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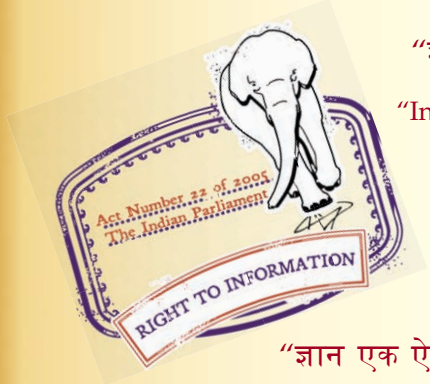
IS 11676 (1995): Microwave ovens for household and similar purposes [ETD 32: Electrical Appliances]



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"Knowledge is such a treasure which cannot be stolen"

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IS 11676 : 1995

(Reaffirmed 2001)

भारतीय मानक

घरेलू और समान प्रयोजनों के लिए सूक्ष्म तरंग अवन – विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

MICROWAVE OVENS FOR HOUSEHOLD AND SIMILAR PURPOSES — SPECIFICATION

(First Revision)

UDC 641·539

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 1995

Price Group 5

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electrical Appliances Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers general, safety and performance requirements of microwave ovens, the rated voltage not exceeding 250 V a.c. single phase.

This standard was first published in 1986. As per the decision of the third meeting of Electrotechnical Division Council, a separate safety standard on microwave oven has been brought out. In this first revision of this composite standard instead of giving details of safety requirements, reference has been made to the respective safety standard IS 302-2-25 (1994). The revision of this standard is also made with a view to align the performance characteristics in line with corresponding IEC publication.

While preparing this standard assistance has been derived from IEC Publication 705 (1988) '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.

Indian Standard

MICROWAVE OVENS FOR HOUSEHOLD AND SIMILAR PURPOSES — SPECIFICATION

(First Revision)

1 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.

In addition provisions of **1** of IS 302-2-25 (1994) shall also apply.

2 REFERENCES

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

IS No.	*Title*
302-1 (1979)	Safety of household and similar electrical appliances : Part 1 General requirements
302-2-25 (1994)	Safety of household and similar electrical appliances : Part 2 Particular requirement, Section 25 Microwave oven

3 TERMINOLOGY

3.0 Following definitions shall apply in addition to those given in **2** of IS 302-2-25 (1994).

3.1 Usable cavity volume denotes the space within the cavity, that is, available for the load.

3.2 Usable shelf area denotes the area of the shelf, that is, available for the load.

3.3 Rated voltage denotes the voltage assigned to the appliance by the manufacturer.

3.4 Rated microwave frequency denotes the centre frequency of the ISM band.

NOTE – ISM frequency bands are electromagnetic frequencies established by international treaty for Industrial, Scientific and Medical purposes.

4 GENERAL REQUIREMENTS

4.1 The provisions of **3.1** of IS 302-2-25 (1994) shall apply.

5 GENERAL NOTE ON TEST

5.1 The provisions of **4** of IS 302-2-25 (1994) shall apply. Also, the tests mentioned in this standard are conducted for verification as per the sequence of tests:

a) The tests are made with the voltage and nature of supply as stated on the rating plate. The voltage supply is maintained within ±1 percent when the oven is operated under loaded conditions. An a.c. supply shall be essentially sinusoidal.

b) The ambient temperature is maintained at 27 ± 5°C unless otherwise specified.

6 RATING

6.1 The provisions of **5** of IS 302-2-25 (1994) shall apply.

7 CLASSIFICATION

7.1 The provisions of **6** of IS 302-2-25 (1994) shall apply.

8 MARKING

8.1 The provisions of **7** of IS 302-2-25 (1994) shall apply.

9 SAFETY REQUIREMENTS

9.1 The microwave oven shall comply with the requirements given in **8** to **32** of IS 302-2-25 (1994).

10 FINISH

10.1 The external finish used in metal components shall be heat, moisture and corrosion resistant in nature and shall not exceed the microwave emission limit of 5 mW/cm² at a distance of 5 cm or more, at normal operating condition.

