

BS EN 60350-1:2013+A11:2014



BSI Standards Publication

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# Household electric cooking appliances

Part 1: Ranges, ovens, steam ovens and grills — Methods for measuring performance

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## National foreword

This British Standard is the UK implementation of EN 60350-1:2013+A11:2014. It is derived from IEC 60350-1:2011, incorporating corrigenda February 2012 and August 2013. Together with BS EN 60350-2:2013 it supersedes BS EN 50304:2009+A1:2010 (dual numbered as BS EN 60350:2009+A11:2010) which will be withdrawn on 3 June 2016.

IEC corrigendum August 2013 introduces an electronic file containing calculation sheets in Annex E.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags  $\langle C \rangle$   $\langle C1 \rangle$ .

Where a common modification has been introduced by CENELEC amendment, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC amendment A11 are indicated by  $\langle C11 \rangle$   $\langle C111 \rangle$ .

BSI, as a member of CENELEC, is obliged to publish EN 60350-1:2013 as a British Standard. However, attention is drawn to the fact that the UK committee voted against its approval as a European standard. The main technical reasons behind this are summarized below.

Both clauses 7.Z1 and ZB.4 should aim to establish the uncertainties of the measurement method but the current text is related to the tolerances for market surveillance procedures used in Eco-design and Energy labelling. It should be noted that the test results in a product's Technical Documentation have to support the values declared for the Directives. The text within the Directives takes precedence if there is a conflict with what is written in the standard.

Annex ZA should have made references to the Essential Requirements of both the Eco-design of Energy-Related Products and the Energy Labelling of Products Directives.

The UK participation in its preparation was entrusted to Technical Committee CPL/59, Performance of household electrical appliances.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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**Compliance with a British Standard cannot confer immunity from legal obligations.**

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## Amendments/corrigenda issued since publication

Date	Text affected
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**Household electric cooking appliances -  
Part 1: Ranges, ovens, steam ovens and grills -  
Methods for measuring performance**

Appareils de cuisson électrodomestiques -  
Partie 1: Cuisinières, fours, fours à vapeur  
et grils -  
Méthodes de mesure de l'aptitude à la  
fonction

Elektrische Kochgeräte für den  
Hausgebrauch -  
Teil 1: Herde, Backöfen, Dampfgarer und  
Grillgeräte -  
Verfahren zur Messung der  
Gebrauchseigenschaften

This European Standard was approved by CENELEC on 2013-06-03. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## CENELEC

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

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## Foreword

This document (EN 60350-1:2013) consists of the text of IEC 60350-1:2011 + corrigendum Feb. 2012 prepared by IEC/SC 59K "Ovens and microwave ovens, cooking ranges and similar appliances", of IEC/TC 59 "Performance of household and similar electrical appliances", together with the common modifications prepared by CLC/TC 59X "Performance of household and similar electrical appliances".

The following dates are fixed:

- latest date by which this document has to be implemented (dop) 2014-06-03  
at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting (dow) 2016-06-03  
with this document have to be withdrawn

Together with EN 60350-2:2013, this document supersedes EN 50304:2009/EN 60350:2009 + A1:2010/A11:2010.

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

EN 60350-1:2013 includes the following significant technical changes with respect to EN 50304:2009/EN 60350:2009:

- the scope is revised (Clause 1). The ovens covered by this standard may be with or without microwave function. Steam ovens are included;
- new definitions for "Set to off mode" and "Set to standby mode" are included in Clause 3;
- the usable volume is reworded in calculated volume (6.2);
- performance measurements for steam ovens are described in 7.3 and Clause 8;
- an option for assessing the heat distribution with a digital measurement system is included in 7.5.2.4;
- Clause 12 "Standby power" is renamed to "Consumption measurement of low power modes" and the content is adapted to EN 50564;
- a measurement method for measuring the consumption of the cooling down period is added in the informative Annex ZB;
- a measurement method to check applied Microwave Energy during the measurement according to 7.4 is added in the informative Annex ZC.

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 60350-1:2011 are prefixed "Z".

Words in **bold** in the text are defined in Clause 3.

According to the decision D137/061 for CLC/TC 59X, this European Standard has been drawn up as a document which follows, as far as suitable, the structure of IEC 60350-1:2011.

It also describes the evaluation of data declared by the manufacturer and control procedures for checking these values.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

This European Standard is suitable for direct comparison and is considered sufficiently reproducible within given limits for the purpose of energy labelling according to the EU Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products. All paragraphs which are relevant for the measuring of energy labelling are listed in Annex ZA.

## Foreword to amendment A11

This document (EN 60350-1:2013/A11:2014) has been prepared by CLC/TC 59X "Performance of household and similar electrical appliances".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-09-29
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2017-09-29

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

The new amendment covers following issues:

- reference to EN ISO 80000-1:2012 for rounding;
- amending 6.8 mass of the appliances to ensure high reproducibility;
- verification procedure for ensuring that the temperature inside the oven cavity reaches the temperature setting of the thermostat and/or the oven control display within the duration of the test cycle for measuring the energy consumption (7.4.3.2) and implementing this issue to Annex ZE;
- implementation of Annex ZZ which shows the coverage of Commission Regulation and Commission Delegated Regulation and revision of Annex ZA.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

**Annex ZA**  
(normative)

**Overview – Clauses required for the EU Directive on Energy Labelling**

For the procedure required for the EU Directive on Energy Labelling, the following clauses are applicable:

- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 5 General conditions for the measurements
- 6 Dimensions and mass
  - 6.2 Usable Internal dimensions and calculated volume of ovens
  - 6.4 Dimensions of shelves
  - 6.5 Dimensions of grill grids
- 7 Ovens and combi steam ovens
  - 7.2 Preheating the empty oven
  - 7.4 Energy consumption and time for heating a load
    - 7.21 Measurement uncertainty of results
- 12 Consumption measurement of low power modes

Figure 1 Position of the thermocouple for measuring ambient temperature

Figure 4 Usable internal dimensions and calculated volume of ovens

Figure 6 Example of a method of fixing a thermocouple for the test of 7.4

Annex C Addresses of suppliers  
C.7 Brick for testing energy consumption of ovens

Annex D Description of the test brick

Annex E Calculation sheet: Energy consumption of electric ovens

Annex ZA Overview – Clauses required for the EU Directive on Energy Labelling

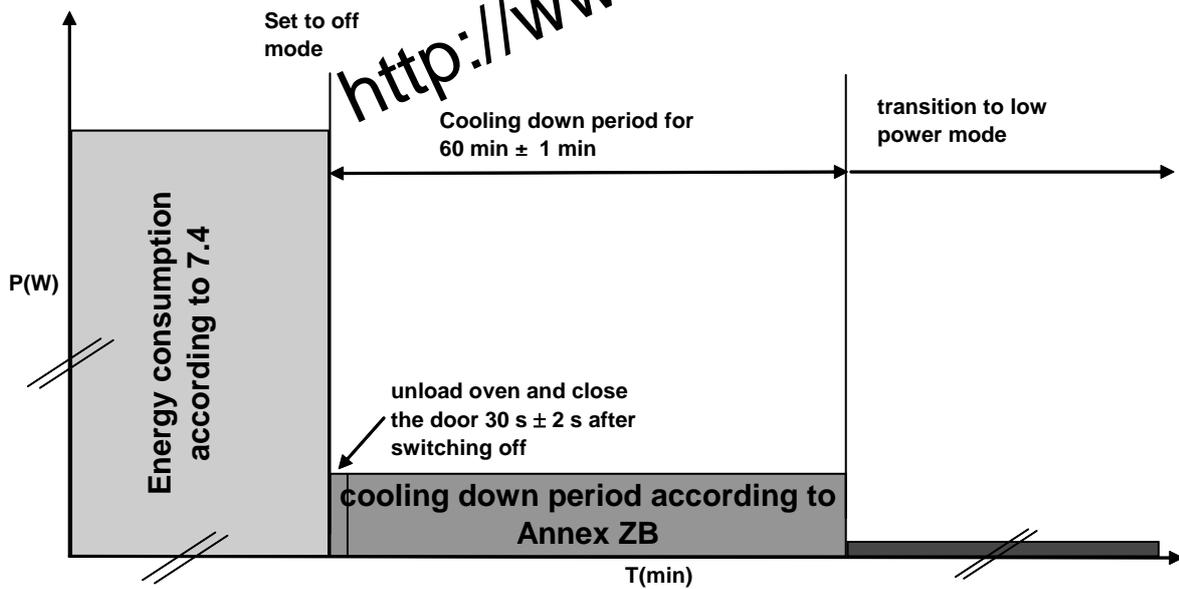
**Annex ZB**  
(informative)

**Measurement of the energy consumption of the cooling down period**

**ZB.1 General**

The purpose of this test is to measure the energy consumption of the cooling down period.

For cooking ranges, ovens and steam ovens the energy consumption of the cooling down period is measured.



**Figure ZB.1 – Phases of energy consumption measurement – Example**

**ZB.2 Preliminary measurements**

For measuring the energy consumption of the cooling down period a pre-test to fix the relevant temperature setting is carried out.

A thermocouple is placed in the empty oven as described in Clause 7.

The temperature control is set to positions where the mean oven temperature rises  $\Delta T_2^i$  as defined in Table 1 can be expected. The oven is run for some time without changing the setting until steady state conditions reached. The oven temperature is determined as the arithmetic mean between the maximum and minimum temperatures at steady state conditions.

NOTE Steady conditions are considered to be attained after five cycles of the thermostat or 1 h, whichever is shorter.

The temperature control setting is adapted until the arithmetic mean between the maximum and minimum temperature is  $\Delta T_2^i \pm 5$  K. This temperature control setting is noted for measuring the energy consumption of the cooling down period.

The oven is cooled down to ambient temperature.

### ZB.3 Measuring the energy consumption of the cooling down period

The procedure to prepare the brick stated in 7.4.2.2 and 7.4.2.3 is followed. The brick is positioned in the oven according to 7.4.3.1. The oven is switched on within 3 min from the removal of the brick from the refrigerator. The temperature control is set to the position determined in ZB.2. The oven is operated for the time  $t_{\Delta T_0}^{i\dots}$  determined in 7.4.4.2.

The measurement shall be started by setting the appliance to **off mode**. The brick is removed and the door shall be closed after  $(30 \pm 2)$  s. The measurement of the low power energy consumption is started immediately when the appliance is **set to off mode**.

If the appliance doesn't offer an off mode it is **set to standby mode**.

The measurement is stopped after 60 min  $\pm$  1 min independent if the ventilation stops automatically.

The energy consumption for the cooling down period  $W_v$  is noted in Wh for each heating mode according to Table 1.

Ensure that the following conditions remain relevant for the duration of the measurement:

- connected to mains power for the duration of the test;
- no network is connected to the product.

### ZB.4 Measurement uncertainty – Energy consumption for the cooling down period

The energy consumption for the cooling down period determined according to ZB.3 shall not be greater than the value declared by the manufacturer plus 15 %.

If the result of the test carried out on the first appliance is greater than the declared value plus 15 %, the test shall be carried out on a further three appliances, which shall be randomly selected from the market.

The arithmetical mean of the values of these three appliances shall not be greater than the declared value plus 10 %.

**Annex ZC**  
(informative)

**Check of applied microwave energy during the measurement according to 7.4**

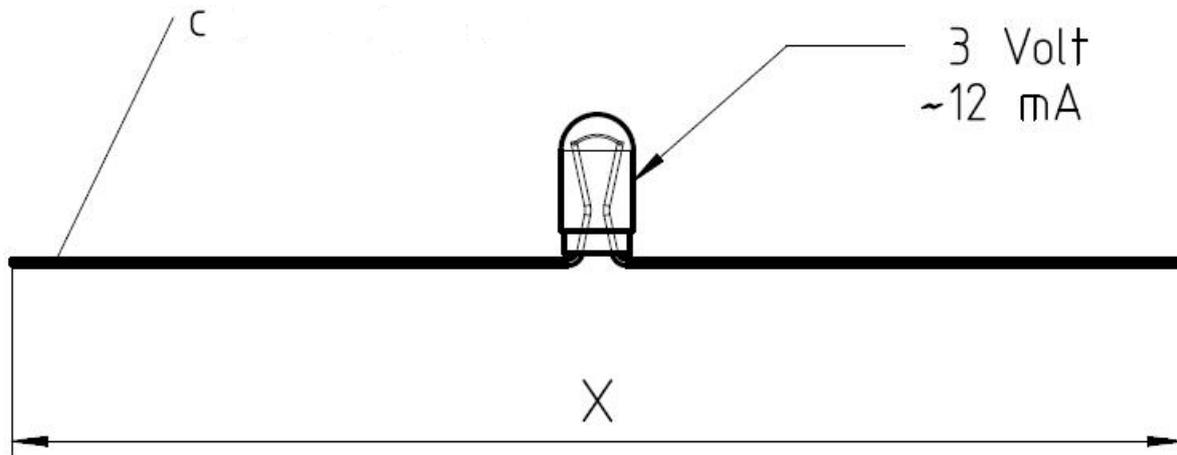
**ZC.1 General**

Heating up the brick according to 7.4 shall only be done with thermal heating. It is not allowed to switch on a magnetron even not for a short period.

The sophisticated method to check a possible applied microwave energy during the energy consumption measurement according to 7.1 is to proof if the magnetron is switched on and off. Depending on the design of the appliances it is not always possible to determine clearly if microwave energy is switched on during the long lasting heating up process. Therefore following method can be used in a pre-test.

**ZC.2 Procedure**

A filament lamp with a rated current of 12 mA and rated voltage less than 6 V with bended connecting wires is used. The length of the wires are approximately half of the wave length of the microwave so the current distribution is maximum in the middle where the filament of the lamp is (see Figure ZC.1).



**Key**

- c connecting wire
- x in the range of 50 mm to 60 mm

**Figure ZC.1 — Filament lamp**

The brick is prepared as described in 7.4.2.3 and placed in the oven as described in 7.4.3.1 The filament lamp is placed on the upper surface of the wet brick. The oven is switched on and operated according to 7.4.3.1 for at least this time which is necessary to have a temperature rise in the brick of 55 K.

Then the oven is switched off and the filament lamp is tested. If microwave energy was applied the electric field during microwave operation will induce currents much more than 12 mA so the filament will be damaged. The lamp can be tested with a resistance-test-equipment or with a small tester for LED lamps. The lamp is put into a socket and the filament will light up if it is not damaged. Otherwise microwave energy was applied.

**Annex ZD**  
(normative)

**Normative references to international publications  
with their corresponding European publications**

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

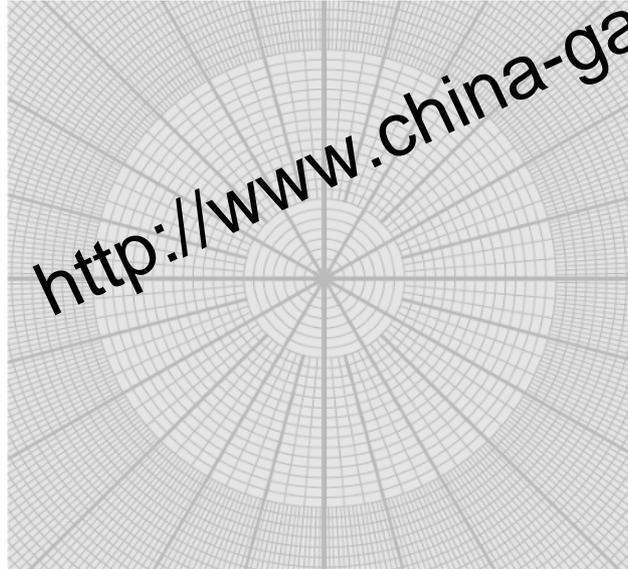
NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60584-2 + A1	1982 1989	Thermocouples Part 2: Tolerances	EN 60584-2	1993
IEC 62301 (mod)	2011	Electrical and electronic household and office equipment – Measurement of low power consumption	EN 50564	2011
ISO 7724	(all parts)	Paints and varnishes - Colorimetry	-	-
ISO 11664-2	-	Colorimetry Part 2: CIE standard illuminants	EN ISO 11664-2	-
CIE 15.2	1986	Colorimetry	-	-

**Annex ZE**  
(informative)

**Marking the temperature setting for checking the oven temperature**

For marking the temperature setting on the panel, a polar coordinate paper can be useful. Polar coordinate paper has concentric circles divided into small arcs to allow an exact marking around a knob.



