FOREWORD
(Formal clause will be added later)

This standard covers performance requirements of microwave ovens.

This standard was first published in 1986 and was first revised in 1995. This second revision has been contemplated with a view to align with the latest international practices and to specify performance and microwave efficiency requirements.

This first revision includes the following significant technical changes:

a) the usable volume is renamed to calculated volume and the measurement method for the calculated is revised (see **7.2**)

b) new definitions for microwave function, combination microwave function, set to off mode, set to standby mode, cooling down period and food support in **3**;

c) a method for measuring the energy consumption of the microwave function in **14**;

d) more precise requirements for instruments and measurements in Table 2;

e) additional product specific requirements for measuring the energy consumption of low power modes in **15**;

f) a method for measuring the energy consumption for the cooling down period in Annex F.

g) the definition of rounding is given in 3.5;

h) the usable volume and the overall volume are respectively determined in 7.2 and 7.3.

While preparing this standard assistance has been derived from IEC Publication 60705: 2010 and Amendment 1, 2014 'Methods of measuring the performance of microwave oven for household and similar purposes'.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2: 1960 'Rules for rounding off numerical values (revised) '. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

MICROWAVE OVENS FOR HOUSEHOLD AND SIMILARPURPOSES - SPECIFICATION

(Second Revision)

SCOPE

1.1 This standard covers general, safety, performance requirements and methods of test for measuring performance of microwave oven for household and similar purposes designed for connection to supplies at a voltage not exceeding 250 V a.c. single phase, 50 Hz.

This 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 it specifies methods for measuring these characteristics.

NOTES:

1 This standard does not deal with

i) microwave ovens which cannot accept a load having a diameter of ≥ 200 mm or a height of ≥ 120 mm;

ii) safety requirements specified in IS 302-2-25.

2 This standard does not apply to ovens incorporating conventional heating means only.

The safety requirements of microwave oven covered under the scope of this standard is given in IS 302-2-25. Before commencement of the tests specified this standard, microwave oven shall be subjected to all the tests specified in IS 302-2-25.

2 REFERENCES

2.1 The Indian Standards listed below are necessary adjuncts to this standard:

IS No	*Title*
302 (Part 1)	Safety of household and similar electrical appliances : Part 1 General requirements
302-2-25	Safety of household and similar electrical appliances : Part 2 Particular requirement, Section 25 Microwave oven
IEC 60584-2	Thermocouples – Part 2: Tolerances
IS/IEC 62301:2011(under preparation)	Household electrical appliances – Measurement of standby power
IS/IEC 60350-1(under preparation)	Household electric cooking appliances – Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance
IS/IEC 60350-1(under preparation)	Household electric cooking appliances – Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance

3 TERMINOLOGY

Following definitions shall apply in addition to those given in IS 302-2-25.

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: ISM frequency bands are the electromagnetic frequencies established by the ITU and reproduced in **CISPR 11 [4].**

3.2 Combination Microwave Oven

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

NOTE: Energy transfer by steam is included in the term thermal heat.

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

3.5 Microwave Function

Heat transfer exclusively by electromagnetic energy in the ISM frequency band of 2 450 MHz

3.6 Combination Microwave Function

Heat transfer by electromagnetic energy simultaneously or sequentially with thermal heat

NOTE: Thermal heat can be a conventional heating function, a forced air circulation function, a hot steam function or steam function. These functions are defined in 3.12 to 3.15 of IS/IEC 60350-1:2011.

3.7 Set to Off Mode

Action where the product is switched off using appliance controls or switches that are accessible and intended for operation by the user during normal use to attain the lowest power consumption that may persist for an indefinite time while connected to a main power source and used in accordance with the manufacturer’s instructions

NOTES:

1 All actions required to set to off mode like for example empty the water tank, remove food, close the door, etc. have to be taken.

2 Definition of OFF mode is given in IS/IEC 62301.

3.8 Set to Standby Mode

Action where the product is switched to standby using appliance controls or switches that are accessible and intended for operation by the user during normal use to attain the lowest power consumption that may persist for an indefinite time while connected to a main power source and used in accordance with the manufacturer's instructions

NOTE: Definition of "standby mode" is given in IS/IEC 62301.

3.9 Cooling Down Period

Unstable condition persisting after completion of the active mode and the appliance is **set to off mode** where the power consumption may change without any intervention by the user

3.10 Food Support

Horizontal support in the cavity on which the load is placed

NOTE: 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.

4 CLASSIFICATION

Appliances are classified according to their type and characteristics.

4.1 According to Type

a) Microwave ovens
b) Combination microwave ovens

The manufacturers shall define the primary cooking function of the appliance, microwave function or thermal heat. The primary cooking function has to be measured with an existing method according to energy consumption.

If the primary cooking function is declared as a microwave function, the requirements given in this standard shall be applied for energy consumption measurement. If the primary cooking function is declared as a thermal heat in that case IS/IEC 60350-1 shall be applied for energy consumption measurement.

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

The type of oven shall be stated in the report.

4.2 According to Characteristics

Usable cavity dimensions

a) Dimensions of shelves
b) Moved food support, e.g. reciprocating tray, turntable
c) Possible thermal heating modes (grilling, hot air, steam function etc.).

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

5 LIST OF MEASUREMENTS

5.1 Performance shall be measured by the tests listed in Table 1.

Table 1
List of Measurements
(Clause 5.1)

Item of measurement	Clause/ sub-clause	Reproducibility	Microwave ovens [a]	Combination microwave ovens
External dimensions	7.1	Yes	*	*
Usable cavity dimensions	7.2	Yes	*	*
Calculated cavity volume	7.3	Yes	*	*
Microwave power output	8	Yes	*	
Efficiency	9	Yes	*	
Square tank	11.1	Yes	*	
Multiple cup	11.2	Yes	*	
Heating beverages	12.1	Yes	*	
Heating simulated food	12.2	Yes	*	
Egg custard	13.3.1	No	*	
Sponge cake	13.3.2	No	*	
Meatloaf	13.3.3	No	*	
Potato gratin	13.3.4	No		*
Cake	13.3.5	No		*
Chicken	13.3.6	No		*
Meat defrosting	13.3	No	*	
Energy consumption for the microwave function	14	Yes	*	
Consumption measurement of low power modes	15	Yes	*	*
* Test is applicable.				
[a] Except for the tests of **11.1**, these tests are also applicable to combination microwave ovens when operated in the microwave only mode.				

The methods described in **8** and **14** are only applicable for appliances with microwave function. If a combination microwave oven does not provide a microwave function the tests are not applicable. The energy consumption measurement cannot be carried out with combined microwave function.

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 have to be rounded, they shall be rounded to the nearest 50 W according to IS: 2. If the rounding takes place to the right of the decimal, 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 ±1 percent, 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 rated frequency ± 1 percent.

The supply voltage measured during the tests shall be recorded.

The supply voltage shall be essentially sinusoidal.

NOTES:

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

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 given in **8, 14** and **15** the temperature shall be 27 °C ± 2 °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 23 ± 5 ºC.

6.4 Water

Potable water conforming to IS shall be used for the tests.

6.5 Initial Condition of the Oven

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

NOTES:

1 The period of at least 6 h can be reduced if it can be demonstrated that the temperatures of the magnetron and the power supply is within 5 K of the ambient temperature and 2 K of the ambient temperature for tests **8** and **14.**

2 Forced cooling may be used to assist in reducing the oven 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
(Clause 6.7)

Parameter	Unit	Minimum Resolution	Minimum Accuracy	Additional Requirements
Mass	g	0.5 g	± 1 g	-
Temperature				
Ambient Temperature	°C	0.1 °C	± 1 K	-
Water Load	°C	0.1 °C	± 1.5 K	1 mm steel tube diameter, class 1 according to IS/IEC 60584-2
Time	s	1 s	± 1 s	-
Energy	Wh	–	± 1 percent	-

Table 3
Instruments
(Clause 6.7)

Parameter	Unit	Minimum Resolution	Minimum Accuracy	Additional Requirements
Electrical energy	Wh	-	± 1.0 percent	-
Voltage	V	-	± 0.5 percent	-
Temperature and energy consumption measurement		-	-	sampling rate ≤ 1s
For test of **15** and Annex F the power measurement requirements shall be in accordance with IS/IEC 62301	W	-	-	according to IS/IEC 62301

6.8 Positioning the Appliance

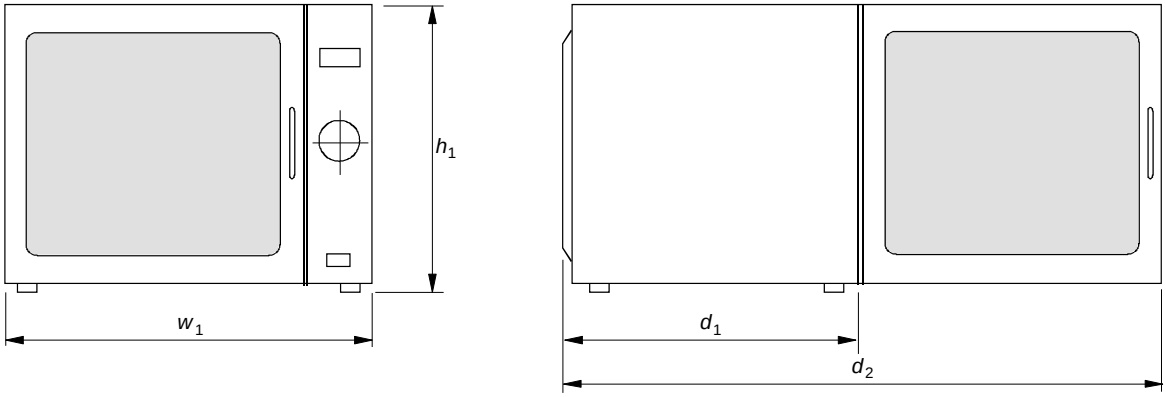
Freestanding appliances are placed with their back against a wall and positioned away from sidewalls, unless otherwise specified in the instructions. Other appliances are installed in accordance with the instructions for installation.

