** specified for **normal operation** is used. The appliance is supplied at **rated voltage** and is operated with the microwave power control at the highest setting.*

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. To simplify the use of the instrument, a non-interfering spacer is mounted on the sensor probe, providing a required minimum distance of 50 mm between the sensor and any part of the appliance.

*The microwave leakage reading with the sensor at any point 50 mm or more from the external surface of the appliance or any **microwave barrier** shall not exceed 50 W/m^2, averaged over the most onerous 20 s interval. The instrument reading shall not exceed 500 W/m^2.*

NOTE ~~1~~201 Microwave leakage ~~may~~ can vary with short heating times, power pulsing and progression of **loads**. Depending on the actual time constant of the instrument, readings are then taken every 2 s or 3 s during some cycles of individual **load** item transport periods.

*In a first test series, the spacer tip is moved over and away from the external surface of the appliance to locate the highest microwave leakage, particular attention being given to the openings and the **microwave barriers**. The region inside a geometric opening into the **microwave enclosure** or **microwave barrier** is not regarded as accessible for this first test series with all barriers in place.*

*A second test series is then carried out at the openings with removed **microwave barriers** (for clarification and information, see informative Annex CC) and any interlock to any of them being defeated. A metal rod with 2,5 mm diameter and 100 mm length (test probe C of IEC 61032) is used with the instrument sensor spacer for this test, as shown in ~~Figure BB.2~~ Figure BB.202. The appliance is operated under **normal operation**.*

*During the operation, the free rod end is moved in any position near or up to maximum 50 mm depth inside the surface of the geometric openings specified in ~~Table BB.101~~ Table BB.201. The position of the sensor is not to be any closer than 50 mm to any part of the external surface of the appliance, and to the surface of the geometric opening of the **microwave enclosure**.*

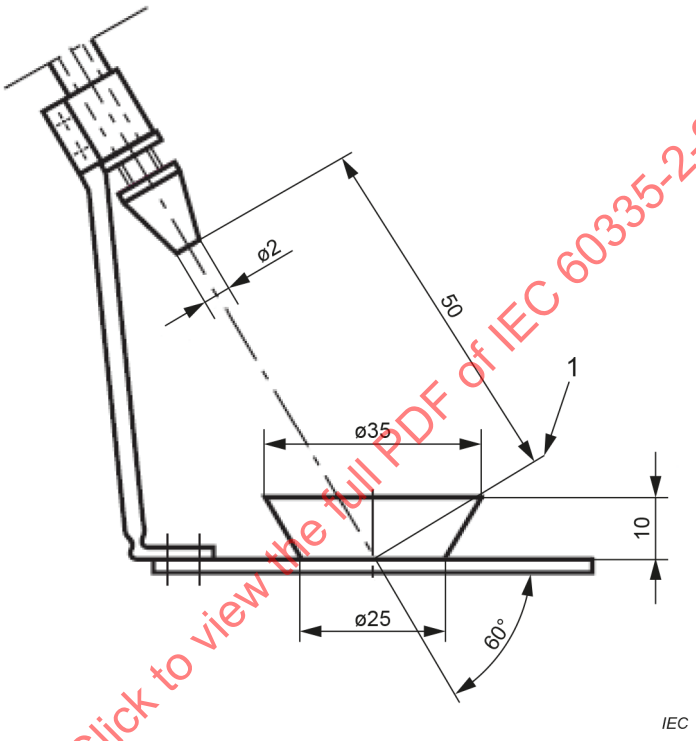
For small openings less than 75 mm in diameter, two additional sensor spacer tip and rod locations are to be used: as shown in ~~Figure BB.2~~ Figure BB.202 but with the spacer tip and its rod end now placed at the opening; and with the rod centre mounted at the sensor spacer tip and a rod end at the opening.

*If the leakage reading is less than 50 W/m^2, the **reference surface** is at the surface of the geometric opening of the **microwave enclosure** without **microwave barrier**. If the leakage reading exceeds 50 W/m^2 under these conditions, the locations of the sensor (not spacer tip) further away from the **microwave enclosure** where this value is measured, are recorded. The position of the **reference surface** away from the surface of the appliance is then determined as 50 mm straight inwards from this sensor position and towards the surface of the appliance.*

NOTE ~~2~~202 If the **microwave barrier** is mounted inside a part of the external cover of the appliance, it will ~~have to~~ be removed for the purpose of the second test series.

NOTE ~~3~~203 The proper length of the wire is different for operating microwave frequencies other than 2 450 MHz.

Dimensions in millimetres

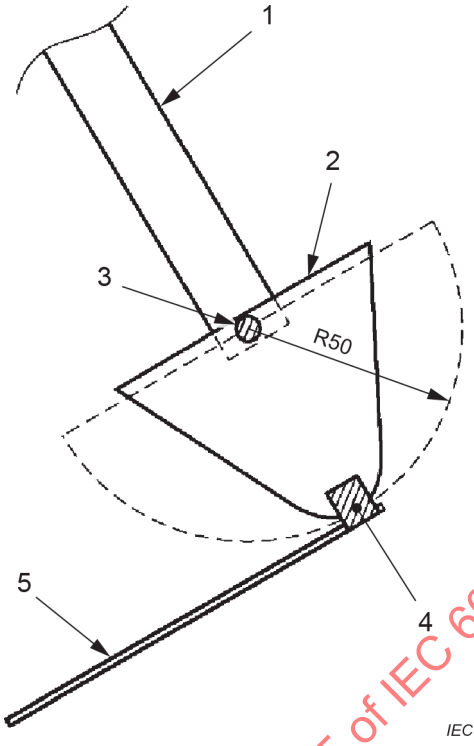


Key

1 bowl

Figure BB.~~1~~.201 – Splash apparatus

Dimensions in millimetres



Key

1 probe handle

2 probe spacer

3 field sensor

4 tape

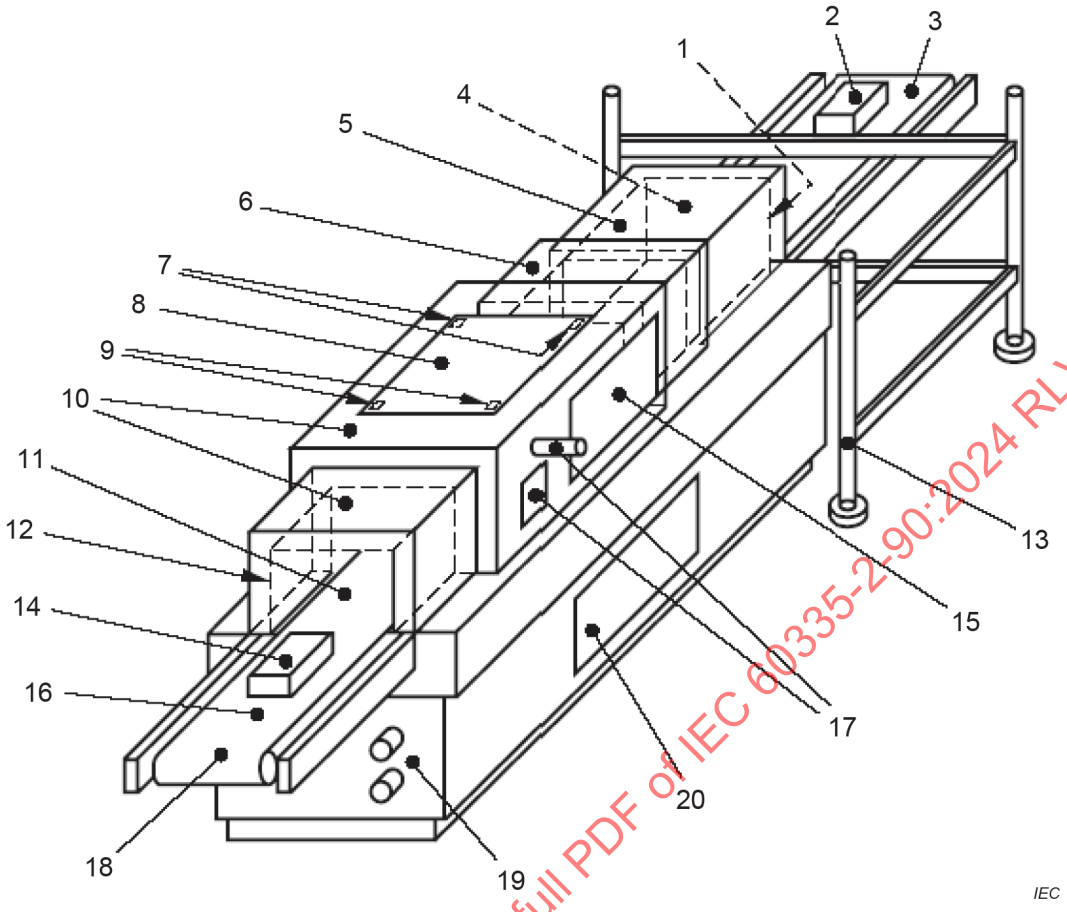
5 metal rod

A hollow metal tube may be used instead of a solid rod. Its outer dimensions are *l* = (100 ± 1) mm, Ø = (2,5 ± 0,15) mm. The metal shall be non-magnetic; aluminium or brass is recommended.

The rod may be fixed to the probe spacer with a thin microwave transparent tape so that the field sensor is located approximately 90° out from the end of the rod. Only when there is not enough space in the vicinity of the access opening is the sensor to be more aligned with the rod. The distance from the rod and any other part of the appliance, including the surface of the access opening to the field sensor, ~~must~~ shall not be less than 50 mm.

The rod should not be in contact with metal parts, since it is to act as an antenna and spurious readings ~~may~~ could then be obtained.

Figure BB~~.2~~.202 – Arrangement for measurement of microwave leakage from access openings



Key

1	reference surface	11	entrance port
2	load	12	reference surface
3	removing area	13	protective blocking structure
4	exit port	14	load
5	microwave barrier	15	cleaning cover
6	microwave enclosure	16	loading area
7	means of microwave interlock	17	viewing opening
8	detachable means of access	18	transportation means
9	means of monitored microwave interlock	19	fixed means of connection
10	microwave enclosure	20	maintenance cover

Note to key 8: Detachable means of access are all parts of the microwave enclosure that can be opened or removed without the aid of tools to get access to the inside for maintenance, with the exception of entrance and exit ports and viewing openings. Examples are tunnels that are opened by drop down or sliding action and cavity lamp covers.

Figure BB~~.3~~.203 – Examples of definitions of Clause 3 ~~and Clause BB.3~~

Annex CC
(informative)

Overview of the requirements for covers, means of access and similar

Table CC.1 gives an overview of the requirements for covers, means of access and similar.

Table CC.1 – Overview of the requirements for covers, means of access and similar

Access means	Operated by	Use of tools	Cycles/ Endurance	Interlocks	Monitored interlocks	Warning signs	Instructions	Mechanical	Purpose
Fixed means of access	**Instructed persons**	No	---	No	No	No	Yes	Steel ball test – Clause 21– with barrier removed	Venting, flushing lamp covers [a]
Means of access that can be opened	**Instructed persons**	No	10 000	Yes 2 interlocks [b]	Yes 1	No	No	Steel ball test – Clause 21 – with barrier removed	Venting, flushing lamp covers, cleaning
Cleaning cover (see 3.~~125~~6.119)	**Instructed persons**	Yes	10 000	Yes 1 interlock [c]	No	Yes	Yes	Steel ball test – Clause 21 when open	**Load** correction, inspection, cleaning
Maintenance cover (see 3.~~124~~6.118)	**Skilled persons**	Yes	300	No	No	Yes [d]	Yes	Steel ball test – Clause 21 when open	Lamp covers
Vending machines – Protective blocking structure (see 3.~~118~~6.112)	**Ordinary persons**	No	200 000	No	No	No	No	Steel ball test – Clause 21 when open and closed	To prevent user access to the **microwave enclosure**[e]

[a] Opening of tunnel by drop down or sliding action.

[b] It should fulfil requirements in Clause 19.

[c] The interlocks shall be located in an area that is free from contamination and the cover shall be self-aligned.

[d] Appliance ~~has to be~~ shall shut down, only for service, microwaves behind.

[e] These requirements ~~are void~~ do not apply if the appliance has a **cavity** door.

Annex DD
(informative)

Rationales for the microwave barrier and associated leakage tests

DD.1 The standard measurement of microwave oven leakage

There are several commercial instruments on the market. Those that perform sufficiently well for the purpose have a small, reasonably isotropic (omnidirectional) sensor at the end of a plastic rod. The sensor reacts to the electric field only. There is also a non-disturbing sensor spacer, which is used to determine a 50 mm minimum distance between the sensor and any part of the appliance as specified in the standard. Testing of instruments includes calibration in the far field (the inaccuracy is allowed to be about ±20 %), and one or two tests intended to show that the sensor is "electrically small" so that it does not itself cause interference (standing waves) to objects nearby.

The scale on microwave leakage instruments is not in the same units as what is actually measured (V/m) but instead in W/m^2 (or mW/cm^2). The conversion is correct only in the free space plane wave case, where the wave impedance is 377 Ω and there is unidirectional propagation. Since a standing wave is the sum of two waves propagating in different directions, and the probe is not direction sensitive, the field impedance then becomes smaller or larger than 377 Ω, so that the instrument reading becomes erroneous. Erroneous readings are also obtained in strongly curved near fields and with the probe in a waveguide or similar where there is a single or multiple mode (having a different impedance).

The minimum 50 mm distance between the instrument sensor and any accessible part of the appliance was specified more than 35 years ago when the first **microwave oven** leakage standard was created. The major reasons were that it was found desirable to use the same type of instruments that were used for far-field exposure measurements.

It was concluded that an electric field sensor instrument would not indicate a proper value for determining the outgoing power flux density if the probe was located:

a) where the field curvature was very significant (in comparison with the wavelength);

b) in the presence of any standing waves near the sensor.

A reasonable compromise with the need to measure emission (i.e. in the source region, so that the "leaking spot" could be found) was found to be 50 mm for the 2 450 MHz ISM band. Even if it was noted in the instrument literature at the time that the same 50 mm distance would be less appropriate for the lower ISM band at 915 MHz, the matter was not considered so problematic that the specification was modified.

The historical reason for the choice of the maximum allowed level of 50 W/m^2 (=5 mW/cm^2) was a result of an existing regulation on free space power flux density of up to 100 W/m^2 being acceptable in commercial and industrial environments, plus considerations of a possibility of two or more **microwave ovens** being located close to each other. Later, when household **microwave ovens** came on the market, the nature of door leakage was found to typically be from only some few leaking spots, so that the power flux density decreased almost quadratic with the distance away from these. There was no reason why the user would remain very near the closed door of an operating oven. Widely publicised investigations showed that the actual exposure of any part of the human body became very low, particularly in consideration of a reasonable averaging time of 5 min to 10 min for hazard assessment. As a result, the 50 W/m^2 limit was applied also to household **microwave ovens**.

In the beginning of the 1970's, the US authorities responsible for radiation safety found some quality problems with some **microwave oven** models and introduced a 10 W/m^2 "factory limit" for new unused ovens, in order to dampen any public concerns. Only one or two other countries followed.

In the meantime, the oven safety standard was successively developed and the value 50 W/m^2 became the worldwide limit after all tests. However, in empty operation and after a potentially destructive door test, 100 W/m^2 was instead required. The rationales for the higher value under no-**load** conditions were reported difficulties by some manufacturers, and the conclusion that no-**load** operation would typically be even more short-term and an also uncommon fault condition.

In the 1980's, leakage measurements at covers for lamp replacement were dealt with by IEC SC 61B. The hole array in the **cavity** wall, at the lamp, can leak microwaves. The size of the cover may be such that the 50 mm distance to the nearest appliance part can be maintained also with the sensor almost inside the external housing from which the cover has been removed. A case had been reported where the instrument reading was quite high in this condition, but there was a very low reading with the whole housing removed. The reason for the high reading was that a standing wave inside the housing had been created. There was an electric field but no real leakage since the standing wave is the sum of an outwards- and inwards-going wave and may have no net power flux. In addition, if a finger ~~would be~~ were put into the opening, the standing wave would disappear and only the real leakage becomes the possible hazard. SC 61B added a statement to the standard to the effect that the instrument sensor should not be closer to the opening plane than 50 mm, i.e. the region inside the cover should not be considered accessible with regard to the leakage measurement. The same principle is adhered to in this standard, but the actual leakage situation is now really assessed, by the extended test in 32.1.

DD.2 Microwave hazards – the basic restriction

Microwave exposure is considered to be potentially hazardous if the heating of parts of the human body exceeds certain values. These are specified as SAR values (specific absorption rate) and are expressed in W/kg tissue. The lowest SAR value of whole-body exposure where there may be some risks has been found to be 4 W/kg. A safety factor of 10 is subsequently applied for microwave workers (**instructed persons**), and a further safety factor of 5 for the general public (**ordinary persons**), resulting in the basic restriction of 0,4 W/kg and 0,08 W/kg in the two cases. Local, non-hazardous exposure limited to the head and trunk may be up to 10 W/kg and 2 W/kg, respectively. Twice this (20 W/kg and 4 W/kg) are considered non-hazardous locally in the extremities (including hands and fingers). The integration volumes are then over any 10 g body mass, and the time integration is over 6 min.

DD.3 Microwave hazard evaluation – the free space exposure method

For all practical exposure situations (except from communication devices such as mobile phones for which a total source maximum power concept may apply), two simplified verification methods are used in industry and for protection of microwave workers and the general public, a maximum allowed far-field power flux density far away from the source, and an emission standard for appliances such as **microwave ovens**.

The issue is now if the relaxation of SAR values for parts of the body, in combination with the integration volume, is compatible with the free space exposure method.

When parts of the human body having a small radius of curvature are heated, diffraction, resonant and other focusing or amplification phenomena may occur. In the case of 2 450 MHz, the internal wavelengths in tissues as well as the penetration depth limitation result in only fingers being of major interest. In principle, also bent knuckles and elbows could create focusing effects, but fingers are definitely much more problematic with regard to the effects discussed here. It is not assumed that other protruding parts of the body such as the nose, ears or penis are brought very close to microwave leakage sources in commercial or household heating equipment.

The following modelling results indicate the degree of compatibility between the basic restriction and the free space exposure method:

Numerical modelling using commercially available electromagnetic software was used. A finger with 13 mm diameter and typical dielectric data (homogeneous, with ε = 40 – *j*10, where the loss factor (10) is lowered in consideration of bone and tendons) was exposed to 10 W/m^2 in free space. The strongest absorption occurred for TM*z* polarisation (i.e. with the impinging electric field parallel to the finger axis) and the mode in the finger then becomes of the TMz_1 type, having two opposite axial zones of maximum heating intensity. The maximum power intensity becomes 5 W/dm^3 and the average over the worst 10 cm^3 becomes about 1,8 W/dm^3.

If the finger ~~would be~~ were exposed to a plane wave with a power flux density of 50 W/m^2, which is allowed from **microwave ovens**, etc., the maximum value would become 25 W/dm^3 and the 10 cm^3 integrated value would become 9 W/dm^3.

The conclusions are that:

– The **ordinary person** basic restriction is exceeded. However, **ordinary persons** are with today's standards only exposed to **microwave ovens** with a door, where the leakage source is so small that the high intensity is over a significantly smaller volume of the finger. Additionally, there is no reason to keep the hand near the closed door of an operating microwave oven. There are numerous reports from experimental investigations in the 70's, which clearly indicate the averaged exposure level over several minutes is 10 to 100 times lower than 10 W/m^2. Therefore, the actual absorption is within the SAR limit.

– The **instructed person** basic restriction is about the same as the actual SAR value. However, the actual situation with an operator occupied with **load** removal at the port of a continuously operating tunnel **microwave oven** for long periods is more onerous than with a **microwave oven** with a door, but the working hand can typically not be near the opening more than about half the time. An additional aggravating factor is that the tunnel opening is larger than an oven door as a leakage source, so that the region with a high microwave energy density may extend further out than from an oven door. Therefore, the construction of the tunnel end regions as well as the measurement method ~~must~~ shall ensure that SAR values in the human finger exceeding those under 50 W/m^2 far field exposure are not exceeded.

– The operating conditions of the tunnel oven shall be such that any higher average leakage levels do not occur. However, parts of a tunnel **microwave oven** can be operated empty with the operator still removing **loads**. Therefore, the 100 W/m^2 value for an operating empty oven with a door should not be applicable for tunnel ovens.

DD.4 Microwave hazards from openings in cavities, and from tunnel ends

The actually absorbed microwave power in a part of the human body is always very dependent on the field configuration, and the field configuration at the body part is also strongly modified by the part itself. This means that even knowledge about the true power flux density or the electric field intensity cannot be used to assess the actual microwave absorption rate. It becomes necessary to establish a more complete scenario before any calculations of the absorption can be made. Hence, the leakage intensity measured as a quasi-plane free space wave at 50 mm or more away from the source will now not alone determine the level of hazard. The actual hazard also depends on:

– any possibility of access into a region where there is microwave energy;

– the size of the opening, which may determine the type of field characteristics, or allow several kinds of microwave field characteristics;

– any objects, including a **load** to be heated or a part of the body in the opening, which may also determine the type of field characteristics.

The access situation is of course crucial and ~~must~~ shall be standardized in some ways so that reasonably simple and objective procedures and requirements can be established. Since only the arm, hand and finger are considered to be the parts of the body that may get in contact with or be inserted into openings in these appliances, two important issues can be directly quantified: 1) all geometric factors (by test probe B, etc.), and 2) as addressed above, these parts of the body are less sensitive than for example the head.

An important principle is that a "hazard boundary" (called **reference surface** in this standard) is defined somewhere in the vicinity of the physical opening surface and that a leakage instrument reading of 50 W/m^2 is to apply for the tests. This means that what remains is to construct tests which will ensure, with reasonable certainty, that actual power densities (in W/m^3, or SAR values in W/kg) in human fingers, hand or arm "contacting" the **reference surface** will not exceed those caused by a "normal" leakage source such as a **microwave oven** door region giving a power flux density reading of 50 W/m^2 at 50 mm distance from any part of the appliance.

The field configuration then becomes the issue, i.e. how to obtain realistic measurement results with the same type of instruments as used for **microwave ovens** with a door. Clearly, there is a need for simplification and standardization using some typical scenarios. The most important matter is then to consider cases where access would be more severe than in the normal door leakage case. These "onerous" cases are:

– The field configuration is such that there is a very high intensity in a region, and the intensity diminishes very quickly with increasing distance, so that no reading may be obtained but there may still be a quite hazardous microwave energy density 50 mm or less from the instrument sensor. Structures creating non-radiating near fields or strongly evanescent modes have this effect.

– The field configuration is such that a microwave power flux is bound to a dielectric object. A **load** that is heated and is conveyed out of a tunnel oven is the most typical example, and a bound surface wave may then exist, and "transport" a quite large microwave power away from the opening. This may then be manifested as a measurable leakage 500 mm or more away from the opening, whilst no leakage can be measured (using the 50 mm sensor distance) at the opening. A problem with this type of wave is of course that it ~~must~~ shall be assumed that the operator hand actually contacts the **loads** and then becomes a part of the scenario. Another problem with this kind of wave is that any measured leakage may become spurious and confusing, since it ~~may not~~ cannot be discovered in the region where it emanates.

Cases where a non-hazardous condition exists but a high instrument reading is obtained are also undesirable. The lamp cover case addressed above is of this kind.

In this standard, a method of leakage extraction and non-shielding **microwave barriers** is used. One end of the metal rod may act as a receiving antenna and since the end can be located very close to parts of the oven and **load**, it will also pick up near fields, evanescent modes and surface waves when suitably oriented. A "spatial averaging" of the externally available microwave energy also results, since the instrument sensor is still not closer than 50 mm to any other object.

The tip of the rod may be inserted up to 50 mm into **entrance and exit ports**. This may be considered onerous, but is for discouraging constructions with certain operator-accessible "curtains" intended to reduce leakage, and due to the particular need to compensate for the imperfections of the simple measurement method in view of the wide variety of objects in and geometries of the ports, and possible prolonged operator presence at these ports.

DD.5 The time averaging

There are only two-time integration specifications in the existing international standards:

a) 6 min for whole-body exposure (probably including fingers), and

b) criteria for duty cycles in cases of very short pulses such as from radar transmitters. Additionally, in some national legislation there is a ceiling value of exposure on non-ionising radiation. A ceiling value of e.g. 250 W/m^2 and a 10 W/m^2 average may be interpreted as maximum 300/25 = 12 s isolated strong exposure being allowed during any 6 min interval with no exposure during the remaining 5 min 48 s of the interval.

The 6 min integration time is quite compatible with typical cases of irradiation of parts of the body having a radius of curvature larger than about one free space wavelength of 2 450 MHz microwaves. In such cases, essentially a plane damped wave propagation can be assumed, as well as a depth of 30 mm to 40 mm in the tissue over which equilibration by heat conduction takes place. Using the heat conductivity data and the Fourier heat conduction equation then results in a time constant (i.e. about 63 % of the stationary conditions have occurred) of about 5 min. A useful comparison is with boiling of an egg in 100 °C water. It takes about 5 min for the centre to reach a temperature of about 65 °C.

