

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Household microwave ovens – Methods for measuring performance

Fours à micro-ondes à usage domestique – Méthodes de mesure de l'aptitude à la fonction



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CONTENTS

FOREWORD.....	5
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	8
4 Classification.....	9
4.1 According to type.....	9
4.2 According to characteristics	9
5 List of measurements	9
6 General conditions for measurements.....	10
6.1 General.....	10
6.2 Supply voltage	11
6.3 Test room	11
6.4 Water.....	11
6.5 Initial condition of the appliance	11
6.6 Control setting	11
6.7 Instruments and measurements	11
6.8 Positioning the appliance	12
7 Dimensions and volume.....	12
7.1 External dimensions.....	12
7.2 Internal dimensions and calculated volume	13
7.2.1 General	13
7.2.2 Internal height	14
7.2.3 Internal width.....	15
7.2.4 Internal depth	15
7.2.5 Reciprocating tray	15
7.2.6 Calculated volume	15
7.3 Dimensions of accessories.....	16
7.3.1 Dimensions of food support	16
7.3.2 Dimensions of grill grids	16
7.4 Overall internal dimensions and overall volume.....	17
7.4.1 General	17
7.4.2 Overall height (H)	17
7.4.3 Overall width (W)	17
7.4.4 Overall depth (D).....	18
7.4.5 Overall volume of rectangular cavities	18
7.4.6 Overall volume of non-rectangular cavities	18
8 Determination of microwave power output	18
9 Efficiency.....	19
10 Energy consumption for the microwave function	19
10.1 Purpose	19
10.2 Test load.....	20
10.3 Preparation	20
10.4 Positioning the load in the appliance.....	20
10.5 Measurement of energy consumption for a cooking cycle.....	20
10.6 Calculation for the energy consumption of a cooking cycle.....	21
10.7 Final result.....	23

10.8	Reporting of test results	23
11	Consumption measurement of low-power modes	23
12	Technical tests for performance	23
12.1	Purpose	23
12.2	Square tank test.....	24
12.2.1	Procedure.....	24
12.2.2	Assessment.....	24
12.3	Multiple beakers test.....	24
12.3.1	Procedure.....	24
12.3.2	Assessment.....	27
13	Heating beverages	27
13.1	Purpose	27
13.2	Procedure	27
13.3	Assessment	28
14	Cooking performance	28
14.1	General.....	28
14.2	Assessment	28
14.3	Tests	29
14.3.1	Egg custard	29
14.3.2	Sponge cake.....	29
14.3.3	Meatloaf	30
14.3.4	Potato gratin.....	31
14.3.5	Cake.....	32
14.3.6	Chicken	33
15	Defrosting performance	33
15.1	Purpose	33
15.2	Assessment	33
15.3	Measurement.....	34
15.3.1	Container.....	34
15.3.2	Ingredients	35
15.3.3	Procedure.....	35
Annex A (informative)	Defrosting raspberries	36
A.1	Purpose	36
A.2	Test method – Raspberries	36
A.2.1	Container.....	36
A.2.2	Ingredients	36
A.2.3	Procedure.....	36
Annex B (informative)	Stirrer.....	37
Annex C (informative)	Glass container for Clause 8 and Clause 10.....	38
Bibliography		39
Figure 1	– External dimensions of the microwave oven	13
Figure 2	– Gauge for measuring these dimensions.....	14
Figure 3	– Internal dimensions.....	14
Figure 4	– Turntable	16
Figure 5	– Examples for determining the entire area and usable area of a grill grid.....	17
Figure 6	– Square tank	22

Figure 7 – Beaker	25
Figure 8 – Position of beakers on rectangular food supports	26
Figure 9 – Position of beakers on the turntable	26
Figure 10 – Beaker position for the test of heating beverages	27
Figure 11 – Shallow dish.....	35
Figure B.1 – Plastic stirring adapter	37
Figure B.2 – Example stirrer	37
Figure C.1 – Example: small beaker (600 ml).....	38
Table 1 – List of measurements	10
Table 2 – Instruments	12
Table 3 – Measurements.....	12
Table 4 – Test loads for measuring the energy consumption	20
Table C.1 – Specification – Glass containers	38

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IEC 60705 has been prepared by subcommittee 59K: Performance of household and similar cooking appliances, of IEC technical committee 59: Performance of household and similar electrical appliances. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2010, Amendment 1: 2014 and Amendment 2: 2018. This edition constitutes a technical revision.

