

INTERNATIONAL STANDARD



**Household electric cooking appliances –
Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring
performance**

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RVV

INTERNATIONAL STANDARD



**Household electric cooking appliances –
Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring
performance**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 97.040.20

ISBN 978-2-8322-6699-1

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	7
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	11
4 List of measurements	15
4.1 Dimensions and mass	15
4.2 Oven and combi steam oven	15
4.3 Steam oven and combi steam oven.....	15
4.4 Grill.....	15
4.5 Warming compartments	15
4.6 Cleaning	15
5 General conditions for the measurement	16
5.1 Test room	16
5.2 Electricity supply.....	16
5.3 Instrumentation	17
5.4 Positioning the appliance	18
5.5 Preheating	19
5.6 Setting of controls.....	19
5.7 Rounding	19
6 Dimensions and mass.....	19
6.1 Overall dimensions	19
6.2 ~~Usable~~ Internal dimensions and calculated volume	21
6.2.1 General	21
6.2.2 ~~Usable~~ Internal height.....	23
6.2.3 ~~Usable~~ Internal width	23
6.2.4 ~~Usable~~ Internal depth	23
6.2.5 Calculated volume	23
6.3 Overall internal dimensions and overall volume.....	24
6.3.1 General	24
6.3.2 Overall height (H)	24
6.3.3 Overall width (W)	24
6.3.4 Overall depth (D)	24
6.3.5 Overall volume of rectangular cavities	24
6.3.6 Overall volume of non-rectangular cavities	24
6.4 Dimensions of shelves and steaming accessories	24
6.5 Dimensions of grill grids.....	25
6.5.1 Entire area.....	25
6.5.2 Usable area	25
6.6 Dimensions of warming compartments	25
~~6.7 Level of shelf~~	~~25~~
6.7 Mass of the appliance	26
7 ~~Ovens and combi steam ovens~~ Preheating and accuracy.....	26
7.1 ~~General Purpose~~	26
7.2 Test setup.....	26
7.3 Preheating the empty oven	27
7.4 Accuracy of the control	27

7.4.1	Purpose	27
7.4.2	Measurements	27
7.4.3	Assessment	28
8	Energy consumption and time for heating a load	28
8.1	Purpose	28
8.2	Symbols and abbreviations	28
8.3	Test load	29
8.3.1	General	29
8.3.2	Pre-treatment	29
8.3.3	Preparation	30
8.4	Measurement	31
8.4.1	Test Procedure	35
~~7.4.4~~	~~Evaluation and calculation~~	~~35~~
~~7.4.5~~	~~Reporting of test results~~	~~35~~
8.4.2	Oven settings	39
8.4.3	Phase 1	40
8.4.4	Phase 2	41
8.5	Calculation	41
8.5.1	Smoothing the measured values	41
8.5.2	Determining the average temperature rise for a heating function (phase 2)	41
8.5.3	Determining the average temperature rise for an eco function (phase 2)	43
8.5.4	Calculation of average ambient temperature	45
8.5.5	Determining the <i>c</i> -factor	46
8.5.6	Determining the <i>s</i> -factor	46
8.6	Acceptance verification of the test results	47
8.6.1	Average temperature rise and standard deviation	47
8.6.2	Temperature setting and average temperature rise	48
8.6.3	<i>c</i> -factor	48
8.6.4	<i>s</i> -factor	48
8.7	Final electric energy consumption	48
8.8	Time for heating a load	49
8.9	Reporting of test results	49
9	Cooking tests	50
9.1	General	50
9.2	Heat distribution	50
9.2.1	Shortbread	50
9.2.2	Small cakes	52
9.3	Ability to supply heat	58
9.3.1	Fatless sponge cake	58
9.3.2	Apple pie	59
10	Steam ovens and combi steam ovens	61
10.1	Ability to supply steam	61
10.1.1	Purpose	61
10.1.2	Ingredients and steaming accessory	61
10.1.3	Procedure	61
10.1.4	Assessment	62
10.2	Distribution of steam	64
10.2.1	Purpose	64

10.2.2	Ingredients, steaming accessories and number of levels.....	64
10.2.3	Procedure.....	64
10.2.4	Assessment.....	65
10.3	Determination of the capacity.....	68
10.3.1	Purpose.....	68
10.3.2	Ingredients.....	68
10.3.3	Mass of peas, steaming accessories and number of levels.....	68
10.3.4	Procedure.....	69
10.3.5	Assessment.....	70
10.4	Accuracy of the temperature control.....	71
11	Effective grilling area.....	72
11.1	Purpose.....	72
11.2	Ingredients.....	72
11.3	Preparation.....	72
11.4	Procedure.....	72
11.5	Assessment.....	73
11.5.1	General.....	73
11.5.2	Criteria of validity.....	73
11.5.3	Criteria of assessment.....	73
12	Warming compartments.....	74
13	Cleaning.....	75
13.1	Pyrolytic self-cleaning ovens.....	75
13.2	Ovens with catalytic cleaning.....	75
14	Consumption measurement of low-power modes.....	75
14.1	Purpose and combination of appliances.....	75
14.2	Measurement.....	76
14.2.1	Principles.....	76
14.2.2	Determination of power consumption in off mode.....	77
14.2.3	Determination of power consumption in standby mode.....	77
14.2.4	Determination of power consumption in standby mode in condition of networked standby.....	78
14.2.5	Determination of power consumption in delay start.....	78
Annex A (normative)	Colour measuring instrument.....	79
~~Annex B (normative)~~	~~Brown shade charts.....~~	~~80~~
Annex B (informative)	Addresses of suppliers.....	82
B.1	General.....	82
B.2	Testing ingredients for small cakes.....	82
B.3	Food mixer.....	84
B.4	Colour measuring instrument.....	85
B.5	Steaming basket.....	85
Annex C (normative)	Description of the test brick.....	87
C.1	Specification.....	87
C.2	Supplier and order specification.....	87
Annex D (informative)	Check of applied microwave energy during the measurement according to Clause 8.....	95
D.1	General.....	95
D.2	Procedure.....	95

~~Annex E (informative) Data and calculation sheet: Energy consumption for heating a load (7.4)~~	
~~Annex F (normative) Green shade charts~~	
Annex E (informative) Marking the temperature setting for checking the oven temperature	96
Annex F (informative) Approach to calculate the f -factor	97
~~Annex G (informative) Measurement of the energy consumption of the cooling down period~~	
Annex G (normative) Low-power mode measurements	98
Bibliography	100
Figure 1 – Position of the thermocouple for measuring ambient temperature	16
Figure 2 – Dimensions of appliances	20
Figure 3 – Dimensions of built-in appliances	21
Figure 4 – ~~Usable~~ Internal dimensions	22
Figure 5 – Gauge for measuring these dimensions	22
~~Figure 6 – Device for checking the level of shelves~~	
Figure 6 – Examples for determining the entire area and usable area of a grill grid	25
Figure 7 – Example of a thermocouple ~~for the test of 7.4~~	30
Figure 8 – Entire process of measurement	37
Figure 9 – Installation observer thermocouple	38
Figure 10 – Vertical installation of the observer thermocouple	38
Figure 11 – Horizontal installation of the observer thermocouple	39
Figure 12 – Example – average temperature rise for a heating function	42
Figure 13 – Examples – set temperature reached	44
Figure 14 – Example – set temperature not reached	45
Figure 15 – Shape of the nozzle for extruding pastry	51
Figure 16 – Position of pastry strips on the baking ~~sheet~~ tray	51
~~Figure 10 – Convex colour sample~~	
Figure 17 – Template for the sectioning of small cakes	57
Figure 18 – Reference values of cooking time (t_{ref})	71
Figure 19 – Determining the assessable area of a slice of toast – Example	73
Figure A.1 – Colour measuring instrument	79
Figure C.1 – Position of the thermocouples	88
Figure D.1 – Filament lamp	95
Figure E.1 – Polar coordinate paper – Example	96
~~Table 1 – settings~~	
Table 1 – Instruments	18
Table 2 – Measurements	18
Table 3 – Symbols	28
Table 4 – Temperature rise for three settings	40
Table 5 – Ingredients	53
~~Table B.1 – Classification of shade numbers~~	

~~Table B.2 – Examples for the shade charts~~	~~83~~
Table B.1 – Ingredient specification	83
Table B.2 – Food mixer – revolutions per minute	84
Table B.3 – Mixing time and setting	84
~~Table F.1 – Specification of relevant green shade charts~~	~~84~~
~~Figure G.1 – Phases of energy consumption measurement – Example~~	~~84~~
Table G.1 – Step by step instruction for measuring low-power modes	98

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD ELECTRIC COOKING APPLIANCES –

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60350-1:2016+AMD1:2021 CSV. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60350-1 has been prepared by subcommittee 59K: Performance of household and similar electrical cooking appliances, of IEC technical committee 59: Performance of household and similar electrical appliances. It is an International Standard.

This third edition cancels and replaces the second edition published in 2016 and Interpretation Sheet 1:2021. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) new definitions for heating function, eco function and definitions relevant for low power mode considerations are amended in Clause 3;
- b) order of clauses is changed;
- c) revision of 5.3;
- d) update of 6.2 in order to improve the reliability of volume measurement;
- e) removal of 6.7, Level of shelf;
- f) revision of Clause 7 concerning the accuracy of **eco functions** with residual heat use;
- g) revision of Clause 8 in order to improve the reliability of the method for measuring the energy consumption, especially regarding anti-circumvention;
- h) unique energy consumption measurement for all **heating functions** and **eco functions** with an indication of the energy consumption for a temperature increase of 165 K (compared to 155 K currently for forced air circulation function, for example), which results in higher energy consumption values compared to the previous edition;
- i) R_y replaced by L^* in Clause 9 and reference to IEC TS 63350;
- j) cooking time for reference measurement introduced for broccoli in Clause 10;
- k) yellow part replaced by hue angle value in Clause 10;
- l) requirements for digital assessment (see former 7.5.3.6.3) are obsolete as specified in IEC TS 63350;
- m) revision of Clause 14 (Consumption measurement of low power modes, previous Clause 12);
- n) former Annex G (informative) is cancelled due to the fact that this method for measuring an associated activity has been not applied;
- o) former Annexes B and F are obsolete, up-to-date shade charts are specified in IEC TS 63350;
- p) former Annex E will be substituted by a supporting document located on the IEC's website.

The document contains supplementary material highlighted by notes indicating the link.

The text of this International Standard is based on the following documents:

Draft	Report on voting
59K/365/FDIS	59K/370/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

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

A list of all parts in the IEC 60350 series, published under the general title *Household electric cooking appliances*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

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.

NOTE 1 This document is also applicable to portable appliances with similar functionalities that were previously covered by the withdrawn IEC 61817.

The **ovens** covered by this document ~~may~~ can be with or without microwave function.

Manufacturers ~~should~~ are expected to define the primary cooking function of the appliance – microwave function or thermal heat. The primary cooking function ~~should be~~ is 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.

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

NOTE 2 For measurement of energy consumption and time for heating a load (see Clause 8), this document is furthermore not applicable to:

- microwave combination function;
- **ovens** with reciprocating trays or turntable;
- **small cavity ovens** (see 3.16);
- **ovens** without adjustable temperature control;
- **heating functions and eco functions** other than defined in this document;
- appliances with only solo **steam function**.

NOTE 3 This document does not apply to

- microwave ovens (IEC 60705).

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

This document does not specify a classification or ranking for performance.

~~NOTE 3 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 4 This document does not deal with safety requirements (IEC 60335-2-6 and IEC 60335-2-9).

NOTE 5 Appliances covered by this document ~~may~~ can be built-in or for placing on a working surface or the floor.

NOTE 6 There is no measurement method for the energy consumption for grilling and **steam functions** available.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, Thermocouples – Part 2: Tolerances~~

IEC 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 62301:2011, *Household electrical appliances – Measurement of standby power*

IEC TS 63350:2022, *Household electrical appliances – Specification of the properties of a digital system for measuring the performance*

IEC 63474¹, *Electrical and electronic household and office equipment – Measurement of networked standby power consumption of edge equipment*

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

~~CIE 15, Colorimetry~~

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

active mode

mode in which the appliance is connected to a mains power source, has been activated, and is performing any of the intended functions

EXAMPLE Producing heat transfer by thermal heat, electromagnetic energy or condensation

Note 1 to entry: Examples of recognised associated functions include displaying recipes, running an egg timer, software download, running a cooling fan and the like.

3.2

combi steam oven

appliance or compartment of a **cooking range** in which food is cooked by a combination of **oven** and **steam oven**

Note 1 to entry: Appliances with only a steam assist function also exist. For these **ovens**, the **steam function** can only be tested if this function is described in the instruction manual or if the appliance provides a setting for **steam function**.

Note 2 to entry: The term "steam" does not refer to the evaporated water from the food.

3.3

cooking range

appliance having a **hob** and at least one **oven** and which ~~may~~ can incorporate a **grill**

¹ Under preparation. Stage at the time of publication: IEC CDV 63474:2022.

3.4

delay start

condition where the user has selected a specified delay to the beginning of any **active mode**

Note 1 to entry: This mode is only applicable if the appliance provides a delay start function for the user.

3.5

eco function

heat transmission by natural air circulation, forced air circulation or radiation for certain applications using efficient technical solutions

EXAMPLE Technical solutions:

- residual heat usage;
- low-power heating;
- or a combination of both.

3.6

grill

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

3.7

heating function

heat transmission by natural or forced air circulation, or radiation for baking and roasting

EXAMPLE

- Forced air circulation function which heats food mainly by circulating the air with the aid of a fan;
- conventional **heating function** which heats food mainly by natural convection of the air;
- or a combination of both functions.

Note 1 to entry: Heat transmission by steam or by microwave power, also in combination with any **heating function**, is excluded.

3.8

hob

cooktop

appliance or part of an appliance which incorporates one or more **cooking zones** and/or **cooking areas** including a **control** unit

Note 1 to entry: The **control** unit can be included in the **hob** itself or integrated in a **cooking range**.

3.9

hot steam function

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

3.10

multiple cavity appliance

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

3.11

network

communication infrastructure with a topology of links, an architecture, including the physical components, organizational principles, communication procedures and formats (protocols)

3.12

off mode

condition in which the appliance is connected to the mains and is not providing any **active mode** or **standby mode** and where the mode can persist for an indefinite time

Note 1 to entry: The following shall also be considered as **off mode**:

- a) conditions providing only an indication of **off mode**;
- b) conditions providing only functionalities intended to ensure electromagnetic compatibility.

3.13

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

3.14

oven thermostat

device or sensor that detects the temperature inside the cavity in order to control the set temperature

3.15

oven with catalytic cleaning

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

3.16

small cavity oven

oven with the following dimensions:

- both ~~usable~~ internal width and ~~usable~~ internal depth are < 250 mm, or
- either one of internal width and internal depth is < 120 mm. or
- ~~usable~~ internal height is < 120 mm

Note 1 to entry: The defined maximum size of small cavity **ovens** in this document is ~~due~~ adapted to the size of the test load used in Clause 8.

3.17

standby mode

condition where the appliance is connected to the mains and provides only the following functions, which can persist for an indefinite duration:

- (a) reactivation function, or reactivation function and a mere indication of enabled reactivation function;
- (b) information or status display;
- (c) detection function for emergency measures.

3.18

standby mode in condition of networked standby

condition where the appliance is connected to the mains and provides only the reactivation function through a connection to a **network**, which can persist for an indefinite duration

Note 1 to entry: This mode is only applicable to appliances that provide a connection function to a **network**.

3.19

pyrolytic self-cleaning oven

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

3.20

steam oven

appliance or compartment of a **cooking range** in which food is cooked mainly by steam condensation at ambient pressure

Note 1 to entry: Appliances are fitted with their own steam generator.

Note 2 to entry: The term "steam" does not refer to the evaporated water from the food.

3.21

steam function

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

3.22

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

3.12

conventional heating function

~~heat transmission to the food by radiation and natural convection only~~

Note 1 to entry: ~~This does not include conventional heating functions which operate a top heating element only (i.e. grill element).~~

3.13

forced air circulation function

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

Note 1 to entry: ~~This does not include circulated air functions which operate a top heating element only (i.e. grill element).~~

3.16

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~~

3.17

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 such as empty the water tank, remove the food, close the door, etc., have to be taken.~~

Note 2 to entry: ~~For the definition of off mode IEC 62301 is relevant.~~

3.18

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 the definition of standby mode IEC 62301 is relevant.~~

4 List of measurements

4.1 Dimensions and mass

The following measurements are carried out:

- overall dimensions (see 6.1);
- internal dimensions (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 6.7).

4.2 Oven and combi steam oven

The following measurements are carried out:

- preheating the empty **oven** (see 7.3);
- accuracy of the control (see 7.4);
- energy consumption and time for heating a load (see Clause 8);
- heat distribution (see 9.2);
- ability to supply heat (see 9.3).

4.3 Steam oven and combi steam oven

The following measurements are carried out:

- ability to supply steam (see 10.1);
- distribution of steam (see 10.2);
- determination of the capacity (see 10.3).

4.4 Grill

The following measurements are carried out:

- grilling area (see Clause 11);
- ~~grilling (see 9.3).~~

4.5 Warming compartments

The following measurements are carried out:

- temperature control and energy consumption (see Clause 12).

4.6 Cleaning

The following measurements are carried out:

- cleaning of pyrolytic self-cleaning **ovens** (see 13.1);
- cleaning of **ovens** with catalytic cleaning (see 13.2).

5 General conditions for the measurement

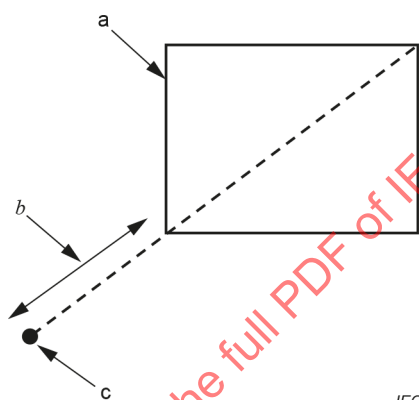
5.1 Test room

The tests are carried out in a substantially draught-free room in which the ambient temperature is maintained at $(20 \pm 5 \text{ } 23 \pm 2) \text{ }^{\circ}\text{C}$.

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

For the tests specified in 9.2.1, 9.3.1, 9.3.2, Clause 10 and Clause 11, maintaining the ambient temperature at $(25 \pm 5) \text{ }^{\circ}\text{C}$ is sufficient.

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 under test and at a distance of 0,5 m diagonally from one of the front edges of the appliance (see Figure 1).



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 $\pm 1 \text{ } \%$.

~~For tests 7.2, 7.4 and 7.5.3:~~

- the supply voltage shall be maintained at the main terminal at the rated voltage $\pm 1 \text{ } \%$, while the heating elements are switched on;
- the supply frequency shall be at the rated frequency $\pm 1 \text{ } \%$ throughout the test. If a frequency range is indicated, then the test frequency shall be the nominal frequency of the country in which the appliance is intended to be used.

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.

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

~~For Clause 12 and Annex G, the power measurement requirements shall be in accordance with IEC 62301.~~

5.3 Instrumentation

~~The temperature measuring instrument including thermocouples shall have an accuracy of $\pm 0,5$ K within the temperature range of 0°C to 100°C and an accuracy of ± 2 K within the temperature range 100°C to 300°C .~~

~~The energy measuring meter shall have an accuracy of $\pm 1\%$ of the reading.~~

~~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 7.4) are made with two thermocouples with a 1 mm steel tube diameter, class 1 according to IEC 60584-2. The thermocouple shall be accurate to $\pm 1,5$ K;~~

~~NOTE— The steel tube of the thermocouple eases the insertion of the thermocouple into the brick. Other types of thermocouples can be used provided they are shown to give the same results. The measuring point is the first contact point of the two thermo-wires.~~

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

~~For tests according to Clause 8 the temperature measurements in the load are made with a 0,5 mm steel tube diameter, class 1 according to IEC 60584-2. The thermocouple shall be accurate to $\pm 1,5$ K.~~

~~For Clause 12 and Annex G, the measurement requirements shall be in accordance with IEC 62301.~~

Instruments used and measurements made for this document shall comply with the specifications in Table 1 and Table 2.

Table 1 – Instruments

Parameter	Unit	Minimum resolution	Maximum permissible error	Details / Additional requirements
Mass	g			
≤ 3 000 g		0,1 g	± 0,1 g	
> 3 000 g		0,5 g	± 3 g	
Temperature (thermocouples)				
• ambient temperature	°C	0,1 °C	± 0,5 K	Thermocouple with welded point
• temperature in the cavity in a range of 0 °C to 100 °C	°C	0,1 °C	± 0,5 K	Thermocouple with welded point (suitable to measurements inside of ovens with wet-steam functions)
• temperature in the cavity in a range of 100 °C to 300 °C	°C	0,1 °C	± 2,5 K	Thermocouple with welded point.
• centre temperature of the brick	°C	0,1 °C	± 1,5 K	1 mm steel tube thermocouple, class 1 in accordance with IEC 60584-1.
Dimensions	mm	1 mm	1 mm	≤ 1 mm or 0,5 % whatever is the greater
Time	s	1 s	± 1 s per hour	

Table 2 – Measurements

Parameter	Unit	Maximum permissible error	Additional requirements
Voltage	V	± 0,5 %	Measured value.
Energy consumption measurement	Wh	± 1,5 % or ± 10 Wh	Whichever is greater
Temperature measurement	°C	± 1,0 K	Excluding the thermocouples Sampling rate ≤ 1 s
For Clause 14, the power measurement requirements shall be in accordance with IEC 62301		-	In accordance with IEC 62301

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 installation of the appliance ~~it should be ensured that~~, the surface ~~is~~ shall be horizontal.

~~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 m³/h.~~

~~NOTE — The condition of measurement for **ovens** with integrated air extraction is similar to that in IEC 61591.~~

When the appliance is connected to the mains for the first time, it shall be operated once on any setting for at least 1 h before the energy consumption is measured in order to avoid changes in the appliance's performance or consumption values when tested 'out-of-the-box' compared to some time later at the same settings.

If the appliance is disconnected from the mains, it shall be ensured that required basic settings, like the time, are set and finalized before starting the measurement.

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.

~~The appliance is operated for all tests in the delivery status with unchanged default settings. Ensure that no network is connected to the appliance for the duration of the measurement.~~

All tests, except the measurements for low-power modes (see Clause 14), shall be carried out:

- with the default factory settings;
- ensuring that no **network** is connected to the appliance for the duration of the measurement.

Using any modes and controls, resulting in measurements that are unrepresentative of the appliance's true characteristics that can occur during baking and roasting under comparable conditions are not allowed.

EXAMPLE A camera used to detect that the appliance is under test is not allowed.

5.7 Rounding

~~If it is required that~~ numbers ~~are~~ shall be rounded, they shall be rounded in accordance with ISO 80000-1:2009, Clause B.3, rule B.

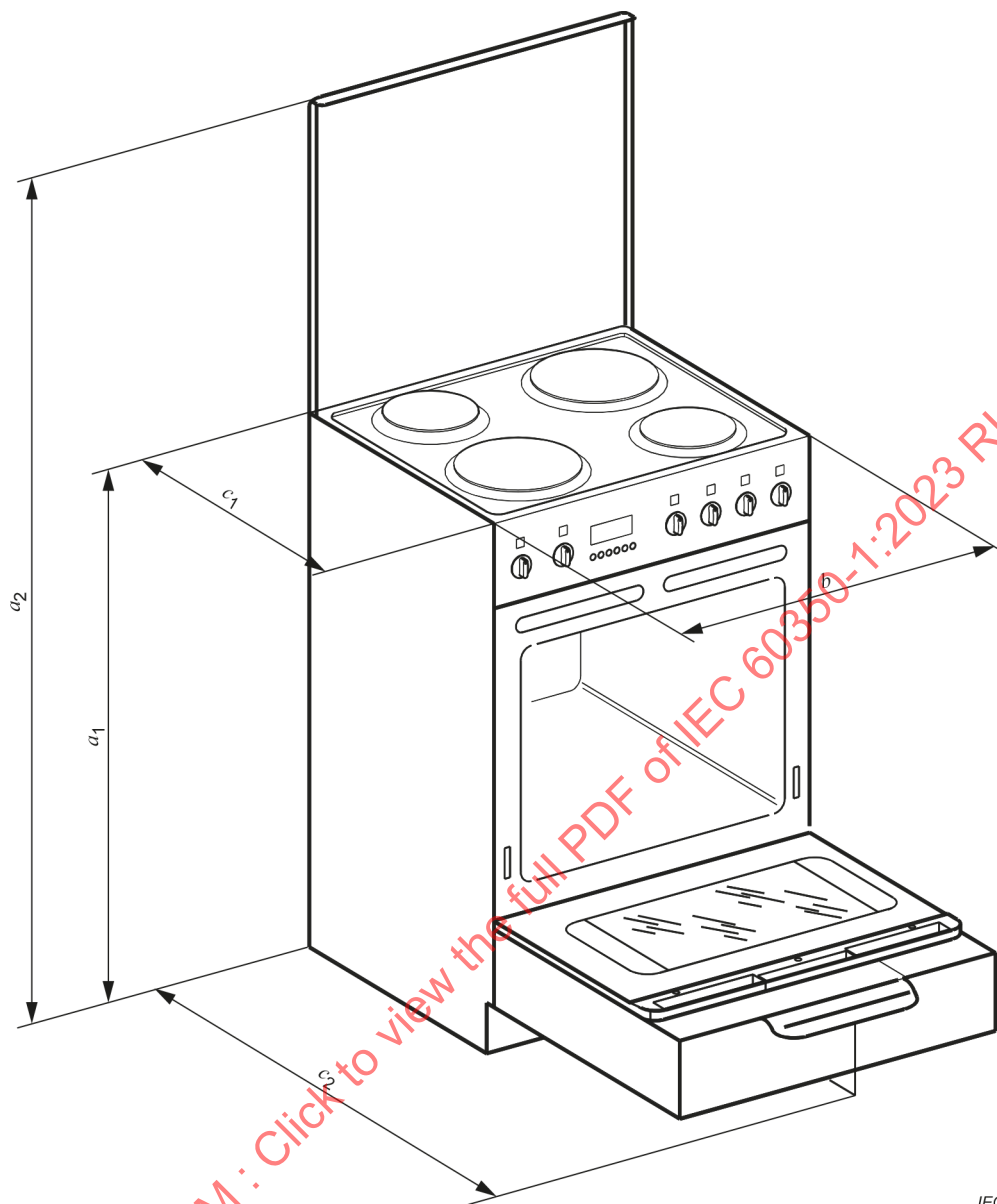
6 Dimensions and mass

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.

Built-in **ovens** are measured as shown in Figure 3.



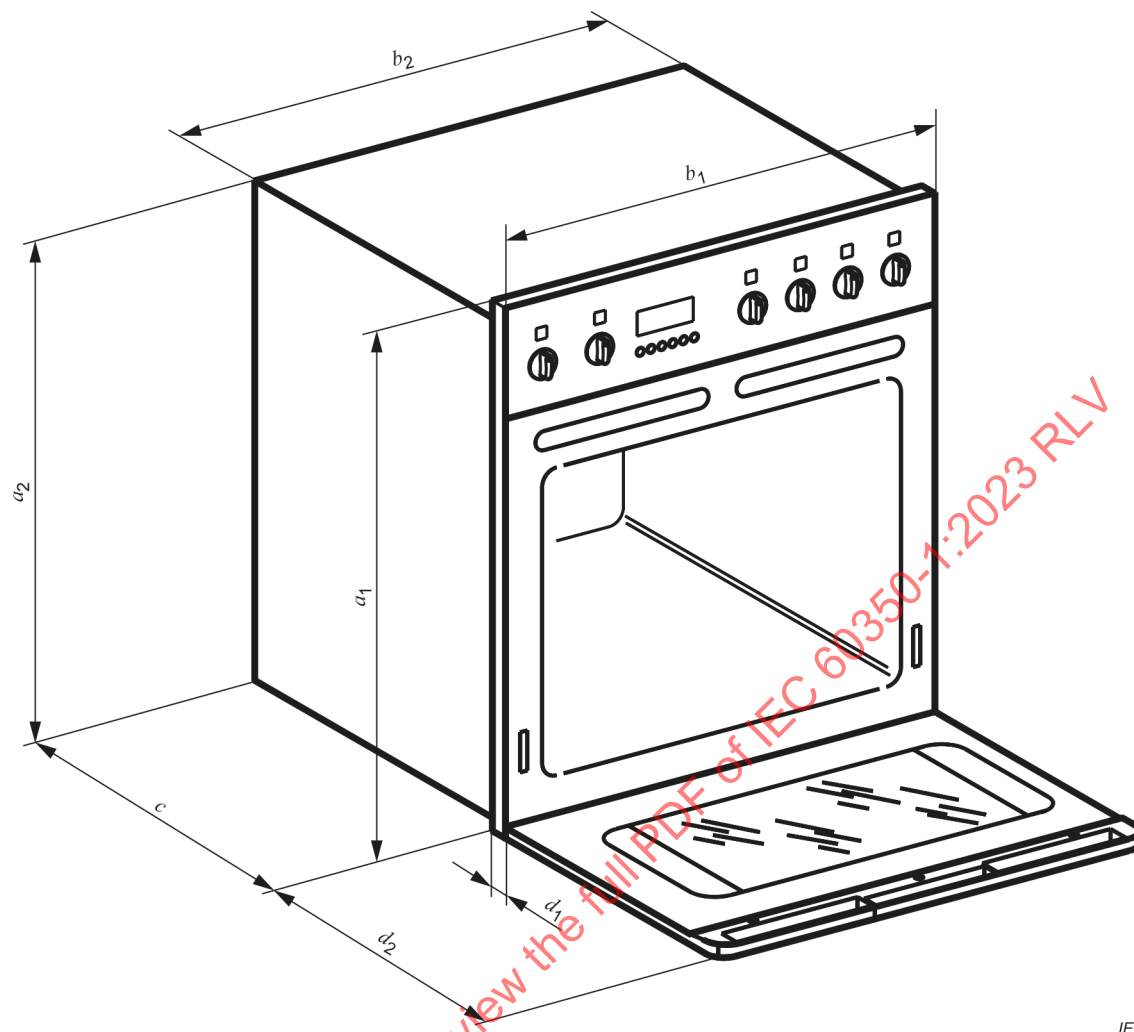
IEC

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

Key

- a_1 height from the supporting surface to the **hob** surface
- 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



IEC

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 appliances**6.2 Usable Internal dimensions and calculated volume****6.2.1 General**

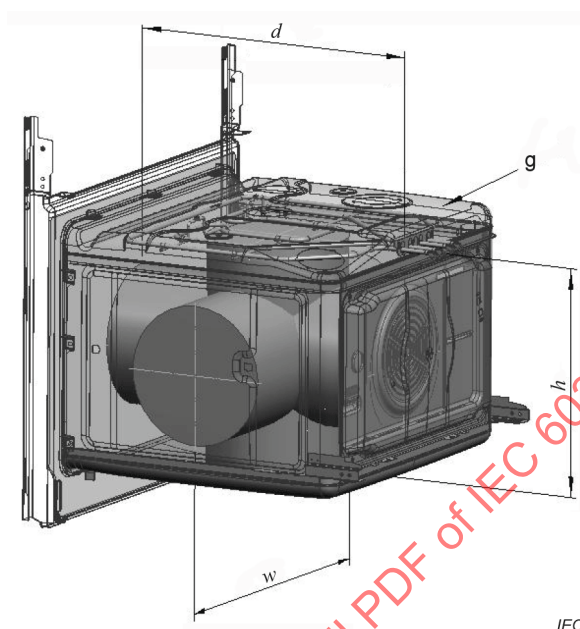
~~Removable items specified in the user instructions to be not essential for the operation of the appliance in the manner for which it is intended shall be removed before measurement is carried out.~~

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

The measurement of the calculated 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 measurements are shown in Figure 4.

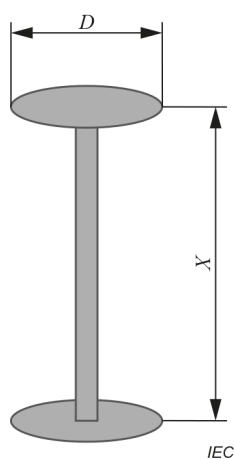
For verification purposes, the gauge shown in Figure 5, shall be used to determine all three dimensions. The gauge shall be used without appreciable force. Dimensions are stated in millimetres.



Key

- d ~~usable~~ depth
- g heating element
- h ~~usable~~ height
- w ~~usable~~ width

Figure 4 – ~~Usable~~ Internal dimensions



Key

- $D = 200 \text{ mm or } 120 \text{ mm}$
- $X = \text{dimension to be measured}$

Figure 5 – Gauge for measuring these dimensions

6.2.2 Usable Internal 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.~~ No accessories, such as a grill grid, are inserted.

A lamp, a heating element or similar object in the area of the cylinder can constitute the lowest point of the ceiling. Protruding parts such as lamp covers, heating elements and fixing hooks shall not be removed or folded away.

If 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~~ internal depth and the middle of the ~~usable~~ internal width.

6.2.3 Usable Internal width

The ~~usable~~ internal 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.

Side racks shall be removed if they can be removed without a tool. If parts are fixed to or by the side racks, they shall be removed as well.

NOTE 1 A coin or a spoon is not considered as a tool.

If 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 2 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 Internal 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.

Protruding parts such as the baffle or components of the door shall not be removed.

If 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~~ internal 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 ~~full~~ the nearest litre.

6.3 Overall internal dimensions and overall volume

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.

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 and steaming accessories

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 cm².

NOTE The shelf can be a baking ~~sheet~~ tray or a steaming accessory.

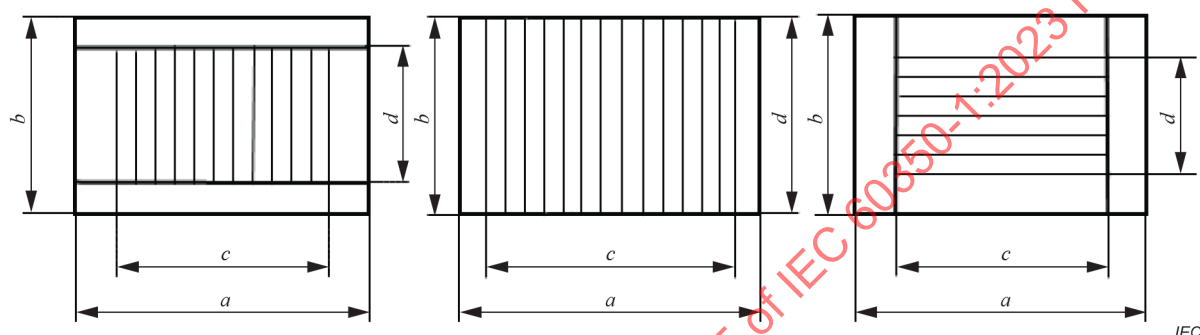
6.5 Dimensions of grill grids

6.5.1 Entire area

The entire area of the grill grid is determined by measuring the maximum width and the maximum depth of the outer rods. This entire area of the grill grid is calculated and stated in square centimetres, rounded to 10 cm².

6.5.2 Usable area

The usable width and usable depth of the grill grid are measured, by considering only the inner grid, which is suitable for placing food. The usable area of the grill grid is calculated and stated in square centimetres, rounded to 10 cm². See Figure 6.



Key

- a is the maximum width of the grill grid
- b is the maximum depth of the grill grid
- c is the usable width of the grill grid
- d is the usable depth of the grill grid

Figure 6 – Examples for determining the entire area and usable area of a grill grid

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 can 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 6. 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.~~

~~For the measurement of the level of shelves the same devices as for hotplates are used (see IEC 60350-2).~~

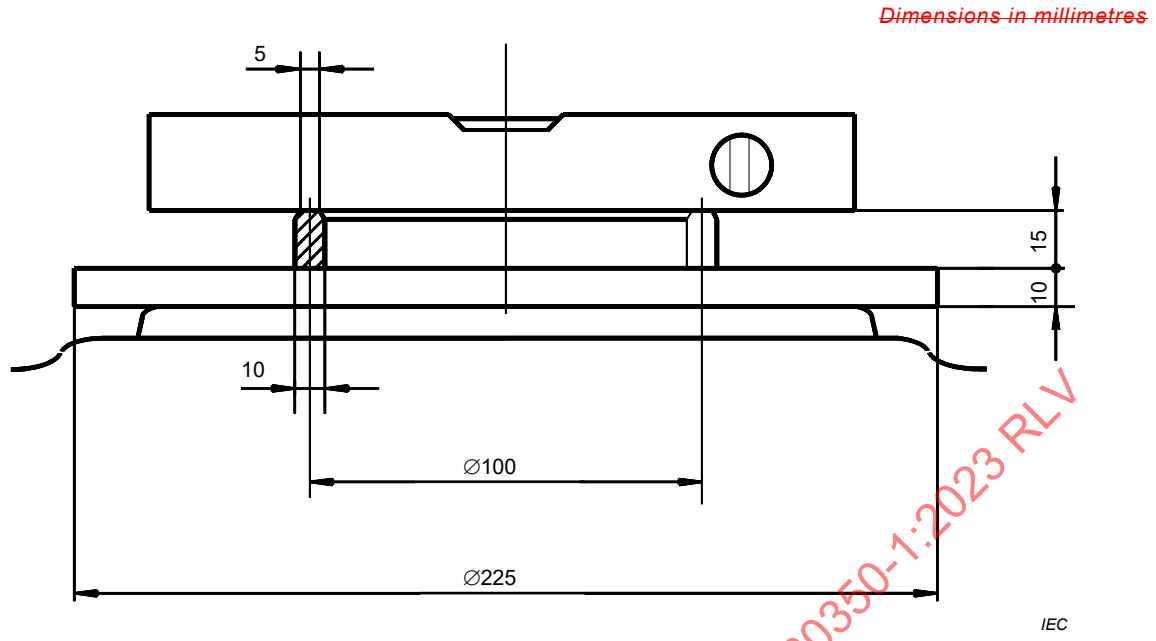


Figure 6 – Device for checking the level of shelves

~~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.~~

6.7 Mass of the appliance

The mass of the appliance ~~including only the accessory which is used to perform the test of 7.4~~ is determined and expressed in kilogrammes, rounded to the nearest kilogramme. ~~To determine the mass, only the accessory described in the test in Clause 8 shall be considered.~~

7 ~~Ovens and combi steam ovens~~ Preheating and accuracy

7.1 ~~General Purpose~~

The purpose of the tests in Clause 7 is to assess the performance of the **oven** and **combi steam oven** in relation to preheating, ~~and functioning of the control, and energy consumption.~~ ~~The performance is also assessed by means of cooking tests.~~

7.2 Test setup

The air temperature in the empty **oven** and **combi steam oven** is measured with a thermocouple ~~according that conforms to the criteria specified in 5.3~~ fixed to the grid that is delivered with the appliance. It is 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.

If no grid can be purchased from the manufacturer of the appliance, the thermocouple ~~should~~ **shall** 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.

~~It is essential that~~ The door ~~is~~ **shall** be completely closed.

~~The baking tests of Clause 7 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.~~

7.3 Preheating the empty oven

The purpose of this test is to measure the energy consumption and time it takes to preheat an empty **oven** or **combi steam 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~~ shall be measured separately. Only the cavity measured shall be switched on.

A **heating function**, **eco function** or **hot steam function** shall be selected. The temperature control is set ~~at~~ to the maximum position ~~for each function~~. The appliance is heated until the rise ~~is~~ reaches 165 K.

~~— 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_{ph} (t_{ph} means preheating) in minutes and seconds and the energy consumption E_{ph} in kWh shall be measured.

The time for preheating of the empty **oven**, t_{ph} , shall be reported and rounded to the nearest half minute.

The energy consumption for preheating the empty **oven**, E_{ph} , shall be reported in kWh and rounded to ~~the nearest kWh to two decimals~~ **two decimal spaces**.

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

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

7.4 Accuracy of the control

7.4.1 Purpose

The purpose of this test is to determine the accuracy of the temperature control and to calculate the corrected temperature setting used for tests for Clause 9.

7.4.2 Measurements

Prior to the measurements, the whole appliance shall be at ambient temperature of $(23 \pm 2) ^\circ\text{C}$.

The temperature control element is set to the position marked $150 ^\circ\text{C}$ and the appliance is heated for $t_{\text{check}, 150} = 60 \text{ min}$. Then the temperature control element is set to the position marked $200 ^\circ\text{C}$ and the appliance is heated for further $t_{\text{check}, 200} = 60 \text{ min}$. Then the temperature control element is set to the position marked $250 ^\circ\text{C}$ and the appliance is heated for a further $t_{\text{check}, 250} = 60 \text{ min}$.

Markings of the control element for grilling are ignored. If 250 °C is not marked, the next higher marked setting is taken into account. If the highest marked setting is below 250 °C, the highest possible marked setting ~~has to~~ shall be chosen. If the control element is not marked in degrees Celsius, the control element is set at appropriate markings taking into account the instructions for use.

Measurements ~~are~~ shall be performed without fast preheating function.

The **oven** temperature is recorded continuously in line with 7.2.

~~The **oven** temperature is respectively determined as the arithmetic mean of the minimum and maximum temperature reached during the last 20 min of t_{check} .~~

~~The arithmetic mean of the **oven** temperature and the minimum and maximum temperatures are noted for each setting.~~

7.4.3 Assessment

For assessing the accuracy of control, the deviations from each set temperature (V_{150} , V_{200} , V_{250}) to the **oven** temperatures are determined where the **oven** temperature is the arithmetic mean during the last 20 min of t_{check} .

Regarding the corrected temperature setting used for the tests in Clause 9, the level of the deviations V_{150} , V_{200} and V_{250} are decisive. The temperature setting used for tests in Clause 9 shall only be corrected if all deviations V_{150} , V_{200} and V_{250} are < 20 K.

NOTE Deviations equal to or more than 20 K are not corrected because the device is assumed to have an **eco function** that uses residual heat.

To calculate the corrected temperature setting for the tests in Clause 9, the **oven** temperatures T_{150} and T_{200} are used and linear regression is applied.

8 Energy consumption and time for heating a load

8.1 Purpose

The purpose of this test is to measure the energy consumption and the time for heating a load for a given **heating function** or an **eco function** in an **oven**, **combi steam oven** and combi microwave oven. The load is a water-saturated brick ~~which simulates both the thermal properties and the water content of food (e.g. meat)~~ that is representative of any food, e.g. a roast dinner.

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

8.2 Symbols and abbreviations

Table 3 shows the main symbols used in Clause 8.