The compliance shall be checked by visual inspection. Microwave leakage is checked as per **32.1** of IS 302-2-25 (1994).

11 EXTERNAL DIMENSIONS

11.1 The external dimensions measured shall be as follows:

Height *a*1 = Vertical dimension measured from the lower edge of the oven (floor)

to the upper edge of the top, with the door closed. If adjustable levelling feet are provided, they should be moved up and down to determine minimum and maximum possible heights.

Height $a2$ = Maximum vertical dimension measured from the lower edge (floor) to a horizontal plane at the maximum height of the oven, with the door open.

Width b = Horizontal dimension, between the sides, as measured between two parallel vertical planes against the sides of the oven, including all projections.

Depth $c1$ = Horizontal dimension as measured from a vertical rear plane against the appliance and the most prominent part of the front, knobs and handles not being taken into account and the door being closed.

Depth $c2$ = Horizontal dimension as measured from a vertical rear plane against the appliance and the most prominent part of the front, with the door open, knobs and handles not being taken into account.

Measure the dimensions and it should comply with the manufacturer's declaration.

12 USABLE CAVITY VOLUME

12.1 The usable cavity volume and shelf area shall be checked as follows.

12.1.1 The usable cavity volume is calculated as the space within the geometric shape bounded by a shelf in the lowest position, by the walls of the cavity, by the ceiling internal cover or heating element and by the closed door. For the ovens having unusual or irregular shaped internal covers or shelves, the minimum dimension is to be used.

For ovens having rotating shelves, the usable volume is calculated by using the radius equal to the shortest distances from the centre of rotation to the nearest wall or inner surface of the door.

Measure the dimensions and it should comply with the manufacturer's declaration. The measured value shall be within ± 10 percent of the declared value.

12.1.2 *Usable Shelf Area*

The usable shelf area is calculated from the part of the plane on which the load can be placed.

Measure the dimensions and it should comply with the manufacturer's declaration. The measured value shall be within ± 10 percent of the declared value.

13 MICROWAVE POWER OUTPUT

13.1 The measurement is made as per the Appendix AA of IS 302-2-25 (1994), the microwave power output should be within the range of ± 10 percent of the declared value of the manufacture.

14 EFFICIENCY

14.1 The efficiency is calculated by dividing the microwave power output (as per **13.1** above) by the corresponding power input. The value shall comply with the declared value of the manufacturer. The measured efficiency shall be within ± 10 percent of the declared value.

15 UNIFORM HEATING

15.1 Water Tests

The water tests specified in this clause are for screening of heating uniformity of microwave ovens. They offer the advantage of direct numerical results. Since heating, cooking and defrosting of food may involve the load geometry and other characteristics of the load and the microwave, field distribution is dependent to some degree on the load geometry, the numerical results calculated from these tests should be used with caution. The water tests in this clause are complementary to the heating, cooking and defrosting performance tests of **16.1** to **18.1** which provide more detailed information on heating uniformity.

The tests are intended only for ovens having a rated microwave frequency of 2 450 MHz.

The load specified is potable water having an initial temperature of 27 ± 2°C.

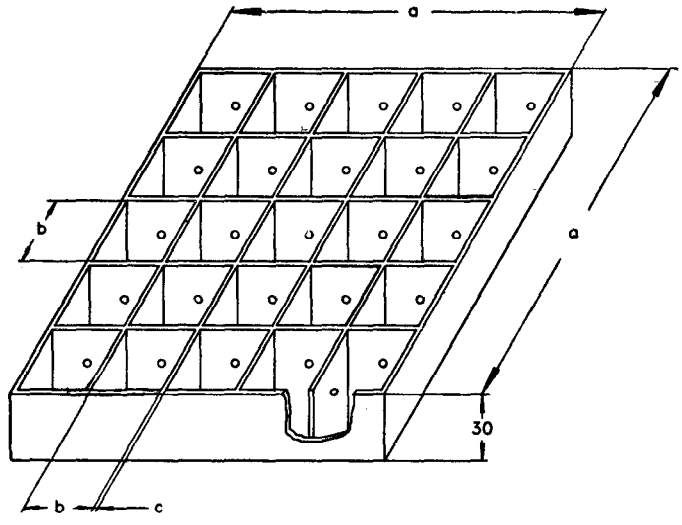
The microwave power output measured according to **13.1** as used to calculate the heating times corresponding to the energy values given for the various loads.

