BRITISH STANDARD

BS EN
50304:2001
Incorporating
Corrigendum No. 1

Electric ovens for household use — Methods for measuring energy consumption

The European Standard EN 50304:2001 has the status of a British Standard

ICS 97.040.20

National foreword

This British Standard is the official English language version of EN 50304:2001, including Corrigendum March 2002.

The UK participation in its preparation was entrusted by Technical Committee CPL/59, Performance of household electrical appliances, to Subcommittee CPL/59/9, Cooking and microwave appliances, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 17 June 2002

Summary of pages

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Amendments issued since publication

Amd. No.	Date	Comments
13842 Corrigendum No. 1	17 June 2002	Addition of footnote to Annex C

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50304

May 2001

ICS 97.040.20

Supersedes HD 376 S2:1984
Incorporating corrigendum March 2002

English version

Electric ovens for household use - Methods for measuring the energy consumption

Fours électriques à usage domestique - Méthodes de mesure de la consommation d'énergie

Elektrische Backöfen für den Hausgebrauch - Verfahren zur Messung des Energieverbrauchs

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50304:2001 E

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 59X, Consumer information related to household electrical appliances.

According to the decision of CLC/TC 59X, taken at the meeting in Brussels on 7th/8th October 1996 and confirmed at the meeting in Paris on 26th/27th March 1998 this standard has been drawn up as a self-contained CENELEC document. But it follows, as far as suitable, the structure of IEC 60350:1999.

Based on an interlaboratory test performed by nine laboratories test results obtained according to this standard are for direct comparison and are considered sufficiently reproducible within given limits for the purpose of energy labelling in according to the Commission Directive on energy labelling and standard product information.

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 92/75/EEC on "Indication by labelling and standard product information of the consumption of energy and other resources by household appliances".

It deals only with those test procedures that are required for the Commission Directive on Energy labelling for ovens.

It also defines permitted tolerances to values declared by the manufacturer and control procedures for checking these values.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50304 on 2000-04-01.

This European Standard supersedes HD 376 S2:1984.

The following dates were fixed:

- latest date by which the EN has to be implemented - at national level by publication of an identical - national standard or by endorsement	(dop)	2001-11-01
- latest date by which national standards conflicting - with the EN have to be withdrawn	(dow)	2003-04-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexe A is normative, annexes B, C and D are informative.

Contents

1 Scope

This standard applies to electric ovens for household use.

It is not applicable to:

- microwave ovens and microwave combination ovens;
- small cavity ovens (see 4.4);
- ovens without adjustable temperature control;
- heating functions others than defined in 4.1 - 4.3.

2 Object

The object of this standard is to specify in accordance with the Council Directive on energy labelling and standard product information:

- energy consumption using a standardised load during a standardised test procedure;
- some performance characteristics (like volume, time for heating a load and baking trays area);
- permitted tolerances to values declared by the manufacturer and control procedures for checking these declared values.

This standard is concerned neither with safety nor with performance requirements.

3 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 60350	1999	*Electric cooking ranges, hobs, ovens and grills for household use - Methods for measuring performance (IEC 60350:1999)*
EN 60584-2	1993	*Thermocouples – Part 2: Tolerances (IEC 60584-2:1982 + A1:1989)*
EN 61591	1997	*Household range hoods - Methods for measuring the performance (IEC 61591:1997)*

4 Definitions

For the purpose of this standard the following definitions apply:

4.1
conventional heating function
food is cooked 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).

4.2
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.

4.3
hot steam function
food is heated with hot steam (T >> 100 °C) at ambient pressure (1 bar)

4.4
small cavity oven
an oven with the following dimensions related to the usable 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 artificial standard load.

4.5
multiple cavity appliance
an 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

5 List of measurements

5.1 *Dimensions*

- Overall dimensions (clause 7);
- Dimensions of the usable volume and the surface area (clause 7).

