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PAKISTAN STANDARD

HOUSEHOLD MICROWAVE OVENS- METHODS FOR MEASURING PERFORMANCE

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HOUSEHOLD MICROWAVE OVENS- METHODS FOR MEASURING PERFORMANCE

0. FOREWORD

0.1 This Pakistan Standard was adopted by the authority of the Board of Directors for Pakistan Standards and Quality Control Authority after approval by the Technical Committee for "Household Microwave Ovens- Methods for Measuring Performance" had been approved and endorsed by the Electrotechnical National Standards Committee on January 9, 2020.

0.2 This Pakistan Standard was adopted on the basis of IEC: 60705/2018 since IEC Standard have been established in 2010, hence it is deemed necessary to adopt the International standard to keep abreast with the latest technology and as par with IEC standard.

0.3 This Pakistan Standard is an adoption of IEC: 60705/2018 "Household Microwave Ovens- Methods for Measuring Performance" and its use hereby acknowledged with thanks.

0.4 This standard is subject to periodical review in order to keep pace with the development in industry. Any suggestions for improvement shall be recorded and placed before the revising committee in due course.

0.5 This standard is intended chiefly to cover the technical provisions relating to this standard and it does not include all the necessary provisions of a Contract.

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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 it 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.

ISO 80000-1:2009, *Quantities and units – Part 1: General*

3 Terms and definitions

For the purpose of this document, the following terms and 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 [4].

3.2
combination microwave oven
microwave oven in which the microwave energy is combined with thermal energy

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.

* Figures in square brackets refer to the bibliography.

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 [a]	Combination microwave ovens
External dimensions	7.1	Yes	*	*
Usable internal dimensions and usable volume	7.2	Yes	*	*
Overall internal dimensions and overall volume	7.3	Yes	*	*
Microwave power output	8	Yes	*	
Efficiency	9	Yes	*	
Square tank	10.2	Yes	*	
Multiple cup	10.3	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	*	
* Test is applicable.				
[a] Except for the tests of 10.2, these tests are also applicable to **combination microwave ovens** when operated in the microwave only mode.				

6 General conditions for measurements

6.1 General

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.

If numbers have to be rounded, they shall be rounded to the nearest 50 W according to ISO 80000-1:2009, Annex 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 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.

6.3 Test room

The tests are carried out in a substantially draught-free room in which the ambient temperature is maintained at 20 °C ± 5 °C.

6.4 Water

Potable water is used for the tests.

6.5 Initial condition of the oven

At the beginning of each test,

– *the temperatures of the magnetron and the power supply 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.

6.6 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.

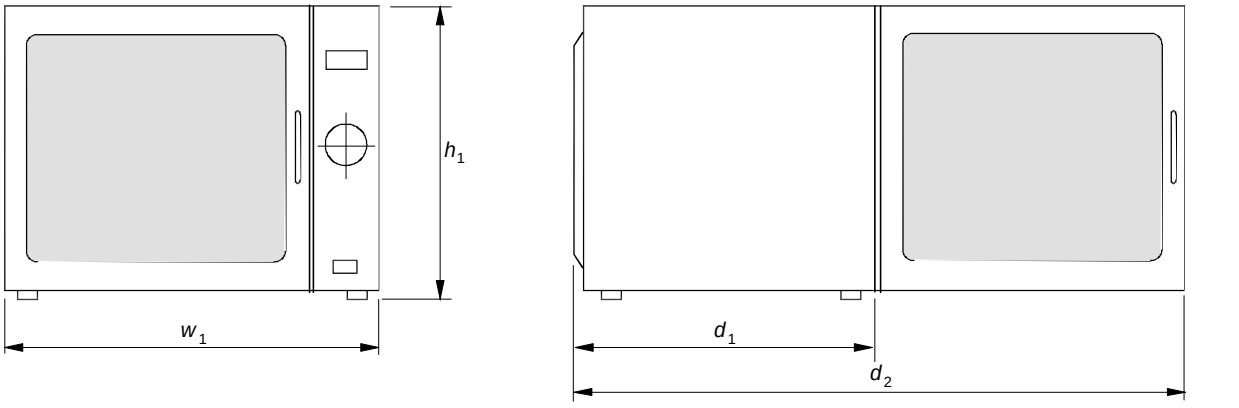
7 Dimensions and volume

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.



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 usable 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.