The most onerous heating pattern in a Ø 13 mm finger under plane wave 2 450 MHz irradiation is uneven, with about 5 mm distance between the hot and cold areas. It can be shown that the overall microwave coupling is strongest for about Ø16 mm finger diameter. The corresponding distance between hot and cold areas then becomes 7 mm or less.

The Fourier heat conduction equation is spatially quadratic. Using the boiling of a Ø40 mm egg in 5 min having a distance between the cold and hot regions of 20 mm as a basis, a 7 mm distance would be similarly equilibrated in (7/20)^2 of (5×60) s, i.e. about 35 s integration time is adequate.

There is, however, another factor to also consider. Even a very localised heating rate should not be so high that there will be any risk of pain or injury during the time of integration. A suitable acceptable local temperature rise may be set to 5 K, in consideration of both that the skin area with heat-sensing nerves will be heated at least by conduction and that such a temperature rise under short term conditions will not cause any injury in the fingers. A normal person will feel and react to a temperature increase of the same order or less, about 3 K, within a few seconds.

A homogeneous SAR value of 20 W/kg (the basic restriction for **instructed person** fingers) will result in a temperature rise rate of about 0,5 K/min.

Now supposing that only e.g. the tip of a finger absorbs all power and the remainder of the 10 g absorbs no power. Such scenarios are actually not uncommon and may occur e.g. with the finger contacting damaged **microwave oven** seals and in some near field cases. The volume of that part of the tip that absorbs microwaves is now set to 0,5 cm^3 (which is the volume of a hemisphere with Ø12 mm). Using this in relation to the 10 cm^3 of the basic restriction, one obtains a 20 times faster "allowed" temperature rise rate of 10 K/min. This will also mean that the person will feel the heating of the finger within 20 s. Since the equilibration by heat conduction has about the same time constant as above, one again arrives at about 30 s suitable integration time.

There is an extreme case of the tip of the finger touching a leaking narrow slot in a metal surface. The local SAR value becomes very dependent on the dryness of the skin. As an example, a Ø13 mm finger tip with 1 mm dry skin is pressed against the centre of a 2 mm wide and 100 mm long slot. This has a leakage that would be measured to 50 W/m^2 at 50 mm distance (i.e. the electric field strength is 137 V/m) with no finger. The local SAR value then becomes about 30 W/dm^3, over a 4 mm wide and 1,5 mm deep volume. This local value is in itself approximately within the basic restriction. If the finger is wet and the skin is thin, the local SAR value may be up to 50 times larger but the two small heated volumes contacting the slot sides are then only about 1 mm wide and deep. The thermal equilibration distance is now over only 2 mm, so the heat conduction has now a time constant of $(2/20)^2 \times (5 \times 60)$ s = 3 s. The local, thermally insulated heating rate could be up to 40 K/min. However, heat conduction would result in a stationary temperature rise of less than about 3 K, which is also acceptable. Hence, there is no need to have a shorter integration time than about 30 s even in this most onerous case of high local SAR values in microwave **cavity** oven situations.

DD.6 Conclusions and modifications of the standards for ovens with a cavity door

The 6 min time of integration specified in existing international standards is inadequate for the purposes now under investigation. A more realistic value should be 30 s. There may be cases of open-ended microwave applicators intended for heating of a contacting **load**. Such applicators may cause almost instantaneous injury if contacted by any part of the body when in operation, and other provisions for safety ~~must~~ shall be applied.

The existing emission standard for **microwave ovens** specifies an integration time of about 2 s for the measurement. This is for historical and practical rather than safety reasons. A typical household **microwave oven** has either a ceiling stirrer or a turntable, and with the specified circularly cylindrical test **load**, the leakage variation periodicity will be comparable to or less than the specified integration time. Measurements are then correct and made easily and quickly with the present standard.

Since the door-less appliances considered in informative Annex DD may behave quite differently and there is no reason to introduce limitations on construction that have no relevance to safety considerations, 20 s time of integration for leakage measurements shall be applied. This is shorter than 30 s, but also allows for faster measurements and easier integration. The most onerous 20 s interval shall be chosen and the instrument integration time of 2 s to 3 s shall be maintained.

For reasons given here, the allowed leakage level shall not be 100 W/m^2 in empty operation, as for **microwave ovens** with a door. The regular value of 50 W/m^2 shall apply.

In addition, a maximum measured (integrated, ceiling) value of 500 W/m^2, consistent with the instrument integration time of 2 s to 3 s, is introduced to simplify instrument specifications and handling as well as the numerical integration in cases of highly variable leakage. Such strong variability may occur for example in appliances with a protective device consisting of a built-in leakage monitor coupled to a cut-out.

Annex EE
(normative)

Microwave ovens intended to be used on board ships

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.

Annex EE modifies the corresponding clauses and subclauses of the main part of this standard or, where this is not applicable, of Part 1 of IEC 60335, to indicate requirements for commercial **microwave ovens** intended to be used on board ships. Where it is unclear whether a clause or subclause of this annex is intended to modify the corresponding text of the main part of this standard or that of Part 1, this is specified.

~~**3 Terms and definitions**~~

~~**EE.3.101**~~
~~**open deck**~~
~~area which is exposed to marine environment~~

~~**EE.3.102**~~
~~**dayroom**~~
~~area which may be exposed to marine environment from time to time~~

~~EE.~~6 Classification

~~EE.~~**6.2** *Addition:*

Appliances for **open deck** use shall be IPX6.

~~EE.~~7 Marking and instructions

~~EE.~~**7.1** *Modification:*

Replace the second dashed item of ~~Part 1~~ the first list by the following:

– **rated frequency** or **rated frequency range** in Hz;

~~EE.~~**7.12** *Addition:*

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

– usage on board ships;
– installation place (**open deck** protective enclosure, **dayrooms**);
– fastening means.

*The instructions for **microwave ovens** that are intended to be used on board ships shall state:*

CAUTION: Verify that the voltage and frequency of the mains supply of the ship matches the **rated voltage** and **rated frequency** or **rated frequency range** of the **microwave oven**.

~~*Modification:*~~

Replace the eleventh dashed item by the following:

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

~~EE.~~11 Heating

11.5 *Addition:*

***Microwave ovens** marked with a **rated frequency** are tested with the most onerous frequency within ± 4 % of the **rated frequency**.*

***Microwave ovens** marked with a **rated frequency range** are tested with the most onerous frequency within this range.*

~~EE.~~22 Construction

EE.22.~~101~~201 Appliances shall withstand the pulses to which they ~~may~~ can be subjected.

Compliance is checked by carrying out the half-sine pulse tests specified in IEC 60068-2-27 under the following conditions.

The appliance is fastened in its normal position of use to a shock-testing machine by means of straps around the enclosure.

The type of pulse is a half-sine pulse and the severity is as follows:

– *application of the half-sine pulse is in all 3 axes;*
– *peak acceleration: 250 m/s^2;*
– *duration of each half-sine pulse: 6 ms;*
– *number of half-sine pulses in each direction: 1 000 ± 10.*

The appliance shall show no damage that could impair compliance with 8.1, 16.3, Clause 29 and 32.1, and connections shall not have worked loose.

EE.22.~~102~~202 Appliances 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 upon a vibration table by means of straps around the enclosure. The type of vibration is sinusoidal and the severity is as follows:

– *direction of vibration is vertical and horizontal;*
– *amplitude of vibration: 0,35 mm;*
– *sweep frequency range: 10 Hz to 150 Hz;*
– *duration of the test: 30 min.*

The appliance shall show no damage that could impair compliance with 8.1, 16.3, Clause 29 and 32.1 and connections shall not have worked loose.

EE.22.~~103~~203 **Shelves** shall have a **non-detachable** slip resistant top surface.

Compliance is checked by inspection and the following test.

*The top surface of the **shelf** is coated with cooking oil. The appliance is placed with the door forwards on and fixed to a surface which can be tilted downwards to the right in one direction*

*by 12°. An empty dinner plate as described in IEC 60436:~~2004~~2015/AMD1:2020, Item A.1 of Table A.1 is used for the test and placed centrally on the **shelf**. The oven is then slowly tilted.*

*In a second test and for **microwave ovens** with rotatable **shelves**, the **shelf** is rotated by 90°, the plate is again placed centrally and the **microwave oven** is then slowly tilted. For **microwave ovens** with **non-detachable shelves**, the **microwave oven** is rotated by 90°, the plate is again placed centrally and the **microwave oven** is then slowly tilted.*

*During each of these tests, the plate shall not slide onto a raised **shelf** periphery if any, or onto the **cavity** wall.*

NOTE During the tests, the oven is not energised and it is possible that the **cavity** door is open.

28 Screws and connections

28.1 *Addition:*

Screws made of carbon steel and alloy steel shall be made in accordance with ISO 898-1.

Screws made of corrosion-resistant stainless-steel shall be made in accordance with ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4.

28.4 *Addition:*

Screws that make mechanical connections and electrical connections shall be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts during operational stress and contact corrosion.

Screws that make mechanical connections and provide earthing continuity shall

– be one of the types specified in Table EE.201 and be made in accordance with ISO 898-1 or ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4, and
– have a minimum outer thread diameter of 2,8 mm, and
– be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts due to operational stress and contact corrosion. They shall be designed so that a minimum contact pressure remains.

Compliance is checked by inspection and by measuring the assembling torques for screwed connections providing earthing continuity by applying a torque as specified in Table EE.201 to turn the screw in the fastening direction. The screw shall not turn.

The screw shall not have been unfastened prior to performing this test.

Table EE.201 – Assembling torques for screwed connections providing earthing continuity

Outer thread diameter of the screw *mm*	*Assembling torque* *Nm*	
	Screwed connections for the mechanical strength of the screws A2-70 according to ISO 3506-1, or ISO 3506-2, or ISO 3506-3, or ISO 3506-4 and 5.8 according to ISO 898-1	*Screwed connections for the mechanical strength of the screws > 8.8 according to ISO 898-1*
> 2,8 and ≤ 3,6	*0,8*	*1,3*
> 3,6 and ≤ 4,2	*1,9*	*3,0*
> 4,2 and ≤ 5,3	*3,7*	*6,0*
> 5,3 and ≤ 6,3	*6,5*	*10,0*
M8	*15,0*	*25,0*
M10	*31,0*	*50,0*

31 Resistance to rusting

Replace as follows:

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is checked by the salt mist test Kb of IEC 60068-2-52:

– *for **open deck** use, severity 1 is applicable;*
– *for **dayrooms** use, severity 2 is applicable.*

Before the test, coatings are scratched by means 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 mm ± 0,02 mm. The pin is loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches are made by drawing the pin along the surface of the coating at the speed of approximately 20 mm/s. Five scratches are made at least 5 mm apart and at least 5 mm from the edges.

After the test, the appliance shall not have deteriorated to such an extent that compliance with this standard, in particular with Clauses 8 and 27, is impaired. The coating shall not be broken and shall not have detached from the metal surface.

Bibliography

The Bibliography of Part 1 is applicable except as follows.

Addition:

IEC 60335-2-25, *Household and similar electrical appliances – Safety – Part 2-25: Particular requirements for microwave ovens, including combination microwave ovens*

IEC 60519-6, *Safety in ~~electroheat~~ installations for electroheating and electromagnetic processing – Part 6: ~~Specifications for safety of industrial microwave heating equipment~~ Particular requirements for high frequency dielectric and microwave heating and processing equipment*

IEC 60601 (all parts), *Medical electrical equipment*

IEC 60989:1991 [3], *Separating transformers, autotransformers, variable transformers and reactors*

IEC 61270-1, *Capacitors for microwave ovens – Part 1: General*

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3 Withdrawn.

IEC 60335-2-90

Edition 5.0 2024-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Household and similar electrical appliances – Safety –
Part 2-90: Particular requirements for commercial microwave ovens

Appareils électrodomestiques et analogues – Sécurité –
Partie 2-90: Exigences particulières pour les fours à micro-ondes à usage commercial

IEC 60335-2-90:2024-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-90: Particular requirements for commercial microwave ovens

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60335-2-90 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 fifth edition cancels and replaces the fourth edition published in 2015 including its Amendment 1:2019. This edition constitutes a technical revision.

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

a) the appliance used in area open to the public has been introduced in Clause 1, 3.8.107, 7.12, 8.1.1, 11.8, 20.2, 22.103.2, 22.105 and 22.117;
b) Subclauses 5.5, 7.12.1, 11.2, 11.7, 20.1 and 20.101 have been modified to add for stacking installation;

c) Subclauses 7.1, 11.7 and 22.61 have been modified for the appliance outlets and socket-outlets;

d) Subclause 7.12 has been improved in clarity;

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 16.101 has been modified to move the content of 16.101.1, 16.101.2 directly under 16.101.

h) Subclauses 19.11.2, 19.13, Clause 21, Subclauses 22.105, 22.111 and Annex AA have been improved in clarity;

i) Annex BB and Annex EE have been modified to add screw requirements.

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

Draft	Report on voting
61B/702/FDIS	61B/706/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 commercial microwave ovens.

When a particular subclause of Part 1 is not mentioned in 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** type 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, USA and Canada).
– 6.1: Microwave ovens may be class 0I if the rated voltage does not exceed more than 150 V (Japan).
– 7.12: Some warnings have to be marked on the appliance and be visible to the user (Canada).
– 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 only measured 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 only measured at the end of the test (USA).
– 22.112: Microwave leakage is not to exceed 50 W/m^2 (Japan and USA).
– 22.116: All access to the cavity has to be prevented (USA).
– 27.2: A terminal for an external equipotential conductor is not required (Japan).

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 can differ.

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

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

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

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

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

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

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-90: Particular requirements for commercial 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** with a **cavity** door intended for commercial use, their **rated voltage** being not more than 250 V for single-phase appliances connected between one phase and neutral and 480 V for other appliances.

These appliances are not intended for household and similar purposes. They are used for commercial processing of food, also in **areas open to the public**, for example in kitchens of restaurants, canteens, hospitals and in commercial enterprises such as bakeries and butcheries;

– the safety of **combination microwave ovens** with a **cavity** door, the requirements of which are contained in normative Annex AA;

– the safety of **microwave ovens** without a **cavity** door and with **transportation means** that are intended for commercial use only, for the heating of food and beverages, the requirements of which are contained in normative Annex BB.

Microwave ovens covered by normative Annex BB have **transportation means** for moving the **load** through the **microwave oven**. Requirements for tunnel microwave ovens and several types of microwave vending machines are covered.

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

In normative Annex BB, a **microwave oven** without a **cavity** door and with **transportation means** is described as a **microwave oven**. All clauses of this standard apply to these appliances unless otherwise specified in normative Annex BB.

This part of IEC 60335 also takes into account **ordinary persons** having access to the **removing area** of the vending machine.

The appliance can be built into a vending machine, in which case IEC 60335-2-75 can also be applicable.

Appliances that use non-electrical energy are within the scope of this standard.

As far as is practicable, this standard deals with the common hazards presented by these types of appliances.

This standard does not take into account the use of a **microwave oven** without a **cavity** door and with **transportation means** by **ordinary persons** except in the vicinity of **entrance and exit ports**.

The rationales for particular microwave exposure conditions and measures related to microwave energy being confined by an open structure are given in normative Annex BB.

Attention is drawn to the fact that

– for appliances intended to be used in vehicles or on trains, on board ships or board aircraft, additional requirements can be necessary;
– for appliances intended to be used in tropical countries, special requirements can be necessary;
– in many countries, the national health authorities, the national authorities responsible for the protection of labour and similar authorities specify additional requirements;
– in many countries, national authorities specify additional requirements to BB.22.101.1.

This standard does not apply to

– **Microwave ovens** including **combination microwave ovens** for household use covered by IEC 60335-2-25 and used in the following environments by laymen:
  - staff kitchen areas in shops, offices and other working environments;
  - farm houses;
  - by clients in hotels, motels and other residential type environments;
  - bed and breakfast type environments.
– 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).

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60068-2-6, *Environmental testing – Part 2-6: 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 60335-2-36, *Household and similar electrical appliances – Safety – Part 2-36: Particular requirements for commercial electric cooking ranges, ovens, hobs and hob elements*

IEC 60335-2-42, *Household and similar electrical appliances – Safety – Part 2-42: Particular requirements for commercial electric forced convection ovens, steam cookers and steam-convection ovens*

IEC 60335-2-49, *Household and similar electrical appliances − Safety − Part 2-49: Particular requirements for commercial electric appliances for keeping food and crockery warm*

IEC 60335-2-75, *Household and similar electrical appliances – Safety – Part 2-75: Particular requirements for commercial dispensing appliances and vending machines*

IEC 60436:2015, *Electric dishwashers for household use – Methods for measuring the performance*
IEC 60436:2015/AMD1:2020

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

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

ISO 3506-1, *Fasteners – Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs with specified grades and property classes*

ISO 3506-2, *Fasteners – Mechanical properties of corrosion-resistant stainless steel fasteners – Part 2: Nuts with specified grades and property classes*

ISO 3506-3, *Mechanical properties of corrosion-resistant stainless steel fasteners – Part 3: Set screws and similar fasteners not under tensile stress*

ISO 3506-4, *Mechanical properties of corrosion-resistant stainless steel fasteners – Part 4: Tapping screws*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1 Definitions relating to physical characteristics

3.1.7

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 under the following conditions:

The appliance is operated 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 placed on the centre of the **shelf**. If the **rated microwave power output** exceeds 2 200 W, two such vessels are used and placed contiguously in the **cavity**.

3.1.101
rated microwave power output
microwave power output assigned to the appliance by the manufacturer

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 between 300 MHz and 30 GHz, for heating food and beverages in a **cavity**

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

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

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

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

3.6.104
monitored door interlock
door interlock system that incorporates a supervision device

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

3.6.106
transportation means
means to transport the **load** through the **microwave oven**

Note 1 to entry: An example of a **transportation means** is a belt, an arm or an inclined plane.

3.6.107
microwave enclosure
structure that is intended to confine microwave energy to a defined region

Note 1 to entry: Barriers mounted outside the **microwave enclosure** are not considered a part of the **microwave enclosure**.

Note 2 to entry: A **microwave enclosure** can consist of a **cavity**, quarter wave chokes (acting by impedance transformation), mode chokes (acting by field pattern mismatching) and microwave energy absorbers.

3.6.108
microwave barrier
physical barrier, which is microwave transparent, limiting access to the **microwave enclosure**, mounted outside the **microwave enclosure** and can only be removed with the aid of tools

Note 1 to entry: A **microwave barrier** can be mounted between the **microwave enclosure** and the external cover of the appliance.

Note 2 to entry: Devices such as an array of metal chains or hinged metal plates at **entrance and exit ports** intended to reduce microwave leakage are not considered **microwave barriers**.

Note 3 to entry: Construction requirements are given in BB.22.101.

Note 4 to entry: Informative Annex DD mentions about rationale for the **microwave barrier** and associated leakage test.

3.6.109
entrance and exit ports
openings in the **microwave enclosure** through which **loads** move

3.6.110
loading area
area on which the **load** is placed

3.6.111
means of monitored microwave interlock
means of microwave interlock that incorporates a supervision device

3.6.112
protective blocking structure
movable mechanical structure located in the **removing area** limiting access to the **microwave enclosure**

3.6.113
removing area
area from which the **load** is removed

3.6.114
viewing opening
opening in the **cavity** through which the warm up process can be visually monitored

3.6.115
fixed means of connection
all parts of the **microwave enclosure** that are permanently open with the exception of **entrance and exit ports** and **viewing openings**

Note 1 to entry: **Fixed means of connection** can be used for venting and water flushing.

3.6.116
Void

3.6.117
means of microwave interlock
mechanical or electrical safety devices or systems that operate when certain conditions are not fulfilled (e.g. an interlock system that prevents the operation of the microwave generator when a means of access is open)

3.6.118
maintenance cover
structural feature of any part of the equipment that can be opened or removed by the use of a tool to provide access for routine maintenance, service, replacement of expendable parts, etc. in microwave containing areas

3.6.119
cleaning cover
part of the **microwave enclosure** that can be opened or removed, only with the aid of a tool, for frequent cleaning purposes, during operation

3.6.120
reference surface
surface in the vicinity of entrance and exits ports defined depending on the reading of microwave leakage of 32.1 of normative Annex BB

Note 1 to entry: If the leakage reading is less or equal to 50 W/m^2, the **reference surface** is the surface of the geometric opening of the **microwave enclosure** without **microwave barrier**.

Note 2 to entry: If the leakage reading exceeds 50 W/m^2, the **reference surface** is an artificial surface located 50 mm away from the locations where the sensor of the instrument measures leakage readings of 50 W/m^2 straight inwards towards the appliance.

Note 3 to entry: For further explanation, refer to 32.1 of normative Annex BB.

3.8 Definitions relating to miscellaneous matters

3.8.101
instructed person
person who is sufficiently instructed and monitored to know how to avoid any danger caused by the operation of **microwave ovens**

3.8.102
skilled person
person with suitable professional education, knowledge and experience to discern and to avoid any danger caused by the operation of **microwave ovens**

3.8.103
ordinary person
person who is neither a **skilled person** nor an **instructed person**

3.8.104
load
food and beverages that can be heated up in a **microwave oven**

3.8.105
area open to the public
area in which the general public, including children, can have access

Note 1 to entry: Examples include customer areas in:

– grocery stores;
– canteens;
– train stations;
– self-service restaurants.

3.8.106
open deck
area that is exposed to marine environment

3.8.107
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:*

An additional sample can be required for the test of 19.104.

Six samples of the interlocks are required for the test of 24.1.4.

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, 22.116, Clause 7 to Clause 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 and 22.116), Clause 23 to Clause 31 and 32.2, 21.101 to 21.105 and 19.104.

5.5 *Addition:*

The tests are carried out with the appliances in any stacked combination or any movable part of it placed in the most unfavourable condition that can occur in normal use.

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**.

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 appliances have external enclosures, other than working surfaces, that cannot meet the limit in Table 3 specified for external enclosures of **motor-operated appliances**, they shall be marked with symbol IEC 60417-5041 (2002-10) or with the substance of the following:

CAUTION: Hot surface.

If appliances have external **accessible surfaces**, for which temperature rise limits are specified in Table 101 and Table 102 and for which the provisions of footnote b to Table 101 and Table 102 apply, then the appliance shall be marked with symbol IEC 60417-5041 (2002-10) or with the substance of the following:

CAUTION: Hot surface

7.6 *Addition:*

	[symbol IEC 60417-5021 (2002-10)]	equipotentiality
	[symbol IEC 60417-5041 (2002-10)]	caution, hot surface

7.12 *Addition:*

The instructions shall include the substance of the following:

– 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 any 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 or other foods must not be heated in sealed containers since they are liable to explode.

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

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

– 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**.

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

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

– Eggs in their shell and whole hard-boiled eggs should not be heated in **microwave ovens** since they may 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**).

– The appliance should not be cleaned with a water jet (for appliances intended to stand on the floor and which are not at least IPX5).

– Statement on usage on commercial road vehicles (for appliances intended to be used on commercial road vehicles).

– The appliance must not be cleaned with a steam cleaner (for appliances which are not at least IPX5).

NOTE 102 If the oven is incorporated in a vending machine, no warnings and instructions can be required.

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

The manufacturer shall declare that the appliance is also intended to be used in an **area open to the public**. For this case, it shall be stated whether this appliance is allowed to be placed or installed less than 850 mm above the floor.

If the appliance is not suitable for use in an **area open to the public**, the instruction shall include the substance of the following warning:

WARNING: This appliance shall not be placed or installed where the public has access.

7.12.1 *Addition:*

If the installation instructions state that a **microwave oven** can be placed on top of another **microwave oven**, they shall state model or type reference of the suitable **microwave ovens**. Instructions shall be given for the stacking way of the **microwave ovens**. The instructions shall state how to use the fixing attachments, if any, in a correct way. The instructions shall also state the maximum number of stacked **microwave ovens**.

7.14 *Addition:*

The warning specified in 7.1 shall be in lettering at least 3 mm high.

The warning specified in 7.101 shall be in lettering at least 5 mm high.

The height of the triangle used with symbol IEC 60417-5041 (2002-10) shall be at least 12 mm.

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 or door. It shall not be placed on surfaces that are exempted from the limits in Table 3, Table 101 and Table 102.

7.101 A label shall be provided, together with instructions for fixing it in a conspicuous place close to the appliance. The label shall state the substance of the following.

– WARNING: Liquids or other foods must not be heated in sealed containers since they are liable to explode;
– WARNING: Microwave heating of beverages can result in delayed eruptive boiling, therefore care must be taken when handling the container;
– WARNING: The contents of feeding bottles and baby food jars must be stirred or shaken and the temperature checked before consumption, in order to avoid burns.