5.2 *Energy consumption and heating times*

- Preheating of the empty oven (8.2);
- Heating of the load (8.3).

6 General conditions for measurements

6.1 *General*

The manufacturer's instructions regarding installation of the oven shall be followed.

Prior to every test the whole appliance (this includes the material and the insulation) shall be at ambient temperature. In multiple cavity appliances each oven cavity has to be measured separately. Only the cavity measured shall be switched on.

In case an oven has several variants of the functions as described in 4.1 – 4.3, the manufacturer can choose the variant to be tested. This has to be reported (see clause 9).

Unless otherwise specified, measurements are conducted under the following conditions:

6.2 *Ambient temperature*

The tests are carried out in a substantially draught-free room in which the ambient temperature is maintained at (23 ± 2) °C during the complete test.

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

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

6.3 *Electrical supply*

The supply voltage shall be maintained at the main terminal at 230 V ± 1 % or at 400 V ± 1 %, as defined by the manufacturers installation guide, while the heating elements are switched on. The supply frequency shall be at nominal 50 Hz ± 1 %.

The supply voltage measured during the tests shall be recorded.

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

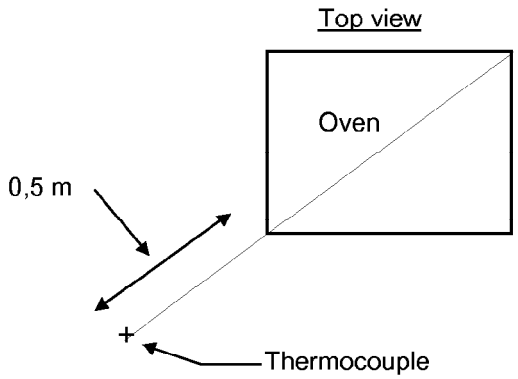


Figure 1 - Position of the thermocouple

6.4 *Load*

The load for test 8.3 shall be a brick with two holes for temperature measurements as shown in annex A.

A new brick shall be dried before using it for the first time in forced air circulation in an oven of about 50 l volume at ≥ 175 °C for three hours. No more than two bricks shall be dried at the same time in the same oven.

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 g. The dry weight m_d shall be in accordance with the dry weight specified in annex A. The brick shall be identified for accurate calculation of the water absorption according to 8.3.2.

Place markings 32 mm from the measuring point of the two thermocouples with steel tube 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.

NOTE 1 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 2.

NOTE 2 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.)

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. A brick that has already been soaked in water needs at least eight hours to be dried as described above.

NOTE 4 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 5 A brick can be used for about 20 tests when handled with normal care.

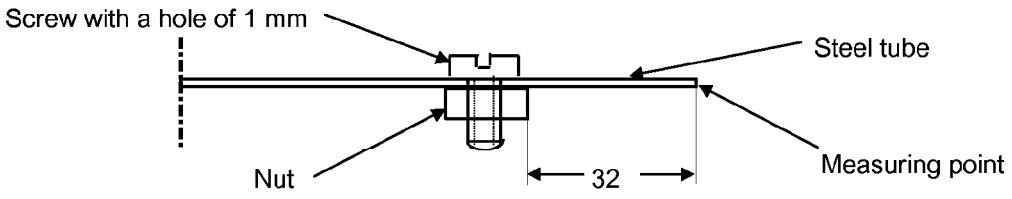


Figure 2 - Example of a method of fixing a thermocouple

6.5 *Instrumentation*

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 load are made with two thermocouples with 1 mm steel tube diameter, class 1 according to EN 60584-2. The thermocouple shall be accurate to ± 1,5 K.

NOTE The steel tube of the thermocouple eases the insertion of the thermocouple into the brick. See also note 2 in 6.4.

The temperature measurement system excluding the thermocouple shall be accurate to ± 1,0 K.

The energy measurements shall be accurate to ± 1,5 % or ± 10 Wh whatever is the greater.