**Figure ZE.1 – Polar coordinate paper – Example**

 **Annex ZZ**  
(informative)

**Coverage of Requirements of Commission Regulation (EU) No 66/2014 and  
Commission Delegated Regulation (EU) No 65/2014 and  
Commission Regulation (EC) No 1275/2008**

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers only the following requirements out of those given in *Commission Regulation (EU) No 66/2014 of 14 January 2014* implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household **ovens** and *Commission Delegated Regulation (EU) No 65/2014 of 1 October 2014* supplementing Directive 2010/30/EU with regard to energy labeling of household **ovens**:

- ensuring that the prospective harmonized standard(s) provides, where appropriate, revised and/or new definitions for at least the appliances and parameters included in the Commission Regulation (EU) No 66/2014 and in the Commission Delegated Regulation (EU) No 65/2014., including additional requirements for the measurement of low power modes according (EC) No 1275/2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off-mode electric power consumption of electrical and electronic household and office equipment;
- ensuring that the prospective harmonized standard(s) provides procedures and methods to measure at least the energy consumption for household electric **ovens** as included in the Commission Regulation (EU) No 66/2014 and in the Commission Delegated Regulation (EU) No 66/2014;
- ensuring that the prospective harmonized standard takes into account a load which is representing the food in the test conditions:
  - a test procedure for measuring the energy consumption of an adequate application is confirmed;
  - a test procedure for checking the oven temperature within the duration of measuring the energy consumption to prevent circumvention is introduced;
  - control procedures for checking measured values in comparison to values declared by the manufacturer are updated;
- ensuring that the prospective harmonized standard(s) identifies and controls the sources of variability, in particular for market surveillance purposes; defining a template for a data calculation sheet.

Compliance with this standard provides means of conformity with the specified requirements of the Commission Regulations concerned.

WARNING: Other requirements or other EU Directives or Commission Regulations may be applicable to the products falling within the scope of this standard.

Ⓒ11) Following clauses of this standard are relevant for the Coverage of Requirements of Commission Regulation (EU) No 66/2014 and Commission Delegated Regulation (EU) No 65/2014 and Commission Regulation (EC) No 1275/2008:

1 Scope

2 Normative references

3 Terms and definitions

5 General conditions for measurements

6.2 Usable internal dimensions and calculated volume of ovens

6.8 Mass of the appliance

7.1 General

7.4 Energy consumption and time for heating a load

7.Z1 Measurement uncertainty of results

12 Consumption measurement of low power modes

Annex C Addresses of suppliers

C.7 Brick for testing energy consumption of ovens

Annex D Description of the test brick

Annex E Calculation sheet: Energy consumption of electric ovens

Annex ZE Marking the temperature setting for checking the oven temperature

Annex ZZ Coverage of Requirements of Commission Regulation (EU) No 66/2014 and Commission Delegated Regulation (EU) No 65/2014 and Commission Regulation (EC) No 1275/2008

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## HOUSEHOLD ELECTRIC COOKING APPLIANCES –

### Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance

#### 1 Scope

This part of IEC 60350 specifies methods for measuring the performance of electric **cooking ranges, ovens, steam ovens**, and **grills** for household use.

The ovens covered by this standard may be with or without microwave function.

Manufacturers should 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 in the instruction manual as a microwave function, IEC 60705 is applied for energy consumption measurement. If the primary cooking function is declared as a thermal heat, then IEC 60350-1 is applied for energy consumption measurement.

NOTE 1 If the primary function is not declared by the manufacturer, microwave function and thermal heat should be measured as far as it is possible.

NOTE 2 For measurement of energy consumption and time for heating a load (see 7.4), this standard is furthermore not applicable to:

- microwave combination function;
- ovens with reciprocating trays or turntable;
- small cavity ovens;
- **ovens** without adjustable temperature control;
- heating functions other than defined in 3.12 to 3.14;
- appliances with only solo steam function (3.15).

NOTE 3 This standard does not apply to

- microwave ovens (IEC 60705),
- portable appliances for cooking, grilling, steaming and similar functions (IEC 61817).

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

This standard does not specify requirements for performance.

NOTE 4 Some of the tests which are specified in this standard are not considered to be reproducible since the results may vary between laboratories. They are therefore intended for comparative testing purposes only.

NOTE 5 This standard does not deal with safety requirements (IEC 60335-2-6 and IEC 60335-2-9).

NOTE 6 Appliances covered by this standard may be built-in or for placing on a working surface or the floor.

NOTE 7 There is no measurement method for the energy consumption for grilling and steam functions available.

#### 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.

IEC 60584-2:1982, *Thermocouples – Part 2: Tolerances*  
Amendment 1(1989)

Ⓒ EN 50564:2011, *Electrical and electronic household and office equipment – Measurement of low power consumption (IEC 62301:2011, mod.)* Ⓒ

ISO 7724 (all parts), *Paints and varnishes – Colorimetry*

ISO 11664-2<sup>2</sup>, *Colorimetry – Part 2: CIE standard illuminants for colorimetry*

CIE 15.2:1986, *Colorimetry*

Ⓒ EN ISO 80000-1:2013, *Quantities and units – Part 1: General (ISO 80000-1:2009 + Cor 1:2011)* Ⓒ

### 3 Terms and definitions

For the purposes of this document the following terms and definitions apply.

#### 3.1

##### **cooking range**

appliance having a **hob** and at least one **oven**. It may incorporate a **grill**

#### 3.2

##### **hob**

appliance or part of an appliance which incorporates one or more **cooking zones**

NOTE A hob is also known as a cooktop. Methods for measuring performance of hobs are described in IEC 60350-2.

#### 3.3

##### **oven**

appliance or compartment of a **cooking range** in which food is cooked by radiation, by natural convection, by forced-air circulation or by a combination of these heating methods

#### 3.4

##### **pyrolytic self-cleaning oven**

**oven** in which cooking deposits are removed by heating the **oven** to a sufficiently high temperature

#### 3.5

##### **steam ovens**

appliance or compartment of a cooking range in which food is cooked mainly by steam condensation at ambient pressure. Appliance are fitted with an own steam generator

NOTE Steam does not mean the evaporated water from the food.

#### 3.6

##### **combi steam ovens**

appliance or compartment of a cooking range in which food is cooked by combination of 3.3 and 3.5

NOTE 1 Combi steam ovens with only steam assist function also exist. For these ovens the steam function can only be tested if this function is described in the manual instruction or if the appliance provides a setting for steam function.

NOTE 2 Steam does not mean the evaporated water from the food.

1 This document has been replaced by a new edition (2011), but for the purposes of this standard, the 2005 edition is cited.

2 Also published as CIE S 014-2.

**3.7**

**grill**

appliance or part of an appliance in which food is cooked by radiant heat

**3.8**

**oven with catalytic cleaning**

**oven** in which cooking deposits are removed by breaking them down on a special coating

**3.9**

**warming compartment**

separate compartment in which dishes are placed in order to preheat them prior to serving, or in which food is maintained at serving temperature

**3.10**

**small cavity oven**

**oven** with the following dimensions related to the calculated volume:

- both width and depth < 250 mm,
- or height < 120 mm

NOTE The definition of small cavity ovens in this standard is due to the size of the test load used in 7.4.

**3.11**

**multiple cavity appliance**

appliance that has more than one separate **oven** cavity in which food is cooked and which can be controlled independently, but cannot be installed separately

**3.12**

**conventional heating function**

heat transmission to the food by radiation and natural convection only

NOTE This does not include **ovens** that have a top heating element only (i.e. for the **grilling** function).

**3.13**

**forced air circulation function**

heat transmission to the food by forced air convection, i.e. circulating the air with the help of a fan

NOTE This does not include circulated air functions which operate a **grill** element only.

**3.14**

**hot steam function**

heat transmission to the food by generated steam in combination with radiation and / or convection at ambient pressure (approximately 1 bar) and with a temperature > 100 °C

**3.15**

**steam function**

heat transmission to the food mainly by condensation of steam at ambient pressure (approximately 1 bar) with a temperature ≤ 100 °C

3.21

**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

3.22

**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

Note 1 to entry: 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.

Note 2 to entry: For definition of off mode, EN 50564:2011 is relevant.

3.23

**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 1 to entry: For definition of standby mode, EN 50564:2011 is relevant. 

## 4 List of measurements

### 4.1 Dimensions and mass

The following measurements are carried out:

- overall dimensions (see 6.1);
- internal dimensions of **ovens** and **steam ovens** (see 6.2);
- dimensions of shelves and steaming accessories (see 6.4);
- dimensions of **grill grids** (see 6.5);
- dimensions of **warming compartments** (see 6.6);
- level of the shelf (see 6.7);
- mass of the appliance (see 6.8).

### 4.2 Oven and combi steam oven

The following tests are carried out:

- preheating the empty oven (see 7.2);
- accuracy of the control (see 7.3);
- energy consumption and time for heating a load (7.4);
- heat distribution (see 7.5);
- ability to supply heat (see 7.6).

#### 4.3 Steam oven and combi steam oven

The following tests are carried out:

- distribution of steam (8.1);
- ability to supply steam (8.2);
- performance test with maximum load (8.3).

#### 4.4 Grill

The following tests are carried out:

- grilling area (see 9.2);
- grilling (see 9.3).

#### 4.5 Warming compartment

The following test is carried out:

- temperature control and energy consumption (see Clause 10).

#### 4.6 Cleaning

The following tests are carried out:

- cleaning of pyrolytic self-cleaning ovens (see 11.1);
- cleaning of ovens with catalytic cleaning (see 11.2).

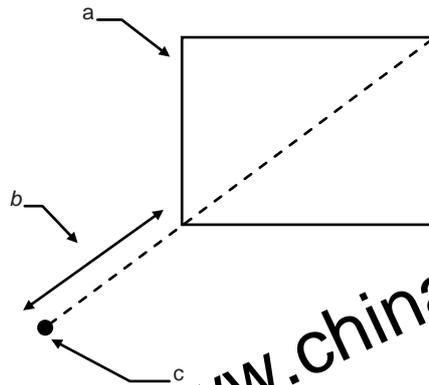
### 5 General conditions for the measurements

#### 5.1 Test room

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

For tests 7.2, 7.4 and 7.5.3.,  $(23 \pm 2)\text{ °C}$  shall be maintained during the complete test.

This ambient temperature is measured at a point that is at the same height as the centre of the calculated volume of the **oven** cavity in test and at a distance of 0,5 m diagonally from one of the front edges of the appliance, see Figure 1.



IEC 668/05

**Key**

- a oven (top view)
- b 0,5 m
- c thermocouple

**Figure 1 – Position of the thermocouple for measuring ambient temperature**

The measurement of the ambient temperature shall not be influenced by the appliance itself or by any other appliance.

## 5.2 Electricity supply

The appliance is supplied at rated voltage,  $\pm 1\%$

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.

For tests 7.2, 7.4 and 7.5.3,

- Ⓒ – the supply voltage shall be maintained at the main terminal at  $230\text{ V} \pm 1\%$  or at  $400\text{ V} \pm 1\%$  as defined by the manufacturer's installation guide, while the heating elements are switched on. The supply frequency shall be at a nominal  $50\text{ Hz} \pm 1\%$ .

For Clause 12 and Annex ZB, the power measurement requirements shall be in accordance with EN 50564. Ⓒ

NOTE In case of a fixed cable, the plug (or the end of the cable) is the reference point to maintain the voltage.

## 5.3 Instrumentation

The temperature measuring instrument including thermocouples shall have an accuracy of 0,5 K within the temperature range of  $0\text{ }^{\circ}\text{C}$  to  $100\text{ }^{\circ}\text{C}$  and an accuracy of 2 K within the temperature range  $100\text{ }^{\circ}\text{C}$  to  $300\text{ }^{\circ}\text{C}$ .

The energy measuring meter shall have an accuracy of 1 %.

For tests 7.2 and 7.4:

- air temperature measurements in the empty **oven** are made with a thermocouple with a welded point (not with a black copper plate);
- temperature measurements in the brick (see 7.3) are made with two thermocouples with 1 mm steel tube diameter, class 1 according to IEC 61591. The thermocouple shall be accurate to  $\pm 1,5\text{ K}$ ;

NOTE The steel tube of the thermocouple eases the insertion of the thermocouple into the brick. Other types of thermocouples may be used provided they are shown to give the same results. (Care should be taken that the measuring point is the first contact point of the two thermowires.)

- the temperature measurement system excluding the thermocouple shall be accurate to  $\pm 1,0$  K;
- the energy measurements shall be accurate to  $\pm 1,5$  % or  $\pm 10$  Wh, whichever is the greater;
- the measurement of the voltage shall be accurate to  $\pm 0,5$  %;
- the measurements of mass shall be accurate to  $\pm 3$  g;
- the measurements of time shall be accurate to  $\pm 0,5$  s;
- the scale for weighing the ingredients shall be accurate to  $\pm 0,1$  g.

Ⓒ For Clause 12 and Annex ZB, the power measurement requirements shall be in accordance with EN 50564. Ⓒ

#### 5.4 Positioning the appliance

Built-in appliances are installed in accordance with the instructions for installation. Other appliances are placed with their back against a wall, unless otherwise specified in the instructions.

Floor-standing appliances are positioned between kitchen cabinets. Table-top appliances are positioned away from side walls.

For tests 7.2 and 7.4 on **ovens** with integrated air-extraction by a fan (or similar device) to the outside of the building, the air outlet is discharged into a flue which has a pressure drop of 50 Pa when there is an airflow of 200 m<sup>3</sup>/h.

NOTE 1 The condition of measurement for ovens with integrated air-extraction is similar to IEC 61591.

NOTE 2 For installation of the appliance it should be ensured that the surface is horizontal.

#### 5.5 Preheating

The appliance is initially at room temperature. However, if preheating is specified, the appliance is preheated in accordance with the instructions for use. If no instructions are given, the appliance is considered to be preheated after the thermostat has switched off the first time.

#### 5.6 Setting of controls

The control is set to give the temperature specified for the test. However, if the temperature cannot be attained due to the construction of the control, the nearest setting related to the specified temperature is chosen.

#### Ⓒ<sub>11</sub> 5.Z1 Rounding

If it is required that numbers are rounded, they shall be rounded according to EN ISO 80000-1:2013, Annex B.3, Rule B. Ⓒ<sub>11</sub>

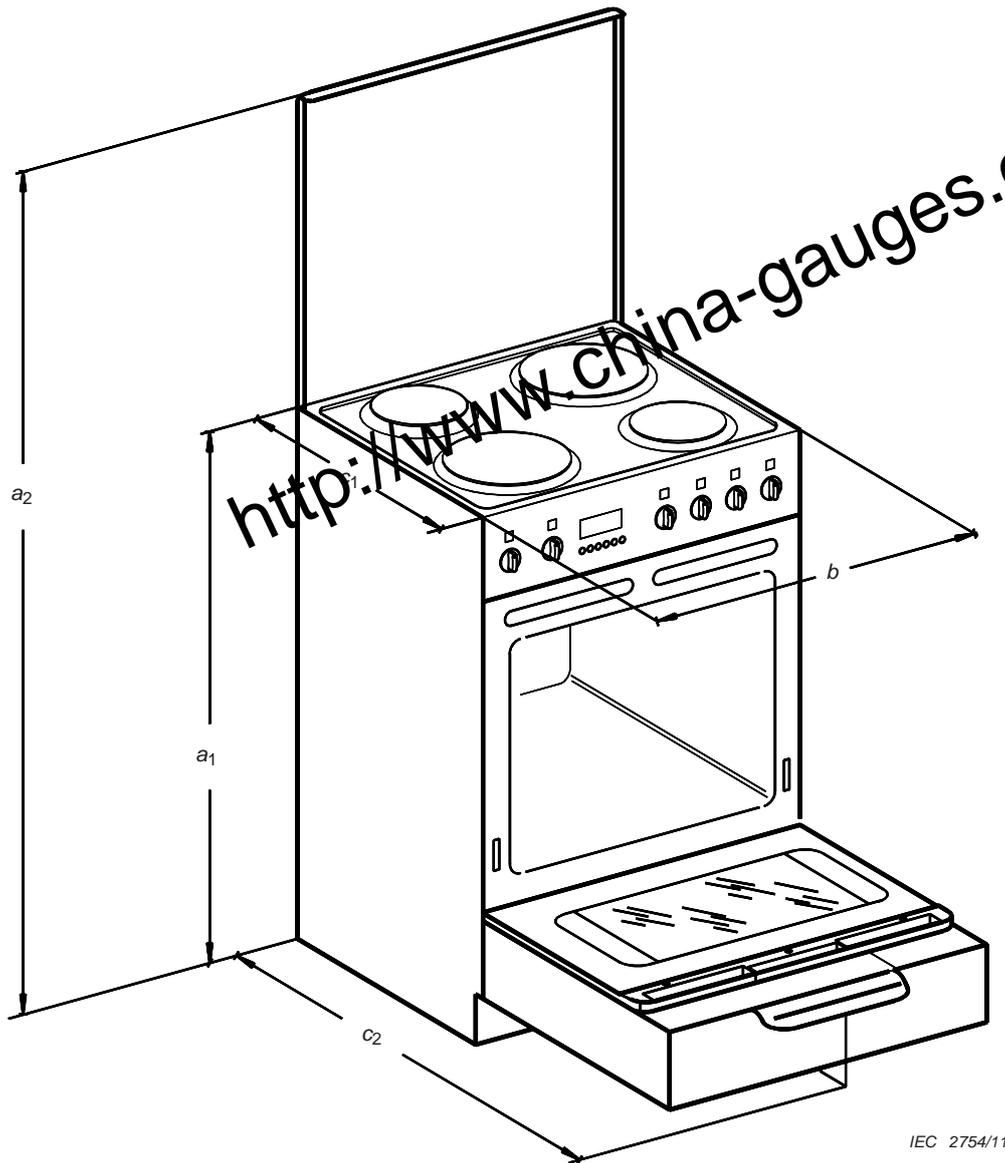
### 6 Dimensions and mass

NOTE Clause 6 is also applicable to steam ovens.