Table 3 – Symbols

$T_{s,k}$	temperature setting displayed by a knob or by the control display, s is the setting and $k = 1, 2, 3$ (summing index)
$T_{o1,k} / T_{o2,k}$	measured observer temperature in phase 1 or phase 2

$T_{a1,k} / T_{a2,k}$	measured ambient temperature in phase 1 or phase 2
$T_{c2,k}$	measured temperature in the cavity centre in phase 2
$\Delta \bar{T}_{c2,1}$	average temperature rise as difference between the average ambient temperature and the cavity temperature measured in phase 2
$\bar{T}_{c2,k}$	measured temperature in the cavity centre in phase 2, smoothed
$\bar{T}_{c2,k}$	average temperature in the cavity centre in phase 2
E_k	measured energy consumption in phase 1, when the last of the two thermocouples in the brick reaches a temperature rise of 55 K
t_k	measured time in phase 1, when the last of the two thermocouples in the brick reaches a temperature rise of 55 K, also applied for phase 2
t_0	start time of phase 1 or phase 2
i_s	start index determined to calculate $\Delta \bar{T}_{c2,1}$ and $\bar{T}_{c2,k}$; i_s depends on the oven function and the temperature profile
c_k	ratio between the observer temperatures measured in phase 1 and in phase 2 in the whole phase (t_0 to t_k)
s_k	ratio between the observer temperatures measured in phase 1 and in phase 2 in the last 20 min of the whole phase (t_0 to t_k)
$\Delta T_{s,k}$	difference between temperature setting T_s and average temperature $\bar{T}_{c2,k}$ in the cavity centre in phase 2
$E_{\Delta T_0}$	calculated nominal energy consumption in kWh for heating a load at ΔT_0
ΔT_0	nominal temperature rise; 165 K for all heating functions and eco functions
$t_{\Delta T_0}$	calculated nominal time in s for heating a load at $\Delta T_0 = 165$ K for all heating functions or eco functions

8.3 Test load

8.3.1 General

The test load shall be a brick with two holes for temperature measurements, as shown in Annex C.

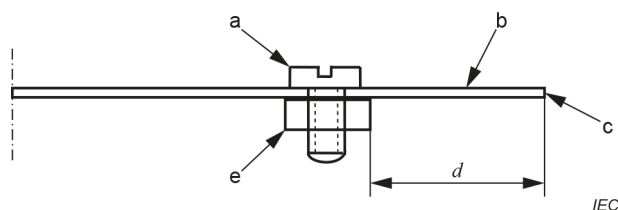
8.3.2 Pre-treatment

A new brick shall be dried before using it for the first time in an **oven** of about 50 l volume with a forced air circulation function at ≥ 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 that is still damp due to a previous test needs at least 8 h to be dried as described above. However, see Note 1 in 8.3.3.

The weight m_d ($_d$ means dry) 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 C.1. The brick shall be identified for accurate calculation of the water absorption in accordance with 8.3.3.

Place markings 32 mm from the measuring point of the two thermocouples in accordance with 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. See the example in Figure 7.



Key

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

Figure 7 – Example of a thermocouple ~~for the test of 7.4~~

The thermocouples may be fixed by means of a droplet of silicon glue at the surface of the brick or by other suitable means.

Owing to the porosity of the brick, ~~care should be taken~~ ensure that the holes of the brick are not enlarged if the thermocouples are removed and reinserted.

NOTE 2 A brick can be used for about twenty tests when handled with normal care.

8.3.3 Preparation

The brick, pre-treated in accordance with 8.3.2, 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 ± 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.

Between test series, the brick should be stored in a refrigerator and preferably not soaked with water. The water used for soaking the brick ~~soaking water~~ should be kept (to reduce dissolving processes), i.e. the brick's storage water can be reused.

After the brick has been taken out of the water container, excessive water is allowed to drip off for 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_w means wet or water; m_d is measured according to 8.3.2). The amount of absorbed water shall be as specified in Clause D.1.

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

8.4 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).~~

~~In case an oven has several variants of the functions as described in 3.12 to 3.14, the manufacturer can choose the variant to be tested. This should be reported (see 7.4.4). Make sure that the function used is not combined with a 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 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 appliance so that the centre of the brick comes as close as possible to the centre but not higher than the centre of the calculated cavity. The longest axis of the brick shall be parallel with the appliance front.~~

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

~~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.~~

~~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 appliance 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 $\frac{\Delta T_k^i}{k}$ as defined in Table 1 can be expected. $\frac{\Delta T_k^i}{k}$ is the difference between the average ambient temperature and the actual oven temperature (measured in 7.4.3.2); $k = 1, 2, 3$ (k is the summing index, i is the heating function).~~

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

~~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 I).~~

~~If the temperature is set by a knob, the knob should always be turned from zero to the required setting.~~

~~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 appliance) and when the last of the two thermocouples in the brick has reached a centre temperature rise of 55 K.~~

Table 1 — settings

temperature rise	Heating functions		
	Conventional (ie)	Forced air circulation (if)	Hot steam (ih)
ΔT_1^i	(140 ± 10) K	(135 ± 10) K	(135 ± 10) K
ΔT_2^i	(180 ± 10) K	(155 ± 10) K	(155 ± 10) K
ΔT_3^i	(220 ± 10) K ^a	(175 ± 10) K ^a	(175 ± 10) K ^a
^a —or the maximum temperature rise if this value cannot be reached.			

The following data is measured:

- the energy consumption(s) E_k^i in kWh and the time(s) t_k^i 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 appliance 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 appliance, is included in the measurement.

7.4.3.2 — Checking the oven temperature

After the test according to 7.4.3.1, the brick is removed from the appliance and the appliance is run without changing the setting for $t_{\text{check}} = 60$ min. The oven temperature $T_{k,\text{measured}}^i$ is determined in line with 7.1 as the arithmetic mean between the maximum and minimum temperatures reached during the last 20 min of t_{check} .

The measured oven temperature $T_{k,\text{measured}}^i$ is stated.

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

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

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

$\Delta T_{k,\text{setting}}^i$ shall be ≤ 20 K.

If $\Delta T_{k,\text{setting}}^i > 20 \text{ K}$ 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 The tolerance of 20 K is needed due to the long chain of tolerances (e.g. thermostat, connection, power of heating elements, control element and printing) and the fact that the temperature scale covers different heating functions.

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 $\Delta T_k^{i\cdots}$ are within the temperatures specified in Table 1, and
- b) the standard deviation $\sigma^{i\cdots}$ as defined in equation (1) is below 0,050 kWh.

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

The standard deviation $\sigma^{i\cdots}$ is calculated from the data pairs $\Delta T_k^{i\cdots} / E_k^{i\cdots}$ measured according to 7.3.2.1 and calculated according to equation (1) for each tested function, $k = 1, 2, 3$ (see Sachs²⁾).

$$\sigma^{i\cdots} = 1,2 \sqrt{\frac{Q_y^{i\cdots} - (Q_x^{i\cdots})^2 / Q_x^{i\cdots}}{n - 2}} \quad (3)$$

where

n is the number of measuring points (for the purposes of this standard, $n = 3$);

1,2 is an approximation factor for f .

NOTE For the purpose of this standard, $\Delta T_k^{i\cdots}$ can only vary between 125 K and 185 K for **forced air circulation** and **hot steam functions** resulting in factor f 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.

$$f^{i\cdots} = \sqrt{1 + \frac{1}{n} + \frac{(T_0^{i\cdots} - \Delta T^{i\cdots})^2}{Q_x^{i\cdots}}} \quad (4)$$

$$Q_y^{i\cdots} = \sum_{k=1}^n (E_k^{i\cdots})^2 - \frac{\left(\sum_{k=1}^n E_k^{i\cdots} \right)^2}{n} \quad (5)$$

$$Q_{xy}^{i\cdots} = \sum_{k=1}^n \Delta T_k^{i\cdots} E_k^{i\cdots} - \frac{\sum_{k=1}^n \Delta T_k^{i\cdots}}{n} \sum_{k=1}^n E_k^{i\cdots} \quad (6)$$

²⁾ Applied statistics, equations 5.29a and 5.69, modified. See the Bibliography.

$$Q_x^{i...} = \sum_{k=1}^n (\Delta T_k^{i...})^2 - \frac{\left(\sum_{k=1}^n \Delta T_k^{i...} \right)^2}{n} \quad (7)$$

$$\overline{\Delta T^{i...}} = \frac{1}{n} \sum_{k=1}^n \Delta T_k^{i...} \quad (8)$$

$$\overline{E^{i...}} = \frac{1}{n} \sum_{k=1}^n E_k^{i...} \quad (9)$$

7.4.4 Evaluation and calculation

7.4.4.1 Electric energy consumption

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

$$\overline{E_{\Delta T_0}^{i...}} = \overline{S^{i...}} \cdot \overline{\Delta T_0^{i...}} + \overline{B^{i...}} \quad (10)$$

where

$\overline{E_{\Delta T_0}^{i...}}$ is the calculated nominal energy consumption in kW·h for heating a load for the different heating functions *ie*, *if* or *ih* at $\overline{\Delta T_0^{i...}}$;

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

$\overline{S^{i...}}$ is the slope related to the different heating functions *ie*, *if* or *ih*, which is calculated according to equation (2);

$\overline{B^{i...}}$ is the intercept which is calculated according to equation (3):

$$\overline{S^{i...}} = \frac{n \sum_{k=1}^n (\Delta T_k^{i...} \cdot E_k^{i...}) - \left(\sum_{k=1}^n \Delta T_k^{i...} \right) \left(\sum_{k=1}^n E_k^{i...} \right)}{n \sum_{k=1}^n (\Delta T_k^{i...})^2 - \left(\sum_{k=1}^n \Delta T_k^{i...} \right)^2} \quad (11)$$

$$\overline{B^{i...}} = \frac{\sum_{k=1}^n E_k^{i...} - \overline{S^{i...}} \sum_{k=1}^n \Delta T_k^{i...}}{n} \quad (12)$$

where

$\overline{\Delta T_k^{i...}}$ is the actual temperature difference for the different heating functions *ie*, *if* or *ih*, as defined in Table 1;

$\overline{E}_k^{i...}$ is the energy consumption in kW·h 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, $n = 3$.

As an example for data and calculation sheets, see Annex E. An Excel 97-2003³ evaluation program, which corresponds directly to Annex E, is available with this document 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 (10) to (12) the E values by the appropriate t values, i.e. replace

— in equation (10) $\overline{E}_{\Delta T_0}^{i...}$ by $\overline{t}_{\Delta T_0}^{i...}$ and

— in equations (12) and (10) $\overline{E}_k^{i...}$ by $\overline{t}_k^{i...}$

where

$\overline{t}_k^{i...}$ is the time measured in min and s according to 7.4.3.1 at the different $\Delta T_k^{i...}$ for the different heating functions *ic*, *if* or *ih*;

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

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 kW·h to two decimals, according to 7.4.4.1;
- time(s) in min according to 7.4.4.2, rounded to the nearest half minute;
- water absorption of the brick according to 7.4.2.3.

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

8.4.1 Test Procedure

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

³ Microsoft Excel is the trade name of a product supplied by Microsoft Corporation.

This information is given for the convenience of users of this 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.

Remove all accessories delivered with the appliance, such as baking trays, side racks that are not used for placing the load.

Measure the cavity temperature $T_{c,k}$ in the empty appliance with a thermocouple that conforms to 5.3 fixed to the grid delivered with the appliance. Place this grid in the appliance 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. If no grid can be purchased from the manufacturer of the appliance, the thermocouple should be positioned in the centre in a suitable way.

Additionally record the temperature $T_{o,k}$ close to the **oven thermostat** continuously. For this, fix a second thermocouple close to the **oven thermostat** inside the cavity as described in Figure 9, Figure 10 and Figure 11. This thermocouple is the "observer thermocouple".

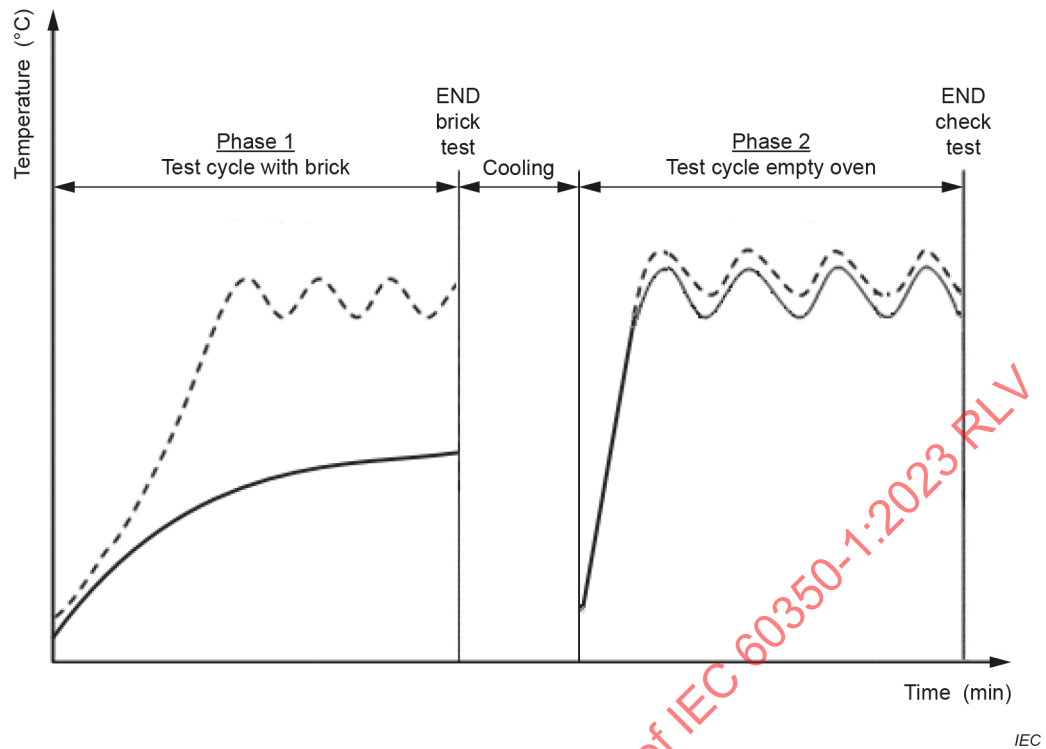
Lead the thermocouples through the door gap in a way that the door is completely closed without applying additional force.

To determine the energy consumption of a **heating function** or an **eco function**, three measurements with different temperature settings are necessary. Each measurement consists of two phases:

- phase 1: energy measurement while the brick is in the **oven**;
- phase 2: determination of the reference temperature and the c -factor (empty **oven**).

The diagram in Figure 8 shows the entire process of measurement.

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV



Phase 1		Cooling	Phase 2	
---	observer temperature $T_{o1,k}$		----	observer temperature $T_{o2,k}$
—	centre temperature brick		—	cavity temperature $T_{c2,k}$

Figure 8 – Entire process of measurement

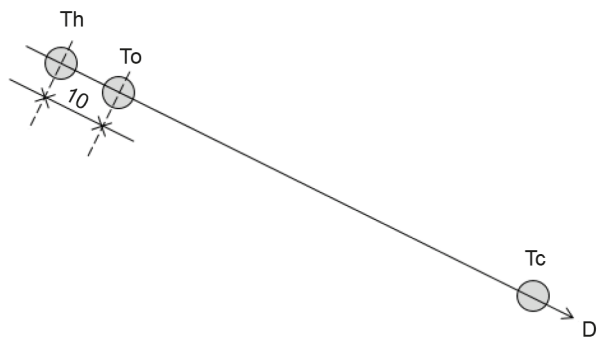
For both phases, the temperature $T_{o,k}$ is recorded continuously with a thermocouple fixed with a distance ≤ 10 mm to the **oven thermostat** inside the cavity without contact. This thermocouple is the observer thermocouple; it is fixed symmetrically in both x and y axes, on the direction of the z axis (see Figure 10 and Figure 11). The D axis is oriented toward the centre of the cavity (see Figure 9). Mount the observer thermocouple on the closest wall of the cavity with a heat resistant tape.

If the **oven thermostat** is not accessible, take into account the manufacturer's instructions regarding the position of the thermocouple.

If more than one **oven thermostat** is available, the information about the **oven thermostat** relevant for the temperature control of the considered cavity can be obtained from the manufacturer's instructions.

Keep the position of the observer thermocouple unchanged during phase 1 and phase 2.

Dimensions in millimetres



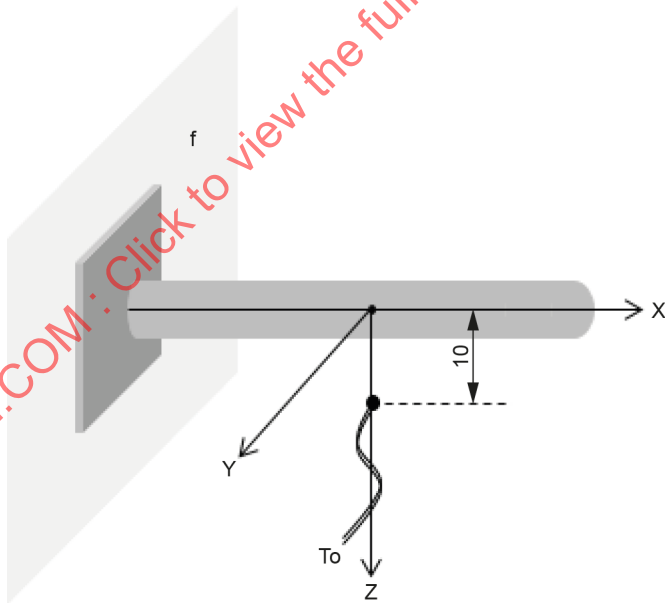
IEC

Key

- Th **oven thermostat**
- To **observer thermocouple**
- Tc **oven centre thermocouple**
- D **direction toward the oven centre**

Figure 9 – Installation observer thermocouple

Dimensions in millimetres



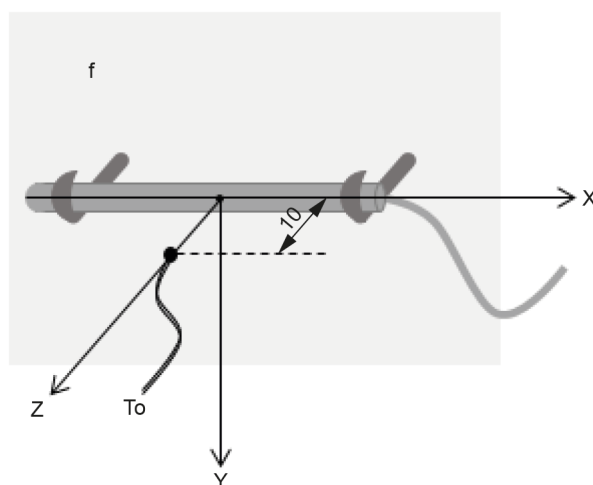
IEC

Key

- f **fixation wall - position of the thermostat to the fixation wall (the thermostat body shows a perpendicular position to the surface of the fixation wall)**
- To **observer thermocouple**
- Z **direction – under thermostat**

Figure 10 – Vertical installation of the observer thermocouple

Dimensions in millimetres

**Key**

f fixation wall - position of the thermostat to the fixation wall where the thermostat body shows a parallel position to the surface of the fixation wall

To observer thermocouple

Z direction – in front of thermostat

Figure 11 – Horizontal installation of the observer thermocouple

8.4.2 Oven settings

For measuring the energy consumption, a **heating function** or **eco function** shall be used. If more than one **heating function** or **eco function** is available, the recommendation in the manufacturer's instructions is taken into account.

The temperature control is set to a position where the average temperature rises $\Delta \bar{T}_{c2,k}$ as defined in Table 4 can be expected. $\Delta \bar{T}_{c2,k}$ is the difference between the average ambient temperature and the average cavity temperature measured in phase 2; $k = 1, 2, 3$ (k is the summing index).

The temperature setting T_s , which is the displayed setting of the knob or the control display (s is the setting), shall be noted. If the temperature steps are not clearly marked, the temperature setting should be determined by the angle according to the visible marks on the knob using polar coordinate paper (see Annex E).

If the temperature is set by a knob, the knob shall always be turned from zero to the required setting.

Table 4 – Temperature rise for three settings

Temperature rise	
$\Delta \bar{T}_{c2,1}$	(135 ± 15) K
$\Delta \bar{T}_{c2,2}$	(165 ± 15) K
$\Delta \bar{T}_{c2,3}$	(195 ± 15) K ^a
^a Or the maximum temperature rise if this value cannot be reached.	

Report the used **heating function** or **eco function** and the temperature setting $T_{s,k}$ for each measurement.

8.4.3 Phase 1

- Remove all accessories delivered with the appliance, such as baking trays and side racks, which are not used for placing the brick.
- Place the brick, prepared in accordance with 8.3.3, in the geometric centre of the calculated cavity with its largest surface centrally on the grid delivered with the appliance, with the thermocouples on the upper side. If no grid can be purchased from the manufacturer of the appliance, any suitable grid should be used, however not a baking tray, tin or similar.
- Insert the grid into a shelf support level of the appliance so that the centre of the brick comes as close as possible to the centre, but not higher than the centre, of the calculated cavity. The longest axis of the brick shall be parallel with the appliance front. 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's centre closest to the cavity's centre, but not higher. Only if the grid is already placed on the lowest level may the centre of the brick be higher than the centre of the cavity.
- If the appliance is prepared with the thermocouples, do not operate it with a function combined with microwave energy. Out-coupled microwave power through the thermocouples can damage instruments.

NOTE 1 See Annex D.

- Start the measurement within 3 min from the removal of the brick from the refrigerator by switching on the appliance following the requirements for setting.

The following data are measured:

- the measured energy consumption(s) E_k in kWh and the time(s) t_k in min and s, when the last of the two thermocouples in the brick reaches a temperature rise of 55 K, $k = 1, 2$ and 3;
- centre temperatures of the brick in °C;
- $T_{o1,k}$ continuously measured by the observer thermocouple in °C;
- ambient temperature $T_{a1,k}$ from the beginning of the test (when the appliance is switched on) to 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 2 The energy consumption of components such as lamps and fans that are automatically switched on with the appliance, is included in the measurement.

8.4.4 Phase 2

In phase 2, the measurement of phase 1 is repeated in an empty **oven**.

For this, remove the brick and cool the appliance as long as it is ensured that the whole appliance (this includes the material and the insulation) is at ambient temperature of $(23 \pm 2) ^\circ\text{C}$. Forced cooling by a fan can be applied.

After cooling, verify that the setting is strictly identical to that used in phase 1 (see 8.4.3). This includes:

- unchanged position of the observer thermocouple;
- same temperature setting $T_{s,k}$;
- same **heating function**.

Switch on the appliance and operate for the same duration of t_k (measured in 8.4.3).

Measure the following data continuously:

- $T_{o2,k}$ from t_0 to t_k by the observer thermocouple during phase 2 in $^\circ\text{C}$;
- $T_{c2,k}$ from t_0 to t_k by the centre thermocouple during phase 2 in $^\circ\text{C}$;
- $T_{a2,k}$ from t_0 to t_k by the thermocouple positioned in accordance with 5.1 for measuring the ambient temperature in $^\circ\text{C}$.

8.5 Calculation

8.5.1 Smoothing the measured values

For further calculation, the measured data $T_{c2,k}$ are smoothed by a moving average applying Formula (1) in order to exclude possible measurement noise.

$$\tilde{T}_{c2,k,i} = \frac{1}{2n+1} \sum_{j=-n}^n T_{c2,k,i+j} \quad (1)$$

Where:

$\tilde{T}_{c2,k,i}$ is the smoothed temperature in the cavity centre in phase 2 in $^\circ\text{C}$;

$T_{c2,k,i+j}$ is the measured temperature in the cavity centre in phase 2 in $^\circ\text{C}$;

i is the sample index;

n is defined by $n = \left\lfloor \frac{f_s \times t_{\text{mov}} - 1}{2} \right\rfloor$ and where $t_{\text{mov}} = 30 \text{ s}$;

f_s is the sampling rate in 1/s.

8.5.2 Determining the average temperature rise for a heating function (phase 2)

If the manufacturer classifies the function under test as a **heating function**, this clause shall be applied to determine the average temperature rise.

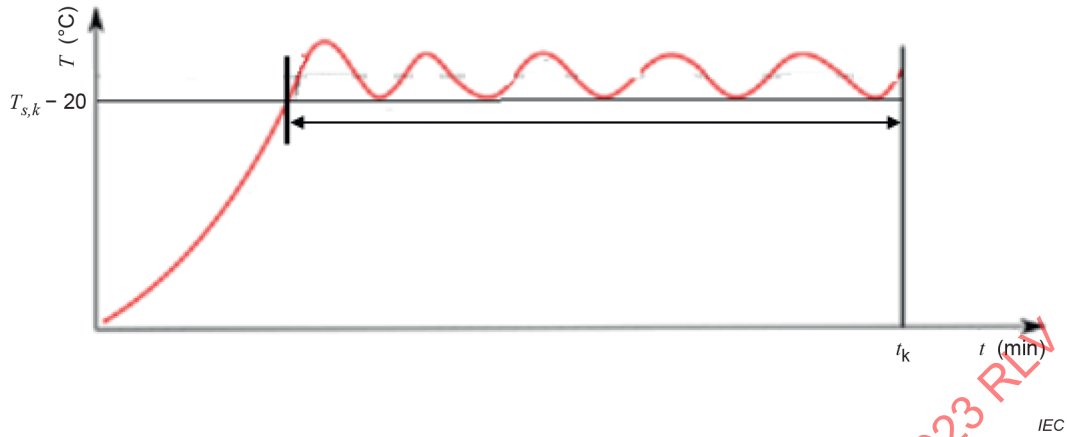


Figure 12 – Example – average temperature rise for a heating function

The average temperature rise for a **heating function** shall be calculated in the following period:

The start of this period shall be the point where $\tilde{T}_{c2,k}$ reaches $T_{s,k} - 20$ K. Hence, the start index i_s shall be defined as:

$$\tilde{T}_{c2,k}(i_s) = T_{s,k} - 20 \quad (2)$$

If the time period between $T_{s,k} - 20$ and end of measurement is less than 60 % of whole time t_k , the time period is prolonged to 60 % of t_k . In this case, the start index i_s shall be defined as:

$$i_s = i_k - 0,6i_k \quad (3)$$

The average temperature rise $\Delta\bar{T}_{c2,k}$ shall be calculated by averaging the difference of $T_{c2,k,i}$ and $T_{a2,k,i}$ for i_s until the end of the measurement (see Figure 12) by applying Formula (4):

$$\Delta\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_k} (\tilde{T}_{c2,k,j} - T_{a2,k,j})}{i_k - i_s + 1} \quad (4)$$

Where:

$\Delta\bar{T}_{c2,k}$ is the average temperature rise in phase 2 in K;

$\tilde{T}_{c2,k,j}$ is the measured temperature in the cavity centre in phase 2, smoothed, in °C;

$T_{a2,k,j}$ is the measured ambient temperature in phase 2 in °C;

i_s is the sample index representing the starting point;

i_k is determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The average temperature $\bar{T}_{c2,k}$ shall be calculated accordingly to Formula (5).

$$\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_k} \tilde{T}_{c2,k,j}}{i_k - i_s + 1} \quad (5)$$

Where:

$\bar{T}_{c2,k}$ is the average temperature in the cavity centre in phase 2 in °C.

8.5.3 Determining the average temperature rise for an eco function (phase 2)

If the manufacturer classifies the function under test as an **eco function**, this clause shall be applied to determine the average temperature rise. For an **eco function**, the temperature shall be averaged within a 20 min period depending on the technical solution used for saving energy. See examples in Figure 13 and Figure 14.

– Technical solution A (See Figure 13)

The average temperature rise $\Delta\bar{T}_{c2,k}$ is calculated by averaging the difference of $T_{c2,k,i}$ and $T_{c2,k,i}$ for 1 200 s starting when the temperature setting is reached. Formulae (6) and (7) shall be applied.

$$\tilde{T}_{c2,k}(i_s) \equiv T_{ks} \quad (6)$$

$$\Delta\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_{1200}+i_s-1} (\tilde{T}_{c2,k,j} - T_{a2,k,j})}{i_{1200}} \quad (7)$$

Where:

$\Delta\bar{T}_{c2,k}$ is the average temperature rise in phase 2 in K;

$\tilde{T}_{c2,k,j}$ is the measured temperature in the cavity centre in phase 2, smoothened in °C;

$T_{a2,k,j}$ is the measured ambient temperature in phase 2 in °C;

i_s the sample index representing the starting point;

i_{1200} is defined by $\lfloor 1\,200 \times f_s \rfloor$.

The average temperature $\bar{T}_{c2,k}$ shall be calculated with Formula (8).

$$\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_{1200+i_s}-1} \tilde{T}_{c2,k,j}}{i_{1200}} \quad (8)$$

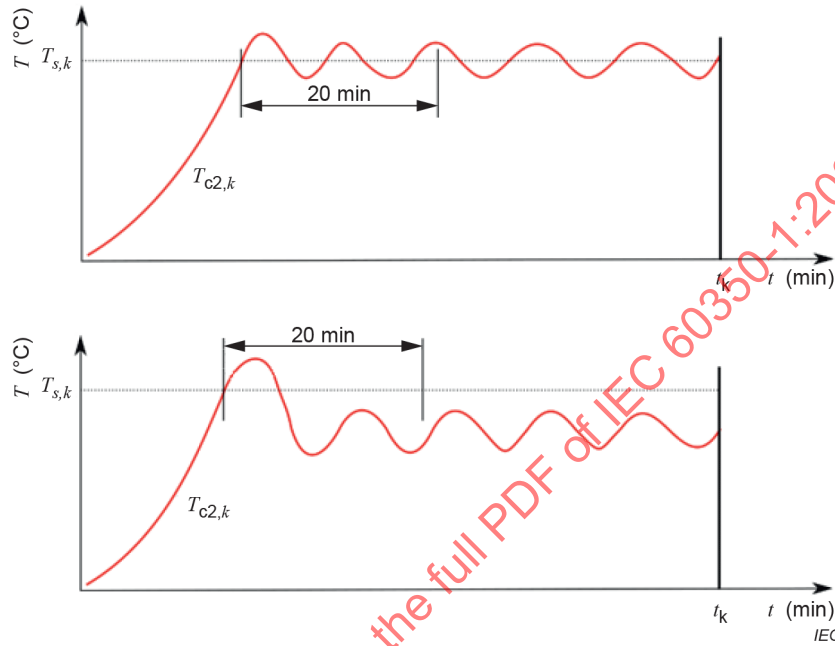


Figure 13 – Examples – set temperature reached

– Technical solution B (See Figure 14)

If the temperature setting is not reached before the last 20 min of phase 2 start, the average temperature rise $\Delta \bar{T}_{c2,k}$ is calculated by averaging the difference of $T_{c2,k,i}$ and $T_{a2,k,i}$ for the last 20 min of phase 2; see Formula (9).

$$\Delta \bar{T}_{c2,k} = \frac{\sum_{j=i_k+1-i_{1200}}^{i_k} (\tilde{T}_{c2,k,j} - T_{a2,k,j})}{i_{1200}} \quad (9)$$

Where:

$\Delta \bar{T}_{c2,k}$ is the average temperature rise in phase 2 in K;

$\tilde{T}_{c2,k,j}$ is the measured temperature in the cavity centre in phase 2, smoothed in °C;

$T_{a2,k,j}$ is the measured ambient temperature in phase 2 in °C;

i_{1200} is defined by $\lfloor 1200 \times f_s \rfloor$;

i_k is the index determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The average temperature $\bar{T}_{c2,k}$ in °C is calculated with Formula (10).

$$\bar{T}_{c2,k} = \frac{\sum_{j=i_k+1-i_{1200}}^{i_k} \tilde{T}_{c2,k,j}}{i_{1200}} \quad (10)$$

Where:

$\bar{T}_{c2,k}$ is the average temperature in phase 2 in °C;

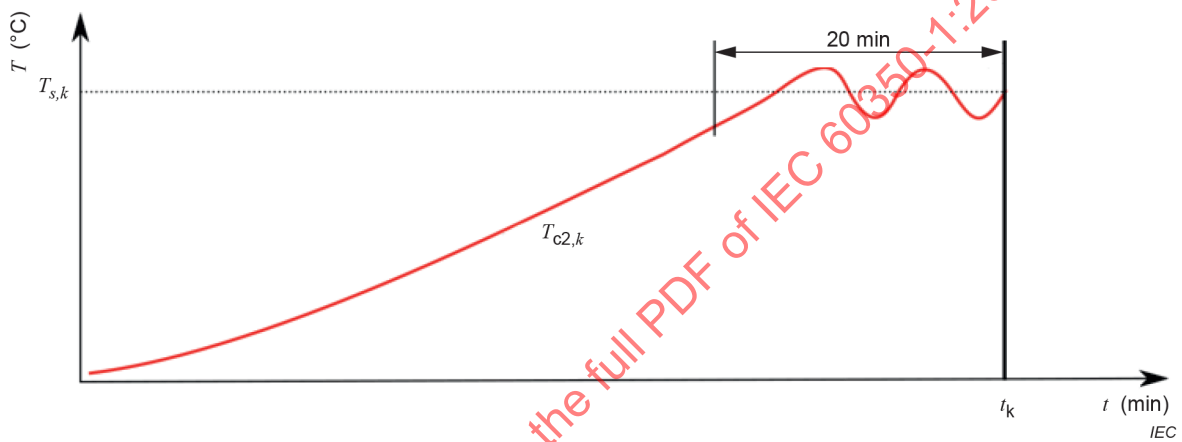


Figure 14 – Example – set temperature not reached

Calculate and note the average temperature rise $\Delta \bar{T}_{c2,k}$ in K for each measurement (each measured heating mode and temperature setting, see Table 4).

Calculate and note the average temperature $\bar{T}_{c2,k}$ in °C for each measurement (each measured heating mode and temperature setting, see Table 4).

8.5.4 Calculation of average ambient temperature

The average ambient temperature in phase 1 and phase 2 is calculated with Formulae (11) and (12):

$$\bar{T}_{a1,k} = \frac{\sum_{j=1}^{i_k} T_{a1,k,j}}{i_k} \quad (11)$$

$$\bar{T}_{a2,k} = \frac{\sum_{j=1}^{i_k} T_{a2,k,j}}{i_k} \quad (12)$$

The average ambient temperature in phase 1 and phase 2 is rounded to one decimal space and reported.

8.5.5 Determining the c -factor

Determine the c_k -factor for each measurement. The c_k -factor is the ratio between the observer temperatures measured in phase 1 and in phase 2 in the whole phase, t_o until t_k , calculated as shown in Formula (13):

$$c_k = \frac{\bar{T}_{o1,k}}{\bar{T}_{o2,k}} \quad (13)$$

Where:

$$\bar{T}_{o1,k} = \frac{\sum_{j=1}^{i_k} T_{o1,k,j}}{i_k} \quad (14)$$

$$\bar{T}_{o2,k} = \frac{\sum_{j=1}^{i_k} T_{o2,k,j}}{i_k} \quad (15)$$

j runs from 1 to i_k , where i_k is determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The c_1 , c_2 and c_3 per **heating function** or **eco function** is rounded to two decimal places and reported.

8.5.6 Determining the s -factor

In the case that the heating mode is designated as a **heating function**, the s -factor shall be determined in addition to the c -factor.

Determine the s_k -factor for each measurement. The s_k -factor is the ratio between the observer temperatures measured in phase 1 and in phase 2 in the last 20 min of the whole phase, $t_k - 20$, calculated as shown in Formulae (16), (17) and (18):

$$s_k = \frac{\bar{T}_{o1,k,20}}{\bar{T}_{o2,k,20}} \quad (16)$$

Where:

$$\bar{T}_{o1,k,20} = \frac{\sum_{j=i_k+1-i_{1200}}^{i_k} T_{o1,k,j}}{i_k} \quad (17)$$

$$\bar{T}_{o2,k,20} = \frac{\sum_{j=i_k+1-i_{1200}}^{i_k} T_{o2,k,j}}{i_k} \quad (18)$$

i_{1200} is defined by $\lfloor 1200 \times f_s \rfloor$

j runs from 1 to i_{1200} , where i_k is determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The s_1 , s_2 and s_3 for the **heating function** is rounded to two decimal places and reported.

8.6 Acceptance verification of the test results

8.6.1 Average temperature rise and standard deviation

Results of the tests in accordance with 8.5 shall only be accepted if

- a) the average temperature rises $\Delta \bar{T}_{c2,k}$ are within the temperatures specified in Table 4, and
- a) the standard deviation σ as defined in Formula (11) is below 0,050 kWh.

Otherwise, for the appropriate function, all measurements shall be repeated in accordance with 8.4.

The standard deviation σ is calculated, from the data pairs $\Delta \bar{T}_{c2,k}$ and E_k measured in accordance with 8.4, according to Formula (19) for each **heating function** or **eco function**, $k = 1, 2, 3$ (see Sachs⁴).

$$\sigma = f \sqrt{\frac{Q_y - \frac{Q_{xy}^2}{Q_x}}{n-2}} \quad (19)$$

where

n is the number of measuring points (for the purposes of this standard, $n = 3$);

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

For calculating the standard deviation, the f -factor of 1,2 shall be used.

⁴ Applied statistics, formulas 5.29a and 5.69, modified. See the Bibliography.

NOTE 1 For the purpose of this standard, $\Delta\bar{T}_{c2,k}$ can only vary between 120 K and 210 K resulting in an f -factor of between 1,15 and 1,21. The approach to calculate the f -factor is given in Annex F for information only.

NOTE 2 The terms Q are described in Annex F.

8.6.2 Temperature setting and average temperature rise

The difference $\Delta T_{s,k}$ between $T_{s,k}$ and $\bar{T}_{c2,k}$ shall be calculated with Formula (20):

$$\Delta T_{s,k} = T_s - \bar{T}_{c2,k} \quad (20)$$

Where

$\Delta T_{s,k}$ is the difference between the set temperature and the average temperature;

$T_{s,k}$ is the set temperature;

$\bar{T}_{c2,k}$ is the average temperature in the cavity centre in phase 2.

The difference $\Delta T_{s,k}$ shall be ≤ 20 K.

If any of the difference $\Delta T_{s,k}$ is > 20 K, the measurement shall be repeated in accordance with 8.4 with an appropriate function.

NOTE The tolerance of 20 K is needed due to the long chain of tolerances (e.g. thermostat, connection, power of heating elements, control element and printing) and the fact that the temperature scale covers different **heating functions** and **eco functions**.

8.6.3 c -factor

The c -factor is used to show that the thermal behaviour of the **oven** in phase 1 and phase 2 is similar.

NOTE The c -factor is less than one, since each load, i.e. the brick in the case of energy measurement, influences the thermal behaviour.

The c_k -factors calculated in 8.5.5 for a function designated as a **heating function** shall be $c_k \geq 0,92$.

The c_k -factors calculated in 8.5.5 for a function designated as an **eco function** shall be $c_k \geq 0,82$.

8.6.4 s -factor

The s_k -factors are used to show that a function designated as a **heating function** does not use residual heat.

The s_k -factors calculated in 8.5.6 for a function designated as a **heating function** shall be $s_k \geq 0,92$.

8.7 Final electric energy consumption

If the acceptance criteria requested in 8.6 are fulfilled, the final energy consumption is calculated for the nominal temperature rise using the linear regression based on the calculated data point ΔT_k (see 8.5) and the measured data point E_k (see 8.4.3); see Formula (21):

$$E_{\Delta T_0} = S \cdot \Delta T_0 + B \quad (21)$$

Where:

- $E_{\Delta T_0}$ is the calculated nominal energy consumption in kWh for heating a load at the setting of the appliance with a temperature rise of ΔT_0 ;
- ΔT_0 is 165 K for all **heating functions** and **eco functions**;
- S is the slope calculated according to Formula (22);
- B is the intercept calculated according to Formula (23).

$$S = \frac{n \sum_{k=1}^n (\Delta \bar{T}_{c2,k} \cdot E_k) - \left(\sum_{k=1}^n \Delta \bar{T}_{c2,k} \right) \left(\sum_{k=1}^n E_k \right)}{n \sum_{k=1}^n (\Delta \bar{T}_{c2,k})^2 - \left(\sum_{k=1}^n \Delta \bar{T}_{c2,k} \right)^2} \quad (22)$$

$$B = \frac{\sum_{k=1}^n E_k - S \cdot \sum_{k=1}^n \Delta \bar{T}_{c2,k}}{n} \quad (23)$$

8.8 Time for heating a load

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

Replace in the Formulas (21) to (23) the E values by the appropriate t values, i.e. replace

- in Formula (21), $E_{\Delta T_0}$ by $t_{\Delta T_0}$;
- in Formulae (22) and (23), E_k by t_k .

Where:

- $t_{\Delta T_0}$ is the calculated nominal time in s for heating a load at $\Delta T_0 = 165$ K for all **heating functions** or **eco functions**.

8.9 Reporting of test results

A supplementary file to calculate the energy consumption and related values is located at <https://www.iec.ch/sc59k/supportingdocuments>. These calculations may be made in any suitable spreadsheet programs.

Report the following data for the measured **heating functions** or **eco functions**:

- a) type of the appliance, available **heating function(s)** and **eco function(s)**;
- b) supply voltage at which the measurements were made;
- c) tested **heating function(s)** and/or **eco function(s)**;
- d) energy consumption(s) $E_{\Delta T_0}$ in kWh to three decimal places, in accordance with 8.7;

e) time(s) $t_{\Delta T_0}$, rounded to the nearest minute.

For **multiple cavity appliances**, the values shall be reported separately for each cavity.

9 Cooking tests

9.1 General

Owing to the use of food, the tests specified in Clause 9 are considered to be applicable for comparative testing only.

All tests in this clause shall be carried out applying a corrected temperature setting in accordance with the approach determined in 7.4.

The **heating function** that is used for measuring the energy consumption (see Clause 8) should be used for determining the heat distribution on one level (see 9.2.2) and for measuring the ability to supply heat on one level (see 9.3).

If an **eco function** is used for measuring the energy consumption (see Clause 8), that function should be used for determining the heat distribution on one level (see 9.2.2) and for measuring the ability to supply heat on one level (see 9.3.1).

NOTE As already stated in the definition, an **eco function** is used for certain applications. Hence, not all performance tests are applicable.

For baking on two or more levels, the function recommended in the instruction manual is used.

9.2 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.~~

9.2.1 Shortbread

9.2.1.1 Purpose

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

9.2.1.2 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

9.2.1.3 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 $(5 \pm 2) ^\circ\text{C}$ for at least 8 h. Remove the loaf from the refrigerator ~~approximately 1 h~~ 60 min to 80 min before further handling.

Extrude the loaf into strips by means of a worm conveyor attachment using the nozzle as shown in Figure 15. Cut the strips to a length that fits the baking ~~sheet~~ tray supplied with the appliance

or that recommended by the manufacturer. Position the pastry strips as shown in Figure 16 so that they will be parallel to the appliance door.

Dimensions in millimetres

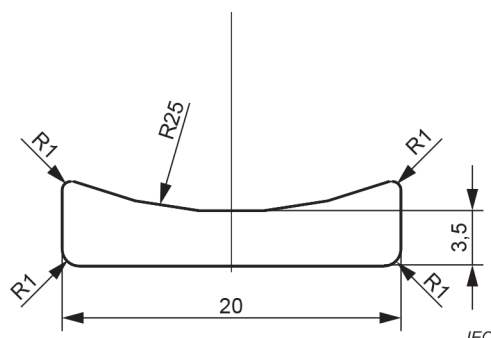


Figure 15 – Shape of the nozzle for extruding pastry

Dimensions in millimetres

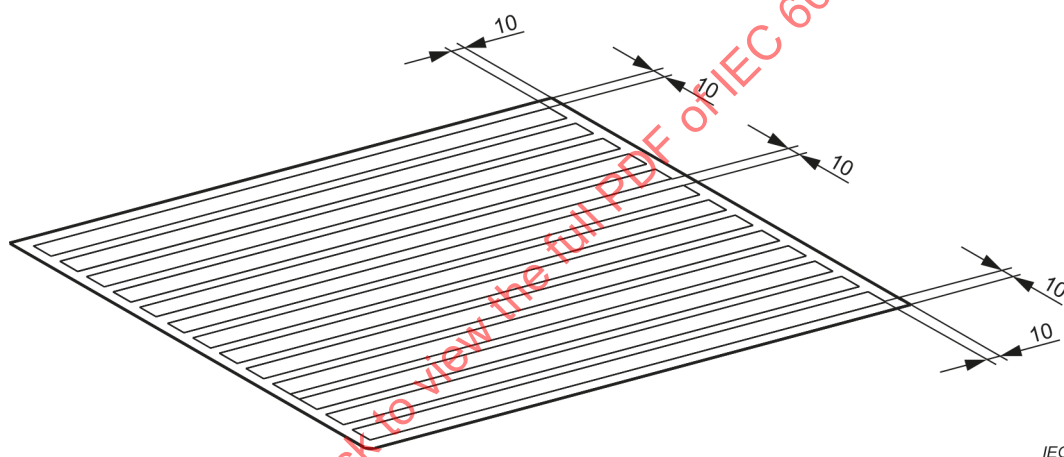


Figure 16 – Position of pastry strips on the baking ~~sheet~~ tray

9.2.1.4 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 without preheating.