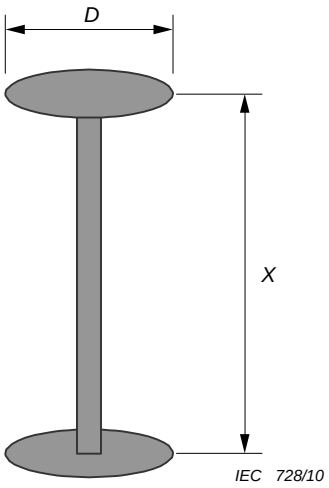
The measurement of the usable oven volume is to be carried out at ambient temperature.

The height, width and depth of the usable volume in the cavity shall be measured according to 7.2.2 – 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.



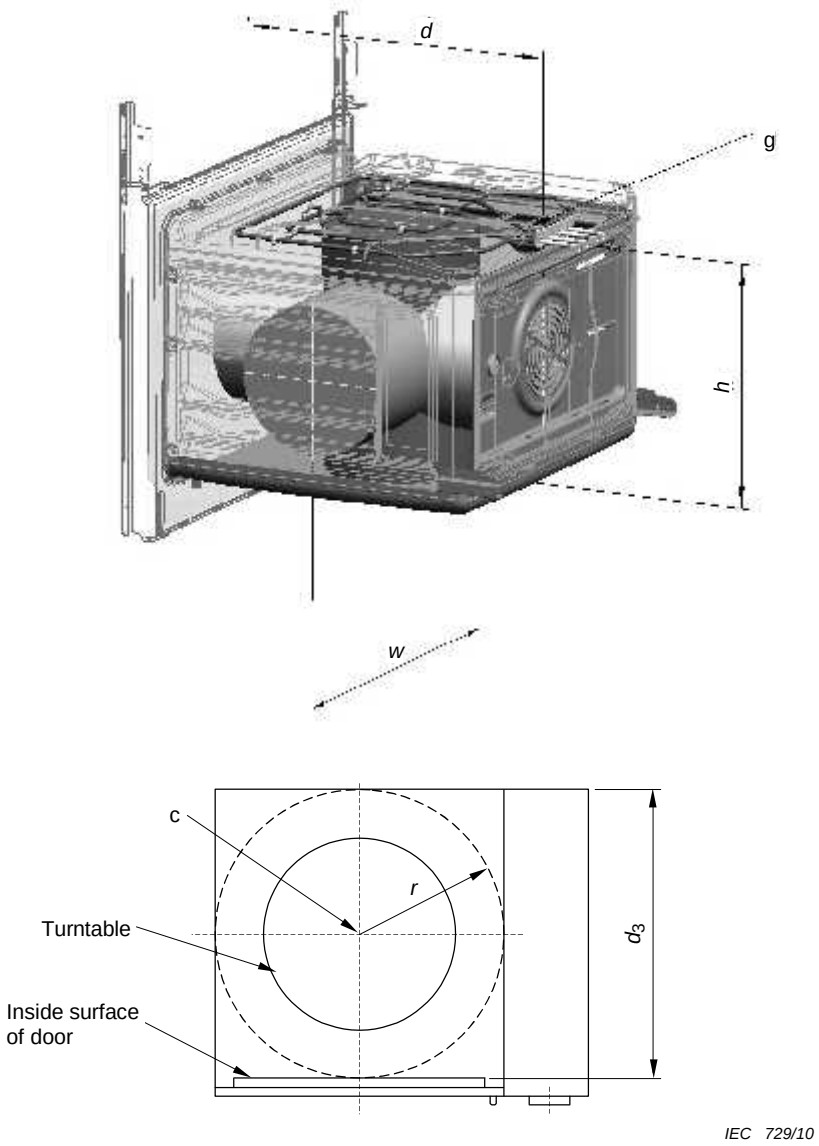
Key

D = 200 mm or 120 mm

X = dimension to be measured

(See Subclauses 7.2.2, 7.2.3 and 7.2.4)

Figure 2a – Gauge for determining the usable volume



Key

d usable depth

g heating element

h usable height

w usable width

c centre of rotation of the turntable

r 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 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 Usable volume

The usable volume is calculated from these dimensions and is given in litres rounded to the next 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 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.

NOTE In any case the largest achievable total volume is to be reported.

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:

– 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.

7.3.2 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

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 °C ± 1 °C 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 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 °C ± 2 °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

$$P = \frac{4{,}187 \cdot m_w (T_2 - T_1) + 0{,}55 \cdot c m_2 (T_0 - T_1)}{t}$$

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 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, 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.