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

8.1.1 *Addition:*

*For appliances intended to be used in the **area open to the public**, test probe 18 of IEC 61032 is applied.*

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.

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 intended to be fixed to the floor, **microwave ovens** intended to be stacked onto other **microwave ovens** or appliances with a mass greater than 40 kg and not provided with rollers, castors or similar means, are installed in accordance with the installation instructions. If no instructions are supplied, these appliances are placed on the floor as near as possible to the walls of the test corner.*

11.3 *Addition:*

*Where the external **accessible surfaces** are suitably flat and access permits, the test probe of Figure 102 is used to measure the temperature rises of external **accessible surfaces** specified in Table 101 and Table 102. 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 in cycles, each cycle consisting of a heating period of 4 min followed by a rest period of 1 min until steady conditions are established. The last cycle does not include a rest period of 1 min. Boiling water is added to the water **load** when half of the water **load** has evaporated.*

*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 **microwave ovens** intended to be stacked onto other **microwave ovens**, the tests shall be also conducted under the most unfavourable stacking conditions in accordance with the instructions. In this case, all **microwave ovens** are operated simultaneously under normal use and supplied by the same voltage.*

11.8 *Modification:*

Replace the first paragraph by the following text:

*For appliances intended to be used in **areas open to the public**, the temperature rises are monitored continuously and shall not exceed the values shown in Table 3 and Table 102.*

For other appliances, the temperature rise shall not exceed the values shown in Table 3 and Table 101.

Addition:

For Table 3:

- *The temperature rises of external surfaces are only measured on the surfaces that are not placed against the wall and the floor of the test corner.*
- *There are no temperature limits for air-outlet grilles and for surfaces up to a distance of 25 mm from them.*
- *When the required values for external enclosures of **motor-operated appliances** are not met, the maximum temperature rise shall not exceed the limit by more than 25 K to the values indicated.*

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

Surface [a]	***Temperature rise of external accessible surfaces*** *K* [b]
Bare metal	*48*
Coated metal [c]	*59*
Glass and ceramic	*65*
Plastic and plastic coating > 0,4 mm [d, e]	*74*

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 103):*

- ***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 which, according to the installation conditions of Subclause 11.2, shall be against the walls and where these surfaces are inaccessible to a 75 mm diameter probe having a hemispherical end;*
- *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 exceed the limit by more than 25 K to 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.*

Table 102 – Maximum temperature rises of external accessible surfaces for appliances intended to be used in areas open to the public under normal operating conditions

Surface [a]	***Temperature rise of external accessible surfaces*** K	
	Appliances and parts situated not more than 850 mm above the floor after installation	***Appliances and parts situated more than 850 mm above the floor after installation*** [b]
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 103):*
- ***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 which, according to the installation condition of Subclause 11.2, shall be against the walls and where these surfaces are inaccessible to a 75 mm diameter probe having a hemispherical end;*
- *surfaces on the oven door within 10 mm from the left, right and lower edge of the oven door, or 25 mm from the upper edge of the oven door (Zone 1). For* ***built-in appliances****, the edges shall be considered between the oven door and decorative trims, if any;*
- *surfaces around the oven door within 10 mm from the left, right or lower edge of the oven door, or 25 mm from the upper edge of the oven door (Zone 2). For* ***built-in appliances****, the edges shall be considered between the 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 exceed the limit by more than 25 K to the values indicated.*

[c] *Metal is considered coated when a coating having a minimum thickness of 90 µm made by enamel, powder 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.*

12 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.

15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.1.1 *Addition:*

In addition, appliances which are intended to be situated not more than 850 mm above the floor, except those marked IPX5 or IPX6, are subjected for 5 min to the following splash test.

The apparatus shown in Figure BB.201 is used. The appliance is placed in normal position of use and adjustable feet shall be set in accordance with the instructions for use to the most unfavourable height.

For appliances normally used on the floor, the bowl is placed on the floor and is moved around in such a way as to splash the appliance from all directions. During the test, the water pressure is so regulated that the water splashes up 150 mm above the bottom of the bowl. The bowl is not positioned underneath the appliance.

For all other appliances, the bowl is placed on the same plane where the appliance is placed and is moved around in such a way as to splash the appliance from all directions. During the test, the water pressure is so regulated that the water splashes up 100 mm above the bottom of the bowl. The bowl is not positioned underneath the appliance.

Care is taken that the appliance is not hit by the direct jet.

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 electric strength test of 16.3.

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.

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 one of the following tests.

– *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.

– *For other power transformers, 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.

Addition:

The tests are not carried out on the power transformer that supplies the magnetron and its associated circuits, these are 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 can be expected in normal use.

Compliance is checked by the following test.

The door system is subjected to 100 000 cycles of operation with the appliance supplied at ***rated voltage*** *and containing an appropriate microwave-absorbing* ***load****. It is then subjected to 100 000 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 six 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 1 000 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 19.104, 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 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:*

During the tests, the temperature of windings shall not exceed the values shown in Table 8. Only appliances that allow a preselected 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.*

19.101 *Appliances are operated with controls set at the most unfavourable position and without a* ***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 exceeds 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;

– 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 potatoes placed on the **shelf** in the position where they are most likely to ignite and propagate flames to other combustible material.*

Each potato has an approximately ellipsoidal shape and a mass between 125 g and 150 g. The length of the shorter principal axis is at least 40 mm. The length of the longer 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 longer axis of the potato, is inserted along this axis of at least one of the potatoes. The number of potatoes to be used is stated in Table 103.

*If the potatoes do not ignite, the test is repeated with the **load** reduced by one potato. If a single potato does not ignite, it is ignited artificially.*

Table 103 – Number of potatoes

Rated microwave power output *W*	***Volume of the cavity*** *l*	***Number of potatoes***
<600	*≥14 and <28*	*2*
≥600 and <1 000	*≥28 and <42*	*4*
≥1 000 and <2 000	*≥42 and <56*	*6*
≥2 000	*≥56*	*6 + N* [a]
NOTE The **rated microwave power output** or the volume of the **cavity** applies, whichever results in the higher number of potatoes.		
[a] *N is 2 for each 500 W increase in power output or for each 14 l increase in volume.*		

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.

20 Stability and mechanical hazards

This clause of part 1 is applicable except as follows.

20.1 *Modification:*

Replace the first paragraph of the compliance criterion by the following:

*For stacked appliances intended to be placed on the floor, the appliances, not connected to the supply mains, are placed in any normal position of use on a plane inclined at an angle of 15° to the horizontal, the **supply cord** resting on the inclined plane in the most unfavourable position. However, if part of any appliance comes into contact with the horizontal supporting surface when the stacked appliances are tilted through an angle of 15°, the stacked appliances are placed on a horizontal support and tilted in the most unfavourable direction through an angle of 15°.*

*For other than stacked appliances intended to be placed on the floor, the appliances, not connected to the supply mains, are placed in any normal position of use on a plane inclined at an angle of 10° to the horizontal, the **supply cord** resting on the inclined plane in the most unfavourable position. However, if part of any appliance comes into contact with the horizontal supporting surface when the appliances are tilted through an angle of 10°, the appliances are placed on a horizontal support and tilted in the most unfavourable direction through an angle of 10°.*

20.2 *Addition:*

*For appliances intend to be used in **areas open to the public**, test probe 18 of IEC 61032 is applied.*

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.

For appliances intended to be used on the floor, the mass is

- *23 kg for **cavity** doors, or the mass that can be placed in the oven in accordance with the instructions, if this is higher;*
- *7 kg for other doors.*

For appliances intended to be used on a table, the mass is

- *7 kg for **stationary appliances**;*
- *3,5 kg for **portable appliances**.*

The appliance shall not tilt.

NOTE 1 A sandbag can be used for the **load**.

*For **microwave ovens** intended to be stacked onto other **microwave ovens**, the test is repeated under the stacking conditions in accordance with the instructions. Each door of **microwave ovens** in stacked condition is tested one at a time.*

If the appliance has more than one door, the test is conducted on each door, one at a time, during the above tests.

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 25 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 25 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 50 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 10 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 furthest from the door hinge. An attempt is made to close the door with a force of 90 N applied at the other corner furthest 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 furthest 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 140 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.

22.101 **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 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** 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. Additionally, for appliances intended to be used in **areas open to the public**, test probe 18 is also used. Each probe is applied one at a time.*

During the tests, the operation of the 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.

Compliance is checked by inspection.

22.105 At least one of the **door interlocks** shall be concealed and not 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 any position and an attempt is made to operate the concealed **door interlock** by applying test probe B and, for appliances intended to be installed in an **area open to the public**, then test probe 18, to all openings. The test is repeated with a rod, as shown in Figure 101, to any openings of the **door interlock** mechanism. The test probes and rod shall be applied 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 interlocks*** *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, the rod and the magnet, each applied separately. For appliances intended to be used in* ***areas open to the public****, test probe 18 is additionally applied separately.*

The concealed ***door interlocks*** *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.*

The supervision device is replaced for subsequent tests if it fails in the closed circuit position.

It is necessary to render other ***door interlocks*** *inoperative in order to perform this test.*

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.

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.

For appliances having a ***rated voltage*** *under 150 V and those with a* ***rated current*** *over 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 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 10 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.

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 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 of 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 Appliances shall be constructed so that **shelves** do not fall out of their supports when subjected to a **load**. **Shelves** intended to be partially withdrawn in use shall not tip when they have partially been removed from the oven.

Compliance is checked by the following test.

*A vessel filled with sand or shot is placed on the **shelf**. The total mass in kilograms is equal to 30 kg/m^2 of the **shelf** area. The **shelf**, with the vessel placed centrally on it, is inserted into the oven and moved as close as possible to one of the side walls. It is left in this position for 1 min and then withdrawn. It is then reinserted, moved as close as possible to the other side wall and left for one minute.*

*During the test, the **shelf** shall not fall away from its support.*

*For **shelves** intended to be partially withdrawn in use, the test is repeated with the **shelf** pulled out by 50 % of its depth. An additional force of 10 N is applied vertically downwards on the centre of the exposed front edge of the **shelf**.*

*During the test, the **shelf** shall not tip.*

NOTE A small angle of deflection is ignored.

22.115 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 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.

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

Compliance is checked by inspection and the following test.

*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**.*

22.117 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, for appliances intended to be used in an **area open to the public**, in addition test probe 18, one at a time.*

22.118 Lights, switches or push-buttons for the indication of danger, alarm or similar situations shall be coloured red.

Compliance is checked by inspection.

22.119 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.

22.120 Appliances for installing in commercial road vehicles, coaches, busses, food stalls and similar vehicles shall withstand the vibrations to which they 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, Clause 29 and 32.1, and connections shall not have worked loose.

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*
– *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[1] is not applicable to power transformers that supply the magnetron.

24.1.4 *Modification:*

*The number of cycles of operation for **thermostats** is increased to 30 000.*

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.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Modification:*

Appliances shall not be provided with an appliance inlet.

25.3 *Addition:*

Fixed appliances and appliances with a mass greater than 40 kg and not provided with rollers, castors or similar means shall be constructed so that the **supply cord** can be connected after the appliance has been installed in accordance with the installation instructions.

Terminals for the permanent connection of cables to fixed wiring may also be suitable for a **supply cord** of **type X attachment**. In this case, a cord anchorage complying with 25.16 shall be fitted to the appliance.

1 Withdrawn.

25.7 *Modification:*

Instead of the types of **supply cords** specified, the following applies:

Supply cords shall be oil-resistant and shall not be lighter than ordinary polychloroprene sheathed flexible cord (code designation 60245 IEC 57) or equivalent synthetic elastomer sheathed cord.

25.14 *Addition:*

*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.

27.2 *Addition:*

Stationary appliances shall be provided with a terminal for the connection of an external equipotential bonding conductor. This terminal shall be in effective electrical contact with all fixed exposed metal parts and shall allow the connection of a conductor having a nominal cross-sectional area up to 10 mm^2. It shall be located in a position convenient for the connection of the conductor after installation of the appliance.

NOTE 101 Small fixed exposed metal parts, for example nameplates, are not required to be in electrical contact with the terminal.

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 and those with a keep-warm function, 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.*

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**.

Dimensions in millimetres

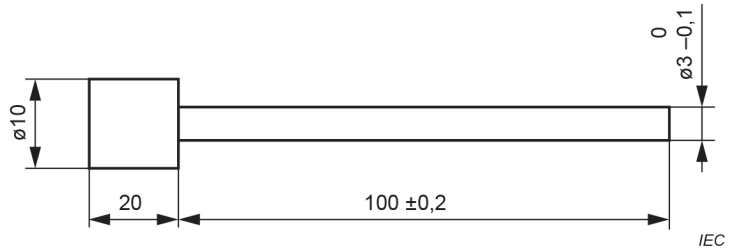
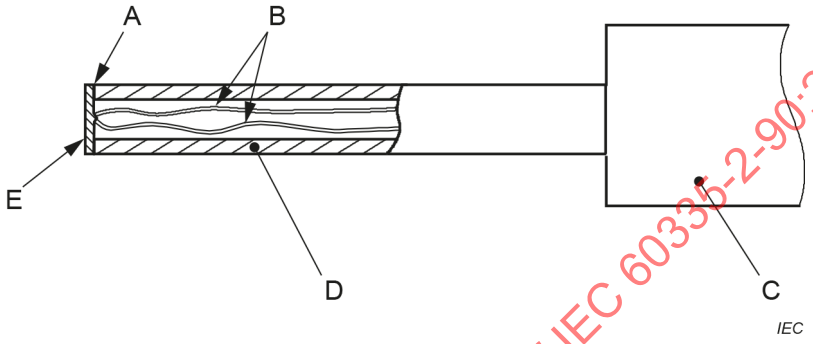


Figure 101 – Test rod for door interlock concealment



Key

A adhesive

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

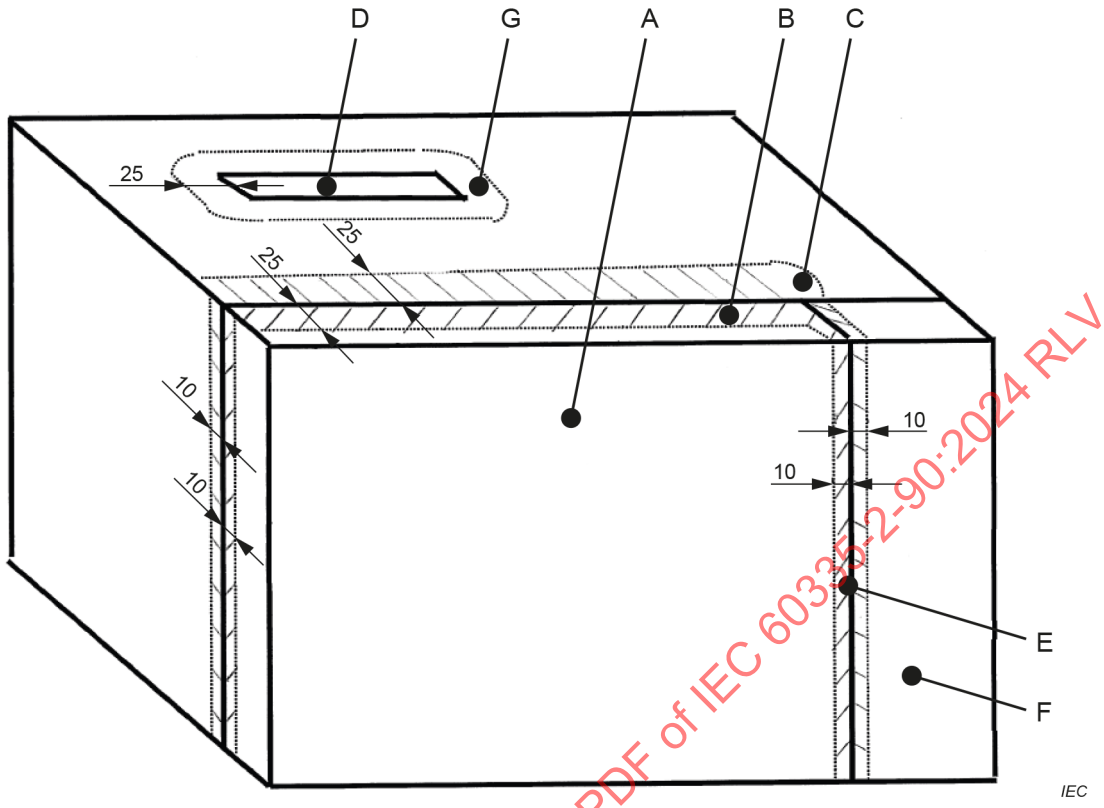
C handle arrangement permitting a contact force of 4 N ± 1 N

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 102 – Probe for measuring surface temperatures

Dimensions in millimetres



Key

A oven door
B excluded area on the oven door (Zone 1)
C excluded area around the oven door (Zone 2)
D vent
E door gap
F oven front surface
G excluded area around vents (Zone 3)

Figure 103 – Front view of appliance with identification of excluded areas

Annexes

The annexes of Part 1 are applicable except as follows.

Annex A
(informative)

Routine tests

This annex of Part 1 is applicable except as follows.

A.2 Earth continuity test

Modification:

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

A.101 Marking and instructions

The covers dealt with in 7.1 are checked to ensure that they are marked with the warnings concerning microwave energy.

The presence of the warning sign and warning text dealt with in BB.22.201.6 is checked.

The appliance is checked to ensure that the corresponding labels, instructions and manuals 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

A.103.1 *The **microwave oven** is supplied at **rated voltage** and operated with the microwave power control adjusted to the highest setting. The energy flux density of microwave leakage is measured at any point approximately 50 mm from the*

– *external surface of the appliance for **microwave ovens** not covered by normative Annex BB, or*
– ***reference surface** for **microwave ovens** covered by normative Annex BB.*

A.103.2 *For **microwave ovens***

– *not covered by normative Annex BB, an appropriate **load** may be used, or*
– *covered by normative Annex BB, a **load** as specified in 3.1.9 of normative Annex BB shall be used.*

A.103.3 *The measuring instrument is moved*

– *over the external surface of the appliance for **microwave ovens** not covered by normative Annex BB, or*
– *over the external surface of the appliance and any **microwave barrier** for **microwave ovens** covered by normative Annex BB*

and the microwave leakage is measured.

A.103.4 *The microwave leakage shall not exceed*

– *50 W/m^2 for **microwave ovens** not covered by normative Annex BB, or*

– *50 W/m^2, averaged over the most onerous 20 s interval and 500 W/m^2 measured as peak value for **microwave ovens** covered by normative Annex BB,*

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.104.2 *Instruments shall be subjected to 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 the measurements specified in A.104.3, the minimum resolution of the instrument under test (IUT) shall be 1 W/m^2.*

A.104.3 *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 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 readings 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.*

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.

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 **combination microwave ovens** with commercial electric forced convection ovens, steam cookers and steam-convection ovens, IEC 60335-2-42 is also applicable.

AA.1.202 For **combination microwave ovens** with commercial electric cooking ranges, ovens, hobs and hob element, IEC 60335-2-36 is also applicable.

AA.1.203 For **combination microwave ovens** with commercial electric appliances for keeping food and crockery warm, IEC 60335-2-49 is also applicable.

AA.1.204 For **combination microwave ovens** with commercial dispensing appliances or vending machines, IEC 60335-2-75 is also applicable.

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 (see Clause 2 of this 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

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

5.101

Replace as follows.

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

11 Heating

AA.11.7.201 ***Combination microwave ovens*** *incorporating resistive heating elements where simultaneous operation is intended, are operated with the resistive heating elements switched on as specified in the manufacturer's instructions under the conditions of Clause 11 of the relevant standard but using the* ***load*** *specified in 3.1.9, the microwave power output being approximately 50 %.*

If no instructions are provided, the appliance is operated until steady conditions are established.

18 Endurance

Addition:

Before measuring the microwave leakage, the following additional conditioning is carried out.

– *resistive heating elements for radiant heating are operated for 30 min;*
– *resistive heating elements for convection heating are operated for 60 min.*

19 Abnormal operation

19.1

Modify as follows.

The test of 19.102 is carried out with the appliance supplied at 1,06 times ***rated voltage****.*

29 Clearances, creepage distances and solid insulation

Replace as follows.

This clause of Part 1 is applicable except as follows.

29.2 *Modification:*

Replace the second paragraph by the following:

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

29.3 *Addition:*

There are no thickness requirements for sheaths of **visibly glowing heating elements** if the **door interlocks** provide **all-pole disconnection**.

Annex BB
(normative)

Requirements for commercial microwave ovens without a cavity door and with conveyor-type means

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.

Annex BB modifies the corresponding clauses and subclauses of the main part of this standard or, where this is not applicable, of Part 1 of IEC 60335, to indicate requirements for commercial microwave ovens without a **cavity** door and with conveyor-type means. Where it is unclear whether a clause or subclause of this annex is intended to modify the corresponding text of the main part of this standard or that of Part 1, this is specified.

3 Terms and definitions

NOTE 201 For more details, see Figure BB.203.

3.1.9
normal operation

Replacement:

operation of the appliance under the following conditions:

The **microwave oven** without a **cavity** door and with conveyor-type means is operated according to the manufacturer's instructions. If no instructions are provided, the appliance is operated under the following conditions.

a) Tunnel type appliances are operated under the following conditions:
   1) if the **entrance and exit port** heights are adjustable, the largest height is used;
   2) the highest generator power settings are used.

b) The **load** to be heated up consists of *N* cylindrical containers of borosilicate glass with a maximum thickness of 3 mm and an external diameter of approximately 190 mm, filled with (1 000 ± 50) g potable water having an initial temperature of (20 ± 2) °C. These containers are placed so that all containers are inside the **cavity** and as many as possible microwave generators are operating at the same time.

   The number *N* results from the following formula:

$$N = P/1\ 100\ \text{W}$$ (*P* = **rated microwave power output** [W])

   The result of *N* shall be rounded off to the nearest integer.

   If is not possible to use these containers, containers of the same material and thickness and with a water mass of not less than 275 g ± 15 g shall be used.

   An excess number of containers are prepared, so that the whole length and width of the **transportation means** inside the **microwave enclosure** is loaded.

   The conveyor speed is set to the lowest reasonable value that will not bring the **loads** to boiling.

   Loads are taken out and are replaced with new cold **loads** on the **loading area** as they come out on the **removing area**.

c) Single special **load** vending type appliances are operated with their intended **load**. Other vending type appliances are operated under the following conditions.

1) Sealed plastic bags with potable water are used, with a water mass corresponding to the weight of typical **loads** for which the appliance is intended.

The appliance is operated for consecutive cycles, the duration of each cycle is determined by the following formula:

$$t = m \times 4{,}187 \times \Delta T/P$$

where

t is the duration of each cycle (s);

m is the mass of the water (g);

ΔT is the required temperature rise of 55 K, and

P is the **rated microwave power output** (W).

The initial temperature should be 20 °C ± 5 °C.

2) New **loads** are supplied with the shortest possible pauses between runs.

Note 201 to entry: Care should be taken when handling the **load**.

3.6.101

Replace as follows.

cavity
space within the **microwave enclosure** where the **load** is heated with high microwave energy

Note 1 to entry: Waveguides between the microwave generator and **cavity** are included since they also contain high microwave energy.

7 Marking and instructions

7.1 *Addition to the first list of items:*

– water pressure or pressure areas in kilopascals (kPa) for the appliances that are determined for the connection to the water supply, or this is fixed in the instructions for use.

Replacement of the 5th dashed item of the first list:

– model or type reference and serial number of the appliance. If the generator(s) is separate from the **cavity** part of the appliance, this information shall also appear on the generator(s);

7.12 *Add the following 3 dashed items:*

– WARNING: Do not programme excessive heating times. Overheating can result in contamination or fire.

– Details for necessary cleaning required for hygienic reasons (e.g. **cavity**, **transportation means**) and also for functional reasons (e.g. **means of microwave interlock**, sensor).

– Information necessary for dispatch, positioning, installation and operation, including details of weight, dimensions and required minimum distances.

Replace the ninth dashed item by the following:

– If smoke is observed, follow the instructions supplied by the manufacturer in order to contain the fire.

BB.7.201.1

A label shall be provided, together with instructions for fixing it in a conspicuous place close to the exit port. The label shall state the substance of the following, if applicable.

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

– WARNING: Microwaved food and beverages can be very hot, handle with care.

Compliance is checked by inspection.

BB.7.201.2 The instructions for the operator shall include the substance of the following warnings.

– WARNING: If parts of **entrance ports and exit ports**, means of access, **viewing openings**, **microwave barriers**, covers, the **microwave enclosure** or any other means named by the manufacturer are damaged, the appliance shall not be operated until it is repaired by a **skilled person**. Until repairs are carried out, the appliance shall be set in a permanent non-operational condition (e.g. with key switch, code-card or similar devices). Further details shall be included in the instructions for use.