The ~~sheet~~ tray is inserted into the appliance in accordance with the instructions for use. If instructions are not given, the ~~sheet~~ tray is positioned as close as possible to the centre of the cold appliance. The ~~sheet~~ tray is removed from the appliance when the strips have attained a golden-brown colour. The baking time is noted.

The ~~sheet~~ tray 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~~ in accordance with IEC TS 63350. Circles with a diameter of 20 mm are measured over the strips lengthwise, beginning and ending approximately 20 mm ~~(related to from the centre of the circle)~~ from the end of each strip. The measurements are

carried out in steps of approximately 50 mm. If the surface at the defined areas is damaged by cracks, holes, etc., the measurement is shifted to other areas.

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 $(43 \pm 5) \%$~~ lightness value L^* of $(70,1 \pm 2,35)$.

NOTE ~~A supplier of~~ Annex B recommends suppliers for the colour measuring instrument and digital measuring systems ~~is given in Annex C.~~

9.2.1.5 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~~ tray while still hot but left in their original position.

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

9.2.1.6 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.

9.2.2 Small cakes

9.2.2.1 Purpose

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.

9.2.2.2 Ingredients

The quantities of ingredients for 30 to 40 small cakes are indicated in Table 5. For a reproducible result, always prepare the same amount and discard any surplus mixture. Ingredients as defined in Annex B should be used.

Table 5 – 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~~ Medium-sized hen eggs, approximately (55 ± 5) g, are beaten and sieved until homogeneous, then weighed. If frozen egg mixture is used, follow the instructions of Clause B.2.
Wheat flour without raising agent, unbleached. Mineral content: maximum 0,5 % (dry substance)	450 ± 1	Gluten: at least 24 %.
Baking powder	15 ± 0,5	Phosphate baking powder (double acting) shall be used (not baking soda).
Salt	6 ± 0,1	
If more than 40 small cakes are required, two identical kitchen machines should be used simultaneously.		
NOTE The eggs are sieved to remove any chalazae.		

9.2.2.3 Paper cases

As the paper quality affects the rising height and spreading, only the paper cases specified in Annex B 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/m² bleached greaseproof paper.

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

9.2.2.4 Number of small cakes and positioning on the baking ~~sheet~~ tray

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

The width and the depth of the baking ~~sheets~~ trays 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 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 ± 4 mm from the edge of the usable area of the baking ~~sheet~~ tray, measured in accordance with 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~~ trays that ~~may~~ can be cooked simultaneously are followed.

9.2.2.5 Procedure

~~All ingredients shall be at ambient temperature before starting.~~

Beat together butter and sugar in a food mixer until the mixture 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 $(23 \pm 2) ^\circ\text{C}$ directly after mixing.

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

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

Weigh $(28 \pm 0,5)$ g of the mixture into the centre of the paper cases and place them evenly on the baking ~~sheets~~ trays. Bake immediately.

NOTE 2 The tests are carried out using corrected temperature control settings according to the differences determined by the test of 7.4.

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 appliance when the end of the preheating phase is indicated, for example by visual or acoustic signal, or after a recommended preheating time. If no instructions are given, the appliance is set to $160 ^\circ\text{C}$ for a forced air circulation function or to $185 ^\circ\text{C}$ for a conventional **heating function** and the baking ~~sheet~~ tray is placed in the middle of the cold appliance. While the small cakes are baking, the position of the baking ~~sheet~~ tray 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~~ trays are placed simultaneously in the appliance one above the other and removed simultaneously at the end of baking. While the small cakes are baking, the position of the baking ~~sheets~~ trays 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 appliance when the end of the preheating phase is indicated, for example by visual or acoustic signal, or after a recommended preheating time.

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

NOTE 3 Baking on two levels is not carried out for ~~small oven cavities~~ **cavity ovens**, 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).

9.2.2.6 Assessment

9.2.2.6.1 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 in accordance with 9.2.2.6.3, at least 50 % of the base shall be undamaged. Otherwise the test shall be repeated.

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

The 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~~ tray shall be assessed separately (single result) and they are also 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.

9.2.2.6.2 Visual assessment

For comparative results, the evaluation of browning may be done by a visual check using the criteria for assessment in 9.2.2.6.4

The brown shade numbers ~~of Table B.1 are~~ specified in IEC TS 63350 shall be used to evaluate browning. For a visual check, the same background colour and illumination shall be used for each tray.

NOTE A supplementary file to generate the brown shade chart is located at <https://www.iec.ch/sc59k/supportingdocuments>.

9.2.2.6.3 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 ± 5 %. Less than 10 % of the entire surface may deviate by up to ± 8 %.~~

~~The entire surface is divided in 1 cm^2 sections. None of the mean values of the 1 cm^2 sections shall deviate by more than ± 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 are positioned 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 10) 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 11). 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 10, and the smaller section is used as the convex colour sample.

The surface of the convex colour sample should be < 35 specular gloss value for an angle of 85° (according to ISO 2813).

NOTE 6—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) are positioned at the height of 13 mm (total height 28 mm at the highest point).

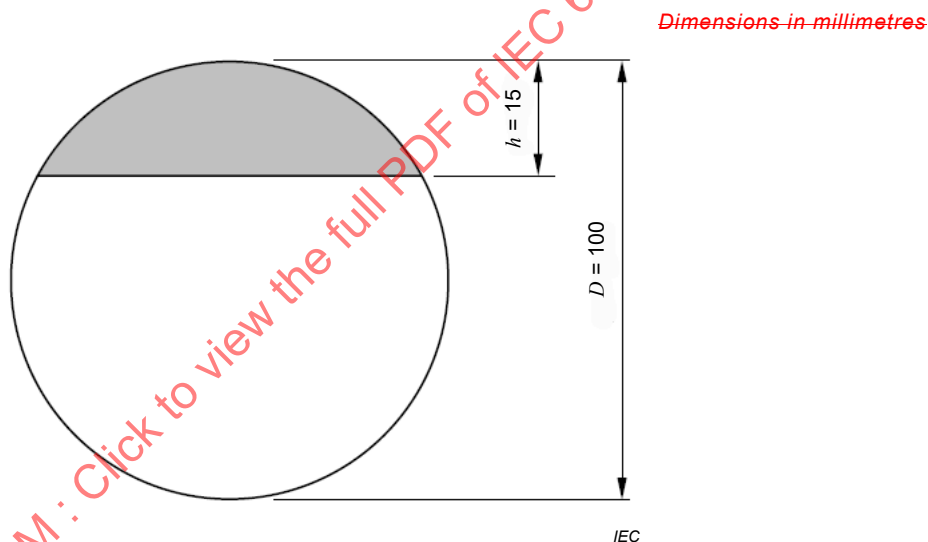


Figure 10—Convex colour sample

d) Definition of the illuminance

The measurement is taken under a full spectral fluorescent triband or equivalent from 5 700 K to 7 000 K, with a colour rendering index $R_a > 90\%$ of illumination.

NOTE 7—Suppliers for suitable lamps are indicated in Annex C.

NOTE 8—Suppliers of colour measuring systems which meet these requirements, are given in Annex C.

For reproducible results of the evaluation of browning, any digital measurement system shall be used which complies with the requirements in IEC TS 63350, except the requirements for colour recognition and verification of resolution.

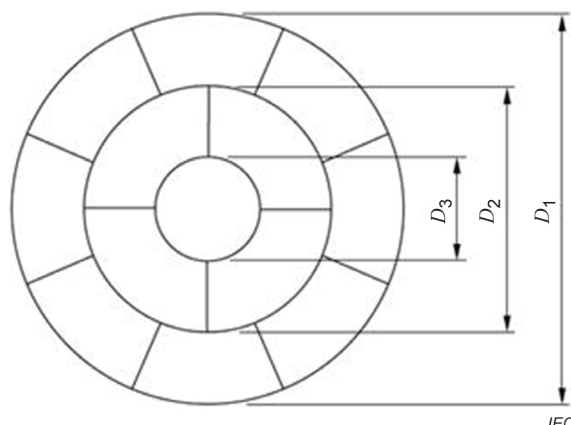
9.2.2.6.4 Criteria for assessment (digital and visual)

The following criteria are relevant for the assessment:

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 17.

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



Key:

- D_1 dimension of small cake
 D_2 dimension of middle section
 D_3 dimension of central section

$$D_2 = \frac{\sqrt{5}}{\sqrt{13}} \times D_1 \approx 0,6 \times D_1$$

$$D_3 = \frac{1}{\sqrt{13}} \times D_1 \approx 0,3 \times D_1$$

Figure 17 – Template for the sectioning of small cakes

The arithmetic average of ~~reflection value R_x~~ lightness value L^* is calculated for the whole area of each section.

A ~~brown~~ shade number is determined ~~according to Annex B~~ in accordance IEC TS 63350 and reported for each section.

1) Acceptable browning on the top

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

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

The results of the test of 9.2.2 shall only be accepted if the average browning on the top of all baking ~~sheets~~ trays baked simultaneously is in the range of shade number 9,5 to 10,5.

NOTE Decimal places result from averaging.

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.

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

2) "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.

Cakes properly browned = number of cakes where all sections have shade numbers between 8 and 12.

3) "Percentage properly browned" on the top

The percentage properly browned is the number of cakes properly browned divided by the total number of cakes and multiplied by 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~~ tray separately and of all ~~sheets~~ trays baked simultaneously (single results per ~~sheet~~ tray and overall results).

b) Evaluation of the base of the small cakes

The ~~reflection value R_y~~ lightness value L^* for the undamaged part of the base of each small cake is determined. A brown shade number is determined ~~according to Annex B~~ in accordance with IEC TS 63350 and noted for each small cake.

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

1) *Average browning on the base*

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

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

2) *Browning difference on the base*

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

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

9.3 Ability to supply heat

9.3.1 Fatless sponge cake

9.3.1.1 Purpose

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.

9.3.1.2 Ingredients

- 100 g white wheat flour without raising agent
- 100 g maize ~~flour~~ starch (corn ~~flour~~ starch)
- 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 water (approximately 45 °C)

These ingredients are sufficient to make one cake.

9.3.1.3 Procedure

Separate the egg whites from the yolks.

Whisk the egg whites with the 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 baking tin with greaseproof paper. The tin is made from steel, black coloured without non-stick coating, not enamelled and has an inner bottom diameter of (260 ± 15) mm and a height of (65 ± 10) mm. Spoon in the dough and distribute to a uniform thickness. Follow the instructions for use for this type of cake with regard to preheating, positioning in the appliance and setting of the control. If no instructions are given, place the cake as close as possible to the centre of the cavity and set the control 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 appliance 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.

9.3.1.4 Assessment

The brown shade chart ~~of Annex B is~~ specified in IEC TS 63350 shall be used ~~to assess browning~~. Small irregularities are ignored. Irregularities can be, for example, small bubbles on the top and small cracks in the crust.

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. ~~Photos can document the baking result~~ ~~may be documented by photographs~~.

9.3.2 Apple pie

9.3.2.1 Purpose

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.

9.3.2.2 Ingredients

Dough:

- 300 g white wheat flour without raising agent
- 175 g butter, with a fat content of (83 ± 2) % (salted)
- 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 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.

9.3.2.3 Procedure

Mix the flour and sugar together and rub in the butter. Add the beaten egg and sufficient water to bind into 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 $(5 \pm 2) ^\circ\text{C}$. Peel, core and cut the apples into slices approximately 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 an inner bottom diameter of (200 ± 15) mm and a height of (50 ± 15) mm. The tin is made from steel, black coloured without non-stick coating and not enamelled.

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 control and cooking time. If no instructions are given, the pie is positioned as close as possible to the centre of the cold appliance cavity and the control is set so that the mean **oven** temperature is $160 ^\circ\text{C}$ for **ovens** with forced-air circulation and $185 ^\circ\text{C}$ for **ovens** with natural convection and the pie is left in the appliance until it is cooked.

In **ovens** with forced-air circulation, the maximum number of shelves is used in accordance with the instructions for use, one pie being placed on each shelf. All the pies are removed from the appliance 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 appliance 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 appliance to cook two pies simultaneously.

9.3.2.4 Assessment

The pie is removed from the appliance 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 brown shade chart specified in **Annex B** IEC TS 63350.

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.

10 Steam ovens and combi steam ovens

NOTE These tests are applicable for comparative testing only.

10.1 Ability to supply steam

10.1.1 Purpose

The purpose of this test is to assess the ability to supply sufficient steam to steam a small and comparable load of green vegetables by comparing the colour of the load with the colour of a reference ~~probe~~ measurement.

NOTE 1 The more the colour of the load differs from the reference ~~probe~~ measurement, the lower is the ability to supply steam.

NOTE 2 Tests in Clause 10 are applicable for **combi steam ovens**, if a **steam function** is available, and for **steam ovens**.

10.1.2 Ingredients and steaming accessory

The measurements are made with (300 ± 10) g fresh broccoli (*Brassica oleracea* var. *italica*) with a uniform green colour, divided into equal florets. The corolla of the florets shall have a diameter D of 35 mm to 45 mm. ~~Cut stalks short, but the florets should not fall to pieces. A stalk length of approximately 5 mm is necessary to determine the doneness sufficiently.~~ The stalks of the florets shall have a length of (10 ± 2) mm, whereby the length is measured from the bottom of the stalk to the lowest branch of the stalk, but the floret should not fall to pieces. Do not rinse the broccoli.

~~NOTE 1~~ For comparative testing, broccoli is used only from one batch bought from the same supplier at the same time and stored under the same conditions until needed for the tests.

~~NOTE 2~~ Small yellow parts ~~are~~ can be removed.

~~NOTE 3~~ Large florets ~~may~~ can be cut in pieces to reduce waste.

~~NOTE 4~~ Rinsing water can influence the result.

The florets shall be at ambient temperature.

Use the accessory in accordance with the manufacturer's instructions. If no accessory is supplied and no instructions are given, take a square glass container with a height of (50 ± 10) mm and outer bottom dimensions of 250 mm × 250 mm.

10.1.3 Procedure

10.1.3.1 Reference ~~probe~~ measurement

Prepare a reference ~~probe~~ measurement and a main ~~probe~~ measurement.

Use a cooking zone with a diameter of ≥ 180 mm and ≤ 220 mm and of $(1\,700 \pm 200)$ W. Take a ~~piece~~ of stainless-steel cookware with an outer bottom diameter of (220 ± 10) mm. Fill in approximately 400 g water, cover with a lid and heat up the water with the maximum power setting.

When the water starts boiling, a steaming basket filled with (300 ± 10) g of prepared broccoli florets is positioned.

NOTE 1 A supplier for a suitable steaming basket is indicated in Annex B.

Steam the broccoli by maximum setting ~~until the stalks of the florets are al dente~~ for (300 ± 10) s (reference doneness).

NOTE 2 With this cooking time, the broccoli is al dente, which means it is steamed but the stalks are still crunchy stalks and the florets are not mashed florets.

After steaming, the broccoli is removed.

NOTE 3 For comparative testing, ideally the reference-probe measurement(s) and the main-probe measurement are-ready steamed at the same time.

10.1.3.2 Main-probe measurement

The temperature of the water shall be $(15 \pm 1) ^\circ\text{C}$.

For appliances without a fixed fresh water supply, the tank shall be filled with water until the maximum level is reached.

Distribute (300 ± 10) g fresh broccoli florets evenly on the accessory.

Steam in accordance with the manufacturer's instructions for this type of food with respect to the **steam function**, temperature, shelf position and preheating. If preheating is recommended, the broccoli is placed in the **steam oven** when the end of the preheating phase is indicated, for example by visual or acoustical signal, or after the recommended preheating time.

If no instructions are given:

- set the **steam function**;
- adjust the temperature to the highest possible setting $\leq 100 ^\circ\text{C}$;
- place the accessory in the middle of the cavity. The middle of the cavity is calculated in accordance with 6.2;
- do not preheat.

Steam the broccoli until the doneness of the main-probe measurement is identical to the doneness of the reference-probe measurement. The main-probe measurement shall be al dente, too.

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

If the doneness of the main-probe measurement and the reference-probe measurement differ, the test shall be repeated by adapting the cooking time of the main-probe measurement.

NOTE Preliminary tests could be necessary to achieve the desired doneness of the-probe measurement.

While the broccoli is steamed, the position of the accessory shall not be changed.

After steaming, the broccoli is removed.

10.1.4 Assessment

The assessment shall be carried out immediately after steaming and shall be finished no more than 5 min after steaming.

The doneness-has-to shall be assessed with several same-sized florets immediately after the steaming process. For comparative testing, it is necessary that all-probes measurements have the same doneness as the reference-probe measurement (see 10.1.3.1).

If the doneness is valid, the colours of the main-probe measurement and reference-probe measurement are determined using the green shade chart specified in IEC TS 63350 as follows:

- inspect the upper side of the florets only, the bottom side and stalks are not relevant;

- find ~~the Natural Colour System (NCS®⁵)~~ green shade charts which characterize the colours of the main ~~probe~~ measurement and the reference ~~probe~~ measurement best ~~by using the shade charts specified in Annex F~~; colour shall be visible in a concentrated area, while single florets are not relevant;
- ~~state the yellow parts C_{main} and C_{R} in % (for an example, see Annex F, Note 3);~~
- ~~calculate the difference ΔC_{supply} as follows and state in %:~~

$$\Delta C_{\text{supply}} = |C_{\text{main}} - C_{\text{R}}| \quad (13)$$

where:

- ~~C_{main} is the yellow part of the colour of the main probe;~~
- ~~C_{R} is the yellow part of the colour of the reference probe;~~
- ~~ΔC_{supply} is the difference between C_{main} and C_{R} .~~

- state the hue angle values h_{main} and h_{R} in h_{ab} ;
- calculate the difference Δh_{supply} as follows and state in h_{ab} :

$$\Delta h_{\text{supply}} = |h_{\text{main}} - h_{\text{R}}| \quad (24)$$

where:

- h_{main} is the hue angle value of the colour of the main measurement;
- h_{R} is the hue angle value of the colour of the reference measurement;
- Δh_{supply} is the difference between h_{main} and h_{R} .

NOTE h_{ab} in degrees is the value stated on the green shade chart in IEC TS 63350:2022, Table 2.

The difference ~~ΔC_{supply}~~ Δh_{supply} defines the ability of the appliance to supply steam. The bigger ~~ΔC_{supply}~~ Δh_{supply} is, the lower the ability to supply steam is.

NOTE 1 Supplementary files to generate the green shade chart are located at <https://www.iec.ch/sc59k/supportingdocuments>.

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

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

The following data are stated:

- ~~ΔC_{supply}~~ Δh_{supply} ;
- the cooking time (preheating time included);
- the energy consumption in Wh (preheating included);

⁵ ~~NCS® is the trade name of a product supplied by NCS Colour.~~

~~This information is given for the convenience of users of this 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.~~

- the water consumption;
- whether the water tank shall be refilled during steaming.

10.2 Distribution of steam

10.2.1 Purpose

The purpose of this test is to assess the horizontal distribution of steam and optionally the vertical distribution.

NOTE The main application of **steam ovens** is usually steaming on one level. Some **steam ovens** allow steaming on more levels simultaneously.

The distribution of steam becomes apparent in the distribution of the green colours of steamed broccoli. The more the colours of the broccoli differ, the more uneven the distribution of steam is.

In addition, the main ~~probe~~ measurement is compared with a reference ~~probe~~ measurement in order to notice the best achievable colour of the batch of broccoli used.

10.2.2 Ingredients, steaming accessories and number of levels

The measurements are made with fresh broccoli florets, prepared in accordance with 10.1.2.

The quantity of the florets depends on the size of the steaming accessory. Use approximately 1 g/cm².

The steaming accessory measured in accordance with 6.4 shall cover at least 80 % of the usable width and 70 % of the usable depth of the cavity measured in accordance with 6.2.

If the supplied steaming accessory recommended in the instruction fits these dimensions, this accessory shall be used. If the supplied or recommended accessory does not fit the above conditions, another steaming accessory, which shall be a perforated container fitting the above condition as far as possible, shall be used.

For testing, the horizontal distribution of steam on one level is used.

Optionally the vertical distribution of steam can be tested if steaming on more levels is recommended in the manufacturer's instructions. The manufacturer's instructions regarding the number of levels steamed simultaneously are followed.

10.2.3 Procedure

Prepare the reference ~~probe~~ measurement in accordance with 10.1.3.1 and the main ~~probe~~ measurement as follows.

NOTE 1 For comparative testing, ideally the reference ~~probe~~ measurement and the main ~~probe~~ measurement(s) are steamed at the same time.

For appliances without a fixed fresh water supply, the tank shall be filled with water until the maximum level is reached. The temperature of the water shall be $(15 \pm 1) ^\circ\text{C}$.

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

The mass of broccoli filled in is stated.

Steam the broccoli in accordance with the manufacturer's instructions for this type of food with respect to the **steam function**, temperature, shelf position and preheating. If preheating is recommended, the broccoli is placed in the **steam oven** when the end of the preheating phase is indicated, for example by visual or acoustical signal, or after the recommended preheating time.

For testing the vertical distribution of steam (only if recommended in the manufacturer's instructions), the accessories are placed simultaneously in the **steam oven** following the manufacturer's instructions.

If no instructions are given:

- set the **steam function**;
- adjust the temperature to the highest possible setting ≤ 100 °C;
- place the accessory in the middle of the calculated cavity;
- do not preheat.

Steam the broccoli until the doneness of the main ~~probe~~ measurement is identical with the doneness of the reference ~~probe~~ measurement. If the doneness of the main ~~probe~~ measurement is unequal, steam until all areas of the main ~~probe~~ measurement are at least al dente, even if other areas are overcooked.

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

If the doneness of the main ~~probe~~ measurement and the reference ~~probe~~ measurement differ, the test shall be repeated by adapting the cooking time of the main ~~probe~~ measurement.

NOTE 2 Preliminary tests could be necessary to achieve the desired doneness of the ~~probe~~ measurement.

While the broccoli is steamed, the position of the accessory/accessories shall not be changed.

After steaming, the broccoli is removed.

If more levels are steamed (test of the vertical distribution of steam), all accessories are removed simultaneously.

10.2.4 Assessment

The assessment shall be carried out immediately after steaming and shall be finished no more than 5 min after steaming.

The doneness ~~has to~~ shall be assessed with several same-sized florets immediately after the steaming process. For comparative testing it is necessary that all ~~probes~~ measurements have the same doneness as the reference ~~probe~~ measurement (see 10.1.3.1).

If the doneness is valid, the colours of the main ~~probe~~ measurement and reference ~~probe~~ measurement are determined as follows:

- inspect the upper side of the florets only, bottom side and stalks are not relevant;
- detect the areas of the upper side of the main ~~probe~~ measurement with the minimum (= ~~best worst~~) ~~yellow part~~ hue angle value and the maximum (= ~~worst best~~) ~~yellow part~~ hue angle value of the green colour; colours shall be visible in concentrated areas, while single florets are not relevant;
- find the ~~NCS~~ green shade charts which characterize the colours of both areas best by using the green shade charts specified in ~~Annex F~~ IEC TS 63350;

- state the yellow parts $C_{\max}$ and $C_{\min}$ of the main probe in % (for an example see Annex F, Note 3);
- calculate the difference $\Delta C_{\text{distribute}}$ as follows and state in %:

$$\Delta C_{\text{distribute}} = |C_{\max} - C_{\min}| \quad (14)$$

where:

$C_{\min}$ is the yellow part of the colour of the greenest area within the main probe in %;

$C_{\max}$ is the yellow part of the colour of the most olive-brown turned area within the main probe in %;

$\Delta C_{\text{distribute}}$ is the difference of the yellow parts $C_{\max}$ and $C_{\min}$;

- state the hue angle values $h_{\max}$ and $h_{\min}$ of the main measurement in h_{ab} ;
- calculate the difference $\Delta h_{\text{distribute}}$ as follows and state in h_{ab} :

$$\Delta h_{\text{distribute}} = h_{\max} - h_{\min} \quad (25)$$

where:

$h_{\max}$ is the hue angle value of the colour of the greenest area within the main measurement in h_{ab} ;

$h_{\min}$ is the hue angle value of the colour of the most olive-brown turned area within the main measurement in h_{ab} ;

$\Delta h_{\text{distribute}}$ is the difference of the hue angle values $h_{\max}$ and $h_{\min}$;

- find the NCS green shade chart which characterizes the colour of the reference probe measurement best and state the yellow part C_R hue angle value h_R of the reference probe measurement;

- calculate the difference $\Delta C_{\text{control}}^{\min}$ as follows and state in %:

$$\Delta C_{\text{control}}^{\min} = |C_{\min} - C_R| \quad (15)$$

where:

$\Delta C_{\text{control}}^{\min}$ is the minimum colour difference between main probe and reference probe;

$C_{\min}$ is the yellow part of the colour of the greenest area within the main probe in %;

C_R is the yellow part of the colour within the reference probe in %.

- calculate the difference $\Delta h_{\text{control}}^{\min}$ as follows and state in h_{ab} :

$$\Delta h_{\text{control}}^{\min} = |h_{\max} - h_R| \quad (26)$$

where:

- $\Delta h_{\text{control}}^{\text{min}}$ is the minimum colour difference between main measurement and reference measurement;
- h_{max} is the hue angle value of the colour of the greenest area within the main measurement in h_{ab} ;
- h_R is the hue angle value of the colour within the reference measurement in h_{ab} .

— calculate the difference $\Delta G_{\text{control}}^{\text{max}}$ as following and state in %:

$$\Delta G_{\text{control}}^{\text{max}} = \frac{|G_{\text{max}} - G_R|}{G_R} \quad (16)$$

where:

- $\Delta G_{\text{control}}^{\text{max}}$ is the maximum colour difference between main probe and reference probe;
- G_{max} is the yellow part of the colour of the most olive-brown turned area within the main probe in %;
- G_R is the yellow part of the colour within the reference probe in %.

— calculate the difference $\Delta h_{\text{control}}^{\text{max}}$ as following and state in h_{ab} .

$$\Delta h_{\text{control}}^{\text{max}} = |h_{\text{min}} - h_R| \quad (27)$$

where:

- $\Delta h_{\text{control}}^{\text{max}}$ is the maximum colour difference between main measurement and reference measurement;
- h_{min} is the hue angle value of the colour of the most olive-brown turned area within the main measurement in h_{ab} ;
- h_R is the hue angle value of the colour within the reference measurement in h_{ab} .

The difference $\Delta G_{\text{distribute}}$ $\Delta h_{\text{distribute}}$ determined on one level defines the horizontal distribution of steam.

The difference $\Delta G_{\text{distribute}}$ $\Delta h_{\text{distribute}}$ determined on more levels defines the vertical distribution of steam.

The differences $\Delta G_{\text{control}}^{\text{min}}$ and $\Delta G_{\text{control}}^{\text{max}}$ $\Delta h_{\text{control}}^{\text{min}}$ and $\Delta h_{\text{control}}^{\text{max}}$ define the differences between the green colour of the main probe measurement and the best achievable colour.

NOTE 1 The bigger $\Delta G_{\text{distribute}}$ $\Delta h_{\text{distribute}}$ is, the more uneven the distribution of steam is. The bigger $\Delta G_{\text{control}}^{\text{max}}$ and $\Delta G_{\text{control}}^{\text{min}}$ $\Delta h_{\text{control}}^{\text{max}}$ and $\Delta h_{\text{control}}^{\text{min}}$ are, the worse is the ability to steam broccoli in general.

The water consumption is recorded either by a 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.

The following data are stated for the horizontal steam distribution:

~~$\Delta G_{\text{distribute}}$, $\Delta G_{\text{control}}^{\text{max}}$ and $\Delta G_{\text{control}}^{\text{min}}$ in %;~~

- $\Delta h_{\text{distribute}}$, $\Delta h_{\text{control}}^{\text{max}}$ and $\Delta h_{\text{control}}^{\text{min}}$ in h_{ab} ;
- the mass of broccoli per level (before steaming);
- the cooking time (preheating time included);
- the energy consumption (preheating included) in Wh;
- the water consumption;
- whether the water tank shall be refilled during steaming.

If the optional test for vertical steam distribution has been carried out, the following data are stated:

~~$\Delta G_{\text{distribute}}$, $\Delta G_{\text{control}}^{\text{max}}$ and $\Delta G_{\text{control}}^{\text{min}}$ in %;~~

- $\Delta h_{\text{distribute}}$, $\Delta h_{\text{control}}^{\text{max}}$ and $\Delta h_{\text{control}}^{\text{min}}$ in h_{ab} ;
- the number of levels used simultaneously;
- the mass of broccoli per level and over all levels (before steaming);
- the cooking time (preheating time included);
- the energy consumption (preheating included) in Wh;
- the water consumption;
- whether the water tank shall be refilled during steaming.

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

10.3 Determination of the capacity

10.3.1 Purpose

The purpose of this test is to assess the capacity of the appliance. The measurements are made with deep-frozen peas, which simulate a heavy load. The capacity of the appliance is determined by the maximum mass ($= m_{\text{max}}$ in g) of frozen peas steamed.

This heavy load is representative of the capacity of the appliance, for example of the extent to which it is possible to prepare a full meal for one or more persons. The amount of frozen peas, which can be steamed up to $(85 \pm 1) ^\circ\text{C}$, be uniform in colour, in a certain time with only ~~the range of one water tank filling one tank of water~~, categorizes the **steam oven** to a high-level capacity, middle-level capacity and low-level capacity.

10.3.2 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.~~ The peas shall not have any bits of ice. The colour of the frozen peas shall be homogenous and green as far as possible.

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

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

10.3.3 Mass of peas, steaming accessories and number of levels

The mass of peas, the number of levels used simultaneously and the accessory/accessories are determined according to the manufacturer's instructions.

If no instructions are given:

- the maximum load depends on the size of the supplied steaming accessory;
- the height of the load measured in the accessory shall be (40 ± 2) mm. If the height of the accessory is lower than 40 mm, the peas shall be filled at maximum height;
- only one level is used.

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

10.3.4 Procedure

10.3.4.1 General

For appliances without a fixed fresh water supply the tank shall be filled with water until the maximum level is reached. The temperature of water shall be (15 ± 1) °C.

Take the peas out of the freezer and fill the necessary amount into the steaming accessory/accessories.

Check the height of the load with a gauge and weigh the total amount. Steam the peas immediately after filling in the accessory.

Steam in accordance with the manufacturer's instructions for this type of food with respect to the **steam function**, temperature, shelf position/s and preheating.

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

If no instructions are given:

- set the **steam function**;
- adjust the temperature to the highest possible setting ≤ 100 °C;
- place the accessory/accessories in the middle of the calculated cavity;
- do not preheat.

Thermocouples are led through the door gap in such a way that the door is completely sealed.

While the peas are steaming, the position of the accessory shall not be changed.

At the end of steaming, remove all accessories immediately and simultaneously.

10.3.4.2 Preliminary test

A preliminary test is carried out to determine the position of the coldest spot of the load.

Fix one thermocouple in accordance with 5.3 on each used level in the geometrical centre of the load.

Steam the peas in accordance with 10.3.4.1.

When the centre of the load reaches approximately 70 °C, remove the accessory/accessories.

Detect the coldest spot and check the temperature distribution of the whole load in a sensory manner (e.g. visually or by feeling the coldest spot).

The position of the coldest spot is noted (area, height and level if necessary).

NOTE 1 The coldest spot is easier to determine if more thermocouples are evenly distributed in the load.

NOTE 2 Normally, the coldest spot is located under the surface.

10.3.4.3 Main test

For the main test, five thermocouples are used. One is positioned at the detected coldest spot. The others are evenly distributed in the mass of the peas in order to detect if the coldest spot moves.

When the last of the thermocouples has reached a temperature of $(85 \pm 1) ^\circ\text{C}$, the steaming process is finished. State the cooking time.

10.3.5 Assessment

10.3.5.1 Criteria for validity

In a first step, ensure the validity of the main test. In a second step, state the final result (see 10.3.5.2).

Results of the main test in accordance with 10.3.4.3 are valid and shall only be accepted if the following criteria are fulfilled.

a) Uniformity of colour

Determine the colour of the peas immediately after steaming. The determination shall be finished no more than 5 min after steaming.

Detect the areas of the steamed peas with the minimum (= ~~best~~ worst) and maximum (= ~~worst~~ best) ~~yellow part~~ hue angle value of the green colour, see IEC TS 63350. Colours shall be visible in concentrated areas, while single peas are not relevant. Check also the peas under the surface.

Find the ~~NCS~~ green shade charts which characterize the colours of the best and worst area by using the green shade charts specified in ~~Annex F~~ IEC TS 63350. State the ~~yellow parts~~ hue angle values of these colours. Calculate the difference of the ~~yellow parts~~ (for an example see Annex F, Note 3) hue angle values. The difference between the minimum and maximum ~~yellow parts~~ hue angle values shall not be more than ~~10 %~~ 7.

NOTE Supplementary files to generate the green shade chart are located at <https://www.iec.ch/sc59k/supportingdocuments>.

b) Cooking time

The cooking time is determined in relation to the reference time t_{ref} given in Figure 18 for this load, preheating time included.

Cooking time shall not be longer than two times of the reference time.

The determined cooking time can be included into Figure 18.

NOTE The reference line in Figure 18 is determined empirically.

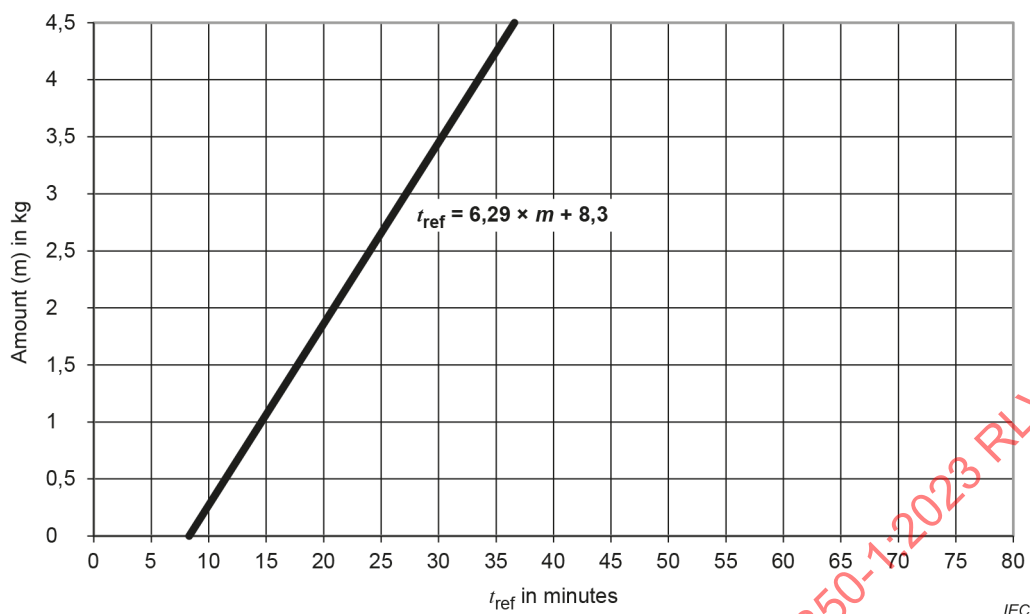


Figure 18 – Reference values of cooking time (t_{ref})

c) Water tank

The water tank shall not be refilled during steaming.

If one of these criteria is not fulfilled, the test shall be repeated with a lower mass of peas. The mass of peas shall be reduced in 20 % increments from the frozen peas' mass before steaming.

10.3.5.2 Final result

If the result is valid, the capacity – i.e. the maximum amount of peas m_{max} steamed with an acceptable quality according to the criteria in 10.3.5.1 – shall be stated.

NOTE 1 Steaming more than 2 000 g of frozen peas is representative for a high-level capacity **steam oven** which is more applicable, for example, for menu cooking for a group of persons. A **steam oven** which steams less than 1 000 g of frozen peas has a low-level capacity.

The number of levels used simultaneously is stated.

The energy consumption is expressed in Wh (preheating included).

NOTE 2 Energy consumption and cooking time are not comparable as different amounts of peas are taken as a basis.

10.4 Accuracy of the temperature control

The purpose of this test is to determine the accuracy for the **steam function** of the temperature control for a low setting.

Prior to the measurements, the whole appliance shall be at ambient temperature of $(23 \pm 2) ^\circ\text{C}$. The temperature control element is set to the position marked $90 ^\circ\text{C}$ and the appliance is heated for $t_{\text{check},90} = 45 \text{ min}$.

If the control element is not marked at $90 ^\circ\text{C}$, the next lower marked setting is taken into account.

The temperature is recorded continuously in line with 7.2.

The temperature is respectively determined as the arithmetic mean of the minimum and maximum temperature reached during the last 20 min of t_{check} .

The arithmetic mean of the temperature and the minimum and maximum temperatures are noted.

11 Effective grilling area

11.1 Purpose

The purpose of this test is to determine the effective grilling area (E). The effective grilling area is the part of the usable area of the grill grid (see 6.5) where white bread reaches a required browning intensity during grilling.

11.2 Ingredients

The measurement is done with factory-made white bread made of wheat (e.g. Golden Toast⁶), which is commonly available and suitable for toasting. The slices of bread shall have an edge length of at least 80 mm and a thickness of $12 \text{ mm} \pm 1 \text{ mm}$. It shall be fine-pored.

If more than one loaf of bread is necessary, it shall be from the same batch. Therefore, the bread shall be bought from the same supplier, at the same time and stored under same conditions until needed for the measurements. It shall be used before the expiry date.

11.3 Preparation

Discard the first two and the last two slices of one package because these slices often have a different texture. Remove the crust and cut the slices of bread to an edge length of $70 \text{ mm} \pm 1 \text{ mm}$.

Determine the usable area of the grill grid (A_U) and state it in cm^2 . Cover the usable area of the grill grid completely (without gaps in between) with bread. For this, it can be necessary to trim some slices. The minimum width and length of each slice shall not be less than 35 mm.

11.4 Procedure

Follow the operating instructions with respect to the **heating function**, temperature, shelf and preheating. If preheating is recommended, the grill grid is 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 grill grid is placed in the highest possible level in the not-preheated **oven** until it reaches the stop position of the rack, the door is closed, and the bread is grilled with the highest possible setting.

During the grilling process, the door may be opened once for a maximum of 3 s to check the browning, but without moving the grid.

Remove the grill grid when the bread is browned and burnt spots start to appear ($\geq$ shade number 15).

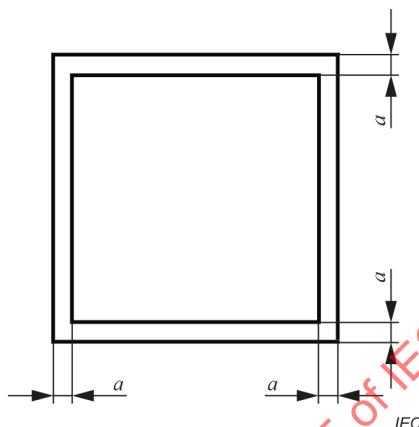
⁶ Golden Toast is the trade name of a product supplied by Lieken Brot und Backwaren GmbH. Golden Toast might be commercially available through other suppliers after the date of publication of this standard. This information is given for the convenience of the users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products ~~may~~ can be used if they can be shown to lead to the same results.

11.5 Assessment

11.5.1 General

Assess the browning of the bread within 1 h. Through the grilling process, the slices of bread might bulge, which could increase the browning of the edges. Therefore, the top area of a slice of toast is reduced alongside its outline shown in Figure 19 by 2 mm to 3 mm from each side.

The assessable area (A_a) is the top area after grilling considering the shrinkage of toast and cutting the slices; see Figure 19.



Key

a is the rejected part of each edge length; $2 \text{ mm} \leq a \leq 3 \text{ mm}$

Figure 19 – Determining the assessable area of a slice of toast – Example

11.5.2 Criteria of validity

For a valid result, sufficient browning is required. This is ensured if the percentage of burned parts of the assessable area in total is $\geq 3 \%$ to $\leq 15 \%$. Burned areas ($A_{\geq 15}$) are defined by showing a shade number ≥ 15 in accordance with ~~Annex B~~ IEC TS 63350. To determine the shade numbers, a digital evaluation system in accordance with ~~7.5.3.6.3~~ IEC TS 63350 should be used.

If the result is invalid, repeat the test with adapted time.

11.5.3 Criteria of assessment

The relative effective grilling area E_r is calculated with the following formula:

$$E_r = \frac{A_{8-14}}{A_a - A_{\geq 15}} \times 100 \quad (28)$$

where

E_r is the relative effective grilling area, in %;

A_{8-14} is the assessable properly browned area with a shade number within the range of ≥ 8 and ≤ 14 , in cm^2 ;

$A_{\geq 15}$ is the assessable burnt area with a shade number ≥ 15 , in cm^2 ;

A_a is the assessable area, in cm^2 .

The absolute effective grilling area E_a in cm^2 is calculated as follows:

$$E_a = \frac{A_{8-14}}{A_a} \times A_u \quad (29)$$

Additionally, the following areas shall be noted:

- the not browned area N in cm^2 :

$$N = \frac{A_{<8}}{A_a} \times A_u \quad (30)$$

- the burnt area B in cm^2 :

$$B = \frac{A_{\geq 15}}{A_a} \times A_u \quad (31)$$

where

A_{8-14} is the assessable properly browned area with a shade number within the range of ≥ 8 and ≤ 14 , in cm^2 ;

$A_{\geq 15}$ is the assessable burnt area with a shade number ≥ 15 , in cm^2 ;

$A_{<8}$ is the assessable not browned area with a shade number < 8 ;

A_a is the assessable area, in cm^2 ;

A_u is the usable area of the grill grid, in cm^2 .

The final effective grilling area is calculated as an average of three valid tests.

Additionally, if the upper surface of the bread that is assessed is above or below half the ~~usable~~ height measured in accordance with 6.2.2, this shall be reported.

12 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 Wh for 1 h of operation.

13 Cleaning

13.1 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 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 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/dm².

The door is closed and the **oven** energized for 3 h with the temperature control set to 250 °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.

13.2 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 1 000 g 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.

14 Consumption measurement of low-power modes

~~In addition to IEC 62301, the following requirements are given.~~

14.1 Purpose and combination of appliances

This clause sets out determination of **off mode**, **standby mode**, **standby mode in condition of networked standby** and **delay start**. Other low-power modes can exist in some appliances, but for the current designs, these are not considered important in terms of duration and energy

consumption. For example, the cooling down period is an associated activity to the **active mode** in which the cooling fan runs for safety reasons. The measurement of the energy consumption of these associated activities is not considered.