7 DIMENSIONS AND VOLUME

7.1 External Dimensions

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 Fig. 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.



h_1 height

w_1 width

d_1 depth

d_2 depth with the door open

Figure 1 - External Dimensions of the Microwave Oven

7.2 Usable Internal Dimensions and Calculated Volume

7.2.1 General

Removable items specified in the user instructions to be not essential for the operation of the appliance in the manner for which it is intended shall be removed before measurement is carried out.

The turntable is essential for the operation of the appliance therefore it is not removed.

> **NOTE**- Safe operation should be guaranteed. Therefore, necessary parts, for example, lamp cover, shall not be removed for measuring the calculated volume.

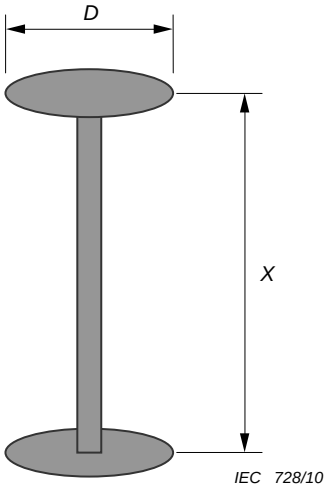
The measurement of the usable oven volume is to be carried out at ambient temperature.

The height, width and depth of the calculated volume in the cavity shall be measured according to tests specified in **7.2.2** to **7.2.4**.

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

Dimensions are stated in millimetres.

Microwave ovens having a usable height of less than 120 mm are disregarded.



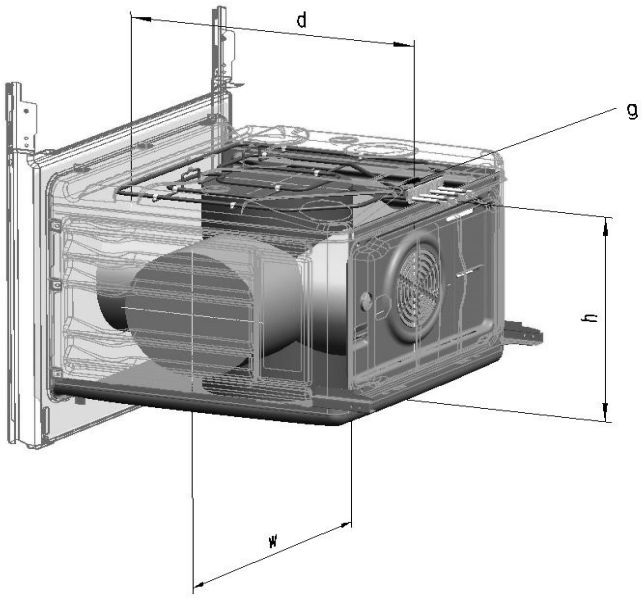
Key

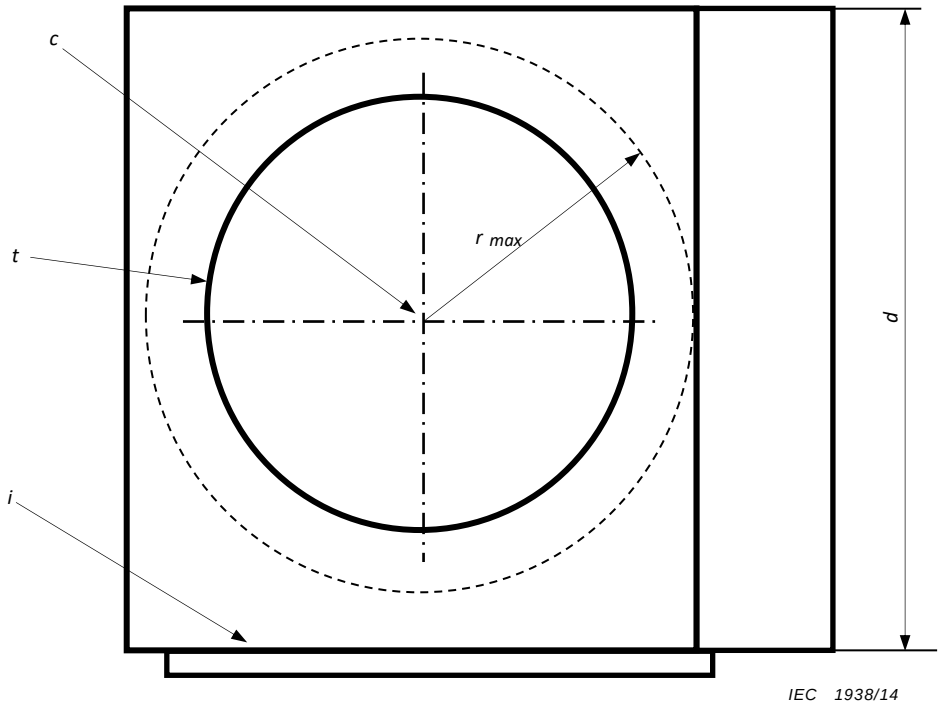
D = 200 mm or 120 mm

X = dimension to be measured

(*See* **7.2.2, 7.2.3** and **7.2.4**)

Figure 2a – Gauge for Determining the Usable Volume





Key

d	usable depth	*t*	turntable
g	heating element	*i*	inside surface of oven door
h	usable height	*w*	usable width
c	centre of rotation of the turntable	r_{max}	distance from c to the nearest wall

Figure 2b - Example of Usable Cavity Dimensions

Figure 2 – Usable Internal Dimensions

7.2.2 Usable Height

The usable 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. The lowest point of the ceiling can be constituted by a lamp, a heating element or similar object in the area of the cylinder.

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 usable depth and the middle of the usable width.

7.2.3 Usable Width

The usable 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.

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

7.2.4 Usable Depth

The usable 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 usable 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 usable depth. The door is closed carefully so that the gauge is compressed to give the usable depth.

NOTE-The centre of the rear wall of the cavity is defined by the middle of the usable height and the middle of the usable 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 usable dimension in the direction of reciprocation as measured above.

7.2.6 Calculated Volume

The usable 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 usable volume is determined by the circular area formed by twice the minimum distance between the axis of rotation of the turntable and the nearest wall or door multiplied with the usable height.

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.

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.

7.2.7 *Dimensions of Food Support*

The usable width and usable 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 in the units of cm^2, rounded to the nearest 10 cm^2.

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

7.3 Overall internal dimensions and overall volume

7.3.1 *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:

a) those occupied by removable items specified by the manufacturer as not essential for the operation of the appliance, such as shelves or temperature probes;

b) those occupied by radiant heating elements if provided;

c) those occupied by minor irregularities in the cooking compartment walls, including covers over waveguides and lamps;

d) those occupied by turntables or reciprocating trays, their drive mechanisms and support arrangements;

e) corner radii smaller than 10 mm at the intersections of the interior surfaces of the cooking cavity.

Dimensions are stated in millimetres.

7.3.2 *Overall Height (H)*

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

7.3.3 *Overall Width (W)*

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

7.3.4 *Overall Depth (D)*

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.

NOTE: The overall dimensions of microwave drawers may be measured using the same principles.

7.3.5 *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 litre.

7.3.6 *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 litre.

8 DETERMINATION OF MICROWAVE POWER OUTPUT

8.1 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 as described in **14**, 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 oven and the empty container are at ambient temperature. Water having an initial temperature of 15 ± 1ºC is used for the test. The water temperature is measured immediately before it is poured into the container.

A quantity of 1 000 g ± 5 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 oven is operated and the time for the water temperature to attain 27 ± 2 C is measured. The oven is then switched off and the final water temperature is measured within 60 s.

NOTES:

1 The water is stirred before its temperature is measured.

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

The microwave power output is calculated from the formula

$$P = \frac{4{,}187 \cdot m_{\mathrm{w}}(T_1 - T_0) + 0{,}55 \cdot m_{\mathrm{c}}(T_1 - T_{\mathrm{A}})}{t}$$

where

P is the microwave power output (W);

m_{w} is the mass of the water (g);

m_{c} is the mass of the container (g);

T_{A} is the ambient temperature (°C);

T_0 is the initial temperature of the water (°C);

T_1 is the final temperature of the water (°C);

t is the heating time (s), excluding the magnetron filament heating-up time.