There should be a 30 min rest period before and between tests.

15.2 Square Tank Tests

Two tank sizes are specified. Either or both sizes may be used. However, tanks of the same size are used for comparison tests.

The tanks are specified in Fig. 1. Tank 1 is filled with 50 ± 5 g and tank 2 with $1\,000 \pm 10$ g of water.



All dimensions in millimetres.

	a	*b*	*c*
TANK 1	168	31·2	2
TANK 2	228	42	3

The holes in the tank compartment separators allow the water load to reach a uniform height throughout the tank.

FIG. 1 SQUARE TANKS

For ovens with one self only, the tests of **15.3** and **15.4** are made.

For ovens with two shelves, the test of **15.3** is made sequentially with a tank on each shelf. The test of **15.4** is made with one tank on each shelf.

15.3 Single Square Tank Test

The tank is filled with water and the initial temperature is then placed centrally on the shelf, with one side parallel to the front of the oven.

Tank 1 is heated at full power for a time corresponding to 50 kW for Tank 2 time corresponding value is 100 kW.

The tank is removed from the oven and the water stirred before measuring the temperatures. Thermocouples with time constant less than 2 s are to be used. The measurement shall be completed within 30 s after the end of the heating period, including at least 5 s while the thermocouples are inserted into the water.

Evaluation: In order to assess temperature differences within the load, minimum and maximum values of the temperature rise of nine inner compartments are calculated as percentage of the average temperature rise of all 25 compartments.

In order to assess corner edge heating effects, 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.

15.4 Two Square Tanks Test

Two tanks of equal size are used. Water temperature is measured before the heating.

For ovens with one shelf only, the two tanks are placed on top of each other and as in **15.3.**

For ovens with two shelves, one tank is placed on each shelf, as in **15.3.** Manufacturer's instructions are used for selection when more than two shelf positions are available.

For the two small tanks, heating is at full power for the time corresponding to 100 kW. For

the two large tanks, the correspondiug value is 200 kW.

The tanks are removed from the oven and the water loads stirred before measuring the temperatures. Thermocouples as specified in **15.3** are to be used. The top tank temperatures are measured as in **15.3** while nested on the bottom tank. It is then removed and the bottom tank temperatures are measured within 60 s after the end of the heating.

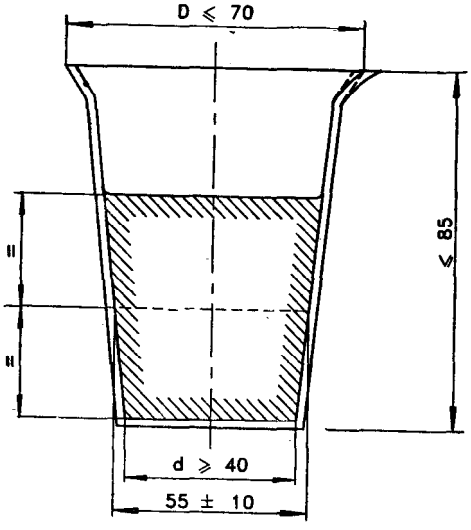
Evaluation: In order to assess the uniformity of large volume heating, the average temperature rise of the top tank is delivered by the average of that of the bottom tank. The result is expressed as the percentage.

The uniformity of heating in each of the two tanks is evaluated by calculating the minimum and maximum temperature rises as percentages of the average of each tank.

NOTE — The uniformity of heating should not vary between ±20 percent that of the average value.

15.5 Multiple Cup Test

Five cups according to Fig. 2 are used. An insulating pad of beads polystyrene 5 mm thick and of the size suitable for locating the cups during measurements is also used.