– WARNING: Only **instructed persons** shall operate the **microwave oven**. The **instructed persons** shall regularly, but at a minimum of once a year, be instructed by a **skilled person**. A record of the instruction provided shall be recorded.

BB.7.201.3 The service or repair manual shall include the substance of the following:

– WARNING: The **microwave oven** shall comply with requirements of 32.1 after every repair and according to the instructions of the manufacturer.

Attention: Persons shall not be exposed to excessive emitted microwave energy from the microwave generator. All connections, waveguides, flanges, seals etc. of the **microwave enclosure** and **microwave barriers** shall be safely constructed so that the microwave leakage does not exceed the allowed limit. The operation of the appliance without a microwave absorbing **load** is to be avoided. The appliance shall be regularly maintained and kept in a good condition to ensure that microwave leakage does not exceed the allowed limit.

The **microwave oven** shall only be maintained by **skilled persons**.

The manufacturer shall supply detailed recommendations on the prevention of **cavity** fires together with guidance on how fires should be handled, should they occur. Guidance should also be provided on dealing with low water content foods, metal objects and containers with metal.

8 Protection against accessibility to live parts

8.1.1 *Addition:*

Test probe B of IEC 61032 is applied into openings of less than 75 mm that the probe will permit, to any depth and to a distance of 5 times the minor dimension of openings that are greater than 75 mm, up to a maximum of 850 mm. The probe is rotated or angled to all possible positions, during and after insertion.

9 Starting of motor-operated appliances

BB.9.201 Motors that drive the **transportation means** shall start under all voltage conditions that can occur in use.

*Compliance is checked by starting the motor three times at a voltage equal to 0,85 times **rated voltage**, the motor being at room temperature at the beginning of the test.*

*The motor is started each time under the conditions occurring at the beginning of **normal operation** or, for automatic appliances, at the beginning of the normal cycle of operation. The motor shall be allowed to stop between successive starts. For appliances provided with motors having other than centrifugal starting switches, the test is repeated at a voltage equal to 1,06 times **rated voltage**.*

*In all cases, the motor shall start and it shall function in such a way that safety is not affected and overload **protection devices** of the motor shall not operate.*

NOTE Prior to commencing the test, appliances with conveyor means are loaded with the heaviest **load** as specified by the manufacturer. If no instructions are provided, the conditions of 3.1.9 of normative Annex BB apply.

11 Heating

11.7 *Modification:*

The **microwave oven** is operated as specified in 3.1.9 of normative Annex BB until steady conditions are established.

15 Moisture resistance

15.1.1 *Addition:*

Microwave ovens classified as IPX0, IPX1, IPX2, IPX3 and IPX4, which are intended for placing on the floor, shall be subjected for a period of 5 min to the following splash test.

*The apparatus shown in Figure BB.201 is used for the test. During the test, the water pressure is regulated so that the water splashes up 150 mm above the bottom of the bowl. The bowl is placed on the floor for **microwave ovens** normally used on the floor. The bowl is moved around in such a way as to splash the **microwave oven** from all directions. Care shall be taken to ensure that the **microwave oven** is not hit directly by the jet.*

15.2 *Addition:*

*A quantity of 0,5 l of water containing approximately 1 % NaCl is poured steadily over the most unfavourable parts but excluding the **microwave enclosure**, over a period of 15 s.*

*The quantity of 0,5 l of water containing approximately 1 % NaCl, for each kW **rated microwave power output**, is poured steadily at a rate of 0,5 l per 15 s into the **microwave enclosure**.*

BB.15.201 **Microwave ovens** that are provided with a tap intended for filling or cleaning shall be constructed so that the water from the tap cannot come into contact with live parts.

Compliance is checked by the following test.

*The tap is fully opened for 1 min with the **microwave oven** connected to a water supply having the maximum water pressure specified by the manufacturer. Movable parts are placed in the least favourable position. Swivelling outlets on water taps are positioned so that water is directed on to those parts that will give the least favourable test result. Immediately following this treatment, the **microwave oven** shall withstand an electric strength test specified in 16.3.*

18 Endurance

Addition:

The means of access and covers shall be opened and then closed as in normal use. The number of operations is 6 cycles per 1 min or the maximum quantity that is given for the construction.

The following means of access are subjected to the following cycles of operation:

– Means of access and **cleaning covers** that can be opened by **instructed persons** for the purpose of venting, flushing lamp covers, cleaning, etc. — *10 000 cycles*

– Maintenance covers that can be opened by skilled persons — *300 cycles*

– Protective blocking structures which protect ordinary persons — *200 000 cycles*

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

NOTE It can be applicable to render some supervision and system control devices inoperable when carrying out this test.

19 Abnormal operation

19.8 *Addition:*

***Microwave ovens** intended to be star-connected are operated with the neutral conductor being disconnected. Subclause 19.13 shall be applied after the test.*

19.13

Modify as follows.

The microwave leakage shall not exceed 50 W/m^2.

19.104

Add as follows.

*The most onerous condition, i.e. stopping the belt, shall be selected. During the test, any fire in the **cavity** shall be contained within the appliance.*

Table 101 *Replacement of the Note:*

NOTE The **rated microwave power output** or the volume of the **cavity** applies, whichever results in the higher number of potatoes. The number of potatoes is increased if the oven does not start.

BB.19.201

Appliances are operated with the same **load** items as in **normal operation** but with **load** on the **transportation means** only in the **cavity**. The number of **load** items is the lowest allowing operation of at least one microwave generator at maximum power. The period of operation is the longest allowed by the belt speed setting or similar.

20 Stability and mechanical hazards

20.1 *Addition:*

Maintenance covers *on vending appliances that can be opened and accessories shall be placed in the most unfavourable position.*

20.2 *Addition after the first paragraph of Part 1:*

This is also to be applied on operating elements i.e. handles or hand wheels.

Addition:

*If fans of the **microwave oven** can be operated when the means of access is open, rotating and moving parts of motors and fans shall be located or protected in such a way as to provide adequate protection against injury, when the **microwave oven** is used or when cleaned as intended. It shall not be possible to touch the moving or rotating parts of the fans. To fulfil this requirement, it shall be possible to set the **microwave oven** in a permanent non-operational condition (e.g. with key switch, code-card or similar devices).*

Compliance is checked according to the requirements in 8.1.1 of normative Annex BB.

20.101

Add as follows.

***Transportation means** shall withstand weights according to the instructions of the manufacturer.*

Where no instructions are provided, compliance is checked by the following test.

*For appliances with a conveyor belt including **loading areas** and/or **removing areas**, the **transportation means** is stopped and a weight of 23 kg is placed on the **loading area** and **removing area**, in turn. The appliance shall not tilt and there shall be no damage to the **loading area** and **removing area**.*

*For vending-type appliances, the same test is made on the **removing area**, if possible. However, a weight of 8 kg is used.*

NOTE A sandbag can be used for the **load**. The dimensions of the weight accord to the dimensions of the **entrance and exit ports** and to the working area of the **transportation means**.

BB.20.201

Protective enclosures according to 20.2 of normative Annex BB shall not be detachable except where

– *an appropriate interlock prevents operation of motors or fans without protective enclosures;*
– *protective enclosures are a solid part of the housing of the appliance.*

Compliance is checked by inspection.

22 Construction

Modify as follows.

Subclause **22.103** to Subclause **22.115** are applicable only for **cavity** doors that are opened by the user for access to the **load**. Such doors are not a means of access.

NOTE 201 These types of doors can be found in vending machines.

22.116 *Replacement:*

This subclause is not applicable.

The following additional subclauses are applicable for these appliances.

BB.22.201 Protection against accessibility to microwave-containing regions

BB.22.201.1 General

Subclause BB.22.201 deals with **entrance and exit ports**, means of access and **viewing openings**. Only **instructed persons** may be close to these ports, means and openings, except that **ordinary persons** may be in the vicinity of **entrance and exit ports** under certain conditions. The particular requirements relating to **ordinary persons** are given in BB.22.201.4.

NOTE 1 In some countries, **instructed persons** are not allowed to have access to the **loading area**. In this case the requirements for **ordinary persons** of this standard can be applied for **instructed persons**.

The microwave leakage and leakage extraction method in 32.1 of normative Annex BB shall be used for the determination of a **reference surface**. This, together with the type of ports, means and openings and their dimensions determine the specification for **microwave barriers** of the appliance and any separate barrier installations.

NOTE 2 The **microwave barrier** requirements are given in BB.22.201.2 and Table BB.201.

NOTE 3 Requirements on warning signs are also contained in BB.22.201.6.

BB.22.201.2 Microwave enclosure opening and microwave barrier specifications

The dimensions of **viewing openings** and fixed means of access for ventilation, liquid evacuation or similar shall be less than 20 mm × 50 mm.

*A **microwave barrier** shall withstand the tests in 21.102 and 21.104. Furthermore, it should not be possible to insert test probe B of IEC 61032 through any holes in the barrier, with the exception of the accessible end opening.*

Compliance is checked by inspection.

BB.22.201.3 Additionally, the **microwave barrier** shall not be constructed of metal or microwave absorbing material in such a way that it can guide or absorb microwaves, and their accessible openings shall not be larger than the openings which they protect.

The **microwave barrier** shall be removable only with the aid of a tool.

NOTE The function of the **microwave barrier** is to act solely as a mechanical barrier.

Compliance is checked by inspection.

The dimensional and microwave leakage measurement requirements on **microwave barriers** in relation to the dimension and type of opening are given in Table BB.201. The length of the barrier is calculated from the **reference surface**, obtained by the measurements in 32.1 of normative Annex BB. The barrier shall extend all the way to the opening of the **microwave enclosure**.

Table BB.201 – Specifications for microwave barriers

Opening dimension	Allowed use	Required barrier extent	Microwave leakage measurement	Remarks
Allows Ø75 mm	Only **entrance and exit ports**	See remark	With and without 100 mm rod. 20 s time of integration	The required barrier length is 5 × the opening minor dimension, up to 850 mm
Ø75 mm to 20 mm × 50 mm	Only **entrance and exit ports**	180 mm from **reference surface**	With and without 100 mm rod. 20 s time of integration	
20 mm × 50 mm to Ø12 mm	Any purpose	80 mm from **reference surface**	With and without 100 mm rod in **entrance and exit ports** and **viewing openings**. 20 s time of integration	The 100 mm rod is not inserted into permanently open means of access
Ø12 mm to Ø3 mm	Any purpose	None	Only without rod. 20 s time of integration	Ø12 mm holes in **cavity** walls will need protection against leakage
< Ø3 mm and narrow slots in metal surfaces	Any purpose	None	Only without rod. The leakage measurement integration time is that of the instrument (2 s to 3 s) for narrow slots	See Note 3

Compliance is checked by inspection and the tests in 32.1 of normative Annex BB.

NOTE 1 A method for testing the microwave properties of the **microwave barrier** is by a heating test of a part of it in a laboratory **microwave oven**, for about 30 s at 800 W to 1 000 W power setting. Appropriate material does not become hot and in particular it does not show any hot spots.

NOTE 2 The mechanical strength test in 21.102 also applies to visually transparent protective devices over or inside **viewing openings**.

NOTE 3 At 2 450 MHz, narrow slots in the **cavity** can radiate significant microwave energy if their length approaches a half wavelength. A contacting part of the body can then be subjected to a very local but high power absorption, even when there is a small leakage measured 50 mm away. However, the heated volume is only some few mm^3 and heat conduction will limit the temperature rise to a safe level. A shorter integration time is therefore not needed. There can be no leakage from slots less than 3 mm wide in TE_{10} mode, along a wide side longitudinal centreline or in the short side in the plane of a transverse cross section.

BB.22.201.4 For conveyor type appliances, there shall be a barrier installation in all **loading areas** and **removing areas** where **ordinary persons** place or remove the **load**.

– If the **loading areas** or **removing area** for **loads** is 800 mm above floor level, the barrier shall be at least 1 200 mm high.

– If the **loading areas** or **removing area** for **loads** is 1 000 mm above floor level, the barrier shall be at least 1 400 mm high.

– The requirements for other heights shall be in proportion to the above requirements.

– The distance from any part of the **entrance and exit port** to any periphery of the barrier shall be a minimum of 850 mm from the **reference surface** defined and determined in 32.1 of normative Annex BB.

– It shall not be possible to insert test probe B of IEC 61032 through the barriers.

Compliance is checked by inspection.

NOTE 1 There can be additional barrier type devices that are removable with the aid of a tool.

NOTE 2 The mechanical stability requirements on barrier installations are under consideration.

BB.22.201.5 Vending machines with an exit port shall have either a **protective blocking structure** or a **transportation means**.

In appliances with a **protective blocking structure**, the surface of the structure shall be outside the **reference surface** described in 32.1 of normative Annex BB, when the **load** is being removed.

Appliances without a **protective blocking structure** shall comply with the requirements in 8.1.1 but in relation to the **reference surface**.

BB.22.201.6 A microwave warning sign (IEC 60417-6166 (2012-07)) of a size specified in IEC 60417 shall be placed in areas where the **entrance and exit ports** are visible through the barrier, or near the opening in the **microwave barrier** through which the **load** is transported.

The warning text shall include the substance of the following:

MICROWAVE ENERGY

DO NOT INSERT THE HAND OR FOREIGN OBJECTS

The same warning sign shall be placed at **viewing openings** with holes larger than Ø 12 mm and which are not protected by visually transparent protective devices.

27 Provision for earthing

BB.27.201 Any external interconnection cable(s) between a separate main power supply (supplies) in a separate enclosure, and the **cavity** portion in a separate enclosure or installation shall include an additional earthing wire for high voltage circuits. The insulation of the wire shall comply with the requirements for insulation for operating high voltage.

BB.27.202 Any secondary (high voltage) circuit earthing of magnetrons by a separate wire shall be connected to its waveguide in such a way that the wire does not come loose during service or repair.

28 Screws and connections

28.1 *Addition*

Screws made of carbon steel and alloy steel shall be made in accordance with ISO 898-1.

Screws made of corrosion-resistant stainless-steel shall be made in accordance with ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4.

28.4 *Addition*

Screws that make mechanical connections and electrical connections shall be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts during operational stress and contact corrosion.

Screws that make mechanical connections and provide earthing continuity shall

– be one of types specified in Table BB.202 and be made in accordance with ISO 898-1 or ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4, and
– have a minimum outer thread diameter of 2,8 mm, and
– be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts due to operational stress and contact corrosion. They shall be designed so that a minimum contact pressure remains.

Compliance is checked by inspection and by measuring the assembling torques for screwed connections providing earthing continuity by applying a torque as specified in Table BB.202 to turn the screw in the fastening direction. The screw shall not turn.

The screw shall not have been unfastened prior to performing this test.

Table BB.202 – Assembling torques for screwed connections providing earthing continuity

Outer thread diameter of the screw *mm*	***Assembling torque*** *Nm*	
	Screwed connections for the mechanical strength of the screws A2-70 according to ISO 3506-1, or ISO 3506-2, or ISO 3506-3, or ISO 3506-4 and 5.8 according to ISO 898-1	***Screwed connections for the mechanical strength of the screws > 8.8 according to ISO 898-1***
> 2,8 and ≤ 3,6	*0,8*	*1,3*
> 3,6 and ≤ 4,2	*1,9*	*3,0*
> 4,2 and ≤ 5,3	*3,7*	*6,0*
> 5,3 and ≤ 6,3	*6,5*	*10,0*
M8	*15,0*	*25,0*
M10	*31,0*	*50,0*

30 Resistance to heat and fire

30.2

Add as follows.

Microwave ovens intended to be fed automatically shall be tested according to 30.2.3.

32 Radiation, toxicity and similar hazards

32.1

Replace as follows:

Compliance for microwave leakage is checked by the following two test series.

*The **load** specified for **normal operation** is used. The appliance is supplied at **rated voltage** and is operated with the microwave power control at the highest setting.*

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. To simplify the use of the instrument, a non-interfering spacer is mounted on the sensor probe, providing a required minimum distance of 50 mm between the sensor and any part of the appliance.

*The microwave leakage reading with the sensor at any point 50 mm or more from the external surface of the appliance or any **microwave barrier** shall not exceed 50 W/m^2, averaged over the most onerous 20 s interval. The instrument reading shall not exceed 500 W/m^2.*

NOTE 201 Microwave leakage can vary with short heating times, power pulsing and progression of **loads**. Depending on the actual time constant of the instrument, readings are then taken every 2 s or 3 s during some cycles of individual **load** item transport periods.

*In a first test series, the spacer tip is moved over and away from the external surface of the appliance to locate the highest microwave leakage, particular attention being given to the openings and the **microwave barriers**. The region inside a geometric opening into the **microwave enclosure** or **microwave barrier** is not regarded as accessible for this first test series with all barriers in place.*

*A second test series is then carried out at the openings with removed **microwave barriers** (for clarification and information, see informative Annex CC) and any interlock to any of them being defeated. A metal rod with 2,5 mm diameter and 100 mm length (test probe C of IEC 61032) is used with the instrument sensor spacer for this test, as shown in Figure BB.202. The appliance is operated under **normal operation**.*

*During the operation, the free rod end is moved in any position near or up to maximum 50 mm depth inside the surface of the geometric openings specified in Table BB.201. The position of the sensor is not to be any closer than 50 mm to any part of the external surface of the appliance, and to the surface of the geometric opening of the **microwave enclosure**.*

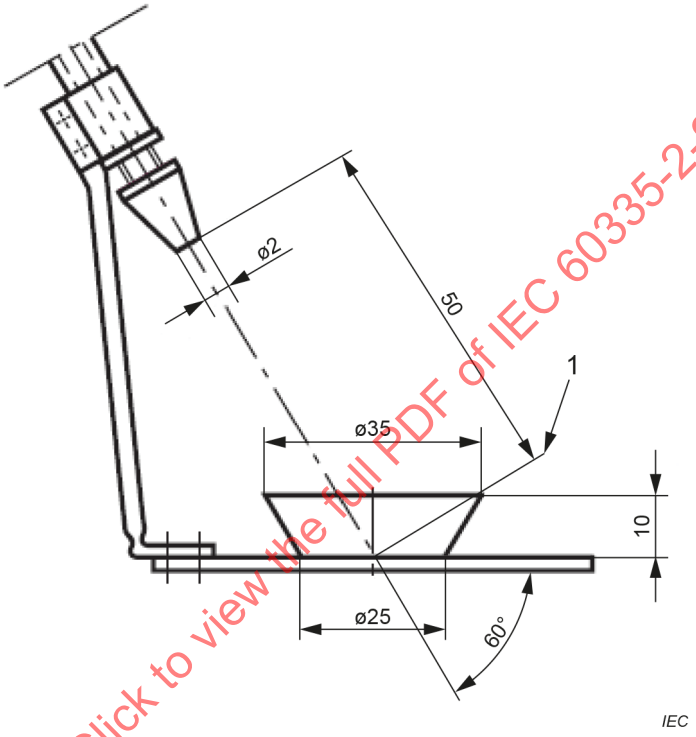
For small openings less than 75 mm in diameter, two additional sensor spacer tip and rod locations are to be used: as shown in Figure BB.202 but with the spacer tip and its rod end now placed at the opening; and with the rod centre mounted at the sensor spacer tip and a rod end at the opening.

*If the leakage reading is less than 50 W/m^2, the **reference surface** is at the surface of the geometric opening of the **microwave enclosure** without **microwave barrier**. If the leakage reading exceeds 50 W/m^2 under these conditions, the locations of the sensor (not spacer tip) further away from the **microwave enclosure** where this value is measured, are recorded. The position of the **reference surface** away from the surface of the appliance is then determined as 50 mm straight inwards from this sensor position and towards the surface of the appliance.*

NOTE 202 If the **microwave barrier** is mounted inside a part of the external cover of the appliance, it will be removed for the purpose of the second test series.

NOTE 203 The proper length of the wire is different for operating microwave frequencies other than 2 450 MHz.

Dimensions in millimetres

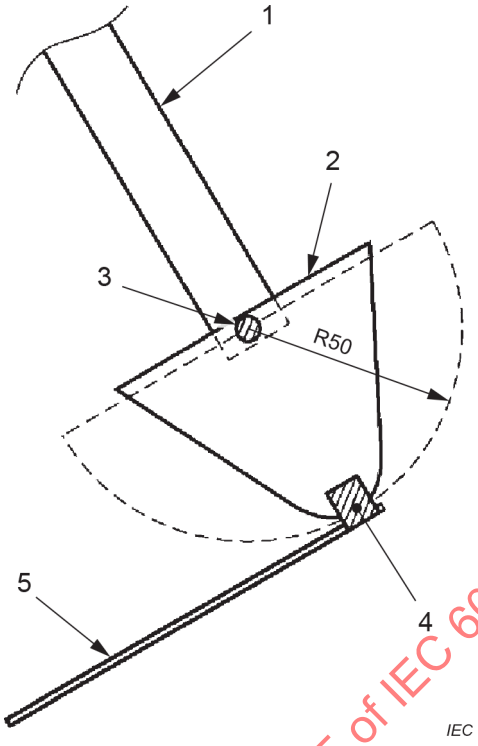


Key

1 bowl

Figure BB.201 – Splash apparatus

Dimensions in millimetres



Key

1 probe handle

2 probe spacer

3 field sensor

4 tape

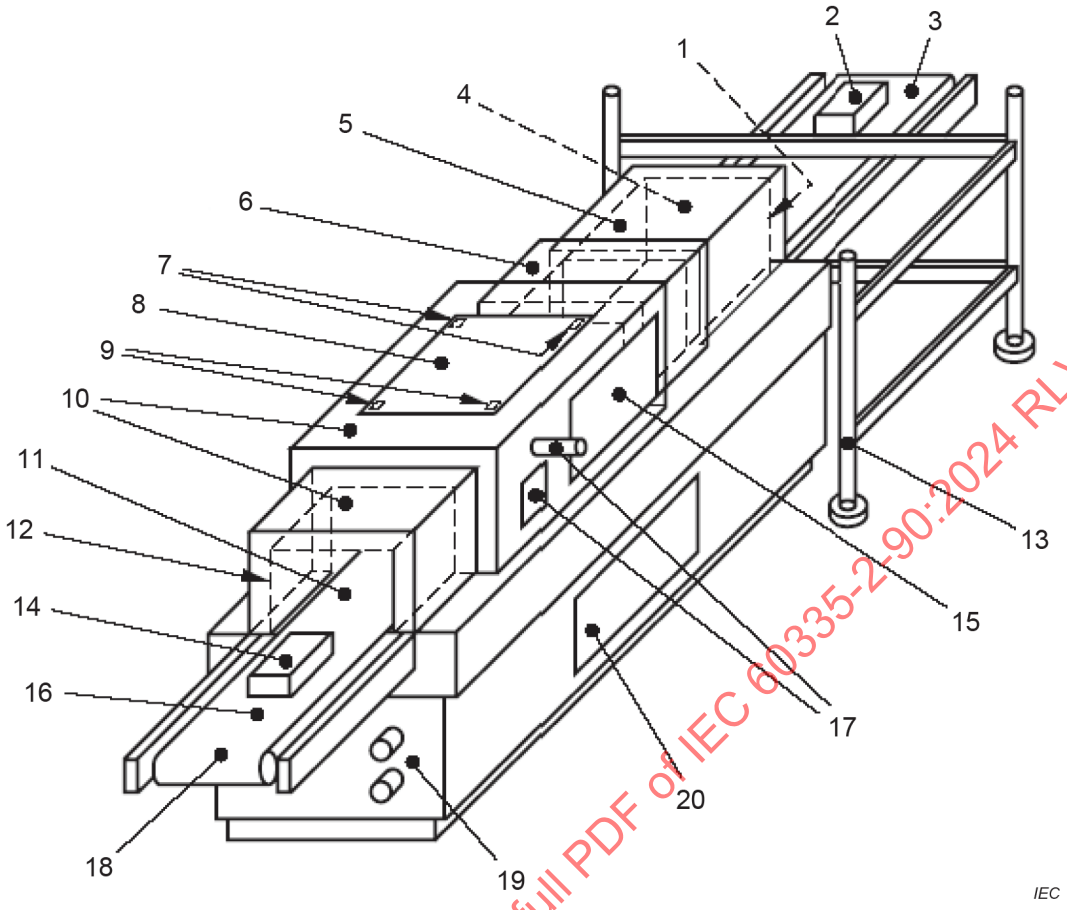
5 metal rod

A hollow metal tube may be used instead of a solid rod. Its outer dimensions are *l* = (100 ± 1) mm, Ø = (2,5 ± 0,15) mm. The metal shall be non-magnetic; aluminium or brass is recommended.

The rod may be fixed to the probe spacer with a thin microwave transparent tape so that the field sensor is located approximately 90° out from the end of the rod. Only when there is not enough space in the vicinity of the access opening is the sensor to be more aligned with the rod. The distance from the rod and any other part of the appliance, including the surface of the access opening to the field sensor, shall not be less than 50 mm.

The rod should not be in contact with metal parts, since it is to act as an antenna and spurious readings could then be obtained.