The measurement of the voltage shall be accurate to ± 0,5 %.

The measurements of mass shall be accurate to ± 3 g.

The measurements of time shall be accurate to ± 5 s.

6.6 *Positioning of the appliance*

6.6.1 *General conditions*

The appliances shall be installed according to the manufacturer's instructions.

6.6.2 *Particular conditions*

- Floor-standing appliances are positioned between kitchen cabinets in accordance with the manufacturer's instructions;
- Built-in ovens are installed in a test enclosure including openings for ventilation, if required by the manufacturer. If the manufacturer's instructions give a range for the inner dimension of the enclosure the smallest dimension(s) shall be used.
- Other ovens are placed away from side walls with their back against a wall, unless otherwise specified in the manufacturer's instructions.
- Ovens with integrated air-extraction by a fan (or similar device) to the outside of the building, for tests according to clause 8, the air outlet is discharged into a flue which has a pressure drop of 50 Pa when there is an airflow of 200 m^3/h.

NOTE 1 The material and colour of the enclosing or adjacent cabinet(s) or walls is not defined in order to be in line with kitchen cabinets in practice.

NOTE 2 The condition of measurement for ovens with integrated air-extraction is similar to EN 61591:1997.

7 Dimensions of the usable volume and the surface area

The height, width and depth of the usable volume within the cavity are measured as shown in Figure 3 and stated in mm.

The usable volume is calculated from these three dimensions and stated in litres, rounded to the nearest whole litre.

The surface area of the largest baking sheet (if more than one) is calculated from the usable depth and width of the baking sheet and is measured 5 mm above its surface and stated in cm^2, rounded to the nearest 10 cm^2. If the appliance is delivered without baking sheets but with a grid, the surface of the grid shall be measured accordingly.

8 Energy consumption and time

8.1 *Measurement of oven temperature*

The oven temperature of each heating function, as appropriate (see 4.1 to 4.3), shall be measured separately. During the test only one heating function (see 4.1 to 4.3) shall be used.

The air temperature in the empty oven is measured with a thermocouple according to 6.5 fixed to the grid which is delivered with the oven and placed in the oven in a way that the welding point of the thermocouple is located at the centre of the usable volume of the oven with a distance of at least 30 mm from the grid.

8.2 *Preheating of 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.

A thermocouple is placed in the oven according to 8.1. It is led through the door gap in a way that the door is completely closed without applying additional force. 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,

NOTE 1 The completely closed door is very essential for the measurements according to 8.2 and 8.3.

The temperature rise is the difference of the oven temperatures (measured according to 8.1) at the beginning and at the end of the test.

The time t_{ph} in minutes and seconds and the energy consumption E_{ph} in kWh shall be measured.

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

NOTE 2 The energy consumption of components, such as lamps and fans which are automatically switched on with the oven, is included in the measurement.

8.3 *Energy consumption and time for heating a load*

8.3.1 *Purpose*

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 as defined in 8.3.2 which simulates both the thermal properties and the water content of food (e.g. meat).

8.3.2 *Preparation*

Before heating the brick, which has been treated according to 6.4, it shall be put into a water container so that the brick is completely covered with water of 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 ± 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 1 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 2 The brick gets approximately the same water content each time it is soaked in water. It is not necessary to dry it completely between uses.

When the water saturated brick with the thermocouples is taken out of the water container, excessive water is allowed to drip off (for about 1 minute). 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 6.4). The amount of absorbed water shall be as specified in annex A.

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

8.3.3 *Measurement*

8.3.3.1 *Procedure*

Three tests are performed for each heating function, as appropriate (see 4.1 - 4.3 and Table 1).

With the appliance at ambient temperature, according to 6.2, the brick, prepared according to 8.3.2, is placed in the geometric centre of the usable oven cavity with its largest surface centrally on the grid delivered with the oven, 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 to the centre of the usable oven cavity. The longer axis of the brick shall be parallel with the oven front.