For an appliance composed of a combination of separate units which ~~may~~ can 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 in combination 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 the 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 the energy consumption of the **active mode** and low-power modes of **hobs** is described in IEC 60350-2.

14.2 Measurement

14.2.1 Principles

The requirements of IEC 62301 and IEC 63474 shall be observed in addition to the following requirements.

However, 5.3 and the requirement defining air speed in IEC 62301:2011, 4.2 shall not apply.

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.

If energy consumption is influenced by the continuously 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 with IEC 62301 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.

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

- instructions for use regarding installation, operation and settings (as applicable) are followed;
- the appliance shall be connected to mains power for the duration of the test;
- no adverse warning indicators are present;
- follow the manufacturer's instructions regarding the configuration of **network** connectivity (where applicable);
- ensure that the **network** is connected to the appliance (when required);
- ensure that all components of the appliances are at ambient temperature;
- ensure that the door is closed;
- after each appliance interaction, wait at least 15 min before commencing with measurements; and

- no interference during measurement by any interaction.

Some appliances can require software updates to ensure secure network operations. It is recommended to allow those updates to be installed and to make a note of it in the test report. Updates can occur or can be requested after activation of network capability and the update process can affect energy during measurement. The measurement starts after the completion of any software update.

The required power consumption can be determined by measuring the power consumption directly for a certain period of time (not less than 10 min). The data shall be recorded at regular intervals of 1 s or less throughout the test using a data logger or computer. The average power is given in watts and rounded with two valid digits after the decimal point.

Alternatively, the energy consumption can be measured for a certain period of time (not less than 10 min) and the power consumption be calculated by dividing the measured energy consumption (measured in Wh) by the duration of the measurement (in h). The calculated power is given in watts and rounded with two valid digits after the decimal point.

Appliances with a power management system switch automatically to **off mode** or **standby mode** after a certain period of time following appliance interaction. Relevant appliance interactions to be considered for measurement are:

- after the appliance has been switched on, or
- at the end of any cycle and associated activities, or
- after any interaction, directly (i.e., physical) or indirectly (e.g., remote user interface) with the appliance, or
- if no other mode, including emergency measures, is triggered.

Appliance interactions during a cycle shall not be considered for measurement. Step-by-step instructions for measuring the low-power modes is given in Annex G.

14.2.2 Determination of power consumption in off mode

This subclause is only applicable to appliances providing an **off mode**.

The appliance under test should be set to **off mode** following the manufacturer's instructions. All actions required to set to **off mode**, such as emptying the water tank, removal of the food, or closing the door, shall be taken.

In all cases, the **off mode** shall be determined over a period of not less than 10 min. The power consumption of the **off mode** is the average of the measured data.

If the appliance provides an **off mode**, it should be described by the manufacturer.

14.2.3 Determination of power consumption in standby mode

This subclause is only applicable to appliances providing a **standby mode**.

The appliance under test should be set to **standby mode** following the manufacturer's instructions. All actions required to set to **standby mode**, such as emptying the water tank, removal of the food, or closing the door, shall be taken.

In all cases, **standby mode** shall be determined over a period of not less than 10 min. The power consumption of the **standby mode** is the average of the measured data.

If the appliance provides a standby mode, it should be described by the manufacturer.

14.2.4 Determination of power consumption in standby mode in condition of networked standby

This subclause is only applicable to appliances providing a **standby mode in condition of networked standby**.

For **appliances** with **network** connectivity, follow the manufacturer's instructions regarding the configuration of the appliance and ensure that **network** (e.g., LAN or WLAN) is connected to the appliance and activated.

The highest possible power consumption can be reached when the appliance is not only connected to the **network** but also to a remote user interface (i.e. an app). Avoid any interaction with the remote user interface during the 15 min waiting time and the measurement.

In all cases, **standby mode in condition of networked standby** shall be determined over a period of not less than 10 min. The power consumption of the **standby mode in condition of networked standby** is the average of the measured data.

Ensure that there is no download and no update running during measurement.

The test report shall contain the description of the **network** connection used.

14.2.5 Determination of power consumption in delay start

This mode is only applicable to appliances providing a **delay start**.

For determination of this mode, the operator can select any **heating function** and any user-programmed delay.

If available, **network** connection shall be activated.

Select any **heating function** and temperature setting, set the delay start and activate **delay start**. Power measurements in **delay start** shall commence at the earliest 15 min after the moment the **delay start** is activated and shall continue for at least 10 min; therefore, the delay start setting shall cover at least 25 min.

The selected **heating function** and temperature, the delay start setting selected, and the duration of the measurement shall be stated with the measured power value.

Where the display changes during the timer countdown, there can be some small variations in power consumption during this mode.

The power consumption of the **delay start** is the average of the measured data.

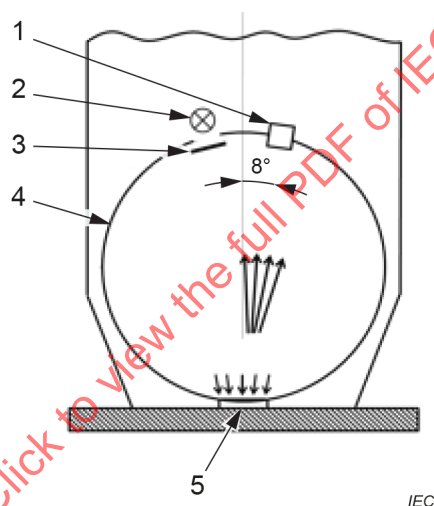
NOTE For an appliance, the term "latched" means that the door is closed, and the door interlock is engaged so that the product could operate if required.

Annex A (normative)

Colour measuring instrument

The instrument (see Figure A.1) is in accordance with CIE 15 with the following specification:

- measuring geometry: diffuse, 8° vertical deviation;
- measuring aperture: diameter 8 mm to 16 mm;
- calibration standard: white, pressed barium sulfate (BaSO_4), polytetrafluoroethylene (PTFE) or equivalent;
- wavelength range: $400 \text{ nm} \leq \lambda \leq 700 \text{ nm}$;
- wavelength interval: $\leq 10 \text{ nm}$;
- standard illuminant: CIE standard illuminant D65;
- standard observer: 10°;
- evaluation: CIEXYZ (CIE 1931) / CIELAB (CIE).



Key:

- | | | | |
|---|---------------------|---|-----------------------------------|
| 1 | detector | 4 | integrating sphere |
| 2 | illumination source | 5 | specimen under measuring aperture |
| 3 | shutter | | |

Figure A.1 – Colour measuring instrument

Annex B (normative)

Brown shade charts

Annex B specifies the relation between the reflection value R_y and the shade numbers corresponding to the NCS shade charts (see Tables B.1 and B.2).

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 the 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 can be ordered at official NCS Centres all over the world. The following address shows potential distributors.

Sweden (Head Office)

Scandinavian Colour Institute AB

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

Internet: www.ncscolour.com

E-mail: info@ncscolour.comPost

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex B (informative)

Addresses of suppliers

B.1 General

The information given is for the convenience of users of this document and does not constitute an endorsement by the IEC of the products named. Equivalent products may be used if they can be shown to lead to the same results.

NOTE Possible suppliers for aids used for the assessment of baked or steamed items are recommended in the supporting documents, located at <https://www.iec.ch/sc59k/supportingdocuments>.

B.2 Testing ingredients for small cakes

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

Erbesenbodenstr. 31
D-91207 Lauf – Germany
e-mail: r.stamminger@web.de
Phone: +49 (0) 9123-988975
Fax: +49 (0) 9123-988489
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 B.1.

Table B.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 ⁷ , deep frozen (at least –18 °C) pH 6.4 to 7.0 Dry substance 22,7 % to 23,7 %
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 per 100 g 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/m² bleached greaseproof paper

Manufacturer: Bacher und Demmler GmbH & Co. KG
Kaiser-Wilh.-Str. 7-15
Germany – 12247 Berlin
bu@demmler.de

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 ± 2) °C. Put one package of frozen egg into the warm water so that it is covered completely. It might be necessary to weight it down, for example with a cup. Stir the water from time to time and shake the package.

⁷ Tetra Brik is the trade name of a product supplied by Tetra Pak®. 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.

After 1 h, discard the first lot of water and completely renew with another 5 l of warm water at $(30 \pm 2) ^\circ\text{C}$ completely covering the package 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 $(23 \pm 2) ^\circ\text{C}$. Open the package and mix the egg with a fork for approximately 30 s until it looks homogenous and can thus be used like fresh eggs.

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

An unopened package can be stored in a fridge.

B.3 Food mixer

This clause describes an appropriate food mixer for the dough for the small cakes used in 9.2.2. Mixing times and levels are determined for the Bosch MUM4 series, e.g. Bosch MUM4405⁸.

Specification of an appropriate food mixer:

- power rating $(550 \pm 50) \text{ W}$;
- revolutions per minute, see Table B.2;

Table B.2 – Food mixer – revolutions per minute

	Revolutions per min			
	Level 1	Level 2	Level 3	Level 4
Wire balloon whisk	(53 ± 5)	(93 ± 5)	(185 ± 5)	(325 ± 5)

- wire balloon whisk;
- bowl, approximately 3,5 l, top diameter $(23 \pm 2) \text{ cm}$;
- the machine should be able to beat the sugar and butter to a soft and pale mixture in approximately 5 min.

Table B.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 Lamp for digital measurement systems~~

~~A possible supplier is:~~

~~Narva-Typ Bio-Vital 958
NARVA – Lichtquellen GmbH + Co. KG~~

⁸ BOSCH MUM 4405 is the trade name of a product supplied by Bosch. It might be commercially available by other suppliers after the date of publication of this document. This information is given for the convenience of the 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.

~~www.narva-bel.de
office@nava-bel.de
Erzstraße 22
Germany 09618 Brand-Erbisdorf
Telephone: +49 37322/17200
Fax: +49 37322/17203~~

~~C.5 — Digital measurement system~~

~~Possible suppliers⁹ are~~

- ~~1) — Ziemann & Urban GmbH —
Prüf- und Automatisierungstechnik
www.ziemann-urban.de —
info@ziemann-urban.de~~
- ~~2) — Ing. Büro W. Neubauer —
http://www.fpga-design.de
wn@fpga-design.de~~

B.4 Colour measuring instrument

(See Annex A.)

Possible suppliers of the colour measuring instrument are:

FMS Jansen GmbH & Co. KG
HunterLab
<http://www.hunterlab.de>
info@hunterlab.de

Konica Minolta Sensing Europe B.V. European Service Center
<http://www.konicaminolta.eu>
esc@seu.konicaminolta.eu

~~C.7 — Brick for testing energy consumption of ovens~~

~~(See 7.4.)~~

~~Bricks are available under the type designation “SkamOven Hipor” from the following supplier⁸:~~

~~Skamol A/S
Hesselager Centervej 1
Denmark — 8260 Viby~~

B.5 Steaming basket

(See Clause 10)

A possible supplier is:

⁹ — This information is given for the convenience of the users of this document and does not constitute an endorsement by IEC of the suppliers named.

Fackelmann
<http://www.fackelmann.de>
Art.-no.: 42491

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex C (normative)

Description of the test brick

C.1 Specification

Name	SkamOven Hipor ¹⁰
Bulk density, dry	$(550 \pm 40) \text{ kg/m}^3$
Total porosity	77 %
Dry weight	$(920 \pm 75) \text{ g}$ (without thermocouples), see 8.3.2
Water absorption	$(1\,050 \pm 50) \text{ g}$, see 8.3.3
Height	$(64 \pm 0,5) \text{ mm}$

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

C.2 Supplier and order specification

~~A possible supplier of the brick is:~~

~~SKAMOL INSULATION~~

~~Østergade 58 – 60~~

~~DK – 7900 Nykøbing Mors~~

Bricks are available under the type designation "SkamOven Hipor" from the following supplier:

Skamol A/S
Hesselager Centervej 1
Denmark – 8260 Viby

~~When ordering please state:~~

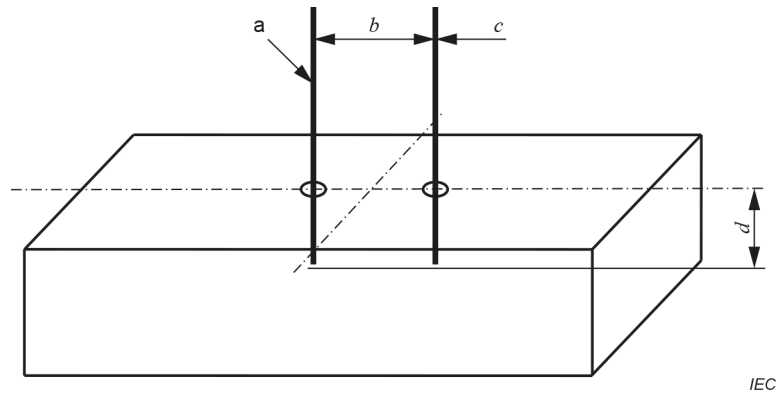
~~— the brick name "Hipor", according to the Electrolux agreement,~~

- length × width × height: 230 mm × 114 mm × 64 mm (see sketch in Figure C.1),
- machined on all six surfaces, tolerances $\pm 0,5 \text{ mm}$.

The diameter of the ~~hole need not and~~ holes should not be bigger than the diameter of the thermocouple.

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 a diameter of 1 mm could serve as a drill.

¹⁰ Hipor is the trade name of a product supplied by SKAMOL A/S. 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.



Key

- a Two metal sheet tube thermocouples
- b 50 mm, with holes which are equidistant to the brick's centre line
- c 1 mm $\varnothing$, both thermocouples and holes
- d 32 mm both thermocouples

Figure C.1 – Position of the thermocouples

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex E
(informative)

Data and calculation sheet: Energy consumption for heating a load (7.4)

The data and calculation sheet should be used to determine the energy consumption for heating a load.

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

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 Δm (g)	end cooking weight (informative) (g)	weight loss (informative) (g)	start temperatures thermocouple		energy consumption E_k (kWh)	time t_k (min)	average ambient temp. (°C)	nominal value ΔT^{ic} (K)	real value $\Delta T^{ic}_{k,setting}$ (°C)	real value ΔT^{ic} (K)	setting $T^{ic}_{k,s}$ (°C)	temperature difference		
						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 $\Delta T_0 = 180\text{ K}$						S * $\Delta T_0 + B$		Slope S		Intercept B		Standard deviation σ					
Energy (linear regression)						calc.		calc.		calc.		calc.					
Time (linear regression)						calc.		calc.		calc.		calc.					



60350_1_Calculation
sheet.xls

Heating function: Forced air circulation (if)													nominal temperature rise: 155 K				
bricks						measured			room		oven temperature						
no.	dry weight m_b (g)	wet weight m_w (g)	absorbed water Δm (g)	end cooking weight (informative) (g)	weight loss (informative) (g)	start temperatures thermocouple		energy consumption E_k (kWh)	time t_k (min)	average ambient temp. (°C)	nominal value ΔT^{if} (K)	real value $\Delta T^{if}_{setting}$ (°C)	real value ΔT^{if} (K)	setting $T^{if}_{k,s}$ (°C)	temperature difference (K)		
			calc.		calc.						135 ± 10		calc.		calc.		
			calc.		calc.						155 ± 10		calc.		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 σ				
Energy (linear regression)						(kWh)			calc.		calc.		$\Delta T^{if}_{k,setting} \leq 20\text{ K}$				
Time (linear regression)						(min)			calc.		calc.		calc.				

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

Annex F (normative)

Green shade charts

Annex F specifies the relevant NCS shade numbers and the yellow parts of the green colours for steamed peas and broccoli (see Table F.1 and Clause 8).

Table F.1 – Specification of relevant green shade charts

NCS shade number	Hue	Yellow part of the green colour [%]
S 2070-G30Y S 3060-G30Y S 4050-G30Y S 5040-G30Y S 6030-G30Y S 7020-G30Y S 8010-G30Y	G30Y	30 %
S 2070-G40Y S 3060-G40Y S 4050-G40Y S 5040-G40Y	G40Y	40 %
S 2070-G50Y S 3060-G50Y S 4050-G50Y S 5040-G50Y S 6030-G50Y S 7020-G50Y S 8010-G50Y	G50Y	50 %
S 2070-G60Y S 3060-G60Y S 4050-G60Y S 5040-G60Y	G60Y	60 %
S 2070-G70Y S 3060-G70Y S 4050-G70Y S 5040-G70Y S 6030-G70Y S 7020-G70Y S 8010-G70Y	G70Y	70 %
S 2070-G80Y S 3060-G80Y S 4050-G80Y S 5040-G80Y	G80Y	80 %

NCS shade number	Hue	Yellow part of the green colour [%]
S 2070-G90Y	G90Y	90 %
S 3060-G90Y		
S 4050-G90Y		
S 5040-G90Y		
S 6030-G90Y		
S 7020-G90Y		
S 8010-G90Y		

NOTE 1—The NCS shade charts, such as the NCS shade charts in Annex B, can be ordered at official NCS Centres all over the world.

NOTE 2—For testing peas and broccoli only the yellow part of the green colour is relevant. First the NCS shade number (see Table F.1) which fits best with the colour of broccoli / peas is determined. Then the yellow part of this green colour is stated.

NOTE 3—Example for stating the difference of the yellow parts of the green colours:

One determined NCS shade number is S2070-G40Y, accordingly the yellow part of this colour is 40 %.

Another determined shade number is S3060-G60Y, accordingly the yellow part of this colour is 60 %.

The difference between the yellow parts of both colours is $60 \% - 40 \% = 20 \%$.

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex G (informative)

Measurement of the energy consumption of the cooling down period

G.1 Purpose

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, see Figure G.1.

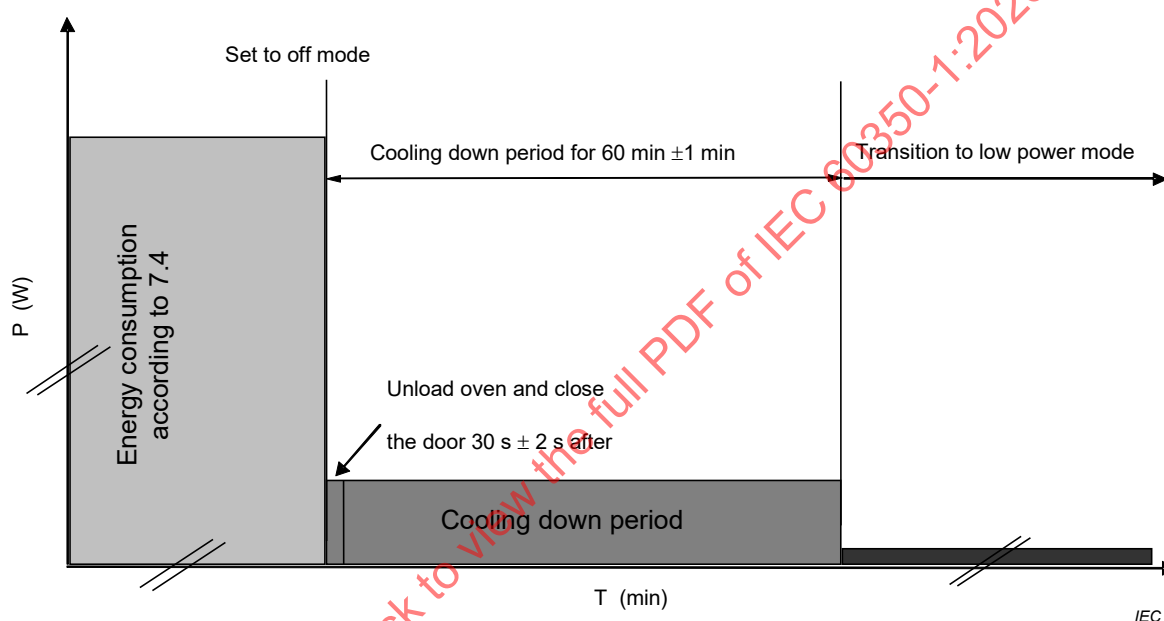


Figure G.1 – Phases of energy consumption measurement – Example

G.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 appliance as described in Clause 7.

The temperature control is set to positions where the mean **oven** temperature rises $\frac{\Delta T_i}{2}$, as defined in Table 1, can be expected. The appliance is run for some time without changing the setting until steady state conditions are 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 $\frac{\Delta T_i}{2} \pm 5$ K. This temperature control setting is noted for measuring the energy consumption of the **cooling down period**.

~~The appliance is cooled down to ambient temperature.~~

~~G.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 appliance according to 7.4.3.1. The appliance 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 Clause G.2. The appliance is operated for the time $\frac{t_{\dots}}{\Delta T_0}$ 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 ± 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 ± 1) min independently of whether the ventilation stops automatically.~~

~~The energy consumption for the **cooling down period** 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:~~

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

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex D (informative)

Check of applied microwave energy during the measurement according to Clause 8

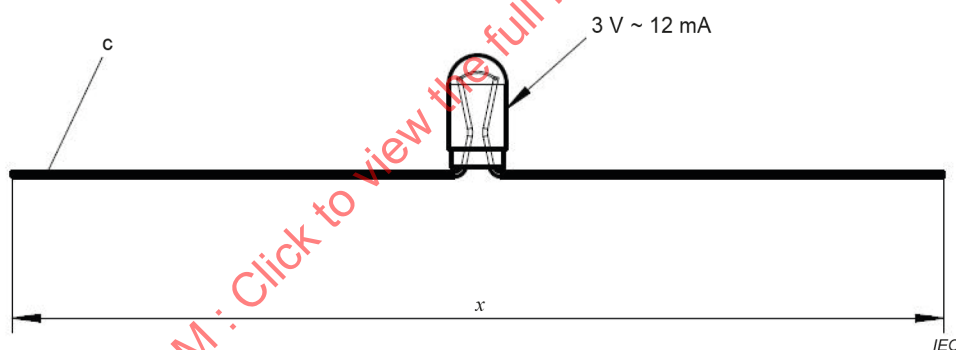
D.1 General

Heating up the brick in accordance with Clause 8 shall only be done with thermal heating. It is not allowed to switch on a magnetron, not even for a short period.

The sophisticated method to check possible applied microwave energy during the energy consumption measurement in accordance with Clause 8 is to prove whether the magnetron is switched on and off. Depending on the design of the appliances, it is not always possible to determine clearly whether the microwave energy is switched on during the long-lasting heating up process. Therefore, the following method can be used in a pre-test.

D.2 Procedure

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



Key

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

Figure D.1 – Filament lamp

The brick is prepared as described in 8.3.3 and placed in the appliance as described in 8.4. The filament lamp is placed on the upper surface of the wet brick. The appliance is switched on and operated in accordance with 8.4.3 for at least the time that is necessary to have a temperature rise in the brick of 55 K.

The appliance is then 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, thereby damaging the filament. The lamp can be tested with 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 this means that microwave energy was applied.

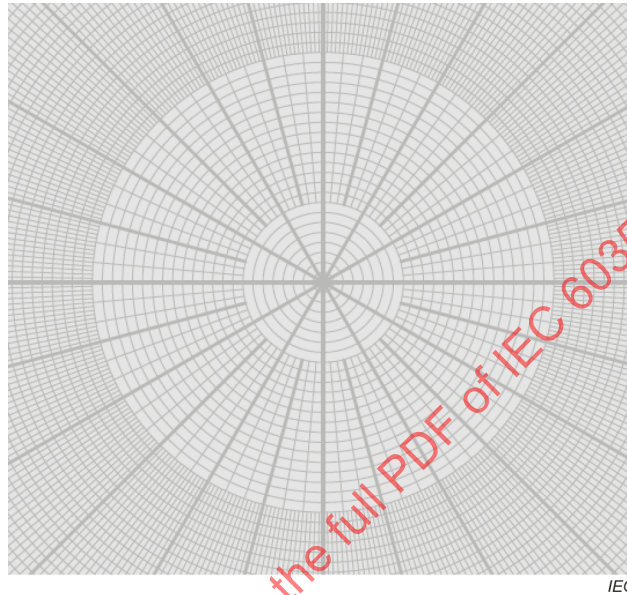
Annex E

(informative)

Marking the temperature setting for checking the oven temperature

For marking the temperature setting on the panel, polar coordinate paper can be useful.

Polar coordinate paper has concentric circles divided into small arcs to allow an exact marking around a knob (see Figure E.1).



IEC

Figure E.1 – Polar coordinate paper – Example

Annex F (informative)

Approach to calculate the f -factor

The following formulas were applied to calculate the f -factor used for calculating the standard deviation in 8.6.1. For calculation in 8.6.1, $f = 1,2$ is always used.

The f -factor is the ratio of the mean regression sum of squares divided by the mean error sum of squares. The value is the probability that the null hypothesis for the full model is true (i.e., that all the regression coefficients are zero).

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

Where:

ΔT_0 is the nominal temperature rise (165 K);

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

$$Q_{xy} = \sum_{k=1}^n \Delta \bar{T}_{c2,k} E_k - \bar{E} \sum_{k=1}^n \Delta \bar{T}_{c2,k}$$

$$Q_x = \sum_{k=1}^n \left(\Delta \bar{T}_{c2,k} \right)^2 - \frac{\left(\sum_{k=1}^n \Delta \bar{T}_{c2,k} \right)^2}{n}$$

$$\Delta \bar{T} = \frac{1}{n} \sum_{k=1}^n \Delta \bar{T}_{c2,k}$$

$$\bar{E} = \frac{1}{n} \sum_{k=1}^n E_k$$

Annex G (normative)

Low-power mode measurements

Table G.1 – Step by step instruction for measuring low-power modes

Standby and off mode							Reference
Mode/ Con- dition	Step	Appliance without delay start and without network standby	Appliance with delay start and without network standby	Appliance without delay start and with network standby	Appliance with delay start and network standby	Measured parameter	
Not connected to network (deactivate network connection if activated)	1	Connect appliance to power supply	Connect appliance to power supply	Connect appliance to power supply	Connect appliance to power supply		14.2.2
	2	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*		14.2.3
	3	Measure power consumption	Measure power consumption	Measure power consumption	Measure power consumption	Standby mode P_s or Off mode P_o	
	4	Turn on appliance	Turn on appliance	Turn on appliance	Turn on appliance		14.2.2
	optional	Complete (any) cycle	Complete (any) cycle	Complete (any) cycle	Complete (any) cycle	Describe in test report	14.2.3
	5	Cool down to ambient temperature	Cool down to ambient temperature	Cool down to ambient temperature	Cool down to ambient temperature		
	6	Appliance interaction**	Appliance interaction**	Appliance interaction**	Appliance interaction**	Describe in test report	
	7	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*		
Connected to network (if available)	8	Measure power consumption	Measure power consumption	Measure power consumption	Measure power consumption	Standby mode P_s or Off mode P_o	
	9	-	-	Turn on appliance if it is not already turned on	Turn on appliance if it is not already turned on		14.2.4
	10	-	-	Activate network connection	Activate network connection		
	optional	-	-	Complete (any) cycle	Complete (any) cycle	Describe in test report	
	11	-	-	Cool down to ambient temperature	Cool down to ambient temperature		
	12	-	-	Wait at least 15 min*	Wait at least 15 min*		
	13	-	-	Measure power consumption	Measure power consumption	Network standby P_n	
	14	-	-	Turn off appliance if it is not already off	Turn off appliance if it is not already off		

	Mode/ Con- dition	Step	Appliance without delay start and without network standby	Appliance with delay start and without network standby	Appliance without delay start and with network standby	Appliance with delay start and network standby	Measured parameter	Reference
Delay start mode	Connected to network (if available)	15	-	Turn on appliance	-	Turn on appliance		14.2.5
		16	-		-	Activate network connection if deactivated		
		17	-	Activate delay start	-	Activate delay start	Describe in test report	
		18	-	Wait at least 15 min *	-	Wait at least 15 min *		
		19	-	Measure power consumption	-	Measure power consumption	Delay start P_D	
* Opening or closing the door by the operator can reactivate the appliance to perform auxiliary functions such as display information or interior light. If an action occurs, 15 min waiting time is needed for the appliance to revert to off mode or standby mode in condition of networked standby. The measurement shall be done with closed door.								
** Appliance interactions can be								
- switch on the appliance;								
- end of active mode and associated activities;								
- cooling phase after completion of the active mode;								
- or any interaction if no other mode is triggered.								

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Bibliography

IEC 60335-2-6, *Household and similar electrical appliances – Safety – Part 2-6: Particular requirements for stationary cooking ranges, hobs, ovens and similar appliances*

IEC 60335-2-9, *Household and similar electrical appliances – Safety – Part 2-9: Particular requirements for grills, toasters and similar portable cooking appliances*

IEC 60350-2, *Household electric cooking appliances – Part 2: Hobs – Methods for measuring performance*

IEC 60705, *Household microwave ovens – Methods for measuring performance*

IEC 61591, ~~Household range hoods~~ *Cooking fume extractors – Methods for measuring performance*

IEC 61817¹¹, *Household portable appliances for cooking, grilling and similar use – Methods of measuring performance*

IEC TR 61923¹², *Household electrical appliances – Method of measuring performance – Assessment of repeatability and reproducibility*

ISO 2813, *Paints and varnishes – Determination of gloss value at 20 degrees, 60 degrees and 85 degrees*

ISO 11664-2, *Colorimetry – Part 2: CIE standard illuminants*

CIE 15:2018, *Colorimetry*

SACHS L. *Applied Statistics – A handbook of techniques*. Second Edition. Springer-Verlag, New York, Berlin, Heidelberg, 1984

¹¹ Withdrawn.

¹² Withdrawn.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**

CONTENTS

FOREWORD.....	6
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	10
4 List of measurements	13
4.1 Dimensions and mass	13
4.2 Oven and combi steam oven	13
4.3 Steam oven and combi steam oven.....	13
4.4 Grill.....	13
4.5 Warming compartments	13
4.6 Cleaning	13
5 General conditions for the measurement	14
5.1 Test room	14
5.2 Electricity supply.....	14
5.3 Instrumentation	14
5.4 Positioning the appliance	15
5.5 Preheating	16
5.6 Setting of controls.....	16
5.7 Rounding	16
6 Dimensions and mass.....	16
6.1 Overall dimensions	16
6.2 Internal dimensions and calculated volume	18
6.2.1 General	18
6.2.2 Internal height	19
6.2.3 Internal width.....	20
6.2.4 Internal depth	20
6.2.5 Calculated volume	20
6.3 Overall internal dimensions and overall volume.....	20
6.3.1 General.....	20
6.3.2 Overall height (H)	21
6.3.3 Overall width (W)	21
6.3.4 Overall depth (D)	21
6.3.5 Overall volume of rectangular cavities	21
6.3.6 Overall volume of non-rectangular cavities	21
6.4 Dimensions of shelves and steaming accessories	21
6.5 Dimensions of grill grids.....	21
6.5.1 Entire area.....	21
6.5.2 Usable area	21
6.6 Dimensions of warming compartments	22
6.7 Mass of the appliance	22
7 Preheating and accuracy	22
7.1 Purpose	22
7.2 Test setup.....	22
7.3 Preheating the empty oven	23
7.4 Accuracy of the control	23
7.4.1 Purpose.....	23

7.4.2	Measurements	23
7.4.3	Assessment	24
8	Energy consumption and time for heating a load	24
8.1	Purpose	24
8.2	Symbols and abbreviations	24
8.3	Test load	25
8.3.1	General	25
8.3.2	Pre-treatment	25
8.3.3	Preparation	26
8.4	Measurement	26
8.4.1	Test Procedure	26
8.4.2	Oven settings	29
8.4.3	Phase 1	30
8.4.4	Phase 2	31
8.5	Calculation	31
8.5.1	Smoothing the measured values	31
8.5.2	Determining the average temperature rise for a heating function (phase 2)	31
8.5.3	Determining the average temperature rise for an eco function (phase 2)	33
8.5.4	Calculation of average ambient temperature	35
8.5.5	Determining the <i>c</i> -factor	36
8.5.6	Determining the <i>s</i> -factor	36
8.6	Acceptance verification of the test results	37
8.6.1	Average temperature rise and standard deviation	37
8.6.2	Temperature setting and average temperature rise	38
8.6.3	<i>c</i> -factor	38
8.6.4	<i>s</i> -factor	38
8.7	Final electric energy consumption	38
8.8	Time for heating a load	39
8.9	Reporting of test results	39
9	Cooking tests	40
9.1	General	40
9.2	Heat distribution	40
9.2.1	Shortbread	40
9.2.2	Small cakes	42
9.3	Ability to supply heat	47
9.3.1	Fatless sponge cake	47
9.3.2	Apple pie	48
10	Steam ovens and combi steam ovens	50
10.1	Ability to supply steam	50
10.1.1	Purpose	50
10.1.2	Ingredients and steaming accessory	50
10.1.3	Procedure	50
10.1.4	Assessment	51
10.2	Distribution of steam	52
10.2.1	Purpose	52
10.2.2	Ingredients, steaming accessories and number of levels	52
10.2.3	Procedure	53
10.2.4	Assessment	54

10.3	Determination of the capacity	56
10.3.1	Purpose	56
10.3.2	Ingredients	56
10.3.3	Mass of peas, steaming accessories and number of levels	56
10.3.4	Procedure	56
10.3.5	Assessment	57
10.4	Accuracy of the temperature control	59
11	Effective grilling area	59
11.1	Purpose	59
11.2	Ingredients	59
11.3	Preparation	59
11.4	Procedure	60
11.5	Assessment	60
11.5.1	General	60
11.5.2	Criteria of validity	60
11.5.3	Criteria of assessment	61
12	Warming compartments	62
13	Cleaning	62
13.1	Pyrolytic self-cleaning ovens	62
13.2	Ovens with catalytic cleaning	62
14	Consumption measurement of low-power modes	63
14.1	Purpose and combination of appliances	63
14.2	Measurement	63
14.2.1	Principles	63
14.2.2	Determination of power consumption in off mode	64
14.2.3	Determination of power consumption in standby mode	65
14.2.4	Determination of power consumption in standby mode in condition of networked standby	65
14.2.5	Determination of power consumption in delay start	65
Annex A (normative)	Colour measuring instrument	67
Annex B (informative)	Addresses of suppliers	68
B.1	General	68
B.2	Testing ingredients for small cakes	68
B.3	Food mixer	70
B.4	Colour measuring instrument	71
B.5	Steaming basket	71
Annex C (normative)	Description of the test brick	72
C.1	Specification	72
C.2	Supplier and order specification	72
Annex D (informative)	Check of applied microwave energy during the measurement according to Clause 8	74
D.1	General	74
D.2	Procedure	74
Annex E (informative)	Marking the temperature setting for checking the oven temperature	75
Annex F (informative)	Approach to calculate the f -factor	76
Annex G (normative)	Low-power mode measurements	77
Bibliography		79

Figure 1 – Position of the thermocouple for measuring ambient temperature.....	14
Figure 2 – Dimensions of appliances	17
Figure 3 – Dimensions of built-in appliances	18
Figure 4 – Internal dimensions.....	19
Figure 5 – Gauge for measuring these dimensions	19
Figure 6 – Examples for determining the entire area and usable area of a grill grid.....	22
Figure 7 – Example of a thermocouple	25
Figure 8 – Entire process of measurement.....	27
Figure 9 – Installation observer thermocouple.....	28
Figure 10 – Vertical installation of the observer thermocouple	28
Figure 11 – Horizontal installation of the observer thermocouple	29
Figure 12 – Example – average temperature rise for a heating function	32
Figure 13 – Examples – set temperature reached	34
Figure 14 – Example – set temperature not reached	35
Figure 15 – Shape of the nozzle for extruding pastry	41
Figure 16 – Position of pastry strips on the baking tray	41
Figure 17 – Template for the sectioning of small cakes	46
Figure 18 – Reference values of cooking time (t_{ref})	58
Figure 19 – Determining the assessable area of a slice of toast – Example	60
Figure A.1 – Colour measuring instrument	67
Figure C.1 – Position of the thermocouples.....	73
Figure D.1 – Filament lamp	74
Figure E.1 – Polar coordinate paper – Example	75
Table 1 – Instruments	15
Table 2 – Measurements.....	15
Table 3 – Symbols	24
Table 4 – Temperature rise for three settings.....	30
Table 5 – Ingredients	43
Table B.1 – Ingredient specification	69
Table B.2 – Food mixer – revolutions per minute	70
Table B.3 – Mixing time and setting	70
Table G.1 – Step by step instruction for measuring low-power modes	77

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD ELECTRIC COOKING APPLIANCES –

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60350-1 has been prepared by subcommittee 59K: Performance of household and similar electrical cooking appliances, of IEC technical committee 59: Performance of household and similar electrical appliances. It is an International Standard.

This third edition cancels and replaces the second edition published in 2016 and Interpretation Sheet 1:2021. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) new definitions for heating function, eco function and definitions relevant for low power mode considerations are amended in Clause 3;
- b) order of clauses is changed;
- c) revision of 5.3;
- d) update of 6.2 in order to improve the reliability of volume measurement;
- e) removal of 6.7, Level of shelf;

- f) revision of Clause 7 concerning the accuracy of **eco functions** with residual heat use;
- g) revision of Clause 8 in order to improve the reliability of the method for measuring the energy consumption, especially regarding anti-circumvention;
- h) unique energy consumption measurement for all **heating functions** and **eco functions** with an indication of the energy consumption for a temperature increase of 165 K (compared to 155 K currently for forced air circulation function, for example), which results in higher energy consumption values compared to the previous edition;
- i) R_y replaced by L^* in Clause 9 and reference to IEC TS 63350;
- j) cooking time for reference measurement introduced for broccoli in Clause 10;
- k) yellow part replaced by hue angle value in Clause 10;
- l) requirements for digital assessment (see former 7.5.3.6.3) are obsolete as specified in IEC TS 63350;
- m) revision of Clause 14 (Consumption measurement of low power modes, previous Clause 12);
- n) former Annex G (informative) is cancelled due to the fact that this method for measuring an associated activity has been not applied;
- o) former Annexes B and F are obsolete, up-to-date shade charts are specified in IEC TS 63350;
- p) former Annex E will be substituted by a supporting document located on the IEC's website.

The document contains supplementary material highlighted by notes indicating the link.

The text of this International Standard is based on the following documents:

Draft	Report on voting
59K/365/FDIS	59K/370/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

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

A list of all parts in the IEC 60350 series, published under the general title *Household electric cooking appliances*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 PDF

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.

NOTE 1 This document is also applicable to portable appliances with similar functionalities that were previously covered by the withdrawn IEC 61817.

The **ovens** covered by this document can be with or without microwave function.

Manufacturers are expected to define the primary cooking function of the appliance – microwave function or thermal heat. The primary cooking function is 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.

If the primary function is not declared by the manufacturer, the performance of the microwave function and thermal heat is measured as far as it is possible.

NOTE 2 For measurement of energy consumption and time for heating a load (see Clause 8), this document is furthermore not applicable to:

- microwave combination function;
- **ovens** with reciprocating trays or turntable;
- **small cavity ovens** (see 3.16);
- **ovens** without adjustable temperature control;
- **heating functions** and **eco functions** other than defined in this document;
- appliances with only solo **steam function**.

NOTE 3 This document does not apply to

- microwave ovens (IEC 60705).

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

This document does not specify a classification or ranking for performance.

NOTE 4 This document does not deal with safety requirements (IEC 60335-2-6 and IEC 60335-2-9).

NOTE 5 Appliances covered by this document can be built-in or for placing on a working surface or the floor.

NOTE 6 There is no measurement method for the energy consumption for grilling and **steam functions** available.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 62301:2011, *Household electrical appliances – Measurement of standby power*

IEC TS 63350:2022, *Household electrical appliances – Specification of the properties of a digital system for measuring the performance*

IEC 63474¹, *Electrical and electronic household and office equipment – Measurement of networked standby power consumption of edge equipment*

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

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

active mode

mode in which the appliance is connected to a mains power source, has been activated, and is performing any of the intended functions

EXAMPLE Producing heat transfer by thermal heat, electromagnetic energy or condensation

Note 1 to entry: Examples of recognised associated functions include displaying recipes, running an egg timer, software download, running a cooling fan and the like.

3.2

combi steam oven

appliance or compartment of a **cooking range** in which food is cooked by a combination of **oven** and **steam oven**

Note 1 to entry: Appliances with only a steam assist function also exist. For these **ovens**, the **steam function** can only be tested if this function is described in the instruction manual or if the appliance provides a setting for **steam function**.

Note 2 to entry: The term "steam" does not refer to the evaporated water from the food.

3.3

cooking range

appliance having a **hob** and at least one **oven** and which can incorporate a **grill**

3.4

delay start

condition where the user has selected a specified delay to the beginning of any **active mode**

Note 1 to entry: This mode is only applicable if the appliance provides a delay start function for the user.

¹ Under preparation. Stage at the time of publication: IEC CDV 63474:2022.

3.5

eco function

heat transmission by natural air circulation, forced air circulation or radiation for certain applications using efficient technical solutions

EXAMPLE Technical solutions:

- residual heat usage;
- low-power heating;
- or a combination of both.

3.6

grill

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

3.7

heating function

heat transmission by natural or forced air circulation, or radiation for baking and roasting

EXAMPLE

- Forced air circulation function which heats food mainly by circulating the air with the aid of a fan;
- conventional **heating function** which heats food mainly by natural convection of the air;
- or a combination of both functions.

Note 1 to entry: Heat transmission by steam or by microwave power, also in combination with any **heating function**, is excluded.

3.8

hob

cooktop

appliance or part of an appliance which incorporates one or more **cooking zones** and/or **cooking areas** including a **control** unit

Note 1 to entry: The **control** unit can be included in the **hob** itself or integrated in a **cooking range**.

3.9

hot steam function

heat transmission to the food by generated steam in combination with radiation or convection, or a combination of both, at ambient pressure (approximately 100 kPa) and with a temperature > 100 °C

3.10

multiple cavity appliance

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

3.11

network

communication infrastructure with a topology of links, an architecture, including the physical components, organizational principles, communication procedures and formats (protocols)

3.12

off mode

condition in which the appliance is connected to the mains and is not providing any **active mode** or **standby mode** and where the mode can persist for an indefinite time

Note 1 to entry: The following shall also be considered as **off mode**:

- a) conditions providing only an indication of **off mode**;
- b) conditions providing only functionalities intended to ensure electromagnetic compatibility.

3.13

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

3.14

oven thermostat

device or sensor that detects the temperature inside the cavity in order to control the set temperature

3.15

oven with catalytic cleaning

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

3.16

small cavity oven

oven with the following dimensions:

- both internal width and internal depth are < 250 mm, or
- either one of internal width and internal depth is < 120 mm. or
- internal height is < 120 mm

Note 1 to entry: The defined maximum size of small cavity **ovens** in this document is adapted to the size of the test load used in Clause 8.

3.17

standby mode

condition where the appliance is connected to the mains and provides only the following functions, which can persist for an indefinite duration:

- (a) reactivation function, or reactivation function and a mere indication of enabled reactivation function;
- (b) information or status display;
- (c) detection function for emergency measures.

3.18

standby mode in condition of networked standby

condition where the appliance is connected to the mains and provides only the reactivation function through a connection to a **network**, which can persist for an indefinite duration

Note 1 to entry: This mode is only applicable to appliances that provide a connection function to a **network**.

3.19

pyrolytic self-cleaning oven

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

3.20

steam oven

appliance or compartment of a **cooking range** in which food is cooked mainly by steam condensation at ambient pressure

Note 1 to entry: Appliances are fitted with their own steam generator.