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

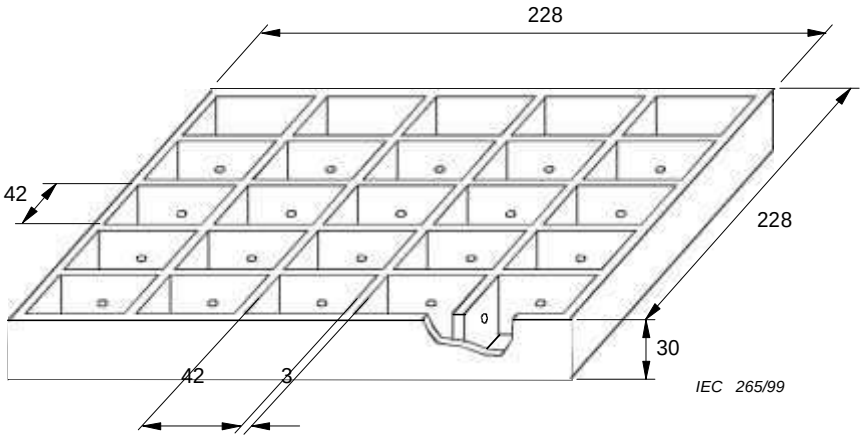
Water having a temperature of 20 °C ± 2 °C is used.

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.

10.2 Square tank test

10.2.1 Procedure

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



Dimensions in millimetres

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

NOTE 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 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·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 rises of the nine inner compartments are calculated as percentages of the average temperature rise of all 25 compartments.

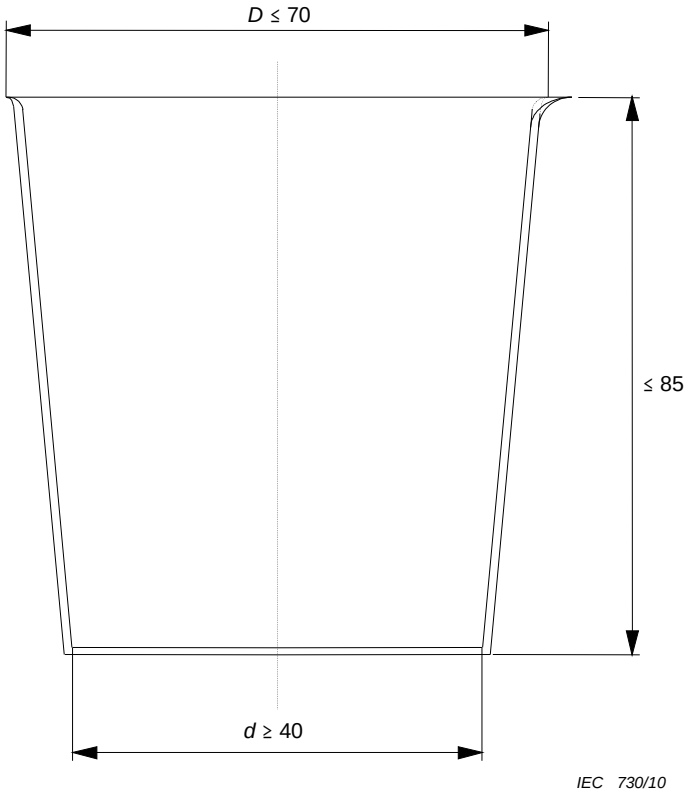
The minimum and maximum values of the temperature rises of the 16 outer compartments are calculated as percentages of the average temperature rise of all 25 compartments.