NOTE 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 closest 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.

The measurement shall be started by switching on the oven within three minutes from the removal of the brick from the refrigerator. The temperature control is set to positions where the mean oven temperature rises $\Delta T_k^{i\ldots}$ as defined in Table 1 can be expected. $\Delta T_k^{i\ldots}$ is the difference between the average ambient temperature and the actual oven temperature (measured in 8.3.3.2), k = 1, 2, 3.

The average ambient temperature during the test is determined by the arithmetic mean of the ambient temperatures measured in accordance with 6.2 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

Heating mode	Heating functions		
	conventional "ic"	forced air "if"	hot steam "ih"
$\Delta T_1^{i\ldots}$	(140 ± 10) K	(135 ± 10) K	(135 ± 10) K
$\Delta T_2^{i\ldots}$	(180 ± 10) K	(155 ± 10) K	(155 ± 10) K
$\Delta T_3^{i\ldots}$	(220 ± 10) K[1)]	(175 ± 10) K[1)]	(175 ± 10) K[1)]
[1)] or the maximum temperature rise if this value cannot be reached			

To these temperatures correspond the measured energy consumption $E_1^{i\ldots}$, $E_2^{i\ldots}$ and $E_3^{i\ldots}$, as appropriate.

The following data is measured:

- the energy consumption(s) $E_{k\ldots}^{i\ldots}$ in kWh and the time(s) $t_k^{i\ldots}$ in min and s, 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 The energy consumption of components such as lamps and fans, which are automatically switched on with the oven, is included in the measurement.

8.3.3.2 *Checking the oven temperature*

After the test according to 8.3.3.1 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 as the arithmetic mean between the maximum and minimum temperatures at steady state conditions.

NOTE 1 Steady conditions are considered to be attained after 5 cycles of the thermostat or one hour whichever is shorter.

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

8.3.3.3 *Acceptance verification of the test results (set temperature and confidence of the measurement)*

Results of the tests according to 8.3.3.1 shall only be accepted if:

a) the mean temperature rises $\Delta T_k^{i...}$ are within the temperatures specified in Table 1, and

b) the standard deviation $\sigma^{i...}$ as defined in equation (1) is below 0,050 kWh.

Otherwise for the appropriate function, all measurements according to 8.3.3 shall be repeated.

The standard deviation $\sigma^{i...}$ is calculated from the data pairs $\Delta T_k^{i...} / E_{k...}^{i...}$ measured according to 8.3.3.1 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].

$$\sigma^{i...} = 1{,}2\sqrt{\frac{Q_y^{i...} - \left(Q_{xy}^{i...}\right)^2 / Q_x^{i...}}{n-2}} \qquad (1)$$

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 $\Delta T_k^{i...}$ can only vary between 125 K and 185 K for forced air and hot steam functions resulting in f factor between 1,16 and 1,21 and between 130 K and 230 K for conventional function resulting in factor f between 1,155 and 1,168. $f^{i...} = \sqrt{1 + \frac{1}{n} + \frac{\left(T_0^{i...} - \overline{\Delta T^{i...}}\right)^2}{Q_x^{i...}}}$

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

$$Q_{xy}^{i...} = \sum_{k=1}^{n} \Delta T_k^{i...} \cdot E_k^{i...} - \overline{E^{i...}} \sum_{k=1}^{n} \Delta T_k^{i...} \qquad (3)$$

$$Q_x^{i...} = \sum_{k=1}^{n}\left(\Delta T_k^{i...}\right)^2 - \frac{\left(\sum_{k=1}^{n} \Delta T_k^{i...}\right)^2}{n} \qquad (4)$$

$$\overline{\Delta T^{i...}} = \frac{1}{n}\sum_{k=1}^{n} \Delta T_k^{i...} \qquad (5a)$$

$$\overline{E^{i...}} = \frac{1}{n}\sum_{k=1}^{n} E_k^{i...} \qquad (5b)$$

8.3.4 *Determination of the energy consumption for all tested functions*

The energy consumption $E^{i...}_{\Delta T_0}$ for the reference temperature rise $\Delta T^{i...}_0$ is calculated using the linear regression based on the measured data points $\Delta T^{i...}_k / E^{i...}_k$, according to the equation:

$$E^{i...}_{\Delta T_0} = S^{i...} \cdot \Delta T^{i...}_0 + B^{i...} \quad (6)$$

where:

$E^{i...}_{\Delta T_0}$ is the calculated nominal energy consumption in kWh for heating a load for the different heating functions *"ic", "if"* or *"ih"* at $\Delta T^{i...}_0$;

$\Delta T^{i...}_0$ = 180 K for conventional heating function
= 155 K for both forced 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 (7)

$B^{i...}$ is the intercept which is calculated according to equation (8):

$$S^{i...} = \frac{n\sum_{k=1}^{n}\left(\Delta T^{i...}_k \cdot E^{i...}_k\right) - \left(\sum_{k=1}^{n}\Delta T^{i...}_k\right)\left(\sum_{k=1}^{n}E^{i...}_k\right)}{n\sum_{k=1}^{n}\left(\Delta T^{i...}_k\right)^2 - \left(\sum_{k=1}^{n}\Delta T^{i...}_k\right)^2} \quad (7)$$

$$B^{i...} = \frac{\sum_{k=1}^{n} E^{i...}_k - S^{i...} \cdot \sum_{k=1}^{n} \Delta T^{i...}_k}{n} \quad (8)$$

where:

$\Delta T^{i...}_k$ is the actual temperature difference for the different heating functions *"ic", "if"* or *"ih"* , as defined in 8.3.3.1;

$E^{i...}_k$ is the energy consumption in kWh measured according to 8.3.3.1 at the different $\Delta T^{i...}_k$ for the different heating functions *"ic", "if"* or *"ih"* ;

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

8.3.5 *Determination of the 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 8.3.4.

Replace in the equations (6) to (8) *E* values by the appropriate *t* values, i.e. replace.

- in equation (6) $E^{i...}_{\Delta T_0}$ by $t^{i...}_{\Delta T_0}$ and
- in equations (7) and (8) $E^{i...}_k$ by $t^{i...}_k$.

where:

$t^{i...}_k$ is the time measured in min and s according to 8.3.3.1 at the different $\Delta T^{i...}_k$ for the different heating function *ic, if* or *ih*;

$t^{i...}_{\Delta T_0}$ is the calculated nominal time in min and s for heating a load for the different heating function *ic, if* or *ih* at $\Delta T^{i...}_0$.

NOTE As an example for evaluation sheets see Annex C. A Microsoft Excel 97 evaluation program, which corresponds directly to annex C, is available with this standard for the automatic calculation of both energy consumption (8.3.4) and the time for heating the load (8.3.5).

These calculations can also be made in any other spreadsheet program under the condition that the same results are achieved.

9 Data to be reported

a) type of the oven, available heating function(s) according to 4.1 to 4.3;

b) usable volume of the oven in litres, according to 7.2;

c) usable surface area of the baking sheet or grid in cm^2, according to 7.2;

d) supply voltage at which the measurements were made;

e) tested functions or variant;

f) energy consumption for preheating the empty oven E_{ph}, according to 8.2, rounded off to the nearest kWh to two decimals; if the oven has an additional preheating setting the relevant value shall be reported too;

g) time for preheating of the empty oven t_{ph}, according to 8.2, if the oven has an additional preheating setting the relevant value shall be reported too; rounded off to the nearest half min;

h) energy consumption(s) in kWh to two decimals, according to 8.3.4;

i) time(s) in min, according to 8.3.5, rounded off to the nearest half min;

j) water absorption of the brick according to 8.3.2.