#### 6.1 Overall dimensions

The overall dimensions of the appliance are measured and stated in millimetres as follows:

- cooking ranges and other appliances placed on a surface are measured as shown in Figure 2;



**Key**

$a_1$  height from the supporting surface to the hob surface

NOTE If adjustable feet are provided, the height is measured with the feet in both extreme positions.

$b$  overall width of the appliance

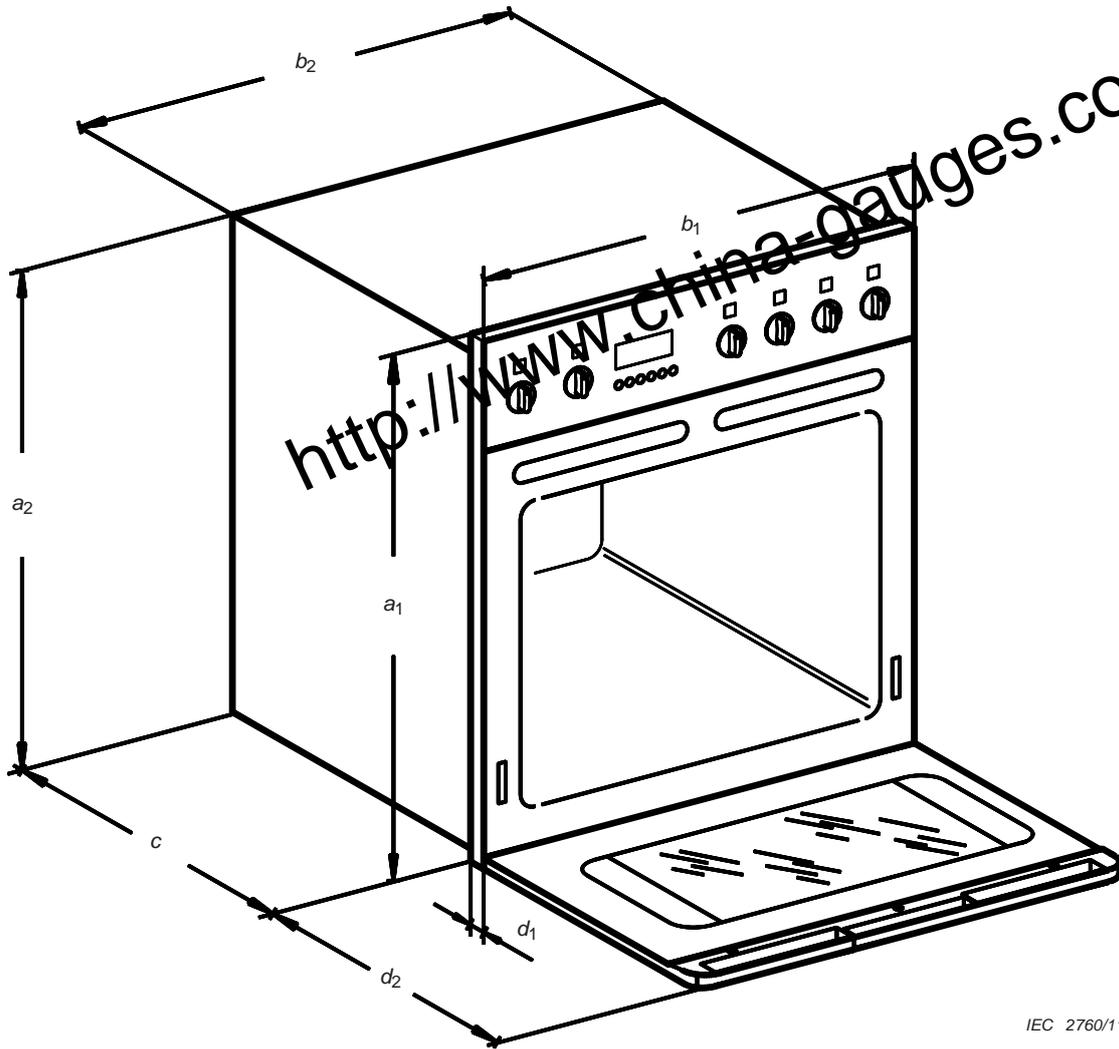
$a_2$  maximum height from the supporting surface to the uppermost part of the appliance, with any lid in the open position

$c_1$  depth of the appliance, ignoring any knobs, etc.

$c_2$  maximum depth of the appliance, with any doors and drawers fully open

**Figure 2 – Dimensions of appliances**

- built-in ovens are measured as shown in Figure 3;



**Key**

- $a_1$  front height of the appliance
- $b_1$  front width of the appliance
- $c$  maximum depth of the appliance within the kitchen furniture
- $a_2$  maximum height of the appliance within the kitchen furniture
- $b_2$  maximum width of the appliance within the kitchen furniture
- $d_1$  depth of the appliance outside the kitchen furniture, ignoring any knobs, etc.
- $d_2$  depth of the appliance outside the kitchen furniture, with any doors and drawers fully open

**Figure 3 – Dimensions of built-in ovens**

**6.2 Usable internal dimensions and calculated volume of ovens**

**6.2.1 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.

NOTE Safety operation should be guaranteed. Therefore necessary parts cannot be removed for measuring the calculated volume.

The measurement of the calculated 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 in accordance with 6.2.2 to 6.2.4. The measurement procedure is also shown in Figure 4a.

For verification purposes a gauge, as shown in Figure 4b, shall be used to determine all of the three dimensions. The gauge shall be used without appreciable force. Dimensions are stated in millimetres.

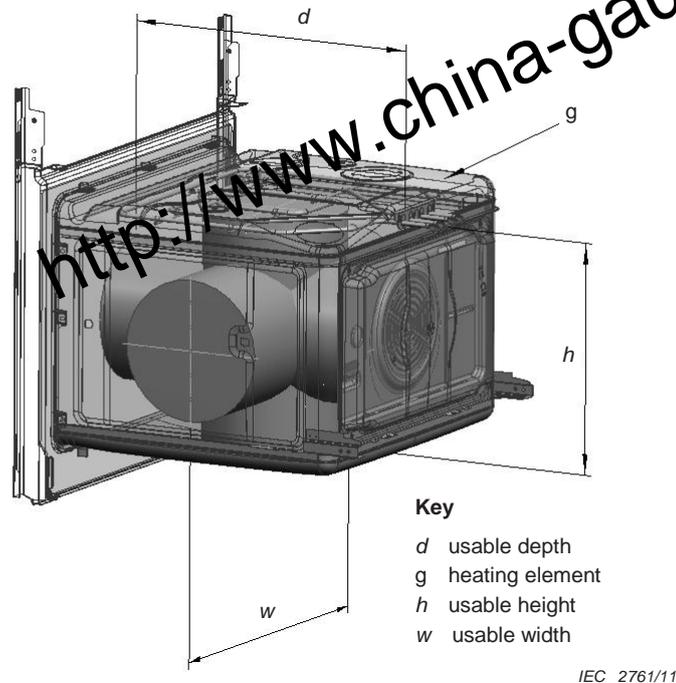


Figure 4a – Measurement procedure

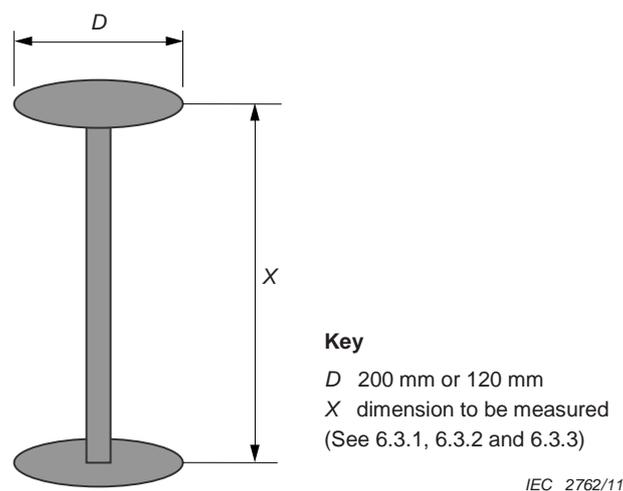


Figure 4b – Gauge for determining the calculated volume

#### Figure 4 – Usable internal dimensions and calculated volume of ovens

##### 6.2.2 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 cavity floor 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.

### 6.2.3 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.

### 6.2.4 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.

### 6.2.5 Calculated volume

The calculated volume is determined from these three dimensions and is stated in litres rounded to the next full litre.

## 6.3 Overall internal dimensions and overall volume of ovens

### 6.3.1 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, racks or temperature probes.
- Those occupied by heating elements.
- Those occupied by minor irregularities in the cooking compartment walls, including covers over temperature sensors and lamps.
- Those occupied by the convection baffle.
- Corner radii smaller than 50 mm at the intersections of the interior surfaces of the cooking cavity.

Dimensions are stated in millimetres.

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

### **6.3.2 Overall height ( $H$ )**

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

### **6.3.3 Overall width ( $W$ )**

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

### **6.3.4 Overall depth ( $D$ )**

The maximum horizontal distance in mm from the plane of the inside surface of the door when closed to the plane of the rear cavity wall.

### **6.3.5 Overall volume of rectangular cavities**

The overall volume is the total internal volume of the cavity in which cooking takes place, expressed as the product of  $H$ ,  $W$  and  $D$  determined as above, divided by  $10^6$  and rounded to the nearest litre.

### **6.3.6 Overall volume of non-rectangular cavities**

Non-rectangular cavities shall have the volume of any non-conforming section such as a curved door or cavity wall determined by direct measurement and the application of conventional geometrical calculations. The remainder of the cavity shall be treated as a rectangular cavity and the individual volumes added together. The volume is expressed to the nearest litre.

## **6.4 Dimensions of shelves**

The usable width and usable depth of the shelf are measured. The dimensions are determined 5 mm above the surface of the shelf.

The surface area is calculated and stated in square centimetres, rounded to the nearest  $10\text{ cm}^2$ .

NOTE The shelf may be a grid or a baking sheet or a steaming accessory.

## **6.5 Dimensions of grill grids**

The width and depth of the grill grid are measured.

The surface area is calculated and stated in square centimetres, rounded to the nearest  $10\text{ cm}^2$ .

NOTE If the grill grid is the shelf of an oven, the dimensions are measured in accordance with 6.4.

## **6.6 Dimensions of warming compartments**

The height, width and depth of the calculated volume within the **warming compartment** are measured and indicated in millimetres.

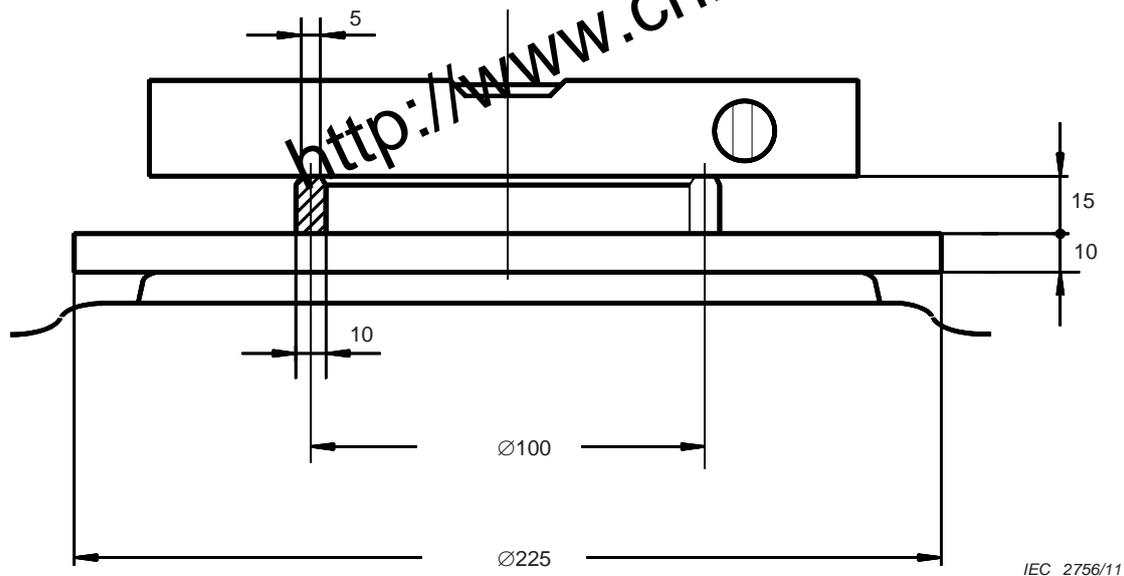
NOTE When a heating element is located inside the **warming compartment**, the dimensions are measured up to its most protruding part.

## 6.7 Level of shelf

The shelf is placed in a central position in the **oven**.

NOTE 1 The shelf may be a grid or a baking sheet.

A device consisting of a disc and an annular ring is placed centrally on the shelf. A spirit level is placed centrally on the ring as shown in Figure 5. The spirit level is rotated to the position where it shows the maximum inclination from the horizontal. Its lower side is then lifted to the horizontal by inserting a feeler gauge between the level and the ring.



*Dimensions in millimetres*

**Figure 5 – Device for checking the level of shelves**

The deviation from the horizontal is given by the thickness of the gauge, in millimetres, to two decimal places. It is expressed as a percentage, rounded to the nearest 0,1 %.

NOTE 2 The direct conversion from millimetres to percentage is possible due to the ring having a diameter of 100 mm.

## 6.8 Mass of the appliance

The mass of the appliance, including accessories, is determined and expressed in kilograms, rounded to the nearest kilogram.

**C11** The mass of the oven, including the oven accessories needed to perform the test of 7.4, is determined and expressed in kilograms, rounded to the nearest kilogram. **C11**

## 7 Ovens and combi steam ovens

### 7.1 General

The purpose of these tests is to assess the performance of the **oven and combi steam oven** in relation to preheating, functioning of the control and energy consumption. The performance is also assessed by means of cooking tests.

The air temperature in the empty **oven and combi steam oven** is measured with a thermocouple according to 5.3 fixed to the grid which is delivered with the appliance and placed in the **oven and combi steam oven** in a way that the welding point of the thermocouple is located at the centre of the calculated volume of the **oven and combi steam oven** with a distance of at least 30 mm from the grid.

NOTE 1 If no grid can be purchased from the manufacturer of the appliance, the thermocouple must be positioned in the centre in a suitable way.

Thermocouples are led through the door gap in a way that the door is completely closed without applying additional force.

NOTE 2 The completely closed door is very essential for tests 7.2 and 7.4.

The baking tests of this clause are carried out using corrected control settings according to the differences determined by the test of 7.3.

NOTE The tests of 7.2, 7.3 and 7.4 are considered to give reproducible results. The tests of 7.5 and 7.6 are applicable for comparative testing only.

## 7.2 Preheating the empty oven

The purpose of this test is to measure the energy consumption and time it takes to preheat an empty **oven** from room temperature by a given temperature rise.

Prior to the measurement, the whole appliance (this includes the material and the insulation) shall be at ambient temperature of  $(23 \pm 2) ^\circ\text{C}$ . In **multiple cavity appliances**, each **oven** cavity has to be measured separately. Only the cavity measured shall be switched on.

The temperature control is set at the maximum position for each function. The **oven** is heated until the rise is

- 180 K for **conventional heating function**,
- 155 K for **forced air circulation function**,
- 155 K for **hot steam function**.

The temperature rise is the difference of the **oven** temperatures measured at the beginning and at the end of the test.

The time  $t_{\text{ph}}$  in minutes and seconds and the energy consumption  $E_{\text{ph}}$  in kWh shall be measured ( $t_{\text{ph}}$ -preheating).

The time for preheating of the empty oven  $t_{\text{ph}}$ , shall be reported; rounded off to the nearest half minute.

The energy consumption for preheating the empty oven  $E_{\text{ph}}$  shall be reported, rounded off to the nearest kWh to two decimals.

If the **oven** has an additional preheating setting, the test is repeated with this setting.

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

## 7.3 Accuracy of the control

The temperature control is set to the position marked 150 °C and the **oven** is heated, the temperature being recorded continuously. When steady conditions are attained, the control is positioned at the setting marked 200 °C. When steady conditions are again attained, the control is positioned at the highest marked setting. The test is terminated when steady conditions are finally attained.

NOTE 1 Steady conditions are considered to be attained after five cycles of the thermostat or 1 h, whichever is shorter.

NOTE 2 Markings of the control for grilling are ignored.

NOTE 3 If the control is not marked in degrees Celsius, the control is set at appropriate markings taking into account the instructions for use.

Additional for **steam functions** the temperature control is terminated for lower positions. The temperature control is set to the position marked at 90 °C and the steam oven is heated, the temperature being recorded continuously.

NOTE 4 If 90 °C are not marked, the next lowest marked setting is taken into account.