The microwave power output is stated in watts, rounded 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

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

where

P is the calculated microwave power output in watts;

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

η is the efficiency;

W_{in} is including the magnetron filament heating-up energy consumption.

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

The efficiency is stated in per cent, rounded to the nearest whole number and shall be not less than 54 percent.

10 TECHNICAL TESTS FOR PERFORMANCE

10.1 General

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

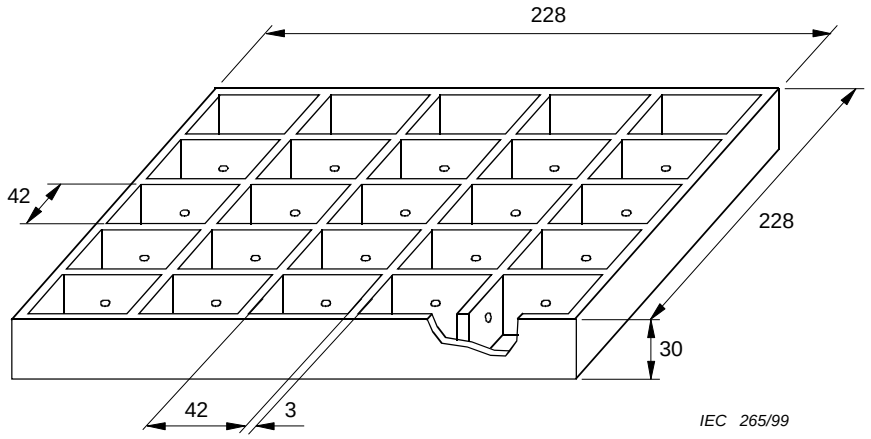
Water having a temperature of 25± 2º C is used.

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

10.2 Square Tank Test

10.2.1 *Procedure*

The tank specified in Fig 3 is filled with 1 000 g ± 10 g of water.



NOTES:

1 There is a small hole approximately in the centre of each separator.

2 The tank is made from microwave transparent material.

Figure 3 – Square Tank

The water temperature is measured. The tank is placed centrally on the food support; 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·s.

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.

10.2.2 Evaluation

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

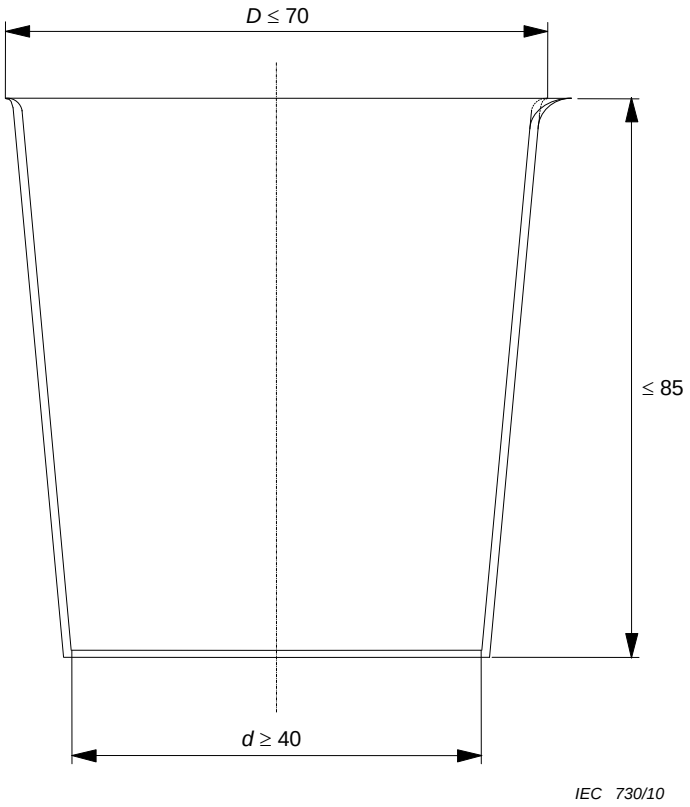
The minimum and maximum values of the temperature rise of the 16 outer compartments are calculated as percentages of the average temperature rise of all 25 compartments.

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

10.3 Multiple Cup Test

10.3.2 Procedure

The five cups as specified in Figure 4 are immersed in water to equalise the temperature.



Dimensions in millimetres

NOTES:

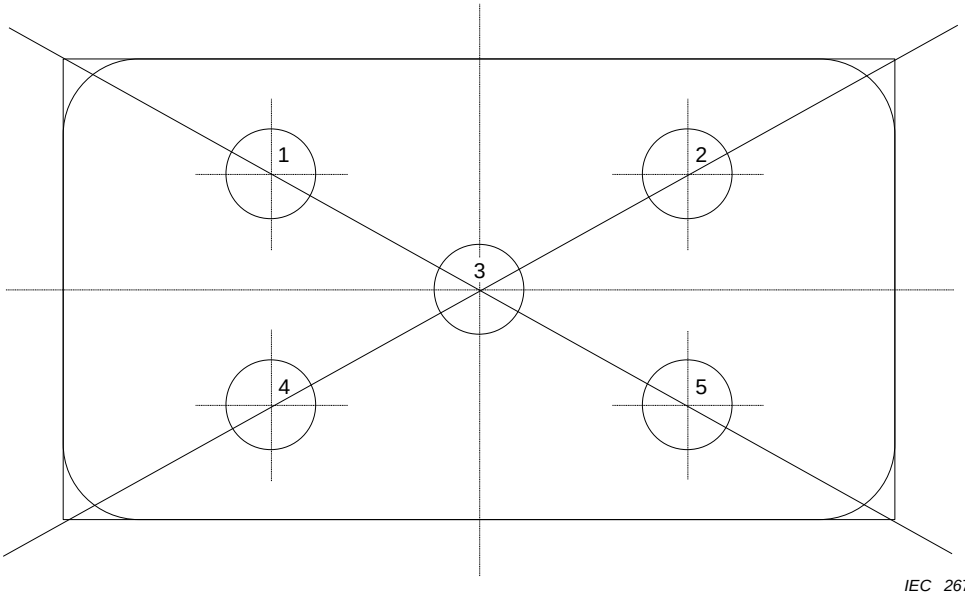
1 The cup is made from thin wall microwave transparent material and has a circular cross-section

2 Possible supplier: Schott Duran Beaker, catalogue number: 21 11 624, high form, with sprout, capacity: 100 ml, external diameter at the bottom: 48mm, height: 80 mm.

3 Schott Duran Beaker is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by BIS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Figure 4 – Cup

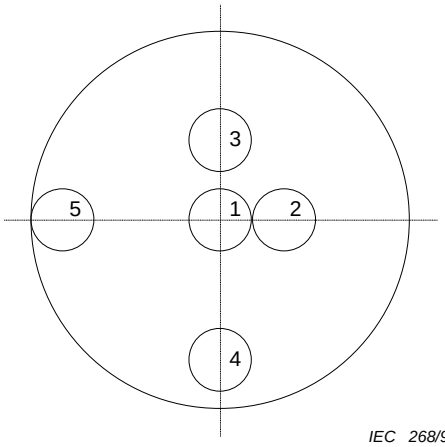
The cups are then removed from the water and dried on the outside. Each cup is filled with 100 g ± 1 g of water and placed on a pad of thermal insulation. The water temperature is measured and the cups are placed on the food support as shown in Fig. 5. They are then heated for a time corresponding to an output energy of 50 kW·s.



IEC 267/99

Cup 3 is placed at the centre of the **food support**. The other cups are placed on the diagonal midway between the centre and each corner.

Figure 5a – Position of Cups on Rectangular Food Supports



IEC 268/99

Cup 1 is at the centre of the turntable.

Cup 2 is contiguous with cup 1.

Cup 3 is centred at distance r/3 + d/2 from the centre of the turntable.

Cup 4 is centred at distance 2r/3 from the centre of the turntable.

Cup 5 is contiguous with the edge of the turntable.

r is the radius of the turntable.

d is the maximum diameter of the cup.

Figure 5b – Position of Cups on the Turntable

Figure 5 – Cup Positions for the Test of 10.3

The cups are removed from the oven and replaced on the pad. The water is stirred and its temperature is measured. The measurements are carried out in numerical order of the cups and within 30 s after the end of the heating period.

The test is repeated; the final temperatures being measured in the reverse order.

***10.3.3** Evaluation*

The average temperature rise of the water is calculated for each cup position. The difference between the maximum and minimum of the five values is then calculated and divided by the total average temperature rise.

The result is stated as a percentage, rounded to the nearest whole number.