This data shall be reported for all heating functions (according to 4.1 to 4.3) as appropriate. For multiple cavity appliances the values shall be reported separately for each cavity.

10 Airborne acoustical noise

Under consideration.

11 Tolerances and control procedures

11.1 *Energy consumption with a load*

The energy consumption determined according to 8.3.4 shall not be greater than the value declared by the manufacturer plus 10% plus 0,040 kWh.

If the result of the test carried out on the first appliance is greater than the declared value plus 10 % plus 0,040 kWh 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 6 % plus 0,040 kWh.

11.2 *Energy consumption for pre-heating an empty oven*

The energy consumption determined according to 8.2 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 %.

11.3 *Preheating time of the empty oven*

The preheating time of the empty oven measured according to 8.2 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 %.

11.4 *Time for heating the load*

The time determined according to 8.3.5 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 %.

11.5 *Oven volume*

The volume determined according to clause 7 shall not differ from the value declared by the manufacturer plus or minus 5 %.

If the result of the test carried out on the first appliance differs from the declared value by more than plus or minus 5 %, the test shall be carried out on a further three appliances, which shall be randomly selected from the market.

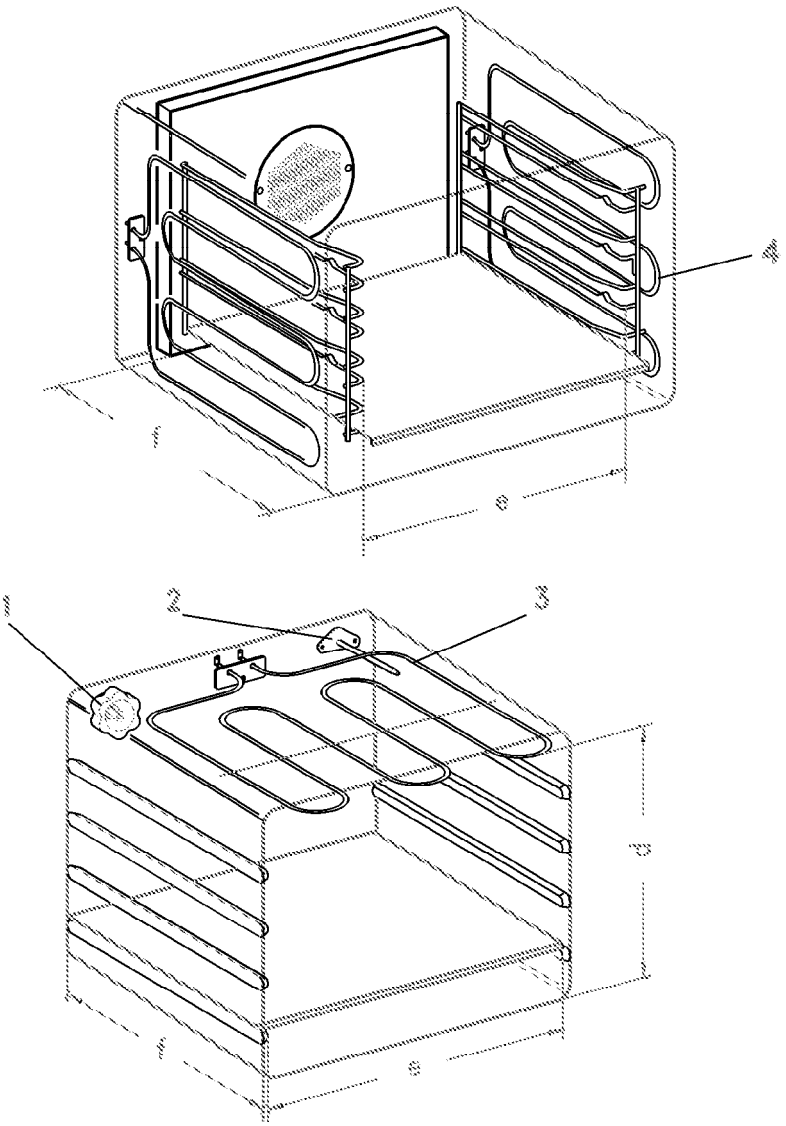
The arithmetical mean of the values of these three appliances shall not differ from the declared value by more than plus or minus 3 %.