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

10.3 Multiple cup test

10.3.1 Procedure

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

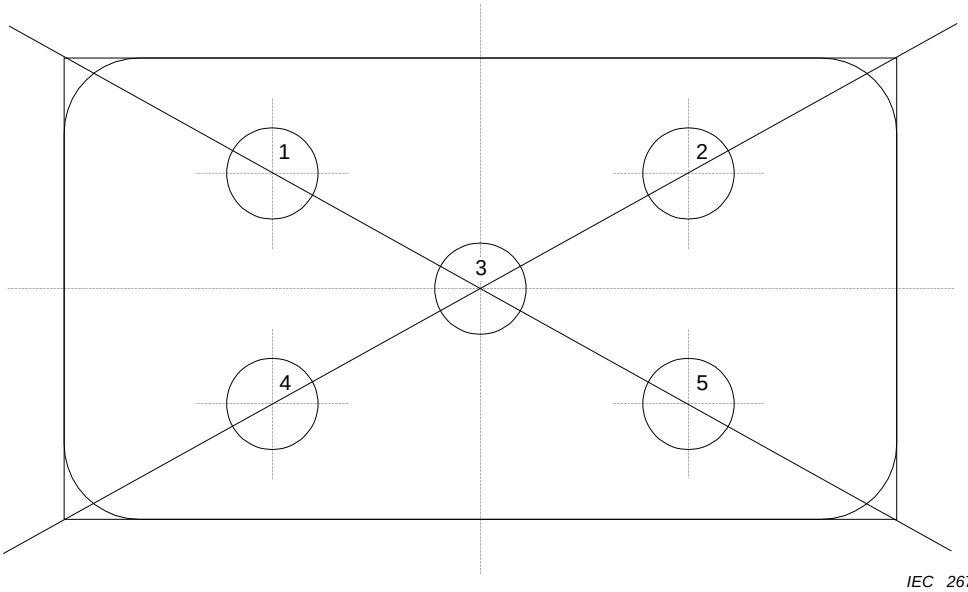


Dimensions in millimetres

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

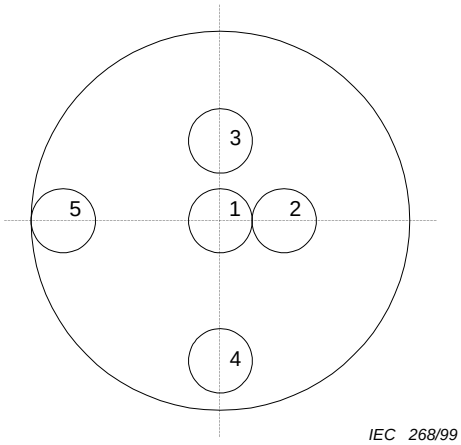
Figure 4 – Cup

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 oven shelf as shown in Figure 5. They are then heated for a time corresponding to an output energy of 50 kW·s.



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

Figure 5a – Position of cups on rectangular shelves



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.

10.3.2 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

11.1 Heating beverages

11.1.1 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.

11.1.2 Procedure

Two cups, as specified in Figure 4, are each filled with 100 g ± 2 g of water having a temperature of 20 °C ± 2 °C. The actual water temperature is measured. The cups are placed on the shelf in the position shown in Figures 6a or 6c.

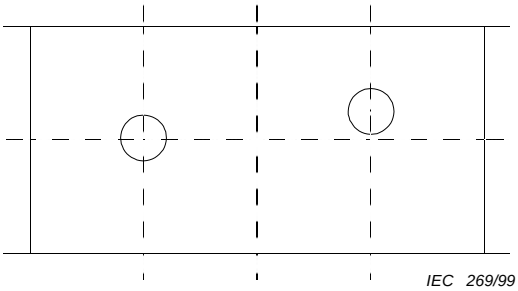
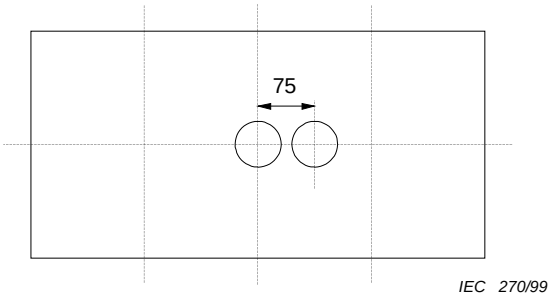


Figure 6a – First position for rectangular shelves



Dimensions in millimetres

Figure 6b – Second position for rectangular shelves

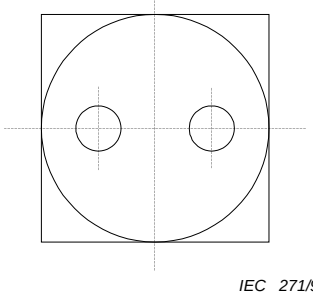
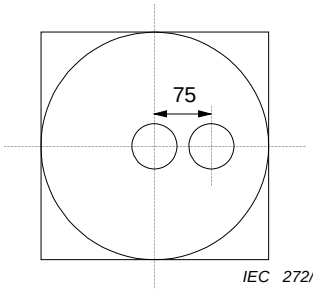


Figure 6c – First position for circular shelves



Dimensions in millimetres

Figure 6d – Second position for circular shelves

Figure 6 – Cup position for the test of 11.1

The oven is operated until the average temperature of the two cups is 80 °C ± 5 °C, 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 Figures 6b or 6d, the heating time being the same.