11 HEATING PERFORMANCE

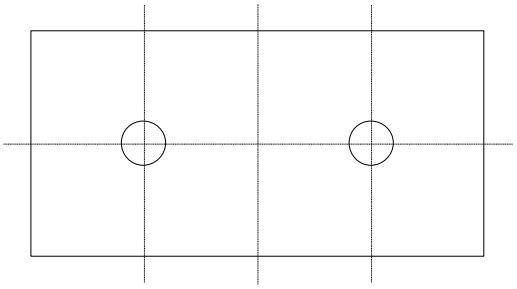
11.2 Heating Beverages

***11.2.2** General*

The purpose of the test is to evaluate the evenness of temperatures and the heating time when the oven is used for heating beverages.

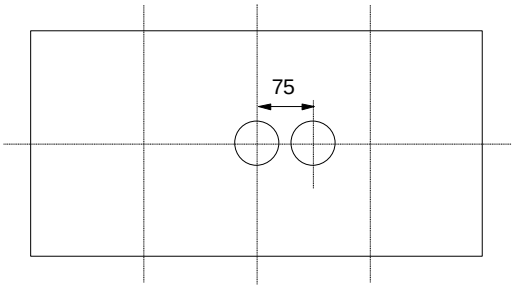
***11.2.3** Procedure*

Two cups, as specified in Fig 4, are each filled with 100 g ± 2 g of water having a temperature of 25 ± 2º C. The actual water temperature is measured. The cups are placed on the food support in the position shown in Fig. 6a or 6c.



IEC 269/99

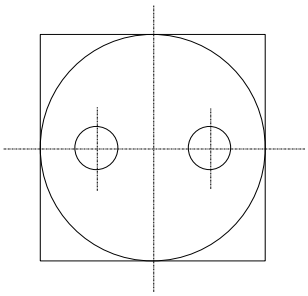
Figure 6a – First Position for Rectangular Food Supports



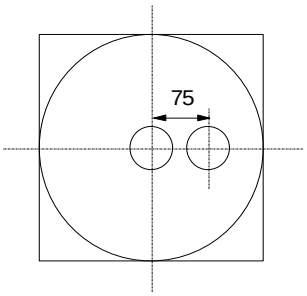
IEC 270/99

Dimensions in millimetres

Figure 6b – Second Position for Rectangular Food Supports



IEC 271/99



IEC 272/99

Dimensions in millimetres

Figure 6c – First position for turntables **Figure 6d – Second position for turntables**

Figure 6 – Cup position for the test of 11.1

The oven is operated until the average temperature of the two cups is 80 ± 5 ºC, the heating time being measured. After heating, the cups are removed from the oven and placed on a pad of thermal insulation. The water is stirred and the temperatures measured within 10 s of the end of the heating period.

NOTE-The heating time includes the magnetron filament heat-up time.

The test is repeated but with the cups placed in the position shown in Fig. 6b or 6d, the heating time being the same.

If the average water temperature of the four cups is not within the range 80 ± 5 ºC, the test is repeated to achieve this condition by adjusting the heating time.

11.1.3 *Evaluation*

The heating time is calculated for a 60 K temperature rise. The result is stated, rounded to the nearest second.

The average water temperature rise of the four cups is calculated. The maximum deviation from the average is divided by the average temperature rise. The result is stated as a percentage variation, rounded to the nearest whole number.

11.2 Heating Simulated Food

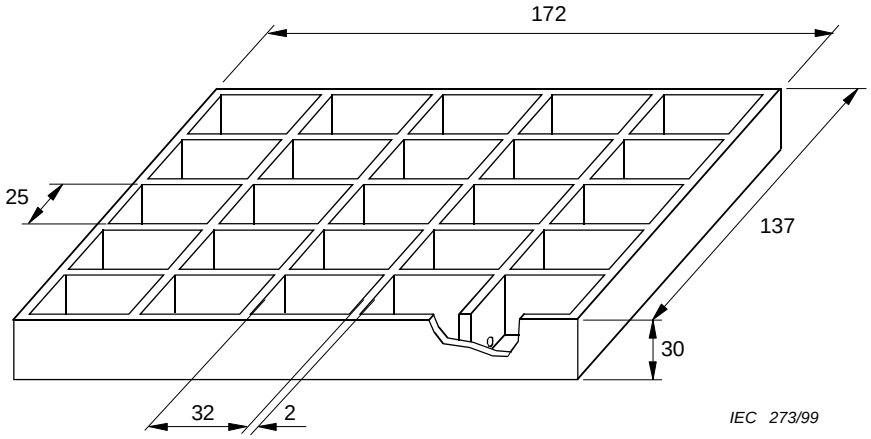
11.2.1 *Test Purpose*

The purpose of the test is to evaluate the ability of the oven to heat uniformly by using a simulated food load.

NOTE-The results are intended to be used to assess the evenness of heating a single portion of food.

11.2.2 Procedure

The tank specified in Fig. 7 is cooled to approximately 10 º C. It is filled with 400 g ± 4 g of water having a temperature of 10 ± 2 º C.



Dimensions in millimetres

NOTES:

1 There is a small hole in each separator at the bottom of the compartment.

2 The tank is made from microwave transparent material.

Figure 7 – Rectangular Tank

The tank is placed in the centre of the food support with the longer sides parallel to the front of the oven. A fixture incorporating 25 regularly spaced thermocouples is placed on the tank and the water is stirred. The water temperature of each compartment is measured. The fixture is removed and the oven is operated within 15 s of the measurement.

The tank is heated until the highest temperature is 40 ± 5 º C.

With the tank still in the oven, the fixture is placed on the tank so that the thermocouples are located centrally in each compartment and approximately 10 mm above the bottom, taking care not to stir the water. The temperatures are measured within 30 s of the end of the heating period.

11.2.3 *Evaluation*

The average temperature rise of all the compartments is calculated. The highest and lowest temperature rises are each divided by the average.

The results are stated as percentage variations, rounded to the nearest whole numbers.

12 COOKING PERFORMANCE

12.1 General

This clause provides test methods using foodstuffs to assess the cooking, baking and roasting performance of the oven. The tests are carried out in accordance with the manufacturer’s instructions for the various types of foods using borosilicate glass dishes having a maximum thickness of 6 mm.

NOTE-Unless otherwise specified by the manufacturer, the tests are carried out using all modes of operation provided, such as a fixed and rotating shelf.

12.2 Evaluation

The speed, result and convenience of using the oven are evaluated.

Speed is the total cooking time including rest periods. It does not include any standing period after heating.

The result is evaluated by assessing:

a) uniformity of cooking, baking, browning or roasting in terms of appearance and texture compared with expected results;
b) parts which are not baked or cooked in terms of size and position;
c) burnt areas of browned foods in terms of size and position.

The results may be evaluated as follows:

a) no overcooking and no undercooking;
b) some parts slightly overcooked or some parts slightly undercooked;
c) some parts slightly overcooked and some parts slightly undercooked;
d) some parts overcooked and some parts undercooked;
e) some parts very overcooked and some parts very undercooked.

Convenience is evaluated by noting the number of procedures required during cooking.

Examples;

a) Separation of the food or removal of parts of it
b) Manual turning of the food
c) A resting period and manual restarting

NOTE-Initial setting procedures for the controls are not evaluated.

12.3 Tests

12.3.1 *Egg Custard*

12.3.1.1 *Purpose of Test*

The purpose of this test is to evaluate the cooking uniformity of a large square food of moderate thickness.

12.3.1.2 *Container*

Square dish having

a) height of 50 mm ± 10 mm;
b) area at the top dimensions of the dish 500 cm^2 ± 50 cm^2.

The height of the food is 20 mm ± 3 mm, its nominal mass being 1 000 g.

If this dish is too large for the oven, a smaller dish providing an area at the top dimensions of the dish 410 cm^2 ± 40 cm^2 may be used instead. In this case the height of the food is 20 mm ± 3 mm, its nominal mass being 750 g.

12.3.1.3 *Ingredients*

750 g fresh milk with a fat content of 3 % to 4 %

375 g beaten eggs

125 g white castor sugar

NOTE-Milk should not be diluted using water to achieve the specified fat content. If dilution is required, it should be carried out using a combination of full-fat and semi-skimmed milk.

12.3.1.4 *Procedure*

Heat the milk to approximately 60 º C. Beat the eggs and pour the milk over them. Add the sugar and beat at medium speed using a food mixer. Strain and pour the mixture into the container. Cover with cling film and place in a refrigerator until the temperature of the mixture is 5 º C ± 2 º C.

Remove the cling film and cook according to the manufacturer's instructions for this type of food. If instructions are not provided, place the dish in the centre of the food support with its sides parallel to the door. The test may be repeated at a reduced power level if this is considered appropriate after evaluation.

Remove the dish from the oven. Make the evaluation after a period of 2 h.

12.3.2 *Sponge Cake*

12.3.2.1 *Purpose of Test*

The purpose of this test is to evaluate the baking uniformity of a circular, thick, expanding food.

12.3.2.2 *Container*

A circular dish having

a) a height of 50 mm ± 10 mm;

b) an external diameter of 220 mm ± 10 mm.