11.6 *Surface area*

The surface area determined according to clause 7 shall not differ from the value declared by the manufacturer plus or minus 5 %.

If the result of the test carried out on the first appliance differs from the declared value by more than plus or minus 5 %, 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 differ from the declared value by more than plus or minus 3 %.



1	lamp	3	grill heating element
2	thermostat	4	oven heating element

d usable height between the upper and lower interior surfaces or heating elements

e usable width between the shelf support or heating elements

f usable depth between the interior rear surface and the inside surface of the closed door.

NOTE For ovens with forced air circulation, the depth is measured to any protecting grid, air duct or spacer on the rear side.

Figure 3 - Dimension of appliances
[IEC 60350:1999]

Annex A
(normative)

Description of the test brick

A.1 Specification

Name:	Hipor
Bulk density, dry:	(550 ± 40) kg/m³;
Total porosity:	77 %;
Dry weight:	(920 ± 75) g (without thermocouples), see 6.4;
Water absorption:	(1050 ± 50) g, see 8.3.2;
Height:	(64 ± 0,5) mm.

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

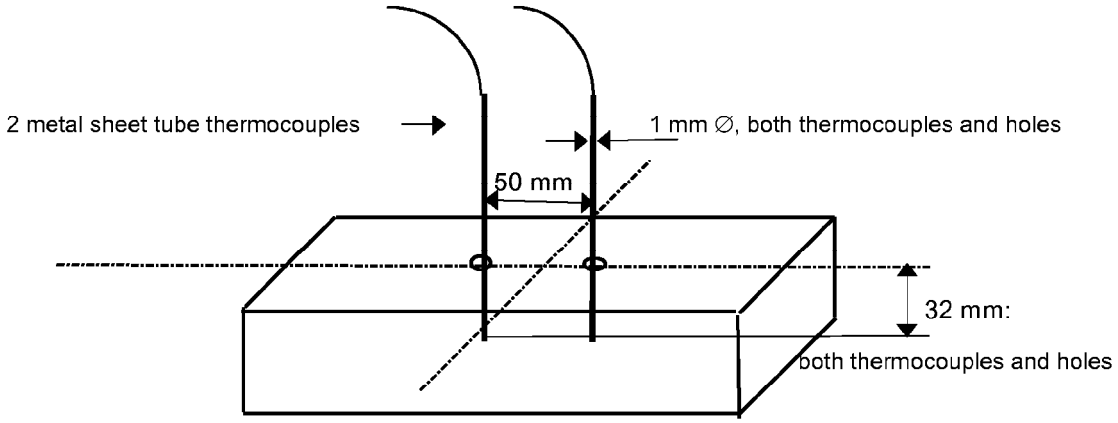
A.2 Supplier and Order Specification

SKAMOL INSULATION
Östergade 58 - 60
DK - 7900 Nyköbing Mors

For your order please state
- the brick name "Hipor", according to Electrolux agreement,
- length x width x height: 230 mm x 114 mm x 64 mm (see sketch in A.3),
- machined on all 6 surfaces, tolerances ± 0,5 mm.

NOTE According to Electrolux agreement a minimum of 126 bricks (at 22 DKK each) have to be ordered, (alternatively 168 bricks at 17 DKK each, 282 at 13 DKK each, 504 at 8 DKK each), prices from 01.09.99.

A.3 Position of the thermocouples



NOTE 1 The diameter of the hole need not and should not be bigger than the diameter of the thermocouple.

NOTE 2 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 and 32 mm long could serve as a drill.