NOTE 5 Temperature control of the lowest setting is relevant for low temperature cooking which requires an accuracy of the temperature control as precise as possible.

The mean temperature is stated in degrees Celsius for each setting when steady conditions are established. The difference between the maximum and minimum temperatures at steady conditions is also stated as the differential in kelvins.

## 7.4 Energy consumption and time for heating a load

### 7.4.1 General

The purpose of this test is to measure the energy consumption and the time for heating a load. The load is a water saturated brick which simulates both the thermal properties and the water content of food (e.g. meat).

Prior to the measurement, the whole appliance (this includes the material and the insulation) shall be at ambient temperature of  $(23 \pm 2)$  °C. In **multiple cavity appliances**, each **oven** cavity has to be measured separately. Only the cavity measured shall be switched on.

### 7.4.2 Test load

#### 7.4.2.1 General

The test load shall be a brick with two holes for temperature measurements, as shown in Figure D.1.

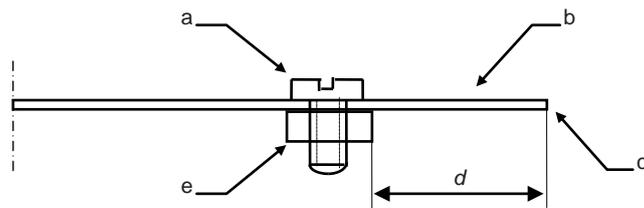
#### 7.4.2.2 Pre-treatment

A new brick shall be dried before using it for the first time in an **oven** of about 50 l volume with **forced air circulation function** at  $\geq 175$  °C for 3 h. No more than two bricks shall be dried at the same time in the same **oven**.

NOTE 1 A brick which is still damp due to a previous test needs at least 8 h to be dried as described above. However, see Note 1 in 7.4.2.3.

The weight  $m_d$  of the completely dry brick without thermocouples shall be measured within 5 min after removal from the **oven** and shall be noted in grams. The dry weight  $m_d$  shall be in accordance with the dry weight specified in Clause D.1. The brick shall be identified for accurate calculation of the water absorption according to 7.4.2.3. ( $m_d$ -dry)

Place markings 32 mm from the measuring point of the two thermocouples according to 5.3, and insert the thermocouples into the holes until the marking matches with the surface of the brick. The thermocouples shall be fixed to ensure that the measuring points remain at a depth of 32 mm during the whole test procedure.



**Key**

- a screw with a hole of 1 mm
- b steel tube
- c measuring point
- d 32 mm
- e nut

**Figure 6 – Example of a method of fixing a thermocouple for the test of 7.3**

NOTE 2 The thermocouples may be fixed by means of a droplet of silicon glue at the surface of the brick or by other suitable means, see Figure 6.

NOTE 3 Due to the porosity of the brick, care should be taken that the holes of the brick are not enlarged if the thermocouples are removed and reinserted.

NOTE 4 A brick can be used for about twenty tests when handled with normal care.

### 7.4.2.3 Preparation

The brick, pre-treated according to 7.4.2.2, shall be prepared for energy measurement as follows.

NOTE 1 It is not necessary to pre-treat the brick between uses. It gets approximately the same water content each time it is soaked in water.

The brick shall be put into a water container so that it is completely covered with water at less than 20 °C. The water container with the brick is placed for at least 8 h into a refrigerator and cooled down to a centre temperature (both thermocouples) of  $(5 \pm 2)$  °C.

A hot brick shall be cooled down in air to a centre temperature below 25 °C before putting it into the cold water.

NOTE 2 A hot brick put directly into cold water would absorb substantially more water due to the capillary effect and different water viscosity at different temperatures.

NOTE 3 Between test series, the brick should be stored in a refrigerator, preferably not soaked with water. The brick soaking water should be kept (to reduce dissolving processes); i.e. re-use of the brick storage water.

After the brick has been taken out of the water container, excessive water is allowed to drip off (for about 1 min). Then the weight of the wet brick  $m_w$  shall be measured and the absorbed amount of water is determined in g taking into account the weight of the thermocouples, if appropriate, by calculating  $\Delta m = m_w - m_d$  ( $m_d$  measured according to 7.4.2.2). The amount of absorbed water shall be as specified in Clause D.1 ( $w_w$ – wet or water).

The temperature of the brick is measured. Both thermocouples shall read  $(5 \pm 2)$  °C.

### 7.4.3 Measurement

#### 7.4.3.1 Procedure

Three tests are performed for each heating function, as appropriate (see 3.12 to 3.14 and Table 1).

NOTE 1 In case an oven has several variants of the functions as described in 3.12 to 3.15, the manufacturer can choose the variant to be tested. This must be reported (see 7.4.4). Make sure that function used is not combined with microwave.

With the appliance at ambient temperature, according to 7.4.1., the brick, prepared according to 7.4.1, is placed in the geometric centre of the calculated **oven** cavity with its largest surface centrally on the grid delivered with the appliance, with the thermocouples on the upper side. The grid is inserted into a shelf support level of the **oven** so that the centre of the brick comes as close as possible to the centre but not higher than the centre of the calculated **oven** cavity. The longest axis of the brick shall be parallel with the appliance front.

NOTE 2 If no grid can be purchased from the manufacturer of the appliance, any suitable grid must be used, however not a baking sheet, tin or similar.

NOTE 3 Where the grid can be inserted in two different positions (e.g. upside down gives a different height), the position should be taken that brings the brick centre as close to the cavity centre, but not higher.

The thermocouple shall be lead through the door gap in a way that the door is completely closed without applying additional force.

NOTE 4 If the appliance is prepared with the thermocouples it should not be operated with a function combined with microwave energy. Out coupled microwave power through the thermocouples can damage instruments.

The measurement shall be started by switching on the **oven** within 3 min from the removal of the brick from the refrigerator. The temperature control is set to positions where the mean **oven** temperature rises  $\Delta T_k^i$  as defined in Table 1 can be expected.  $\Delta T_k^i$  is the difference between the average ambient temperature and the actual **oven** temperature (measured in 7.4.3.2),  $k = 1, 2, 3$  (C11)  $k$  – summing index,  $i$  – heating function (C11).

(C11) The temperature setting  $T_{ks}^i$  shall be noted, where  $T_{ks}^i$  is the temperature setting of the thermostat and / or the oven control display ( $s$  - setting).

NOTE 1 If the temperature steps are not clearly marked, the setting temperature should be determined by the angle considering the visible marks on the knob using polar coordinate paper (see Annex ZE).

NOTE 2 If the temperature is set by a knob, the knob should always be turned from zero to the required setting. (C11)

The average ambient temperature during the test is determined by the arithmetic mean of the ambient temperatures at the beginning of the test (i.e. when switching on the **oven**) and when the last of the two thermocouples in the brick has reached a centre temperature rise of 55 K.

Table 1 – Oven settings

(C11) oven temperature rise (C11)	Heating functions		
	Conventional "ic"	Forced air "if"	Hot steam "ih"
$\Delta T_1^i$	(140 ± 10) K	(135 ± 10) K	(135 ± 10) K
$\Delta T_2^i$	(180 ± 10) K	(155 ± 10) K	(155 ± 10) K
$\Delta T_3^i$	(220 ± 10) K <sup>a</sup>	(175 ± 10) K <sup>a</sup>	(175 ± 10) K <sup>a</sup>

<sup>a</sup> or the maximum temperature rise if this value cannot be reached.

These temperatures correspond to the measured energy consumption  $E_1^{i\dots}$ ,  $E_2^{i\dots}$  and  $E_3^{i\dots}$ , as appropriate.

The following data is measured:

- the energy consumption(s)  $E_{k\dots}^{i\dots}$  in kWh and the time(s)  $t_k^{i\dots}$  in minutes and seconds, as appropriate, when the last of the two thermocouples in the brick reaches a temperature rise of 55 K,  $k = 1, 2, 3$ ;
- centre temperatures of the brick in °C;
- ambient temperature at the start of the test (when the oven is switched on) and at the end of the test (i.e. when the last of the two thermocouples in the brick has reached 55 K temperature rise) in °C.

NOTE 5 The energy consumption of components such as lamps and fans, which are automatically switched on with the appliance, is included in the measurement.

#### 7.4.3.2 Checking the oven temperature

Ⓒ11 After the test according to 7.4.3.1, the brick is removed from the oven and the oven is run for some extra time without changing the setting. The oven temperature is determined in line with 7.1 as the arithmetic mean between the maximum and minimum temperatures at steady state conditions. Ⓒ11

NOTE 1 Steady conditions are considered to be attained after five cycles of the thermostat or 1 h, whichever is shorter.

NOTE 2 A cycle is defined as the time between two thermostat switch off conditions.

Ⓒ11 The measured oven temperature  $T_{k,measured}^i$  is stated.

The difference between  $T_{ks}^i$  and  $T_{k,measured}^i$  is calculated according to Formula (1) and (2), where  $n=3$ .

$$\Delta T_{k,setting}^i = T_{ks}^i - T_{k,measured}^i \quad (1)$$

$$\Delta T_{setting}^i = \frac{1}{n} \sum_{k=1}^n \Delta T_{k,setting}^i \quad (2)$$

$\Delta T_{setting}^i$  shall be  $\leq 20$  K.

If  $\Delta T_{setting}^i$  is greater than 20 K the test shall be carried out on further three appliances, which shall be randomly selected from the market.

The arithmetical mean of the values of these three appliances shall not be greater than 20 K.

NOTE For the verification procedure for ensuring that the temperature inside the oven cavity reaches the temperature setting of the thermostat and/or the oven control the procedure for product conformity checking by market surveillance authorities and the verification tolerances tests are not covered by the Commission Regulation (EU) No 66/2014 of 14 January 2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household ovens and Commission Delegated Regulation (EU) No 65/2014 of 1 October 2013 supplementing Directive 2010/30/EU with regard to energy labelling of household ovens. Ⓒ11

### 7.4.3.3 Acceptance verification of the test results

Results of the tests according to 7.4.3.1 shall only be accepted if

- a) the mean temperature rises  $\Delta T_k^{i\dots}$  are within the temperatures specified in Table 1 and
- b) the standard deviation  $\sigma^{i\dots}$  as defined in equation (1) is below 0,050 kWh/m<sup>2</sup>.

Otherwise, for the appropriate function, all measurements according to 7.4.2 shall be repeated.

The standard deviation  $\sigma^{i\dots}$  is calculated from the data pairs  $\Delta T_k^{i\dots} / E_k^{i\dots}$  measured according to 7.3.2.1 and calculated according to equation (1) for each tested function,  $k = 1, 2, 3$  [see: Lothar Sachs: *Applied statistics*, equations 5.29a and 5.69, modified]<sup>3</sup>.

$$\sigma^{i\dots} = 1,2 \sqrt{\frac{Q_y^{i\dots} - (Q_{xy}^{i\dots})^2 / Q_x^{i\dots}}{n - 2}} \quad (1)$$

where

$n$  is the number of measuring points; for the purpose of this standard,  $n = 3$ ;

1,2 is an approximation factor for  $f$ .

NOTE For the purpose of this standard,  $\Delta T_k^{i\dots}$  can only vary between 125 K and 185 K for **forced air circulation** and **hot steam functions** resulting in  $f$  factor between 1,16 and 1,21 and between 130 K and 230 K for **conventional heating function** resulting in factor  $f$  between 1,155 and 1,168.

$$f^{i\dots} = \sqrt{1 + \frac{1}{n} + \frac{(T_0^{i\dots} - \Delta T^{i\dots})^2}{Q_x^{i\dots}}} \quad (2)$$

$$Q_y^{i\dots} = \sum_{k=1}^n (E_k^{i\dots})^2 - \frac{\left( \sum_{k=1}^n E_k^{i\dots} \right)^2}{n} \quad (3)$$

$$Q_{xy}^{i\dots} = \sum_{k=1}^n \Delta T_k^{i\dots} \cdot E_k^{i\dots} - \overline{E^{i\dots}} \sum_{k=1}^n \Delta T_k^{i\dots} \quad (4)$$

<sup>3</sup> See the Bibliography.

$$Q_X^{i...} = \sum_{k=1}^n (\Delta T_k^{i...})^2 - \frac{\left( \sum_{k=1}^n \Delta T_k^{i...} \right)^2}{n} \quad (5)$$

$$\overline{\Delta T^{i...}} = \frac{1}{n} \sum_{k=1}^n \Delta T_k^{i...} \quad (6)$$

$$\overline{E_k^{i...}} = \frac{1}{n} \sum_{k=1}^n E_k^{i...} \quad (7)$$

#### 7.4.4 Evaluation and calculation

##### 7.4.4.1 Electric energy consumption

The energy consumption  $E_{\Delta T_0}^{i...}$  for the reference temperature rise  $\Delta T_0^{i...}$  is calculated using the linear regression based on the measured data points  $\Delta T_k^{i...} / E_k^{i...}$ , according to the equation:

$$E_{\Delta T_0}^{i...} = S^{i...} \Delta T_0^{i...} + B^{i...} \quad (8)$$

where

$E_{\Delta T_0}^{i...}$  is the calculated nominal energy consumption in kWh for heating a load for the different heating functions "ic", "if" or "ih" at  $\Delta T_0^{i...}$  ;

$\Delta T_0^{i...}$  = 180 K for **conventional heating function**,  
= 155 K for both **forced air circulation** and **hot steam functions**;

$S^{i...}$  is the slope related to the different heating functions "ic", "if" or "ih", which is calculated according to equation (9);

$B^{i...}$  is the intercept which is calculated according to equation (10):

$$S^{i...} = \frac{n \sum_{k=1}^n (\Delta T_k^{i...} \cdot E_k^{i...}) - \left( \sum_{k=1}^n \Delta T_k^{i...} \right) \left( \sum_{k=1}^n E_k^{i...} \right)}{n \sum_{k=1}^n (\Delta T_k^{i...})^2 - \left( \sum_{k=1}^n \Delta T_k^{i...} \right)^2} \quad (9)$$

$$B^{i...} = \frac{\sum_{k=1}^n E_k^{i...} - S^{i...} \sum_{k=1}^n \Delta T_k^{i...}}{n} \quad (10)$$

where

$\Delta T_k^{i...}$  is the actual temperature difference for the different heating functions "ic", "if" or "ih", as defined in 7.3.2.1;

$E_k^{i...}$  is the energy consumption in kWh measured according to 7.4.3.1 at the different  $\Delta T_k^{i...}$  for the different heating functions "ic", "if" or "ih";

$n$  is the number of measuring points; for the purpose of this standard.

☐ 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 European Standard for the automatic calculation of the energy consumption (see 7.4). These calculations may be made in any other spreadsheet programs that lead to equal results. ☐

#### 7.4.4.2 Time for heating the load

The time for heating the load shall be calculated and determined in the same way as the energy consumption is calculated and determined according to 7.4.4.1.

Replace in the equations (8) to (10)  $E$  values by the appropriate  $t$  values, i.e. replace

– in equation (8)  $E_{\Delta T_0}^{i...}$  by  $t_{\Delta T_0}^{i...}$  and

– in equations (9) and (10)  $E_k^{i...}$  by  $t_k^{i...}$

where

$t_k^{i...}$  is the time measured in minutes and seconds according to 7.4.3.1 at the different  $\Delta T_k^{i...}$  for the different heating function ic, if or ih;

$t_{\Delta T_0}^{i...}$  is the calculated nominal time in minutes and seconds for heating a load for the different heating function ic, if or ih at  $\Delta T_0^{i...}$ .

☐ Text deleted ☐

#### 7.4.5 Reporting of test results

The following data shall be reported for all heating functions:

- type of the appliance, available heating function(s) according to 3.12 to 3.14;
- supply voltage at which the measurements were made;
- tested functions or variant;
- energy consumption(s) in kWh to two decimals, according to 7.4.4.1;
- time(s) in minutes, according to 7.4.4.2, rounded off to the nearest half minute;
- water absorption of the brick according to 7.4.2.3.

This data shall be reported for all heating functions (according to 3.12 to 3.14) as appropriate. For **multiple cavity appliances**, the values shall be reported separately for each cavity.

☐<sub>11</sub> Text deleted ☐<sub>11</sub>

## 7.5 Heat distribution

### 7.5.1 General

The heat distribution is assessed by means of the tests of 7.5.2 or 7.5.3 depending on the construction of the **oven** and the instructions for use.

### 7.5.2 Shortbread

#### 7.5.2.1 General

The purpose of this test is to assess the heat distribution within the **oven**.