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

- a) thematically ordered new sequence of the clauses;
- b) updated normative references;
- c) introduced a new definition for microwave generator to open the standard for microwave ovens with one or more magnetrons or solid-state components;
- d) aligned with IEC 60350-1:2023 regarding the definitions and references;

- e) aligned preparation of water load for Clause 8 and Clause 10;
- f) removed the definitions for set to off mode and set to standby mode ;
- g) added new definitions regarding low power modes;
- h) aligned the low power mode measurement, Clause 11, to IEC 60350-1:2023;
- i) revised square tank tests to one new 12.2;
- j) revised the dishes used for Clause 12, Clause 13 and Clause 14 and removal of Annex B;
- k) removed A.3.3;
- l) removed Annex F for measuring the energy consumption of the cooling down period;
- m) former Annex E will be substituted by a supporting document located on the IEC's website.

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

Draft	Report on voting
59K/400/FDIS	59K/404/RVD

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

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

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

Words in **bold** in the text are defined in Clause 3.

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

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HOUSEHOLD MICROWAVE OVENS – METHODS FOR MEASURING PERFORMANCE

1 Scope

This document applies to **microwave ovens** for household and similar use, it also applies to **microwave ovens with grills** and **combination microwave ovens**.

This document defines the main performance characteristics of these appliances, which are of interest to the user, and it specifies methods for measuring these characteristics.

The manufacturer defines the primary cooking function of the appliance, **microwave function** or thermal heat. The primary cooking function will be measured with an existing method according to energy consumption.

If the primary cooking function is declared as a **microwave function**, IEC 60705 will be applied for energy consumption measurement. If the primary cooking function is declared as a thermal heat, IEC 60350-1 will be applied for energy consumption measurement. If the manufacturer does not declare the primary function, the performance of the **microwave function** and thermal heat is measured as far as it is possible.

NOTE 1 There is currently no measurement method for the energy consumption for grilling and steam functions.

NOTE 2 This document does not deal with safety requirements (see IEC 60335-2-25 [1]¹).

NOTE 3 This document does not apply to appliances incorporating thermal heat, steam function or hot steam function only. These appliances are covered by IEC 60350-1.

2 Normative references

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

IEC 60350-1:2023, *Household electric cooking appliances – Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance*

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

ISO 80000-1:2022, *Quantities and units – Part 1: General*

¹ Numbers in square brackets refer to the Bibliography.

3 Terms and definitions

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

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

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

3.1

combination microwave function

heat transfer by electromagnetic energy simultaneously or consecutively with energy transfer by a heating function, by hot steam or by steam

Note 1 to entry: For definitions of a heating function, hot steam function and steam function, IEC 60350-1 is relevant.

3.2

combination microwave oven

appliance which can be operated by **microwave function**, **combination microwave function** and heating function

Note 1 to entry: For the definition of a heating function, IEC 60350-1 is relevant.

3.3

food support

horizontal support in the cavity on which the load is placed

Note 1 to entry: If the appliance is fitted with a turntable, the turntable is the **food support**. The **food support** can also be a shelf or a reciprocating tray. If recommended by manufacturer's instruction, also the cavity bottom can be the **food support**.

3.4

microwave function

function using only 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

3.5

microwave function with grill

heat transmission by electromagnetic energy simultaneously or consecutively with energy transfer by radiant heat typically from the top of the cavity

3.6

microwave oven with grill

microwave oven in which microwave energy is combined with grill

3.7

microwave generator

device in an appliance for generating microwave energy, i.e. one or more magnetrons or solid-state components

3.8

microwave oven

appliance using only 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 [2].

3.9**microwave transparent**

property of a material with microwaves passing through, having negligible absorption and reflection

Note 1 to entry: The relative permittivity of a **microwave transparent** material is less than 7 and the relative loss factor is less than 0,015.

3.10**rated voltage**

voltage assigned to the appliance by the manufacturer

4 Classification**4.1 According to type**

Appliances are classified according to their type:

- **microwave oven**,
- **combination microwave oven**,
- **microwave oven with grill**.

The type shall be reported.

4.2 According to characteristics

Appliances are classified according to their characteristics:

- cavity dimensions,
- dimensions of shelves,
- moved **food support**, e.g. reciprocating tray, turntable,
- possible thermal heating modes (grilling, heating function, steam function etc.), combination modes.

The characteristics shall be reported.

5 List of measurements

Table 1 shows which measurement shall be applied for the relevant function.

Table 1 – List of measurements

Measurements	Clause or subclause	Applicable to				
		microwave function	microwave function with grill	microwave function in combination with heating function	microwave function in combination with hot steam	microwave function in combination with steam
Dimensions and volume	7	Applicable to all appliances which are under the scope.				
Microwave power output	8	x	-	-	-	-
Efficiency	9	x	-	-	-	-
Energy consumption	10	x	-	-	-	-
Consumption measurement of low power modes	11	Applicable to all appliances which are under the scope.				
Square tank	12.2	x	-	-	-	-
Multiple beakers	12.3	x	-	-	-	-
Heating beverages	13	x	-	-	-	-
Egg custard	14.3.1	x	-	-	-	x
Sponge cake	14.3.2	x	-	-	-	x
Meatloaf	14.3.3	x	-	-	-	x
Potato gratin	14.3.4	-	x	x	x	-
Cake	14.3.5	-	x	x	x	-
Chicken	14.3.6	-	x	x	x	-
Meat defrosting	15	x	-	-	-	x
For definition of grill, heating function, hot steam function and steam function, IEC 60350-1 is relevant.						