Figure BB.202 – Arrangement for measurement of microwave leakage from access openings



Key

1	reference surface	11	entrance port
2	load	12	reference surface
3	removing area	13	protective blocking structure
4	exit port	14	load
5	microwave barrier	15	cleaning cover
6	microwave enclosure	16	loading area
7	means of microwave interlock	17	viewing opening
8	detachable means of access	18	transportation means
9	means of monitored microwave interlock	19	fixed means of connection
10	microwave enclosure	20	maintenance cover

Note to key 8: Detachable means of access are all parts of the microwave enclosure that can be opened or removed without the aid of tools to get access to the inside for maintenance, with the exception of entrance and exit ports and viewing openings. Examples are tunnels that are opened by drop down or sliding action and cavity lamp covers.

Figure BB.203 – Examples of definitions of Clause 3

Annex CC
(informative)

Overview of the requirements for covers, means of access and similar

Table CC.1 gives an overview of the requirements for covers, means of access and similar.

Table CC.1 – Overview of the requirements for covers, means of access and similar

Access means	Operated by	Use of tools	Cycles/ Endurance	Interlocks	Monitored interlocks	Warning signs	Instructions	Mechanical	Purpose
Fixed means of access	**Instructed persons**	No	---	No	No	No	Yes	Steel ball test – Clause 21– with barrier removed	Venting, flushing lamp covers [a]
Means of access that can be opened	**Instructed persons**	No	10 000	Yes 2 interlocks [b]	Yes 1	No	No	Steel ball test – Clause 21 – with barrier removed	Venting, flushing lamp covers, cleaning
Cleaning cover (see 3.6.119)	**Instructed persons**	Yes	10 000	Yes 1 interlock [c]	No	Yes	Yes	Steel ball test – Clause 21 when open	**Load** correction, inspection, cleaning
Maintenance cover (see 3.6.118)	**Skilled persons**	Yes	300	No	No	Yes [d]	Yes	Steel ball test – Clause 21 when open	Lamp covers
Vending machines – Protective blocking structure (see 3.6.112)	**Ordinary persons**	No	200 000	No	No	No	No	Steel ball test – Clause 21 when open and closed	To prevent user access to the **microwave enclosure**[e]

[a] Opening of tunnel by drop down or sliding action.

[b] It should fulfil requirements in Clause 19.

[c] The interlocks shall be located in an area that is free from contamination and the cover shall be self-aligned.

[d] Appliance shall shut down, only for service, microwaves behind.

[e] These requirements do not apply if the appliance has a **cavity** door.

Annex DD
(informative)

Rationales for the microwave barrier and associated leakage tests

DD.1 The standard measurement of microwave oven leakage

There are several commercial instruments on the market. Those that perform sufficiently well for the purpose have a small, reasonably isotropic (omnidirectional) sensor at the end of a plastic rod. The sensor reacts to the electric field only. There is also a non-disturbing sensor spacer, which is used to determine a 50 mm minimum distance between the sensor and any part of the appliance as specified in the standard. Testing of instruments includes calibration in the far field (the inaccuracy is allowed to be about ±20 %), and one or two tests intended to show that the sensor is "electrically small" so that it does not itself cause interference (standing waves) to objects nearby.

The scale on microwave leakage instruments is not in the same units as what is actually measured (V/m) but instead in W/m^2 (or mW/cm^2). The conversion is correct only in the free space plane wave case, where the wave impedance is 377 Ω and there is unidirectional propagation. Since a standing wave is the sum of two waves propagating in different directions, and the probe is not direction sensitive, the field impedance then becomes smaller or larger than 377 Ω, so that the instrument reading becomes erroneous. Erroneous readings are also obtained in strongly curved near fields and with the probe in a waveguide or similar where there is a single or multiple mode (having a different impedance).

The minimum 50 mm distance between the instrument sensor and any accessible part of the appliance was specified more than 35 years ago when the first **microwave oven** leakage standard was created. The major reasons were that it was found desirable to use the same type of instruments that were used for far-field exposure measurements.

It was concluded that an electric field sensor instrument would not indicate a proper value for determining the outgoing power flux density if the probe was located:

a) where the field curvature was very significant (in comparison with the wavelength);

b) in the presence of any standing waves near the sensor.

A reasonable compromise with the need to measure emission (i.e. in the source region, so that the "leaking spot" could be found) was found to be 50 mm for the 2 450 MHz ISM band. Even if it was noted in the instrument literature at the time that the same 50 mm distance would be less appropriate for the lower ISM band at 915 MHz, the matter was not considered so problematic that the specification was modified.

The historical reason for the choice of the maximum allowed level of 50 W/m^2 (=5 mW/cm^2) was a result of an existing regulation on free space power flux density of up to 100 W/m^2 being acceptable in commercial and industrial environments, plus considerations of a possibility of two or more **microwave ovens** being located close to each other. Later, when household **microwave ovens** came on the market, the nature of door leakage was found to typically be from only some few leaking spots, so that the power flux density decreased almost quadratic with the distance away from these. There was no reason why the user would remain very near the closed door of an operating oven. Widely publicised investigations showed that the actual exposure of any part of the human body became very low, particularly in consideration of a reasonable averaging time of 5 min to 10 min for hazard assessment. As a result, the 50 W/m^2 limit was applied also to household **microwave ovens**.

In the beginning of the 1970's, the US authorities responsible for radiation safety found some quality problems with some **microwave oven** models and introduced a 10 W/m^2 "factory limit" for new unused ovens, in order to dampen any public concerns. Only one or two other countries followed.

In the meantime, the oven safety standard was successively developed and the value 50 W/m^2 became the worldwide limit after all tests. However, in empty operation and after a potentially destructive door test, 100 W/m^2 was instead required. The rationales for the higher value under no-**load** conditions were reported difficulties by some manufacturers, and the conclusion that no-**load** operation would typically be even more short-term and an also uncommon fault condition.

In the 1980's, leakage measurements at covers for lamp replacement were dealt with by IEC SC 61B. The hole array in the **cavity** wall, at the lamp, can leak microwaves. The size of the cover may be such that the 50 mm distance to the nearest appliance part can be maintained also with the sensor almost inside the external housing from which the cover has been removed. A case had been reported where the instrument reading was quite high in this condition, but there was a very low reading with the whole housing removed. The reason for the high reading was that a standing wave inside the housing had been created. There was an electric field but no real leakage since the standing wave is the sum of an outwards- and inwards-going wave and may have no net power flux. In addition, if a finger were put into the opening, the standing wave would disappear and only the real leakage becomes the possible hazard. SC 61B added a statement to the standard to the effect that the instrument sensor should not be closer to the opening plane than 50 mm, i.e. the region inside the cover should not be considered accessible with regard to the leakage measurement. The same principle is adhered to in this standard, but the actual leakage situation is now really assessed, by the extended test in 32.1.

DD.2 Microwave hazards – the basic restriction

Microwave exposure is considered to be potentially hazardous if the heating of parts of the human body exceeds certain values. These are specified as SAR values (specific absorption rate) and are expressed in W/kg tissue. The lowest SAR value of whole-body exposure where there may be some risks has been found to be 4 W/kg. A safety factor of 10 is subsequently applied for microwave workers (**instructed persons**), and a further safety factor of 5 for the general public (**ordinary persons**), resulting in the basic restriction of 0,4 W/kg and 0,08 W/kg in the two cases. Local, non-hazardous exposure limited to the head and trunk may be up to 10 W/kg and 2 W/kg, respectively. Twice this (20 W/kg and 4 W/kg) are considered non-hazardous locally in the extremities (including hands and fingers). The integration volumes are then over any 10 g body mass, and the time integration is over 6 min.

DD.3 Microwave hazard evaluation – the free space exposure method

For all practical exposure situations (except from communication devices such as mobile phones for which a total source maximum power concept may apply), two simplified verification methods are used in industry and for protection of microwave workers and the general public, a maximum allowed far-field power flux density far away from the source, and an emission standard for appliances such as **microwave ovens**.

The issue is now if the relaxation of SAR values for parts of the body, in combination with the integration volume, is compatible with the free space exposure method.

When parts of the human body having a small radius of curvature are heated, diffraction, resonant and other focusing or amplification phenomena may occur. In the case of 2 450 MHz, the internal wavelengths in tissues as well as the penetration depth limitation result in only fingers being of major interest. In principle, also bent knuckles and elbows could create focusing effects, but fingers are definitely much more problematic with regard to the effects discussed here. It is not assumed that other protruding parts of the body such as the nose, ears or penis are brought very close to microwave leakage sources in commercial or household heating equipment.

The following modelling results indicate the degree of compatibility between the basic restriction and the free space exposure method:

Numerical modelling using commercially available electromagnetic software was used. A finger with 13 mm diameter and typical dielectric data (homogeneous, with ε = 40 – *j*10, where the loss factor (10) is lowered in consideration of bone and tendons) was exposed to 10 W/m^2 in free space. The strongest absorption occurred for TM*z* polarisation (i.e. with the impinging electric field parallel to the finger axis) and the mode in the finger then becomes of the TMz_1 type, having two opposite axial zones of maximum heating intensity. The maximum power intensity becomes 5 W/dm^3 and the average over the worst 10 cm^3 becomes about 1,8 W/dm^3.

If the finger were exposed to a plane wave with a power flux density of 50 W/m^2, which is allowed from **microwave ovens**, etc., the maximum value would become 25 W/dm^3 and the 10 cm^3 integrated value would become 9 W/dm^3.

The conclusions are that:

– The **ordinary person** basic restriction is exceeded. However, **ordinary persons** are with today's standards only exposed to **microwave ovens** with a door, where the leakage source is so small that the high intensity is over a significantly smaller volume of the finger. Additionally, there is no reason to keep the hand near the closed door of an operating microwave oven. There are numerous reports from experimental investigations in the 70's, which clearly indicate the averaged exposure level over several minutes is 10 to 100 times lower than 10 W/m^2. Therefore, the actual absorption is within the SAR limit.

– The **instructed person** basic restriction is about the same as the actual SAR value. However, the actual situation with an operator occupied with **load** removal at the port of a continuously operating tunnel **microwave oven** for long periods is more onerous than with a **microwave oven** with a door, but the working hand can typically not be near the opening more than about half the time. An additional aggravating factor is that the tunnel opening is larger than an oven door as a leakage source, so that the region with a high microwave energy density may extend further out than from an oven door. Therefore, the construction of the tunnel end regions as well as the measurement method shall ensure that SAR values in the human finger exceeding those under 50 W/m^2 far field exposure are not exceeded.

– The operating conditions of the tunnel oven shall be such that any higher average leakage levels do not occur. However, parts of a tunnel **microwave oven** can be operated empty with the operator still removing **loads**. Therefore, the 100 W/m^2 value for an operating empty oven with a door should not be applicable for tunnel ovens.

DD.4 Microwave hazards from openings in cavities, and from tunnel ends

The actually absorbed microwave power in a part of the human body is always very dependent on the field configuration, and the field configuration at the body part is also strongly modified by the part itself. This means that even knowledge about the true power flux density or the electric field intensity cannot be used to assess the actual microwave absorption rate. It becomes necessary to establish a more complete scenario before any calculations of the absorption can be made. Hence, the leakage intensity measured as a quasi-plane free space wave at 50 mm or more away from the source will now not alone determine the level of hazard. The actual hazard also depends on:

– any possibility of access into a region where there is microwave energy;

– the size of the opening, which may determine the type of field characteristics, or allow several kinds of microwave field characteristics;

– any objects, including a **load** to be heated or a part of the body in the opening, which may also determine the type of field characteristics.

The access situation is of course crucial and shall be standardized in some ways so that reasonably simple and objective procedures and requirements can be established. Since only the arm, hand and finger are considered to be the parts of the body that may get in contact with or be inserted into openings in these appliances, two important issues can be directly quantified: 1) all geometric factors (by test probe B, etc.), and 2) as addressed above, these parts of the body are less sensitive than for example the head.

An important principle is that a "hazard boundary" (called **reference surface** in this standard) is defined somewhere in the vicinity of the physical opening surface and that a leakage instrument reading of 50 W/m^2 is to apply for the tests. This means that what remains is to construct tests which will ensure, with reasonable certainty, that actual power densities (in W/m^3, or SAR values in W/kg) in human fingers, hand or arm "contacting" the **reference surface** will not exceed those caused by a "normal" leakage source such as a **microwave oven** door region giving a power flux density reading of 50 W/m^2 at 50 mm distance from any part of the appliance.

The field configuration then becomes the issue, i.e. how to obtain realistic measurement results with the same type of instruments as used for **microwave ovens** with a door. Clearly, there is a need for simplification and standardization using some typical scenarios. The most important matter is then to consider cases where access would be more severe than in the normal door leakage case. These "onerous" cases are:

– The field configuration is such that there is a very high intensity in a region, and the intensity diminishes very quickly with increasing distance, so that no reading may be obtained but there may still be a quite hazardous microwave energy density 50 mm or less from the instrument sensor. Structures creating non-radiating near fields or strongly evanescent modes have this effect.

– The field configuration is such that a microwave power flux is bound to a dielectric object. A **load** that is heated and is conveyed out of a tunnel oven is the most typical example, and a bound surface wave may then exist, and "transport" a quite large microwave power away from the opening. This may then be manifested as a measurable leakage 500 mm or more away from the opening, whilst no leakage can be measured (using the 50 mm sensor distance) at the opening. A problem with this type of wave is of course that it shall be assumed that the operator hand actually contacts the **loads** and then becomes a part of the scenario. Another problem with this kind of wave is that any measured leakage may become spurious and confusing, since it cannot be discovered in the region where it emanates.

Cases where a non-hazardous condition exists but a high instrument reading is obtained are also undesirable. The lamp cover case addressed above is of this kind.

In this standard, a method of leakage extraction and non-shielding **microwave barriers** is used. One end of the metal rod may act as a receiving antenna and since the end can be located very close to parts of the oven and **load**, it will also pick up near fields, evanescent modes and surface waves when suitably oriented. A "spatial averaging" of the externally available microwave energy also results, since the instrument sensor is still not closer than 50 mm to any other object.

The tip of the rod may be inserted up to 50 mm into **entrance and exit ports**. This may be considered onerous, but is for discouraging constructions with certain operator-accessible "curtains" intended to reduce leakage, and due to the particular need to compensate for the imperfections of the simple measurement method in view of the wide variety of objects in and geometries of the ports, and possible prolonged operator presence at these ports.

DD.5 The time averaging

There are only two-time integration specifications in the existing international standards:

a) 6 min for whole-body exposure (probably including fingers), and

b) criteria for duty cycles in cases of very short pulses such as from radar transmitters. Additionally, in some national legislation there is a ceiling value of exposure on non-ionising radiation. A ceiling value of e.g. 250 W/m^2 and a 10 W/m^2 average may be interpreted as maximum 300/25 = 12 s isolated strong exposure being allowed during any 6 min interval with no exposure during the remaining 5 min 48 s of the interval.

The 6 min integration time is quite compatible with typical cases of irradiation of parts of the body having a radius of curvature larger than about one free space wavelength of 2 450 MHz microwaves. In such cases, essentially a plane damped wave propagation can be assumed, as well as a depth of 30 mm to 40 mm in the tissue over which equilibration by heat conduction takes place. Using the heat conductivity data and the Fourier heat conduction equation then results in a time constant (i.e. about 63 % of the stationary conditions have occurred) of about 5 min. A useful comparison is with boiling of an egg in 100 °C water. It takes about 5 min for the centre to reach a temperature of about 65 °C.

The most onerous heating pattern in a Ø 13 mm finger under plane wave 2 450 MHz irradiation is uneven, with about 5 mm distance between the hot and cold areas. It can be shown that the overall microwave coupling is strongest for about Ø16 mm finger diameter. The corresponding distance between hot and cold areas then becomes 7 mm or less.

The Fourier heat conduction equation is spatially quadratic. Using the boiling of a Ø40 mm egg in 5 min having a distance between the cold and hot regions of 20 mm as a basis, a 7 mm distance would be similarly equilibrated in (7/20)^2 of (5×60) s, i.e. about 35 s integration time is adequate.

There is, however, another factor to also consider. Even a very localised heating rate should not be so high that there will be any risk of pain or injury during the time of integration. A suitable acceptable local temperature rise may be set to 5 K, in consideration of both that the skin area with heat-sensing nerves will be heated at least by conduction and that such a temperature rise under short term conditions will not cause any injury in the fingers. A normal person will feel and react to a temperature increase of the same order or less, about 3 K, within a few seconds.

A homogeneous SAR value of 20 W/kg (the basic restriction for **instructed person** fingers) will result in a temperature rise rate of about 0,5 K/min.

Now supposing that only e.g. the tip of a finger absorbs all power and the remainder of the 10 g absorbs no power. Such scenarios are actually not uncommon and may occur e.g. with the finger contacting damaged **microwave oven** seals and in some near field cases. The volume of that part of the tip that absorbs microwaves is now set to 0,5 cm^3 (which is the volume of a hemisphere with Ø12 mm). Using this in relation to the 10 cm^3 of the basic restriction, one obtains a 20 times faster "allowed" temperature rise rate of 10 K/min. This will also mean that the person will feel the heating of the finger within 20 s. Since the equilibration by heat conduction has about the same time constant as above, one again arrives at about 30 s suitable integration time.

There is an extreme case of the tip of the finger touching a leaking narrow slot in a metal surface. The local SAR value becomes very dependent on the dryness of the skin. As an example, a Ø13 mm finger tip with 1 mm dry skin is pressed against the centre of a 2 mm wide and 100 mm long slot. This has a leakage that would be measured to 50 W/m^2 at 50 mm distance (i.e. the electric field strength is 137 V/m) with no finger. The local SAR value then becomes about 30 W/dm^3, over a 4 mm wide and 1,5 mm deep volume. This local value is in itself approximately within the basic restriction. If the finger is wet and the skin is thin, the local SAR value may be up to 50 times larger but the two small heated volumes contacting the slot sides are then only about 1 mm wide and deep. The thermal equilibration distance is now over only 2 mm, so the heat conduction has now a time constant of $(2/20)^2 \times (5 \times 60)$ s = 3 s. The local, thermally insulated heating rate could be up to 40 K/min. However, heat conduction would result in a stationary temperature rise of less than about 3 K, which is also acceptable. Hence, there is no need to have a shorter integration time than about 30 s even in this most onerous case of high local SAR values in microwave **cavity** oven situations.

DD.6 Conclusions and modifications of the standards for ovens with a cavity door

The 6 min time of integration specified in existing international standards is inadequate for the purposes now under investigation. A more realistic value should be 30 s. There may be cases of open-ended microwave applicators intended for heating of a contacting **load**. Such applicators may cause almost instantaneous injury if contacted by any part of the body when in operation, and other provisions for safety shall be applied.

The existing emission standard for **microwave ovens** specifies an integration time of about 2 s for the measurement. This is for historical and practical rather than safety reasons. A typical household **microwave oven** has either a ceiling stirrer or a turntable, and with the specified circularly cylindrical test **load**, the leakage variation periodicity will be comparable to or less than the specified integration time. Measurements are then correct and made easily and quickly with the present standard.

Since the door-less appliances considered in informative Annex DD may behave quite differently and there is no reason to introduce limitations on construction that have no relevance to safety considerations, 20 s time of integration for leakage measurements shall be applied. This is shorter than 30 s, but also allows for faster measurements and easier integration. The most onerous 20 s interval shall be chosen and the instrument integration time of 2 s to 3 s shall be maintained.

For reasons given here, the allowed leakage level shall not be 100 W/m^2 in empty operation, as for **microwave ovens** with a door. The regular value of 50 W/m^2 shall apply.

In addition, a maximum measured (integrated, ceiling) value of 500 W/m^2, consistent with the instrument integration time of 2 s to 3 s, is introduced to simplify instrument specifications and handling as well as the numerical integration in cases of highly variable leakage. Such strong variability may occur for example in appliances with a protective device consisting of a built-in leakage monitor coupled to a cut-out.

Annex EE
(normative)

Microwave ovens intended to be used on board ships

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.

Annex EE modifies the corresponding clauses and subclauses of the main part of this standard or, where this is not applicable, of Part 1 of IEC 60335, to indicate requirements for commercial **microwave ovens** intended to be used on board ships. Where it is unclear whether a clause or subclause of this annex is intended to modify the corresponding text of the main part of this standard or that of Part 1, this is specified.

6 Classification

6.2 *Addition:*

Appliances for **open deck** use shall be IPX6.

7 Marking and instructions

7.1 *Modification:*

Replace the second dashed item of the first list by the following:

– **rated frequency** or **rated frequency range** in Hz;

7.12 *Addition:*

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

– usage on board ships;
– installation place (**open deck** protective enclosure, **dayrooms**);
– fastening means.

*The instructions for **microwave ovens** that are intended to be used on board ships shall state:*

CAUTION: Verify that the voltage and frequency of the mains supply of the ship matches the **rated voltage** and **rated frequency** or **rated frequency range** of the **microwave oven**.

Replace the eleventh dashed item by the following:

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

11 Heating

11.5 *Addition:*

***Microwave ovens** marked with a **rated frequency** are tested with the most onerous frequency within ± 4 % of the **rated frequency**.*

***Microwave ovens** marked with a **rated frequency range** are tested with the most onerous frequency within this range.*

22 Construction

EE.22.201 Appliances shall withstand the pulses to which they can be subjected.

Compliance is checked by carrying out the half-sine pulse tests specified in IEC 60068-2-27 under the following conditions.

The appliance is fastened in its normal position of use to a shock-testing machine by means of straps around the enclosure.

The type of pulse is a half-sine pulse and the severity is as follows:

- *application of the half-sine pulse is in all 3 axes;*
- *peak acceleration: 250 m/s^2;*
- *duration of each half-sine pulse: 6 ms;*
- *number of half-sine pulses in each direction: 1 000 ± 10.*

The appliance shall show no damage that could impair compliance with 8.1, 16.3, Clause 29 and 32.1, and connections shall not have worked loose.

EE.22.202 Appliances shall withstand the vibrations to which they 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 upon a vibration table by means of straps around the enclosure. The type of vibration is sinusoidal and the severity is as follows:

- *direction of vibration is vertical and horizontal;*
- *amplitude of vibration: 0,35 mm;*
- *sweep frequency range: 10 Hz to 150 Hz;*
- *duration of the test: 30 min.*

The appliance shall show no damage that could impair compliance with 8.1, 16.3, Clause 29 and 32.1 and connections shall not have worked loose.

EE.22.203 **Shelves** shall have a **non-detachable** slip resistant top surface.

Compliance is checked by inspection and the following test.

*The top surface of the **shelf** is coated with cooking oil. The appliance is placed with the door forwards on and fixed to a surface which can be tilted downwards to the right in one direction by 12°. An empty dinner plate as described in IEC 60436:2015/AMD1:2020, Item A.1 of Table A.1 is used for the test and placed centrally on the **shelf**. The oven is then slowly tilted.*

*In a second test and for **microwave ovens** with rotatable **shelves**, the **shelf** is rotated by 90°, the plate is again placed centrally and the **microwave oven** is then slowly tilted. For **microwave ovens** with **non-detachable shelves**, the **microwave oven** is rotated by 90°, the plate is again placed centrally and the **microwave oven** is then slowly tilted.*

*During each of these tests, the plate shall not slide onto a raised **shelf** periphery if any, or onto the **cavity** wall.*

NOTE During the tests, the oven is not energised and it is possible that the **cavity** door is open.

28 Screws and connections

28.1 *Addition:*

Screws made of carbon steel and alloy steel shall be made in accordance with ISO 898-1.

Screws made of corrosion-resistant stainless-steel shall be made in accordance with ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4.

28.4 *Addition:*

Screws that make mechanical connections and electrical connections shall be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts during operational stress and contact corrosion.

Screws that make mechanical connections and provide earthing continuity shall

– be one of the types specified in Table EE.201 and be made in accordance with ISO 898-1 or ISO 3506-1 or ISO 3506-2 or ISO 3506-3 or ISO 3506-4, and
– have a minimum outer thread diameter of 2,8 mm, and
– be so designed that the contact pressure does not change appreciably through loosening of the screwed assembly parts due to operational stress and contact corrosion. They shall be designed so that a minimum contact pressure remains.

Compliance is checked by inspection and by measuring the assembling torques for screwed connections providing earthing continuity by applying a torque as specified in Table EE.201 to turn the screw in the fastening direction. The screw shall not turn.

The screw shall not have been unfastened prior to performing this test.