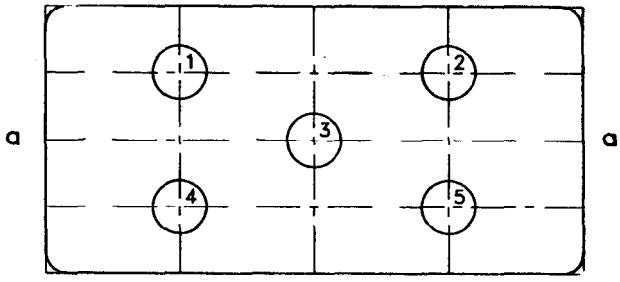


The cup is a thin-walled circular, cross-section and of a microwave transparent material.

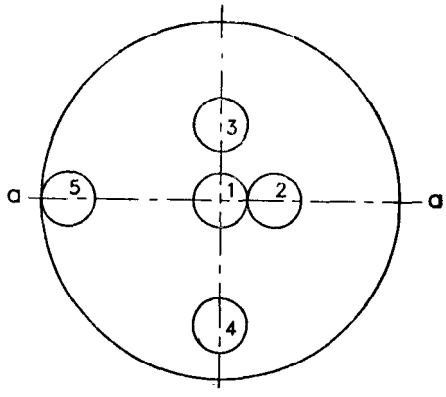
FIG. 2 CUP DIMENSIONS IN MILLIMETRES

The cups are immersed in the water to be used for the load to equalize the temperature. They are then removed and quickly dried on the outside. After filling with 100 ± 1 g of water each cup is placed on the insulating pad.

The initial water temperature is measured in each cup and the cups are then placed on the shelf. On rectangular shelves the cups are positioned as shown in Fig. 3A, on circular shelves as shown in Fig. 3B. The oven is then operated at full power for a time corresponding to 50 kW.



3A RECTANGULAR SHELVES : ALL RECTANGLES ARE EQUAL



Cup 1 at centre
Cup 2 contiguous with cup 1
Cup 3 centre at distance $R/3+D/2$ from shelf centre
Cup 4 at distance $2R/3$ from shelf centre
Cup 5 contiguous with the shelf circumference
R = shelf radius
D = maximum diameter of the cup

3B CIRCULAR SHELVES

FIG. 3 CUP POSITIONS FOR THE TESTS OF CLAUSE 15

After heating the cups are quickly removed from the oven and placed on the insulating pad. After stirring for 1 to 3 s, the temperatures are measured within about 30 s, in the order 1, 2, 3, 4 and 5.

The procedure is then repeated, using the same time as in the first run. However, when measuring the final temperature, the reverse order 5, 4, 3, 2 and 1, is used.

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

NOTE — The result is expressed as a percentage. The uniformity of heating should not vary between 20 percent that of the average value.

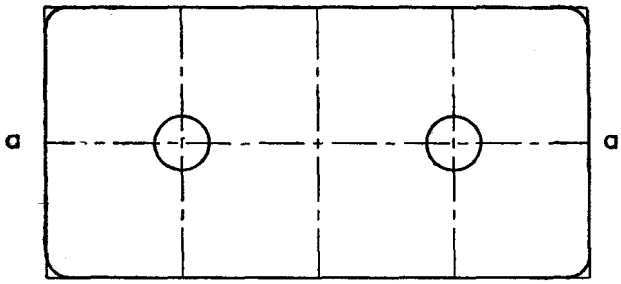
16 HEATING PERFORMANCE

16.1 The purpose of this test in this clause is to evaluate the temperature evenness and heating time when the oven is used for heating beverages.

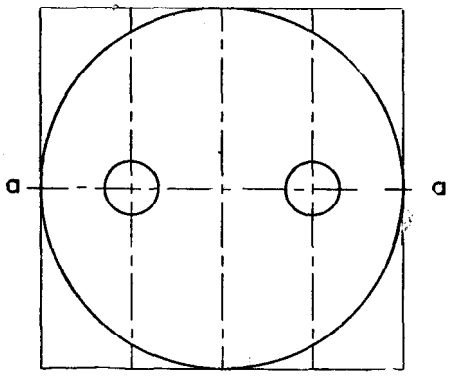
This clause is intended only for ovens having a rated microwave frequency of 2 450 MHz.