6 General conditions for measurements

6.1 General

Unless otherwise specified, the measurements are made under the following conditions.

When a metal **food support** is provided and used for the measurements, the load position and the corresponding shape of the metal **food support** shall be reported.

If not otherwise specified, the **food support** is placed in the cavity in its lowest position.

NOTE The positioning influences the repeatability of the test results.

If numbers shall be rounded, they shall be rounded according to ISO 80000-1:2022, Clause B.3 Rule B. If the rounding takes place to the right of the comma, the omitted places shall not be filled with zeros.

6.2 Supply voltage

The supply voltage shall be maintained at the main terminal at **rated voltage** $\pm 1\%$, while the microwave operation is switched on. If the appliance has a **rated voltage** range, the tests are carried out at the nominal voltage of the country where the appliance is intended to be used.

The supply frequency shall be at the rated frequency $\pm 1\%$ throughout the test. If a frequency range is indicated, then the test frequency shall be the nominal frequency of the country in which the appliance is intended to be used.

The supply voltage measured during the tests shall be recorded.

The supply voltage shall be essentially sinusoidal.

NOTE 1 For recording the supply voltage, only the power on period is relevant.

NOTE 2 In the case of a fixed cable, the plug (or the end of the cable furthest from the appliance) is the reference point to maintain the voltage.

6.3 Test room

For the tests in Clause 8, Clause 10 and Clause 11, the temperature shall be $23\text{ °C} \pm 2\text{ °C}$ during the entire test.

The measurement of the ambient temperature shall not be influenced by the appliance itself or by any other appliance.

The other tests are carried out in a substantially draught-free room in which the ambient temperature is maintained at $20\text{ °C} \pm 5\text{ °C}$.

6.4 Water

Potable water is used for the tests.

6.5 Initial condition of the appliance

At the beginning of each test, the appliance has not been operated for a period of at least 6 h.

NOTE 1 The period of at least 6 h can be reduced if it can be demonstrated that the temperature of the **microwave generator** and the power supply is within 5 K of the ambient temperature and 2 K of the ambient temperature for tests Clause 8 and Clause 10.

Forced cooling can be used to assist in reducing the appliance temperature.

6.6 Control setting

The tests are carried out with the controls set to give the highest power output. Unless otherwise specified, the measurements are made with boost function, if available.

6.7 Instruments and measurements

Instruments used and measurements made for this document shall comply with the following specifications detailed in Table 2 and Table 3.

Table 2 – Instruments

Parameter	Unit	Minimum resolution	Maximum permissible error	Additional requirements
Mass	g	0,5 g	± 1 g	
Temperature				
– ambient temperature	°C	0,1 °C	± 1 K	
– water load	°C	0,1 °C	$\pm 1,5$ K	1 mm steel tube diameter, class 1 according to IEC 60584-1
Time	s	1 s	± 1 s	
Energy	Wh	–	± 1 %	
Dimensions	mm	1 mm	1 mm	≤ 1 mm or 0,5 % whatever is the greater

Table 3 – Measurements

Parameter	Unit	Minimum resolution	Maximum permissible error	Additional requirements
Electrical energy	Wh		$\pm 1,0$ %	
Voltage	V		$\pm 0,5$ %	
Temperature and energy consumption measurement				Sampling rate ≤ 1 s

6.8 Positioning the appliance

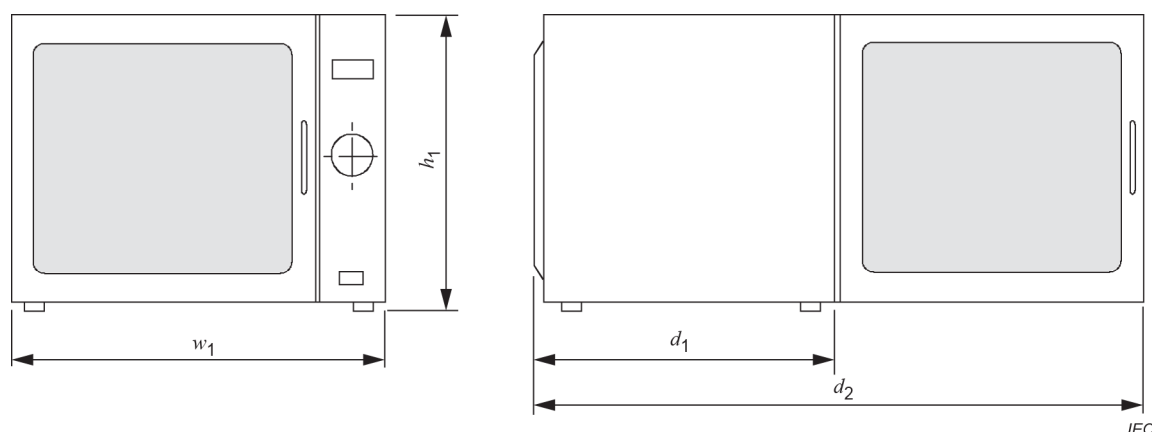
Freestanding appliances are placed with their back against a wall and positioned away from sidewalls, unless otherwise specified in the instructions. Other appliances are installed in accordance with the instructions for installation.