Table EE.201 – Assembling torques for screwed connections providing earthing continuity

Outer thread diameter of the screw *mm*	***Assembling torque*** *Nm*	
	Screwed connections for the mechanical strength of the screws A2-70 according to ISO 3506-1, or ISO 3506-2, or ISO 3506-3, or ISO 3506-4 and 5.8 according to ISO 898-1	***Screwed connections for the mechanical strength of the screws > 8.8 according to ISO 898-1***
> 2,8 and ≤ 3,6	*0,8*	*1,3*
> 3,6 and ≤ 4,2	*1,9*	*3,0*
> 4,2 and ≤ 5,3	*3,7*	*6,0*
> 5,3 and ≤ 6,3	*6,5*	*10,0*
M8	*15,0*	*25,0*
M10	*31,0*	*50,0*

31 Resistance to rusting

Replace as follows:

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is checked by the salt mist test Kb of IEC 60068-2-52:

– *for **open deck** use, severity 1 is applicable;*
– *for **dayrooms** use, severity 2 is applicable.*

Before the test, coatings are scratched by means 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 mm ± 0,02 mm. The pin is loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches are made by drawing the pin along the surface of the coating at the speed of approximately 20 mm/s. Five scratches are made at least 5 mm apart and at least 5 mm from the edges.

After the test, the appliance shall not have deteriorated to such an extent that compliance with this standard, in particular with Clauses 8 and 27, is impaired. The coating shall not be broken and shall not have detached from the metal surface.

Bibliography

The Bibliography of Part 1 is applicable except as follows.

Addition:

IEC 60335-2-25, *Household and similar electrical appliances – Safety – Part 2-25: Particular requirements for microwave ovens, including combination microwave ovens*

IEC 60519-6, *Safety in installations for electroheating and electromagnetic processing − Part 6: Particular requirements for high frequency dielectric and microwave heating and processing equipment*

IEC 60601 (all parts), *Medical electrical equipment*

IEC 60989:1991 [2], *Separating transformers, autotransformers, variable transformers and reactors*

IEC 61270-1, *Capacitors for microwave ovens – Part 1: General*

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2 Withdrawn.

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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APPAREILS ÉLECTRODOMESTIQUES ET ANALOGUES – SÉCURITÉ –

Partie 2-90: Exigences particulières pour les fours à micro-ondes à usage commercial

AVANT-PROPOS

1) La Commission Électrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'IEC attire l'attention sur le fait que la mise en application du présent document peut entraîner l'utilisation d'un ou de plusieurs brevets. L'IEC ne prend pas position quant à la preuve, à la validité et à l'applicabilité de tout droit de brevet revendiqué à cet égard. À la date de publication du présent document, l'IEC n'avait pas reçu notification qu'un ou plusieurs brevets pouvaient être nécessaires à sa mise en application. Toutefois, il y a lieu d'avertir les responsables de la mise en application du présent document que des informations plus récentes sont susceptibles de figurer dans la base de données de brevets, disponible à l'adresse https://patents.iec.ch. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets.

L'IEC 60335-2-90 a été établie par le sous-comité 61B: Sécurité des fours à micro-ondes à usage domestique et commercial, du comité d'études 61 de l'IEC: Sécurité des appareils électrodomestiques et analogues. Il s'agit d'une Norme internationale.

Cette cinquième édition annule et remplace la quatrième édition parue en 2015, y compris son Amendement 1:2019. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) les appareils utilisés dans une zone ouverte au public ont été ajoutés à l'Article 1, en 3.8.107, en 7.12, en 8.1.1, en 11.8, en 20.2, en 22.103.2, en 22.105 et en 22.117;

b) les 5.5, 7.12.1, 11.2, 11.7, 20.1 et 20.101 ont été modifiés afin de couvrir l'installation des appareils par empilage;

c) les 7.1, 11.7 et 22.61 ont été modifiés pour les socles femelles de connecteurs et les socles de prises de courant;

d) le 7.12 a été amélioré pour plus de clarté;

e) des valeurs d'échauffement maximales ont été ajoutées pour les surfaces accessibles extérieures en 11.8;

f) le critère d'essai a été modifié en 15.101;

g) le 16.101 a été modifié pour déplacer le contenu du 16.101.1, du 16.101.2 directement sous le 16.101;

h) le 19.11.2, le 19.13, l'Article 21, le 22.105, le 22.111 et l'Annexe AA ont été améliorés pour plus de clarté;

i) l'Annexe BB et l'Annexe EE ont été modifiées afin d'ajouter les exigences relatives aux vis.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
61B/702/FDIS	61B/706/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La version française de la norme n'a pas été soumise au vote.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 60335, publiées sous le titre général: *Appareils électrodomestiques et analogues – Sécurité*, se trouve sur le site web de l'IEC.

La présente partie 2 doit être utilisée conjointement avec la dernière édition de l'IEC 60335-1 et ses amendements sauf si cette édition l'exclut. Dans ce cas, la dernière édition qui n'exclut pas la présente partie 2 est utilisée. Elle a été établie sur la base de la sixième édition (2020) de cette norme.

NOTE 1 L'expression "la Partie 1" utilisée dans la présente norme fait référence à l'IEC 60335-1.

La présente partie 2 complète ou modifie les articles correspondants de l'IEC 60335-1, de façon à transformer cette publication en norme IEC: Exigences particulières pour les fours à micro-ondes à usage commercial.

Lorsqu'un paragraphe particulier de la Partie 1 n'est pas mentionné dans cette partie 2, ce paragraphe s'applique pour autant que cela soit raisonnable. Lorsque la présente norme mentionne "addition", "modification" ou "remplacement", le texte correspondant de la Partie 1 doit être adapté en conséquence.

NOTE 2 Le système de numérotation suivant est utilisé:

– les paragraphes, tableaux et figures qui s'ajoutent à ceux de la Partie 1 sont numérotés à partir de 101;

– à l'exception de celles qui sont dans un nouveau paragraphe ou de celles qui concernent des notes de la Partie 1, les notes sont numérotées à partir de 101, y compris celles des articles ou paragraphes qui sont remplacés;

– les annexes qui sont ajoutées sont désignées AA, BB, etc.

NOTE 3 Les caractères d'imprimerie suivants sont utilisés:

– exigences: caractères romains;

– *modalités d'essais: caractères italiques*;

– notes: petits caractères romains.

Les termes en **gras** dans le texte sont définis à l'Article 3. Lorsqu'une définition concerne un adjectif, l'adjectif et le nom associé figurent également en gras.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

NOTE 4 L'attention des Comités nationaux est attirée sur le fait que les fabricants d'appareils et les organismes d'essai peuvent avoir besoin d'une période transitoire après la publication d'une nouvelle publication IEC, ou d'une publication amendée ou révisée, pour fabriquer des produits conformes aux nouvelles exigences et pour adapter leurs équipements aux nouveaux essais ou aux essais révisés.

Le comité recommande que le contenu de cette publication soit adopté pour application nationale (obligatoire) au plus tôt 12 mois et au plus tard 36 mois après la date de publication.

Les différences suivantes existent dans les pays indiqués ci-après.

– 5.3: Les fuites micro-ondes ne doivent pas dépasser 10 W/m2 pendant l'essai initial (Japon, États-Unis et Canada).

– 6.1: Les fours à micro-ondes peuvent être de classe 0I si leur tension assignée ne dépasse pas 150 V (Japon).

– 7.12: Certaines mises en garde doivent être marquées sur l'appareil et être visibles pour l'utilisateur (Canada).

– Article 18: L'essai est réalisé sur deux appareils (États-Unis).

– 19.11.2: La variation de tension absorbée n'est pas appliquée (États-Unis).

– 19.13: Les fuites micro-ondes sont mesurées seulement à l'issue de chaque essai (États-Unis).

– 21.102: La force appliquée est de 222 N (États-Unis).

– 21.105: Les fuites micro-ondes ne doivent pas dépasser 50 W/m2 (Japon et États-Unis).

– 22.111: Les fuites micro-ondes sont mesurées seulement à l'issue de l'essai (États-Unis).

– 22.112: Les fuites micro-ondes ne doivent pas dépasser 50 W/m2 (Japon et États-Unis).

– 22.116: Tout accès à la cavité doit être empêché (États-Unis).

– 27.2: Une borne pour le raccordement d'un conducteur équipotentiel externe n'est pas exigée (Japon).

INTRODUCTION

Il a été admis par hypothèse, en établissant la présente Norme internationale, que l'exécution de ses dispositions était confiée à des personnes expérimentées et ayant une qualification appropriée.

Les documents de recommandations concernant l'application des exigences de sécurité pour les appareils peuvent être consultés dans les documents de support du CE 61 et du SC 61B, accessibles sur le site web de l'IEC à l'adresse:

https://www.iec.ch/tc61/supportingdocuments
https://www.iec.ch/sc61b/supportingdocuments

Cette information est donnée à l'intention des utilisateurs de la présente Norme internationale et ne constitue nullement un remplacement du texte normatif de la présente norme.

La présente norme reconnaît le niveau de protection internationalement accepté contre les dangers électriques, mécaniques, thermiques, liés au feu et au rayonnement des appareils, lorsqu'ils fonctionnent comme en usage normal en tenant compte des instructions du fabricant. Elle couvre également les situations anormales auxquelles on peut s'attendre dans la pratique et elle tient compte de la façon dont les phénomènes électromagnétiques peuvent affecter le fonctionnement sûr des appareils.

Cette norme tient compte autant que possible des exigences de l'IEC 60364, de façon à rester compatible avec les règles d'installation quand l'appareil est raccordé au réseau d'alimentation. Cependant, des règles nationales d'installation peuvent être différentes.

Si un appareil relevant du domaine d'application de la présente norme comporte également des fonctions couvertes par une autre Partie 2 de l'IEC 60335, la Partie 2 correspondante est appliquée à chaque fonction séparément, dans la limite du raisonnable. Si cela s'applique, l'influence d'une fonction sur les autres fonctions est prise en compte.

Lorsqu'une Partie 2 ne comporte pas d'exigences complémentaires pour couvrir les risques traités dans la Partie 1, la Partie 1 s'applique.

NOTE 1 Cela signifie que les comités d'études responsables pour les Parties 2 ont déterminé qu'il n'était pas nécessaire de spécifier des exigences particulières pour l'appareil en question en plus des exigences générales.

Cette norme est une norme de famille de produits traitant de la sécurité d'appareils et a préséance sur les normes horizontales et génériques couvrant le même sujet.

NOTE 2 Les publications horizontales, les publications fondamentales de sécurité et les publications groupées de sécurité couvrant un danger ne s'appliquent pas, parce qu'elles ont été prises en considération lorsque les exigences générales et particulières ont été étudiées pour la série de normes IEC 60335.

Un appareil conforme au texte de la présente norme ne sera pas nécessairement jugé conforme aux principes de sécurité de la norme si, lorsqu'il est examiné et soumis aux essais, il apparaît qu'il présente d'autres caractéristiques qui compromettent le niveau de sécurité visé par ces exigences.

Un appareil utilisant des matériaux ou présentant des modes de construction différents de ceux décrits dans les exigences de la présente norme peut être examiné et soumis aux essais en fonction de l'objectif poursuivi par ces exigences et, s'il est jugé pratiquement équivalent, il peut être estimé conforme aux principes de sécurité de la présente norme.

NOTE 3 Les normes traitant des aspects non relatifs à la sécurité des appareils électrodomestiques sont:

– les normes IEC publiées par le comité d'études 59 concernant les méthodes de mesure d'aptitude à la fonction;
– les normes CISPR 11 et CISPR 14-1, ainsi que les normes applicables de la série IEC 61000-3 concernant les émissions électromagnétiques;
– la norme CISPR 14-2 concernant l'immunité électromagnétique;
– les normes IEC publiées par le comité d'études 111 concernant l'environnement.

APPAREILS ÉLECTRODOMESTIQUES ET ANALOGUES – SÉCURITÉ –

Partie 2-90: Exigences particulières pour les fours à micro-ondes à usage commercial

1 Domaine d'application

L'article de la Partie 1 est remplacé par le texte suivant.

La présente partie de l'IEC 60335 traite:

– de la sécurité des **fours à micro-ondes** à usage commercial avec porte de **cavité** dont la **tension assignée** est inférieure ou égale à 250 V pour les appareils monophasés raccordés entre un conducteur de phase et le conducteur de neutre, et à 480 V pour les autres appareils.

  Ces appareils ne sont pas destinés à un usage domestique ou analogue. Ils sont utilisés pour la transformation commerciale des denrées alimentaires, également dans les zones **ouvertes au public**, par exemple dans les cuisines de restaurants, de cantines, d'hôpitaux et dans les entreprises commerciales telles que les boulangeries et les boucheries;

– de la sécurité des **fours à micro-ondes combinés** avec porte de **cavité**, dont les exigences sont fournies à l'Annexe AA normative;

– de la sécurité des **fours à micro-ondes** sans porte de **cavité** et avec **moyen de transport** qui sont destinés à un usage commercial uniquement, pour le chauffage des aliments et des boissons, dont les exigences sont contenues à l'Annexe BB normative.

Les **fours à micro-ondes** couverts par l'Annexe BB normative disposent d'un **moyen de transport** pour déplacer la **charge** à travers le **four à micro-ondes**. Les exigences pour les tunnels à micro-ondes et plusieurs types de distributeurs à micro-ondes sont couvertes.

La présente norme traite également des **fours à micro-ondes** destinés à être utilisés à bord de navires, pour lesquels l'Annexe EE normative s'applique.

L'Annexe BB normative décrit un **four à micro-ondes** sans porte de **cavité** et avec **moyen de transport** comme un **four à micro-ondes**. Sauf indication contraire dans l'Annexe BB normative, tous les articles de la présente norme s'appliquent à ces appareils.

La présente partie de l'IEC 60335 prend également en compte les **personnes ordinaires** qui accèdent à la **zone de retrait** du distributeur automatique.

L'appareil peut être intégré à un distributeur automatique, auquel cas l'IEC 60335-2-75 peut aussi s'appliquer.

Les appareils qui utilisent une énergie non électrique relèvent du domaine d'application de la présente norme.

Dans la mesure du possible, la présente norme traite des dangers courants que présentent ces types d'appareils.

La présente norme ne prend pas en compte l'utilisation d'un **four à micro-ondes** sans porte de **cavité** et avec **moyens de transport** par des **personnes ordinaires**, sauf à proximité des **orifices d'entrée et de sortie**.

L'Annexe BB normative fournit les justifications pour des conditions particulières d'exposition aux micro-ondes, ainsi que des mesures liées à l'énergie micro-ondes confinée par une structure ouverte.

L'attention est attirée sur le fait que

– pour les appareils destinés à être utilisés dans des véhicules ou des trains, à bord de navires ou à bord d'avions, des exigences supplémentaires peuvent être nécessaires;
– pour les appareils destinés à être utilisés dans des pays tropicaux, des exigences particulières peuvent être nécessaires;
– dans de nombreux pays, des exigences supplémentaires sont spécifiées par les organismes nationaux de la santé, par les organismes nationaux responsables de la protection des travailleurs et par des organismes similaires;
– dans de nombreux pays, les organismes nationaux spécifient des exigences supplémentaires au BB.22.101.1.

La présente norme ne s'applique pas

– aux **fours à micro-ondes**, y compris les **fours à micro-ondes combinés** destinés à un usage domestique couverts par l'IEC 60335-2-25 et utilisés par des usagers non avertis dans les environnements suivants:
  • les coins cuisines réservés au personnel des magasins, bureaux et autres environnements professionnels;
  • les fermes;
  • par les clients dans les hôtels, les motels et autres environnements résidentiels;
  • les environnements de type chambres d'hôtes;
– aux installations de chauffage industriel à hyperfréquences (IEC 60519-6);
– aux appareils destinés à des usages médicaux (IEC 60601);
– aux appareils destinés à être utilisés dans des locaux qui présentent des conditions particulières, telles que la présence d'une atmosphère corrosive ou explosive (poussière, vapeur ou gaz).

2 Références normatives

L'article de la Partie 1 s'applique, avec l'exception suivante.

Addition:

IEC 60068-2-6, *Essais d'environnement – Partie 2-6: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-27, *Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs*

IEC 60068-2-52, *Essais d'environnement – Partie 2-52: Essais – Essai Kb: Brouillard salin, essai cyclique (solution de chlorure de sodium)*

IEC 60335-2-36, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-36: Exigences particulières pour les cuisinières, les fours, les tables de cuisson et les foyers de cuisson électriques à usage commercial*

IEC 60335-2-42, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-42: Exigences particulières pour les fours à convection forcée, les cuiseurs à vapeur et les fours combinés vapeur-convection électriques à usage commercial*

IEC 60335-2-49, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-49: Exigences particulières pour les appareils électriques à usage commercial destinés à maintenir au chaud les aliments et la vaisselle*

IEC 60335-2-75, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-75: Exigences particulières pour les distributeurs commerciaux avec ou sans moyen de paiement*

IEC 60436:2015, *Lave-vaisselle électrique à usage domestique – Méthodes de mesure de l'aptitude à la fonction*
IEC 60436:2015/AMD 1:2020

IEC 60584-1, *Couples thermoélectriques – Partie 1: Spécifications et tolérances en matière de FEM*

ISO 898-1, *Caractéristiques mécaniques des éléments de fixation en acier au carbone et en acier allié – Partie 1: Vis, goujons et tiges filetées de classes de qualité spécifiées – Filetages à pas gros et filetages à pas fin*

ISO 3506-1, *Fixations – Caractéristiques mécaniques des fixations en acier inoxydable résistant à la corrosion – Partie 1: Vis, goujons et tiges filetées de grades et classes de qualité spécifiés*

ISO 3506-2, *Fixations – Caractéristiques mécaniques des fixations en acier inoxydable résistant à la corrosion – Partie 2: Écrous de grades et classes de qualité spécifiés*

ISO 3506-3, *Caractéristiques mécaniques des éléments de fixation en acier inoxydable résistant à la corrosion – Partie 3: Vis sans tête et éléments de fixation similaires non soumis à des contraintes de traction*

ISO 3506-4, *Caractéristiques mécaniques des éléments de fixation en acier inoxydable résistant à la corrosion – Partie 4: Vis à tôle*

3 Termes et définitions

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

3.1 Définitions relatives aux caractéristiques physiques

3.1.7

Note 101 à l'article: La **fréquence assignée** est la fréquence absorbée.

3.1.9
conditions de fonctionnement normal

Modification:

Remplacer le premier alinéa par ce qui suit:

fonctionnement de l'appareil dans les conditions suivantes:

L'appareil est mis en fonctionnement avec 1 000 g ± 50 g d'eau potable à une température initiale de 20 °C ± 2 °C dans un récipient cylindrique en verre de borosilicate d'une épaisseur maximale de 3 mm et d'un diamètre extérieur de 190 mm environ. Le récipient est placé au centre de l'**étagère**. Si la **puissance restituée assignée des micro-ondes** dépasse 2 200 W, deux de ces cuves sont utilisées et placées de façon contiguë dans la **cavité**.

3.1.101
puissance restituée assignée des micro-ondes
puissance micro-ondes restituée assignée à l'appareil par le fabricant

3.5 Définitions relatives aux types d'appareils

3.5.101
four à micro-ondes
appareil qui utilise l'énergie électromagnétique d'une ou de plusieurs bandes de fréquence ISM (Industriel, Scientifique et Médical) comprises entre 300 MHz et 30 GHz, pour le chauffage des aliments et des boissons dans une **cavité**

Note 1 à l'article: Les bandes de fréquences ISM sont les fréquences électromagnétiques établies par l'UIT et reproduites dans la CISPR 11.

3.5.102
four à micro-ondes combiné
four à micro-ondes dans lequel la chaleur est également fournie dans la **cavité** par le fonctionnement simultané ou consécutif d'éléments chauffants résistifs

Note 1 à l'article: Les éléments chauffants résistifs sont utilisés pour fournir de la chaleur radiante, de la chaleur par convection ou de la vapeur.

3.6 Définitions relatives aux parties d'un appareil

3.6.101
cavité
espace délimité par les parois internes et la porte, dans lequel est placée la **charge**

3.6.102
étagère
support horizontal dans la **cavité** sur lequel est placée la **charge**

3.6.103
verrouillage de porte
dispositif ou système dont la fonction est d'empêcher le fonctionnement du ou des générateurs de micro-ondes à moins que la porte du four ne soit fermée

3.6.104
verrouillage de porte asservi
système de **verrouillage de porte** qui incorpore un dispositif de surveillance

3.6.105
sonde thermique
dispositif qui fait partie de la commande du four et qui est introduit dans les aliments afin de mesurer leur température

3.6.106
moyen de transport
moyen qui permet de transporter la **charge** à travers le **four à micro-ondes**

Note 1 à l'article: Une courroie, un bras ou un plan incliné est un exemple de **moyen de transport**.

3.6.107
enceinte micro-ondes
structure destinée à confiner l'énergie micro-ondes dans une région définie

Note 1 à l'article: Les barrières montées à l'extérieur de l'**enceinte micro-ondes** ne sont pas considérées comme faisant partie de l'**enceinte micro-ondes**.

Note 2 à l'article: Une **enceinte micro-ondes** peut être constituée d'une **cavité**, de pièges quart d'ondes (qui fonctionnent par transformation d'impédance), de pièges de mode (qui fonctionnent par désadaptation du diagramme de champ) et d'absorbeurs d'énergie micro-ondes.

3.6.108
barrière micro-ondes
barrière physique transparente aux micro-ondes, qui limite l'accès à l'**enceinte micro-ondes**, montée à l'extérieur de l'**enceinte micro-ondes** et qui ne peut être enlevée qu'à l'aide d'outils

Note 1 à l'article: Une **barrière micro-ondes** peut être montée entre l'**enceinte micro-ondes** et le couvercle extérieur de l'appareil.

Note 2 à l'article: Les dispositifs, tels qu'un réseau de chaînes métalliques ou des plaques métalliques à charnières au niveau des **orifices d'entrée et de sortie** destinés à réduire les fuites micro-ondes, ne sont pas considérés comme des **barrières micro-ondes**.

Note 3 à l'article: Les exigences de construction sont fournies en BB.22.101.

Note 4 à l'article: L'Annexe DD informative traite de la justification des essais relatifs aux **barrières micro-ondes** et aux fuites associées.

3.6.109
orifices d'entrée et de sortie
ouvertures dans l'**enceinte micro-ondes** traversées par les **charges**

3.6.110
zone de chargement
zone sur laquelle est placée la **charge**

3.6.111
dispositif de verrouillage asservi de micro-ondes
dispositif de verrouillage de micro-ondes qui comporte un dispositif de surveillance

3.6.112
structure de blocage de protection
structure mécanique mobile située dans la **zone de retrait**, qui limite l'accès à l'**enceinte micro-ondes**

3.6.113
zone de retrait
zone dans laquelle est retirée la **charge**

3.6.114
ouverture de vision
ouverture dans la **cavité**, par laquelle le processus de réchauffement peut être visuellement contrôlé

3.6.115
dispositif de raccordement fixe
toutes les parties de l'**enceinte micro-ondes** qui sont ouvertes en permanence à l'exception des **orifices d'entrée et de sortie** et des **ouvertures de vision**

Note 1 à l'article: Les **dispositifs de raccordement fixes** peuvent être utilisés pour la ventilation et l'injection d'eau.

3.6.116
Vacant

3.6.117
dispositif de verrouillage micro-ondes
dispositif ou système de sécurité mécanique ou électrique qui fonctionne lorsque certaines conditions ne sont pas remplies (par exemple, un système de verrouillage qui empêche le fonctionnement du générateur micro-ondes lorsqu'un moyen d'accès est ouvert)

3.6.118
capot pour l'entretien
élément structurel de toute partie de l'équipement qui peut être ouvert ou retiré à l'aide d'un outil pour permettre l'accès lors des opérations d'entretien de routine, la maintenance, le remplacement des pièces accessoires, etc. dans les zones contenant des micro-ondes

3.6.119
capot pour le nettoyage
partie de l'**enceinte micro-ondes** qui peut être ouverte ou enlevée uniquement à l'aide d'un outil pour les opérations de nettoyage fréquentes, au cours du fonctionnement

3.6.120
surface de référence
surface au voisinage des orifices d'entrée et de sortie définie en fonction de la valeur lue des fuites micro-ondes au 32.1 de l'Annexe BB normative.

Note 1 à l'article: Si la valeur lue des fuites est inférieure ou égale à 50 W/m^2, la **surface de référence** est la surface de l'ouverture géométrique de l'**enceinte micro-ondes** sans **barrière micro-ondes**.

Note 2 à l'article: Si la valeur lue des fuites est supérieure à 50 W/m^2, la **surface de référence** est une surface artificielle située à 50 mm des emplacements, où le capteur de l'instrument mesure les valeurs lues de fuites de 50 W/m^2 vers l'intérieur et vers l'appareil.

Note 3 à l'article: Pour plus d'explications, voir le 32.1 de l'Annexe BB normative.