The containers used in the test are the two cups as shown in Fig. 2. The load is 100 ± 1g of potable water in each cup. The initial water temperature is 27 ± 2°C.

The cups are fitted with the specified load, the temperature is measured and the tubs are placed on the shelf. The cups are located continuously side by side on line *a-a* of Fig 4A and 4B, with one cup in the centre and the other on the right. The oven is operated at full power.



4A RECTANGULAR SHELVES: ALL EIGHT RECTANGLES ARE EQUAL



4B CIRCULAR SHELVES: ALL EIGHT RECTANGLES ARE EQUAL

FIG. 4 CUP POSITIONS FOR THE TESTS OF CLAUSE 16

The test is then repeated but with the cups located as shown in Fig 4A for rectangular shelves and Fig. 4B for circular shelves.

The heating time is the same for each test so that the average final temperature of the four cups is 80 ± 5°C.

It is normally necessary to repeat the tests in order to obtain the appropriate heating time.

The water is stirred for at least 1 s to equalize the temperatures before measurements. The final water temperature measurement shall be completed within 10 s after the end of the heating time.

Evaluation: The heating time, which includes any start-up time, is stated.

For comparisons between ovens, the stated heating times should be normalized to 60 K temperature rise. If, for example, the average temperature rise is 57 K and each heating time is 120 s, the normalized heating time will be 120 × 60/57 = 126 s.

The average temperature rise of the four cups is calculated. The division of each temperature rise from the average is then calculated and the largest deviation divided by the average temperature rise. The result is expressed as percentage.

17 COOKING PERFORMANCE

17.1 This clause provides test methods for the cooking of foods. However, due to important relationship between microwave field distribution, food, oven and utensil geometry, the cooking procedure specified by the manufacturer may give better performance for foods similar to those employed in the following tests. In this case or if the test methods are not relevant the tests are conducted according to manufacturer's instructions and stated in the report.

The food load tests outlined in the clause shall be used for direct comparison within a single laboratory during a specified time period.

There should be a 30 min rest period before and between tests.

Evaluation: The evaluation is made in terms of three performance factors: speed, cooking results and convenience.

Speed is stated as the total cooking time including rest periods. The specified rest period after cooking and removal of the load from the oven shall, however, not be included.

Cooking result evaluation is by assessing:

a) Uniformity of heating, cooking or baking: in general terms of appearance and texture in relation to expected results;

b) Areas which are not baked or not cooked: in terms of size and position of the raw area not baked or not cooked; in terms and position of the raw area, large or centrally positioned raw areas are considered to be more critical faults;

c) Burnt areas or browned foods: interim of size and position of burnt areas, large or centrally positioned burnt areas are considered to be more critical faults.

To assist in the evaluation of results, the following order of merits may be used:

a) No overcooking and no undercooking;

b) Slightly overcooked or slightly undercooked;

c) Slightly overcooked and slightly undercooked;

d) Overcooked and undercooked, raw areas; and

e) Very overcooked, burnt, still undercooked, raw areas.

Convenience evaluation is by noting the number of procedures required during the total operation. Initial setting procedures for the controls are, however, excluded. Examples of procedures which are included, are:

a) Separation of the load of removal of parts of it;

b) Stirring or manual turning of the load; and

c) A waiting period followed by manual resetting and restart.

17.1.1 *Test A*

Purpose: To evaluate the cooking uniformity of a large rectangular food of moderate thickness (egg custard).

The container for doing the test should be a square borosilicate glass or plastic container with a maximum material thickness of 8 mm, fulfilling the following dimensional requirements:

— Height : 50 ± 10 mm

— Area at the top of the food load : 500 ± 10 cm^2

— Height of the food load : 20 ± 3 mm

The nominal mass of the food load is 1 000 g. If this does not correspond to the requirements above, the mass shall be adapted accordingly.