7 Dimensions and volume

7.1 External dimensions

For free-standing appliances or appliances placed on a surface, the overall height, width and depth of the appliance, excluding any knobs and handles on the front surface, are measured. The depth is also measured with the door fully open. The dimensions are shown in Figure 1. If adjustable feet are provided, the height of the appliance is determined with the feet in their minimum and maximum positions.

The dimensions are stated in millimetres.

**Key** h_1 height w_1 width d_1 depth d_2 depth with the door open**Figure 1 – External dimensions of the microwave oven**

For built-in appliances, IEC 60350-1:2023, Figure 3, is applicable.

7.2 Internal dimensions and calculated volume**7.2.1 General**

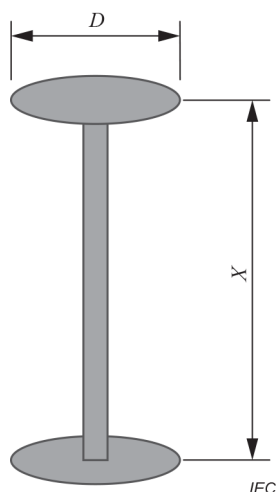
The measurement of the calculated volume is to be carried out at ambient temperature.

For verification purposes, a gauge, as shown in Figure 2, shall be used to determine all of the three dimensions. The gauge shall be used without appreciable force. Dimensions are stated in millimetres.

The height, width and depth of the calculated volume in the cavity shall be measured according to 7.2.2 to 7.2.4. The measurements are shown in Figure 3.

The turntable is essential for the operation of the appliance, therefore it is not removed. How to consider the turntable is shown in Figure 4.

Appliances having an internal height of less than 120 mm are disregarded.



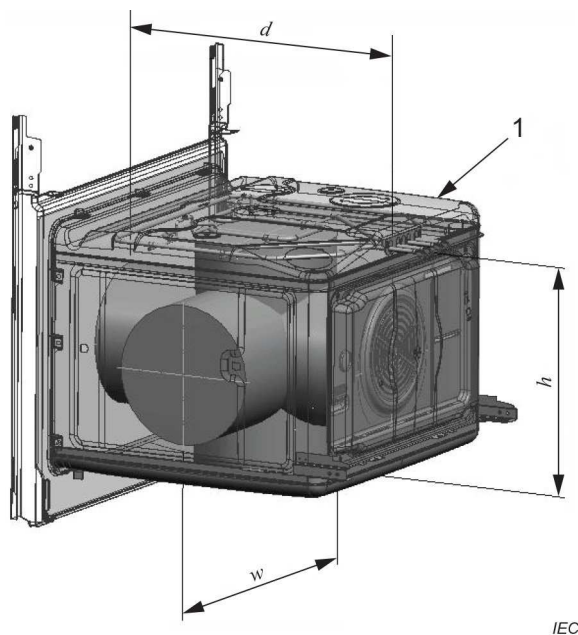
Key

D 200 mm or 120 mm

X dimension to be measured

(See 7.2.2, 7.2.3 and 7.2.4.)

Figure 2 – Gauge for measuring these dimensions



Key

d depth

g heating element

h height

w width

Figure 3 – Internal dimensions

7.2.2 Internal height

The height is the maximum length of a cylinder with a diameter of 200 mm reaching vertically from the centre of the cooking cavity bottom (if it does not have a turntable) or from the turntable to the lowest point on the ceiling. No accessories, such as a grill grid, are inserted.

A lamp, a heating element, or similar object in the area of the cylinder can constitute the lowest point of the ceiling. Protruding parts such as lamp covers, heating elements and fixing hooks shall not be removed or folded away.

In the event that either the width or the depth of the cavity is less than 250 mm, the diameter of the cylinder to be measured shall be reduced to 120 mm.

NOTE The centre of the cavity bottom is defined by the middle of the depth and the middle of the width.

7.2.3 Internal width

The width is the maximum length of a cylinder with a diameter of 200 mm reaching horizontally from the left-hand side wall to the right-hand side wall of the cavity.

