

English Version

Materials and articles in contact with food stuffs - Test method  
for the resistance to microwave heating of ceramic, glass, glass-  
ceramic or plastics cookware

Matériaux et articles en contact avec les denrées  
alimentaires - Méthode d'essai de la résistance des articles  
culinaires en céramique, verre, vitrocéramique ou plastique  
au chauffage par micro-ondes

Werkstoffe und Gegenstände in Kontakt mit Lebensmitteln  
- Prüfverfahren für die Beständigkeit von Kochgeschirr aus  
Keramik, Glas, Glaskeramik oder Kunststoff bei Erhitzung  
in der Mikrowelle

This European Standard was approved by CEN on 15 March 2007.

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## Foreword

This document (EN 15284:2007) has been prepared by Technical Committee CEN/TC 194 "Utensils in contact with food", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2007, and conflicting national standards shall be withdrawn at the latest by October 2007.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

## Introduction

This European Standard specifies a method for subjecting articles designated as suitable for use in a microwave oven to a standard amount of energy for short and long time periods in a normal domestic microwave oven. The minimum power level specified is close to the maximum power capacity of most European domestic microwave ovens and the limits will permit the use of a wide range of domestic microwave ovens without alteration. The short time period is meant to be typical of use of articles for the reheating of foods and beverages, and the long time period is meant to represent use of articles for cooking. The articles are tested in an empty condition in order to create worst-case conditions with respect to heating of the article and thermal stress to the article. Certain types of ceramic and plastics can absorb water in use, and so in order to simulate real use ceramic and plastics articles are immersed in water for 1 h before the test.

The objectives of the method are to exclude:

- articles that could damage the oven (non-metallic articles with metallic decoration can cause arcing; very porous ceramic articles can absorb water that would be rapidly heated when the article is microwaved, and thus reach a high temperature and pressure which may cause the article to explode);
- articles that may be damaged by microwave heating;
- articles where handles exceed a safe handling temperature after the short time period of heating only. Safe handling temperatures of 56 °C for ceramic, glass-ceramic or glass and 60 °C for plastics handles were chosen by reference to a one minute contact time in EN ISO 13732-1 [1].

Articles are tested by heating in a microwave oven for both a short and a long period of time. For articles with handles, the temperature of the handle is measured after the short period of heating. Additional data can be derived by measurement of the surface temperature of the articles after both the short and the long periods of heating. This will provide useful information for manufacturers and suppliers of cookware.

## 1 Scope

This European Standard specifies a method for the determination of the resistance to microwave heating of cookware made of ceramic, glass, glass-ceramic or plastics.

It is applicable to articles that are intended for multiple re-use in a microwave oven. It is not applicable to articles, particularly those made from plastics, which are intended to be discarded after one use.

## 2 Principle

An article is subjected to microwaves in the presence of water external to the test specimen for both a short and a long period of time, and any damage to the article is noted. For articles with handles, the temperature of the handle is measured after the short period of heating. The maximum surface temperature can be determined after the short and long periods of heating in order to provide additional information for manufacturers and suppliers.

## 3 Apparatus

**3.1 Microwave oven, fitted with a turntable**, capable of an output of at least 600 W (as determined in 5.1).

**3.2 Surface temperature measuring apparatus**, comprising an electrical thermometer with a contact sensor made of metal and having insignificant heat capacity (instrument accuracy shall be at least  $\pm 1$  °C).

**3.3 Two water containers small enough to fit into the rear corners of the oven**, each capable of containing 125 ml of water.

**3.4 Stopwatch**, capable of measuring to an accuracy of  $\pm 1$  s.

## 4 Test specimens

At least three identical test specimens of each type (representing the range of shapes and functions of the set of cookware or tableware being examined) shall be tested. Where there are articles made from different materials in the set, three test pieces representing each material shall be taken.

## 5 Calibration of microwave oven

### 5.1 Determination of power output

In order to protect the magnetron during the procedure (Clause 6) it is necessary to provide ballast in the form of 250 ml of water (6.4) in two containers (3.3). Therefore, also include this ballast during calibration but ignore it for the purpose of the calculation (5.2).

Make the measurement with a water load in a glass container. The water and container temperature shall initially be below ambient temperature and be raised to an equal temperature above ambient. This procedure ensures that any heat gains or losses from the surroundings have a minimum effect.

A cylindrical container of borosilicate glass shall be used for the test. It shall have 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 shall be determined.

The stirring and measuring devices shall have a low heat capacity.

At the start of the test ensure that the oven is at ambient temperature of  $(20 \pm 3) ^\circ\text{C}$ , and measure that temperature. Add  $1\,000\text{ g} \pm 5\text{ g}$  of water to the container and determine its actual mass. Cool the container and water to  $(5 \pm 1) ^\circ\text{C}$  below ambient temperature. Stir the water, measure its temperature and immediately place the container in the centre of the oven on the turntable at its lowest normal position. Operate the oven until a temperature  $(5 \pm 1) ^\circ\text{C}$  above ambient temperature is obtained and record the time of operation. Measure the temperature of the water and container within 60 s of the oven being switched off.

NOTE 1 Trial and error might be required to achieve the correct temperature rise.