3.8 Définitions relatives à des sujets divers

3.8.101
personne formée
personne suffisamment formée et supervisée, qui sait comment éviter tout danger provoqué par le fonctionnement des **fours à micro-ondes**

3.8.102
personne qualifiée
personne qui dispose d'une formation professionnelle, de connaissances et d'une expérience adéquates pour discerner et éviter tout danger provoqué par le fonctionnement des **fours à micro-ondes**

3.8.103
personne ordinaire
personne qui n'est ni une **personne qualifiée** ni une **personne formée**

3.8.104
charge
aliments et boissons qui peuvent être réchauffés dans un **four à micro-ondes**

3.8.105
zone ouverte au public
zone à laquelle le grand public, y compris les enfants, peut avoir accès

Note 1 à l'article: Par exemple, cela inclut les zones client dans:

– les épiceries;
– les cantines;
– les gares;
– les restaurants en libre-service.

3.8.106
pont découvert
zone exposée à l'environnement marin

3.8.107
salle de séjour
zone qui peut occasionnellement être exposée à un environnement marin

4 Exigences générales

L'article de la Partie 1 s'applique.

5 Conditions générales d'essais

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

5.2 *Addition:*

Un échantillon supplémentaire peut être exigé pour l'essai du 19.104.

Six échantillons du système de verrouillage sont exigés pour l'essai du 24.1.4.

5.3 *Modification:*

Au lieu d'effectuer les essais dans l'ordre des articles, ils sont effectués dans l'ordre suivant des articles et paragraphes: 32.1, 22.113, 22.108, 22.116, Articles 7 à 17, Article 20, Article 21 (sauf 21.101 à 21.105), Article 18, Article 19 (sauf 19.104), Article 22 (sauf 22.108, 22.113 et 22.116), Articles 23 à 31, 32.2, 21.101 à 21.105 et 19.104.

5.5 *Addition:*

Les essais sont effectués avec les appareils empilés ou en plaçant toute partie mobile de ceux-ci dans la condition la plus défavorable qui peut se produire en usage normal.

5.101 *Les **fours à micro-ondes** sont soumis à l'essai comme des **appareils à moteur**.*

5.102 *Les **sondes thermiques de la classe III** ne sont soumises qu'aux essais du 22.112.*

6 Classification

L'article de la Partie 1 s'applique, avec l'exception suivante.

6.1 *Modification:*

Les **fours à micro-ondes** doivent être de la **classe I**.

7 Marquage et instructions

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

7.1 *Addition:*

Les appareils doivent porter le marquage de la fréquence nominale, en mégahertz, de la bande ISM dans laquelle ils fonctionnent.

Si le retrait d'un couvercle provoque une fuite micro-ondes qui dépasse la valeur spécifiée en 32.1, ce couvercle doit porter un marquage qui comporte en substance l'indication suivante:

MISE EN GARDE: Énergie micro-ondes – Ne pas enlever ce couvercle

Si les appareils ont des enceintes externes, autres que les surfaces de travail, qui ne peuvent pas satisfaire à la limite spécifiée dans le Tableau 3 pour les enceintes externes des **appareils à moteur**, ils doivent être marqués avec le symbole IEC 60417-5041(2002-10) ou avec, en substance, le marquage suivant:

ATTENTION: Surface très chaude.

Si des appareils possèdent des **surfaces accessibles** extérieures, pour lesquelles des limites d'échauffement sont spécifiées dans le Tableau 101 et le Tableau 102 et pour lesquelles les dispositions de la note de bas de tableau b du Tableau 101 et du Tableau 102 s'appliquent, l'appareil doit porter un marquage sur lequel est apposé le symbole IEC 60417-5041 (2002-10) ou qui comporte en substance l'indication suivante:

ATTENTION: Surface très chaude

7.6 *Addition:*

	[symbole IEC 60417-5021 (2002-10)]	équipotentialité
	[symbole IEC 60417-5041 (2002-10)]	attention: surface très chaude

7.12 *Addition:*

Les instructions doivent comporter en substance les indications suivantes:

– MISE EN GARDE: Si la porte ou les joints de porte sont endommagés, le four ne doit pas être mis en fonctionnement avant d'avoir été réparé par une personne compétente.

– MISE EN GARDE: Il est dangereux pour toute personne n'ayant pas le statut de personne compétente d'effectuer une opération de maintenance ou de réparation qui implique le retrait d'un couvercle assurant une protection contre l'exposition à l'énergie micro-ondes.

NOTE 101 Cette mise en garde est nécessaire si les fuites micro-ondes dépassent la limite spécifiée en 32.1 lors du retrait d'un couvercle.

– MISE EN GARDE: Les liquides ou autres aliments ne doivent pas être chauffés dans des récipients fermés hermétiquement, car ils risquent d'exploser.

– MISE EN GARDE: Le chauffage de boissons au micro-ondes peut provoquer un jaillissement différé de liquide en ébullition; par conséquent, des précautions doivent être prises lors de la manipulation du récipient.

– MISE EN GARDE: Le contenu des biberons et des pots d'aliments pour bébé doit être remué ou agité, et la température doit être vérifiée avant consommation de façon à éviter les brûlures.
– Hauteur minimale de l'espace libre nécessaire au-dessus de la surface supérieure du four.
– Utiliser uniquement des ustensiles appropriés à l'usage dans les **fours à micro-ondes**.
– Pendant le chauffage d'aliments dans des récipients en plastique ou en papier, surveiller le four en raison de la possibilité d'inflammation.
– Si de la fumée apparaît, arrêter ou débrancher l'appareil, et garder la porte fermée pour étouffer les flammes éventuelles.
– Il convient de ne pas chauffer les œufs dans leur coquille et les œufs durs entiers dans un **four à micro-ondes**, dans la mesure où ils peuvent exploser, même après la fin de cuisson.
– Les détails relatifs au nettoyage des joints de porte, des cavités et des parties adjacentes.
– Il convient de nettoyer le four régulièrement et d'enlever tout dépôt alimentaire.
– Si le four n'est pas maintenu dans un bon état de propreté, sa surface peut se dégrader, ce qui peut altérer la durée de vie de l'appareil, voire conduire à une situation dangereuse.
– Utiliser uniquement la sonde de température recommandée pour ce four (pour les appareils qui permettent l'emploi d'une **sonde thermique**).
– Il convient de ne pas nettoyer l'appareil avec un jet d'eau (pour les appareils destinés à être placés sur le sol et qui ne sont pas au moins IPX5).
– Un énoncé concernant l'usage dans des véhicules routiers commerciaux (pour les appareils destinés à être utilisés dans des véhicules routiers commerciaux).
– L'appareil ne doit pas être nettoyé avec un appareil de nettoyage à vapeur (pour les appareils qui ne sont pas au moins IPX5).

NOTE 102 Si le four est incorporé dans un distributeur automatique, ces mises en garde et instructions peuvent ne pas être exigées.

Si le symbole IEC 60417-5041 (2002-10) est marqué sur l'appareil, sa signification doit être expliquée.

Le fabricant doit déclarer que l'appareil est également destiné à être utilisé dans une **zone ouverte au public**. Dans ce cas, il doit être indiqué s'il est admis de placer ou d'installer cet appareil à moins de 850 mm au-dessus du sol.

Si l'appareil ne convient pas à un usage dans une **zone ouverte au public**, les instructions doivent inclure en substance la mise en garde suivante:

MISE EN GARDE: Cet appareil ne doit pas être placé ni installé dans un endroit auquel le public a accès.

7.12.1 *Addition:*

Si les instructions d'installation indiquent qu'un **four à micro-ondes** peut être placé au-dessus d'un autre **four à micro-ondes**, elles doivent mentionner la référence du modèle ou du type des **fours à micro-ondes** appropriés. Des instructions doivent être fournies pour la méthode d'empilage des **fours à micro-ondes**. Les instructions doivent indiquer comment utiliser les fixations de manière correcte, le cas échéant. Les instructions doivent également indiquer le nombre maximal de **fours à micro-ondes** empilés.

7.14 *Addition:*

La hauteur des lettres de la mise en garde spécifiée en 7.1 doit être d'au moins 3 mm.

La hauteur des lettres de la mise en garde spécifiée en 7.101 doit être d'au moins 5 mm.

La hauteur du triangle associé au symbole IEC 60417-5041 (2002-10) doit être d'au moins 12 mm.

7.15 *Addition:*

Si le marquage des surfaces très chaudes donné en 7.1 ou le symbole IEC 60417-5041 (2002-10) est apposé sur l'appareil, il doit être visible lorsque l'appareil est mis en fonctionnement comme en usage normal, y compris lors de l'actionnement d'un interrupteur, du réglage d'un dispositif de commande ou de l'ouverture d'un couvercle ou d'une porte. Celui-ci ne doit pas être placé sur des surfaces qui sont exemptées des limites du Tableau 3, du Tableau 101 et du Tableau 102.

7.101 Une étiquette doit être fournie, accompagnée des instructions permettant de la fixer à un endroit bien visible à proximité de l'appareil. L'étiquette doit comporter en substance les indications suivantes.

– MISE EN GARDE: Les liquides ou autres aliments ne doivent pas être chauffés dans des récipients fermés hermétiquement, car ils risquent d'exploser;
– MISE EN GARDE: Le chauffage de boissons au micro-ondes peut provoquer un jaillissement différé de liquide en ébullition; par conséquent, des précautions doivent être prises lors de la manipulation du récipient;
– MISE EN GARDE: Le contenu des biberons et des pots d'aliments pour bébé doit être remué ou agité, et la température doit être vérifiée avant consommation de façon à éviter les brûlures.

La vérification est effectuée par examen.

8 Protection contre l'accès aux parties actives

L'article de la Partie 1 s'applique, avec l'exception suivante.

8.1.1 *Addition:*

*Pour les appareils destinés à être utilisés dans la **zone ouverte au public**, le calibre d'essai 18 de l'IEC 61032 est appliqué.*

9 Démarrage des appareils à moteur

L'article de la Partie 1 ne s'applique pas.

10 Puissance et courant

L'article de la Partie 1 s'applique.

11 Échauffements

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

11.2 *Addition:*

*Les appareils, autres que les **appareils à encastrer**, sont placés comme cela est spécifié pour les **appareils chauffants**.*

Un plafond est placé au-dessus de l'appareil à la hauteur minimale indiquée dans les instructions. Le plafond a une profondeur de 300 mm à partir de la paroi arrière du coin d'essai et une longueur qui dépasse d'au moins 150 mm la largeur de l'appareil.

Les appareils destinés à être fixés au sol, les ***fours à micro-ondes*** *destinés à être empilés sur d'autres* ***fours à micro-ondes*** *ou les appareils dont la masse est supérieure à 40 kg et qui ne sont pas équipés de rouleaux, roulettes ou dispositifs analogues, sont installés conformément aux instructions du fabricant. Si aucune instruction n'est fournie, ces appareils sont placés sur le sol le plus près possible des parois du coin d'essai.*

11.3 *Addition:*

Lorsque les ***surfaces accessibles*** *extérieures sont suffisamment planes et que l'accès le permet, le calibre d'essai de la Figure 102 est utilisé pour mesurer les échauffements des* ***surfaces accessibles*** *extérieures spécifiées dans le Tableau 101 et le Tableau 102. Le calibre est appliqué avec une force de 4 N ± 1 N sur la surface de manière à établir le meilleur contact possible entre le calibre et la surface. Le mesurage est réalisé après une durée de contact de 30 s.*

Le calibre peut être maintenu en place à l'aide d'une pince de laboratoire sur statif ou d'un dispositif analogue. Tout instrument de mesure qui produit les mêmes résultats que le calibre peut être utilisé.

11.7 *Remplacement:*

Les appareils sont mis en fonctionnement par cycles, chaque cycle étant constitué d'une période de chauffage de 4 min suivie d'une période de repos de 1 min jusqu'à l'établissement des conditions de régime. Le dernier cycle ne comprend pas de période de repos de 1 min. De l'eau bouillante est ajoutée à la charge d'eau lorsqu'elle s'est évaporée de moitié.

Les socles femelles de connecteurs accessibles à l'utilisateur et les socles de prises de courant accessibles à l'utilisateur sont chargés avec une charge résistive qui donne la ***charge de sortie*** *marquée. Le courant dans les socles femelles de connecteurs et les socles de prises de courant de l'appareil est chargé en permanence.*

Pour les ***fours à micro-ondes*** *destinés à être empilés sur d'autres* ***fours à micro-ondes****, les essais doivent également être réalisés dans les conditions d'empilage les plus défavorables, conformément aux instructions. Dans ce cas, tous les* ***fours à micro-ondes*** *sont mis en fonctionnement simultanément en usage normal et alimentés à la même tension.*

11.8 *Modification:*

Remplacer le premier alinéa par le texte suivant:

Pour les appareils destinés à être utilisés dans des ***zones ouvertes au public****, les échauffements sont surveillés en permanence et ne doivent pas dépasser les valeurs indiquées dans le Tableau 3 et le Tableau 102..*

Pour les autres appareils, l'échauffement ne doit pas dépasser les valeurs indiquées dans le Tableau 3 et le Tableau 101.

Addition:

Pour le Tableau 3:

– *Les échauffements des surfaces extérieures sont mesurés uniquement sur les surfaces qui ne sont pas placées le long de la paroi et du sol du coin d'essai.*

– *Il n'existe pas de limites de température pour les grilles de sortie d'air et pour les surfaces jusqu'à une distance de 25 mm de celles-ci.*

– *Lorsque les valeurs exigées pour les enceintes externes des **appareils à moteur** ne sont pas respectées, l'échauffement maximal ne doit pas dépasser la limite de plus de 25 K par rapport aux valeurs indiquées.*

Tableau 101 – Échauffements maximaux des surfaces accessibles extérieures en conditions de fonctionnement normal

Surface [a]	***Échauffement des surfaces accessibles extérieures*** *K* [b]
Métal nu	*48*
Métal recouvert [c]	*59*
Verre et céramique	*65*
Plastique et revêtement plastique > 0,4 mm [d, e]	*74*

NOTE Les limites d'échauffement des poignées, boutons, manettes, claviers, pavés numériques et parties analogues sont spécifiées dans le Tableau 3.

[a] *Les surfaces ou éléments suivants ne doivent pas être pris en compte (voir Figure 103):*
- *la **cavité** (les températures de surface ne sont mesurées que lorsque la porte est fermée);*
- *les poignées ou boutons de commande, y compris les pavés numériques, claviers et analogues: toute partie de l'équipement que l'utilisateur a besoin de toucher pour faire fonctionner ou régler le matériel. L'équipement doit être installé conformément aux instructions du fabricant;*
- *les surfaces situées à moins de 5 mm des boutons tactiles, quelle que soit leur forme;*
- *les surfaces extérieures des appareils qui, conformément aux conditions d'installation spécifiées en 11.2, doivent être placées le long des parois et lorsque ces surfaces sont inaccessibles par un calibre d'un diamètre de 75 mm et à extrémité hémisphérique;*
- *les surfaces de la porte du **four à micro-ondes** situées à moins de 10 mm du bord gauche, droit et inférieur de la porte du **four à micro-ondes**, ou à moins 25 mm du bord supérieur de la porte du **four à micro-ondes** (Zone 1). Pour les **appareils à encastrer**, les bords doivent être pris en compte entre la porte du **four à micro-ondes** et les garnitures décoratives, le cas échéant;*
- *les surfaces autour de la porte du **four à micro-ondes** situées à moins de 10 mm du bord gauche, droit ou inférieur de la porte du **four à micro-ondes**, ou à moins de 25 mm du bord supérieur de la porte du **four à micro-ondes** (Zone 2). Pour les **appareils à encastrer**, les bords doivent être pris en compte entre la porte du **four à micro-ondes** et les garnitures décoratives, le cas échéant;*
- *les surfaces situées à moins de 25 mm des évents, comme les grilles de sortie d'air (Zone 3).*

[b] *Lorsque les valeurs exigées ne sont pas respectées, l'échauffement maximal ne doit pas dépasser la limite de plus de 25 K par rapport aux valeurs indiquées.*

[c] *Un métal est considéré comme recouvert lorsqu'un revêtement d'une épaisseur minimale de 90 µm en émail, en poudre ou non constitué majoritairement de plastique est utilisé.*

[d] *La limite d'échauffement du plastique s'applique également aux matériaux en plastique avec une finition métallique d'une épaisseur inférieure à 0,1 mm.*

[e] *Lorsque l'épaisseur du revêtement plastique ne dépasse pas 0,4 mm, les limites d'échauffement du métal recouvert ou du matériau en verre ou céramique s'appliquent.*

Tableau 102 – Échauffements maximaux des surfaces extérieures accessibles pour les appareils destinés à être utilisés dans des zones ouvertes au public en conditions de fonctionnement normale

Surface [a]	***Échauffement des surfaces accessibles extérieures*** K	
	Appareils et parties situés à moins de 850 mm au-dessus du sol après installation	***Appareils et parties situés à plus de 850 mm au-dessus du sol après installation*** [b]
Métal nu	*38*	*42*
Métal recouvert [c]	*42*	*49*
Verre et céramique	*51*	*56*
Plastique et revêtement plastique > 0,4 mm [d, e]	*58*	*62*

NOTE Les limites d'échauffement des poignées, boutons, manettes, claviers, pavés numériques et parties analogues sont spécifiées dans le Tableau 3.

[a] *Les surfaces ou éléments suivants ne doivent pas être pris en compte (voir Figure 103):*
- *la **cavité** (les températures de surface ne sont mesurées que lorsque la porte est fermée);*
- *les poignées ou boutons de commande, y compris les pavés numériques, claviers et analogues: toute partie de l'équipement que l'utilisateur a besoin de toucher pour faire fonctionner ou régler le matériel. L'équipement doit être installé conformément aux instructions du fabricant;*
- *les surfaces situées à moins de 5 mm des boutons tactiles, quelle que soit leur forme;*
- *les surfaces extérieures des appareils qui, conformément aux conditions d'installation spécifiées en 11.2, doivent être placées le long des parois et lorsque ces surfaces sont inaccessibles par un calibre d'un diamètre de 75 mm et à extrémité hémisphérique;*
- *les surfaces de la porte du four situées à moins de 10 mm du bord gauche, droit et inférieur de la porte du four, ou à moins de 25 mm du bord supérieur de la porte du four (Zone 1). Pour les **appareils à encastrer**, les bords doivent être pris en compte entre la porte du four et les garnitures décoratives, le cas échéant;*
- *les surfaces autour de la porte du four situées à moins de 10 mm du bord gauche, droit ou inférieur de la porte du four, ou à moins 25 mm du bord supérieur de la porte du four (Zone 2). Pour les **appareils à encastrer**, les bords doivent être pris en compte entre la porte du four et les garnitures décoratives, le cas échéant;*
- *les surfaces situées à moins de 25 mm des évents, comme les grilles de sortie d'air (Zone 3).*

[b] *Lorsque les valeurs exigées ne sont pas respectées, l'échauffement maximal ne doit pas dépasser la limite de plus de 25 K par rapport aux valeurs indiquées.*

[c] *Un métal est considéré comme recouvert lorsqu'un revêtement d'une épaisseur minimale de 90 µm en émail, en poudre ou non constitué majoritairement de plastique est utilisé.*

[d] *La limite d'échauffement du plastique s'applique également aux matériaux en plastique avec une finition métallique d'une épaisseur inférieure à 0,1 mm.*

[e] *Lorsque l'épaisseur du revêtement plastique ne dépasse pas 0,4 mm, les limites d'échauffement du métal recouvert ou du matériau en verre ou céramique s'appliquent.*

12 Charge des batteries à ions métalliques

L'article de la Partie 1 s'applique.

13 Courant de fuite et rigidité diélectrique à la température de régime

L'article de la Partie 1 s'applique.

14 Surtensions transitoires

L'article de la Partie 1 s'applique.

15 Résistance à l'humidité

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

15.1.1 *Addition:*

En outre, les appareils destinés à être placés à moins de 850 mm au-dessus du sol, à l'exception de ceux marqués IPX5 et IPX6, sont soumis pendant 5 min à l'essai d'éclaboussement suivant.

L'appareillage représenté à la Figure BB.201 est utilisé. L'appareil est placé en position normale d'emploi; les pieds réglables doivent être réglés conformément aux instructions d'emploi sur la hauteur la plus défavorable.

Pour les appareils normalement utilisés sur le sol, le bol est placé sur le sol et est déplacé autour de l'appareil de manière à éclabousser celui-ci dans toutes les directions. Pendant l'essai, la pression de l'eau est réglée de telle sorte que l'eau rejaillisse à 150 mm au-dessus du fond du bol. Le bol n'est pas positionné sous l'appareil.

Pour tous les autres appareils, le bol est placé sur le même plan que celui où est installé l'appareil et est déplacé autour de l'appareil de manière à éclabousser celui-ci dans toutes les directions. Pendant l'essai, la pression de l'eau est réglée de telle sorte que l'eau rejaillisse à 100 mm au-dessus du fond du bol. Le bol n'est pas positionné sous l'appareil.

Veiller à ce que le jet d'eau ne touche pas directement l'appareil.

15.2 *Addition:*

*Une quantité de 0,5 l de la même solution de débordement est versée en continu sur l'**étagère** pendant 1 min. Si l'**étagère** peut recueillir le liquide renversé, elle est remplie avec la solution, et une quantité supplémentaire égale à 0,5 l est alors ajoutée pendant 1 min.*

15.101 Les **sondes thermiques** doivent être conçues de telle sorte que leur isolation ne soit pas altérée par l'eau.

La vérification est effectuée par l'essai suivant.

La sonde est totalement immergée dans de l'eau à 20 °C ± 5 °C qui contient environ 1 % de NaCl. La solution est portée à ébullition en 15 min environ. Ensuite, la sonde est retirée de la solution bouillante et immergée pendant 30 min dans la solution dont la température est de 20 °C ± 5 °C.

Cette procédure est répétée cinq fois, après quoi la sonde est retirée de la solution. Toute trace de liquide est alors enlevée de la surface.

La sonde doit ensuite satisfaire à l'essai de rigidité diélectrique du 16.3.

NOTE Les **sondes thermiques amovibles** ne sont pas reliées à l'appareil pour cet essai. Les **sondes thermiques non amovibles**, immergées autant qu'il est possible, sont soumises à l'essai dans la **cavité**.

16 Courant de fuite et rigidité diélectrique

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

16.101 Les enroulements du transformateur de puissance qui alimente le magnétron doivent avoir une isolation adéquate.

La vérification est effectuée par l'un des essais suivants.

– *Pour les alimentations à découpage, l'isolation entre les enroulements primaire et secondaire des transformateurs d'alimentation à découpage est soumise pendant 1 min à une tension de forme d'onde pratiquement sinusoïdale et d'une fréquence de 50 Hz ou 60 Hz. La valeur de la tension est égale à 1,414 fois la valeur de crête de la **tension de service** secondaire plus 750 V, avec une valeur minimale de 1 250 V.*

  Aucun claquage ne doit se produire entre les enroulements ou entre les spires adjacentes du même enroulement.

– *Pour les autres transformateurs de puissance, une tension égale à deux fois la **tension de service** est induite dans l'enroulement secondaire du transformateur en appliquant aux bornes de l'enroulement primaire une tension sinusoïdale dont la fréquence est supérieure à la **fréquence assignée**.*

  La durée de l'essai est de:

  - *60 s pour des fréquences inférieures ou égales au double de la **fréquence assignée**; ou*
  - $120 \times \frac{\textbf{fréquence assignée}}{\text{fréquence d'essai}}$ *s, avec une durée minimale de 15 s, pour les fréquences supérieures.*

  NOTE La fréquence de la tension d'essai est supérieure à la **fréquence assignée** pour éviter un courant d'excitation excessif.

  Une tension de valeur maximale égale au tiers de la tension d'essai est appliquée, puis rapidement augmentée sans provoquer de transitoires. A l'issue de l'essai, la tension est réduite d'une manière similaire jusqu'à approximativement un tiers de sa valeur totale avant la mise hors tension.

  Aucun claquage ne doit se produire entre les enroulements ou entre les spires adjacentes du même enroulement.

17 Protection contre la surcharge des transformateurs et des circuits associés

L'article de la Partie 1 s'applique, avec l'exception suivante.

Addition:

Les essais ne sont pas effectués sur le transformateur de puissance qui alimente le magnétron et ses circuits associés, ceux-ci étant vérifiés pendant les essais de l'Article 19.

18 Endurance

L'article de la Partie 1 est remplacé par le texte suivant.

Le système de porte, y compris les charnières, les joints et autres parties associées, doit être construit de façon à résister à l'usure susceptible de se produire en usage normal.

La vérification est effectuée par l'essai suivant.

*Le système de porte est soumis à 100 000 cycles de fonctionnement, l'appareil étant alimenté à la **tension assignée** et contenant une **charge** appropriée absorbant les micro-ondes. Il est ensuite soumis à 100 000 cycles de fonctionnement sans génération de micro-ondes.*

La porte est ouverte et fermée comme en usage normal. Elle est ouverte depuis la position fermée jusqu'à un angle d'environ 10° avant d'être entièrement ouverte. La cadence de fonctionnement est de six cycles par minute. Avec l'accord du fabricant, la cadence de fonctionnement sans génération de micro-ondes peut être portée à 12 cycles par minute.