In the event that either the height or the depth of the cavity is less than 250 mm, the diameter of the cylinder to be measured shall be reduced to 120 mm.

Side racks shall be removed if they can be removed without a tool. If parts are fixed to or by the side racks, they shall be removed as well.

NOTE 1 A coin or a spoon is not considered as a tool.

NOTE 2 The centre of the side wall of the cavity is defined by the middle of the depth and the middle of the height.

7.2.4 Internal depth

The depth is the maximum length of a cylinder with a diameter of 200 mm reaching horizontally from the centre of the rear wall to the inner face of the closed door.

In the event that either the width or the height of the cavity is less than 250 mm, the diameter of the cylinder to be measured shall be reduced to 120 mm.

For measuring the depth, the gauge is placed on a support in such a way that the axis lies horizontally in the centre of the cavity, the axis being extended slightly over the expected depth. The door is closed carefully so that the gauge is compressed to give the depth.

NOTE The centre of the rear wall of the cavity is defined by the middle of the height and the middle of the width.

7.2.5 Reciprocating tray

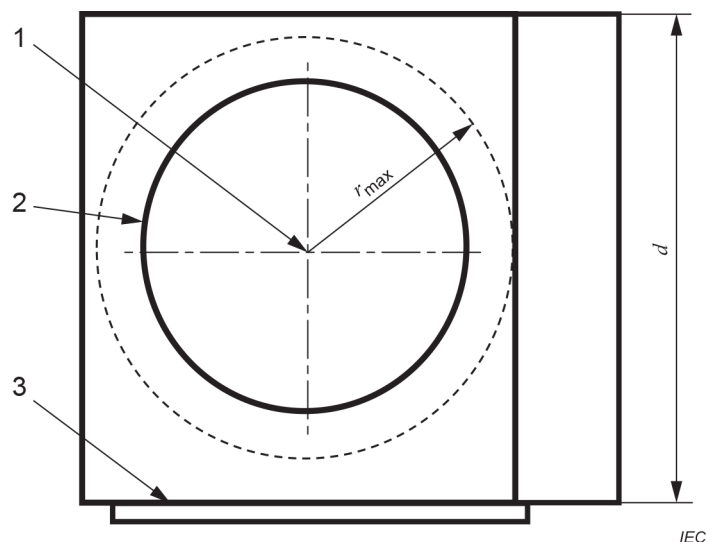
If there is a reciprocating tray, the extent of movement of the tray is measured and subtracted from the internal dimension in the direction of reciprocation as measured above.

7.2.6 Calculated volume

The volume is calculated from these dimensions and is given in litres rounded to the nearest full litre.

If the appliance has a turntable, the base area for the volume is determined by the circular area formed by twice the minimum distance (independent at which height) between the axis of rotation of the turntable and the nearest wall or door multiplied with the internal height, as shown in Figure 4.

If the turntable can be switched off the rectangular volume from the dimension's width, height and depth is calculated. Both circular and rectangular volumes are stated.



Key

d	depth
$r_{\max}$	distance from centre of rotation of the turntable to the nearest wall
1	centre of rotation of the turntable
2	turntable
3	inside surface of the door

Figure 4 – Turntable

If it is permissible to operate the appliance with the cavity divided into two parts by the use of components supplied with the appliance, the volume of each part shall be determined separately and the two volumes are added together.

In any case, the largest achievable volume shall be reported.

7.3 Dimensions of accessories

7.3.1 Dimensions of food support

The width and depth of a rectangular **food support** are measured or for a round **food support**, the diameter is measured. The dimensions are determined 5 mm above the surface of the **food support**.

The surface area is calculated (cm^2), rounded to the nearest 10 cm^2 .

NOTE The **food support** can be a shelf, grid, baking sheet, turntable or the bottom of cavity.