Note 2 to entry: The term "steam" does not refer to the evaporated water from the food.

3.21

steam function

heat transmission to the food mainly by condensation of steam at ambient pressure (approximately 100 kPa) and with a temperature $\leq 100\text{ }^{\circ}\text{C}$

3.22

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

4 List of measurements

4.1 Dimensions and mass

The following measurements are carried out:

- overall dimensions (see 6.1);
- internal dimensions (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);
- mass of the appliance (see 6.7).

4.2 Oven and combi steam oven

The following measurements are carried out:

- preheating the empty **oven** (see 7.3);
- accuracy of the control (see 7.4);
- energy consumption and time for heating a load (see Clause 8);
- heat distribution (see 9.2);
- ability to supply heat (see 9.3).

4.3 Steam oven and combi steam oven

The following measurements are carried out:

- ability to supply steam (see 10.1);
- distribution of steam (see 10.2);
- determination of the capacity (see 10.3).

4.4 Grill

The following measurements are carried out:

- grilling area (see Clause 11);

4.5 Warming compartments

The following measurements are carried out:

- temperature control and energy consumption (see Clause 12).

4.6 Cleaning

The following measurements are carried out:

- cleaning of pyrolytic self-cleaning **ovens** (see 13.1);
- cleaning of **ovens** with catalytic cleaning (see 13.2).

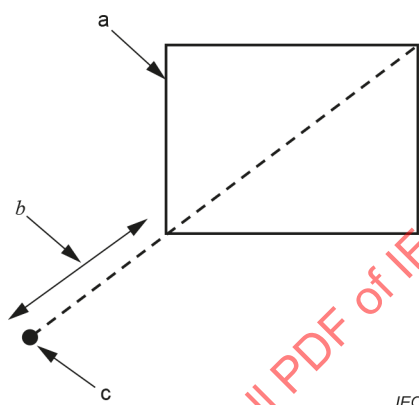
5 General conditions for the measurement

5.1 Test room

The tests are carried out in a substantially draught-free room in which the ambient temperature is maintained at $(23 \pm 2) ^\circ\text{C}$.

For the tests specified in 9.2.1, 9.3.1, 9.3.2, Clause 10 and Clause 11, maintaining the ambient temperature at $(25 \pm 5) ^\circ\text{C}$ is sufficient.

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 under test and at a distance of 0,5 m diagonally from one of the front edges of the appliance (see Figure 1).



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 $\pm 1 \%$.

- the supply voltage shall be maintained at the main terminal at the rated voltage $\pm 1 \%$, while the heating elements are switched on;
- the supply frequency shall be at the rated frequency $\pm 1 \%$ throughout the test. If a frequency range is indicated, then the test frequency shall be the nominal frequency of the country in which the appliance is intended to be used.

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.

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

5.3 Instrumentation

Instruments used and measurements made for this document shall comply with the specifications in Table 1 and Table 2.

Table 1 – Instruments

Parameter	Unit	Minimum resolution	Maximum permissible error	Details / Additional requirements
Mass	g			
≤ 3 000 g		0,1 g	± 0,1 g	
> 3 000 g		0,5 g	± 3 g	
Temperature (thermocouples)				
• ambient temperature	°C	0,1 °C	± 0,5 K	Thermocouple with welded point
• temperature in the cavity in a range of 0 °C to 100 °C	°C	0,1 °C	± 0,5 K	Thermocouple with welded point (suitable to measurements inside of ovens with wet-steam functions)
• temperature in the cavity in a range of 100 °C to 300 °C	°C	0,1 °C	± 2,5 K	Thermocouple with welded point.
• centre temperature of the brick	°C	0,1 °C	± 1,5 K	1 mm steel tube thermocouple, class 1 in accordance with IEC 60584-1.
Dimensions	mm	1 mm	1 mm	≤ 1 mm or 0,5 % whatever is the greater
Time	s	1 s	± 1 s per hour	

Table 2 – Measurements

Parameter	Unit	Maximum permissible error	Additional requirements
Voltage	V	± 0,5 %	Measured value.
Energy consumption measurement	Wh	± 1,5 % or ± 10 Wh	Whichever is greater
Temperature measurement	°C	± 1,0 K	Excluding the thermocouples Sampling rate ≤ 1 s
For Clause 14, the power measurement requirements shall be in accordance with IEC 62301		-	In accordance with IEC 62301

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 installation of the appliance, the surface shall be horizontal.

When the appliance is connected to the mains for the first time, it shall be operated once on any setting for at least 1 h before the energy consumption is measured in order to avoid changes in the appliance's performance or consumption values when tested 'out-of-the-box' compared to some time later at the same settings.

If the appliance is disconnected from the mains, it shall be ensured that required basic settings, like the time, are set and finalized before starting the measurement.

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.

All tests, except the measurements for low-power modes (see Clause 14), shall be carried out:

- with the default factory settings;
- ensuring that no **network** is connected to the appliance for the duration of the measurement.

Using any modes and controls, resulting in measurements that are unrepresentative of the appliance's true characteristics that can occur during baking and roasting under comparable conditions are not allowed.

EXAMPLE A camera used to detect that the appliance is under test is not allowed.

5.7 Rounding

If numbers shall be rounded, they shall be rounded in accordance with ISO 80000-1:2009, Clause B.3, rule B.

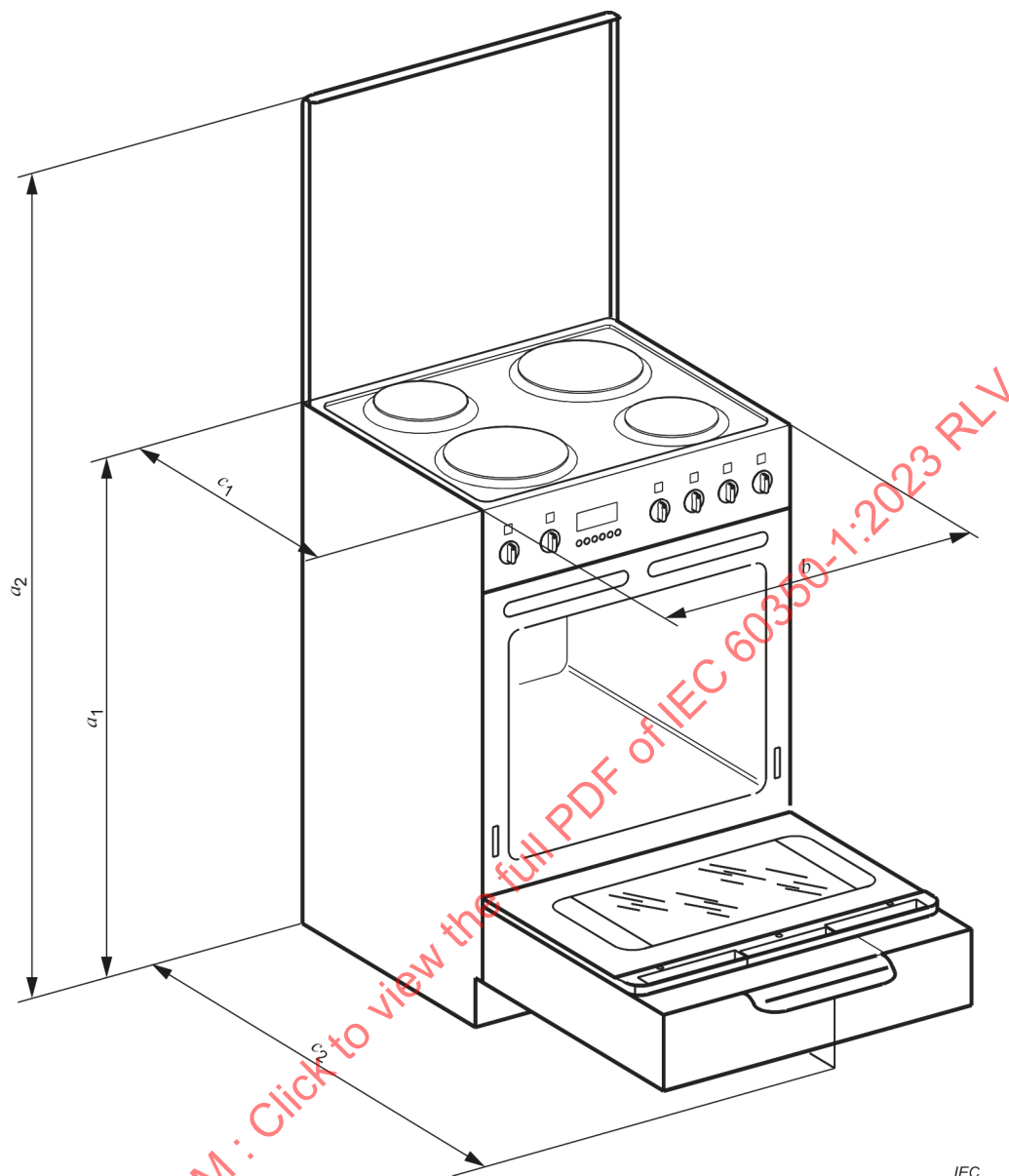
6 Dimensions and mass

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.

Built-in **ovens** are measured as shown in Figure 3.



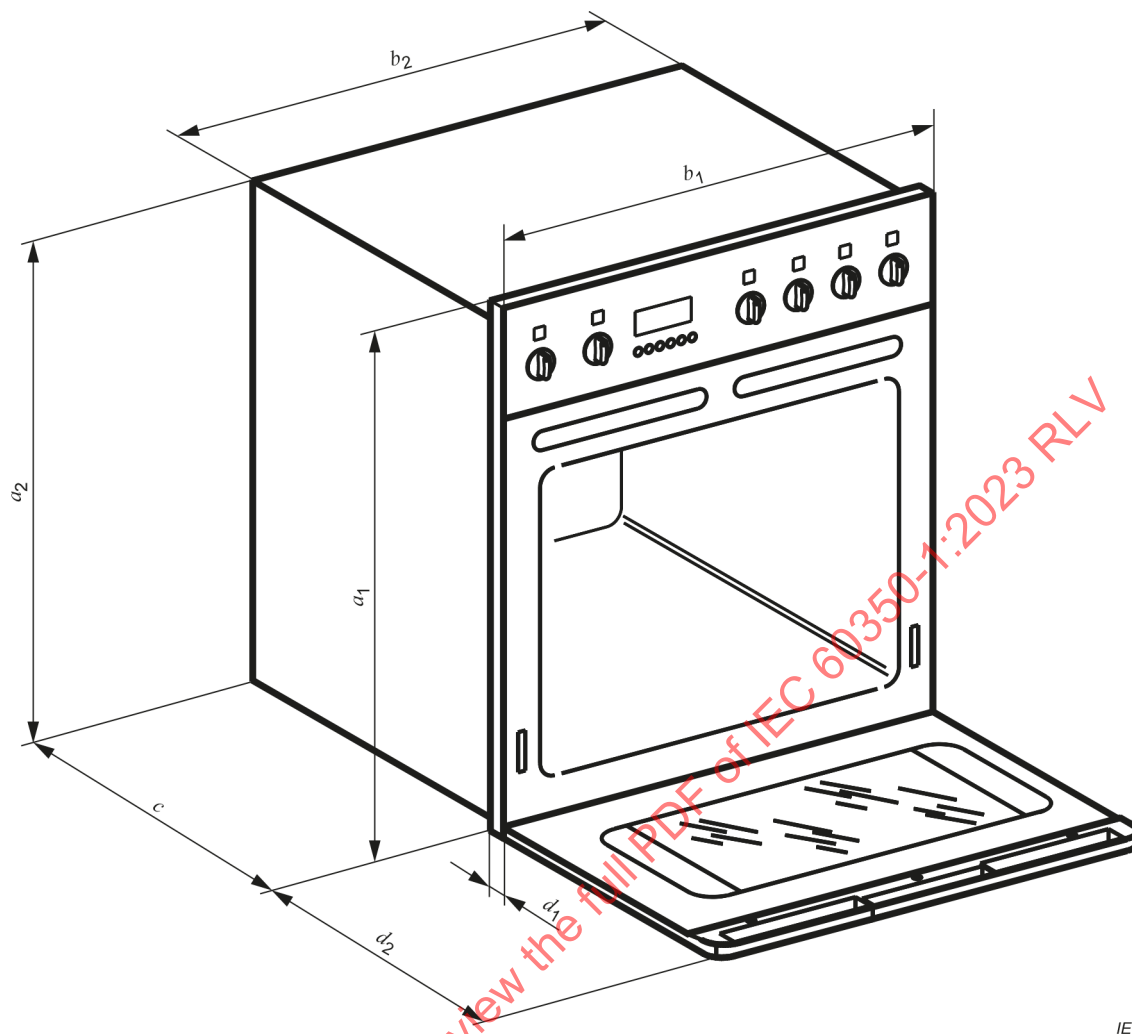
IEC

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

Key

- a_1 height from the supporting surface to the **hob** surface
- 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



IEC

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 appliances

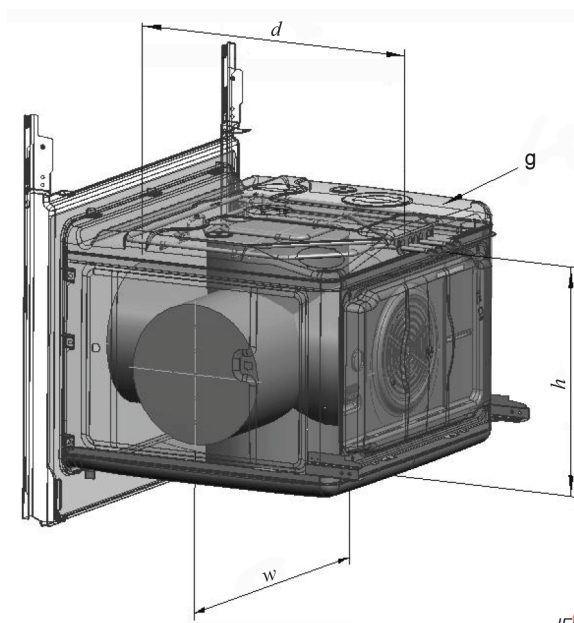
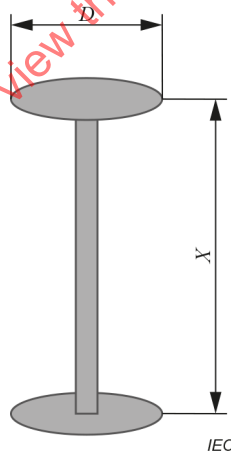
6.2 Internal dimensions and calculated volume

6.2.1 General

The measurement of the calculated 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 measurements are shown in Figure 4.

For verification purposes, the gauge shown in Figure 5, shall be used to determine all three dimensions. The gauge shall be used without appreciable force. Dimensions are stated in millimetres.

**Key** d depth g heating element h height w width**Figure 4 – Internal dimensions****Key** $D = 200 \text{ mm or } 120 \text{ mm}$ $X = \text{dimension to be measured}$ **Figure 5 – Gauge for measuring these dimensions****6.2.2 Internal height**

The 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. No accessories, such as a grill grid, are inserted.

A lamp, a heating element or similar object in the area of the cylinder can constitute the lowest point of the ceiling. Protruding parts such as lamp covers, heating elements and fixing hooks shall not be removed or folded away.

If 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 internal depth and the middle of the internal width.

6.2.3 Internal width

The internal 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.

Side racks shall be removed if they can be removed without a tool. If parts are fixed to or by the side racks, they shall be removed as well.

NOTE 1 A coin or a spoon is not considered as a tool.

If 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 2 The centre of the side wall of the cavity is defined by the middle of the depth and the middle of the height.

6.2.4 Internal depth

The 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.

Protruding parts such as the baffle or components of the door shall not be removed.

If 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 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 depth. The door is closed carefully so that the gauge is compressed to give the internal depth.

NOTE The centre of the rear wall of the cavity is defined by the middle of the height and the middle of the width.

6.2.5 Calculated volume

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

6.3 Overall internal dimensions and overall volume

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.

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 and steaming accessories

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 cm².

NOTE The shelf can be a baking tray or a steaming accessory.

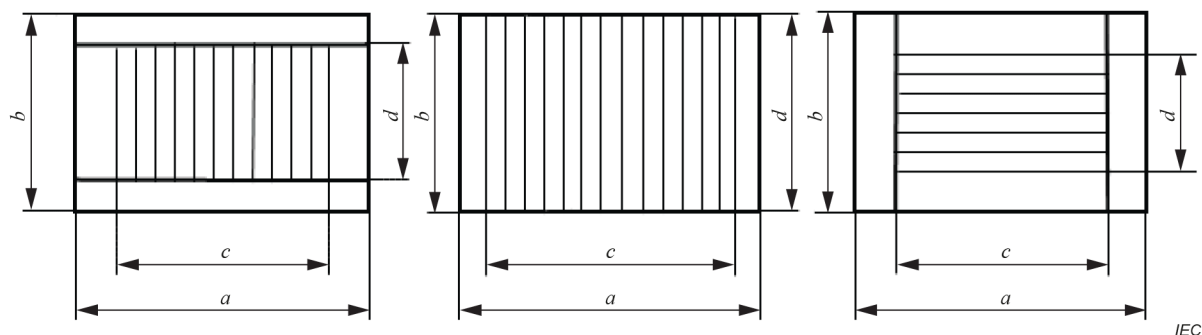
6.5 Dimensions of grill grids

6.5.1 Entire area

The entire area of the grill grid is determined by measuring the maximum width and the maximum depth of the outer rods. This entire area of the grill grid is calculated and stated in square centimetres, rounded to 10 cm².

6.5.2 Usable area

The usable width and usable depth of the grill grid are measured, by considering only the inner grid, which is suitable for placing food. The usable area of the grill grid is calculated and stated in square centimetres, rounded to 10 cm². See Figure 6.



Key

- a* is the maximum width of the grill grid
- b* is the maximum depth of the grill grid
- c* is the usable width of the grill grid
- d* is the usable depth of the grill grid

Figure 6 – Examples for determining the entire area and usable area of a grill grid

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 Mass of the appliance

The mass of the appliance is determined and expressed in kilogrammes, rounded to the nearest kilogramme. To determine the mass, only the accessory described in the test in Clause 8 shall be considered.

7 Preheating and accuracy

7.1 Purpose

The purpose of the tests in Clause 7 is to assess the performance of the **oven** and **combi steam oven** in relation to preheating and functioning of the control.

7.2 Test setup

The air temperature in the empty **oven** and **combi steam oven** is measured with a thermocouple that conforms to the criteria specified in 5.3 fixed to the grid that is delivered with the appliance. It is 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.

If no grid can be purchased from the manufacturer of the appliance, the thermocouple shall 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.

The door shall be completely closed.

7.3 Preheating the empty oven

The purpose of this test is to measure the energy consumption and time it takes to preheat an empty **oven** or **combi steam 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 shall be measured separately. Only the cavity measured shall be switched on.

A **heating function**, **eco function** or **hot steam function** shall be selected. The temperature control is set to the maximum position. The appliance is heated until the rise reaches 165 K.

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

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

The time for preheating of the empty **oven**, t_{ph} , shall be reported and rounded to the nearest half minute.

The energy consumption for preheating the empty **oven**, E_{ph} , shall be reported in kWh and rounded to two decimal spaces.

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

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

7.4 Accuracy of the control

7.4.1 Purpose

The purpose of this test is to determine the accuracy of the temperature control and to calculate the corrected temperature setting used for tests for Clause 9.

7.4.2 Measurements

Prior to the measurements, the whole appliance shall be at ambient temperature of $(23 \pm 2) ^\circ\text{C}$.

The temperature control element is set to the position marked $150 ^\circ\text{C}$ and the appliance is heated for $t_{\text{check}, 150} = 60 \text{ min}$. Then the temperature control element is set to the position marked $200 ^\circ\text{C}$ and the appliance is heated for further $t_{\text{check}, 200} = 60 \text{ min}$. Then the temperature control element is set to the position marked $250 ^\circ\text{C}$ and the appliance is heated for a further $t_{\text{check}, 250} = 60 \text{ min}$.

Markings of the control element for grilling are ignored. If $250 ^\circ\text{C}$ is not marked, the next higher marked setting is taken into account. If the highest marked setting is below $250 ^\circ\text{C}$, the highest possible marked setting shall be chosen. If the control element is not marked in degrees Celsius, the control element is set at appropriate markings taking into account the instructions for use.

Measurements shall be performed without fast preheating function.

The **oven** temperature is recorded continuously in line with 7.2.

7.4.3 Assessment

For assessing the accuracy of control, the deviations from each set temperature (V_{150} , V_{200} , V_{250}) to the **oven** temperatures are determined where the **oven** temperature is the arithmetic mean during the last 20 min of t_{check} .

Regarding the corrected temperature setting used for the tests in Clause 9, the level of the deviations V_{150} , V_{200} and V_{250} are decisive. The temperature setting used for tests in Clause 9 shall only be corrected if all deviations V_{150} , V_{200} and V_{250} are < 20 K.

NOTE Deviations equal to or more than 20 K are not corrected because the device is assumed to have an **eco function** that uses residual heat.

To calculate the corrected temperature setting for the tests in Clause 9, the **oven** temperatures T_{150} and T_{200} are used and linear regression is applied.

8 Energy consumption and time for heating a load

8.1 Purpose

The purpose of this test is to measure the energy consumption and the time for heating a load for a given **heating function** or an **eco function** in an **oven**, **combi steam oven** and combi microwave oven. The load is a water-saturated brick that is representative of any food, e.g. a roast dinner.

8.2 Symbols and abbreviations

Table 3 shows the main symbols used in Clause 8.

Table 3 – Symbols

$T_{s,k}$	temperature setting displayed by a knob or by the control display, s is the setting and $k = 1, 2, 3$ (summing index)
$T_{o1,k} / T_{o2,k}$	measured observer temperature in phase 1 or phase 2
$T_{a1,k} / T_{a2,k}$	measured ambient temperature in phase 1 or phase 2
$T_{c2,k}$	measured temperature in the cavity centre in phase 2
$\Delta \bar{T}_{c2,1}$	average temperature rise as difference between the average ambient temperature and the cavity temperature measured in phase 2
$\tilde{T}_{c2,k}$	measured temperature in the cavity centre in phase 2, smoothed
$\bar{T}_{c2,k}$	average temperature in the cavity centre in phase 2
E_k	measured energy consumption in phase 1, when the last of the two thermocouples in the brick reaches a temperature rise of 55 K
t_k	measured time in phase 1, when the last of the two thermocouples in the brick reaches a temperature rise of 55 K, also applied for phase 2
t_0	start time of phase 1 or phase 2
i_s	start index determined to calculate $\Delta \bar{T}_{c2,1}$ and $\tilde{T}_{c2,k}$; i_s depends on the oven function and the temperature profile
c_k	ratio between the observer temperatures measured in phase 1 and in phase 2 in the whole phase (t_0 to t_k)
s_k	ratio between the observer temperatures measured in phase 1 and in phase 2 in the last 20 min of the whole phase (t_0 to t_k)

$\Delta T_{s,k}$	difference between temperature setting T_s and average temperature $\bar{T}_{c2,k}$ in the cavity centre in phase 2
$E_{\Delta T_0}$	calculated nominal energy consumption in kWh for heating a load at ΔT_0
ΔT_0	nominal temperature rise; 165 K for all heating functions and eco functions
$t_{\Delta T_0}$	calculated nominal time in s for heating a load at $\Delta T_0 = 165$ K for all heating functions or eco functions

8.3 Test load

8.3.1 General

The test load shall be a brick with two holes for temperature measurements, as shown in Annex C.

8.3.2 Pre-treatment

A new brick shall be dried before using it for the first time in an **oven** with a forced air circulation function at ≥ 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 that is still damp due to a previous test needs at least 8 h to be dried as described above. However, see Note 1 in 8.3.3.

The weight m_d (d means dry) 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 C.1. The brick shall be identified for accurate calculation of the water absorption in accordance with 8.3.3.

Place markings 32 mm from the measuring point of the two thermocouples in accordance with 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. See the example in Figure 7.

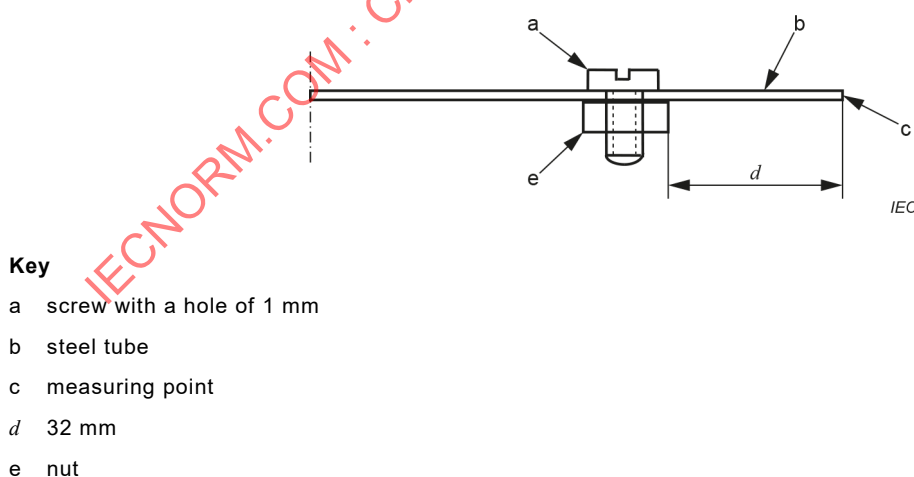


Figure 7 – Example of a thermocouple

The thermocouples may be fixed by means of a droplet of silicon glue at the surface of the brick or by other suitable means.

Owing to the porosity of the brick, ensure that the holes of the brick are not enlarged if the thermocouples are removed and reinserted.

NOTE 2 A brick can be used for about twenty tests when handled with normal care.

8.3.3 Preparation

The brick, pre-treated in accordance with 8.3.2, 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 ± 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.

Between test series, the brick should be stored in a refrigerator and preferably not soaked with water. The water used for soaking the brick should be kept (to reduce dissolving processes), i.e. the brick's storage water can be reused.

After the brick has been taken out of the water container, excessive water is allowed to drip off for 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_w means wet or water; m_d is measured according to 8.3.2). The amount of absorbed water shall be as specified in Clause D.1.

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

8.4 Measurement

8.4.1 Test Procedure

Prior to all measurements, the whole appliance (this includes the material and the insulation) shall be at an ambient temperature of (23 ± 2) °C. In **multiple cavity appliances**, measure each **oven** cavity separately and switch on only the cavity measured.

Remove all accessories delivered with the appliance, such as baking trays, side racks that are not used for placing the load.

Measure the cavity temperature $T_{c,k}$ in the empty appliance with a thermocouple that conforms to 5.3 fixed to the grid delivered with the appliance. Place this grid in the appliance 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. If no grid can be purchased from the manufacturer of the appliance, the thermocouple should be positioned in the centre in a suitable way.

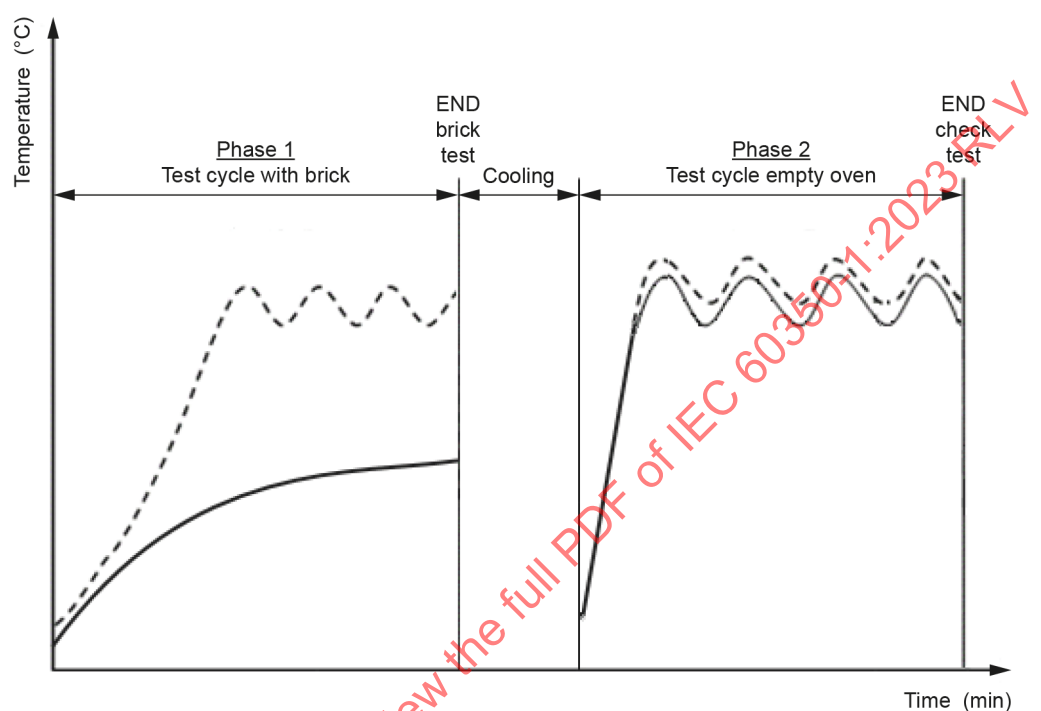
Additionally record the temperature $T_{o,k}$ close to the **oven thermostat** continuously. For this, fix a second thermocouple close to the **oven thermostat** inside the cavity as described in Figure 9, Figure 10 and Figure 11. This thermocouple is the "observer thermocouple".

Lead the thermocouples through the door gap in a way that the door is completely closed without applying additional force.

To determine the energy consumption of a **heating function** or an **eco function**, three measurements with different temperature settings are necessary. Each measurement consists of two phases:

- phase 1: energy measurement while the brick is in the **oven**;
- phase 2: determination of the reference temperature and the c -factor (empty **oven**).

The diagram in Figure 8 shows the entire process of measurement.



IEC

Phase 1		Cooling	Phase 2	
---	observer temperature $T_{o1,k}$		----	observer temperature $T_{o2,k}$
—	centre temperature brick		—	cavity temperature $T_{c2,k}$

Figure 8 – Entire process of measurement

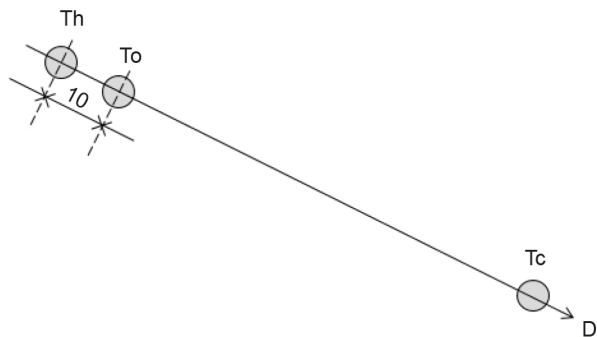
For both phases, the temperature $T_{o,k}$ is recorded continuously with a thermocouple fixed with a distance ≤ 10 mm to the **oven thermostat** inside the cavity without contact. This thermocouple is the observer thermocouple; it is fixed symmetrically in both x and y axes, on the direction of the z axis (see Figure 10 and Figure 11). The D axis is oriented toward the centre of the cavity (see Figure 9). Mount the observer thermocouple on the closest wall of the cavity with a heat resistant tape.

If the **oven thermostat** is not accessible, take into account the manufacturer's instructions regarding the position of the thermocouple.

If more than one **oven thermostat** is available, the information about the **oven thermostat** relevant for the temperature control of the considered cavity can be obtained from the manufacturer's instructions.

Keep the position of the observer thermocouple unchanged during phase 1 and phase 2.

Dimensions in millimetres

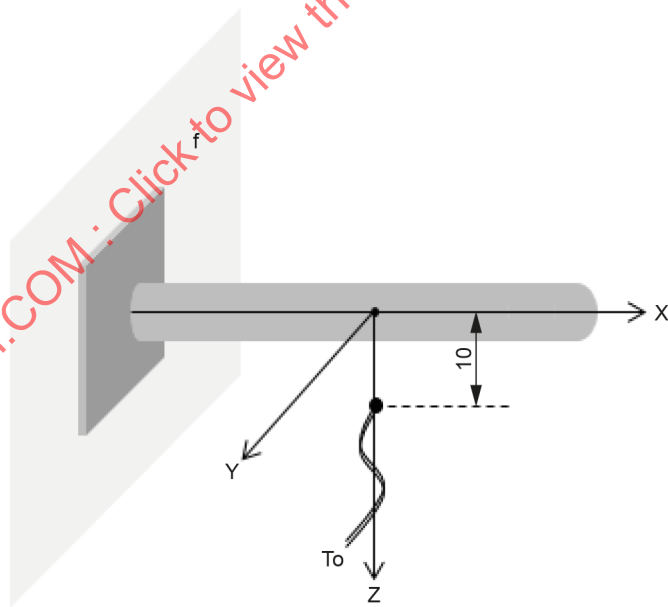


Key

- Th oven thermostat
- To observer thermocouple
- Tc oven centre thermocouple
- D direction toward the oven centre

Figure 9 – Installation observer thermocouple

Dimensions in millimetres

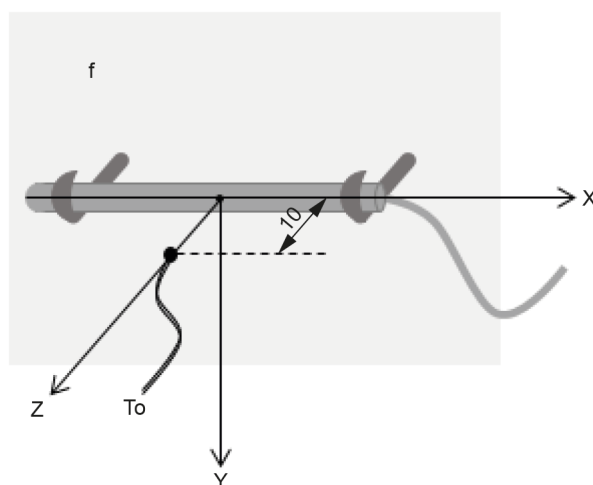


Key

- f fixation wall - position of the thermostat to the fixation wall (the thermostat body shows a perpendicular position to the surface of the fixation wall)
- To observer thermocouple
- Z direction – under thermostat

Figure 10 – Vertical installation of the observer thermocouple

Dimensions in millimetres

**Key**

f fixation wall - position of the thermostat to the fixation wall where the thermostat body shows a parallel position to the surface of the fixation wall

To observer thermocouple

Z direction – in front of thermostat

Figure 11 – Horizontal installation of the observer thermocouple

8.4.2 Oven settings

For measuring the energy consumption, a **heating function** or **eco function** shall be used. If more than one **heating function** or **eco function** is available, the recommendation in the manufacturer's instructions is taken into account.

The temperature control is set to a position where the average temperature rises $\Delta \bar{T}_{c2,k}$ as defined in Table 4 can be expected. $\Delta \bar{T}_{c2,k}$ is the difference between the average ambient temperature and the average cavity temperature measured in phase 2; $k = 1, 2, 3$ (k is the summing index).

The temperature setting T_s , which is the displayed setting of the knob or the control display (s is the setting), shall be noted. If the temperature steps are not clearly marked, the temperature setting should be determined by the angle according to the visible marks on the knob using polar coordinate paper (see Annex E).

If the temperature is set by a knob, the knob shall always be turned from zero to the required setting.

Table 4 – Temperature rise for three settings

Temperature rise	
$\Delta \bar{T}_{c2,1}$	(135 ± 15) K
$\Delta \bar{T}_{c2,2}$	(165 ± 15) K
$\Delta \bar{T}_{c2,3}$	(195 ± 15) K ^a
^a Or the maximum temperature rise if this value cannot be reached.	

Report the used **heating function** or **eco function** and the temperature setting $T_{s,k}$ for each measurement.

8.4.3 Phase 1

- Remove all accessories delivered with the appliance, such as baking trays and side racks, which are not used for placing the brick.
- Place the brick, prepared in accordance with 8.3.3, in the geometric centre of the calculated cavity with its largest surface centrally on the grid delivered with the appliance, with the thermocouples on the upper side. If no grid can be purchased from the manufacturer of the appliance, any suitable grid should be used, however not a baking tray, tin or similar.
- Insert the grid into a shelf support level of the appliance so that the centre of the brick comes as close as possible to the centre, but not higher than the centre, of the calculated cavity. The longest axis of the brick shall be parallel with the appliance front. 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's centre closest to the cavity's centre, but not higher. Only if the grid is already placed on the lowest level may the centre of the brick be higher than the centre of the cavity.
- If the appliance is prepared with the thermocouples, do not operate it with a function combined with microwave energy. Out-coupled microwave power through the thermocouples can damage instruments.

NOTE 1 See Annex D.

- Start the measurement within 3 min from the removal of the brick from the refrigerator by switching on the appliance following the requirements for setting.

The following data are measured:

- the measured energy consumption(s) E_k in kWh and the time(s) t_k in min and s, when the last of the two thermocouples in the brick reaches a temperature rise of 55 K, $k = 1, 2$ and 3;
- centre temperatures of the brick in °C;
- $T_{o1,k}$ continuously measured by the observer thermocouple in °C;
- ambient temperature $T_{a1,k}$ from the beginning of the test (when the appliance is switched on) to 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 2 The energy consumption of components such as lamps and fans that are automatically switched on with the appliance, is included in the measurement.

8.4.4 Phase 2

In phase 2, the measurement of phase 1 is repeated in an empty **oven**.

For this, remove the brick and cool the appliance as long as it is ensured that the whole appliance (this includes the material and the insulation) is at ambient temperature of $(23 \pm 2) ^\circ\text{C}$. Forced cooling by a fan can be applied.

After cooling, verify that the setting is strictly identical to that used in phase 1 (see 8.4.3). This includes:

- unchanged position of the observer thermocouple;
- same temperature setting $T_{s,k}$;
- same **heating function**.

Switch on the appliance and operate for the same duration of t_k (measured in 8.4.3).

Measure the following data continuously:

- $T_{o2,k}$ from t_0 to t_k by the observer thermocouple during phase 2 in $^\circ\text{C}$;
- $T_{c2,k}$ from t_0 to t_k by the centre thermocouple during phase 2 in $^\circ\text{C}$;
- $T_{a2,k}$ from t_0 to t_k by the thermocouple positioned in accordance with 5.1 for measuring the ambient temperature in $^\circ\text{C}$.

8.5 Calculation

8.5.1 Smoothing the measured values

For further calculation, the measured data $T_{c2,k}$ are smoothed by a moving average applying Formula (1) in order to exclude possible measurement noise.

$$\tilde{T}_{c2,k,i} = \frac{1}{2n+1} \sum_{j=-n}^n T_{c2,k,i+j} \quad (1)$$

Where:

$\tilde{T}_{c2,k,i}$ is the smoothed temperature in the cavity centre in phase 2 in $^\circ\text{C}$;

$T_{c2,k,i+j}$ is the measured temperature in the cavity centre in phase 2 in $^\circ\text{C}$;

i is the sample index;

n is defined by $n = \left\lfloor \frac{f_s \times t_{\text{mov}} - 1}{2} \right\rfloor$ and where $t_{\text{mov}} = 30 \text{ s}$;

f_s is the sampling rate in 1/s.

8.5.2 Determining the average temperature rise for a heating function (phase 2)

If the manufacturer classifies the function under test as a **heating function**, this clause shall be applied to determine the average temperature rise.

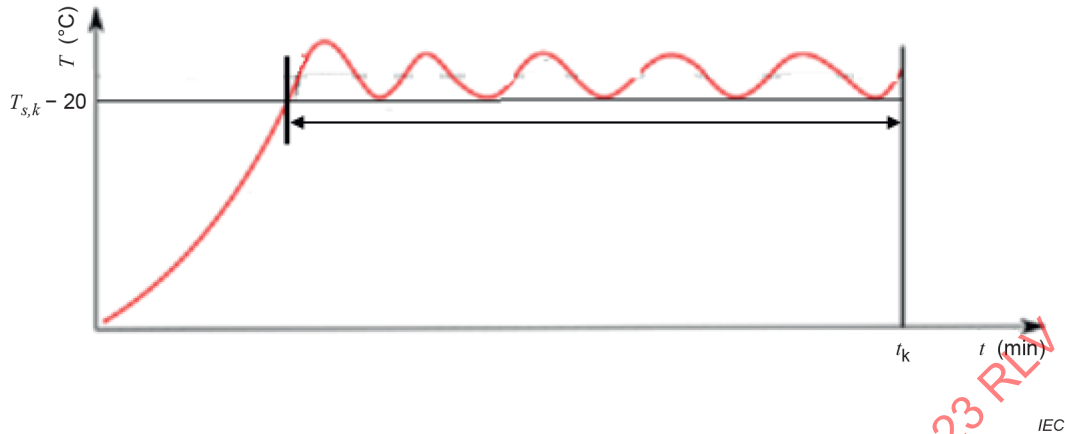


Figure 12 – Example – average temperature rise for a heating function

The average temperature rise for a **heating function** shall be calculated in the following period:

The start of this period shall be the point where $\tilde{T}_{c2,k}$ reaches $T_{s,k} - 20$ K. Hence, the start index i_s shall be defined as:

$$\tilde{T}_{c2,k}(i_s) = T_{s,k} - 20 \quad (2)$$

If the time period between $T_{s,k} - 20$ and end of measurement is less than 60 % of whole time t_k , the time period is prolonged to 60 % of t_k . In this case, the start index i_s shall be defined as:

$$i_s = i_k - 0,6i_k \quad (3)$$

The average temperature rise $\Delta\bar{T}_{c2,k}$ shall be calculated by averaging the difference of $T_{c2,k,i}$ and $T_{a2,k,i}$ for i_s until the end of the measurement (see Figure 12) by applying Formula (4):

$$\Delta\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_k} (\tilde{T}_{c2,k,j} - T_{a2,k,j})}{i_k - i_s + 1} \quad (4)$$

Where:

$\Delta\bar{T}_{c2,k}$ is the average temperature rise in phase 2 in K;

$\tilde{T}_{c2,k,j}$ is the measured temperature in the cavity centre in phase 2, smoothed, in °C;

$T_{a2,k,j}$ is the measured ambient temperature in phase 2 in °C;

i_s is the sample index representing the starting point;

i_k is determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The average temperature $\bar{T}_{c2,k}$ shall be calculated accordingly to Formula (5).

$$\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_k} \tilde{T}_{c2,k,j}}{i_k - i_s + 1} \quad (5)$$

Where:

$\bar{T}_{c2,k}$ is the average temperature in the cavity centre in phase 2 in °C.

8.5.3 Determining the average temperature rise for an eco function (phase 2)

If the manufacturer classifies the function under test as an **eco function**, this clause shall be applied to determine the average temperature rise. For an **eco function**, the temperature shall be averaged within a 20 min period depending on the technical solution used for saving energy. See examples in Figure 13 and Figure 14.

– Technical solution A (See Figure 13)

The average temperature rise $\Delta\bar{T}_{c2,k}$ is calculated by averaging the difference of $T_{c2,k,i}$ and $T_{c2,k,i}$ for 1 200 s starting when the temperature setting is reached. Formulae (6) and (7) shall be applied.

$$\tilde{T}_{c2,k}(i_s) \equiv T_{ks} \quad (6)$$

$$\Delta\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_{1200+i_s}-1} (\tilde{T}_{c2,k,j} - T_{a2,k,j})}{i_{1200}} \quad (7)$$

Where:

$\Delta\bar{T}_{c2,k}$ is the average temperature rise in phase 2 in K;

$\tilde{T}_{c2,k,j}$ is the measured temperature in the cavity centre in phase 2, smoothened in °C;

$T_{a2,k,j}$ is the measured ambient temperature in phase 2 in °C;

i_s the sample index representing the starting point;

i_{1200} is defined by $\lfloor 1\,200 \times f_s \rfloor$.