Determination of load mass is normally done as a pretesting for the container to be used.

Ingredients:

750 g cow's milk of approximately 3 percent fat content,

375 g eggs, and

125 g sugar (sucrose).

Procedure: Heat the milk to approximately 60°C. Beat the eggs and pour the warm milk over them. Add the sugar and beat at medium speed using a good food mixer. Strain and pour the mixture into the container. Place in a refrigerator until the temperature of the mixture is at 5 ± 2°C.

Heat according to manufacturer's instructions for this type of load. If such instructions are not available, place the load in the central of the shelf with sides parallel to the oven front; heat at a rate corresponding to 300 W and try to obtain an adequate result. If this is not possible or this rate is too low, tests are made at a suitable power level, which shall be reported.

Remove the load from the above. After a rest period of 2 h, evaluate the speed, cooking result and convenience.

17.1.2 *Test B*

Purpose: To evaluate heating (baking) uniformity of a cylindrical, thick, expanding food.

The container for this test should be a circular borosilicate glass or a plastic container with a maximum material thickness of 6 mm, fulfilling the following dimensional requirements.

Height of 50 ± 10 mm, initial diameter at the top of the food load should be 200 ± 10 mm and initial height of the food load be 15 ± 2 mm.

The nominal mass of the food load is 475 g. If this does not correspond to the requirement above, the mass shall be adapted accordingly.

Determination of load mass is normally done as a pretesting for the container to be used.

Ingredients:

170 g wheat baking flour,

170 g sugar (sucrose),

10 g baking powder,

100 g cold potable water,

50 g margarine (good quality household type, 80-85 percent fat), and

125 g egg.

Grease proof paper of approximately 200 mm diameter is also required.

Procedure: Whisk egg and sugar for 2-3 min. Melt margarine and add. Gradually add flour, baking powder and water. Place the greaseproof paper in the bottom of the container and pour the container. Better temperature should be 20 ± 2°C and the standing time after mixing shall not exceed 10 min.

Heat according to the oven manufacturer's instruction for this type of load. If such instructions are not available, place the load in the centre of the shelf; heat at a rate corresponding to 400 W and try to obtain an adequate result. If this is not possible or this rate is too low, the tests are made at a suitable power level, which shall be reported.

Remove the load from the oven. After the rest period of 5 min, cut the load into eight pieces. Evaluate the speed, cooking result and convenience.

17.1.3 *Test C*

Purpose : To evaluate cooking uniformity of a thick, brick-shaped food.

The container for this test is made up of a rectangular borosilicate glass or plastic container with a maximum thickness of 6 mm fulfilling the following dimensional requirements:

Length to width ratio of 2-2·5 to 1; height of 75 ± 15 mm, area at the top of the food load should be 200 ± 40 cm^2 and the height of the food load should be 45 ± 3 mm.

The nominal mass of the food is 900 g. If this does not correspond to the requirements above, the mass shall be adapted accordingly.

Determination of load mass is normally done as a pretesting for the container to be used.

Ingredients: 800 g minuted lean beef (maximum 20 percent fat content),

115 g eggs, and

2 g table salt.

Clingfilm to cover top surface of load.

Procedure: Beat the egg and mix in the beef and salt. Carefully pack the mixture in the container avoiding air pockets. Compact the mixture by using another container and ensure that the surface is flat. Cover with the clingfilm and place in a refrigerator until the temperature of the mixture is at 5 ± 2°C.

Heat according to the oven manufacturer's instructions for this type of load. If such instructions are not available, place the load in the centre of the shelf with the long side parallel to the ovenfront, heat at a rate corresponding to 400 W and try to obtain an adequate result. If this is not possible or this rate is too low, tests are made at a suitable power level, which shall be reported.

Remove the load from the oven. After a rest period of 5 min, remove the film and cut the load vertically into five equal sections. Evaluate the speed, cooking result and convenience.

18 DEFROSTING PERFORMANCE

18.1 The clause provides test methods for defrosting of foods. However, due to the important relationship between microwave field distribution, food, over and the utensil geometry, the defrosting procedure specified by the manufacturer may give a better performance for foods similar to those employed in the following tests. In this case or if the test methods are not relevant, the tests are conducted according to manufacturer's instructions and are stated in the results.

