

Household microwave ovens — Methods for measuring performance

The European Standard EN 60705:1999, with the incorporation of amendment A1:2004 and amendment A2:2006, has the status of a British Standard

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Committees responsible for this British Standard

The British Standard is the official English language version of EN 60705:1999 including amendment A1:2004, amendment A2:2006 and Corrigendum March 2005. It is identical with IEC 60705:1999 including amendment 1:2004 and amendment 2:2006. It supersedes BS EN 60705:1995 which will be withdrawn on 2002-04-01.

The UK participation in its preparation was entrusted by Technical Committee CPL/59, Performance of household electrical appliances, to Subcommittee CPL/59/9, Cooking and microwave appliances, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

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Summary of pages

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Household microwave ovens — Methods for measuring performance

(includes amendments A1:2004 and A2:2006)
(IEC 60705:1999 + A1:2004 + A2:2006)

Fours à micro-ondes à usage domestique
Méthodes de mesure de l'aptitude à la fonction
(inclut les amendements A1:2004 et A2:2006)
(CEI 60705:1999 + A1:2004 + A2:2006)

Verfahren zur Messung der
Gebrauchstauglichkeit von
Mikrowellengeräten für den Hausgebrauch und
ähnliche Zwecke
(enthält Änderungen A1:2004 und A2:2006)
(IEC 60705:1999 + A1:2004 + A2:2006)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of document 59H/97/FDIS, future edition 3 of IEC 60705, prepared by SC 59H, Microwave ovens, of IEC TC 59, Performance of household electrical appliances, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60705 on 1999-04-01.

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The following dates were fixed:

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Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only. In this standard, Annex ZA is normative and Annexes A, B and C are informative. Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60705:1999 was approved by CENELEC as a European Standard without any modification.

In the official version, for Annex C, Bibliography, the following notes have to be added for the standards indicated:

- | | |
|--------------------------------|--|
| IEC 60335-2-35 (modified). | NOTE: Harmonized as EN 60335-2-25:1996 |
| IEC 60335-2-90 (not modified). | NOTE: Harmonized as EN 60335-2-90:1997 |
| IEC 60350 (not modified). | NOTE: Harmonized as EN 60350:1999 |

Foreword to amendment A1

The text of document 59K/94/FDIS, future amendment 1 to IEC 60705:1999, prepared by SC 59K, Ovens and microwave ovens, cooking ranges and similar appliances of IEC TC 59, Performance of household electrical appliances, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60705:1999 on 2004-10-01.

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Endorsement notice

The text of amendment 1:2004 to the International Standard IEC 60705:1999 was approved by CENELEC as an amendment to the European Standard without any modification.

Foreword to amendment A2

The text of document 59K/129/FDIS, future amendment 2 to IEC 60705:1999, prepared by SC 59K, Ovens and microwave ovens, cooking ranges and similar appliances of IEC TC 59, Performance of household electrical appliances, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 60705:1999 on 2006-03-01.

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2009-03-01

Endorsement notice

The text of amendment 2:2006 to the International Standard IEC 60705:1999 was approved by CENELEC as an amendment to the European Standard without any modification.



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HOUSEHOLD MICROWAVE OVENS – METHODS FOR MEASURING PERFORMANCE

1 Scope

This International Standard applies to **microwave ovens** for household use. It also applies to **combination microwave ovens**.

This standard defines the main performance characteristics of household microwave ovens which are of interest to the user and specifies methods for measuring these characteristics.

NOTE 1 This standard does not deal with:

- ovens which cannot accept a load having a diameter of ≥ 200 mm;
- safety requirements (see IEC 60335-2-25 [1]* and IEC 60335-2-90 [2]).

NOTE 2 This standard does not apply to ovens incorporating conventional heating means only (see IEC 60350) [3].

2 Normative references

The following referenced documents are indispensable for the application 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.

CISPR 11:1997, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electro-magnetic disturbance characteristics – Limits and methods of measurement*

3 Definitions

For the purpose of this International Standard, the following definitions apply.

3.1

microwave oven

appliance using electromagnetic energy in the ISM frequency band of 2 450 MHz, for heating food and beverages in the cavity.

NOTE 1 The microwave oven may incorporate a browning element.

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

3.2

combination microwave oven

microwave oven in which the microwave energy is combined with thermal energy

* Figures in square brackets refer to the bibliography given in annex C.

3.3

microwave transparent

property of a material having negligible absorption and reflection of microwaves

NOTE The relative permittivity of a microwave transparent material is less than 7 and the relative loss factor is less than 0,015.

3.4

rated voltage

voltage assigned to the appliance by the manufacturer

4 Classification

Appliances are classified according to their type and characteristics.

4.1 According to type

- **microwave ovens;**
- **combination microwave ovens.**

The type of oven shall be stated in the report.

4.2 According to characteristics

- usable cavity dimensions;
- with or without a turntable.

The characteristics of the oven shall be stated in the report.

5 List of measurements

Performance is measured by the tests listed in table 1.