If the average water temperature of the four cups is not within the range 80 °C ± 5 °C, 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

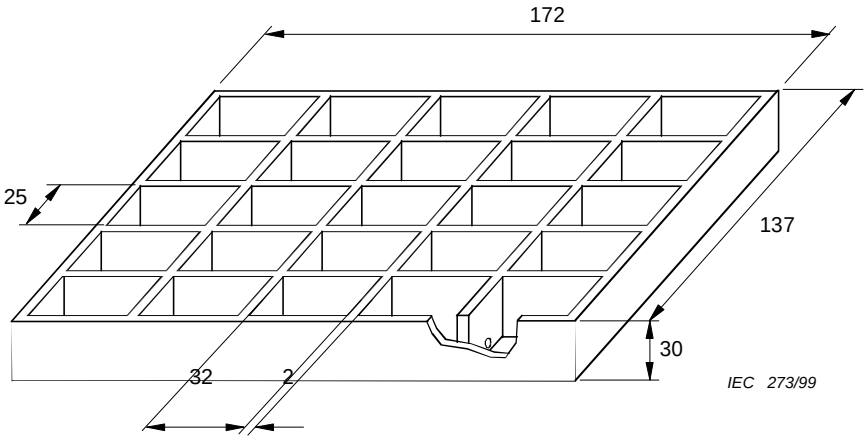
11.2.1 Test purpose

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 Figure 7 is cooled to approximately 10 °C. It is filled with 400 g ± 4 g of water having a temperature of 10 °C ± 2 °C.



Dimensions in millimetres

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

NOTE 2 The tank is made from microwave transparent material.

Figure 7 – Rectangular tank

The tank is placed in the centre of the shelf 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 °C ± 5 °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:

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

The results may be evaluated as follows:

– no overcooking and no undercooking;
– some parts slightly overcooked or some parts slightly undercooked;
– some parts slightly overcooked and some parts slightly undercooked;
– some parts overcooked and some parts undercooked;
– some parts very overcooked and some parts very undercooked.

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

EXAMPLES

– Separation of the food or removal of parts of it
– Manual turning of the food
– 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

– height of 50 mm ± 10 mm;
– 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 °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 °C ± 2 °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 shelf 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 height of 50 mm ± 10 mm;
– 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 %

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 shelf. 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 %

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 °C ± 2 °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 shelf 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 height of 50 mm ± 10 mm;
– 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 %

50 g beaten eggs

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

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 °C to 220 °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 %

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 in the oven 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 °C. 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 °C to 230 °C. 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 °C ± 2 °C for at least 12 h.

Remove the clingfilm and place the chicken on the grill grid and drip tray. Place the tray in the oven and cook according to the manufacturer's instructions. The microwave and thermal energy may be used simultaneously or sequentially in accordance with the manufacturer's instructions. If instructions are not provided, place the tray in the centre of the shelf 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 °C, 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:

– no parts warmer than 25 °C and no parts cooler than 0 °C;
– no parts warmer than 25 °C and some parts cooler than 0 °C;
– some parts warmer than 25 °C but not cooked and some parts cooler than 0 °C;
– some parts warmer than 25 °C with portions cooked and no parts cooler than 0 °C;
– some parts warmer than 25 °C with portions cooked and some parts cooler than 0 °C.

NOTE 1 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

– Separation of the food or removal of parts of it
– Manual turning of the food
– A resting period and manual restarting

NOTE 2 Initial setting procedures for the controls are not evaluated.