The average temperature $\bar{T}_{c2,k}$ shall be calculated with Formula (8).

$$\bar{T}_{c2,k} = \frac{\sum_{j=i_s}^{i_{1200+i_s}-1} \tilde{T}_{c2,k,j}}{i_{1200}} \quad (8)$$

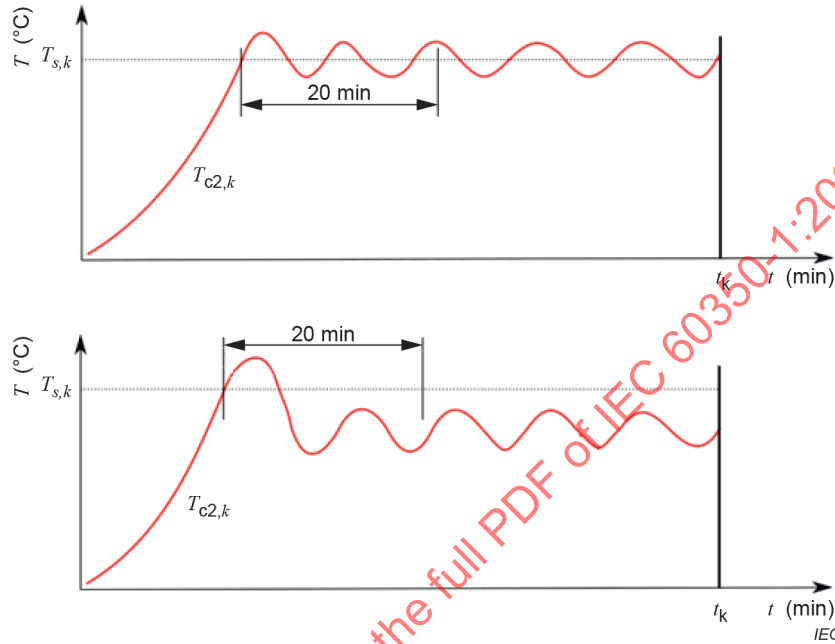


Figure 13 – Examples – set temperature reached

– Technical solution B (See Figure 14)

If the temperature setting is not reached before the last 20 min of phase 2 start, the average temperature rise $\Delta \bar{T}_{c2,k}$ is calculated by averaging the difference of $T_{c2,k,i}$ and $T_{a2,k,i}$ for the last 20 min of phase 2; see Formula (9).

$$\Delta \bar{T}_{c2,k} = \frac{\sum_{j=i_k+1}^{i_k} (\tilde{T}_{c2,k,j} - T_{a2,k,j})}{i_{1200}} \quad (9)$$

Where:

$\Delta \bar{T}_{c2,k}$ is the average temperature rise in phase 2 in K;

$\tilde{T}_{c2,k,j}$ is the measured temperature in the cavity centre in phase 2, smoothed in °C;

$T_{a2,k,j}$ is the measured ambient temperature in phase 2 in °C;

i_{1200} is defined by $\lfloor 1200 \times f_s \rfloor$;

i_k is the index determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The average temperature $\bar{T}_{c2,k}$ in °C is calculated with Formula (10).

$$\bar{T}_{c2,k} = \frac{\sum_{j=i_k+1-i_{1200}}^{i_k} \tilde{T}_{c2,k,j}}{i_{1200}} \quad (10)$$

Where:

$\bar{T}_{c2,k}$ is the average temperature in phase 2 in °C;

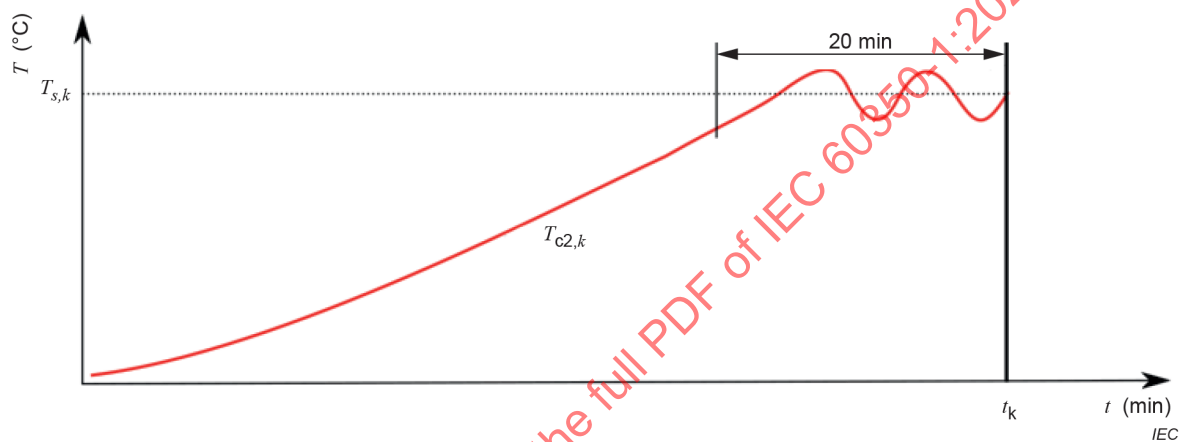


Figure 14 – Example – set temperature not reached

Calculate and note the average temperature rise $\Delta \bar{T}_{c2,k}$ in K for each measurement (each measured heating mode and temperature setting, see Table 4).

Calculate and note the average temperature $\bar{T}_{c2,k}$ in °C for each measurement (each measured heating mode and temperature setting, see Table 4).

8.5.4 Calculation of average ambient temperature

The average ambient temperature in phase 1 and phase 2 is calculated with Formulae (11) and (12):

$$\bar{T}_{a1,k} = \frac{\sum_{j=1}^{i_k} T_{a1,k,j}}{i_k} \quad (11)$$

$$\bar{T}_{a2,k} = \frac{\sum_{j=1}^{i_k} T_{a2,k,j}}{i_k} \quad (12)$$

The average ambient temperature in phase 1 and phase 2 is rounded to one decimal space and reported.

8.5.5 Determining the c -factor

Determine the c_k -factor for each measurement. The c_k -factor is the ratio between the observer temperatures measured in phase 1 and in phase 2 in the whole phase, t_o until t_k , calculated as shown in Formula (13):

$$c_k = \frac{\bar{T}_{o1,k}}{\bar{T}_{o2,k}} \quad (13)$$

Where:

$$\bar{T}_{o1,k} = \frac{\sum_{j=1}^{i_k} T_{o1,k,j}}{i_k} \quad (14)$$

$$\bar{T}_{o2,k} = \frac{\sum_{j=1}^{i_k} T_{o2,k,j}}{i_k} \quad (15)$$

j runs from 1 to i_k , where i_k is determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The c_1 , c_2 and c_3 per **heating function** or **eco function** is rounded to two decimal places and reported.

8.5.6 Determining the s -factor

In the case that the heating mode is designated as a **heating function**, the s -factor shall be determined in addition to the c -factor.

Determine the s_k -factor for each measurement. The s_k -factor is the ratio between the observer temperatures measured in phase 1 and in phase 2 in the last 20 min of the whole phase, $t_k - 20$, calculated as shown in Formulae (16), (17) and (18):

$$s_k = \frac{\bar{T}_{o1,k,20}}{\bar{T}_{o2,k,20}} \quad (16)$$

Where:

$$\bar{T}_{o1,k,20} = \frac{\sum_{j=i_k+1-i_{1200}}^{i_k} T_{o1,k,j}}{i_k} \quad (17)$$

$$\bar{T}_{o2,k,20} = \frac{\sum_{j=i_k+1-i_{1200}}^{i_k} T_{o2,k,j}}{i_k} \quad (18)$$

i_{1200} is defined by $\lfloor 1200 \times f_s \rfloor$

j runs from 1 to i_{1200} , where i_k is determined by $i_k = \lfloor t_k \times f_s \rfloor$.

The s_1 , s_2 and s_3 for the **heating function** is rounded to two decimal places and reported.

8.6 Acceptance verification of the test results

8.6.1 Average temperature rise and standard deviation

Results of the tests in accordance with 8.5 shall only be accepted if

- a) the average temperature rises $\Delta \bar{T}_{c2,k}$ are within the temperatures specified in Table 4, and
- b) the standard deviation σ as defined in Formula (11) is below 0,050 kWh.

Otherwise, for the appropriate function, all measurements shall be repeated in accordance with 8.4.

The standard deviation σ is calculated, from the data pairs $\Delta \bar{T}_{c2,k}$ and E_k measured in accordance with 8.4, according to Formula (19) for each **heating function** or **eco function**, $k = 1, 2, 3$ (see Sachs²).

$$\sigma = f \sqrt{\frac{Q_y - \frac{Q_{xy}^2}{Q_x}}{n-2}} \quad (19)$$

where

n is the number of measuring points (for the purposes of this standard, $n = 3$);

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

For calculating the standard deviation, the f -factor of 1,2 shall be used.

NOTE 1 For the purpose of this standard, $\Delta \bar{T}_{c2,k}$ can only vary between 120 K and 210 K resulting in an f -factor of between 1,15 and 1,21. The approach to calculate the f -factor is given in Annex F for information only.

² *Applied statistics*, formulas 5.29a and 5.69, modified. See the Bibliography.

NOTE 2 The terms Q are described in Annex F.

8.6.2 Temperature setting and average temperature rise

The difference $\Delta T_{s,k}$ between $T_{s,k}$ and $\bar{T}_{c2,k}$ shall be calculated with Formula (20):

$$\Delta T_{s,k} = T_s - \bar{T}_{c2,k} \quad (20)$$

Where

$\Delta T_{s,k}$ is the difference between the set temperature and the average temperature;

$T_{s,k}$ is the set temperature;

$\bar{T}_{c2,k}$ is the average temperature in the cavity centre in phase 2.

The difference $\Delta T_{s,k}$ shall be ≤ 20 K.

If any of the difference $\Delta T_{s,k}$ is > 20 K, the measurement shall be repeated in accordance with 8.4 with an appropriate function.

NOTE The tolerance of 20 K is needed due to the long chain of tolerances (e.g. thermostat, connection, power of heating elements, control element and printing) and the fact that the temperature scale covers different **heating functions** and **eco functions**.

8.6.3 c -factor

The c -factor is used to show that the thermal behaviour of the **oven** in phase 1 and phase 2 is similar.

NOTE The c -factor is less than one, since each load, i.e. the brick in the case of energy measurement, influences the thermal behaviour.

The c_k -factors calculated in 8.5.5 for a function designated as a **heating function** shall be $c_k \geq 0,92$.

The c_k -factors calculated in 8.5.5 for a function designated as an **eco function** shall be $c_k \geq 0,82$.

8.6.4 s -factor

The s_k -factors are used to show that a function designated as a **heating function** does not use residual heat.

The s_k -factors calculated in 8.5.6 for a function designated as a **heating function** shall be $s_k \geq 0,92$.

8.7 Final electric energy consumption

If the acceptance criteria requested in 8.6 are fulfilled, the final energy consumption is calculated for the nominal temperature rise using the linear regression based on the calculated data point ΔT_k (see 8.5) and the measured data point E_k (see 8.4.3); see Formula (21):

$$E_{\Delta T_0} = S \cdot \Delta T_0 + B \quad (21)$$

Where:

- $E_{\Delta T_0}$ is the calculated nominal energy consumption in kWh for heating a load at the setting of the appliance with a temperature rise of ΔT_0 ;
- ΔT_0 is 165 K for all **heating functions** and **eco functions**;
- S is the slope calculated according to Formula (22);
- B is the intercept calculated according to Formula (23).

$$S = \frac{n \sum_{k=1}^n (\Delta \bar{T}_{c2,k} \cdot E_k) - \left(\sum_{k=1}^n \Delta \bar{T}_{c2,k} \right) \left(\sum_{k=1}^n E_k \right)}{n \sum_{k=1}^n (\Delta \bar{T}_{c2,k})^2 - \left(\sum_{k=1}^n \Delta \bar{T}_{c2,k} \right)^2} \quad (22)$$

$$B = \frac{\sum_{k=1}^n E_k - S \cdot \sum_{k=1}^n \Delta \bar{T}_{c2,k}}{n} \quad (23)$$

8.8 Time for heating a load

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

Replace in the Formulas (21) to (23) the E values by the appropriate t values, i.e. replace

- in Formula (21), $E_{\Delta T_0}$ by $t_{\Delta T_0}$;
- in Formulae (22) and (23), E_k by t_k .

Where:

- $t_{\Delta T_0}$ is the calculated nominal time in s for heating a load at $\Delta T_0 = 165$ K for all **heating functions** or **eco functions**.

8.9 Reporting of test results

A supplementary file to calculate the energy consumption and related values is located at <https://www.iec.ch/sc59k/supportingdocuments>. These calculations may be made in any suitable spreadsheet programs.

Report the following data for the measured **heating functions** or **eco functions**:

- a) type of the appliance, available **heating function(s)** and **eco function(s)**;
- b) supply voltage at which the measurements were made;
- c) tested **heating function(s)** and/or **eco function(s)**;
- d) energy consumption(s) $E_{\Delta T_0}$ in kWh to three decimal places, in accordance with 8.7;
- e) time(s) $t_{\Delta T_0}$, rounded to the nearest minute.

For **multiple cavity appliances**, the values shall be reported separately for each cavity.

9 Cooking tests

9.1 General

Owing to the use of food, the tests specified in Clause 9 are considered to be applicable for comparative testing only.

All tests in this clause shall be carried out applying a corrected temperature setting in accordance with the approach determined in 7.4.

The **heating function** that is used for measuring the energy consumption (see Clause 8) should be used for determining the heat distribution on one level (see 9.2.2) and for measuring the ability to supply heat on one level (see 9.3).

If an **eco function** is used for measuring the energy consumption (see Clause 8), that function should be used for determining the heat distribution on one level (see 9.2.2) and for measuring the ability to supply heat on one level (see 9.3.1).

NOTE As already stated in the definition, an **eco function** is used for certain applications. Hence, not all performance tests are applicable.

For baking on two or more levels, the function recommended in the instruction manual is used.

9.2 Heat distribution

9.2.1 Shortbread

9.2.1.1 Purpose

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

9.2.1.2 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

9.2.1.3 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 $(5 \pm 2) ^\circ\text{C}$ for at least 8 h. Remove the loaf from the refrigerator 60 min to 80 min before further handling.

Extrude the loaf into strips by means of a worm conveyor attachment using the nozzle as shown in Figure 15. Cut the strips to a length that fits the baking tray supplied with the appliance or that recommended by the manufacturer. Position the pastry strips as shown in Figure 16 so that they will be parallel to the appliance door.

Dimensions in millimetres

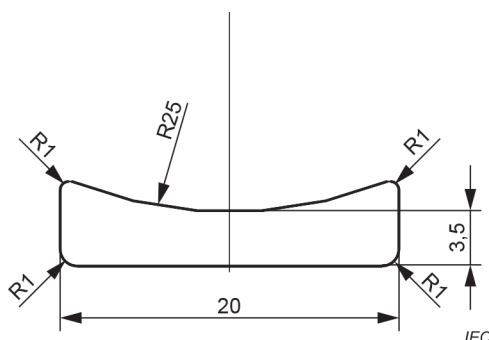


Figure 15 – Shape of the nozzle for extruding pastry

Dimensions in millimetres

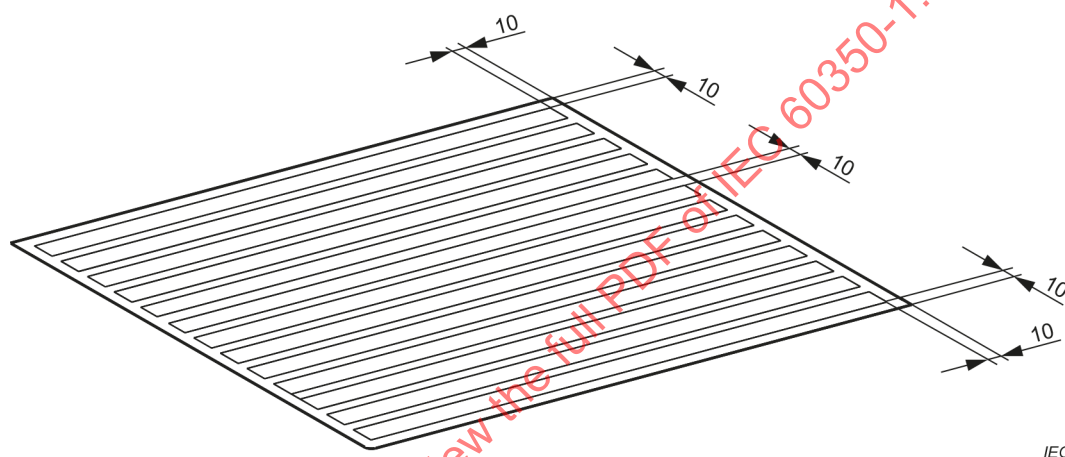


Figure 16 – Position of pastry strips on the baking tray

9.2.1.4 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 without preheating.

The tray is inserted into the appliance in accordance with the instructions for use. If instructions are not given, the tray is positioned as close as possible to the centre of the cold appliance. The tray is removed from the appliance when the strips have attained a golden-brown colour. The baking time is noted.

The tray 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 in accordance with IEC TS 63350. Circles with a diameter of 20 mm are measured over the strips lengthwise, beginning and ending approximately 20 mm from the centre of the circle from the end of each strip. The measurements are carried out in steps of approximately 50 mm. If the surface at the defined areas is damaged by cracks, holes, etc., the measurement is shifted to other areas.

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 lightness value L^* of $(70,1 \pm 2,35)$.

NOTE Annex B recommends suppliers for the colour measuring instrument and digital measuring systems.

9.2.1.5 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 tray while still hot but left in their original position.

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

9.2.1.6 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.

9.2.2 Small cakes

9.2.2.1 Purpose

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

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

9.2.2.2 Ingredients

The quantities of ingredients for 30 to 40 small cakes are indicated in Table 5. For a reproducible result, always prepare the same amount and discard any surplus mixture. Ingredients as defined in Annex B should be used.

Table 5 – Ingredients

Ingredients	Quantities g	Remarks
Butter, with a fat content of $(83 \pm 2) \%$	$340 \pm 0,5$	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)	$340 \pm 0,5$	d95/d05: 90 % of the sugar crystals shall have a grain size of 0,10 mm to 0,35 mm.
Eggs	300 ± 1	Medium-sized hen eggs, approximately (55 ± 5) g, are beaten and sieved until homogeneous, then weighed. If frozen egg mixture is used, follow the instructions of Clause B.2.
Wheat flour without raising agent, unbleached. Mineral content: maximum 0,5 % (dry substance)	450 ± 1	Gluten: at least 24 %.
Baking powder	$15 \pm 0,5$	Phosphate baking powder (double acting) shall be used (not baking soda).
Salt	$6 \pm 0,1$	
If more than 40 small cakes are required, two identical kitchen machines should be used simultaneously.		
NOTE The eggs are sieved to remove any chalazae.		

9.2.2.3 Paper cases

As the paper quality affects the rising height and spreading, only the paper cases specified in Annex B 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^2 bleached greaseproof paper.

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

9.2.2.4 Number of small cakes and positioning on the baking tray

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

The width and the depth of the baking trays 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 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 $14 \text{ mm} \pm 4 \text{ mm}$ from the edge of the usable area of the baking tray, measured in accordance with 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 trays that can be cooked simultaneously are followed.

9.2.2.5 Procedure

Beat together butter and sugar in a food mixer until the mixture 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 $(23 \pm 2) ^\circ\text{C}$ directly after mixing.

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

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

Weigh $(28 \pm 0,5)$ g of the mixture into the centre of the paper cases and place them evenly on the baking trays. Bake immediately.

NOTE 2 The tests are carried out using corrected temperature control settings according to the differences determined by the test of 7.4.

a) Baking on one level

Follow the operating instructions with respect to the function, temperature, shelf position and preheating. If preheating is recommended, small cakes are placed in the appliance when the end of the preheating phase is indicated, for example by visual or acoustic signal, or after a recommended preheating time. If no instructions are given, the appliance is set to $160 ^\circ\text{C}$ for a forced air circulation function or to $185 ^\circ\text{C}$ for a conventional **heating function** and the baking tray is placed in the middle of the cold appliance. While the small cakes are baking, the position of the baking tray 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 trays are placed simultaneously in the appliance one above the other and removed simultaneously at the end of baking. While the small cakes are baking, the position of the baking trays shall not be changed. Follow the operating instructions with respect to the function, temperature, shelf position and preheating. If preheating is recommended, the small cakes are placed in the appliance when the end of the preheating phase is indicated, for example by visual or acoustic signal, or after a recommended preheating time.

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

NOTE 3 Baking on two levels is not carried out for **small cavity ovens**.

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).

9.2.2.6 Assessment

9.2.2.6.1 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 in accordance with 9.2.2.6.3, at least 50 % of the base shall be undamaged. Otherwise the test shall be repeated.

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

The 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 tray shall be assessed separately (single result) and they are also 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.

9.2.2.6.2 Visual assessment

For comparative results, the evaluation of browning may be done by a visual check using the criteria for assessment in 9.2.2.6.4

The brown shade numbers specified in IEC TS 63350 shall be used to evaluate browning. For a visual check, the same background colour and illumination shall be used for each tray.

NOTE A supplementary file to generate the brown shade chart is located at <https://www.iec.ch/sc59k/supportingdocuments>.

9.2.2.6.3 Digital assessment

For reproducible results of the evaluation of browning, any digital measurement system shall be used which complies with the requirements in IEC TS 63350, except the requirements for colour recognition and verification of resolution.

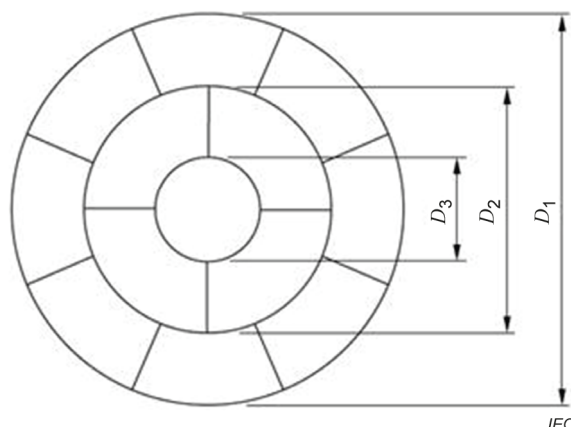
9.2.2.6.4 Criteria for assessment (digital and visual)

The following criteria are relevant for the assessment:

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 17.

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



Key:

- D_1 dimension of small cake
 D_2 dimension of middle section
 D_3 dimension of central section

$$D_2 = \frac{\sqrt{5}}{\sqrt{13}} \times D_1 \approx 0,6 \times D_1$$

$$D_3 = \frac{1}{\sqrt{13}} \times D_1 \approx 0,3 \times D_1$$

Figure 17 – Template for the sectioning of small cakes

The arithmetic average of lightness value L^* is calculated for the whole area of each section. A brown shade number is determined in accordance IEC TS 63350 and reported for each section.

1) *Acceptable browning on the top*

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

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

The results of the test of 9.2.2 shall only be accepted if the average browning on the top of all baking trays baked simultaneously is in the range of shade number 9,5 to 10,5.

NOTE Decimal places result from averaging.

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.

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

2) *"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.

Cakes properly browned = number of cakes where all sections have shade numbers between 8 and 12.

3) *"Percentage properly browned" on the top*

The percentage properly browned is the number of cakes properly browned divided by the total number of cakes and multiplied by 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 tray separately and of all trays baked simultaneously (single results per tray and overall results).

b) Evaluation of the base of the small cakes

The lightness value L^* for the undamaged part of the base of each small cake is determined. A brown shade number is determined in accordance with IEC TS 63350 and noted for each small cake.

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

1) Average browning on the base

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

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

2) Browning difference on the base

The maximum browning difference between the shade numbers is determined and reported as the browning difference on the base of each baking tray separately and for all trays baked simultaneously (single result per tray 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.

The browning difference between top and base (absolute value) is reported for each tray separately and for all trays baked simultaneously (single results per tray 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 tray separately.

9.3 Ability to supply heat**9.3.1 Fatless sponge cake****9.3.1.1 Purpose**

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.

9.3.1.2 Ingredients

100 g white wheat flour without raising agent

100 g maize starch (corn starch)

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 water (approximately 45 °C)

These ingredients are sufficient to make one cake.

9.3.1.3 Procedure

Separate the egg whites from the yolks.

Whisk the egg whites with the 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 baking tin with greaseproof paper. The tin is made from steel, black coloured without non-stick coating, not enamelled and has an inner bottom diameter of (260 ± 15) mm and a height of (65 ± 10) mm. Spoon in the dough and distribute to a uniform thickness. Follow the instructions for use for this type of cake with regard to preheating, positioning in the appliance and setting of the control. If no instructions are given, place the cake as close as possible to the centre of the cavity and set the control 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 appliance 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.

9.3.1.4 Assessment

The brown shade chart specified in IEC TS 63350 shall be used. Small irregularities are ignored. Irregularities can be, for example, small bubbles on the top and small cracks in the crust.

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. Photos can document the baking result.

9.3.2 Apple pie

9.3.2.1 Purpose

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.

9.3.2.2 Ingredients

Dough:

- 300 g white wheat flour without raising agent
- 175 g butter, with a fat content of (83 ± 2) % (salted)
- 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 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.

9.3.2.3 Procedure

Mix the flour and sugar together and rub in the butter. Add the beaten egg and sufficient water to bind into 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 $(5 \pm 2) ^\circ\text{C}$. Peel, core and cut the apples into slices approximately 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 an inner bottom diameter of (200 ± 15) mm and a height of (50 ± 15) mm. The tin is made from steel, black coloured without non-stick coating and not enamelled.

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 control and cooking time. If no instructions are given, the pie is positioned as close as possible to the centre of the cold appliance cavity and the control is set so that the mean **oven** temperature is $160 ^\circ\text{C}$ for **ovens** with forced-air circulation and $185 ^\circ\text{C}$ for **ovens** with natural convection and the pie is left in the appliance until it is cooked.

In **ovens** with forced-air circulation, the maximum number of shelves is used in accordance with the instructions for use, one pie being placed on each shelf. All the pies are removed from the appliance 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 appliance 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 appliance to cook two pies simultaneously.

9.3.2.4 Assessment

The pie is removed from the appliance 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 brown shade chart specified in IEC TS 63350.

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.

10 Steam ovens and combi steam ovens

NOTE These tests are applicable for comparative testing only.

10.1 Ability to supply steam

10.1.1 Purpose

The purpose of this test is to assess the ability to supply sufficient steam to steam a small and comparable load of green vegetables by comparing the colour of the load with the colour of a reference measurement.

NOTE 1 The more the colour of the load differs from the reference measurement, the lower is the ability to supply steam.

NOTE 2 Tests in Clause 10 are applicable for **combi steam ovens**, if a **steam function** is available, and for **steam ovens**.

10.1.2 Ingredients and steaming accessory

The measurements are made with (300 ± 10) g fresh broccoli (*Brassica oleracea* var. *italica*) with a uniform green colour, divided into equal florets. The corolla of the florets shall have a diameter D of 35 mm to 45 mm. The stalks of the florets shall have a length of (10 ± 2) mm, whereby the length is measured from the bottom of the stalk to the lowest branch of the stalk, but the floret should not fall to pieces. Do not rinse the broccoli.

For comparative testing, broccoli is used only from one batch bought from the same supplier at the same time and stored under the same conditions until needed for the tests.

Small yellow parts can be removed. Large florets can be cut in pieces to reduce waste.

NOTE Rinsing water can influence the result.

The florets shall be at ambient temperature.

Use the accessory in accordance with the manufacturer's instructions. If no accessory is supplied and no instructions are given, take a square glass container with a height of (50 ± 10) mm and outer bottom dimensions of 250 mm × 250 mm.

10.1.3 Procedure

10.1.3.1 Reference measurement

Prepare a reference measurement and a main measurement.

Use a cooking zone with a diameter of ≥ 180 mm and ≤ 220 mm and of $(1\,700 \pm 200)$ W. Take a piece of stainless-steel cookware with an outer bottom diameter of (220 ± 10) mm. Fill in approximately 400 g water, cover with a lid and heat up the water with the maximum power setting.

When the water starts boiling, a steaming basket filled with (300 ± 10) g of prepared broccoli florets is positioned.

NOTE 1 A supplier for a suitable steaming basket is indicated in Annex B.

Steam the broccoli by maximum setting for (300 ± 10) s (reference doneness).

NOTE 2 With this cooking time, the broccoli is al dente, which means it is steamed but the stalks are still crunchy and the florets are not mashed.

After steaming, the broccoli is removed.

NOTE 3 For comparative testing, ideally the reference measurement(s) and the main measurement are steamed at the same time.

10.1.3.2 Main measurement

The temperature of the water shall be $(15 \pm 1) ^\circ\text{C}$.

For appliances without a fixed fresh water supply, the tank shall be filled with water until the maximum level is reached.

Distribute (300 ± 10) g fresh broccoli florets evenly on the accessory.

Steam in accordance with the manufacturer's instructions for this type of food with respect to the **steam function**, temperature, shelf position and preheating. If preheating is recommended, the broccoli is placed in the **steam oven** when the end of the preheating phase is indicated, for example by visual or acoustical signal, or after the recommended preheating time.

If no instructions are given:

- set the **steam function**;
- adjust the temperature to the highest possible setting $\leq 100 ^\circ\text{C}$;
- place the accessory in the middle of the cavity. The middle of the cavity is calculated in accordance with 6.2;
- do not preheat.

Steam the broccoli until the doneness of the main measurement is identical to the doneness of the reference measurement. The main measurement shall be al dente, too.

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

If the doneness of the main measurement and the reference measurement differ, the test shall be repeated by adapting the cooking time of the main measurement.

NOTE Preliminary tests could be necessary to achieve the desired doneness of the measurement.

While the broccoli is steamed, the position of the accessory shall not be changed.

After steaming, the broccoli is removed.

10.1.4 Assessment

The assessment shall be carried out immediately after steaming and shall be finished no more than 5 min after steaming.

The doneness shall be assessed with several same-sized florets immediately after the steaming process. For comparative testing, it is necessary that all measurements have the same doneness as the reference measurement (see 10.1.3.1).

If the doneness is valid, the colours of the main measurement and reference measurement are determined using the green shade chart specified in IEC TS 63350 as follows:

- inspect the upper side of the florets only, the bottom side and stalks are not relevant;
- find green shade charts which characterize the colours of the main measurement and the reference measurement best; colour shall be visible in a concentrated area, while single florets are not relevant;
- state the hue angle values h_{main} and h_{R} in h_{ab} ;
- calculate the difference Δh_{supply} as follows and state in h_{ab} :

$$\Delta h_{\text{supply}} = |h_{\text{main}} - h_{\text{R}}| \quad (24)$$

where:

h_{main} is the hue angle value of the colour of the main measurement;

h_{R} is the hue angle value of the colour of the reference measurement;

Δh_{supply} is the difference between h_{main} and h_{R} .

NOTE h_{ab} in degrees is the value stated on the green shade chart in IEC TS 63350:2022, Table 2.

The difference Δh_{supply} defines the ability of the appliance to supply steam. The bigger Δh_{supply} is, the lower the ability to supply steam is.

NOTE 1 Supplementary files to generate the green shade chart are located at <https://www.iec.ch/sc59k/supportingdocuments>.

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

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

The following data are stated:

- Δh_{supply} ;
- the cooking time (preheating time included);
- the energy consumption in Wh (preheating included);
- the water consumption;
- whether the water tank shall be refilled during steaming.

10.2 Distribution of steam

10.2.1 Purpose

The purpose of this test is to assess the horizontal distribution of steam and optionally the vertical distribution.

NOTE The main application of **steam ovens** is usually steaming on one level. Some **steam ovens** allow steaming on more levels simultaneously.

The distribution of steam becomes apparent in the distribution of the green colours of steamed broccoli. The more the colours of the broccoli differ, the more uneven the distribution of steam is.

In addition, the main measurement is compared with a reference measurement in order to notice the best achievable colour of the batch of broccoli used.

10.2.2 Ingredients, steaming accessories and number of levels

The measurements are made with fresh broccoli florets, prepared in accordance with 10.1.2.

The quantity of the florets depends on the size of the steaming accessory. Use approximately 1 g/cm².

The steaming accessory measured in accordance with 6.4 shall cover at least 80 % of the usable width and 70 % of the usable depth of the cavity measured in accordance with 6.2.

If the supplied steaming accessory recommended in the instruction fits these dimensions, this accessory shall be used. If the supplied or recommended accessory does not fit the above conditions, another steaming accessory, which shall be a perforated container fitting the above condition as far as possible, shall be used.

For testing, the horizontal distribution of steam on one level is used.

Optionally the vertical distribution of steam can be tested if steaming on more levels is recommended in the manufacturer's instructions. The manufacturer's instructions regarding the number of levels steamed simultaneously are followed.

10.2.3 Procedure

Prepare the reference measurement in accordance with 10.1.3.1 and the main measurement as follows.

NOTE 1 For comparative testing, ideally the reference measurement and the main measurement(s) are steamed at the same time.

For appliances without a fixed fresh water supply, the tank shall be filled with water until the maximum level is reached. The temperature of the water shall be $(15 \pm 1) ^\circ\text{C}$.

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

The mass of broccoli filled in is stated.

Steam the broccoli in accordance with the manufacturer's instructions for this type of food with respect to the **steam function**, temperature, shelf position and preheating. If preheating is recommended, the broccoli is placed in the **steam oven** when the end of the preheating phase is indicated, for example by visual or acoustical signal, or after the recommended preheating time.

For testing the vertical distribution of steam (only if recommended in the manufacturer's instructions), the accessories are placed simultaneously in the **steam oven** following the manufacturer's instructions.

If no instructions are given:

- set the **steam function**;
- adjust the temperature to the highest possible setting $\leq 100 ^\circ\text{C}$;
- place the accessory in the middle of the calculated cavity;
- do not preheat.

Steam the broccoli until the doneness of the main measurement is identical with the doneness of the reference measurement. If the doneness of the main measurement is unequal, steam until all areas of the main measurement are at least al dente, even if other areas are overcooked.

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

If the doneness of the main measurement and the reference measurement differ, the test shall be repeated by adapting the cooking time of the main measurement.

NOTE 2 Preliminary tests could be necessary to achieve the desired doneness of the measurement.

While the broccoli is steamed, the position of the accessory/accessories shall not be changed.

After steaming, the broccoli is removed.

If more levels are steamed (test of the vertical distribution of steam), all accessories are removed simultaneously.

10.2.4 Assessment

The assessment shall be carried out immediately after steaming and shall be finished no more than 5 min after steaming.

The doneness shall be assessed with several same-sized florets immediately after the steaming process. For comparative testing it is necessary that all measurements have the same doneness as the reference measurement (see 10.1.3.1).

If the doneness is valid, the colours of the main measurement and reference measurement are determined as follows:

- inspect the upper side of the florets only, bottom side and stalks are not relevant;
- detect the areas of the upper side of the main measurement with the minimum (= worst) hue angle value and the maximum (= best) hue angle value of the green colour; colours shall be visible in concentrated areas, while single florets are not relevant;
- find the green shade charts which characterize the colours of both areas best by using the green shade charts specified in IEC TS 63350;
- state the hue angle values $h_{\max}$ and $h_{\min}$ of the main measurement in h_{ab} ;
- calculate the difference $\Delta h_{\text{distribute}}$ as follows and state in h_{ab} :

$$\Delta h_{\text{distribute}} = h_{\max} - h_{\min} \quad (25)$$

where:

$h_{\max}$ is the hue angle value of the colour of the greenest area within the main measurement in h_{ab} ;

$h_{\min}$ is the hue angle value of the colour of the most olive-brown turned area within the main measurement in h_{ab} ;

$\Delta h_{\text{distribute}}$ is the difference of the hue angle values $h_{\max}$ and $h_{\min}$;

- find the green shade chart which characterizes the colour of the reference measurement best and state the hue angle value h_R of the reference measurement;
- calculate the difference $\Delta h_{\text{control}}^{\min}$ as follows and state in h_{ab} :

$$\Delta h_{\text{control}}^{\min} = |h_{\max} - h_R| \quad (26)$$

where:

$\Delta h_{\text{control}}^{\min}$ is the minimum colour difference between main measurement and reference measurement;

$h_{\max}$ is the hue angle value of the colour of the greenest area within the main measurement in h_{ab} ;

h_R is the hue angle value of the colour within the reference measurement in h_{ab} .

- calculate the difference $\Delta h_{\text{control}}^{\text{max}}$ as following and state in h_{ab} :

$$\Delta h_{\text{control}}^{\text{max}} = |h_{\text{min}} - h_R| \quad (27)$$

where:

$\Delta h_{\text{control}}^{\text{max}}$ is the maximum colour difference between main measurement and reference measurement;

h_{min} is the hue angle value of the colour of the most olive-brown turned area within the main measurement in h_{ab} ;

h_R is the hue angle value of the colour within the reference measurement in h_{ab} .

The difference $\Delta h_{\text{distribute}}$ determined on one level defines the horizontal distribution of steam.

The difference $\Delta h_{\text{distribute}}$ determined on more levels defines the vertical distribution of steam.

The differences $\Delta h_{\text{control}}^{\text{min}}$ and $\Delta h_{\text{control}}^{\text{max}}$ define the differences between the green colour of the main measurement and the best achievable colour.

NOTE 1 The bigger $\Delta h_{\text{distribute}}$ is, the more uneven the distribution of steam is. The bigger $\Delta h_{\text{control}}^{\text{max}}$ and $\Delta h_{\text{control}}^{\text{min}}$ are, the worse is the ability to steam broccoli in general.

The water consumption is recorded either by a 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.

The following data are stated for the horizontal steam distribution:

- $\Delta h_{\text{distribute}}$, $\Delta h_{\text{control}}^{\text{max}}$ and $\Delta h_{\text{control}}^{\text{min}}$ in h_{ab} ;
- the mass of broccoli per level (before steaming);
- the cooking time (preheating time included);
- the energy consumption (preheating included) in Wh;
- the water consumption;
- whether the water tank shall be refilled during steaming.

If the optional test for vertical steam distribution has been carried out, the following data are stated:

- $\Delta h_{\text{distribute}}$, $\Delta h_{\text{control}}^{\text{max}}$ and $\Delta h_{\text{control}}^{\text{min}}$ in h_{ab} ;
- the number of levels used simultaneously;
- the mass of broccoli per level and over all levels (before steaming);
- the cooking time (preheating time included);
- the energy consumption (preheating included) in Wh;
- the water consumption;
- whether the water tank shall be refilled during steaming.

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

10.3 Determination of the capacity

10.3.1 Purpose

The purpose of this test is to assess the capacity of the appliance. The measurements are made with deep-frozen peas, which simulate a heavy load. The capacity of the appliance is determined by the maximum mass ($= m_{\max}$ in g) of frozen peas steamed.

This heavy load is representative of the capacity of the appliance, for example of the extent to which it is possible to prepare a full meal for one or more persons. The amount of frozen peas, which can be steamed up to $(85 \pm 1) ^\circ\text{C}$, be uniform in colour, in a certain time with only one tank of water, categorizes the **steam oven** to a high-level capacity, middle-level capacity and low-level capacity.

10.3.2 Ingredients

The measurements are made with deep-frozen peas. The peas shall not have any bits of ice. The colour of the frozen peas shall be homogenous and green as far as possible.

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

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

10.3.3 Mass of peas, steaming accessories and number of levels

The mass of peas, the number of levels used simultaneously and the accessory/accessories are determined according to the manufacturer's instructions.

If no instructions are given:

- the maximum load depends on the size of the supplied steaming accessory;
- the height of the load measured in the accessory shall be (40 ± 2) mm. If the height of the accessory is lower than 40 mm, the peas shall be filled at maximum height;
- only one level is used.

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

10.3.4 Procedure

10.3.4.1 General

For appliances without a fixed fresh water supply the tank shall be filled with water until the maximum level is reached. The temperature of water shall be $(15 \pm 1) ^\circ\text{C}$.

Take the peas out of the freezer and fill the necessary amount into the steaming accessory/accessories.

Check the height of the load with a gauge and weigh the total amount. Steam the peas immediately after filling in the accessory.

Steam in accordance with the manufacturer's instructions for this type of food with respect to the **steam function**, temperature, shelf position/s and preheating.

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

If no instructions are given:

- set the **steam function**;
- adjust the temperature to the highest possible setting $\leq 100\text{ °C}$;
- place the accessory/accessories in the middle of the calculated cavity;
- do not preheat.

Thermocouples are led through the door gap in such a way that the door is completely sealed.

While the peas are steaming, the position of the accessory shall not be changed.

At the end of steaming, remove all accessories immediately and simultaneously.

10.3.4.2 Preliminary test

A preliminary test is carried out to determine the position of the coldest spot of the load.

Fix one thermocouple in accordance with 5.3 on each used level in the geometrical centre of the load.

Steam the peas in accordance with 10.3.4.1.

When the centre of the load reaches approximately 70 °C , remove the accessory/accessories.

Detect the coldest spot and check the temperature distribution of the whole load in a sensory manner (e.g. visually or by feeling the coldest spot).

The position of the coldest spot is noted (area, height and level if necessary).

NOTE 1 The coldest spot is easier to determine if more thermocouples are evenly distributed in the load.

NOTE 2 Normally, the coldest spot is located under the surface.

10.3.4.3 Main test

For the main test, five thermocouples are used. One is positioned at the detected coldest spot. The others are evenly distributed in the mass of the peas in order to detect if the coldest spot moves.

When the last of the thermocouples has reached a temperature of $(85 \pm 1)\text{ °C}$, the steaming process is finished. State the cooking time.

10.3.5 Assessment

10.3.5.1 Criteria for validity

In a first step, ensure the validity of the main test. In a second step, state the final result (see 10.3.5.2).

Results of the main test in accordance with 10.3.4.3 are valid and shall only be accepted if the following criteria are fulfilled.

a) Uniformity of colour

Determine the colour of the peas immediately after steaming. The determination shall be finished no more than 5 min after steaming.

Detect the areas of the steamed peas with the minimum (= worst) and maximum (= best) hue angle value of the green colour, see IEC TS 63350. Colours shall be visible in

concentrated areas, while single peas are not relevant. Check also the peas under the surface.

Find the green shade charts which characterize the colours of the best and worst area by using the green shade charts specified in IEC TS 63350. State the hue angle values of these colours. Calculate the difference of the hue angle values. The difference between the minimum and maximum hue angle values shall not be more than 7.

NOTE Supplementary files to generate the green shade chart are located at <https://www.iec.ch/sc59k/supportingdocuments>.

b) Cooking time

The cooking time is determined in relation to the reference time t_{ref} given in Figure 18 for this load, preheating time included.

Cooking time shall not be longer than two times of the reference time.

The determined cooking time can be included into Figure 18.

NOTE The reference line in Figure 18 is determined empirically.