Table 1 – List of measurements

Item of measurement	Clause or subclause	Reproducibility	Microwave ovens ¹⁾	Combination microwave ovens
External dimensions	7.1	Yes	*	*
Usable cavity dimensions	7.2	Yes	*	*
Usable cavity volume	7.3	Yes	*	*
Microwave power output	8	Yes	*	
Efficiency	9	Yes	*	
Square tank	10.1	Yes	*	
Multiple cup	10.2	Yes	*	
Heating beverages	11.1	Yes	*	
Heating simulated food	11.2	Yes	*	
Egg custard	12.3.1	No	*	
Sponge cake	12.3.2	No	*	
Meatloaf	12.3.3	No	*	
Potato gratin	12.3.4	No		*
Cake	12.3.5	No		*
Chicken	12.3.6	No		*
Meat defrosting	13.3	No	*	
Batter	Annex A	No	*	
* Test is applicable.				
¹⁾ Except for the tests of 10.1, these tests are also applicable to combination microwave ovens when operated in the microwave only mode.				

6 General conditions for measurements

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

When a metal turn table or any metal accessories are provided and used for the measurements, the load position and the corresponding shape of the metal turn table or any metal accessories shall be reported, together with the test results.

NOTE The positioning influences the repeatability of the test results.

6.1 Supply voltage

*The appliance is supplied at **rated voltage** ± 1 %. 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. This voltage is stated in the report.*

NOTE The supply voltage should be essentially sinusoidal. Results of the tests may otherwise be affected.

6.2 Test room

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

6.3 Water

Potable water is used for the tests.

6.4 Initial condition of the oven

At the beginning of each test,

- *the temperatures of the magnetron and the power transformer shall be within 5 K of the ambient temperature, or*
- *the oven has not been operated for a period of at least 6 h. However, this period may be reduced if it can be demonstrated that the microwave power output, as determined in clause 8, is available earlier.*

NOTE Forced cooling may be used to assist in reducing the oven temperature.

6.5 Control setting

The tests are carried out with the controls set to give the highest power output.

7 Dimensions and volume

7.1 External dimensions

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.

7.2 Usable cavity dimensions

The usable cavity dimensions provide information on the space available for food containers. Significant protrusions such as stirrer covers are taken into account, but not minor details such as rounded edges.

The usable dimensions are determined as follows:

- *usable height, the vertical distance between the major plane of the shelf and the plane of the ceiling, which is determined by the lowest point within a 100 mm radius from the vertical centre line of the cavity;*
- *usable width, the horizontal distance between the major planes of the side walls;*
- *usable depth, the horizontal distance between the major plane of the inside of the closed door and the major plane of the rear wall;*
- *usable diameter, twice the shortest distance from the centre of rotation of the turntable to the nearest wall or the door.*

An example is shown in figure 2.

Dimensions are stated in millimetres.

7.3 Usable volume

The usable volume provides information for classification of cavity sizes.

The usable volume is calculated from the usable height, width and depth measured in 7.2. For ovens with a turntable, the usable volume is the circular cylinder calculated from the diameter and height.

The volume is stated in litres, rounded to the nearest 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 and the heat capacity of the container have a minimum effect, but in any case a correction factor is introduced. However, the procedure requires the water temperature to be measured accurately.

A cylindrical container of borosilicate glass is used for the test. It has a maximum thickness of 3 mm, an external diameter of approximately 190 mm and a height of approximately 90 mm. The mass of the container is determined.

At the start of the test, the oven 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 container is then immediately placed in the centre of the oven shelf, which is in its lowest normal position. The oven is operated and the time for the water temperature to attain $20\text{ °C} \pm 2\text{ °C}$ is measured. The oven is then switched off and the final water temperature is measured within 60 s.

NOTE 1 The water is stirred before its temperature is measured.

NOTE 2 Stirring and measuring devices are to have a low heat capacity.

The microwave power output is calculated from the formula:

$$P = \frac{4,187 \cdot m_w(T_2 - T_1) + 0,55 \cdot m_c(T_2 - T_0)}{t}$$

where

P is the microwave power output, in watts;

m_w is the mass of the water, in grams;

m_c is the mass of the container, in grams;

T_0 is the ambient temperature, in degrees Celsius;

T_1 is the initial temperature of the water, in degrees Celsius;

T_2 is the final temperature of the water, in degrees Celsius;

t is the heating time, in seconds, excluding the magnetron filament heating-up time.

The microwave power output is stated in watts, rounded off to the nearest 50 W.

9 Efficiency

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

The efficiency of the oven is calculated from the formula:

$$\eta = 100 \frac{Pt}{W_{in}}$$

where

P is the calculated microwave power output in watts;

t is the heating time, in seconds;

η is the efficiency;

W_{in} is the energy input, in watt-seconds.

NOTE The energy input includes the energy consumed during the magnetron filament heat-up time.

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

10 Technical tests for performance

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 clauses 11 to 13 and provide additional evaluation of heating uniformity.

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

The microwave power output measured according to clause 8 is used to calculate the heating times corresponding to the energy values given for the various loads.

10.1 Square tank test

10.1.1 Procedure

The tank specified in figure 3 is filled with $1\ 000\text{ g} \pm 10\text{ g}$ of water. The water temperature is measured. The tank is placed centrally on the shelf, one side being parallel to the front of the oven. The oven is operated for a time corresponding to an output energy of 100 kW.

The tank is removed from the oven. The water temperature is measured within 30 s after the end of the heating period.

NOTE The temperature measurement is facilitated by using equipment having 25 thermocouples.

If the oven has more than one shelf position, the test is carried out with the tank on each position in turn.

10.1.2 Evaluation

The minimum and maximum values of the temperature rises of the nine inner compartments are calculated as percentages of the average temperature rise of all 25 compartments.

The minimum and maximum values of the temperature rises of the 16 outer compartments are calculated as percentages of the average temperature rise of all 25 compartments.

The calculated values are stated, rounded to the nearest whole number.