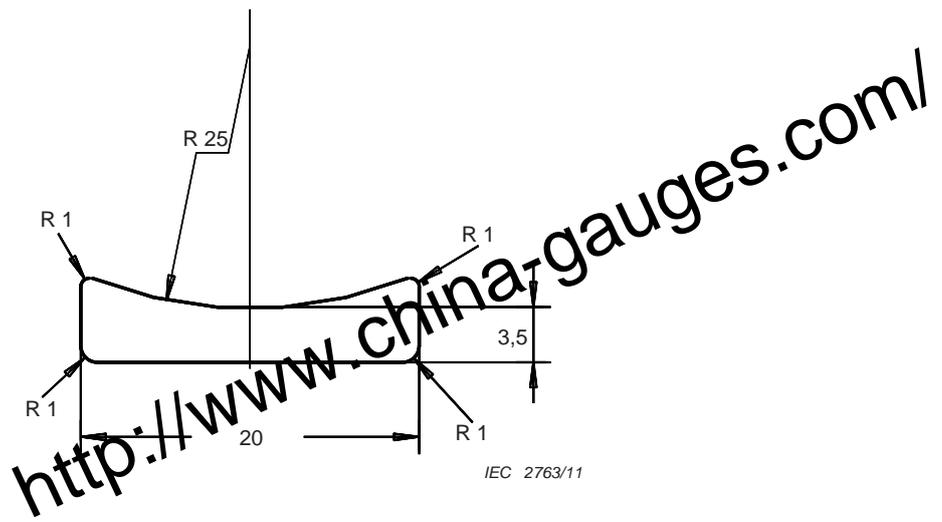
#### 7.5.2.2 Ingredients

500 g white wheat flour, without raising agent  
200 g baking margarine with 80 % fat content, or salted butter  
200 g castor sugar (max. grain size 0,3 mm)  
2 eggs (55 g to 60 g, with shell)  
3 g salt

#### 7.5.2.3 Procedure

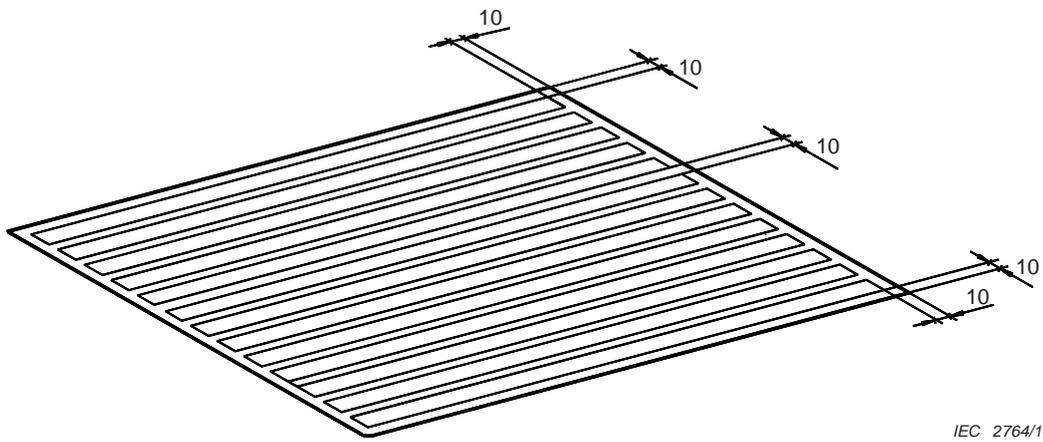
Mix together the flour, castor sugar and salt. Rub in the margarine. Beat the eggs and add to the flour mixture, mix lightly in a food mixer until the dough is smooth. Remove the dough from the mixing bowl and form it into a loaf. Cover and store it in a refrigerator at a temperature of  $5\text{ °C} \pm 2\text{ °C}$  for at least 8 h. Remove the loaf from the refrigerator approximately 1 h before further handling.

Extrude the loaf into strips by means of a worm conveyor attachment using the nozzle as shown in Figure 7. Cut the strips to a length that fits the baking sheet supplied with the oven or that recommended by the manufacturer. Position the pastry strips as shown in Figure 8 so that they will be parallel to the **oven** door.



*Dimensions in millimetres*

**Figure 7 – Shape of the nozzle for extruding pastry**



*Dimensions in millimetres*

**Figure 8 – Position of pastry strips on the baking sheet**

#### 7.5.2.4 Preliminary measurements

Preliminary tests are carried out to determine the appropriate baking time to achieve the specified browning.

The control is set in accordance with the instructions for use for this type of mixture. If instructions are not given, the control is set so that the centre oven temperature is 175 °C for **ovens** with forced-air circulation and 200 °C for **ovens** with natural convection. When the thermostat cuts out for the first time, the sheet is inserted into the oven in accordance with the instructions for use. If instructions are not given, the sheet is positioned as close as possible to the centre of the **oven**. The sheet is removed from the **oven** when the strips have attained a golden brown colour. The baking time is noted.

The sheet is placed on a grid and allowed to cool down. The browning of the top is measured using the colour measuring instrument specified in Annex A or a digital measuring system according to 7.5.3.6.3. Circles with a diameter of 20 mm are measured over the strips lengthwise, beginning and ending approximately 20 mm (related to the centre of the circle) from the end of each strip. The measurements are carried out in steps of approximately 50 mm. In case the surface at the defined areas is damaged by cracks, holes etc. the measurement is carried out shifted.

The average browning is calculated by dividing the sum of the values by their number.

The baking time is suitable when the average browning on top of the strips correlates to a reflection value  $R_y$  of  $(43 \pm 5)$  %.

NOTE A supplier of the colour measuring instrument and digital measuring systems is given in Annex C.

#### 7.5.2.5 Heat distribution test

The procedure stated for preliminary measurements is followed, the strips being baked for the time which has been determined.

The strips are loosened from the sheet while still hot but left in their original position.

If the instructions state that a number of sheets can be baked simultaneously, an additional test is carried out with the maximum number of sheets, the baking time being increased, if necessary.

#### 7.5.2.6 Assessment

Within 1 h after baking, the browning is determined for both the top and bottom of the strips as stated for the preliminary measurements.

The following results are calculated and stated:

- the maximum browning difference on the top;
- the maximum browning difference on the bottom;
- the average browning on the top;
- the average browning on the bottom.

### 7.5.3 Small cakes

#### 7.5.3.1 General

This test is intended to assess the vertical and horizontal heat distribution, especially for a mixture that rises during cooking.

NOTE The test is carried out using the general conditions of measurements as stated in Clause 5.

### 7.5.3.2 Ingredients

The quantities of ingredients for 30 to 40 small cakes are indicated in Table 2. For a reproducible result always prepare the same amount and discard any surplus mixture.

Table 2 – Ingredients

Ingredients	Quantities g	Remarks
Butter, with a fat content of 83 % ± 2 %	340 ± 0,5	Unsalted butter should be used. If unsalted butter is not available, the salt content of butter should be subtracted from the salt added to the mixture.
White sugar, fine (grain size 0,10 mm to 0,35 mm, d95/d05)	340 ± 0,5	d95/d05: 90 % of the sugar crystals shall have a grain size of 0,10 mm to 0,35 mm
Eggs	300 ± 1	Middle sized hen eggs (approximately 55 g ± 5 g) are beaten and sieved until homogeneous, then weighed. If frozen egg mixture is used follow the instructions of Clause C.1.
Wheat flour without raising agent, unbleached Mineral content: maximum 0,5 % (dry substance)	450 ± 1	Gluten: at least 24,0 %
Baking powder	15 ± 0,5	Phosphate baking powder (double acting) shall be used (not baking soda).
Salt	6 ± 0,1	
NOTE 1 For reproducible results, ingredients as defined in Annex C should be used.		
NOTE 2 The eggs are sieved to remove any chalazae.		
NOTE 3 If more than 40 small cakes are required, two identical kitchen machines should be used simultaneously.		

### 7.5.3.3 Paper cases

As the paper quality affects the rising height and spreading, only the paper cases specified in Annex C shall be used for reproducible results. The paper cases are 48 mm in base diameter and 29 mm in height. They are made of 70 g/m<sup>2</sup> bleached greaseproof paper.

NOTE A supplier of paper cases is indicated in Annex C.

### 7.5.3.4 Quantity

The baking sheet shall be measured according to 6.4 and cover at least 80 % of the usable width and 70 % of the usable depth of the cavity measured according to 6.2. If the supplied baking sheet or the sheet recommended in the instructions fits these dimensions, this baking sheet shall be used. If the supplied or recommended baking sheet does not fit the above condition or no recommendation is given, then a baking sheet fitting the above condition, made of aluminium, no coating, matt finished, 0,9 mm ± 0,1 mm thickness, lip height maximum 6 mm shall be used.

The width and the depth of the baking sheets are measured in accordance with 6.4 and each divided by 75 mm to give the number of small cakes to be placed along its sides. The numbers are rounded down to give a whole number of cakes. Multiply the number of cakes from the depth and the width to give the total number for the whole tray.

Example:

A width of 470 mm divided by 75 mm equals 6,3. This gives 6 columns of cakes.

A depth of 295 mm divided by 75 mm equals 3,9. This gives 3 rows of cakes.

Therefore the total number of cakes on the tray is 18.

The base of the outermost cakes should be at a distance of approximately 14 mm from the edge of the usable area of the baking sheet measured according to 6.4. Distribute the cakes evenly on the tray, in such a way that they do not touch each other.

The manufacturer's instructions regarding the number of baking sheets, which may be cooked simultaneously, are followed.

#### **7.5.3.5 Procedure**

All ingredients shall be at ambient temperature before starting.

Beat together butter and sugar in a food mixer until it becomes soft and pale in colour so that all the sugar is incorporated into the mix. Gradually add the egg mixture. Sift the flour, baking powder and salt together and gently fold into the mixture; loosen the mixture as required from the edge of the bowl to ensure that the mixture is homogeneous.

The temperature of the mixture shall be  $23\text{ °C} \pm 2\text{ °C}$  directly after mixing.

NOTE 1 A suitable food mixer for which the mixing time has been determined is indicated in Annex C.

NOTE 2 Ensure that the paper cases maintain a uniform circular shape by carefully peeling cases from the outside of the batch without distortion.

Weigh  $28\text{ g} \pm 0,5\text{ g}$  of the mixture into the centre of the paper cases and place them evenly on the baking sheets. Bake immediately.

NOTE 3 The tests are carried out using corrected temperature control settings according to the differences determined by the test of 7.3.

##### **a) Baking on one level**

Follow the operating instructions with respect to the heating function, temperature, shelf position and preheating. If preheating is recommended, small cakes are placed in the oven when the end of the preheating phase is indicated, for example by visual or acoustic signal, or after a recommended pre-heating time. If no instructions are given, the oven is set to  $160\text{ °C}$  for forced air circulation function or to  $185\text{ °C}$  for conventional heating function and the baking sheet is placed in the middle of the calculated cavity of the cold oven. While the small cakes are baking, the position of the baking sheet shall not be changed.

The baking time shall not exceed 40 min when baking on one level (including preheating time).

##### **b) Baking on two levels**

The baking sheets are placed simultaneously in the oven one above the other and removed simultaneously at the end of baking. While the small cakes are baking, the position of the baking sheets shall not be changed. Follow the operating instructions with respect to the heating function, temperature, shelf position and preheating. If preheating is recommended, the small cakes are placed in the oven when the end of the preheating phase is indicated, for example by visual or acoustic signal, or after a recommended pre-heating time.

If no instructions for small cakes on two levels are given, the oven is set to  $160\text{ °C}$  for forced air circulation function and the baking sheets are spaced evenly in the cold oven. The horizontal position of the baking sheets shall be in the middle of the cavity base area. The vertical position of the sheets shall be spaced at one third and two third of the usable height of the ovens as near as possible without modifying the shelf racks.

NOTE 4 Baking on two levels is not carried out for small oven cavities, as defined in 3.10.

The baking time shall not exceed 50 min when baking on two levels (including preheating time).

c) Baking on more than two levels

If the operating instructions recommend baking on more than two levels simultaneously, then cakes are baked in accordance with the instructions (heating function, temperature, shelf position, preheating and baking time).

**7.5.3.6 Assessment**

**7.5.3.6.1 General**

Within 30 min after baking, the paper cases are very carefully removed so that the largest base area possible can be assessed. For assessment according to 7.5.3.6.3, at least 50 % of the base shall be undamaged. Otherwise the test shall be repeated.

NOTE Cooling the small cakes quickly can aid clean removal of paper cases.

Browning of the top and base of the cakes, the differences of browning between these, and the evenness of rise, are assessed within 1 h after baking. If small cakes have been baked on several levels simultaneously each sheet shall be assessed separately (single result) and additionally they are assessed together (overall result).

The requirements of the results of these small cakes baked on one or more levels are different. This shall be considered in the evaluation.

**7.5.3.6.2 Visual assessment**

For comparative results the evaluation of browning may be done by a visual check using the criteria for assessment in 7.5.3.6.4.

The shade numbers of the Table B.1 are used to evaluate browning. For a visual check, the same background colour and illumination shall be used for each tray.

**7.5.3.6.3 Digital assessment**

For reproducible results of the evaluation of browning, any digital measurement system shall be used which meets the following requirements when the measurements are taken.

a) Evenness of light distribution on the measurement area

The reflection value  $R_Y$  of a uniform coloured shade chart shall be measured over the entire surface to be analysed, for example, the size of the baking sheet or one small cake. The shade chart shall be coloured in shade number 10, which is defined in Annex B.

The mean value of the reflection value  $R_Y$  over the entire surface is determined. More than 90 % of the entire surface may deviate from the mean value by up to  $\pm 5\%$ . Less than 10 % of the entire surface may deviate by up to  $\pm 8\%$ .

The entire surface is divided in  $1\text{ cm}^2$  sections. None of the mean values of the  $1\text{ cm}^2$  sections shall deviate by more than  $\pm 5\%$  of the mean value of the entire surface.

NOTE 1 Shade number 10 is used to check the quality of the illumination as it is the most desired shade.

NOTE 2 Each small cake can be measured separately.

b) Recognition of the reference colours

The shade numbers defined in Annex B shall be confirmed in all positions of the surface to be assessed.

This is ensured using the following check:

Flat circular calibrated colour samples with a diameter of 70 mm in every shade number defined in Annex B are placed at a height of 28 mm. The reflection value  $R_Y$  of the calibrated colour samples shall be measured in the corners of the area to be assessed

(where the outermost small cakes are positioned during the measurement), as well as in the centre.

The reflection value  $R_Y$  of the calibrated colour samples shall be measured with the deviations given in Annex B.

NOTE 3 To ensure that the light conditions and the focal length which will be used for the assessment are comparable, the colour samples should be at the height of 28 mm.

NOTE 4 Squared colour samples with a length of 70 mm and width of 70 mm could be used as well.

NOTE 5 Technical details are not fixed in order to be open for technical progress (e.g. camera, software).

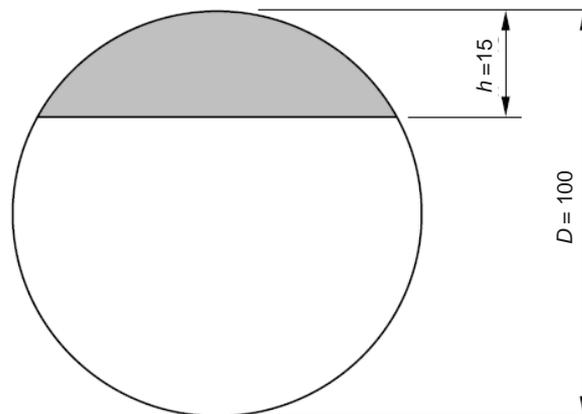
c) Consistent colour recognition on a convex surface

A convex colour sample (shape as defined in Figure 9) with a smooth and matt finished surface painted in shade number 10, is placed at a height of 13 mm in the corners of the area to be assessed (where the outermost small cakes are positioned during the measurement), as well as in the centre. The reflection value is measured in 13 sections (defined in Figure 10). The mean value of the reflection values of all sections in each position is calculated. The extreme values may deviate by  $\pm 9\%$  of the mean value.

Definition of the convex colour sample: a ball with a smooth surface and a diameter of 100 mm is cut at a depth of 15 mm, as illustrated in Figure 9, and the smaller section is used as the convex colour sample.

NOTE 6 The surface of the convex colour sample should be  $<35$  specular gloss value for an angle of  $85^\circ$  (according to ISO 2813:1994).

NOTE 7 To ensure that the light conditions and the focal length which will be used for the assessment are comparable, the convex colour samples (height of convex colour sample is 15 mm) should be positioned at the height of 13 mm (total height 28 mm at the highest point).



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Dimensions in millimetres

Figure 9 – Convex colour sample

d) Definition of the illuminance

The measurement is taken under a full spectral fluorescent triband or equivalent from 6 000 K to 7 000 K, colour rendering index  $R_a > 90\%$  illumination.

NOTE 8 Suppliers for suitable lamps are indicated in Annex C.

NOTE 9 Suppliers of colour measuring systems which meets these requirements, are given in Annex C.

7.5.3.6.4 Criteria for assessment (digital and visual)

a) Evaluation on the top of the small cakes

The top of each small cake is divided into 13 nearly equally sized sections, as shown schematically in Figure 10.

The values are adapted to the size and shape of each small cake.