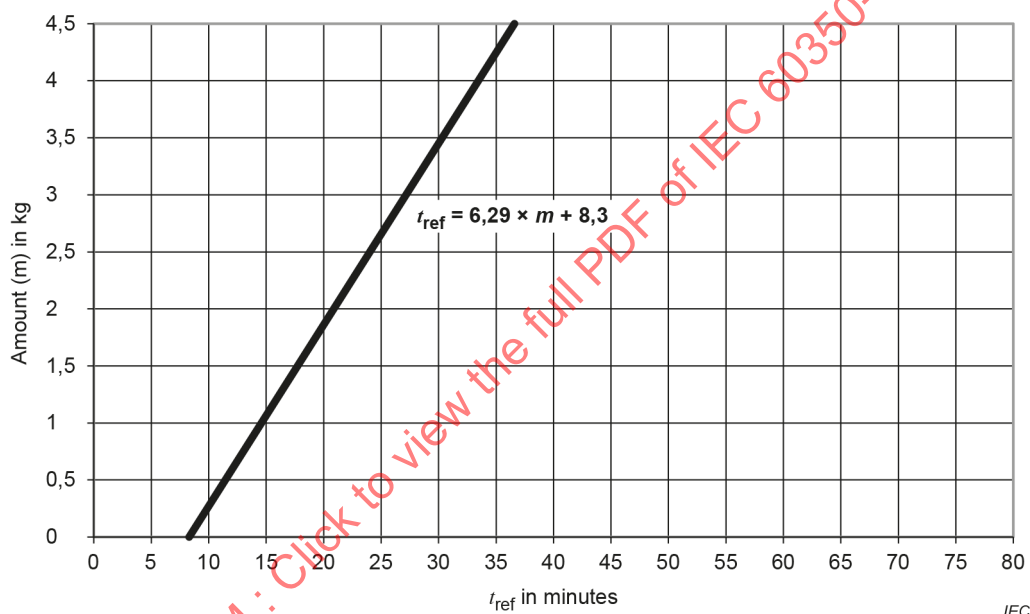


Figure 18 – Reference values of cooking time (t_{ref})

c) Water tank

The water tank shall not be refilled during steaming.

If one of these criteria is not fulfilled, the test shall be repeated with a lower mass of peas. The mass of peas shall be reduced in 20 % increments from the frozen peas' mass before steaming.

10.3.5.2 Final result

If the result is valid, the capacity – i.e. the maximum amount of peas m_{max} steamed with an acceptable quality according to the criteria in 10.3.5.1 – shall be stated.

NOTE 1 Steaming more than 2 000 g of frozen peas is representative for a high-level capacity **steam oven** which is more applicable, for example, for menu cooking for a group of persons. A **steam oven** which steams less than 1 000 g of frozen peas has a low-level capacity.

The number of levels used simultaneously is stated.

The energy consumption is expressed in Wh (preheating included).

NOTE 2 Energy consumption and cooking time are not comparable as different amounts of peas are taken as a basis.

10.4 Accuracy of the temperature control

The purpose of this test is to determine the accuracy for the **steam function** of the temperature control for a low setting.

Prior to the measurements, the whole appliance shall be at ambient temperature of $(23 \pm 2) ^\circ\text{C}$. The temperature control element is set to the position marked $90 ^\circ\text{C}$ and the appliance is heated for $t_{\text{check},90} = 45 \text{ min}$.

If the control element is not marked at $90 ^\circ\text{C}$, the next lower marked setting is taken into account.

The temperature is recorded continuously in line with 7.2.

The temperature is respectively determined as the arithmetic mean of the minimum and maximum temperature reached during the last 20 min of t_{check} .

The arithmetic mean of the temperature and the minimum and maximum temperatures are noted.

11 Effective grilling area

11.1 Purpose

The purpose of this test is to determine the effective grilling area (E). The effective grilling area is the part of the usable area of the grill grid (see 6.5) where white bread reaches a required browning intensity during grilling.

11.2 Ingredients

The measurement is done with factory-made white bread made of wheat (e.g. Golden Toast³), which is commonly available and suitable for toasting. The slices of bread shall have an edge length of at least 80 mm and a thickness of $12 \text{ mm} \pm 1 \text{ mm}$. It shall be fine-pored.

If more than one loaf of bread is necessary, it shall be from the same batch. Therefore, the bread shall be bought from the same supplier, at the same time and stored under same conditions until needed for the measurements. It shall be used before the expiry date.

11.3 Preparation

Discard the first two and the last two slices of one package because these slices often have a different texture. Remove the crust and cut the slices of bread to an edge length of $70 \text{ mm} \pm 1 \text{ mm}$.

Determine the usable area of the grill grid (A_U) and state it in cm^2 . Cover the usable area of the grill grid completely (without gaps in between) with bread. For this, it can be necessary to trim some slices. The minimum width and length of each slice shall not be less than 35 mm.

³ Golden Toast is the trade name of a product supplied by Lieken Brot und Backwaren GmbH. Golden Toast might be commercially available through other suppliers after the date of publication of this standard. This information is given for the convenience of the users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products can be used if they can be shown to lead to the same results.

11.4 Procedure

Follow the operating instructions with respect to the **heating function**, temperature, shelf and preheating. If preheating is recommended, the grill grid is 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 grill grid is placed in the highest possible level in the not-preheated **oven** until it reaches the stop position of the rack, the door is closed, and the bread is grilled with the highest possible setting.

During the grilling process, the door may be opened once for a maximum of 3 s to check the browning, but without moving the grid.

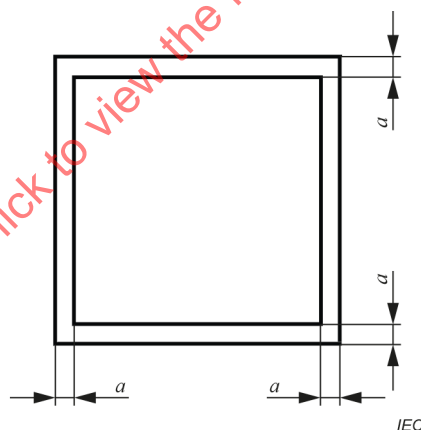
Remove the grill grid when the bread is browned and burnt spots start to appear ($\geq$ shade number 15).

11.5 Assessment

11.5.1 General

Assess the browning of the bread within 1 h. Through the grilling process, the slices of bread might bulge, which could increase the browning of the edges. Therefore, the top area of a slice of toast is reduced alongside its outline shown in Figure 19 by 2 mm to 3 mm from each side.

The assessable area (A_a) is the top area after grilling considering the shrinkage of toast and cutting the slices; see Figure 19.



Key

a is the rejected part of each edge length; $2 \text{ mm} \leq a \leq 3 \text{ mm}$

Figure 19 – Determining the assessable area of a slice of toast – Example

11.5.2 Criteria of validity

For a valid result, sufficient browning is required. This is ensured if the percentage of burned parts of the assessable area in total is $\geq 3 \%$ to $\leq 15 \%$. Burned areas ($A_{\geq 15}$) are defined by showing a shade number ≥ 15 in accordance with IEC TS 63350. To determine the shade numbers, a digital evaluation system in accordance with IEC TS 63350 should be used.

If the result is invalid, repeat the test with adapted time.

11.5.3 Criteria of assessment

The relative effective grilling area E_r is calculated with the following formula:

$$E_r = \frac{A_{8-14}}{A_a - A_{\geq 15}} \times 100 \quad (28)$$

where

E_r is the relative effective grilling area, in %;

A_{8-14} is the assessable properly browned area with a shade number within the range of ≥ 8 and ≤ 14 , in cm^2 ;

$A_{\geq 15}$ is the assessable burnt area with a shade number ≥ 15 , in cm^2 ;

A_a is the assessable area, in cm^2 .

The absolute effective grilling area E_a in cm^2 is calculated as follows:

$$E_a = \frac{A_{8-14}}{A_a} \times A_u \quad (29)$$

Additionally, the following areas shall be noted:

– the not browned area N in cm^2 :

$$N = \frac{A_{<8}}{A_a} \times A_u \quad (30)$$

– the burnt area B in cm^2 :

$$B = \frac{A_{\geq 15}}{A_a} \times A_u \quad (31)$$

where

A_{8-14} is the assessable properly browned area with a shade number within the range of ≥ 8 and ≤ 14 , in cm^2 ;

$A_{\geq 15}$ is the assessable burnt area with a shade number ≥ 15 , in cm^2 ;

$A_{<8}$ is the assessable not browned area with a shade number < 8 ;

A_a is the assessable area, in cm^2 ;

A_u is the usable area of the grill grid, in cm^2 .

The final effective grilling area is calculated as an average of three valid tests.

Additionally, if the upper surface of the bread that is assessed is above or below half the height measured in accordance with 6.2.2, this shall be reported.

12 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 Wh for 1 h of operation.

13 Cleaning

13.1 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 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 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/dm².

The door is closed and the **oven** energized for 3 h with the temperature control set to 250 °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.

13.2 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 1 000 g 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.

14 Consumption measurement of low-power modes

14.1 Purpose and combination of appliances

This clause sets out determination of **off mode**, **standby mode**, **standby mode in condition of networked standby** and **delay start**. Other low-power modes can exist in some appliances, but for the current designs, these are not considered important in terms of duration and energy consumption. For example, the cooling down period is an associated activity to the **active mode** in which the cooling fan runs for safety reasons. The measurement of the energy consumption of these associated activities is not considered.

For an appliance composed of a combination of separate units which can 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 in combination 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 the 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 the energy consumption of the **active mode** and low-power modes of **hobs** is described in IEC 60350-2.

14.2 Measurement

14.2.1 Principles

The requirements of IEC 62301 and IEC 63474 shall be observed in addition to the following requirements.

However, 5.3 and the requirement defining air speed in IEC 62301:2011, 4.2 shall not apply.

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.

If energy consumption is influenced by the continuously 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 with IEC 62301 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.

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

- instructions for use regarding installation, operation and settings (as applicable) are followed;
- the appliance shall be connected to mains power for the duration of the test;
- no adverse warning indicators are present;
- follow the manufacturer's instructions regarding the configuration of **network** connectivity (where applicable);
- ensure that the **network** is connected to the appliance (when required);
- ensure that all components of the appliances are at ambient temperature;
- ensure that the door is closed;
- after each appliance interaction, wait at least 15 min before commencing with measurements; and
- no interference during measurement by any interaction.

Some appliances can require software updates to ensure secure network operations. It is recommended to allow those updates to be installed and to make a note of it in the test report. Updates can occur or can be requested after activation of network capability and the update process can affect energy during measurement. The measurement starts after the completion of any software update.

The required power consumption can be determined by measuring the power consumption directly for a certain period of time (not less than 10 min). The data shall be recorded at regular intervals of 1 s or less throughout the test using a data logger or computer. The average power is given in watts and rounded with two valid digits after the decimal point.

Alternatively, the energy consumption can be measured for a certain period of time (not less than 10 min) and the power consumption be calculated by dividing the measured energy consumption (measured in Wh) by the duration of the measurement (in h). The calculated power is given in watts and rounded with two valid digits after the decimal point.

Appliances with a power management system switch automatically to **off mode** or **standby mode** after a certain period of time following appliance interaction. Relevant appliance interactions to be considered for measurement are:

- after the appliance has been switched on, or
- at the end of any cycle and associated activities, or
- after any interaction, directly (i.e., physical) or indirectly (e.g., remote user interface) with the appliance, or
- if no other mode, including emergency measures, is triggered.

Appliance interactions during a cycle shall not be considered for measurement. Step-by-step instructions for measuring the low-power modes is given in Annex G.

14.2.2 Determination of power consumption in off mode

This subclause is only applicable to appliances providing an **off mode**.

The appliance under test should be set to **off mode** following the manufacturer's instructions. All actions required to set to **off mode**, such as emptying the water tank, removal of the food, or closing the door, shall be taken.

In all cases, the **off mode** shall be determined over a period of not less than 10 min. The power consumption of the **off mode** is the average of the measured data.

If the appliance provides an **off mode**, it should be described by the manufacturer.

14.2.3 Determination of power consumption in standby mode

This subclause is only applicable to appliances providing a **standby mode**.

The appliance under test should be set to **standby mode** following the manufacturer's instructions. All actions required to set to **standby mode**, such as emptying the water tank, removal of the food, or closing the door, shall be taken.

In all cases, **standby mode** shall be determined over a period of not less than 10 min. The power consumption of the **standby mode** is the average of the measured data.

If the appliance provides a standby mode, it should be described by the manufacturer.

14.2.4 Determination of power consumption in standby mode in condition of networked standby

This subclause is only applicable to appliances providing a **standby mode in condition of networked standby**.

For **appliances** with **network** connectivity, follow the manufacturer's instructions regarding the configuration of the appliance and ensure that **network** (e.g., LAN or WLAN) is connected to the appliance and activated.

The highest possible power consumption can be reached when the appliance is not only connected to the **network** but also to a remote user interface (i.e. an app). Avoid any interaction with the remote user interface during the 15 min waiting time and the measurement.

In all cases, **standby mode in condition of networked standby** shall be determined over a period of not less than 10 min. The power consumption of the **standby mode in condition of networked standby** is the average of the measured data.

Ensure that there is no download and no update running during measurement.

The test report shall contain the description of the **network** connection used.

14.2.5 Determination of power consumption in delay start

This mode is only applicable to appliances providing a **delay start**.

For determination of this mode, the operator can select any **heating function** and any user-programmed delay.

If available, **network** connection shall be activated.

Select any **heating function** and temperature setting, set the delay start and activate **delay start**. Power measurements in **delay start** shall commence at the earliest 15 min after the moment the **delay start** is activated and shall continue for at least 10 min; therefore, the delay start setting shall cover at least 25 min.

The selected **heating function** and temperature, the delay start setting selected, and the duration of the measurement shall be stated with the measured power value.

Where the display changes during the timer countdown, there can be some small variations in power consumption during this mode.

The power consumption of the **delay start** is the average of the measured data.

NOTE For an appliance, the term "latched" means that the door is closed, and the door interlock is engaged so that the product could operate if required.

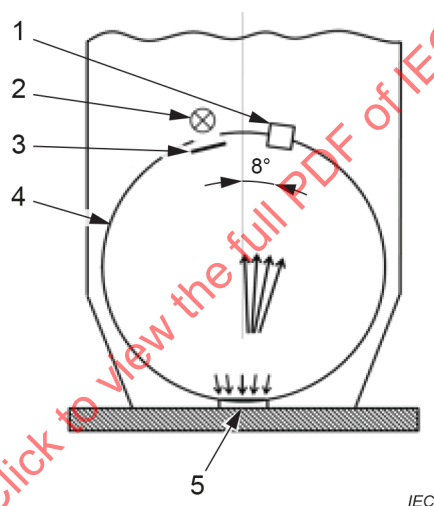
IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex A (normative)

Colour measuring instrument

The instrument (see Figure A.1) is in accordance with CIE 15 with the following specification:

- measuring geometry: diffuse, 8° vertical deviation;
- measuring aperture: diameter 8 mm to 16 mm;
- calibration standard: white, pressed barium sulfate (BaSO_4), polytetrafluoroethylene (PTFE) or equivalent;
- wavelength range: $400 \text{ nm} \leq \lambda \leq 700 \text{ nm}$;
- wavelength interval: $\leq 10 \text{ nm}$;
- standard illuminant: CIE standard illuminant D65;
- standard observer: 10°;
- evaluation: CIEXYZ (CIE 1931) / CIELAB (CIE).



Key:

- | | | | |
|---|---------------------|---|-----------------------------------|
| 1 | detector | 4 | integrating sphere |
| 2 | illumination source | 5 | specimen under measuring aperture |
| 3 | shutter | | |

Figure A.1 – Colour measuring instrument

Annex B (informative)

Addresses of suppliers

B.1 General

The information given is for the convenience of users of this document and does not constitute an endorsement by the IEC of the products named. Equivalent products may be used if they can be shown to lead to the same results.

NOTE Possible suppliers for aids used for the assessment of baked or steamed items are recommended in the supporting documents, located at <https://www.iec.ch/sc59k/supportingdocuments>.

B.2 Testing ingredients for small cakes

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

Erbesenbodenstr. 31
D-91207 Lauf – Germany
e-mail: r.stamminger@web.de
Phone: +49 (0) 9123-988975
Fax: +49 (0) 9123-988489
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 B.1.

Table B.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 ⁴ , deep frozen (at least –18 °C) pH 6.4 to 7.0 Dry substance 22,7 % to 23,7 %
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 per 100 g 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/m² bleached greaseproof paper

Manufacturer: Bacher und Demmler GmbH & Co. KG
Kaiser-Wilh.-Str. 7-15
Germany – 12247 Berlin
bu@demmler.de

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 ± 2) °C. Put one package of frozen egg into the warm water so that it is covered completely. It might be necessary to weight it down, for example with a cup. Stir the water from time to time and shake the package.

⁴ Tetra Brik is the trade name of a product supplied by Tetra Pak®. 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.

After 1 h, discard the first lot of water and completely renew with another 5 l of warm water at $(30 \pm 2) ^\circ\text{C}$ completely covering the package 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 $(23 \pm 2) ^\circ\text{C}$. Open the package and mix the egg with a fork for approximately 30 s until it looks homogenous and can thus be used like fresh eggs.

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

An unopened package can be stored in a fridge.

B.3 Food mixer

This clause describes an appropriate food mixer for the dough for the small cakes used in 9.2.2. Mixing times and levels are determined for the Bosch MUM4 series, e.g. Bosch MUM4405⁵.

Specification of an appropriate food mixer:

- power rating $(550 \pm 50) \text{ W}$;
- revolutions per minute, see Table B.2;

Table B.2 – Food mixer – revolutions per minute

	Revolutions per min			
	Level 1	Level 2	Level 3	Level 4
Wire balloon whisk	(53 ± 5)	(93 ± 5)	(185 ± 5)	(325 ± 5)

- wire balloon whisk;
- bowl, approximately 3,5 l, top diameter $(23 \pm 2) \text{ cm}$;
- the machine should be able to beat the sugar and butter to a soft and pale mixture in approximately 5 min.

Table B.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

⁵ BOSCH MUM 4405 is the trade name of a product supplied by Bosch. It might be commercially available by other suppliers after the date of publication of this document. This information is given for the convenience of the 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.

B.4 Colour measuring instrument

(See Annex A.)

Possible suppliers of the colour measuring instrument are:

FMS Jansen GmbH & Co. KG
HunterLab
<http://www.hunterlab.de>
info@hunterlab.de

Konica Minolta Sensing Europe B.V. European Service Center
<http://www.konicaminolta.eu>
esc@seu.konicaminolta.eu

B.5 Steaming basket

(See Clause 10)

A possible supplier is:

Fackelmann
<http://www.fackelmann.de>
Art.-no.: 42491

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex C (normative)

Description of the test brick

C.1 Specification

Name	SkamOven Hipor ⁶
Bulk density, dry	$(550 \pm 40) \text{ kg/m}^3$
Total porosity	77 %
Dry weight	$(920 \pm 75) \text{ g}$ (without thermocouples), see 8.3.2
Water absorption	$(1\,050 \pm 50) \text{ g}$, see 8.3.3
Height	$(64 \pm 0,5) \text{ mm}$

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

C.2 Supplier and order specification

Bricks are available under the type designation "SkamOven Hipor" from the following supplier:

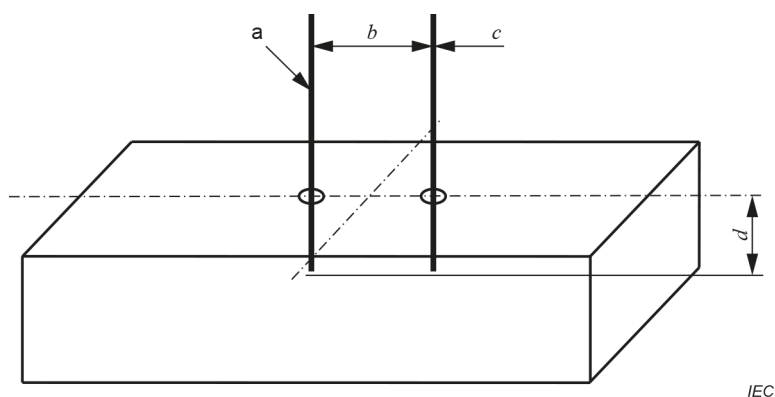
Skamol A/S
Hesselager Centervej 1
Denmark – 8260 Viby

- length × width × height: 230 mm × 114 mm × 64 mm (see sketch in Figure C.1),
- machined on all six surfaces, tolerances $\pm 0,5 \text{ mm}$.

The diameter of the holes should not be bigger than the diameter of the thermocouple.

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 a diameter of 1 mm could serve as a drill.

⁶ Hipor is the trade name of a product supplied by SKAMOL A/S. 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.

**Key**

- a Two metal sheet tube thermocouples
- b 50 mm, with holes which are equidistant to the brick's centre line
- c 1 mm Ø, both thermocouples and holes
- d 32 mm both thermocouples

Figure C.1 – Position of the thermocouples

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

Annex D (informative)

Check of applied microwave energy during the measurement according to Clause 8

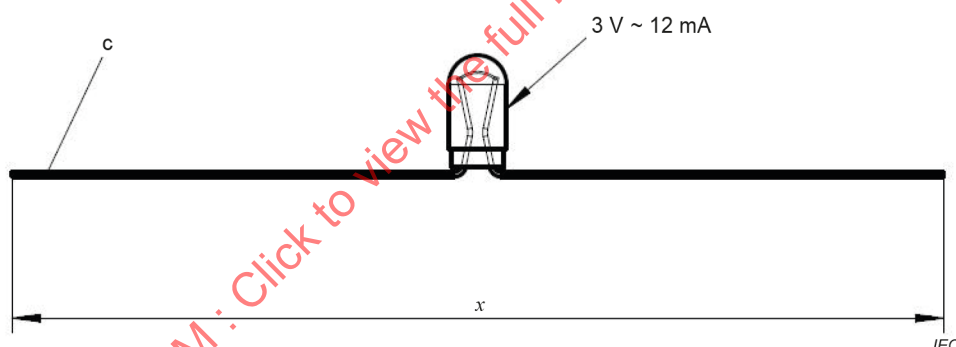
D.1 General

Heating up the brick in accordance with Clause 8 shall only be done with thermal heating. It is not allowed to switch on a magnetron, not even for a short period.

The sophisticated method to check possible applied microwave energy during the energy consumption measurement in accordance with Clause 8 is to prove whether the magnetron is switched on and off. Depending on the design of the appliances, it is not always possible to determine clearly whether the microwave energy is switched on during the long-lasting heating up process. Therefore, the following method can be used in a pre-test.

D.2 Procedure

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



Key

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

Figure D.1 – Filament lamp

The brick is prepared as described in 8.3.3 and placed in the appliance as described in 8.4. The filament lamp is placed on the upper surface of the wet brick. The appliance is switched on and operated in accordance with 8.4.3 for at least the time that is necessary to have a temperature rise in the brick of 55 K.

The appliance is then 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, thereby damaging the filament. The lamp can be tested with 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 this means that microwave energy was applied.

Annex E

(informative)

Marking the temperature setting for checking the oven temperature

For marking the temperature setting on the panel, polar coordinate paper can be useful.

Polar coordinate paper has concentric circles divided into small arcs to allow an exact marking around a knob (see Figure E.1).

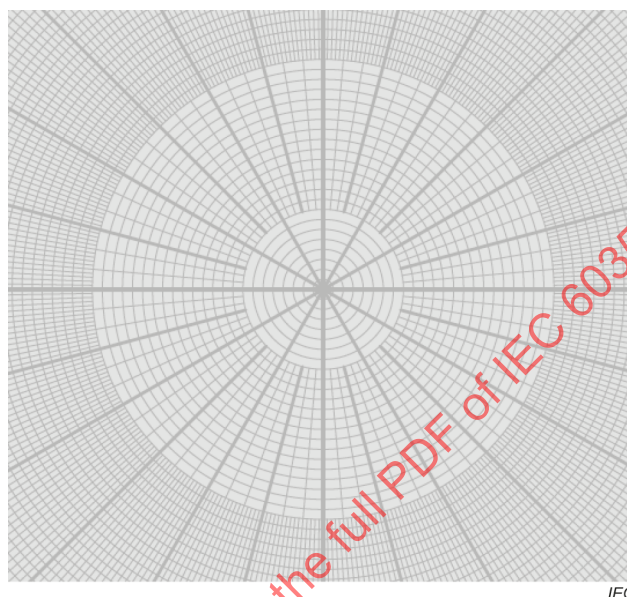


Figure E.1 – Polar coordinate paper – Example

Annex F (informative)

Approach to calculate the f -factor

The following formulas were applied to calculate the f -factor used for calculating the standard deviation in 8.6.1. For calculation in 8.6.1, $f = 1,2$ is always used.

The f -factor is the ratio of the mean regression sum of squares divided by the mean error sum of squares. The value is the probability that the null hypothesis for the full model is true (i.e., that all the regression coefficients are zero).

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

Where:

ΔT_0 is the nominal temperature rise (165 K);

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

$$Q_{xy} = \sum_{k=1}^n \Delta \bar{T}_{c2,k} \cdot E_k - \bar{E} \sum_{k=1}^n \Delta \bar{T}_{c2,k}$$

$$Q_x = \sum_{k=1}^n \left(\Delta \bar{T}_{c2,k} \right)^2 - \frac{\left(\sum_{k=1}^n \Delta \bar{T}_{c2,k} \right)^2}{n}$$

$$\Delta \bar{T} = \frac{1}{n} \sum_{k=1}^n \Delta \bar{T}_{c2,k}$$

$$\bar{E} = \frac{1}{n} \sum_{k=1}^n E_k$$

Annex G (normative)

Low-power mode measurements

Table G.1 – Step by step instruction for measuring low-power modes

Standby and off mode							Reference
Mode/ Con- dition	Step	Appliance without delay start and without network standby	Appliance with delay start and without network standby	Appliance without delay start and with network standby	Appliance with delay start and network standby	Measured parameter	
Not connected to network (deactivate network connection if activated)	1	Connect appliance to power supply	Connect appliance to power supply	Connect appliance to power supply	Connect appliance to power supply		14.2.2
	2	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*		14.2.3
	3	Measure power consumption	Measure power consumption	Measure power consumption	Measure power consumption	Standby mode P_s or Off mode P_o	
	4	Turn on appliance	Turn on appliance	Turn on appliance	Turn on appliance		14.2.2
	optional	Complete (any) cycle	Complete (any) cycle	Complete (any) cycle	Complete (any) cycle	Describe in test report	14.2.3
	5	Cool down to ambient temperature	Cool down to ambient temperature	Cool down to ambient temperature	Cool down to ambient temperature		
	6	Appliance interaction**	Appliance interaction**	Appliance interaction**	Appliance interaction**	Describe in test report	
	7	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*	Wait at least 15 min*		
Connected to network (if available)	8	Measure power consumption	Measure power consumption	Measure power consumption	Measure power consumption	Standby mode P_s or Off mode P_o	
	9	-	-	Turn on appliance if it is not already turned on	Turn on appliance if it is not already turned on		14.2.4
	10	-	-	Activate network connection	Activate network connection		
	optional	-	-	Complete (any) cycle	Complete (any) cycle	Describe in test report	
	11	-	-	Cool down to ambient temperature	Cool down to ambient temperature		
	12	-	-	Wait at least 15 min*	Wait at least 15 min*		
	13	-	-	Measure power consumption	Measure power consumption	Network standby P_n	
	14	-	-	Turn off appliance if it is not already off	Turn off appliance if it is not already off		

standby		
Turn on appliance	-	Turn on appliance
	-	Activate network connection if deactivated
Activate delay start	-	Activate delay start
Wait at least 15 min *	-	Wait at least 15 min *
Measure power consumption	-	Measure power consumption

ator can reactivate the appliance to perform auxiliary functions such as display information or interior to revert to off mode or standby mode or standby mode in condition of networked standby. The measu

activities;
 re active mode;
 s triggered.

Bibliography

IEC 60335-2-6, *Household and similar electrical appliances – Safety – Part 2-6: Particular requirements for stationary cooking ranges, hobs, ovens and similar appliances*

IEC 60335-2-9, *Household and similar electrical appliances – Safety – Part 2-9: Particular requirements for grills, toasters and similar portable cooking appliances*

IEC 60350-2, *Household electric cooking appliances – Part 2: Hobs – Methods for measuring performance*

IEC 60705, *Household microwave ovens – Methods for measuring performance*

IEC 61591, *Cooking fume extractors – Methods for measuring performance*

IEC 61817⁷, *Household portable appliances for cooking, grilling and similar use – Methods of measuring performance*

IEC TR 61923⁸, *Household electrical appliances – Method of measuring performance – Assessment of repeatability and reproducibility*

ISO 2813, *Paints and varnishes – Determination of gloss value at 20 degrees, 60 degrees and 85 degrees*

ISO 11664-2, *Colorimetry – Part 2: CIE standard illuminants*

CIE 15:2018, *Colorimetry*

SACHS L. *Applied Statistics – A handbook of techniques*. Second Edition. Springer-Verlag, New York, Berlin, Heidelberg, 1984

⁷ Withdrawn.

⁸ Withdrawn.

SOMMAIRE

AVANT-PROPOS	84
1 Domaine d'application	87
2 Références normatives	88
3 Termes et définitions	88
4 Liste des mesurages	91
4.1 Dimensions et masse	91
4.2 Four et four à vapeur combiné	92
4.3 Four à vapeur et four à vapeur combiné	92
4.4 Gril	92
4.5 Compartiments de réchauffage	92
4.6 Nettoyage	92
5 Conditions de mesurage générales	92
5.1 Local d'essai	92
5.2 Alimentation électrique	93
5.3 Appareillage de mesure	94
5.4 Positionnement de l'appareil	95
5.5 Préchauffage	95
5.6 Réglage des commandes	95
5.7 Arrondi	95
6 Dimensions et masse	95
6.1 Dimensions hors tout	95
6.2 Dimensions intérieures et volume calculé	97
6.2.1 Généralités	97
6.2.2 Hauteur intérieure	99
6.2.3 Largeur intérieure	99
6.2.4 Profondeur intérieure	99
6.2.5 Volume calculé	100
6.3 Dimensions intérieures globales et volume global	100
6.3.1 Généralités	100
6.3.2 Hauteur globale (H)	100
6.3.3 Largeur globale (W)	100
6.3.4 Profondeur globale (D)	100
6.3.5 Volume global des cavités rectangulaires	100
6.3.6 Volume global des cavités non rectangulaires	100
6.4 Dimensions des étagères et des accessoires à vapeur	101
6.5 Dimensions des grilles de gril	101
6.5.1 Surface totale	101
6.5.2 Surface utile	101
6.6 Dimensions des compartiments de réchauffage	101
6.7 Masse de l'appareil	101
7 Préchauffage et exactitude	102
7.1 Objet	102
7.2 Montage d'essai	102
7.3 Préchauffage du four vide	102
7.4 Exactitude de la commande	103
7.4.1 Objet	103

7.4.2	Mesurages.....	103
7.4.3	Évaluation	103
8	Consommation d'énergie et temps de chauffage d'une charge.....	103
8.1	Objet.....	103
8.2	Symboles et abréviations	104
8.3	Charge d'essai.....	104
8.3.1	Généralités.....	104
8.3.2	Prétraitement.....	104
8.3.3	Préparation.....	105
8.4	Mesurage.....	106
8.4.1	Procédure d'essai.....	106
8.4.2	Réglages du four	109
8.4.3	Phase 1	110
8.4.4	Phase 2	111
8.5	Calcul	111
8.5.1	Lissage des valeurs mesurées.....	111
8.5.2	Détermination de l'échauffement moyen pour une fonction de chauffage (phase 2)	112
8.5.3	Détermination de l'échauffement moyen pour une fonction éco (phase 2)	113
8.5.4	Calcul de la température ambiante moyenne	116
8.5.5	Détermination du facteur c	116
8.5.6	Détermination du facteur s	117
8.6	Vérification d'acceptation des résultats d'essai	117
8.6.1	Échauffement moyen et écart-type	117
8.6.2	Réglage de température et échauffement moyen	118
8.6.3	Facteur c	119
8.6.4	Facteur s	119
8.7	Consommation d'énergie électrique finale	119
8.8	Temps pour le chauffage d'une charge	120
8.9	Rapport des résultats d'essai	120
9	Essais de cuisson.....	120
9.1	Généralités.....	120
9.2	Répartition de la chaleur	121
9.2.1	Sablés	121
9.2.2	Petits gâteaux	123
9.3	Aptitude à produire de la chaleur	128
9.3.1	Biscuit de Savoie sans graisse	128
9.3.2	Tarte aux pommes	129
10	Fours à vapeur et fours à vapeur combinés	131
10.1	Aptitude à produire de la vapeur	131
10.1.1	Objet	131
10.1.2	Ingrédients et accessoire à vapeur	131
10.1.3	Procédure.....	132
10.1.4	Évaluation	133
10.2	Répartition de la vapeur.....	134
10.2.1	Objet	134
10.2.2	Ingrédients, accessoires à vapeur et nombre de niveaux	134
10.2.3	Procédure.....	134

10.2.4	Évaluation	135
10.3	Détermination de la capacité.....	137
10.3.1	Objet	137
10.3.2	Ingrédients	137
10.3.3	Masse de pois, accessoires à vapeur et nombre de niveaux	138
10.3.4	Procédure.....	138
10.3.5	Évaluation	139
10.4	Exactitude de la commande de température.....	140
11	Surface effective de grillage	141
11.1	Objet.....	141
11.2	Ingrédients.....	141
11.3	Préparation.....	141
11.4	Procédure.....	141
11.5	Évaluation.....	142
11.5.1	Généralités	142
11.5.2	Critères de validité	142
11.5.3	Critères de vérification.....	142
12	Compartiments de réchauffage	144
13	Nettoyage.....	144
13.1	Fours autonettoyants par pyrolyse	144
13.2	Fours à nettoyage par catalyse	144
14	Mesurage de la consommation des modes faible puissance	145
14.1	Objet et combinaison d'appareils	145
14.2	Mesurage.....	145
14.2.1	Principes	145
14.2.2	Détermination de la consommation de puissance en mode arrêt.....	147
14.2.3	Détermination de la consommation de puissance en mode veille	147
14.2.4	Détermination de la consommation de puissance en mode veille avec maintien de la connexion au réseau.....	147
14.2.5	Détermination de la consommation de puissance en démarrage différé	147
Annex A (normative)	Colorimètre	149
Annex B (informative)	Adresses des fournisseurs	150
B.1	Généralités	150
B.2	Ingrédients pour les essais des petits gâteaux.....	150
B.3	Batteur.....	152
B.4	Colorimètre	153
B.5	Panier vapeur	153
Annex C (normative)	Description de la brique d'essai	154
C.1	Spécification	154
C.2	Fournisseur et spécification de commande.....	154
Annex D (informative)	Vérification de l'énergie à micro-ondes appliquée au cours des mesurages selon l'Article 8.....	156
D.1	Généralités	156
D.2	Procédure	156
Annex E (informative)	Marquage du réglage de température pour la vérification de la température du four	157
Annex F (informative)	Méthode de calcul du facteur f	158
Annex G (normative)	Mesurage des modes faible puissance.....	159

Bibliographie.....	161
Figure 1 – Position du couple thermoélectrique pour le mesurage de la température ambiante.....	93
Figure 2 – Dimensions des appareils	96
Figure 3 – Dimensions des appareils à encastrer	97
Figure 4 – Dimensions intérieures.....	98
Figure 5 – Gabarit pour le mesurage des dimensions.....	98
Figure 6 – Exemples pour la détermination de la surface totale et de la surface utile d'une grille de gril	101
Figure 7 – Exemple de couple thermoélectrique.....	105
Figure 8 – Processus de mesurage complet.....	107
Figure 9 – Installation du couple thermoélectrique observateur	108
Figure 10 – Installation verticale du couple thermoélectrique observateur.....	108
Figure 11 – Installation horizontale du couple thermoélectrique observateur.....	109
Figure 12 – Exemple – Échauffement moyen pour une fonction de chauffage	112
Figure 13 – Exemples – Consigne de température atteinte	114
Figure 14 – Exemple – Consigne de température non atteinte	115
Figure 15 – Forme de la douille ruban pour la confection des bandes de pâte	121
Figure 16 – Position des bandes de pâte sur la plaque à pâtisserie	122
Figure 17 – Gabarit pour la division en sections des petits gâteaux	127
Figure 18 – Valeurs de référence du temps de cuisson (t_{ref})	140
Figure 19 – Détermination de la surface évaluable d'une tranche de pain grillé – Exemple	142
Figure A.1 – Colorimètre	149
Figure C.1 – Position des couples thermoélectriques	155
Figure D.1 – Lampe à filament.....	156
Figure E.1 – Feuille de papier à coordonnées polaires – Exemple	157
Tableau 1 – Appareils de mesure.....	94
Tableau 2 – Mesurages	94
Tableau 3 – Symboles	104
Tableau 4 – Échauffement pour trois réglages	110
Tableau 5 – Ingrédients	124
Tableau B.1 – Spécification des ingrédients.....	151
Tableau B.2 – Batteur – Nombre de tours par minute.....	152
Tableau B.3 – Temps de mélange et réglages	153
Tableau G.1 – Instructions pas à pas pour le mesurage des modes faible puissance	159

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

APPAREILS DE CUISSON ÉLECTRODOMESTIQUES –

Partie 1: Cuisinières, fours, fours à vapeur et grils – Méthodes de mesure de l'aptitude à la fonction

AVANT-PROPOS

- 1) La Commission Électrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
- 3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
- 4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets.

L'IEC 60350-1 a été établie par le sous-comité 59K: Aptitude à la fonction des appareils électrodomestiques et similaires de cuisson électrique, du comité d'études 59 de l'IEC: Aptitude à la fonction des appareils électrodomestiques et analogues. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2016 et la Fiche d'interprétation 1:2021. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) ajout de nouvelles définitions pour la fonction de chauffage et la fonction éco, avec un amendement concernant les considérations relatives au mode faible puissance à l'Article 3;
- b) modification de l'ordre des articles;
- c) révision du 5.3;
- d) mise à jour du 6.2 afin d'améliorer la fiabilité de la mesure du volume;
- e) suppression du 6.7, Horizontalité de l'étagère;
- f) révision de l'Article 7 relatif à l'exactitude des **fonctions éco** avec utilisation de la chaleur résiduelle;
- g) révision de l'Article 8 afin d'améliorer la fiabilité de la méthode de mesure de la consommation d'énergie, en particulier en ce qui concerne l'anticonournement;
- h) mesurage de la consommation d'énergie unique pour l'ensemble des **fonctions de chauffage** et des **fonctions éco** avec indication de la consommation d'énergie pour une augmentation de la température de 165 K (comparée à 155 K actuellement pour une fonction de circulation forcée de l'air, par exemple), ce qui donne des valeurs de consommation d'énergie supérieures à celles de l'édition précédente;
- i) remplacement de R_y par L^* dans l'Article 9 et référence à l'IEC TS 63350;
- j) introduction du temps de cuisson pour la mesure de référence des brocolis à l'Article 10;
- k) remplacement du terme "partie jaune" par le terme "valeur d'angle de teinte" à l'Article 10;
- l) les exigences relatives à la vérification numérique (voir l'ancien 7.5.3.6.3) sont obsolètes, comme cela est spécifié dans l'IEC TS 63350;
- m) révision de l'Article 14 (Mesurage de la consommation des modes faible puissance, ancien Article 12);
- n) annulation de l'ancienne Annexe G (informative) en raison de l'absence d'application de cette méthode de mesure d'une activité associée;
- o) les anciennes Annexes B et F sont obsolètes, car des nuanciers plus récents sont spécifiés dans l'IEC TS 63350;
- p) l'ancienne Annexe E sera remplacée par un document de support disponible sur le site web de l'IEC.

Ce document contient des informations supplémentaires mises en évidence par des notes qui indiquent le lien.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
59K/365/FDIS	59K/370/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Les termes en **gras** dans le texte sont spécifiquement définis à l'Article 3.

Une liste de toutes les parties de la série IEC 60350, publiées sous le titre général *Appareils de cuisson électrodomestiques*, se trouve sur le site web de l'IEC.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de ce document indique qu'il contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer ce document en utilisant une imprimante couleur.

IECNORM.COM : Click to view the full PDF of IEC 60350-1:2023 RLV

APPAREILS DE CUISSON ÉLECTRODOMESTIQUES –

Partie 1: Cuisinières, fours, fours à vapeur et grils – Méthodes de mesure de l'aptitude à la fonction

1 Domaine d'application

La présente partie de l'IEC 60350 spécifie les méthodes de mesure de l'aptitude à la fonction des **cuisinières**, des **fours**, des **fours à vapeur** et des **grils** électriques à usage domestique.

NOTE 1 Le présent document s'applique également aux appareils mobiles équipés de fonctionnalités similaires, qui étaient auparavant couverts par l'IEC 61817 aujourd'hui supprimée.

Les **fours** couverts par le présent document peuvent disposer ou non d'une fonction micro-ondes.

Les fabricants sont présumés définir la fonction de cuisson principale de l'appareil: micro-ondes ou chaleur thermique. La fonction de cuisson principale est mesurée au moyen d'une méthode existante en fonction de la consommation d'énergie. Si la fonction de cuisson principale est déclarée dans le manuel d'instruction comme étant la fonction micro-ondes, l'IEC 60705 s'applique pour le mesurage de la consommation d'énergie. Si la fonction de cuisson principale est déclarée comme étant la chaleur thermique, l'IEC 60350-1 s'applique pour le mesurage de la consommation d'énergie.

Si la fonction principale n'est pas déclarée par le fabricant, l'aptitude à la fonction micro-ondes et à la fonction chaleur thermique est mesurée autant que possible.

NOTE 2 Pour le mesurage de la consommation d'énergie et du temps de chauffage d'une charge (voir l'Article 8), le présent document ne s'applique pas non plus aux:

- fonctions micro-ondes combinées;
- **fours** avec plateau coulissant ou plateau tournant;
- **fours à petite cavité** (voir le 3.16);
- **fours** sans commande de température réglable;
- **fonctions de chauffage** et **fonctions éco** autres que celles définies dans le présent document;
- appareils avec **fonction de vapeur** uniquement.

NOTE 3 Le présent document ne s'applique pas aux:

- fours à micro-ondes (IEC 60705).

Le présent document définit les caractéristiques de performance principales de ces appareils qui sont pertinentes pour l'utilisateur et spécifie les méthodes de mesure de ces caractéristiques.

Le présent document ne spécifie pas un système de classement pour l'aptitude à la fonction de ces appareils.

NOTE 4 Le présent document ne traite pas des exigences de sécurité (IEC 60335-2-6 et IEC 60335-2-9).

NOTE 5 Les appareils couverts par le présent document peuvent être posés sur le sol, encastrés ou placés sur un plan de travail.

NOTE 6 Aucune méthode de mesure de la consommation d'énergie n'est disponible pour les **fonctions de vapeur** et de gril.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60584-1, *Couples thermoélectriques – Partie 1: Spécifications et tolérances en matière de FEM*

IEC 62301:2011, *Appareils électrodomestiques – Mesure de la consommation en veille*

IEC TS 63350:2022, *Household electrical appliances – Specification of the properties of a digital system for measuring the performance* (disponible en anglais seulement)

IEC 63474¹, *Appareils électriques et électroniques pour application domestique et équipement de bureau – Mesure de la consommation d'énergie en veille avec maintien de la connexion au réseau des équipements de périphérie*

ISO 80000-1:2009, *Grandeurs et unités – Partie 1: Généralités*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <https://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <https://www.iso.org/obp>

3.1

mode actif

mode dans lequel l'appareil est raccordé à une source d'alimentation secteur, a été activé et exécute l'une des fonctions prévues

EXEMPLE Réalisation d'un transfert de chaleur par la chaleur thermique, l'énergie électromagnétique ou la condensation

Note 1 à l'article: L'affichage de recettes, l'utilisation d'un minuteur, le téléchargement d'un logiciel, le fonctionnement d'un ventilateur, etc. constituent des exemples de fonctions associées reconnues.