Après l'essai, les fuites micro-ondes ne doivent pas dépasser la limite spécifiée en 32.1 et le système de porte doit toujours fonctionner.

NOTE 101 Les dispositifs de commande peuvent être rendus inopérants pour effectuer l'essai.

NOTE 102 Les composants dont la détérioration ne compromet pas la conformité à la présente norme peuvent être remplacés pour mener l'essai à son terme.

NOTE 103 Des briques ou une quantité d'eau additionnelle maximale de 1 000 g peuvent être ajoutées, si nécessaire, pour éviter d'arrêter l'essai à cause d'une surchauffe.

19 Fonctionnement anormal

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

19.1 *Modification:*

Au lieu de soumettre les appareils aux essais du 19.2 au 19.10, la vérification est effectuée par les essais du 19.101 au 19.104, l'appareil étant alimenté à la tension assignée.

19.11.2 *Addition:*

Le circuit anode-cathode du magnétron est successivement ouvert et court-circuité. Si l'une de ces conditions de défaut entraîne un courant d'entrée qui augmente lorsque la tension diminue, l'essai est effectué en alimentant l'appareil à une tension égale à 0,94 fois la ***tension assignée****. Cependant, si le courant d'entrée augmente plus que proportionnellement par rapport à la tension, l'appareil est alimenté à une tension égale à 1,06 fois la* ***tension assignée****.*

Le filament du magnétron n'est pas court-circuité.

19.13 *Addition:*

Pendant les essais, la température des enroulements ne doit pas dépasser les valeurs indiquées dans le Tableau 8. Seuls les appareils avec présélection de l'heure de démarrage et ceux qui comportent une fonction de maintien au chaud sont considérés comme des appareils qui sont en mis en fonctionnement jusqu'à l'établissement des conditions de régime.

Toutefois, lors des essais du 19.11.3, le Tableau 8 s'applique uniquement aux enroulements du transformateur de l'alimentation du ou des générateurs de micro-ondes, le cas échéant.

Pendant les essais, les fuites micro-ondes, mesurées conformément au 32.1, mais avec la ***charge*** *spécifiée pour chaque paragraphe, ne doivent pas dépasser 100 W/m^2. L'appareil doit être conforme au 32.1 s'il peut être mis en fonctionnement après les essais.*

19.101 *Les appareils sont mis en fonctionnement en réglant les dispositifs de commande à la position la plus défavorable et sans* ***charge*** *dans la* ***cavité****.*

La durée de fonctionnement est le temps maximal autorisé par la minuterie ou le temps nécessaire pour établir les conditions de régime, si cette durée est plus courte.

Si les fuites micro-ondes dépassent 100 W/m^2, la méthode alternative de mesurage suivante, qui modifie la limite des fuites micro-ondes du 19.13, doit être appliquée.

Pour identifier et marquer tous les points où les valeurs de crête des fuites micro-ondes dépassent 100 W/m^2, l'antenne de l'instrument est à nouveau déplacée sur la surface extérieure de l'appareil, en portant une attention particulière à la porte et à ses joints.

NOTE 1 Une fonction de retenue de crête de l'instrument de mesure, le cas échéant, peut être activée pour identifier les points où les valeurs de crête des fuites micro-ondes dépassent 100 W/m^2.

Les valeurs de fuites de chaque point doivent être enregistrées, et la valeur moyenne des fuites de tout point sur l'intervalle de 20 s le plus défavorable ne doit pas dépasser 100 W/m^2. De plus, la valeur de crête ne doit pas dépasser 500 W/m^2.

NOTE 2 Étant donné que le temps de rotation du brasseur et/ou du plateau ainsi que le nombre de pales de l'agitateur de micro-ondes déterminent la fréquence et la durée des valeurs de crête réelles des fuites, des instruments aux spécifications appropriées (temps d'échantillonnage minimal, capacité à mesurer les valeurs de crête de la puissance surfacique, capacité à établir la moyenne de ces valeurs, par exemple) peuvent être utilisés.

19.102 *Les appareils sont mis en fonctionnement dans les **conditions de fonctionnement normal**, en mettant en court-circuit la minuterie ou les autres dispositifs de commande qui fonctionnent en usage normal.*

Si l'appareil comporte plusieurs dispositifs de commande, ceux-ci sont successivement court-circuités. Ces courts-circuits sont appliqués successivement.

19.103 *Les appareils sont mis en fonctionnement dans les **conditions de fonctionnement normal** et en simulant les conditions de premier défaut susceptibles de se produire. Les dispositifs de commande sont réglés sur la position la plus défavorable et l'appareil est mis en fonctionnement pendant le temps maximal autorisé par la minuterie ou 90 min, si cette durée est plus courte.*

NOTE Les conditions de défaut sont par exemple:

– l'obturation des ouvertures d'air sur un même plan;
– le blocage du rotor des moteurs si le couple de démarrage du rotor bloqué est inférieur au couple à pleine charge;
– le blocage des parties mobiles susceptibles d'être coincées.

19.104 *L'appareil est mis en fonctionnement en réglant les dispositifs de commande sur la position la plus défavorable et en plaçant des pommes de terre sur l'**étagère** dans la position, où elles sont les plus susceptibles de s'enflammer et de propager des flammes à d'autres matériaux combustibles.*

Chaque pomme de terre a une forme approximativement ellipsoïdale et une masse comprise entre 125 g et 150 g. La longueur du petit axe principal est d'au moins 40 mm. La longueur du grand axe principal ne dépasse pas 140 mm et peut être réduite symétriquement de manière à obtenir la masse spécifiée. Un fil d'acier, d'un diamètre de 1,5 mm ± 0,5 mm et approximativement de la même longueur que le grand axe de la pomme de terre, est inséré le long de cet axe d'au moins une des pommes de terre. Le nombre de pommes de terre à utiliser est déterminé dans le Tableau 103.

Si les pommes de terre ne s'enflamment pas, l'essai est répété en enlevant une pomme de terre. Si une pomme de terre seule ne s'enflamme pas, elle est enflammée artificiellement.

Tableau 103 – Nombre de pommes de terre

Puissance restituée assignée des micro-ondes *W*	***Volume de la cavité*** *l*	***Nombre de pommes de terre***
< 600	*≥ 14 et < 28*	*2*
≥ 600 et < 1 000	*≥ 28 et < 42*	*4*
≥ 1 000 et < 2 000	*≥ 42 et < 56*	*6*
≥ 2 000	*≥ 56*	*6 + N* [a]
NOTE La **puissance restituée assignée des micro-ondes** ou le volume de la **cavité** s'applique, si cette approche permet d'utiliser le nombre de pommes de terre le plus important.		
[a] *N est égal à 2 pour chaque augmentation de puissance restituée de 500 W ou pour chaque augmentation de volume de 14 l.*		

L'essai est achevé 15 min après l'arrêt de la génération de micro-ondes ou l'extinction du feu dans la cavité.

*Pendant l'essai, tout feu dans la **cavité** doit être contenu dans l'appareil.*

NOTE 1 Le 19.13 ne s'applique pas pendant l'essai.

*Après l'essai, si l'appareil est encore en état de fonctionner, toute **étagère amovible** endommagée est remplacée et le 19.13 s'applique. Si l'appareil n'est pas conforme, l'essai est répété sur un appareil neuf.*

NOTE 2 La non-conformité peut résulter de l'effet cumulatif d'essais précédents.

20 Stabilité et dangers mécaniques

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

20.1 *Modification:*

Remplacer le premier alinéa des critères de conformité par ce qui suit.

*Pour les appareils empilés destinés à être placés sur le sol, les appareils non raccordés au réseau d'alimentation sont placés en position normale d'emploi sur un plan incliné de 15° par rapport à l'horizontale, le **câble d'alimentation** reposant sur le plan incliné dans la position la plus défavorable. Toutefois, si une partie d'un appareil entre en contact avec la surface d'appui horizontale lorsque les appareils empilés sont inclinés à un angle de 15°, les appareils empilés sont placés sur un support horizontal et inclinés dans la direction la plus défavorable à un angle de 15°.*

*Pour les appareils autres que les appareils empilés destinés à être placés sur le sol, les appareils non raccordés au réseau d'alimentation sont placés en position normale d'emploi sur un plan incliné de 10° par rapport à l'horizontale, le **câble d'alimentation** reposant sur le plan incliné dans la position la plus défavorable. Toutefois, si une partie de tout appareil entre en contact avec la surface d'appui horizontale lorsque les appareils sont inclinés à un angle de 10°, les appareils sont placés sur un support horizontal et inclinés dans la direction la plus défavorable à un angle de 10°.*

20.2 *Addition:*

*Pour les appareils destinés à être utilisés dans les **zones ouvertes au public**, le calibre d'essai 18 de l'IEC 61032 est appliqué.*

20.101 Les appareils équipés de portes à charnière horizontale dans leur partie inférieure et sur lesquelles il est possible de placer une **charge** doivent avoir une stabilité adéquate.

La vérification est effectuée par l'essai suivant.

L'appareil est placé sur une surface horizontale, la porte ouverte, et une masse est délicatement placée au centre géométrique de la porte.

Pour les appareils destinés à être utilisés sur le sol, la masse est de

– *23 kg pour les portes de **cavité**, ou la masse pouvant être placée dans le four conformément aux instructions, si celle-ci est supérieure;*
– *7 kg pour les autres portes.*

Pour les appareils destinés à être utilisés sur une table, la masse est de

– *7 kg pour les **appareils fixes**;*
– *3,5 kg pour les **appareils mobiles**.*

L'appareil ne doit pas basculer.

NOTE 1 Un sac de sable peut constituer la **charge**.

*Pour les **fours à micro-ondes** destinés à être empilés sur d'autres **fours à micro-ondes**, l'essai est répété dans les conditions d'empilage, conformément aux instructions. Chaque porte de **fours à micro-ondes** empilés est soumise à l'essai l'une après l'autre.*

Si l'appareil comporte plus d'une porte, l'essai est effectué sur chaque porte, l'une après l'autre, au cours des essais ci-dessus.

21 Résistance mécanique

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

Addition:

La vérification est également effectuée par les essais du 21.101 au 21.105. Lors de ces essais, l'appareil est fixé sur un support rigide, sauf pour l'essai du 21.102.

21.101 *Les portes à charnières sont placées dans une position d'ouverture à un angle d'environ 30° avant d'être entièrement ouvertes. Les portes à glissières sont ouvertes approximativement aux deux tiers de leur course. Une force de 35 N est appliquée sur la surface interne d'une porte à charnière, en un point situé à 25 mm du bord libre, ou sur la poignée d'une porte à glissières.*

La force est appliquée au moyen d'un dynamomètre dont la constante de rappel est de 1,05 N/mm. Elle est tout d'abord appliquée avec une force opposée de l'autre côté de la porte ou de la poignée. La force opposée est ensuite relâchée pour permettre à la porte de compléter sa course jusqu'à la position entièrement ouverte.

L'essai est effectué 25 fois.

*L'essai est répété sur les portes des **appareils fixes** et des **appareils à encastrer**, sauf que:*

– *la porte est initialement placée à mi-chemin entre les positions entièrement ouverte et fermée;*

– *la force appliquée est égale à 1,5 fois la force exigée pour ouvrir la porte ou à 65 N, si cette valeur est plus élevée. Cependant, si la force ne peut pas être mesurée ou si la porte est ouverte indirectement, la force de 65 N s'applique.*

L'essai est effectué 25 fois.

Les portes sont ensuite placées à mi-chemin entre les positions entièrement ouverte et fermée. Une force de fermeture de 90 N est appliquée sur la surface extérieure d'une porte à charnière, en un point situé à 25 mm du bord libre, ou sur la poignée d'une porte à glissières, en commençant par appliquer la force opposée de la manière décrite ci-dessus.

Cet essai est effectué 50 fois.

L'appareil doit alors être conforme au 32.1.

21.102 *Les portes à charnières latérales sont placées en position d'ouverture totale. Une force verticale de 140 N ou la force maximale qui peut être appliquée sans faire basculer l'appareil dans n'importe quelle position de la porte, si cette valeur est plus faible, est ensuite appliquée sur le bord libre de la porte et la porte est fermée.* La porte est à nouveau totalement ouverte, la force étant maintenue.

Cet essai est effectué 10 fois.

Les portes à charnières inférieures sont ouvertes. Une force de 140 N ou la force maximale qui peut être appliquée sans faire basculer l'appareil, si cette valeur est plus faible, est appliquée sur la surface interne de la porte dans la position la plus défavorable à 25 mm du bord libre.

La force est maintenue pendant 15 min.

L'appareil doit alors être conforme au 32.1.

21.103 *Un cube de bois de 20 mm de côté est attaché à l'un des coins intérieurs le plus éloigné des charnières. Une tentative est faite pour fermer la porte avec une force de 90 N, appliquée sur l'autre coin le plus éloigné des charnières, dans une direction perpendiculaire à la surface de la porte.*

La force est maintenue pendant 5 s.

Le cube est ensuite retiré. La porte est fermée lentement jusqu'à ce que la génération de micro-ondes devienne possible. La porte et ses dispositifs d'ouverture sont alors manipulés afin de déterminer la position qui donne la fuite maximale de micro-ondes.

L'appareil doit alors être conforme au 32.1.

L'essai est répété, le cube en bois attaché à l'autre coin le plus éloigné de la charnière.

NOTE L'essai ne s'applique pas aux portes à glissières.

21.104 *La porte est fermée et la surface externe est soumise à trois coups, ayant chacun une énergie de 3 J. Ces coups sont appliqués sur la partie centrale de la porte, éventuellement au même endroit.*

Le choc est appliqué au moyen d'une bille d'acier d'un diamètre de 50 mm et d'une masse d'environ 0,5 kg. La bille est suspendue par un cordon approprié fixé dans le plan de la porte. La bille est lâchée à la manière d'un pendule de la hauteur exigée pour frapper la surface avec l'énergie d'impact spécifiée.

La porte est ensuite ouverte, et sa surface de contact avec le four est soumise à trois chocs similaires.

La surface interne d'une porte à charnière est soumise à trois chocs comme cela est indiqué ci-dessus, en effectuant l'essai avec la porte en position entièrement ouverte. Les chocs sont appliqués sur la partie centrale de la porte et peuvent être appliqués en un même point. Cependant, si une porte à charnière inférieure est horizontale en position entièrement ouverte, les chocs sont appliqués en lâchant la bille d'acier en chute libre d'une hauteur qui permet d'obtenir l'énergie d'impact spécifiée.

Une porte à charnière inférieure est soumise à un essai supplémentaire en appliquant trois chocs similaires au joint. Les chocs sont appliqués à trois endroits différents.

L'appareil doit alors être conforme au 32.1.

21.105 *Une porte à charnière inférieure est ouverte, et une cheville en bois dur d'un diamètre de 10 mm et d'une longueur de 300 mm est placée le long de la charnière inférieure. La cheville est mise en place en plaçant une extrémité à fleur de l'un des bords extérieurs de la porte. Une force de fermeture de 140 N est appliquée au centre de la poignée, perpendiculairement à la surface de la porte. La force est maintenue pendant 5 s.*

L'essai est répété en plaçant une extrémité à fleur de l'autre bord extérieur de la porte, puis la cheville est placée en position centrale par rapport à la charnière.

Les fuites micro-ondes sont alors mesurées dans les conditions spécifiées en 32.1 et ne doivent pas dépasser 100 W/m^2.

22 Construction

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

22.101 Les appareils à encastrer doivent être ventilés uniquement par l'avant, à moins que des dispositions ne soient prises pour une ventilation à travers un conduit.

La vérification est effectuée par examen.

22.102 Les ouvertures d'aération doivent être conçues de façon que toute humidité ou graisse évacuée à travers elles ne puisse affecter les **distances dans l'air** et les **lignes de fuite** entre les **parties actives** et les autres parties de l'appareil.

La vérification est effectuée par examen.

22.103 Les appareils doivent être construits conformément au 22.103.1 ou au 22.103.2.

22.103.1 Les appareils doivent comporter au moins deux **verrouillages de porte** actionnés par l'ouverture de la porte, l'un étant un **verrouillage de porte asservi**. Au moins l'un des **verrouillages de porte** doit être dissimulé et ne doit pas être actionnable par une intervention manuelle.

La vérification est effectuée par examen, et la dissimulation est vérifiée conformément au 22.105.

NOTE Les deux **verrouillages de porte** peuvent être incorporés dans le système de **verrouillage de porte asservi**.

22.103.2 Les appareils doivent comporter deux **verrouillages de porte asservis** indépendants actionnés par l'ouverture de la porte. Dans ce cas, le 22.105 ne s'applique pas.

NOTE Il n'est pas nécessaire de dissimuler les **verrouillages de porte**, car deux **verrouillages de porte asservis** indépendants comportent des dispositifs de surveillance.

La vérification est effectuée par examen et par l'essai suivant.

*La porte est ouverte lentement tout en tentant de neutraliser manuellement l'un des **verrouillages de porte accessibles** en appliquant le calibre d'essai B. En outre, pour les appareils destinés à être installés dans des **zones ouvertes au public**, le calibre d'essai 18 est également utilisé. Chaque calibre est appliqué séparément.*

Pendant les essais, le fonctionnement du ou des générateurs de micro-ondes ne doit pas être possible.

22.104 Au moins un **verrouillage de porte** du 22.103.1 et les deux **verrouillages de porte asservis** du 22.103.2 doivent comporter un interrupteur qui déconnecte le ou les générateurs de micro-ondes ou leur circuit d'alimentation.

La vérification est effectuée par examen.

22.105 Au moins l'un des **verrouillages de porte** doit être dissimulé et ne doit pas être actionnable par une intervention manuelle. Ce **verrouillage de porte** doit agir avant que l'un des **verrouillages de porte accessibles** puisse être neutralisé.

La vérification est effectuée par l'essai suivant.

*La porte est placée dans n'importe quelle position, et une tentative est effectuée pour actionner le **verrouillage de porte** dissimulé en appliquant le calibre d'essai B et, pour les appareils destinés à être utilisés dans les **zones ouvertes au public**, ensuite par le calibre d'essai 18, à toutes les ouvertures. L'essai est répété en appliquant une tige, comme cela est représenté sur la Figure 101, à toutes les ouvertures du mécanisme de **verrouillage de porte**. Les calibres et la tige d'essai doivent être appliqués séparément.*

*Les **verrouillages de porte** à fonctionnement magnétique sont également évalués en appliquant un aimant sur l'enveloppe au-dessus de l'interrupteur du **verrouillage de porte**. L'aimant présente la même configuration physique et la même orientation magnétique que les aimants qui actionnent le **verrouillage de porte**. Il doit être capable d'exercer une force de 50 N ± 5 N lorsqu'il est appliqué sur une armature en acier doux de 80 mm × 50 mm × 8 mm. De plus, l'aimant doit être capable d'exercer une force de 5 N ± 0,5 N à une distance de 10 mm de l'armature.*

*Il ne doit pas être possible de mettre en fonctionnement les **verrouillages de porte** dissimulés pendant les essais.*

*La porte est ouverte lentement tandis qu'une tentative de neutraliser manuellement l'un des **verrouillages de porte accessibles** est effectuée en appliquant séparément le calibre d'essai B, la tige puis l'aimant. Pour les appareils destinés à être utilisés dans les **zones ouvertes au public**, le calibre d'essai 18 est en outre appliqué séparément.*

*Les **verrouillages de porte** dissimulés doivent agir avant que l'un des **verrouillages de porte accessibles** puisse être neutralisé.*

22.106 Le dispositif de surveillance de chaque **verrouillage de porte asservi** doit rendre l'appareil inopérant si sa partie interrupteur ne parvient plus à commander le ou les générateurs de micro-ondes.

La vérification est effectuée par l'essai suivant.

*La partie interrupteur du **verrouillage de porte asservi** est rendue inopérante. L'appareil est alimenté à la **tension assignée** par une source d'alimentation dont le pouvoir de coupure est d'au moins 1,5 kA pour les appareils de **tension assignée** supérieure à 150 V et 1,0 kA pour les autres appareils.*

*Les appareils dont la **tension assignée** est inférieure à 150 V et dont le **courant assigné** est supérieur à 20 A sont alimentés à la **tension assignée** par une source d'alimentation dont le pouvoir de coupure est d'au moins 5,0 kA.*

*L'appareil est mis en fonctionnement avec la porte fermée, et une tentative est alors effectuée pour accéder à la **cavité** de façon normale. Il ne doit pas être possible d'ouvrir la porte, sauf si le ou les générateurs de micro-ondes cessent de fonctionner et restent inopérants. Il ne doit pas avoir de défaillance du dispositif de surveillance en position de circuit ouvert.*

Le dispositif de surveillance est remplacé pour les essais suivants si la défaillance se produit en position circuit fermé.

*Il est nécessaire de mettre les autres **verrouillages de porte** hors service afin de réaliser cet essai.*

Si un fusible interne du circuit d'alimentation du ou des générateurs de micro-ondes se rompt, il est remplacé et l'essai est effectué deux fois de plus. Le fusible interne doit se rompre à chaque fois.

L'essai est effectué à nouveau trois fois, mais en connectant une impédance de (0,4 + j 0,25) Ω en série avec la source d'alimentation. Le fusible interne doit se rompre à chaque fois.

*Pour les appareils de **tension assignée** inférieure à 150 V et pour ceux ayant un **courant assigné** supérieur à 20 A, l'essai avec l'impédance en série n'est pas effectué.*

NOTE En cas de rupture du fusible interne, les interrupteurs, les filtres et le câblage peuvent être remplacés à chaque fois, si cela est indiqué dans les instructions d'entretien professionnel.

22.107 La défaillance d'un composant électrique ou mécanique qui compromet le fonctionnement d'un **verrouillage de porte** ne doit pas altérer le fonctionnement d'un autre **verrouillage de porte** ou rendre inopérant le système de surveillance du **verrouillage de porte asservi**, sauf si l'appareil est rendu inopérant.

La vérification est effectuée par examen et, si nécessaire, en simulant une défaillance du composant et en mettant l'appareil en fonctionnement comme en usage normal.

NOTE Cette exigence ne s'applique pas aux composants du dispositif de surveillance qui satisfont à l'essai du 22.106.

22.108 Les **verrouillages de porte** incorporés pour satisfaire au 22.103 doivent fonctionner avant qu'une fuite excessive de micro-ondes ne se produise.

La vérification est effectuée par l'essai suivant.

*Tous les **verrouillages de porte**, sauf un, sont rendus inopérants. L'appareil est alimenté à la **tension assignée** et mis en fonctionnement avec la **charge** spécifiée en 32.1. La séquence d'ouverture de porte est effectuée par petits incréments au cours desquels les fuites micro-ondes sont mesurées.*

L'appareil doit satisfaire au 32.1.

*L'essai est répété successivement sur chaque **verrouillage de porte**.*

NOTE 1 Les **verrouillages de porte** sont uniquement soumis à l'essai s'ils sont nécessaires pour démontrer la conformité au 22.103.

NOTE 2 Il peut être opportun de rendre inopérant le dispositif de surveillance de **verrouillage de porte asservi** pendant la conduite de l'essai.

22.109 Aucune fuite excessive de micro-ondes ne doit se produire lorsqu'un matériau mince est introduit entre la porte et sa surface de contact.

La vérification est effectuée en fermant la porte sur une bande de papier d'une largeur de 60 mm ± 5 mm et d'une épaisseur de 0,15 mm ± 0,05 mm, le papier étant placé entre la porte et sa surface de contact.

L'appareil doit alors être conforme au 32.1.

L'essai est réalisé 10 fois, en plaçant le papier en différents endroits.

22.110 Aucune fuite excessive de micro-ondes ne doit se produire lorsque les joints de porte sont souillés par des résidus alimentaires.

La vérification est effectuée par l'essai suivant.

Le joint de porte est recouvert d'huile de cuisine. Si le joint est en feuillure, la gorge est remplie d'huile.

L'appareil doit alors être conforme au 32.1.

22.111 Aucune fuite excessive de micro-ondes ne doit se produire lorsque les coins de la porte sont soumis à une déformation.

La vérification est effectuée par l'essai suivant.

*L'appareil est alimenté à la **tension assignée** et mis en fonctionnement avec la **charge** spécifiée en 32.1. La porte et son dispositif d'ouverture sont manipulés jusqu'à l'obtention de l'espace maximal permettant la génération de micro-ondes. Une force de traction est appliquée perpendiculairement à la surface de la porte, à chaque coin, successivement. La force est lentement augmentée jusqu'à 40 N.*

Pendant l'essai, les fuites micro-ondes sont mesurées dans les conditions spécifiées en 32.1 et ne doivent pas dépasser 100 W/m^2.

Après l'essai, l'appareil doit être conforme au 32.1.

22.112 Aucune fuite excessive de micro-ondes ne doit se produire, et la **sonde thermique** ne doit pas être endommagée lorsqu'une sonde ou que son câble est coincé dans la porte.

La vérification est effectuée par l'essai suivant.