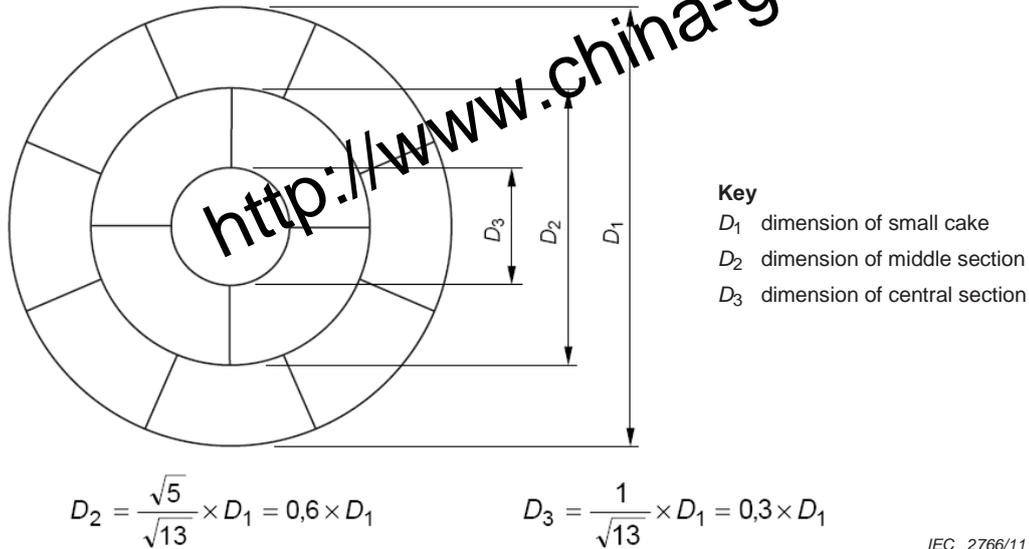


Figure 10 – Template for the sectioning of small cakes

The arithmetic average of reflection value  $R_y$  is calculated for the whole area of each section.

A shade number is determined according to Annex B and noted for each section.

1) *Acceptable browning on the top*

The average browning on the top of each single sheet and of all sheets baked simultaneously is calculated by dividing the sum of the shade numbers by thirteen times the number of cakes.

$$\text{average browning} = \frac{\text{sum of the shade numbers}}{13 \times \text{number of cakes}}$$

The average browning on the top is reported to one decimal place (single results per sheet and overall result).

Results of the test according to 7.5.3 shall only be accepted if the average browning on the top of all baking sheets baked simultaneously is in the range of 9,5 to 10,5. Otherwise, the test shall be repeated with a modified setting. If the baking time exceeds 40 min (preheating time included) for baking on one level or 50 min (preheating time included) for baking on two levels respectively, the oven temperature shall be increased accordingly.

NOTE 1 The average browning should be within the given range for a comparable result.

2) *CPB (Cakes properly browned) on the top*

All cakes with at least one section having a shade number outside the range 8 to 12 are not included.

CPB = Number of cakes where all sections have shade numbers between 8 and 12

3) *PPB (Percentage properly browned) on the top*

PPB = CPB / total number of cakes × 100 %

4) *Browning difference on the top*

The maximum difference between the shade numbers of all sections is determined and reported as browning difference on the top of each baking sheet separately and of all sheets baked simultaneously (single results per sheet and overall results).

b) Evaluation of the base of the small cakes

The reflection value  $R_y$  for the undamaged part of the base of each small cake is determined. A shade number is determined according to Annex B and noted for each small cake.

NOTE 2 At least 50 % of the base of each small cake should not be damaged after removing the paper case. Otherwise the test should be repeated.

1) *Average browning on the base*

The average browning on the base for each sheet separately and of all sheets baked simultaneously is calculated by dividing the sum of the shade numbers by the number of cakes.

$$\text{Average browning of the bottom} = \frac{\text{sum of the shade numbers}}{\text{number of cakes}}$$

The average browning on the base is reported to one decimal place (single results per sheet and overall result).

2) *Browning difference on the base*

The maximum browning difference between the shade numbers is determined and reported as browning difference on the base of each baking sheet separately and of all sheets baked simultaneously (single result per sheet and overall result).

c) Evaluation of the browning difference between top and base (top – base)

The browning difference between top and base is calculated by subtracting the average browning on the base from the average browning on the top.

$$\text{top} - \text{base} = |\text{average browning on the top} - \text{average browning on the base}|$$

The browning difference between top and base (absolute value) is reported for each sheet separately and of all sheets baked simultaneously (single results per sheet and overall result).

d) Measurement of the height of small cakes

The highest point of each small cake is measured and recorded in millimetres. Cutting or stabbing shall not affect the height of the cake.

The minimum height and the maximum height shall be recorded for each sheet separately.

## **7.6 Ability to supply heat**

### **7.6.1 Fatless sponge cake**

#### **7.6.1.1 General**

The purpose of this test is to assess the evenness of the heat supply by cooking a medium load at medium temperature.

NOTE This test is applicable for comparative testing only.

#### 7.6.1.2 Ingredients

100 g white wheat flour without raising agent  
100 g maize flour (corn flour)  
3 g baking powder  
150 g castor sugar (max. grain size 0,3 mm)  
3 eggs (55 g to 60 g, with shell)  
30 ml hot water (approximately 45 °C)

These ingredients are sufficient to make one cake.

#### 7.6.1.3 Procedure

Separate the egg whites from the yolks.

Whisk the egg whites with the hot water until a firm consistency is reached. Add the sugar and egg yolks and whisk for 2,5 min. Sift the wheat flour, maize flour and baking powder together and gently fold into the egg and sugar mixture.

Line the base of an ungreased cake tin with greaseproof paper. The tin is uncoated and has a diameter of 260 mm  $\pm$  10 mm and a height of 65 mm  $\pm$  10 mm. Spoon in the cake mixture and distribute to a uniform thickness. Follow the instructions for use for this type of cake with regard to preheating, positioning in the **oven** and setting of the thermostat. If no instructions are given, place the cake as close as possible to the centre of the **oven** and set the thermostat so that the **oven** temperature is 150 °C for **ovens** with forced-air circulation and 175 °C for **ovens** with natural convection. After baking for approximately 35 min, take the cake out of the **oven** and allow it to cool. Remove the cake from the tin and carefully remove the paper lining.

If the instructions for use state that the cakes can be baked on more than one level, the test is carried out accordingly.

#### 7.6.1.4 Assessment

The shade chart of Annex B is used to assess browning. Small irregularities are ignored.

The following results are stated:

- the maximum browning difference on the top;
- the maximum browning difference on the bottom.

The cake is cut vertically through the centre and the baking is evaluated. The height of the cake is measured at the centre and at the lowest and highest point of the edge.

The evaluation of baking includes a visual assessment of the thickness of the crust, cracks, craters and texture. The baking result may be documented by photographs.

### 7.6.2 Apple pie

#### 7.6.2.1 General

The purpose of this test is to assess the ability to supply sufficient heat to cook a heavy load.

NOTE This test is applicable for comparative testing only.

#### **7.6.2.2 Ingredients**

Dough:

300 g white wheat flour without raising agent  
175 g baking margarine with 80 % fat content or salted butter  
75 g castor sugar (max. grain size 0,3 mm)  
1 egg (55 g to 60 g, with shell)  
50 ml water

Filling:

25 g fresh white breadcrumbs  
50 g seedless raisins  
400 g fresh cooking apples (prepared weight)  
75 g castor sugar, grain size max. 0,3 mm

These ingredients are sufficient to make one pie.

#### **7.6.2.3 Procedure**

Mix the flour and sugar together and rub in the margarine. Add the beaten egg and sufficient water to bind into a soft dough. Mix until a uniform consistency has been reached and knead the dough into a ball. Cover and store for at least half-an-hour in a refrigerator at a temperature of  $5\text{ °C} \pm 2\text{ °C}$ . Peel, core and cut the apples into slices up to 13 mm thick.

Remove the dough from the refrigerator and divide it into a two-third and one-third portion. Roll out each portion to a thickness of 5 mm without kneading it again. Use the larger portion to line the base and sides of a baking tin having a diameter of  $200\text{ mm} \pm 10\text{ mm}$  and a height of  $50\text{ mm} \pm 15\text{ mm}$ .

Sprinkle the breadcrumbs evenly over the dough. Place the apple slices, raisins and sugar evenly over the breadcrumbs packing them down well. Cover the top with the remaining layer of pastry. Seal and trim the edges. Make an incision in the top to allow the steam to escape.

Follow the instructions for use for this type of pie with regard to preheating, positioning in the **oven**, setting of thermostat and cooking time. If no instructions are given, the pie is positioned as close as possible to the centre of the **oven** and the thermostat is set so that the mean oven temperature is  $160\text{ °C}$  for **ovens** with forced-air circulation and  $185\text{ °C}$  for **ovens** with natural convection and the pie is left in the oven until it is cooked.

In **ovens** with forced-air circulation, the maximum number of shelves are used in accordance with the instructions for use, one pie being placed on each shelf. All the pies are removed from the **oven** at the same time. In **ovens** with natural convection up to two pies are baked simultaneously, in accordance with the instructions for use, either on one shelf or two separate shelves. If two separate shelves are used, one pie may be removed from the **oven** first and the other moved into its place.

Alternatively, the pies may be interchanged once.

NOTE Only one pie is cooked if there is insufficient space in the **oven** to cook two pies simultaneously.

#### **7.6.2.4 Assessment**

The pie is removed from the oven and allowed to cool down.

The uniformity of browning on the top and on the bottom of the pie is assessed by using the colour measuring instrument specified in Annex A or the shade chart specified in Annex B.

The following results are stated:

- the maximum browning difference on the top;
- the maximum browning difference on the bottom.

The pie is cut vertically and assessed to check whether the filling is sufficiently cooked.

The cooking time is stated.

## 8 Steam ovens and combi steam ovens

NOTE These tests are applicable for comparative testing only.

### 8.1 Distribution of steam

#### 8.1.1 General

This test is intended to assess the vertical and horizontal steam distribution for a heavy load.

#### 8.1.2 Ingredients

The measurements are made with fresh broccoli florets. Care has to be taken to ensure that all the florets are mixed together to have a comparable probe.

NOTE Yellow parts of the broccoli should be removed. Florets with a big colour deviation are unsuitable. The florets should be of equal size. Large florets may be cut in pieces to reduce waste.

#### 8.1.3 Quantity

The quantity depends on the size of oven cavity.

The steaming accessory measured according to 6.4 shall cover at least 80 % of the usable width and 70 % of the usable depth of the cavity measured according to 6.2. If the supplied steaming accessory or the sheet recommended in the instructions fits these dimensions this accessory shall be used. If the supplied or recommended accessory does not fit the above condition or no recommendation is given, then a steaming accessory, which should be a perforated container, fitting the above condition as far as possible shall be used.

Distribute the florets evenly on the accessory, in such a way that they do not lie upon each other (single-layer) and they cover the whole surface of the accessory. The florets are placed side by side in the accessory with stalks downward. The upper side of the florets should be at approximately the same level of 4 cm.

Additional to one level the manufacturer's instructions regarding the number of accessories, which may be cooked simultaneously in different levels, are followed.

NOTE The amount of broccoli florets per dm<sup>2</sup> usable area of the steam ovens accessory is approximately 85 g/dm<sup>2</sup>.

#### 8.1.4 Procedure

The broccoli must be at ambient temperature before starting.

Divide broccoli into equal florets without rinsing. The florets shall have a diameter of 35 mm – 45 mm. Cut stalk short (approximately 5 mm long).

NOTE 1 Do not rinse the broccoli as additional water can influence the result.

Follow the operating instructions with respect to the steam function, temperature, shelf position and preheating.

For more levels the accessories are placed simultaneously in the steam ovens one above the other and removed simultaneously at the end of cooking.

While the florets are cooking, the position of the accessory must not be changed.

For appliance without fixed fresh water supply the tank shall be filled with water until maximum level. The temperature of water shall be  $15\text{ °C} \pm 1\text{ °C}$ .

If preheating is recommended, the broccoli are placed in the steam ovens when the end of the preheating phase is indicated, e.g. by visual or acoustic signal, or after recommended preheating time.

If no instructions are given, the accessory is placed in the middle of the calculated cavity of the cold steam ovens. The steam oven is set to  $100\text{ °C}$  or highest possible setting (steam function).

Preliminary tests are carried out to determine the appropriate cooking time to achieve the desired doneness. The doneness is assessed with several florets of the same size.

NOTE 2 Only testing results of different probes with nearly the same doneness are allowed to be compared.

#### **8.1.5 Assessment**

The measurement shall be carried out immediately. The assessment shall be finished at least 15 min after cooking.

The accessory is removed from the steam oven.

Preliminary the doneness of florets is assessed. The texture is assessed with several florets of the same size chosen from different parts of the accessory. All stalks are cooked at least al dente. The florets shall not be mashed. If florets are mashed, the testing is repeated with a modified setting.

The minimal and maximal colour deviation shall be stated in relation to a reference probe prepared by the reference procedure specified in Annex G.

The uniformity of colour of the florets is assessed by using the shade chart specified in Annex F.

The quantity of broccoli cooking simultaneously is stated.

The cooking time is stated (preheating time included).

The energy consumption is expressed in watt-hours (preheating included).

NOTE 1 Energy consumption and cooking time are not comparable as different amounts are taken as a basis.

The water consumption is recorded either by water meter or by metering the residual water content of the tank and steam generator.

NOTE 2 Residual water is water which can be used for further cooking processes.

It shall be stated, if the water tank must be refilled during cooking.

## 8.2 Ability to supply steam

### 8.2.1 General

The purpose of this test is to assess the ability to supply sufficient steam to cook a small and comparable load of green vegetables.

### 8.2.2 Ingredients

The measurements are made with fresh broccoli.

300 g  $\pm$  10 g fresh broccoli, divided into florets, is used.

NOTE Yellow parts of the broccoli should be removed. Florets with a big colour deviation are unsuitable. The florets should be of equal size. Large florets may be cut in pieces to reduce waste.

### 8.2.3 Procedure

The broccoli must be at ambient temperature before starting.

Divide broccoli into equal florets without rinsing. The florets shall have a diameter of 35 mm – 45 mm. Cut stalk short (approximately 5 mm long). The florets should not fall to pieces. Distribute the florets evenly on the accessory, in such a way that they do not lie upon each other (single-layer). The florets are placed in the accessory with stalks downward.

NOTE 1 Do not rinse the broccoli as additional water can influence the result.

Follow the operating instructions with respect to the steam function, temperature, shelf position and preheating.

While the florets are cooking, the position of the accessory must not be changed.

For appliance without fixed fresh water supply the tank shall be filled with water until maximum level. The temperature of water shall be 15 °C  $\pm$  1 °C.

If preheating is recommended, the broccoli are placed in the oven when the end of the preheating phase is indicated, e.g. by visual or acoustical signal, or after recommended preheating time.

The steaming accessories are set into in the oven simultaneously. The position is not changed during cooking process. The steaming accessories are removed simultaneously.

If no instructions are given, the accessory is placed in the middle of the calculated cavity of the cold steam ovens. The steam oven is set to 100 °C or highest possible setting (steam function).

Preliminary tests are carried out to determine the appropriate cooking time to achieve the desired doneness. The doneness is assessed with several florets of the same size.

NOTE 2 Only testing results with nearly the same doneness are allowed to be compared.

### 8.2.4 Assessment

The measurement shall be carried out immediately. The assessment shall be finished at least 15 min after cooking.

The accessory is removed from the steam oven.

Preliminary the doneness of florets is assessed. The texture is assessed with several florets of the same size. All stalks are cooked at least al dente. The florets shall not be mashed. If florets are mashed, the testing is repeated with a modified setting.

The colour deviation shall be stated in relation to a reference probe prepared by the reference procedure specified in Annex G.

The uniformity of colour is assessed by using the shade chart specified in Annex F.

The cooking time is stated (preheating time included).

The energy consumption is expressed in watt-hours (preheating included).

The water consumption is recorded either by water meter or by metering the residual water content of the tank and steam generator.

NOTE Residual water is water which can be used for further cooking processes.

It shall be stated, if the water tank must be refilled during cooking.

### **8.3 Performance test with maximum load**

#### **8.3.1 General**

The purpose of this test is to assess the capacity of the appliance. It is checked by a heavy frozen load with a high thickness.

#### **8.3.2 Ingredients**

The measurements are made with deep frozen peas. Care has to be taken to ensure that the peas are without any bits of ice. Colour of frozen peas shall be homogenous and green as far as possible.

NOTE 1 The peas should be stored in a freezer having a temperature of approximately  $-20\text{ }^{\circ}\text{C}$ .

NOTE 2 The peas should have a diameter of approximately 8 mm, classified as "petits pois".

#### **8.3.3 Quantity**

The maximum load is determined according to instruction manual.

But if no recommendation is given the maximum load depends on the size of steaming accessories. The height of the load measured in the accessory shall be  $40\text{ mm} \pm 2\text{ mm}$ . If the height of the accessories is lower than 40 mm the peas shall be filled at maximum height.

NOTE A minimum filling height of 20 mm is needed to position the thermocouple correctly. The thermocouple must be covered by peas.

The number of steaming accessories used simultaneously is determined according to instruction manual. If no recommendation is given peas are cooked only on one level.