The height of the food is 20 mm ± 2 mm, its nominal mass being 475 g.

12.3.2.3 *Ingredients*

170 g soft white wheat flour, low gluten content

170 g white castor sugar

10 g baking powder

100 g water

50 g margarine with a fat content of 80 to 85 percent

125 g beaten eggs

Baking paper approximately 200 mm diameter.

12.3.2.4 *Procedure*

Ensure that the ingredients are at room temperature. Whisk the eggs and sugar for 2 min to 3 min and add the melted margarine. Gradually add the flour, baking powder and water. Place the baking paper in the bottom of the dish and pour in the batter.

Within 10 min of mixing, place the dish in the oven and cook according to the manufacturer's instructions for this type of load. If instructions are not provided, place the dish in the centre of the food support. The test may be repeated at a reduced power level if this is considered appropriate after evaluation.

Remove the dish from the oven. After a period of 5 min, measure the maximum and minimum heights of the cake. Cut the cake into eight pieces and make the evaluation.

12.3.3 *Meatloaf*

12.3.3.1 *Purpose of Test*

The purpose of this test is to evaluate cooking uniformity of a thick, rectangular food.

12.3.3.2 *Container*

Rectangular dish having

a length to width ratio of approximately 2.25 to 1;

a height of 75 mm ± 15 mm;

an area at the top of the dish of 225 cm^2 ± 25 cm^2.

The height of the food is 45 mm ± 3 mm, its nominal mass being 900 g.

12.3.3.3 *Ingredients*

800 g minced beef with a maximum fat content of 20 percent

115 g beaten eggs

2 g salt

Clingfilm

12.3.3.4 *Procedure*

Beat the eggs and mix in the minced beef and salt. Place the mixture in the dish and compact it as much as possible to ensure that there are no air pockets and that the surface is flat. Cover with the Clingfilm and place in a refrigerator until the temperature of the mixture is 5 º C ± 2 º C.

Remove the Clingfilm and cook according to the manufacturer's instructions for this type of food. If instructions are not provided, place the dish in the centre of the food support with the longer sides parallel to the door. The test may be repeated at a reduced power level if this is considered appropriate after evaluation.

Remove the dish from the oven. After a period of 5 min, measure the temperature in the centre of the meatloaf. Cut the meatloaf vertically into six equal sections and make the evaluation.

12.3.4 *Potato Gratin*

12.3.4.1 *Purpose of Test*

The purpose of this test is to evaluate the cooking and browning uniformity of a large circular food of moderate thickness.

12.3.4.2 *Container*

A circular dish having

a) a height of 50 mm ± 10 mm;

b) an external diameter of 220 mm ± 10 mm.

The height of the food is approximately 40 mm, its nominal mass being 1,1 kg.

12.3.4.3 *Ingredients*

750 g peeled potatoes, firm texture

100 g shredded cheese with a fat content between 25 to 30 percent

50 g beaten eggs

200 g mixture of milk and cream with a fat content between 15 to 20 percent

5 g salt

12.3.4.4 Procedure

Cut the potatoes into slices of 3 mm to 4 mm thickness. Fill the ungreased dish with approximately half the amount of potatoes and cover with about half of the cheese. Add the remaining potatoes and cover with the remaining cheese. Mix the eggs, cream and salt together and pour the mixture over the potatoes.

Cook according to the manufacturer's instructions for this type of food. The microwave and thermal energy may be used simultaneously or sequentially in accordance with the instructions. If instructions are not provided, set the controls so that the microwave power level is in the range of 300 W to 400 W and the thermal heating results in a temperature of 180 º C to 220 º C. The cooking time is 20 min to 30 min.

Remove the dish from the oven. After a period of 5 min, make the evaluation.

The test may be repeated at different control settings if this is considered appropriate after evaluation.

12.3.5 *Cake*

12.3.5.1 *Purpose of Test*

The purpose of the test is to evaluate the baking and browning uniformity of a circular, thick, expanding food.

12.3.5.2 *Container*

Circular dish having

a height of 50 mm ± 10 mm;

an external diameter of 230 mm ± 10 mm.

The height of the food is 22 mm ± 3 mm, its nominal mass being 700 g.

12.3.5.3 *Ingredients*

250 g soft white wheat flour, low gluten content

250 g white castor sugar

15 g baking powder

150 g water

75 g margarine with a fat content between 80 to 85 percent

185 g beaten eggs

Baking paper approximately 200 mm in diameter

12.3.5.4 *Procedure*

Ensure that the ingredients are at room temperature. Whisk the eggs and sugar for 2 min to 3 min and add the melted margarine. Gradually add the flour, baking powder and water. Place the baking paper in the bottom of the dish and pour in the batter.

Within 10 min of mixing, place the dish on the food support and heat according to the manufacturer's instructions for this type of food. The microwave and thermal energy may be used simultaneously or sequentially in accordance with the instructions. If instructions are not provided for this type of food, preheat the oven to 180 ºC. Set the controls so that the microwave power level is in the range of 180 W to 220 W and the thermal heating results in a temperature of 190 ºC to 230 ºC. The baking time is 15 min to 25 min.

Remove the dish from the oven. After a period of 5 min, cut the cake into eight pieces and make the evaluation.

Tests may be repeated at different control settings if this is considered appropriate after evaluation.

12.3.6 *Chicken*

12.3.6.1 *Purpose of Test*

The purpose of this test is to evaluate the roasting and cooking uniformity of poultry.

12.3.6.2 *Container*

Grill grid and drip tray or other container specified by manufacturer.

12.3.6.3 *Ingredients*

Chicken, 1 200 g ± 200 g, without offal

Clingfilm

12.3.6.4 *Procedure*

Wash and dry the chicken. Cover it with the Clingfilm and place it in a refrigerator having a temperature of 5 ºC ± 2 ºC for at least 12 h.

Remove the Clingfilm and place the chicken on the food support as described in the manufacturer’s instructions. Cook according to the manufacturer’s instructions. The microwave and thermal heat may be used simultaneously or sequentially in accordance with the manufacturer’s instructions. If instructions are not provided, place the chicken in the centre of the food support and set the controls as appropriate for this type of food.

Remove the chicken from the oven and allow it to stand for 2 min.

Measure the temperature of the coldest part of the chicken using a probe thermometer.

NOTE: The coldest part is likely to be

– the thickest part;
– close to the bone;
– under the wings or legs.

If the temperature is less than 85 ºC, the test is repeated for a longer time or with different control settings.

The chicken is evaluated for brownness and crispness.

13 DEFROSTING PERFORMANCE

13.1 General

This clause provides a test method to assess the defrosting of a solid food block. The test is carried out in accordance with manufacturer's instructions for defrosting this type of food.

NOTE: Additional defrosting tests for regional use are specified in Annex A.

13.2 Evaluation

The speed, result and convenience of using the oven are evaluated.

Speed is the total defrosting time including rest periods. It does not include any standing period after defrosting.

The result is evaluated by assessing the uniformity of defrosting.

The results may be evaluated as follows:

a) no parts warmer than 25 ºC and no parts cooler than 0 ºC;
b) no parts warmer than 25 ºC and some parts cooler than 0 ºC;
c) some parts warmer than 25 ºC but not cooked and some parts cooler than 0 ºC;
d) some parts warmer than 25 ºC with portions cooked and no parts cooler than 0 ºC;
e) some parts warmer than 25 ºC with portions cooked and some parts cooler than 0 ºC.

NOTE: The temperatures are measured at different heights of the meat using hypodermic probes.

Convenience is evaluated by noting the number of procedures required during defrosting.

Examples:

a) Separation of the food or removal of parts of it
b) Manual turning of the food
c) A resting period and manual restarting

NOTE: Initial setting procedures for the controls are not evaluated.