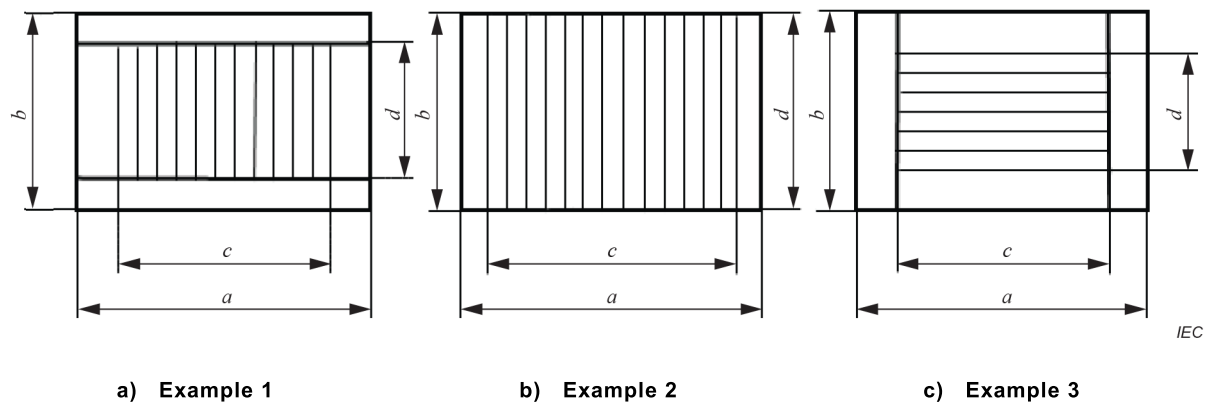
7.3.2 Dimensions of grill grids

7.3.2.1 Entire area

The entire area of the grill grid is determined by measuring the maximum width and the maximum depth of the outer rods. This entire area of the grill grid is calculated and stated in square centimetres, rounded to 10 cm^2 .

7.3.2.2 Usable area

The usable width and usable depth of the grill grid are measured, by considering only the inner grid, which is suitable for placing food. The usable area of the grill grid is calculated and stated in square centimetres, rounded to 10 cm^2 . See Figure 5.



Key

- a* maximum width of the grill grid
- b* maximum depth of the grill grid
- c* usable width of the grill grid
- d* usable depth of the grill grid

Figure 5 – Examples for determining the entire area and usable area of a grill grid

7.4 Overall internal dimensions and overall volume

7.4.1 General

Where the surfaces forming the boundaries of the cavity incorporate protrusions or depressions, the planes used for measurement shall be those comprising the largest percentages of the total areas of the surfaces. Holes in surfaces shall be disregarded when calculating areas for this determination.

The following volumes or spaces shall be disregarded:

- those occupied by removable items specified by the manufacturer as not essential for the operation of the appliance, such as shelves or temperature probes;
- those occupied by radiant heating elements if provided;
- those occupied by minor irregularities in the cooking compartment walls, including covers over waveguides and lamps;
- those occupied by turntables or reciprocating trays, their drive mechanisms and support arrangements;
- corner radii smaller than 10 mm at the intersections of the interior surfaces of the cooking cavity.

Dimensions are stated in millimetres.

7.4.2 Overall height (*H*)

The overall height is the maximum vertical distance in millimetres between the plane of the cooking cavity bottom and the plane of the cavity ceiling.

7.4.3 Overall width (*W*)

The overall width is the maximum horizontal distance in millimetres between the planes of the cavity side walls.

7.4.4 Overall depth (D)

The overall depth is the maximum horizontal distance in millimetres from the plane of the inside surface of the door when closed with the interlocks engaged to the plane of the rear cavity wall.

The overall dimensions of microwave drawers can be measured using the same principles.

7.4.5 Overall volume of rectangular cavities

The overall volume is the total internal volume of the cavity in which cooking takes place and is expressed as the product of H , W and D determined as above, divided by 10^6 and rounded to the nearest full litre.

7.4.6 Overall volume of non-rectangular cavities

At a complex shaped cavity, the following measuring method is considered as one alternative measuring method. Seal all openings of the cavity and fill water to the sealed cavity and separately fill water to the concave space of the door cavity side. The volume is expressed to the nearest full litre.

8 Determination of microwave power output

The measurement is made with a water load in a glass container. The water temperature is initially below ambient temperature and is raised to approximately ambient temperature by heating in the **microwave oven**. This procedure ensures that the heat losses from the water and the container have a minimum effect. However, the procedure requires the water temperature to be measured as adequately as possible.

A cylindrical container of borosilicate glass is used for the test as described in Table 4. It has an external diameter of approximately 190 mm and a height of approximately 90 mm. The mass of the container is to be noted.

At the start of the test, the appliance and the empty container are at ambient temperature.

Water having an initial temperature of $10\text{ °C} \pm 1\text{ °C}$ is used for the test. The water temperature is measured immediately before it is poured into the container.

A quantity of $1\,000\text{ g} \pm 5\text{ g}$ of water is added to the container and its actual mass obtained. The **food support** for microwave heating is placed in the appliance according to the instructions of manufacturers. The container is placed in the centre of this support immediately. The appliance is operated and the time for the water temperature to attain $20\text{ °C} \pm 2\text{ °C}$ is measured. The appliance is then switched off and the container with water is taken out of the cavity. The water is stirred before its temperature is measured with the stirring and measuring device having low heat capacity in accordance with Annex B.

The final water temperature is measured within 60 s.