#### **8.3.4 Procedure**

Take peas out of the freezer and fill the necessary amount into the steam ovens accessory. Check the height of the load by a gauge and weigh the total amount.

NOTE 1 Cook peas immediately after filling into the accessories.

Preliminary tests are carried out to determine the coldest spot of the load.

For preliminary tests fix at least one thermocouple at middle position and check coldest spot after approximately 70°C is reached.

NOTE 2 The coldest spot is better to determine if more thermocouples are even distributed in the load.

The coldest point shall reach  $85\text{ °C} \pm 1\text{ °C}$ . Then cooking process is finished.

Therefore the temperature of the coldest spot is recorded continuously by means of a thermocouple according to 5.3.

Cook according to the manufacturer's instructions for this type of food with respect to the steam function, temperature, shelf position, number of levels and preheating.

For more levels the accessories are placed simultaneously in the steam oven one above the other and removed simultaneously at the end of cooking.

While the peas are cooking, the position of the accessory must not be changed.

For appliance without fixed fresh water supply the tank shall be filled with water until maximum level. The temperature of water shall be  $15\text{ °C} \pm 1\text{ °C}$ .

While the peas are cooking the water tank must not be refilled. If the water amount of the tank is not sufficient, the test shall be repeated with reduced amount of peas.

NOTE 3 The amount of peas should be reduced in 20 % steps.

If preheating is recommended, the peas are placed in the steam oven when the end of the preheating phase is indicated, e.g. by visual or acoustical signal, or after recommended preheating time.

If no instructions are given, the steam oven is set to 100 °C or highest possible setting (steam function) and the accessory is placed in the middle of the calculated cavity of the cold steam oven.

### 8.3.5 Assessment

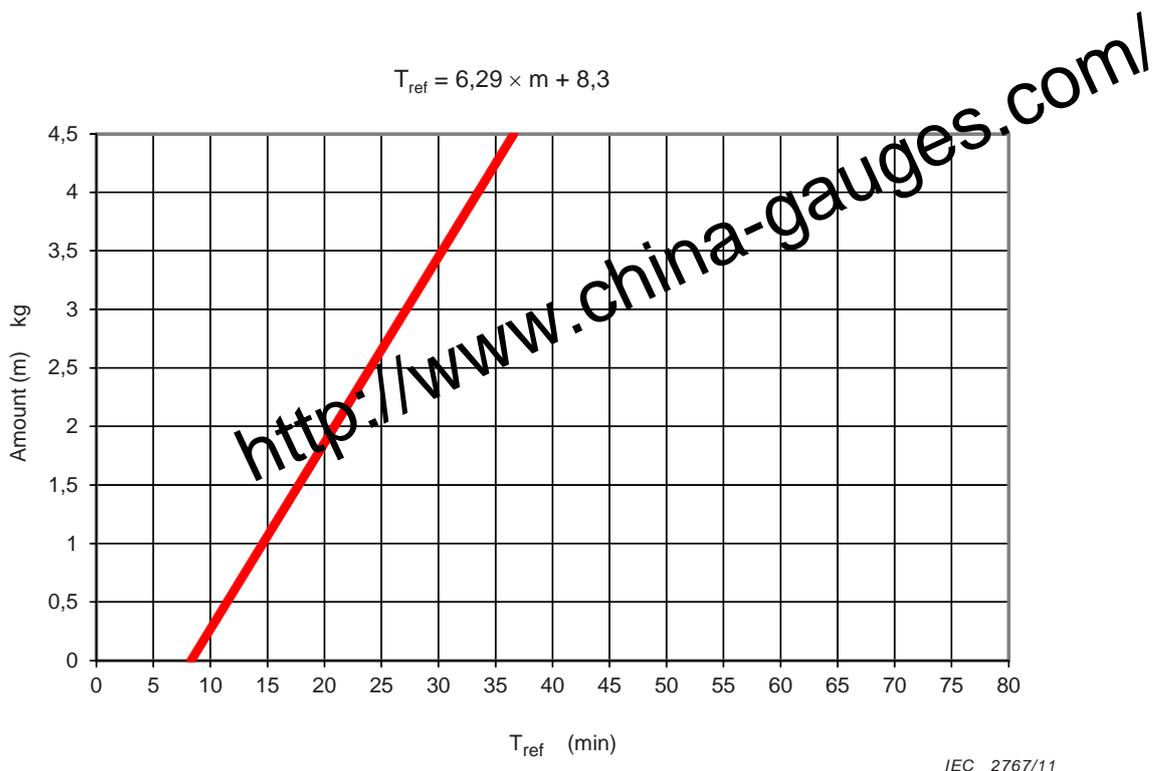
The measurement shall be carried out immediately. The assessment shall be finished at least 15 min after cooking.

The accessory is removed from the steam ovens.

The uniformity of colour of the peas is assessed by using the shade chart specified in Annex F. The minimal and maximal colour deviation shall be stated; while single peas are not relevant. Colour deviation shall be visible in concentrated areas. Also the peas under the surface are relevant for colour deviation. The deviation of the yellow part (Y) shall not be more than 10 % regarding to the NCS system. Otherwise the test is repeated with a smaller amount.

The cooking time is stated. The cooking time is assessed in relation to the reference time  $T_{ref}$  given in Figure 11 for this load, preheating time included. Cooking time shall not be longer than two times of the reference time. Otherwise the test is repeated with a smaller amount.

NOTE 1 The amount of peas should be reduced in 20 % steps.



**Figure 11 – Reference values of cooking time ( $T_{ref}$ )**

NOTE 2 The figures are determined empirical. On this database the optimal cooking time for different amounts are stated.

The maximum amount of peas cooked with an acceptable quality (minimal colour deviation, within the time limit) is stated.

The number of levels used simultaneously is stated.

The energy consumption is expressed in Watt-hours (preheating included).

NOTE 3 Energy consumption and cooking time are not comparable as different amounts are taken as a basis.

The water consumption is recorded either by water meter or by metering the residual water content of the tank or the steam generator.

NOTE 4 Residual water is water which can be used for further cooking processes.

## 9 Grills

### 9.1 General

The purpose of these tests is to determine the performance of **grills** in relation to their size and ability to cook.

### 9.2 Grilling area

#### 9.2.1 General

The purpose of this test is to determine the effective area of the **grill**.



NOTE This test is applicable for comparative testing only.

### 9.2.2 Procedure

The measurements are made with factory-made white bread which is commonly available and suitable for toasting. Care has to be taken to ensure that if more than one loaf is necessary, bread from the same batch is used.

Slices of bread of uniform size having a thickness of  $12\text{ mm} \pm 1\text{ mm}$  are used for the test with the crust removed. The grill grid is completely covered with bread.

NOTE It may be necessary to trim some slices to fit the grill grid.

Preheat the grill in accordance with the instructions for use. If no instructions are given preheat the grill for 5 min on maximum setting.

The grill grid, together with the grill pan, is placed under the grill element in the position recommended in the instructions for use. If no instructions are given, the grill grid is placed in the highest position suitable for grilling. The door is in the open position, unless otherwise specified in the instructions for use.

The grill grid is removed when a part of the bread is well browned but before burning occurs. If there is any shrinkage of the bread, the slices are moved so that the edges coincide with those of the grill grid.

### 9.2.3 Assessment

The shade chart of Annex B is used to determine the area of the bread where the browning is within shade numbers 8 to 14. The effective grilling area is stated in square centimetres and expressed as a percentage of the surface area of the grill grid.

## 9.3 Grilling

### 9.3.1 General

The purpose of this test is to determine the uniformity of cooking and browning of meat.

NOTE This test is applicable for comparative testing only.

### 9.3.2 Ingredients

2 500 g fresh minced beef, fat content 10 % to 20 %.

This quantity is sufficient for 20 burgers.

### 9.3.3 Procedure

Form the minced beef into burgers using a ring mould, each burger weighing 125 g and having a diameter of 75 mm. Compress the burger so that its height is approximately 35 mm.

Distribute the burgers evenly over the grill grid, allowing approximately 15 mm between each burger and between the burgers and the edges.

Preheat the **grill** following the instructions for use for maximum grill setting. If no instructions are given, preheat the **grill** for 5 min.

Place the grill grid and the grill pan under the grill element in the position recommended in the instructions for use. If no instructions are given, place the grill grid so that the top of the burgers is 50 mm to 75 mm below the grill element. The door is in the open position, unless otherwise specified in the instructions for use.

Grill the burgers as recommended in the instructions for use. If no instructions are given, grill one side for 12 min to 15 min, turn the burgers over and grill the other side for 10 min to 15 min.

#### 9.3.4 Assessment

The grill grid is removed from the oven and the temperature is measured at the centre of five burgers using a temperature measuring probe. The burgers are selected from the four corners and the centre of the grill grid. The measurement shall be performed within 2 min.

The difference between the maximum and minimum centre temperatures is stated.

The browning of each burger is assessed as follows and recorded:

- heavily charred            – A
- lightly charred            – B
- medium dark              – C
- medium light              – D
- grey                         – E

## 10 Warming compartments

The purpose of this test is to evaluate the temperature control and the energy consumption of **warming compartments**.

NOTE This test is considered to give reproducible results.

A thermocouple is placed in the geometrical centre of the **warming compartment**. The control is set to the lowest marked position and the **warming compartment** is heated until steady conditions are established. The control is then set to the medium position and heating is continued. When steady conditions are established heating is continued with the control at maximum setting.

When steady conditions are again established the test is continued for 1 h and the energy consumption is measured during this period.

The temperatures for the different settings of the control are stated. If the control is not linear, the average temperatures and the temperature differentials are stated.

The energy consumption is stated in watt-hours for 1 h of operation.

## 11 Cleaning

### 11.1 Pyrolytic self-cleaning ovens

The purpose of this test is to evaluate the self-cleaning process of the **oven**.

NOTE 1 This test is applicable for comparative testing only.

The interior surfaces of the **oven** cavity and door are artificially soiled using a paintbrush.

NOTE 2 The soil is not applied to the door seal and overlapping surfaces between the door and the **oven** cavity.

The artificial soil is made from

- 30 g gravy (20 g meat extract and 10 g water);

- 15 g hydrogenated oil shortening (vegetable cooking fat).

The mixture is evenly applied in a quantity of 0,15 g/dm<sup>2</sup>.

The door is closed and the **oven** energized for 3 h with the temperature control set to 150 °C or the maximum obtainable if this is lower. The **oven** is then allowed to cool down.

The **oven** is then operated in the cleaning mode in accordance with the instructions for use and the energy consumption is measured.

After the **oven** has cooled down it is inspected. It is stated to what extent residues are left and whether they can be removed by means of a damp cloth.

The energy consumption during the cleaning cycle is measured and stated in kilowatt-hours, rounded off to 0,1 kWh.

## 11.2 Ovens with catalytic cleaning

The purpose of this test is to evaluate the catalytic cleaning ability of the **oven**.

NOTE 1 This test is applicable for comparative testing only.

Approximately 1 kg of pork belly is placed in an open roasting pan and 0,125 l of water added. The pan is positioned as close as possible to the centre of the **oven** and heated for 1,5 h at an **oven** temperature of 200 °C for **ovens** with forced-air circulation and 225 °C for **ovens** with natural convection. The pan is removed and the **oven** is allowed to cool down.

The **oven** is inspected and the extent of residues remaining on surfaces with catalytic coating is stated.

NOTE 2 Pork belly is used because this meat provides sufficient fat for soiling the surfaces.

## 12 Consumption measurement of low power modes

In addition to EN 50564, 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 is used for the test.

If appliance A (e.g. hob) can only be operated combined with appliance B (e.g. 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 a device 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 measurement procedure for energy consumption of hobs is described in EN 60350-2.

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 to EN 50564 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 are to be tested and reported. Ⓒ

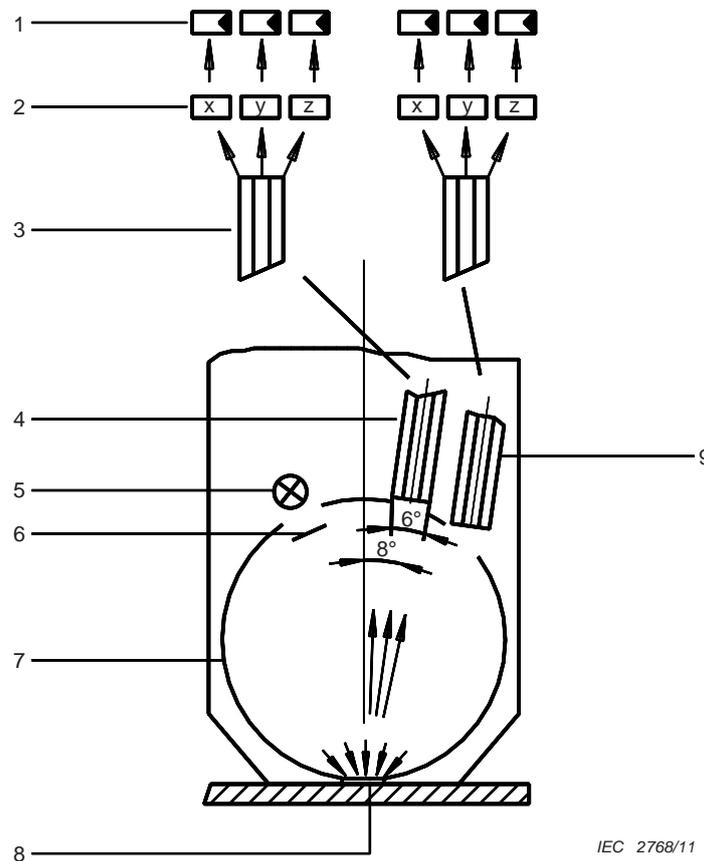
<http://www.china-gauges.com/>

**Annex A**  
(normative)

**Colour measuring instrument**

The instrument (see Figure A.1) is in accordance with ISO 7724, and CIE 15.2 with the following specification:

- measuring geometry: diffuse, 8° vertical deviation,
- measuring aperture: diameter 20 mm, closed by a disk of quartz glass;
- calibration standard: white, according to ISO 7724;
- standard illuminant: D 65, according to ISO 11664-2;
- standard observer: 10°, according to ISO 11664-2;
- evaluation: reflection value  $R_y$ .



IEC 2768/11

**Key**

- |                     |                                     |
|---------------------|-------------------------------------|
| 1 photoreceptors    | 6 shutter                           |
| 2 filters           | 7 integrating sphere                |
| 3 light wave guide  | 8 specimen under measuring aperture |
| 4 measuring channel | 9 reference channel                 |
| 5 xenon flash bulb  |                                     |

**Figure A.1 – Colour measuring instrument**

**Annex B**  
(normative)

**Shade chart**

Tables B.1 and B.2 of this annex specify the relation between reflection value  $R_y$  and shade numbers corresponding to NCS shade charts.

**Table B.1 – Classification of shade numbers**

Measured reflection value $R_y$		Tolerances for 7.5.3.6.3	Shade number
$\geq$	$<$		
	7,2	$\pm 14 \%$	17
7,2	9,3	$\pm 13 \%$	16
9,3	12,2	$\pm 12 \%$	15
12,2	16,4	$\pm 11 \%$	14
16,4	20,1	$\pm 10 \%$	13
20,1	22,9	$\pm 10 \%$	12
22,9	26,5	$\pm 9 \%$	11
26,5	31,7	$\pm 9 \%$	10
31,7	38,5	$\pm 8 \%$	9
38,5	46,9	$\pm 8 \%$	8
46,9	54,2	$\pm 8 \%$	7
54,2	64,3	$\pm 8 \%$	6
64,3	75,2	$\pm 8 \%$	5
75,2		$\pm 8 \%$	4

**Table B.2 – Examples for the shade charts**

NCS		
Shade chart	$L^*$	$R_y$
S 8502-Y	30,3	6,4
S 7020-Y50R	34,4	8,2
S 6030-Y50R	38,6	10,4
S 5040-Y40R	44,5	14,2
S 4050-Y30R	50,4	18,8
S 4040-Y30R	53,4	21,4
S 4030-Y30R	56,6	24,5
S 3040-Y30R	60,5	28,7
S 2060-Y20R	65,7	34,9
S 2040-Y20R	71,1	42,3
S 1050-Y20R	77,1	51,7
S 1040-Y20R	80,1	56,9
S 0530-Y10R	88,1	72,3
S 0520-Y10R	90,9	78,3

NOTE 1 The measured reflection value  $R_y$  does not correlate linearly to the visual perception. Although the widths of the intervals given above increase with increasing reflection value  $R_y$ , visually the steps from shade number to shade number are fairly uniform.

NOTE 2  $R_y$  Reflection values are calculated from the  $L^*$  values based on the CIE  $L^*a^*b^*$  colour system. (measuring conditions: standard illuminant D65 / standard colorimetric observer CIE 1964/ 10°).

NOTE 3 The NCS shade charts<sup>4</sup> can be ordered at official NCS Centres all over the world. The following address shows potential distributors.