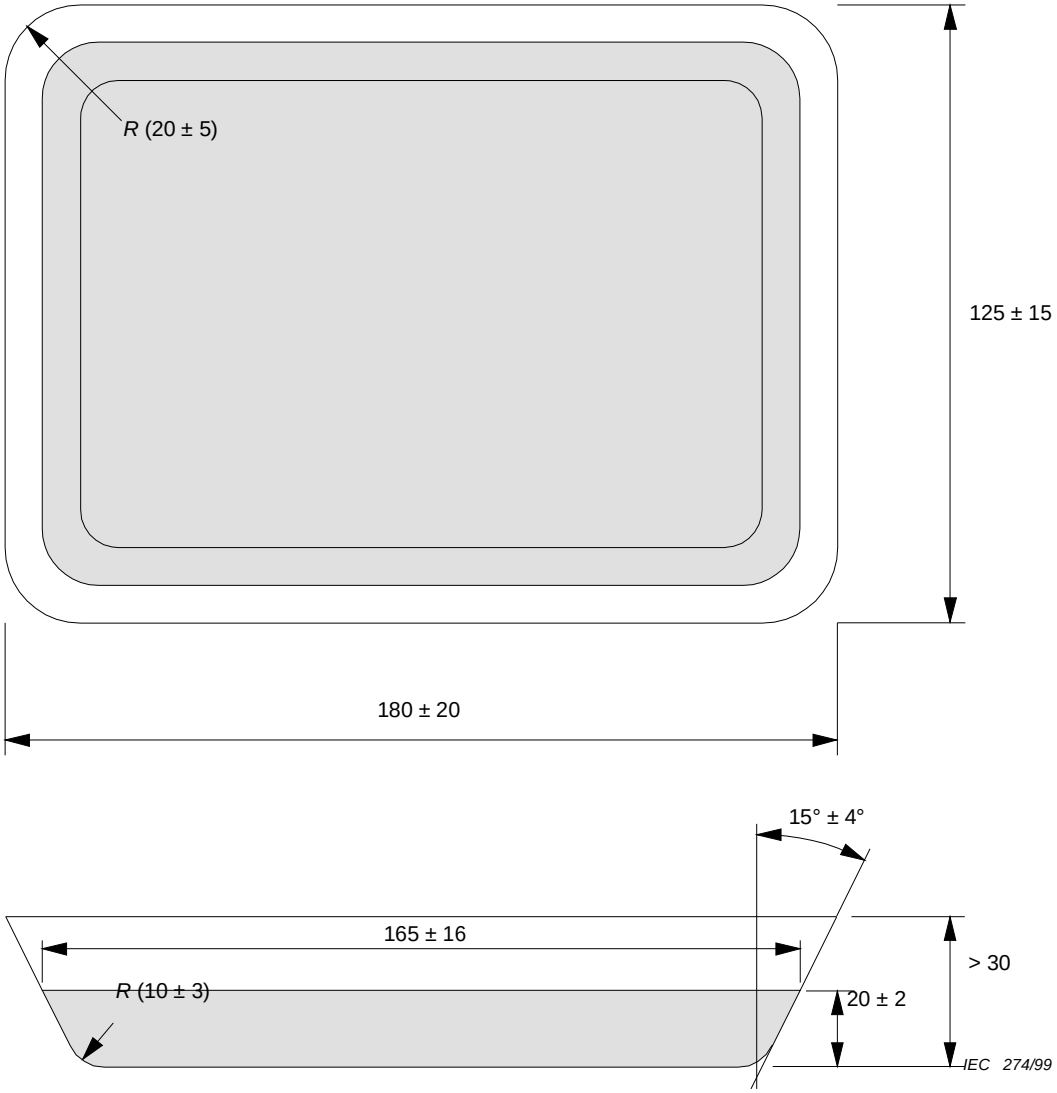
13.3 Meat defrosting

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 Figure 8.



Dimensions in millimetres

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

500 g minced meat having a maximum fat content of 20 %

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 °C 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.

Annex A
(informative)

Regional defrosting tests

A.1 General

These additional defrosting tests are applicable in some countries.

A.2 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.3 Test methods

A.3.1 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.3.2 Raspberries

A.3.2.1 Purpose of test

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

A.3.2.2 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.3.2.3 Ingredients

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

A.3.2.4 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.3.3 Gel

A.3.3.1 Purpose of test

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

A.3.3.2 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.3.3.3 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.3.3.4 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.

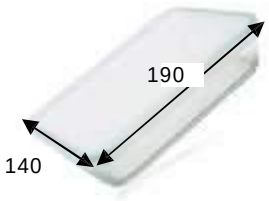
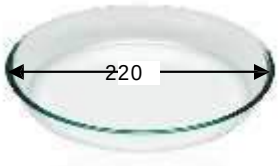
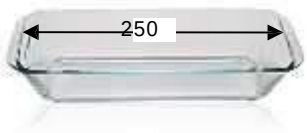
A.4 Evaluation

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
(informative)

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 mm × 124 mm