Annex B
(informative)

Explanation of the formula subscripts

ph = pre-heat

R = room

T = temperature

0 = nominal value

t = time

1 = index to count measurement, for example 1 to 3

w = wet or water

d = dry

k = summing index

Explanation of the formula superscripts

i = heating mode

c = convection

f = forced air

h = hot steam

Annex C
(informative)

Calculation sheet: Energy consumption of electric ovens

Oven Type:		Factory & Brand:		Testlab:	
Voltage:	V	Usable Volume:	l	Operator:	
Standby Power:	W[1)]	Tray surface area:	cm²	Date:	

Funct on:	Conventional heating "ic"											Nominal temperature rise:	180 K
Preheating 180K	with load												
	Bricks							Measured		Room	Oven temperature		
Energy (kWh)	Time (min)	Nr.	dry weight m_d (g)	wet weight m_w (g)	absorbed water Δm (g)	end cooking weight (g)	weight loss (info.) (g)	start tempera-ture (°C)	E_k (kWh)	t_k (min)	average ambient temp. (°C)	Nominal value (K)	real value (°C)	real value (K)
--	--				calc.		calc.					*140 ±10*		calc.
					calc.		calc.					*180 ±10*		calc.
--	--				calc.		calc.					*220 ±10*		calc.
Results at 180 K							Slope S		Intercept B			Standard deviation	
Energy (linear regression)				(kWh)			Calc.		calc.			calc.	
Time (linear regression)				(min)			Calc.		calc.			calc.	

Funct on:	Forced air heating "if"											Nominal temperature rise:	155 K
Preheating 155K	with load												
	Bricks							Measured		Room	Oven temperature		
Energy (kWh)	Time (min)	Nr.	dry weight m_d (g)	wet weight m_w (g)	absorbed water Δm (g)	end cooking weight (g)	Weight loss (info.) (g)	start tempera-ture (°C)	E_k (kWh)	t_k (min)	average ambient temp. (°C)	nominal value (K)	real value (°C)	real value (K)
--	--				calc.		calc.					*135 ±10*		calc.
					calc.		calc.					*155 ±10*		calc.
--	--				calc.		calc.					*175 ±10*		calc.
Results at 155 K							Slope S		Intercept B			Standard deviation	
Energy (linear regression)				(kWh)			Calc.		calc.			calc.	
Time (linear regression)				(min)			Calc.		calc.			calc.	

[1)] Definition and measurement methods are under consideration.

Calculation sheet: Energy consumption of electric ovens (continued)

Oven Type:		Factory & Brand:		Testlab:	
Voltage:	V	Usable Volume:	l	Operator:	
Standby Power:	kW	Tray surface area	cm²	Date:	

Funct on:	Hot steam "ih"												Nominal temperature rise:	155 K
Preheating 155 K		with load												
		Bricks							Measured		Room	Oven temperature		
Energy (kWh)	Time (min)	Nr.	dry weight m_d (g)	wet weight m_w (g)	absorbed water Δm (g)	end cooking weight (g)	Weight loss (info.) (g)	start tempera-ture (°C)	E_k (kWh)	t_k (min)	average ambient temp. (°C)	nominal value (K)	real value (°C)	real value (K)
--	--				calc.		Calc.					*135 ±10*		calc.
					calc.		Calc.					*155 ±10*		calc.
--	--				calc.		Calc.					*175 ±10*		calc.

Results at 155 K		Slope S	Intercept B	Standard deviation
Energy (linear regression)	(kWh)	Calc.	calc.	calc.
Time (linear regression)	(min)	Calc.	calc.	calc.

Annex D
(informative)

Bibliography

IEC 61923:1997, Technical Report 3, *Household electrical appliances - Method of measuring performance - Assessment of repeatability and reproducibility*

Lothar Sachs, *Applied Statistics – A handbook of techniques, second edition.* Springer-Verlag, New York Berlin Heidelberg, 1984.

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