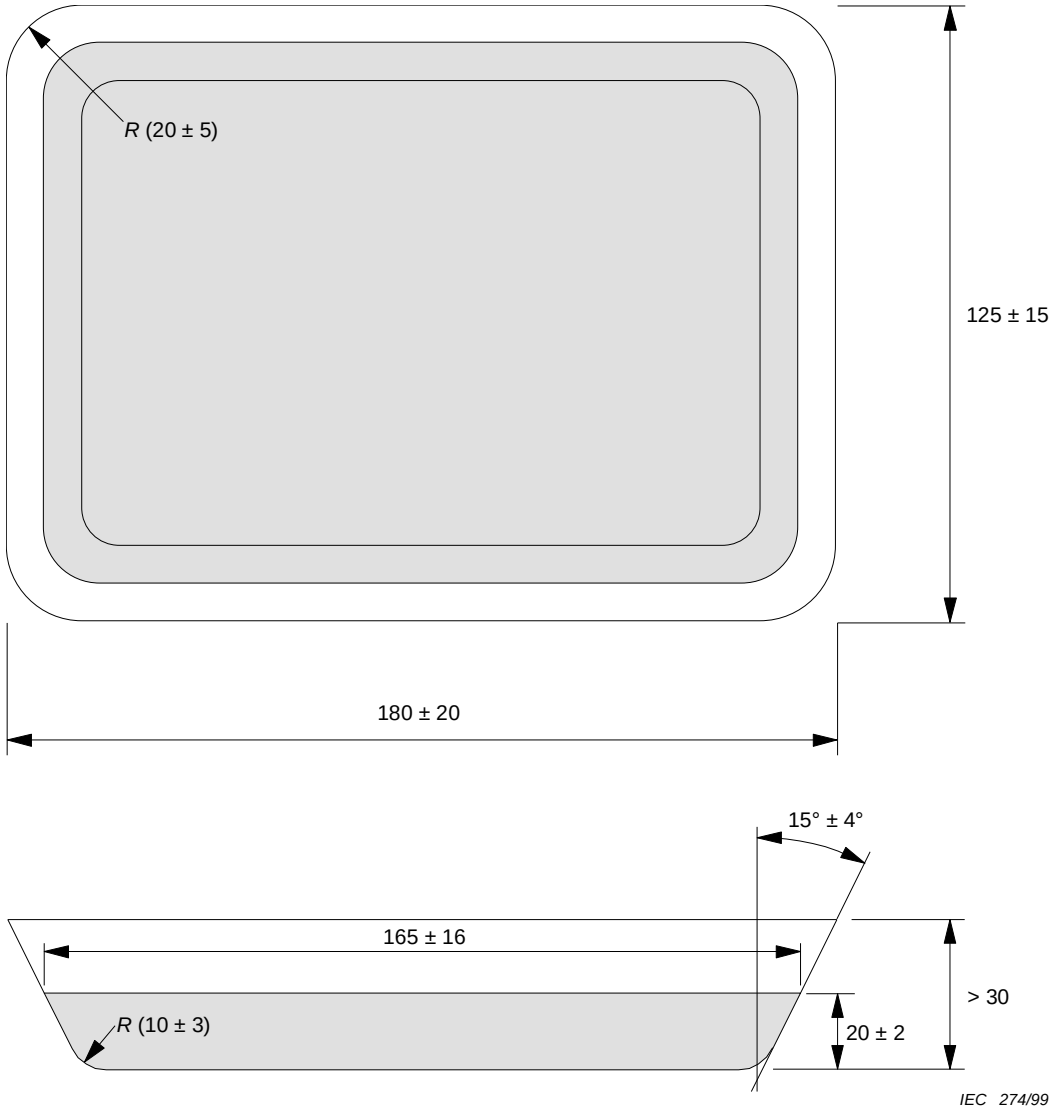
13.3 Meat Defrosting

13.3.1 *Purpose of Test*

The purpose of this test is to evaluate the uniformity of defrosting of a thick food item.

13.3.2 *Container*

Dish as specified in Fig. 8.



NOTE: The dish is made from thin wall microwave transparent material.

Figure 8 – Shallow Dish

Flat, microwave transparent plastic plate approximately 3 mm thick.

The height of the food is 25 mm ± 4 mm, its nominal mass being 500 g.

13.3.3 *Ingredients*

a) 500 g minced meat having a maximum fat content of 20 percent

b) Clingfilm

13.3.4 *Procedure*

Line the dish with Clingfilm. Place the minced meat in the dish and compact it as much as possible to ensure that there are no air pockets and the surface is flat. Fold the Clingfilm over the meat, take it out of the dish and place it on a flat plate. Place the meat in a freezer having a temperature of approximately –20 ºC for at least 12 h.

Remove the Clingfilm and place the frozen block on the flat plastic plate. Defrost according to the manufacturer's instructions for this type of food. If instructions are not

provided, it may be necessary to carry out additional tests to determine the defrost capability of the oven.

Remove the meat from the oven. After a period of 5 min, make the evaluation.

NOTE: Ovens with an automatic defrosting function are also tested using manual defrosting.

14 ENERGY CONSUMPTION FOR THE MICROWAVE FUNCTION

14.1 General

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 having different sizes and shapes are used.

14.2 Test Load

Three different test loads as shown in Table 4 shall be used:

Table 4 – Test loads for measuring the energy consumption

Load	**Glass container, cylindrical made of borosilicate glass**	**Nominal water amount (m_w) pure tape water**
Small (s)	a) External diameter d Ø 90 mm ± 1 mm b) External height h 125 mm ± 1 mm c) Capacity 600 ml d) Maximum weight 200 g	275 g ± 1 g
Middle (m)	a) External diameter d Ø 140 mm ± 1 mm b) External height h 76 mm ± 1 mm c) Capacity 900 ml d) Maximum weight 250 g	350 g ± 1 g
Large (l)	External diameter d Ø 190 mm ± 1 mm External height h 90 mm ± 1 mm Capacity 2000 ml Maximum weight 450 g	1 000 g ± 1 g

The properties of the glass containers shall be in accordance with **3.3**. The actual mass of the used container (m_C) is determined and noted. The actual mass of the water amount is determined and noted (m_W).

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.

14.3 Preparation

At the start of the test the empty glass container and the appliance shall have laboratory ambient temperature. The water is poured into the container and stirred. The temperature is measured when the average temperature of container and water is balanced. The initial temperature, T_0, shall be in the range of 10 °C ± 0.5 °C.

NOTES:

1 Water having an initial temperature 1 °C to 2 °C below the target temperature minimizes the stirring time.

2 The filled container should not be stored in the fridge to avoid the rims getting too cold.

3 To guarantee a sufficient stirring a thermocouple with a plastic adapter should be used. An example is described in Annex C. The stirrer should have a low heat capacity.

14.4 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.

14.5 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 **14.2**):

The measurement shall be started by switching the appliance on within 30 s after the preparation 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 oven 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 oven is then switched off. The water load is removed from the oven and positioned on a thermally insulating pad. The water is stirred with a stirrer (see Annex C) and the final temperature is measured within 20 s after heating is finished.

The oven 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 **14.2**.

The following data shall be recorded for each water load:

a) heating time t_{low} and t_{high} (s); including the magnetron filament heating-up time;

b) initial temperature T_0 (°C);

c) final temperature T_{low} and T_{high} (°C);

d) energy consumption W_{low} and W_{high} (Wh);

e) ambient temperature (°C) at the start of the test (when the water is positioned in the appliance);

f) actual and nominal mass of water (g).

NOTES:

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

2. The recording of the heating time t_{low} and t_{high} are informative and simplify the measurement. Therefore, the magnetron filament heating-up time is included.

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

4. To guarantee a sufficient stirring a thermocouple with a plastic adapter should be used. Examples are described in Annex C. The stirrer should have a low heat capacity.

14.6 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* **14.2**) 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}.

$$\Delta T_{high} = T_{high} - T_0 \quad (1)$$

$$\Delta T_{low} = T_{low} - T_0 \quad (2)$$

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

$$\Delta T_{high,total} = \frac{0{,}55 \times m_c \times \Delta T_{high}}{4{,}187 \times m_w} + \Delta T_{high} \quad (3)$$

$$\Delta T_{low,total} = \frac{0{,}55 \times m_c \times \Delta T_{low}}{4{,}187 \times m_w} + \Delta T_{low} \quad (4)$$

Where,

m_w is the actual mass of the water (g);

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

m_c is the actual mass of the container (g);

T_0 is the initial temperature of the water (°C);

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

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

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

$$\Delta T_{high,norm} = \text{total}\Delta T_{high} \times \frac{m_w}{m_{w,n}} \quad (5)$$

$$\Delta T_{low,norm} = \text{total}\Delta T_{low} \times \frac{m_w}{m_{w,n}} \quad (6)$$

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

$$Q = \frac{(W_{high} - W_{low})}{(\Delta T_{high,norm} - \Delta T_{low,norm})} \quad (7)$$

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

$$W_{50} = W_{low} + Q \cdot (50 - \Delta T_{low,norm}) \quad (8)$$

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

14.7 Final result

The final result (W_{final}) is calculated by sum the calculated energy consumption to reach 50 K (*see* **14.6**) from the small (s), middle (m) and large (l) load.

$$W_{final,\,cooking\,cycle} = \frac{3 \cdot W_{50,s} + 6 \cdot W_{50,m} + 2 \cdot W_{50,l}}{11}$$

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

NOTES:

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

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

3 As an example for data and calculation sheet, see Annex E. An Excel® 97-2003 evaluation program, which corresponds directly to Annex E, is available with this standard for the automatic calculation of the energy consumption. These calculations can also be made in any other spreadsheet program under the condition that the same results are achieved.

14.8 Reporting of test results

The following data shall be reported:

a) microwave power output measured according to **8**;

b) type of the appliance, available heating function(s);

c) fitted with turntable or reciprocating tray;

d) position of the loads;

e) supply voltage at which the measurements were made;

f) energy consumption in Wh rounded to one decimal according to **14.**6 for each load;

g) final result per cooking cycle, W_{final}, in Wh rounded to one decimal according to **14.**7.

The energy consumption per cooking cycle shall not be less than 60Wh.

15 CONSUMPTION MEASUREMENT OF LOW POWER MODES

In addition to the requirements specified in IS/IEC 62301 (under preparation), the following requirements are given.