The microwave power output is calculated from the formula

$$P = \frac{4,187 \times m_{w,m}(T_1 - T_0) + 0,55 \times m_c(T_1 - T_a)}{t} \quad (1)$$

where

P is the calculated microwave power output, expressed in W;

$m_{w,m}$ is the actual measured mass of the water in g;

m_c is the mass of the container in g;

T_a is the ambient temperature in °C;

T_0 is the initial temperature of the water in °C;

T_1 is the final temperature of the water in °C;

t is the heating time, in s, excluding the heating-up time of the **microwave generator**. It starts counting from the moment the appliance reaches 90 % of the nominal input power. The heating up time of solid-state components is ignored.

The microwave power output is reported in watts. The reported value is rounded to the nearest 50 W and for further calculation of the efficiency, the not rounded value is stated.

9 Efficiency

The energy consumed during the test of Clause 8 is measured.

The efficiency of the appliance is calculated from the formula

$$\eta = 100 \frac{Pt}{W_{in}} \quad (2)$$

where

P is the calculated microwave power output (see Clause 8);

t is the heating time, in seconds, excluding the heating-up time of the **microwave generator**;

η is the efficiency;

W_{in} is the total energy consumption in Wh, including the heating-up energy consumption of the **microwave generator**.

The efficiency is stated in per cent, rounded to the nearest whole number.

10 Energy consumption for the microwave function

10.1 Purpose

The purpose of this test is to measure the energy consumption of the appliance by a defined load and temperature rise, which is considered as energy consumption for a cooking cycle. Therefore, three different water loads in glass containers, which have different sizes and shapes are used.

10.2 Test load

Three different test loads as shown in Table 4 are used:

Table 4 – Test loads for measuring the energy consumption

Load	Glass container, cylindrical made of borosilicate glass	Nominal water amount ($m_{w,n}$) pure tap water
Small (s)	External diameter d 90 mm $\pm$ 1 mm External height h 125 mm $\pm$ 1 mm Capacity 600 ml Maximum mass 200 g	275 g $\pm$ 1 g
Middle (m)	External diameter d 140 mm $\pm$ 1 mm External height h 76 mm $\pm$ 1 mm Capacity 900 ml Maximum mass 250 g	350 g $\pm$ 1 g
Large (l)	External diameter d 190 mm $\pm$ 1 mm External height h 90 mm $\pm$ 1 mm Capacity 2 000 ml Maximum mass 450 g	1 000 g $\pm$ 1 g

The properties of the glass containers are indicated in Annex C. The actual mass of the used container (m_c) is determined and noted.

NOTE For calculating the energy consumption, the heat capacity of the beaker is taken into account. Therefore, the theoretical energy in the beaker is calculated.

10.3 Preparation

At the start of the test, the empty glass container and the appliance shall have laboratory ambient temperature (T_a). The initial water temperature (T_0) shall be measured and shall be in the range of 10,0 °C $\pm$ 0,5 °C just before the water is poured into the container. The actual mass of water shall be determined and noted ($m_{w,m}$). Then the filled container is positioned into the appliance in accordance with 10.4. The filled container shall not be stored in the fridge to avoid the rims getting too cold.

10.4 Positioning the load in the appliance

The **food support** for microwave heating is placed in the appliance according to the manufacturers' instructions. The container is immediately placed in the centre of this support.

If no instructions are given, the container is placed in the centre of the turntable or reciprocating tray. If the appliance is not fitted with a turntable or reciprocating tray, the load is placed on the lowest possible **food support** position.

10.5 Measurement of energy consumption for a cooking cycle

The energy consumption for a cooking cycle is measured.

Two tests are performed for each amount of water (see 10.2):

The measurement shall be started by switching the appliance on immediately after the preparation and positioning of the water load. The power control for the **microwave function** is set to the highest possible position. If available, the measurements are made with boost function.

The appliance is operated and the time (t_{high}) for the water to reach a temperature (T_{high}) in between 60 °C and 65 °C is measured. The appliance is then switched off. The water load is removed from the appliance and positioned on a thermally insulating pad. The water is stirred before its temperature is measured with the stirring and measuring devices having low heat capacity in accordance with Annex B.

The appliance is cooled down (see 6.5) and the measurement with the same water load is repeated with a target temperature of 55 °C to 60 °C (T_{low}). The time is measured (t_{low}).

The difference between T_{high} and T_{low} shall be minimum 2 K, otherwise one of the measurements shall be repeated with an adjusted time.

This procedure is carried out for each load defined in 10.2.

The following data shall be recorded for each water load:

- heating time t_{low} and t_{high} in s; including the magnetron filament heating-up time;
- initial temperature T_0 in °C;
- final temperature T_{low} and T_{high} in °C;
- energy consumption W_{low} and W_{high} in Wh;
- ambient temperature (T_a) in °C at the start of the test (when the water is positioned in the appliance);
- actual measured ($m_{w,m}$) and nominal mass of water ($m_{w,n}$) in g.

NOTE 1 The energy consumption of components such as lamps and fans, which are automatically switched on with the appliance, is included in the measurement.