The microwave power output shall be calculated using the following equation:

$$P = \frac{4,187 \times \Delta T}{t} (m_w + 0,55m_c)$$

where

$P$  is the microwave power output in Watts;

$\Delta T$  is the difference between the initial and final water temperature;

$t$  is the time in seconds;

$m_w$  is the mass of water in grams;

$m_c$  is the mass of the container in grams.

The microwave power output shall be stated in Watts, rounded up or down to the nearest 50 W.

NOTE 2 The procedure (Clause 6) is carried out at a power setting that gives a power output in the range of 525 W to 675 W. It may, therefore, be necessary to repeat the calibration to determine the appropriate power setting.

## 5.2 Determination of heating time

Once the power output has been determined, calculate the times needed to give an energy value of 72 000 J for the short period and 468 000 J for the long period of test using the following equation:

$$t = \frac{E}{P}$$

where

$t$  is the time required in seconds;

$P$  is the microwave power output in Watts;

$E$  is the energy required in Joules.

NOTE The range of times needed to meet the power output range given in NOTE 2 to 5.1 is 107 s to 137 s for the short period and 693 s to 891 s for the long period.

## 6 Procedure

6.1 Apply a stain to the surface of the test specimen and wash clear.

NOTE A 1 % aqueous solution of methylene blue is suitable. The test specimen may be immersed in a tank or bath of the staining solution or brushed/wiped with the solution.

6.2 Visually check that the surface is not damaged. Note any small faults (e.g. pinholes in the glaze) prior to testing.

6.3 Except for articles made from glass or glass-ceramic, immerse the test specimen in water at a temperature of  $(20 \pm 3)$  °C for one hour and then wipe the surface dry with a cloth.

6.4 Pour  $(125 \pm 2,5)$  ml of water into each water container and place at the back of the oven so as not to interfere with the turntable.

6.5 Place the test specimen at the centre of the oven on the turntable and microwave for the time determined in 5.2 to apply the specified energy for the short period. ***If electrical arcing begins IMMEDIATELY SWITCH OFF THE OVEN. Terminate the test and state in the test report that at the onset of electrical arcing the test was terminated.***

6.6 After the cycle is completed, open the oven door and, if applicable, using the surface temperature measuring apparatus (3.2), find and record the highest temperature of the handle. When additional data is required, follow this procedure to find the highest surface temperature. Ensure that this process takes no longer than 45 s.

6.7 Immediately following 6.6, set the oven for the long period determined in 5.2 and restart.

6.8 After completion, when additional data is required, record the highest surface temperature (in no more than 45 s). Remove the test specimen from the oven and allow it to cool on an insulated surface to prevent thermal shock.

6.9 Apply stain to the test specimen and wash clear (as in 6.1).

6.10 Visually inspect the test specimen for damage according to the criteria in Table 1. For the colour criterion, an inspector and inspection site that meet the requirements of Clause 4 and 5.2 of EN 12875-2:2001 are required [2].

Table 1 — Inspection criteria

Material	Cracking	Crazing	Scaling	Colour	Melting	Deformation	Suitability for re-use	Charring
Ceramic	+	+ <sup>a</sup>	+ <sup>b</sup>	+ <sup>c</sup>				
Glass, glass-ceramic	+		+ <sup>b</sup>	+ <sup>c</sup>				
Plastics	+			+ <sup>c</sup>	+ <sup>d</sup>	+	+ <sup>e</sup>	+

(+) = to be inspected  
<sup>a</sup> refers to the glaze  
<sup>b</sup> refers to on-glaze decoration  
<sup>c</sup> if several colours are present on one article to be inspected, the colour with the greatest change shall be chosen  
<sup>d</sup> article shall not be too soft to handle  
<sup>e</sup> article shall be washable and stain resistant

6.11 Repeat the test using the different article shapes in the set.

## 7 Results

7.1 Record the highest temperature for each item tested in a set.

7.2 Record any damage that has occurred to individual items.

7.3 Record any arcing, temperature limits and damage.

7.3.1 If arcing occurs (6.5), the article fails the test and is unsuitable for use in a microwave oven.

7.3.2 The maximum surface temperature of handles after the short period heating (6.6) shall not exceed the following limit values:

ceramic, glass-ceramic or glass: 56 °C;

plastics: 60 °C.

NOTE 1 These temperatures can be found by reference to a one minute contact time in EN ISO 13732-1 [1].

NOTE 2 As temperatures measured after the long period of heating vary significantly depending on the microwave oven used for testing, no temperature limit values apart from those for handles are given.

7.4 If any damage occurs (according to the criteria in 6.10), the article fails the test and is unsuitable for use in a microwave oven.

## 8 Test report

The test report shall contain the following information:

- a) name of the testing establishment;
- b) date of the test;
- c) reference to this European Standard, i.e. EN 15284:2007;
- d) if applicable, the maximum handle temperature after the short period heating (6.6);
- e) description of damage (7.2).

Optional additional data

- i) maximum surface temperature after the short heating period (6.6);
- ii) maximum surface temperature after the long heating period (6.8).

## Bibliography

- [1] EN ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*
- [2] EN 12875-2:2001, *Mechanical dishwashing resistance of utensils — Part 2: Inspection of non-metallic articles*