For an appliance composed of a combination of separate units which may consist of one of a variety of different hobs and one of a variety of different ovens the recommended combination as declared in the manufacturer's instruction are used for the test. If appliance A, for example, hob) can only be operated combined with appliance B, for example, oven), first the low power mode for appliance B without appliance A is measured and noted. Afterwards the low power mode for the appliance B combined with the appliance A is measured. The low power consumption of appliance A is calculated by the difference between these two measurements.

When preparing the test report for an appliance composed of a combination of separate units the combination of types of main powered parts (hobs, ovens, grills, warming

plates, griddles, etc.) used for the measurement shall be recorded. The consumption of low power modes shall be noted for each unit A and B separately.

NOTE: The procedure for measuring the energy consumption of hobs is described in IS/IEC 60350-2 (under preparation) and that of ovens in IEC 60350-1 (under preparation).

When testing appliances that are fitted with a clock, the clock shall be adjusted to the correct time and date as specified in the instructions.

In case energy consumption is influenced by continuous changing displayed time of a clock, a measurement period of 24 h is necessary. The average value from this measurement is noted.

If the appliance has an ambient light sensor, two illuminance levels in accordance with IS/IEC 62301 (under preparation) shall be measured during the 24 h period, each illuminance level for 12 h.

If an option is provided to the user to switch off the display both the switched on and switched off mode is to be tested and reported.

Standby power consumption shall not exceed 0.6W

16 MARKING

16.1 The microwave ovens shall contain the relevant information as specified in **7** of IS 302-2-25.

16.1.1 BIS Certification Marking

The microwave ovens may also be marked with the Standard Mark.

16.1.1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

17 TESTS

17.1 Type Tests

All the tests specified in this standard and those specified in IS 302-2-25 shall constitute the type tests and shall be carried out on two samples of the same type and rating selected preferably at random from a regular production lot. Before commencement of the tests, the samples shall be visually examined and inspected for obvious visual defects in respect of components, parts and their assembly, construction, mechanical hazards, markings, provision of suitable terminals for supply connections, earthing and the effectiveness of screws and connections. The external surface finish shall be even and free from finishing defects.

17.2.1 Criteria for Acceptance

Both samples shall successfully pass all the type tests for proving conformity with the requirements of the standard. If any of the samples fails in any of the type tests, the testing authority, at its discretion, may call for fresh samples not exceeding twice the original number

and subject them again to all tests or to the test(s) in which failure(s) had occurred. No failure shall be permitted in the repeat test(s).

17.2 Acceptance Tests

The tests specified in 19.2 of IS 302-2-25 shall constitute the acceptance tests

NOTE - For the purpose of acceptance tests, the humidity treatment may be carried out for 24 hours while conducting the test for moisture resistance [see 15 of IS 302-1 (2008)}

17.2.1 Sampling procedure and criteria for acceptance for acceptance tests shall be as given in IS 2500 (Part 1).

17.3 Routine Tests

The tests specified in 19.3 of IS 302-2-25 shall constitute the routine tests

ANNEX A

REGIONAL DEFROSTING TESTS

A.1

A.2 General

These additional defrosting tests are applicable in some countries.

A.3 Introduction

These tests allow for the evaluation of defrosting of a number of small items simultaneously. The selection of the warmest and coldest items is facilitated due to the use of many small discrete items which tend to exhibit a homogenous physical change during defrosting.

A.4 Test methods

A.4.1 General

The assessment of defrosting small items can be carried out by using foodstuffs such as raspberries or by using artificial substances which simulate food articles.

A.4.2 Raspberries

A.4.2.1 Purpose of test

The purpose of this test is to evaluate the uniformity of defrosting small fruit.

A.4.2.2 Container

Flat microwave transparent plastic plate approximately 3 mm thick and 250 mm in diameter.

NOTE For small ovens, the diameter of the plate may be only 200 mm.

A.4.2.3 Ingredients

Frozen whole raspberries of similar size, and selected so that 60 berries weigh at least 250 g.

A.4.2.4 Procedure

Evenly distribute 250 g □ 20 g of frozen berries on the plate and defrost in accordance with the manufacturer's instructions. If instructions are not provided, the raspberries are defrosted with the controls set so that the microwave power output is approximately 180 W and the defrosting time is 7 min.

The tests may be repeated at a different power level or for a period of time resulting in at least 70 % of the raspberries being defrosted.

NOTE Ovens with an automatic defrosting function are also tested using manual defrosting.

After a standing time of 3 min, remove the raspberries from the oven. Determine the temperature of the warmest raspberry and the mass of those which are still partially frozen.

A.4.3 Gel

A.4.3.1 Purpose of test

The purpose of this test is to evaluate the uniformity of defrosting using small pieces of artificial food.

A.4.3.2 Container

Flat microwave transparent plastic plate approximately 3 mm thick and 250 mm diameter.

NOTE For small ovens, the diameter of the plate may be only 200 mm.

A.4.3.3 Ingredients

3,15 g tri(hydroxymethyl)-aminomethane

1,32 g citric acid (dry)

5,3 g potassium acetate

5 g potassium chloride

100 g standard 87 % glycerol

100 g white sugar

830 g water

15 g gelling agent (carrageenan-kappa)

3 ml indicator solution (cresolphthalein-ortho solution, from a solution of 2 g per 100 g 96 % ethyl alcohol)

A.4.3.4 Procedure

Place all solid ingredients, except for the sugar, gelling agent and glycerol, in a pan and mix with the water. Add the sugar and stir until it is dissolved. Add the glycerol and stir. Add the gelling agent and heat to boiling, stirring frequently. Slowly add the indicator solution while stirring. Remove the pan from the heat source. The solution is poured into individual moulds, each mould being in the form of a cylinder having a diameter of 27 mm ± 0,5 mm and a height of approximately 10 mm with a hemispherical end.

After the gel has cooled and solidified, the pieces are removed from the moulds, positioned individually on plates and covered with clingfilm. Place the plates in a freezer having a temperature of approximately –20 □C for at least 12 h.

Evenly distribute 250 g □ 20 g of the frozen gel on the flat plate and defrost in accordance with the manufacturer's instructions. If instructions are not provided, the gel is defrosted with the controls set so that the microwave power output is approximately 180 W and the defrosting time is 7 min.

The test may be repeated at a different power level or for a period of time resulting in at least 70 % of the pieces being defrosted.

NOTE Ovens with an automatic defrosting function are also tested using manual defrosting.

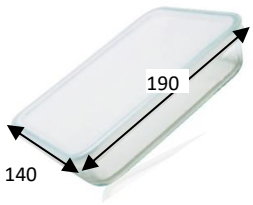
After a standing time of 3 min, remove the gel from the oven. Determine the temperature of the warmest piece and the mass of those which are still partially frozen.

A.5 Evaluation

The evaluation is made as stated in 13.2.

The temperature of the warmest item and the mass of the partially frozen items are stated.

ANNEX B
DISHES FOR CLAUSE 12 AND 13

	Example test dish with description	**Requirements** **Clause 12 and 13**
Meat defrosting (Subclause 13.3)	All in one dish with lid  	For freezing: microwave transparent material 125 mm □ 15 mm and 180 mm □ 20 mm For defrosting: microwave transparent plastic plate (3 mm)
Egg custard (Subclause 12.3.1)	Square roaster/ Easy grip 	Height 50 mm □ 10 mm dimensions at the top of the dish 250 mm × 250mm for smaller cavities: dimensions at the top of the dish 210 mm × 210 mm
Sponge cake, potato gratin, cake (Subclauses 12.3.2, 12.3.4, 12.3.5)	Cake dish 	Height 50 mm □ 10 mm External diameter of the top dimensions 220 mm
Meatloaf (Subclause 12.3.3)	Loaf dish 	Loaf dish length to width 2,25:1 dimensions at the top of the dish 250 × 124 mm

ANNEX C
STIRRER

This annex gives an example of a thermocouple with low heat conductivity. This thermocouple with a plastic stirring adapter should be used in Clauses 8 and 14. The thermocouple should be in accordance with 6.7.