The food load tests outlined in this clause are to be used for direct comparison within a single laboratory during specific time period.

There should be a 30 min rest period before and between tests.

Evaluation: This is made in terms of three performance factors: speed, defrosting result and convenience.

Speed is stated as the total defrosting time including rest periods. The specific rest period after defrosting and removal from the oven should however not be included.

Defrosting result evaluation is made by noting the number of procedures required during the total operation. Initial setting procedures for the controls are, however, excluded. Examples of procedures which are included, are:

a) Separation of the load or removal of parts of it,

b) Stirring of manual turning of the load, and

c) A waiting period followed by manual resetting and restart.

18.1.1 *Meat Defrosting Test*

Purpose: To evaluate the uniformity of defrosting of a thickfood item (minced meat).

The container for this test shall be a rectangular one fulfilling the following dimensional requirements:

Length to width ratio 2-2 5 to 1; area, at the top of the food load should be 200 ± 40 cm^2 and the height of the food load should be 25 ± 4 mm.

The nominal mass of the food load is 500 g. If this does not correspond to the requirement above, the mass shall be adapted accordingly.

Determination of load mass is normally done as a pretesting for the container to be used for shaping the load.

Ingredients:

500 g minced lean meat, and

Plastic or grease proof paper container liner and a flat plate are also required.

Procedure:

Line the container with the plastic or grease proof paper. Pack the meat in the container avoiding air pockets. Compact it using a suitable flat tool.

Freeze the load at a temperature between −18°C and −25°C and let it stand for atleast 12 h in the freezer.

Turn out the frozen block onto a flat plate. Defrost according to the oven manufacturer's instructions for this type of load. When a defrost feature is provided, but precise instructions are not given by the manufacturer for this type of load, additional testing may be done to determine the defrosting tapability of the oven. All conditions and results are to be prepared.

Remove the load from the oven. Evaluate the result after a rest period of 5 min.

Evaluation: To assist in the evaluation of the results, the following order of merits may be used:

a) No warm or frozen parts;
b) Not warm but still frozen parts;
c) Parts slightly warm and still frozen parts;
d) Less than 50 g cooked and warm, and still frozen parts; and
e) More than 50 g cooked and warm, and still frozen parts.

19 TESTS

19.1 Type Test

The tests specified in Table 1 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.

19.1.1 *Criteria of 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).

Table 1 Schedule of Type Tests
(*Clause* 19.1)

Sl No.	Requirements	Clause Reference
i)	Safety requirements	8 to 32 of IS 302-2-25 (1994)
ii)	Finish	10
iii)	External dimensions	11
iv)	Usable cavity volume	12
v)	Microwave power output	13
vi)	Efficiency	14
vii)	Uniform heating	15
viii)	Heating performance	16
ix)	Cooking performance	17
x)	Defrosting performance	18

19.2 Acceptance Tests

The following shall constitute the acceptance tests:

Tests	*Clause Reference of IS 302-2-25 (1994)*
a) Protection against electric shock	8
b) Input	10
c) Temperature rise	11
d) Electrical insulation and leakage current at operating temperature	13

Tests	*Clause Reference of IS 302-2-25 (1994)*
e) Moisture resistance	15
f) Insulation resistance and electric strength (after humidity treatment)	16
g) Provisions for earthing	27

NOTE — For the purpose of acceptance tests, the humidity treatment shall be done for 24 hours while conducting the test for moisture resistance [*see* **15** of IS 302-1 (1979)].

19.2.1 A recommended sampling procedure for acceptance tests is given in Appendix B of IS 302-1 (1979).

19.3 Routine Tests

The following shall constitute the routine tests:

Test	*Clause Reference*
a) Protection against electric shock	8 of IS 302-2-25 (1994)
b) High voltage	13.3.2 of IS 302-1 (1979)
c) Earthing connection	27 of IS 302-2-25 (1994)

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