Sweden (Head Office)

Telephone: +46-(0)8-617 47 00

Scandinavian Colour Institute AB

Fax: +46-(0)8-617 47 01  
Visitors: Ingarngatan 30

Address: P.O. Box 49022, S -100 28 Stockholm

Internet: [www.ncscolour.com](http://www.ncscolour.com)

E-mail: [info@ncscolour.com](mailto:info@ncscolour.com)Post

<http://www.china-gauges.com/>

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<sup>4</sup> This 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 IEC of this product.

**Annex C**  
(informative)

**Addresses of suppliers**

**C.1 General**

The following information is given for the convenience of users of this standard and does not constitute an endorsement by the IEC.

**C.2 Testing ingredients for small cakes**  
(see 7.5.3)

All ingredients for preparation of small cakes as specified in this standard and the paper cases may be obtained from: Stamminger & Demirel Testmaterialien

Telephone: +49 9123 98 89 75  
Fax: +49 9123 98 84 89  
e-mail: [r.stamminger@web.de](mailto:r.stamminger@web.de)  
Erbsenbodenstr. 31  
D-91207 Lauf – Germany

[www.sta-de.com](http://www.sta-de.com)

All ingredients used for reproducible results shall be from the same batch. It is recommended that the ingredients used match the definitions in Table C.1.

**Table C.1 – Ingredient specification**

Ingredients	Problems of constant quality	Quality criteria
Butter	Variation with season and region of origin Salt content	Ingredients: cow's cream, lactobacilli Fat content 82,5 % (minimum 82 %) Water content <16 % Unsalted, pH value in serum 5,2 to 6,3
Sugar	Humidity uptake	Disaccharide Saccharose, anhydrous Refined white sugar EU cat.1 "Raffinade fein RFF" grain size 0,10 mm to 0,35 mm, d95/d05
Egg mixture	Variation of biochemical constitution of eggs with season and nutrition	Hen's egg mixture, pasteurised, homogeneous Packed in Tetra Brik <sup>5</sup> , deep frozen (at least –18 °C) pH 6,4 to 7,0 Dry substance 22,7 % to 23,7 %

<sup>5</sup> Tetra Brik is the trade name of a product supplied by Stamminger & Demirel Testmaterialien. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Table C.1 (1 of 2)

Ingredients	Problems of constant quality	Quality criteria
Flour	Variation with season and region of origin. Humidity uptake. Additives.(	Wheat flour (triticum aestivum L.) Mineral content: maximum 0,5 % (dry substance) Humidity: maximum 15,0 % Falling number: at least 250 s Gluten: at least 24,0 % Sedimentation: at least 26 ml Protein: approx.10,6 % (dry substance) Fat: approx. 1,0 % Carbohydrates: approx. 70,9 % Energy: approx.1 409 kJ / approx. 332 kcal Additive: ascorbic acid
Salt		Grain size < 1 mm
Baking powder	Relation and sort of expanding agent	Substance of content: Natriumhydrogencarbonate (E 500, 33,3 %), Dinatriumdiphosphate (E 450, 46,7 %) Wheat starch

a) Specification for the paper cases

48 mm in base diameter and 29 mm in height. 70 g/m<sup>2</sup> bleached greaseproof paper

Manufacturer: Bacher und Demmler GmbH & Co. KG

Kaiser-Wilh.-Str. 7-15

12247 Berlin

Germany

[bu@demmler.de](mailto:bu@demmler.de)

Telephone: + 49 (0) 30 77 000 8-0;Fax: 0049 (0) 30 77 000 8 – 54

Artikel no: Backförmchen weiß, PE 4,8/2,9cm, 70 4812 70 109 20 14

b) Handling the frozen egg mixture

For defrosting the frozen whole egg package, put approximately 5 l of water into a large vessel at a temperature of 30 °C ± 2 °C. Put one Tetra Brik of frozen egg into the warm water so that it is covered completely. It might be necessary to weight it down, e.g. with a cup. Stir the water from time to time and shake the Tetra Brik.

After 1 h discard the first lot of water and completely renew with another 5 l of warm water at 30 °C ± 2 °C completely covering the Tetra Brik again. Stir the water from time to time and shake the Tetra Brik.

It should be defrosted within 2 h. The whole egg mixture can be used when it has reached a temperature of 23 °C ± 2 °C. Open the Tetra Brik and mix the egg with a fork for approximate 30 s until it looks homogenous and can thus be used like fresh egg.

After opening the Tetra Brik must be used within one day. The egg mixture is beaten with a fork until homogeneous, prior to use.

An unopened Tetra Brik can be stored in a fridge.

### C.3 Food mixer (see 7.5.3)

Specification: power rating: 550 W ± 50 W

- Revolutions per min

Table C.2 – Food mixer – revolutions

	Revs per min			
	Level 1	Level 2	Level 3	Level 4
Wire whisk	53 ± 5 %	90 ± 5 %	185 ± 5 %	325 ± 5 %

- Wire balloon whisk
- Bowl, approximately 3 500 cm<sup>3</sup>, top diameter 23 cm ± 2 cm
- The machine should be able to beat the sugar and butter to a soft and pale mixture in approximately 5 min. A supplier is

Bosch und Siemens Hausgeräte GmbH  
Werner von Siemens Straße 200  
D-83301 Traunreut  
Fax +49 8669 30 2098  
[BSH-Foodmixer-Info@bshg.com](mailto:BSH-Foodmixer-Info@bshg.com)

Recommended mixing time (small cakes) determined for Bosch MUM 4600:

Table C.3 – mixing time and setting

	Mixing time (small cakes)	Recommended setting
Beat together butter and sugar	Approx. 5 min	After stirring at level 1 speed up to level 4
Add egg mixture	Approx. 2,5 min	Start with level 1 and gradually increase to level 4
Fold in flour, baking powder and salt	Approx. 1 min	After stirring at level 1 process at level 4

### C.4 Lamps for digital measurement systems (see 7.5.3.6.3)

Possible suppliers are

1. NARVA – Lichtquellen GmbH + Co. KG  
Narva Typ “BIO light 960”  
[www.narva-bel.de](http://www.narva-bel.de)  
[office@nava-bel.de](mailto:office@nava-bel.de)  
Erzstraße 22  
Germany 09618 Brand-Erbisdorf  
Telephone: +49 37322/17200  
Fax: +49 37322/17203
2. ELEC Handels AG Beleuchtungssysteme  
True-light Typ ESL 15  
[elech@bluewin.ch](mailto:elech@bluewin.ch)  
[www.truelight.ch/elec/index.html](http://www.truelight.ch/elec/index.html)

Eichenweg 33  
CH-8121 Benglen ZH  
Telephone: +41 44 825 24 14  
Fax: +41 44 825 28 73

### C.5 Digital measurement system

Possible suppliers are

1. SLG Prüf- und Zertifizierungs GmbH  
Burgstädterstraße 20  
Germany – 09232 Hartmannsdorf  
<http://www.slg.de.com>  
[service@slg.de.com](mailto:service@slg.de.com)  
Telephone: +49(0)3722/7328-0  
Fax: +49(0)3722/7328-999
2. Ing.-Büro W. Neubauer  
Paradiesweg 4  
Germany – 96148 Baunach  
<http://www.fpga-design.de>  
[wn@fpga-design.de](mailto:wn@fpga-design.de)  
Telephone: +49(0)170/286 60 38

### C.6 Colour measuring instrument (see 7.5.2 and Annex A)

A supplier of the colour measuring instrument is

Dr. Lange

Postfach 19 02 29  
40549 Düsseldorf

### C.7 Brick for testing energy consumption of ovens (see 7.4)

Bricks are available under the type designation “Skamol Hipor” from the following supplier:

Skamol Insulation  
Östergade 58-60  
DK-7900 Nykøbing Mors  
Denmark

**Annex D**  
(normative)

**Description of the test brick**

**D.1 Specification**

Name	Hipor <sup>6</sup>
Bulk density, dry	(550 ± 40) kg/m <sup>3</sup>
Total porosity	77 %
Dry weight	(920 ± 75) g (without thermocouples), see 7.4.2.2
Water absorption	(1 050 ± 50) g, see 7.4.2.3
Height	(64 ± 0,5) mm

The brick is brittle. Tolerances of dry weight, water absorption and height are critical and have to be checked.

**D.2 Supplier and order specification**

SKAMOL INSULATION  
Östergade 58 – 60  
DK – 7900 Nykøbing Mors

*When ordering please state:*

- the brick name "Hipor", according to Electrolux agreement,
- length × width × height: 230 mm × 114 mm × 64 mm (see sketch in Figure D.1),
- machined on all six surfaces, tolerances ± 0,5 mm.

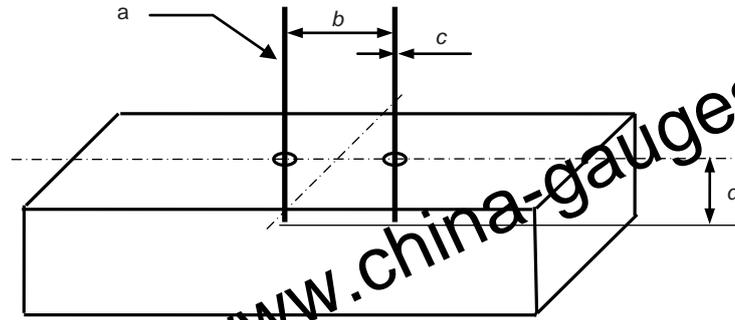
NOTE 1 According to Electrolux agreement, a minimum of 126 bricks have to be ordered. Alternatively quantities of 168, 282 or 504 bricks can be ordered to take advantage of a reduced price range.

NOTE 2 The diameter of the hole need not and should not be bigger than the diameter of the thermocouple.

NOTE 3 If it is not possible to drill the holes 32 mm deep, drill the holes to a depth of about 25 mm, insert the thermocouples into the holes and push them carefully further down the remaining 7 mm. Alternatively, a self-made rigid wire with 1 mm diameter could serve as a drill.

---

<sup>6</sup> Hipor is the trade name of a product supplied by SKAMOL INSULATION. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.



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**Key**

- a Two metal sheet tube thermocouples
- b 50 mm, with holes at  $b/2$
- c  $\varnothing 1$  mm, both thermocouples and holes
- d 32 mm both thermocouples and holes (see NOTE 3 in D.2)

**Figure D.1 – Position of the thermocouples**

Annex E  
(informative)

Calculation Sheet: Energy Consumption for heating a load (7.4)

C11

Brand & Factory:	Oven Type / Model:	Testlab:
Rated Voltage:	Supply voltage:	Operator:
Rated Power:	Calculated Volume (6.2):	Date:

Heating function: Conventional heating "ic"							nominal temperature rise: 180 K								
bricks							measured		room	oven temperature					
no.	dry weight $m_d$ (g)	wet weight $m_w$ (g)	absorbed water $\Delta m$ (g)	end cooking weight (informative) (g)	weight loss (informative) (g)	start temperatures thermocouple		energy consumption $E_i$ (kWh)	time $t_i$ (min)	average ambient temp. (°C)	nominal value $\Delta T^\circ$ (K)	real value (°C)	real value $\Delta T^\circ$ (K)	setting $T_{ks}^{ic}$ (°C)	temperature difference $\Delta T_{ksetting}^{ic}$ (K)
						no. 1 (°C)	no. 2 (°C)								
			calc.		calc.						140±10		calc.		calc.
			calc.		calc.						180±10		calc.		calc.
			calc.		calc.						220±10		calc.		calc.
Results at $\Delta T_0 = 180$ K				$S * \Delta T_0 + B$			Slope S		Intercept B		Standard deviation $\sigma$			$\Delta T_{ksetting}^{ic} \leq 20$ K	
Energy (linear regression)			(kWh)	calc.			calc.		calc.		calc.			calc.	
Time (linear regression)			(min)	calc.			calc.		calc.		calc.			calc.	

Key: calc. - calculation

C11

C11 Continuously:

Heating function: Forced air heating "if"										nominal temperature rise: 155 K					
bricks							measured		room	oven temperature					
no.	dry weight $m_d$ (g)	wet weight $m_w$ (g)	absorbed water $\Delta m$ (g)	end cooking weight (informative) (g)	weight loss (informative) (g)	start temperatures thermocouple no. 1 (°C)   no. 2 (°C)		energy consumption $E_v$ (kWh)	time $t_h$ (min)	average ambient temp. (°C)	nominal value $\Delta T^i$ (K)	real value (°C)	real value $\Delta T^i$ (K)	setting $T_{ks}^{if}$ (°C)	temperature difference $\Delta T_{k,setting}^{if}$ (K)
			calc.								135±10		calc.		calc.
			calc.								155±10		calc.		calc.
			calc.								175±10		calc.		calc.
Results at $\Delta T_0 = 155 \text{ K}$			$S * \Delta T_0 + B$				Slope S		Intercept B		Standard deviation $\sigma$			$\leq 20 \text{ K}$	
Energy (linear regression)			(kWh)				calc.		calc.		calc.			calc.	
Time (linear regression)			(min)				calc.		calc.		calc.			calc.	

Heating function: Hot steam "ih"										nominal temperature rise: 155 K					
bricks							measured		room	oven temperature					
no.	dry weight $m_d$ (g)	wet weight $m_w$ (g)	absorbed water $\Delta m$ (g)	end cooking weight (informative) (g)	weight loss (informative) (g)	start temperatures thermocouple no. 1 (°C)   no. 2 (°C)		energy consumption $E_v$ (kWh)	time $t_h$ (min)	average ambient temp. (°C)	nominal value $\Delta T^h$ (K)	real value (°C)	real value $\Delta T^h$ (K)	setting $T_{ks}^{ih}$ (°C)	temperature difference $\Delta T_{k,setting}^{ih}$ (K)
			calc.								135±10		calc.		calc.
			calc.								155±10		calc.		calc.
			calc.								175±10		calc.		calc.
Results at $\Delta T_0 = 155 \text{ K}$			$S * \Delta T_0 + B$				Slope S		Intercept B		Standard deviation $\sigma$			$\Delta T_{k,setting}^{ih} \leq 20 \text{ K}$	
Energy (linear regression)			(kWh)				calc.		calc.		calc.			calc.	
Time (linear regression)			(min)				calc.		calc.		calc.			calc.	

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**Annex F**  
(normative)

**Green shade chart –  
Cooked peas and broccoli**

This annex specifies the relevant shade numbers for cooked peas and broccoli (Clause 8) corresponding to NCS shade charts.

**Table F.1 – Specification of relevant green shade charts**

Hue	NCS-shade number
G 30 Y	S 2070-G30Y S 3060-G30Y S 4050-G30Y S 5040-G30Y S 6030-G30Y S 7020-G30Y S 8010-G30Y
G 40 Y	S 2070-G40Y S 3060-G40Y S 4050-G40Y S 5040-G40Y
G 50 Y	S 2070-G50Y S 3060-G50Y S 4050-G50Y S 5040-G50Y S 6030-G50Y S 7020-G50Y S 8010-G50Y
G 60 Y	S 2070-G60Y S 3060-G60Y S 4050-G60Y S 5040-G60Y
G 70 Y	S 2070-G70Y S 3060-G70Y S 4050-G70Y S 5040-G70Y S 6030-G70Y S 7020-G70Y S 8010-G70Y
G 80 Y	S 2070-G80Y S 3060-G80Y S 4050-G80Y S 5040-G80Y

Table F.1 (1 of 2)

Hue	NCS-shade number
G 90 Y	S 2070-G90Y
	S 3060-G90Y
	S 4050-G90Y
	S 5040-G90Y
	S 6030-G90Y
	S 7020-G90Y
	S 8010-G90Y

NOTE 1 The NCS shade charts<sup>7</sup> can be ordered at official NCS Centres all over the world like the NCS shade chart in Annex B.

NOTE 2 Example for assessing peas. The uniformity of colour of the peas is assessed by using the shade chart specified in Table F.1. For assessing peas the hue – as a degree of resemblance between green (G) and yellow (Y) – is relevant. The different nuances offered for each hue shall make it easier to determine the best fitting colour. If the colour determined for most peas is S 2070-G40Y and for some peas the colour is S 3060-G60Y the colour deviation is 20 % and the test is not valid. It should be repeated with a smaller amount.

<sup>7</sup> This 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 IEC of this product.

**Annex G**  
(informative)

**Reference system for assessing the steaming performance**

For determine the colour deviation of 8.1.5 and 8.2.4 (broccoli), a reference probe shall be prepared.

For preparing the reference probe, the following items should be used:

Broccoli

Broccoli of the same batch is prepared as described in 8.1.2. Divide broccoli into equal florets without rinsing. The florets shall have a diameter of 35 mm to 45 mm. Cut stalk short (approximately 5 mm long).

Cookware

A stainless steel cookware with a outer bottom diameter of 220 mm to 10 mm should be used. Prepared broccoli is arranged in a steaming cartridge. A supplier for a suitable steaming cartridge is:

Fackelmann<sup>8</sup>  
www.Fackelmann.de

Art. No. 42491

Cooking zone

A radiant cooking zone with a diameter of  $>180$  mm and  $\leq 220$  mm should be used. The nominal power should be  $1700\text{ W} \pm 100\text{ W}$ .

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<sup>8</sup> This 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 IEC of this product.

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Amendment 1 (2005)

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