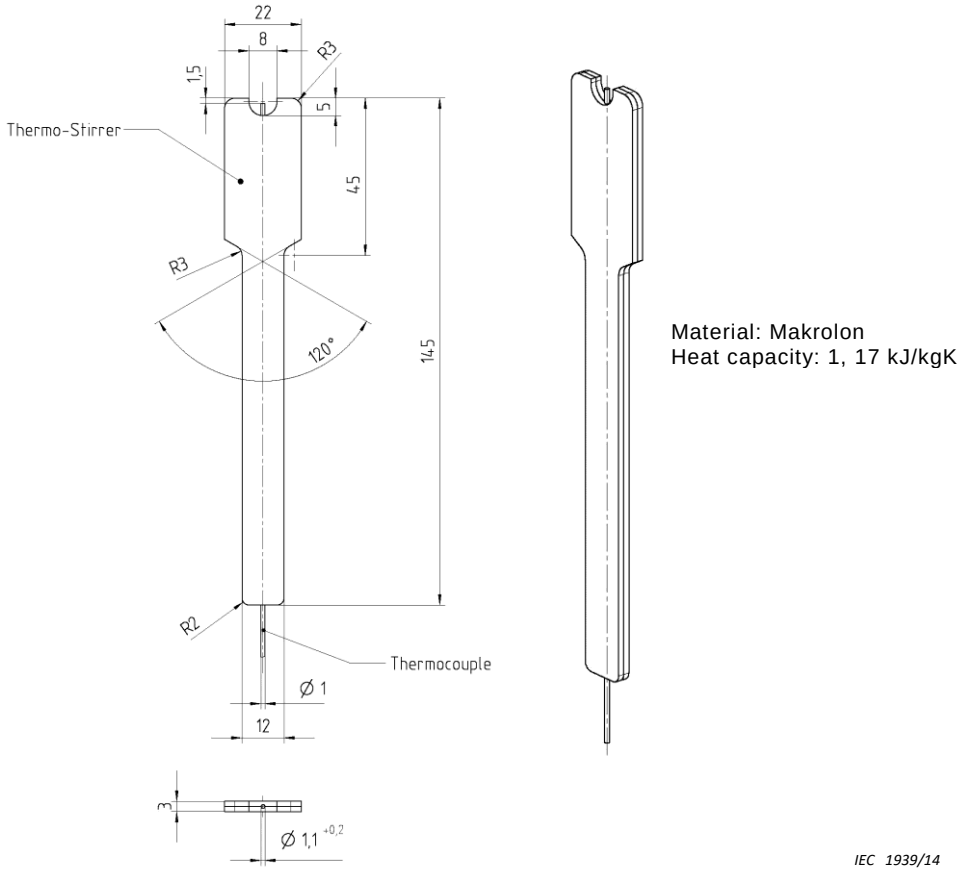


Figure C.1 – Plastic stirring adapter

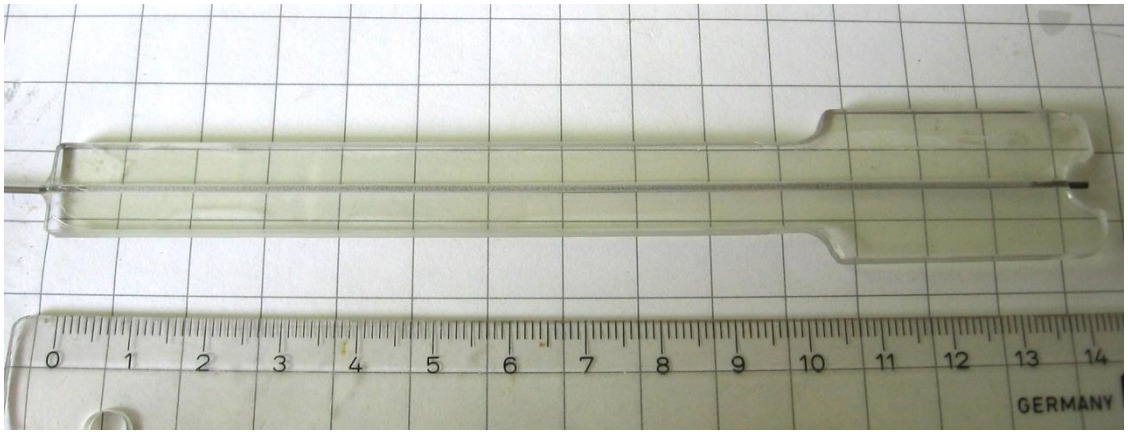


Figure C.2 – Example Stirrer

ANNEX D

GLASS CONTAINER FOR CLAUSE 8 AND 14

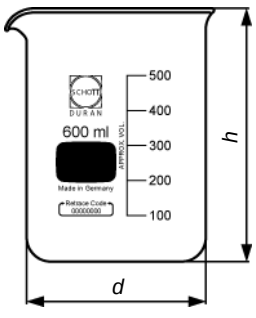
The following catalogue numbers in Table D.1 are relevant for the glass container used in Clauses 8 and 14.

Table D.1 –

Specification – glass containers

Load	Glass container, cylindrical made of borosilicate glass	Nominal water amount (m_W) pure tape water	Possible supplier glass container
Small (s) (Clause 14)	External diameter *d* Ø 90 mm ± 1 mm external height *h* 125 mm ± 1 mm capacity 600 ml Maximum weight 200 g	275 g ± 1 g	Duran Cat. -No 2110648“Beaker low height”
Middle (m) (Clause 14)	External diameter *d* Ø 140 mm ± 1 mm external height *h* 76 mm ± 1 mm capacity 900 ml Maximum weight 250 g	350 g ± 1 g	Duran Cat. -No 2131354“Crystallizing dish”
Large (l) (Clauses 8 and 14)	External diameter *d* Ø 190 mm ± 1 mm external height *h* 90 mm ± 1 mm capacity 2 000 ml Maximum weight 450 g	1 000 g ± 1 g	Duran Cat. -No 2131359“Crystallizing dish”

Figure D.1 shows how to measure the dimensions from the recommended containers.



IEC 1941/14

Figure D.1 – Example: small beaker (600 ml)

ANNEX E
Data and calculation sheet: Energy consumption for a cooking cycle with microwave function (Clause 14)

Identification of the appliance:		**Factory & Brand:**		**Test lab:**	
Supply voltage:	**V**	**Calculated volume**	**Liter**	**Operator:**	
Rated output-power	**W**	**Cavity material:**		**Date:**	
Type microwave oven or combi oven:		**Turntable, reciprocating tray:**		**Position of load:**	

Output-Power (see 8.1)	**W**	**Comment:**	

Nominal mass of water:	**1000**	**g**		**Ambient Temperatur:**		**°C**		**Container-Diameter outside:**		**190**	**mm**						
Target Temperature:	**55°C - 60°C**																
Heating time t_{low}:		**sec**	**Mass of container:**		**g**	**Initial water temp.:**		**°C**	**Mass of water**		**g**	**Final water temp.:**		**°C**	**Energy-Consumption:**		**Wh**
Temperatur rise:	calc	**K**	**Total-Temp. rise:**	calc	**K**	**Normalized temp. rise:**	calc	**K**									
Target Temperature:	**60°C - 65°C**																
Heating time t_{high}:		**sec**	**Mass of container:**		**g**	**Initial water temp.:**		**°C**	**Mass of water**		**g**	**Final water temp.:**		**°C**	**Energy-Consumption:**		**Wh**
Temperatur rise:	calc	**K**	**Total-Temp. rise:**	calc	**K**	**Normalized temp. rise:**	calc	**K**	**Quotient**	calc	**Wh/K**	**Energy to reach 50K:**	calc	**Wh**	**Time to reach 50K**	calc	**Sec**

NOTE Cells with content “calc.” should be calculated.

This publication contains an attached file in the form of an Excel® 97-2003 data sheet program. This file is intended to be used as a complement and does not form an integral part of the publication.

Nominal mass of water:	350	g	Ambient Temperatur:		°C	Container-Diameter outside:	140	mm

Target Temperature:	55°C - 60°C																
Heating time t_{low}:		sec	Mass of container:		g	Initial water temp.:		°C	Mass of water		g	Final water temp.:		°C	Energy-Consumption:		Wh
Temperatur rise:	calc	K	Total-Temp. rise:	calc	K	Normalized temp. rise:	calc	K									
Target Temperature:	60°C - 65°C																
Heating time t_{high}:		sec	Mass of container:		g	Initial water temp.:		°C	Mass of water		g	Final water temp.:		°C	Energy-Consumption:		Wh
Temperatur rise:	calc	K	Total-Temp. rise:	calc	K	Normalized temp. rise:	calc	K	Quotient	calc	Wh/K	Energy to reach 50K:	calc	Wh	Time to reach 50K	calc	Sec

Nominal mass of water:	275	g	Ambient Temperatur:		°C	Container-Diameter outside:	90	mm

Target Temperature:	55°C - 60°C																
Heating time t_{low}:		sec	Mass of container:		g	Initial water temp.:		°C	Mass of water		g	Final water temp.:		°C	Energy-Consumption:		Wh
Temperatur rise:	calc	K	Total-Temp. rise:	calc	K	Normalized temp. rise:	calc	K									
Target Temperature:	60°C - 65°C																
Heating time t_{high}:		sec	Mass of container:		g	Initial water temp.:		°C	Mass of water		g	Final water temp.:		°C	Energy-Consumption:		Wh
Temperatur rise:	calc	K	Total-Temp. rise:	calc	K	Normalized temp. rise:	calc	K	Quotient	calc	Wh/K	Energy to reach 50K:	calc	Wh	Time to reach 50K	calc	Sec

Consumption per cooking cycle:

Water load:	Weighting factor:					
1000 g	2	calc	Wh	Total Energy Consumption:	calc	Wh
350 g	6	calc	Wh			
275 g	3	calc	Wh			