NOTE 2 The recording of the heating time t_{low} and t_{high} is informative and the heating-up time of the **microwave generator** is included.

It is recommended to start with the higher temperature range of 60 °C to 65 °C (T_{high}).

10.6 Calculation for the energy consumption of a cooking cycle

The energy consumption to reach a temperature increase of 50 K (W_{50}) is calculated for each load (see 10.2) using the linear regression based on the measured data points.

The temperature rise (ΔT) is calculated as the difference between the initial temperature T_0 and final temperature T_{high} and T_{low} .

$$\Delta T_{\text{high}} = T_{\text{high}} - T_0 \quad (3)$$

$$\Delta T_{\text{low}} = T_{\text{low}} - T_0 \quad (4)$$

To calculate the total temperature rise, the heat capacity of the container is considered as follows for ΔT_{high} and ΔT_{low} .

$$\Delta T_{\text{high,total}} = \frac{0,55 \times m_c \times (T_{\text{high}} - T_a)}{4,187 \times m_{w,m}} + \Delta T_{\text{high}} \quad (5)$$

$$\Delta T_{\text{low,total}} = \frac{0,55 \times m_c \times (T_{\text{low}} - T_a)}{4,187 \times m_{w,m}} + \Delta T_{\text{low}} \quad (6)$$

where

$m_{w,m}$ is the actual measured mass of the water in g;

m_c is the actual mass of the container in g;

T_0 is the initial temperature of the water in °C;

T_a is the ambient temperature in °C;

T_{low} is the final temperature of the water for the low temperature range in °C;

T_{high} is the final temperature of the water for the high temperature range in °C;

The total temperature rise (ΔT_{total}) is normalized by the actual load.

$$\Delta T_{\text{high, norm}} = \Delta T_{\text{high, total}} \times \frac{m_{w,m}}{m_{w,n}} \quad (7)$$

$$\Delta T_{\text{low, norm}} = \Delta T_{\text{low, total}} \times \frac{m_{w,m}}{m_{w,n}} \quad (8)$$

where

$m_{w,m}$ is the actual measured mass of the water in g;

$m_{w,n}$ is the nominal mass of water in g (275 g, 350 g, 1 000 g);

T_{low} is the final temperature of the water for the low temperature range in °C;

T_{high} is the final temperature of the water for the high temperature range in °C.

The quotient of energy consumption per temperature rise (Q) in Wh/K is calculated.

$$Q = \frac{(W_{\text{high}} - W_{\text{low}})}{(\Delta T_{\text{high, norm}} - \Delta T_{\text{low, norm}})} \quad (9)$$

The energy consumption to heat up the amount of water by 50 K (W_{50}) is calculated.

$$W_{50} = W_{\text{low}} + Q \times (50 - \Delta T_{\text{low, norm}}) \quad (10)$$



W_{50} is determined for the small (s), middle (m) and large (l) load and reported.

10.7 Final result

The final result (W_{final}) is calculated by sum the calculated energy consumption to reach 50 K (see 10.6) from the small (s), middle (m) and large (l) load.

$$W_{\text{final}} = \frac{3 \times W_{50,s} + 6 \times W_{50,m} + 2 \times W_{50,l}}{11} \quad (11)$$

This final energy consumption W_{final} represents the energy consumption for an average cook cycle for microwave cooking energy consumption.

NOTE 1 The weighting factors are related to average household use and represent typical loads.

NOTE 2 The **cooling down period** energy consumption is not taken into account in the final energy consumption.

A supplementary file to calculate the energy consumption and related values is located at <https://www.iec.ch/sc59k/supportingdocuments>. These calculations may be made in any other spreadsheet programs that lead to equal results.

10.8 Reporting of test results

The following data shall be reported:

- microwave power output measured according to Clause 8;
- type of the appliance, available heating function(s);
- fitted with turntable or reciprocating tray;
- position of the loads;
- supply voltage at which the measurements were made;
- energy consumption in Wh, rounded to one decimal according to 10.6 for each load;
- final result per cooking cycle, W_{final} , in Wh, rounded to one decimal according to 10.7.

11 Consumption measurement of low-power modes

For the measurement of low-power modes, the requirements of IEC 60350-1:2023, Clause 14, Annex G, and the relevant definitions in Clause 3, shall be applied.

12 Technical tests for performance

12.1 Purpose

The purpose of these tests is to evaluate uniformity of heating by using water. They offer the advantage of expressing the results numerically. Since heating, cooking and defrosting of food involves the geometry and other characteristics of the load affecting the microwave field distribution, the results of these tests should be used with caution. These water tests are complementary to the performance tests of Clause 14 and Clause 15 and provide additional assessment of heating uniformity.

Water having a temperature of $20\text{ °C} \pm 2\text{ °C}$ is used.