3.2

four à vapeur combiné

appareil ou compartiment d'une **cuisinière** dans lequel l'aliment est cuit par l'association d'un **four** et d'un **four à vapeur**

Note 1 à l'article: Il existe également des appareils qui ne comportent qu'une fonction de vapeur secondaire. Pour ces fours, la **fonction de vapeur** ne peut être soumise à l'essai que si elle figure dans le manuel d'instruction ou si l'appareil comporte un réglage de la **fonction de vapeur**.

Note 2 à l'article: Le terme "vapeur" ne désigne pas l'eau évaporée par l'aliment.

¹ À l'étude. Stade au moment de la publication: IEC CDV 63474:2022.

3.3

cuisinière

appareil qui possède une **table de cuisson** et au moins un **four** et qui peut comporter un **gril**

3.4

démarrage différé

condition dans laquelle l'utilisateur a choisi un retard spécifié pour le début d'un **mode actif**

Note 1 à l'article: Ce mode ne s'applique que si l'appareil offre une fonction de démarrage différé à l'utilisateur.

3.5

fonction éco

transmission de chaleur par circulation naturelle de l'air, circulation forcée de l'air ou rayonnement pour certaines applications qui utilisent des solutions techniques pour les économies d'énergie

EXEMPLE Solutions techniques:

- utilisation de la chaleur résiduelle;
- chauffage à faible puissance;
- ou une combinaison des deux.

3.6

gril

appareil ou partie d'un appareil dans lequel l'aliment est cuit par chauffage par rayonnement

3.7

fonction de chauffage

transmission de chaleur par circulation naturelle de l'air, circulation forcée de l'air ou rayonnement pour la cuisson et le grillage

EXEMPLE

- fonction de circulation forcée de l'air qui chauffe les aliments principalement par circulation de l'air au moyen d'un ventilateur;
- **fonction de chauffage** conventionnelle qui chauffe les aliments principalement par convection naturelle de l'air;
- ou une combinaison de ces deux fonctions.

Note 1 à l'article: La transmission de chaleur par la vapeur ou par l'énergie à hyperfréquence, notamment associées à une **fonction de chauffage**, est exclue.

3.8

table de cuisson

plaque de cuisson

appareil ou partie d'un appareil qui comporte une ou plusieurs **zones de cuisson** et/ou **surfaces de cuisson** avec une unité de **commande**

Note 1 à l'article: L'unité de **commande** peut être intégrée dans la **table de cuisson** elle-même ou dans une **cuisinière**.

3.9

fonction de vapeur brûlante

transmission de chaleur aux aliments par la vapeur générée par rayonnement et/ou par convection à pression ambiante (environ 100 kPa) à une température > 100 °C

3.10

appareil à cavités multiples

appareil qui comporte des cavités séparées dans lequel l'aliment est cuit et qui peut être commandé de façon indépendante, mais qui ne peut pas être installé séparément

3.11

réseau

infrastructure de communication caractérisée par une topologie de liens, une architecture, y compris les composants matériels, des principes organisationnels, des procédures et des formats de communication (protocoles)

3.12

mode arrêt

condition dans laquelle l'appareil est raccordé au secteur et n'assure aucun **mode actif** ni aucun **mode veille**, et dans laquelle le mode peut persister pendant une durée indéfinie.

Note 1 à l'article: Les conditions suivantes doivent également être considérées comme caractéristiques du **mode arrêt**:

- a) conditions ne fournissant qu'une indication du **mode arrêt**;
- b) conditions ne fournissant que les fonctionnalités destinées à assurer la compatibilité électromagnétique.

3.13

four

appareil ou compartiment d'une **cuisinière** dans lequel l'aliment est cuit par rayonnement, par convection naturelle, par circulation forcée de l'air ou par combinaison de ces méthodes de chauffage

3.14

thermostat du four

dispositif ou capteur qui détecte la température à l'intérieur de la cavité afin de réguler la consigne de température

3.15

four autonettoyant par catalyse

four dans lequel les salissures de cuisson sont éliminées par décomposition sur un revêtement spécial

3.16

four à petite cavité

four caractérisé par les dimensions suivantes:

- largeur et profondeur intérieures < 250 mm; ou
- largeur intérieure ou profondeur intérieure < 120 mm; ou
- hauteur intérieure < 120 mm

Note 1 à l'article: Dans le présent document, les dimensions maximales définies pour les **fours** à petite cavité sont adaptées à la taille de la charge d'essai utilisée à l'Article 8.

3.17**mode veille**

condition dans laquelle l'appareil est raccordé au secteur et n'assure que les fonctions suivantes, lesquelles peuvent persister pendant une durée indéfinie:

- (a) fonction de réactivation, ou fonction de réactivation et simple indication que la fonction de réactivation est activée;
- (b) affichage des informations ou de l'état;
- (c) fonction de détection des mesures d'urgence

3.18**mode veille avec maintien de la connexion au réseau**

condition dans laquelle l'appareil est raccordé au secteur et n'assure que la fonction de réactivation par l'intermédiaire d'une connexion à un réseau, et dans laquelle le mode peut persister pendant une durée indéfinie

Note 1 à l'article: Ce mode ne s'applique qu'aux appareils qui disposent d'une fonction de connexion à un **réseau**.

3.19**four autonettoyant par pyrolyse**

four dans lequel les salissures de cuisson sont éliminées par élévation de la température du **four** à une valeur suffisamment élevée

3.20**four à vapeur**

appareil ou compartiment d'une **cuisinière** dans lequel l'aliment est cuit principalement par condensation de vapeur à pression ambiante

Note 1 à l'article: Les appareils sont équipés de leur propre générateur de vapeur.

Note 2 à l'article: Le terme "vapeur" ne désigne pas l'eau évaporée par l'aliment.

3.21**fonction de vapeur**

transmission de chaleur aux aliments principalement par condensation de vapeur à pression ambiante (environ 100 kPa) et à une température $\leq 100\text{ °C}$

3.22**compartiment de réchauffage**

compartiment séparé dans lequel sont placées les assiettes afin d'être préchauffées avant le service ou dans lequel les aliments sont maintenus à la température de service

4 Liste des mesurages**4.1 Dimensions et masse**

Les mesurages suivants sont effectués:

- dimensions hors tout (voir le 6.1);
- dimensions internes (voir le 6.2);
- dimensions des étagères et des accessoires à vapeur (voir le 6.4);
- dimensions des grilles (voir le 6.5);
- dimensions des **compartiments de réchauffage** (voir le 6.6);
- masse de l'appareil (voir le 6.7).

4.2 Four et four à vapeur combiné

Les mesurages suivants sont effectués:

- préchauffage du **four** vide (voir le 7.3);
- exactitude de la commande (voir le 7.4);
- consommation d'énergie et temps de chauffage d'une charge (voir l'Article 8);
- répartition de la chaleur (voir le 9.2);
- aptitude à produire de la chaleur (voir le 9.3).

4.3 Four à vapeur et four à vapeur combiné

Les mesurages suivants sont effectués:

- aptitude à fournir de la vapeur (voir le 10.1);
- répartition de la vapeur (voir le 10.2);
- détermination de la capacité (voir le 10.3).

4.4 Gril

Les mesurages suivants sont effectués:

- surface de grillage (voir l'Article 11).

4.5 Compartiments de réchauffage

Les mesurages suivants sont effectués:

- commande de température et consommation d'énergie (voir l'Article 12).

4.6 Nettoyage

Les mesurages suivants sont effectués:

- nettoyage des **fours** autonettoyants par pyrolyse (voir le 13.1);
- nettoyage des **fours** autonettoyants par catalyse (voir le 13.2).

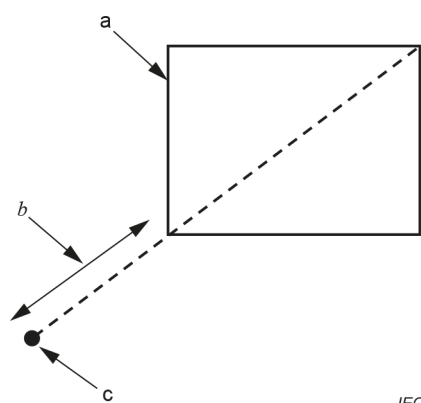
5 Conditions de mesurage générales

5.1 Local d'essai

Les essais sont réalisés dans un local pratiquement exempt de courants d'air dans lequel la température ambiante est maintenue à $(23 \pm 2) ^\circ\text{C}$.

Pour les essais spécifiés au 9.2.1, au 9.3.1, au 9.3.2, à l'Article 10 et à l'Article 11, un maintien de la température ambiante à $(25 \pm 5) ^\circ\text{C}$ suffit.

Cette température ambiante est mesurée à un point qui est à la même hauteur que le centre du volume calculé de la cavité du **four** en essai et à une distance de 0,5 m en diagonale à partir de l'un des bords frontaux de l'appareil (voir la Figure 1).



IEC

Légende

- a four (vue de dessus)
- b 0,5 m
- c couple thermoélectrique

Figure 1 – Position du couple thermoélectrique pour le mesurage de la température ambiante

Le mesurage de la température ambiante ne doit pas être influencé par l'appareil lui-même ou par tout autre appareil.

5.2 Alimentation électrique

L'appareil est alimenté à la tension assignée $\pm 1\%$.

- la tension d'alimentation doit être maintenue à la borne principale à la tension assignée $\pm 1\%$, lorsque les éléments chauffants sont sous tension;
- la fréquence d'alimentation doit être à la fréquence assignée $\pm 1\%$ tout au long de l'essai. Si une plage de fréquences est indiquée, alors la fréquence d'essai doit être la fréquence nominale du pays où l'appareil est destiné à être utilisé.

Si l'appareil comporte une plage de tensions assignées, les essais sont effectués à la tension nominale du pays où l'appareil est destiné à être utilisé.

NOTE Dans le cas d'un câble fixe, la fiche (ou l'extrémité du câble) est le point de référence pour maintenir la tension.

5.3 Appareillage de mesure

Les appareils de mesure utilisés et les mesurages effectués pour les besoins du présent document doivent satisfaire aux spécifications indiquées dans le Tableau 1 et dans le Tableau 2.

Tableau 1 – Appareils de mesure

Paramètre	Unité	Résolution minimale	Erreur maximale admise	Détails/Exigences supplémentaires
Masse	g			
≤ 3 000 g		0,1 g	± 0,1 g	
> 3 000 g		0,5 g	± 3 g	
Température (couples thermoélectriques)				
• température ambiante	°C	0,1 °C	± 0,5 K	Couple thermoélectrique avec point de soudure
• température à l'intérieur de la cavité dans une plage de 0 °C à 100 °C	°C	0,1 °C	± 0,5 K	Couple thermoélectrique avec point de soudure (adapté aux mesurages à l'intérieur des fours qui disposent de fonctions de vapeur humide)
• température à l'intérieur de la cavité dans une plage de 100 °C à 300 °C	°C	0,1 °C	± 2,5 K	Couple thermoélectrique avec point de soudure
• température au centre de la brique	°C	0,1 °C	± 1,5 K	Couple thermoélectrique à tube en acier de 1 mm, de classe 1 conformément à l'IEC 60584-1
Dimensions	mm	1 mm	1 mm	≤ 1 mm ou 0,5 % si cette valeur est la plus élevée
Temps	s	1 s	± 1 s par heure	

Tableau 2 – Mesurages

Paramètre	Unité	Erreur maximale admise	Exigences supplémentaires
Tension	V	± 0,5 %	Valeur mesurée.
Mesurage de la consommation d'énergie	Wh	± 1,5 % ou ± 10 Wh	Valeur la plus élevée des deux
Mesurage de la température	°C	± 1,0 K	À l'exception des couples thermoélectriques Fréquence d'échantillonnage ≤ 1 s
Pour l'Article 14, les exigences de mesurage de la consommation doivent être conformes à l'IEC 62301.		-	Conformément à l'IEC 62301

5.4 Positionnement de l'appareil

Les appareils à encastrer sont installés conformément aux instructions d'installation. Les autres appareils sont placés dos contre un mur, sauf spécification contraire dans les instructions.

Les appareils à poser sur le sol sont positionnés entre des éléments de cuisine. Les appareils à poser sur table sont placés à distance des murs.

Pour l'installation de l'appareil, la surface doit être horizontale.

Lorsque l'appareil est raccordé au secteur pour la première fois, il doit être mis en fonctionnement une fois avec n'importe quel réglage pendant au moins 1 h avant le mesurage de la consommation d'énergie pour éviter toute variation de ses performances ou de ses valeurs de consommation susceptible de se produire s'il est soumis à l'essai dans son "état d'origine" plutôt qu'à un moment ultérieur avec les mêmes réglages.

Si l'appareil est débranché du secteur, il doit être vérifié que les paramètres de base exigés, comme l'heure, sont réglés de manière définitive avant de commencer le mesurage.

5.5 Préchauffage

Au départ, l'appareil est à température ambiante. Cependant, si un préchauffage est spécifié, l'appareil est préchauffé conformément aux instructions d'utilisation. En l'absence d'instructions, l'appareil est considéré comme préchauffé après la première coupure du thermostat.

5.6 Réglage des commandes

La commande est réglée de manière à obtenir la température d'essai spécifiée. Cependant, si la température ne peut être atteinte du fait de la construction de la commande, le réglage le plus proche correspondant à la température spécifiée est choisi.

Tous les essais, à l'exception des mesurages des modes faible puissance (voir l'Article 14), doivent être effectués:

- avec les réglages d'usine par défaut;
- en s'assurant qu'aucun **réseau** n'est relié à l'appareil pendant toute la durée du mesurage.

L'utilisation de modes ou commandes, qui donnent des mesures non représentatives des caractéristiques réelles de l'appareil susceptibles d'être observées lors de la cuisson et du grillage dans des conditions comparables, n'est pas admise.

EXEMPLE Il n'est pas admis d'utiliser une caméra pour détecter que l'appareil est soumis à l'essai.

5.7 Arrondi

Si les nombres doivent être arrondis, ils doivent l'être conformément à l'ISO 80000-1:2009, Article B.3, Règle B.

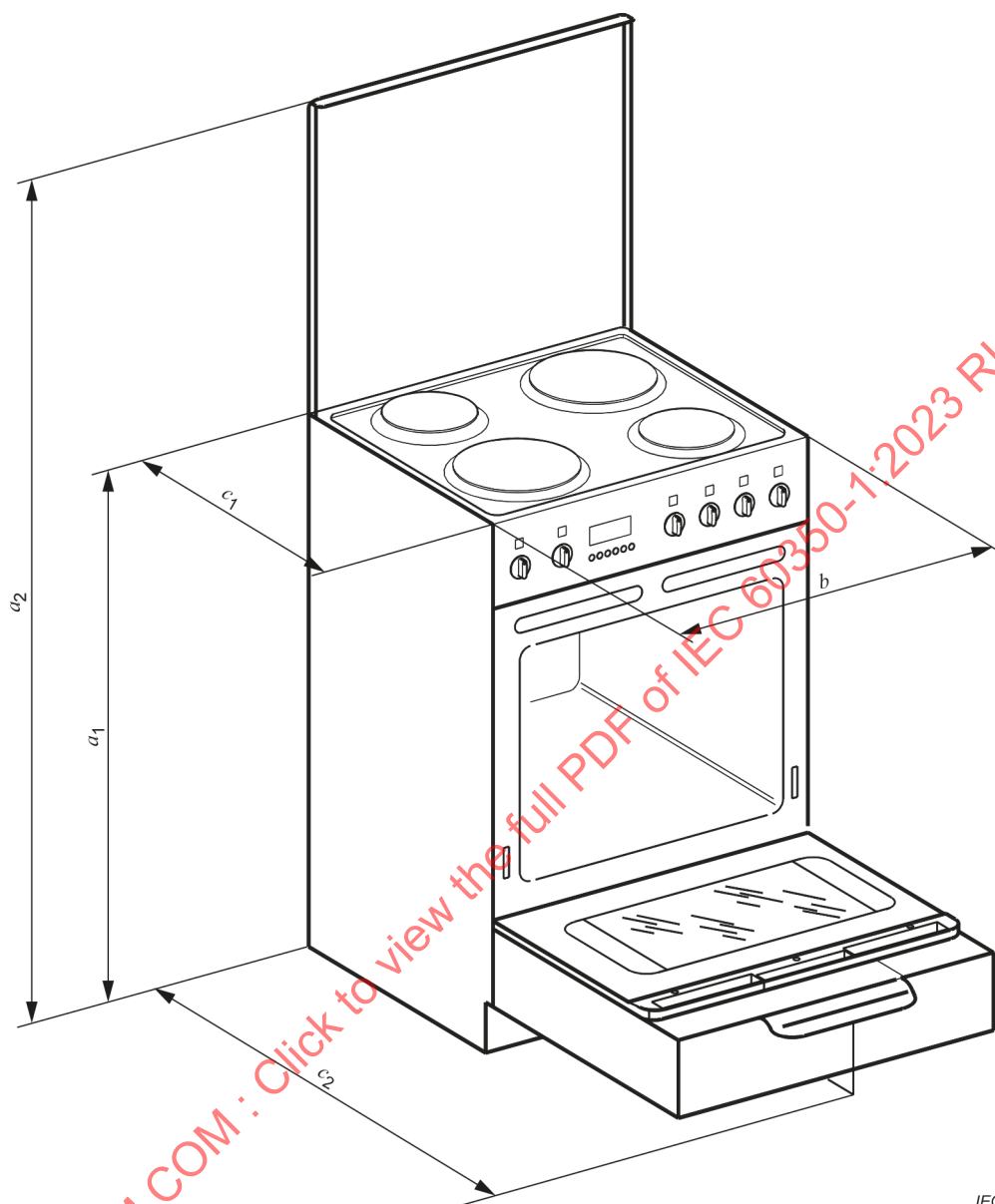
6 Dimensions et masse

6.1 Dimensions hors tout

Les dimensions hors tout de l'appareil sont mesurées et exprimées en millimètres comme suit.

Pour les **cuisinières** et les appareils posés sur une surface, les dimensions indiquées à la Figure 2 sont mesurées.

Pour les **four**s à encastrer, les dimensions indiquées à la Figure 3 sont mesurées.



IEC

Si des pieds réglables sont fournis, la hauteur est mesurée en plaçant les pieds dans les deux positions extrêmes.

Légende

a_1 hauteur mesurée entre la surface de support et la **table de cuisson**

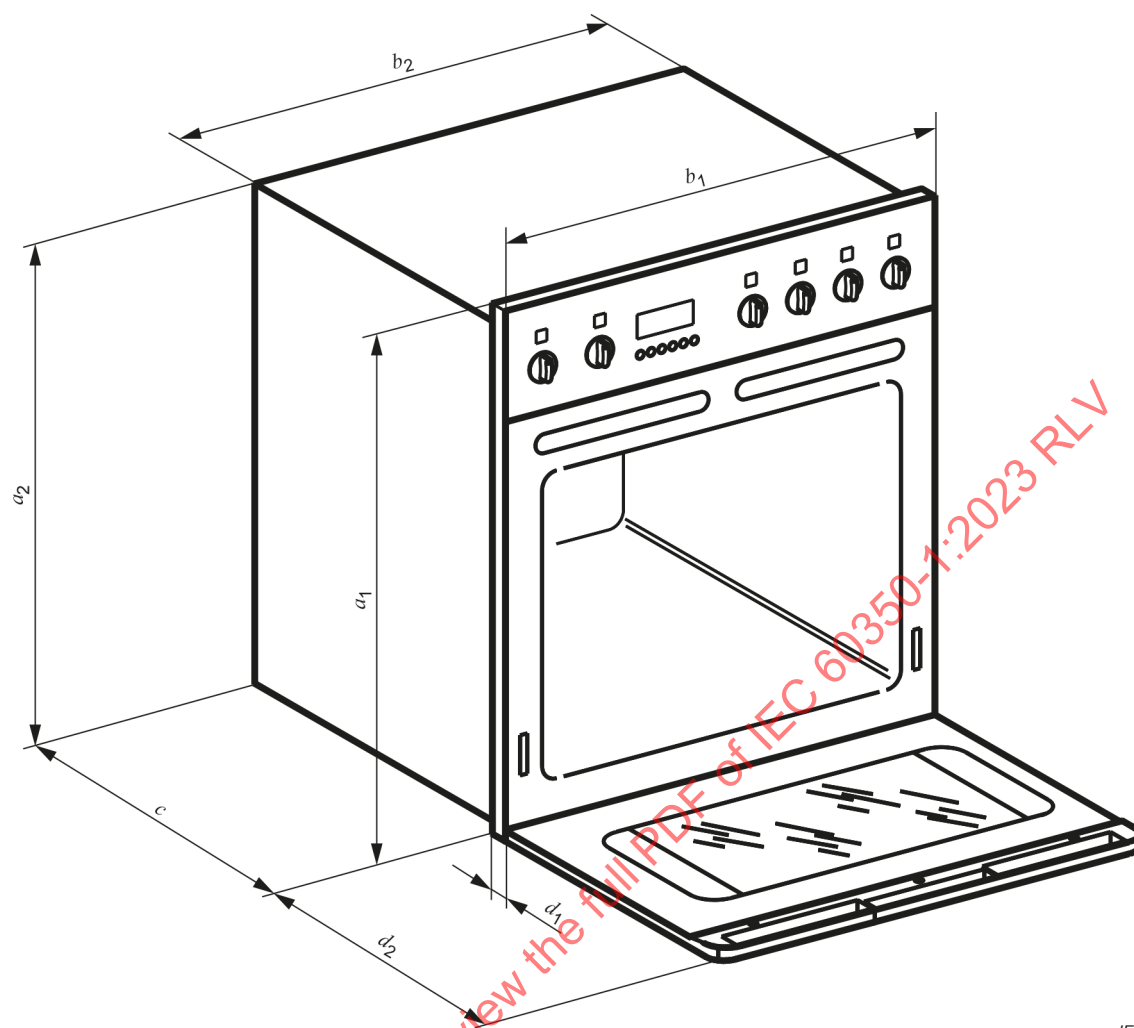
b largeur hors tout de l'appareil

a_2 hauteur maximale entre la surface de support et la partie la plus haute de l'appareil, les couvercles éventuels étant en position ouverte

c_1 profondeur de l'appareil, hors boutons, etc.

c_2 profondeur maximale de l'appareil, portes et tiroirs complètement ouverts

Figure 2 – Dimensions des appareils



IEC

Légende

a_1 hauteur frontale de l'appareil

b_1 largeur frontale de l'appareil

c profondeur maximale de l'appareil à l'intérieur de l'élément de cuisine

a_2 hauteur maximale de l'appareil encastré dans l'élément de cuisine

b_2 largeur maximale de l'appareil encastré dans l'élément de cuisine

d_1 profondeur de l'appareil encastré dans l'élément de cuisine, hors boutons, etc.

d_2 profondeur de l'appareil encastré dans l'élément de cuisine, portes ou tiroirs complètement ouverts

Figure 3 – Dimensions des appareils à encastrer

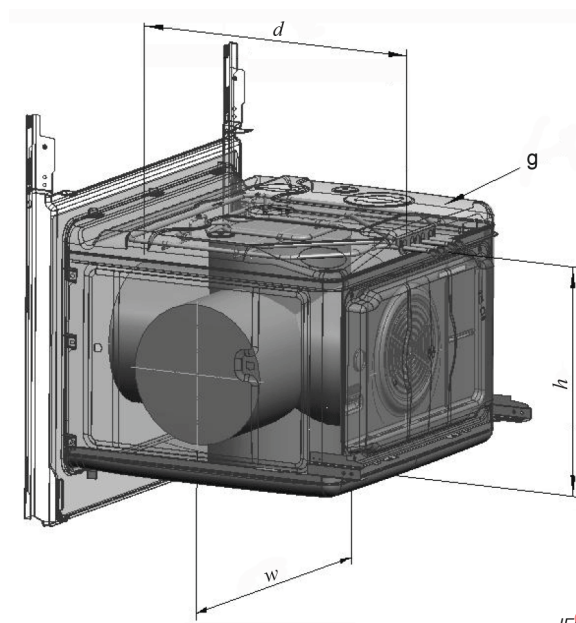
6.2 Dimensions intérieures et volume calculé

6.2.1 Généralités

Le volume calculé doit être mesuré à température ambiante.

La hauteur, la largeur et la profondeur du volume calculé de la cavité doivent être mesurées conformément au 6.2.2 et au 6.2.4. Les mesurages sont représentés à la Figure 4.

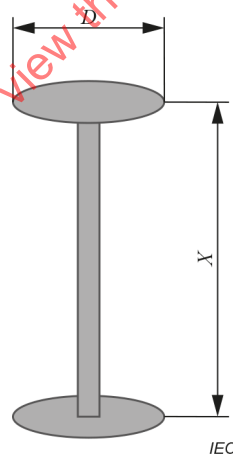
Pour les besoins de vérification, le gabarit représenté à la Figure 5 doit être utilisé pour déterminer l'ensemble des trois dimensions. Le gabarit doit être utilisé sans appliquer de force significative. Les dimensions sont exprimées en millimètres.



Légende

- d profondeur
- g élément chauffant
- h hauteur
- w largeur

Figure 4 – Dimensions intérieures



Légende

- $D = 200 \text{ mm}$ ou 120 mm
- $X =$ dimension à mesurer

Figure 5 – Gabarit pour le mesurage des dimensions

6.2.2 Hauteur intérieure

La hauteur est la longueur maximale d'un cylindre d'un diamètre de 200 mm qui s'insère verticalement entre le centre du plancher de la cavité et le point le plus bas du plafond. Aucun accessoire, comme une grille de gril, n'est inséré.

Une lampe, un élément chauffant ou tout objet similaire situé dans la zone du cylindre peut constituer le point le plus bas du plafond. Les parties en saillie, comme les couvercles de lampes, les éléments chauffants et les crochets de fixation, ne doivent être ni retirées ni repliées.

Si la largeur ou la profondeur de la cavité est inférieure à 250 mm, le diamètre du cylindre à mesurer doit être réduit à 120 mm.

NOTE Le centre du plancher de la cavité est défini par le milieu de la profondeur intérieure et le milieu de la largeur intérieure.

6.2.3 Largeur intérieure

La largeur intérieure est la longueur maximale d'un cylindre d'un diamètre de 200 mm qui s'insère horizontalement entre la paroi latérale gauche et la paroi latérale droite de la cavité.

Les supports latéraux doivent être retirés s'ils peuvent être démontés sans l'aide d'un outil. Si des parties sont fixées aux supports latéraux ou maintenues par ces derniers, ils doivent également être retirés.

NOTE 1 Une pièce ou une cuillère ne constitue pas un outil.

Si la hauteur ou la profondeur de la cavité est inférieure à 250 mm, le diamètre du cylindre à mesurer doit être réduit à 120 mm.

NOTE 2 Le centre de la paroi latérale de la cavité est défini par le milieu de la profondeur et le milieu de la hauteur.

6.2.4 Profondeur intérieure

La profondeur est la longueur maximale d'un cylindre d'un diamètre de 200 mm qui s'insère horizontalement entre le centre de la paroi arrière et la face intérieure de la porte fermée.

Les parties en saillie, comme le déflecteur ou les éléments de la porte, ne doivent pas être retirées.

Si la largeur ou la hauteur de la cavité est inférieure à 250 mm, le diamètre du cylindre à mesurer doit être réduit à 120 mm.

Pour mesurer la profondeur, le gabarit est placé sur un support de sorte que son axe se situe horizontalement au centre de la cavité, la longueur de l'axe étant légèrement supérieure à la profondeur attendue. La porte est ensuite fermée délicatement de façon à comprimer le gabarit pour obtenir la profondeur intérieure.

NOTE Le centre de la paroi arrière de la cavité est défini par le milieu de la hauteur et le milieu de la largeur.

6.2.5 Volume calculé

Le volume calculé est déterminé à partir de ces trois dimensions et est exprimé en litres, arrondi au litre le plus proche.

6.3 Dimensions intérieures globales et volume global

6.3.1 Généralités

Lorsque les surfaces délimitant la cavité comprennent des parties en saillie ou en retrait, les plans utilisés pour le mesurage doivent être ceux présentant les pourcentages les plus élevés de l'aire totale de ces surfaces. Les trous dans les surfaces ne doivent pas être pris en compte lors du calcul des aires pour cette détermination.

Les volumes ou espaces suivants ne doivent pas être pris en compte:

- ceux occupés par les accessoires amovibles spécifiés par le fabricant comme n'étant pas essentiels au fonctionnement de l'appareil, comme les étagères, grilles ou sondes de température;
- ceux occupés par les éléments chauffants;
- ceux occupés par des irrégularités mineures dans les parois du compartiment de cuisson, y compris les caches sur les capteurs de température et les lampes;
- ceux occupés par le déflecteur de convection;
- les rayons de courbure inférieure à 50 mm aux intersections entre les surfaces intérieures de la cavité de cuisson.

Les dimensions sont exprimées en millimètres.

6.3.2 Hauteur globale (H)

Distance verticale maximale, en mm, entre le plan du plancher de la cavité de cuisson et le plan du plafond de la cavité.

6.3.3 Largeur globale (W)

Distance horizontale maximale, en mm, entre les plans des parois latérales de la cavité.

6.3.4 Profondeur globale (D)

Distance horizontale maximale, en mm, entre le plan de la surface intérieure de la porte lorsqu'elle est fermée et le plan de la paroi arrière de la cavité.

6.3.5 Volume global des cavités rectangulaires

Le volume global est le volume intérieur total de la cavité dans lequel est effectuée la cuisson, exprimé comme le produit des dimensions H , W et D déterminées ci-dessus, divisé par 10^6 et arrondi au litre le plus proche.

6.3.6 Volume global des cavités non rectangulaires

Pour les cavités non rectangulaires, le volume de chaque section non conforme, comme une porte ou cavité incurvée, doit être déterminé par mesurage direct et en appliquant les calculs géométriques conventionnels. Le reste de la cavité doit être traité comme une cavité rectangulaire, et les différents volumes additionnés ensemble. Le volume est exprimé au litre le plus proche.

6.4 Dimensions des étagères et des accessoires à vapeur

La largeur et la profondeur utiles de l'étagère sont mesurées. Les dimensions sont déterminées 5 mm au-dessus de la surface de l'étagère.

La surface est calculée et exprimée en centimètres carrés, arrondie aux 10 cm² les plus proches.

NOTE L'étagère peut être une plaque à pâtisserie ou un accessoire à vapeur.

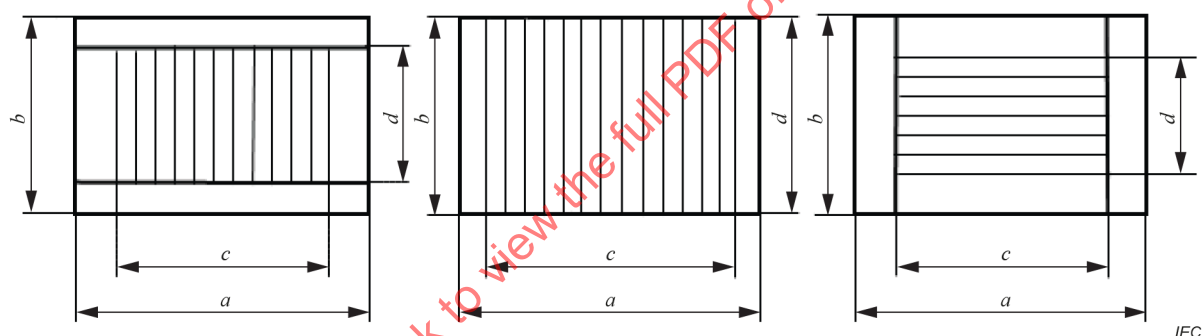
6.5 Dimensions des grilles de gril

6.5.1 Surface totale

La surface totale de la grille est déterminée en mesurant la largeur maximale et la profondeur maximale des barres extérieures. Cette surface totale de la grille est calculée et exprimée en centimètres carrés, arrondie à 10 cm².

6.5.2 Surface utile

La largeur et la profondeur utiles de la grille sont mesurées, en tenant compte uniquement de la grille intérieure, qui est adaptée pour déposer les aliments. La surface utile de la grille est calculée et exprimée en centimètres carrés, arrondie à 10 cm². Voir la Figure 6.



Légende

- a* largeur maximale de la grille
- b* profondeur maximale de la grille
- c* largeur utile de la grille
- d* profondeur utile de la grille

Figure 6 – Exemples pour la détermination de la surface totale et de la surface utile d'une grille de gril

6.6 Dimensions des compartiments de réchauffage

La hauteur, la largeur et la profondeur du volume calculé à l'intérieur du **compartiment de réchauffage** sont déterminées et exprimées en millimètres.

NOTE Lorsqu'un élément chauffant est situé à l'intérieur du **compartiment de réchauffage**, les dimensions sont mesurées jusqu'à la partie la plus en saillie.

6.7 Masse de l'appareil

La masse de l'appareil est déterminée et exprimée en kilogrammes, et est arrondie au kilogramme le plus proche. Seul l'accessoire décrit dans l'essai à l'Article 8 doit être pris en considération pour déterminer la masse.

7 Préchauffage et exactitude

7.1 Objet

Les essais de l'Article 7 ont pour objet d'évaluer l'aptitude à la fonction du **four** et du **four à vapeur combiné** par rapport au préchauffage et au fonctionnement de la commande.

7.2 Montage d'essai

La température de l'air dans le **four** et le **four à vapeur combiné** vides est mesurée à l'aide d'un couple thermoélectrique conforme aux critères spécifiés en 5.3, fixé à la grille fournie avec l'appareil. Le couple thermoélectrique est placé dans le **four** et le **four à vapeur combiné** de sorte que le point de soudure du couple thermoélectrique se situe au centre du volume calculé du **four** et du **four à vapeur combiné** à une distance d'au moins 30 mm de la grille.

Si aucune grille ne peut être achetée auprès du fabricant de l'appareil, le couple thermoélectrique doit être positionné au centre d'une manière adaptée.

Les couples thermoélectriques sont introduits par l'ouverture de la porte de manière à fermer complètement la porte sans exercer une force supplémentaire.

La porte doit être complètement fermée.

7.3 Préchauffage du four vide

Cet essai a pour objet de mesurer la consommation d'énergie et le temps nécessaire pour préchauffer un **four** ou un **four à vapeur combiné** vide à partir de la température ambiante selon un échauffement donné.

Avant le mesurage, l'appareil complet (y compris le matériau et l'isolant) doit être à une température ambiante de $(23 \pm 2) ^\circ\text{C}$. Dans les **appareils à cavités multiples**, chaque cavité du **four** doit être mesurée séparément. Seule la cavité mesurée doit être mise sous tension.

Une **fonction de chauffage**, une **fonction éco** ou une **fonction de vapeur brûlante** doit être choisie. La commande de température est réglée à la position maximale. L'appareil est chauffé jusqu'à ce que l'échauffement atteigne 165 K.

L'échauffement est la différence des températures du **four** mesurées au début et à la fin de l'essai.

Le temps t_{ph} (t_{ph} correspondant au préchauffage) en minutes et secondes et la consommation d'énergie E_{ph} en kWh doivent être mesurés.

Le temps de préchauffage du **four** vide, t_{ph} , doit être consigné et arrondi à la demi-minute la plus proche.

La consommation d'énergie pour le préchauffage du **four** vide, E_{ph} , doit être consignée en kWh et arrondie à deux décimales.

Si le **four** comporte un réglage de préchauffage supplémentaire, l'essai doit être répété avec ce réglage.

NOTE La consommation d'énergie des composants, comme les lampes et ventilateurs qui se mettent automatiquement sous tension en même temps que l'appareil, est comprise dans le mesurage.

7.4 Exactitude de la commande

7.4.1 Objet

Cet essai a pour objet de déterminer l'exactitude de la commande de température et de calculer le réglage de température corrigé utilisé pour les essais spécifiés à l'Article 9.

7.4.2 Mesurages

Avant les mesurages, l'appareil complet doit être à la température ambiante de $(23 \pm 2) ^\circ\text{C}$.

L'élément de commande de température est réglé sur la position marquée $150 ^\circ\text{C}$, puis l'appareil est chauffé pendant $t_{\text{check},150} = 60 \text{ min}$. L'élément de commande de température est ensuite réglé sur la position marquée $200 ^\circ\text{C}$, puis l'appareil est chauffé pendant $t_{\text{check},200} = 60 \text{ min}$ supplémentaires. L'élément de commande de température est ensuite réglé sur la position marquée $250 ^\circ\text{C}$, puis l'appareil est chauffé pendant $t_{\text{check},250} = 60 \text{ min}$ supplémentaires.

Les marquages des positions de l'élément de commande pour le fonctionnement en gril ne sont pas pris en compte. Si la position $250 ^\circ\text{C}$ n'est pas marquée, la position marquée supérieure suivante est prise en compte. Si la position marquée la plus élevée est inférieure à $250 ^\circ\text{C}$, la position marquée la plus élevée possible doit être choisie. Si l'élément de commande n'est pas marqué en degrés Celsius, l'élément de commande est réglé sur des positions marquées appropriées conformément aux instructions d'utilisation.

Les mesurages doivent être effectués sans fonction de préchauffage rapide.

La température du **four** est enregistrée en continu conformément au 7.2.

7.4.3 Évaluation

Afin d'évaluer l'exactitude de la commande, les écarts entre chaque consigne de température (V_{150} , V_{200} , V_{250}) et les températures du **four** sont déterminés lorsque la température du **four** correspond à la moyenne arithmétique pendant les 20 dernières minutes de t_{check} .

En ce qui concerne le réglage de température corrigé utilisé pour les essais spécifiés à l'Article 9, le niveau des écarts V_{150} , V_{200} et V_{250} est déterminant. Le réglage de température utilisé pour les essais spécifiés à l'Article 9 ne doit être corrigé que si tous les écarts V_{150} , V_{200} et V_{250} sont $< 20 \text{ K}$.

NOTE Les écarts supérieurs ou égaux à 20 K ne sont pas corrigés, car l'appareil est présumé comporter une **fonction éco** qui utilise la chaleur résiduelle.

Afin de calculer le réglage de température corrigé pour les essais spécifiés à l'Article 9, les températures T_{150} et T_{200} du **four** sont utilisées et une régression linéaire est appliquée.

8 Consommation d'énergie et temps de chauffage d'une charge

8.1 Objet

Cet essai a pour objet de mesurer la consommation d'énergie et la durée du chauffage d'une charge pour une **fonction de chauffage** ou une **fonction éco** donnée d'un **four**, d'un **four à vapeur combiné** et d'un four à micro-ondes combiné. La charge est une brique saturée d'eau qui représente tout type d'aliment, par exemple un rôti.

8.2 Symboles et abréviations

Le Tableau 3 répertorie les principaux symboles utilisés à l'Article 8.

Tableau 3 – Symboles

$T_{s,k}$	réglage de température affiché par un bouton ou par l'affichage de la commande, s est le réglage et $k = 1, 2, 3$ (indice de sommation)
$T_{o1,k} / T_{o2,k}$	température de l'observateur mesurée lors de la phase 1 ou de la phase 2
$T_{a1,k} / T_{a2,k}$	température ambiante mesurée lors de la phase 1 ou de la phase 2
$T_{c2,k}$	température mesurée au centre de la cavité lors de la phase 2
$\Delta \bar{T}_{c2,1}$	échauffement moyen qui correspond à la différence entre la température ambiante moyenne et la température de la cavité mesurée lors de la phase 2
$\bar{T}_{c2,k}$	température mesurée au centre de la cavité lors de la phase 2, lissée
$\bar{T}_{c2,k}$	température moyenne au centre de la cavité lors de la phase 2
E_k	consommation d'énergie mesurée lors de la phase 1 lorsque le dernier des deux couples thermoélectriques de la brique atteint un échauffement de 55 K
t_k	temps mesuré lors de la phase 1 lorsque le dernier des deux couples thermoélectriques de la brique atteint un échauffement de 55 K, également appliqué pour la phase 2
t_0	heure de début de la phase 1 ou de la phase 2
i_s	indice de début déterminé pour calculer $\Delta \bar{T}_{c2,1}$ et $\bar{T}_{c2,k}$; i_s dépend de la fonction du four et du profil de température
c_k	rapport entre les températures de l'observateur mesurées tout au long de la phase 1 et de la phase 2 (t_0 à t_k)
s_k	rapport entre les températures de l'observateur mesurées pendant les 20 dernières minutes de la phase 1 et de la phase 2 complète (t_0 à t_k)
$\Delta T_{s,k}$	différence entre le réglage de température T_s et la température moyenne $\bar{T}_{c2,k}$ au centre de la cavité lors de la phase 2
$E_{\Delta T_0}$	consommation d'énergie nominale calculée en kWh pour le chauffage d'une charge à ΔT_0
ΔT_0	échauffement nominal; 165 K pour l'ensemble des fonctions de chauffage et des fonctions éco
$t_{\Delta T_0}$	durée nominale calculée en s pour le chauffage d'une charge à $\Delta T_0 = 165$ K pour l'ensemble des fonctions de chauffage ou des fonctions éco

8.3 Charge d'essai

8.3.1 Généralités

La charge d'essai doit être une brique qui comporte deux trous pour les mesurages de température, comme cela est représenté à l'Annex C.

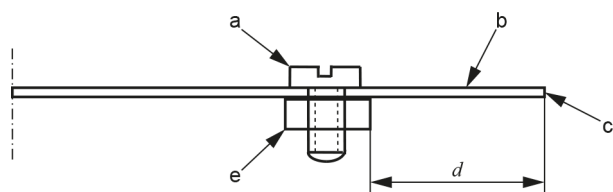
8.3.2 Prétraitement

Une brique neuve doit être séchée avant d'être utilisée pour la première fois dans un **four** avec une fonction à circulation forcée de l'air à ≥ 175 °C pendant 3 h. Le nombre de briques séchées en même temps dans un même **four** ne doit pas être supérieur à deux.

NOTE 1 Si une brique est encore humide par suite d'un essai précédent, au moins 8 h seront nécessaires pour la sécher selon la procédure décrite ci-dessus. Voir néanmoins la Note 1 du 8.3.3.

Le poids m_d (d signifie "à sec") de la brique totalement sèche sans couples thermoélectriques doit être mesuré dans les 5 min qui suivent le retrait du **four**. Il doit être noté en grammes. Le poids à sec m_d doit être conforme au poids à sec spécifié à l'Article C.1. La brique doit être identifiée afin de calculer avec exactitude l'absorption d'eau conformément au 8.3.3.

Placer les marquages à 32 mm du point de mesure des deux couples thermoélectriques conformément au 5.3, puis insérer les couples thermoélectriques dans les trous jusqu'à ce que le marquage coïncide avec la surface de la brique. Les couples thermoélectriques doivent être fixés pour s'assurer que les points de mesure demeurent à une profondeur de 32 mm tout au long de la procédure d'essai. Voir l'exemple à la Figure 7.



Légende

- a vis à trou de 1 mm
- b tube en acier
- c point de mesure
- d 32 mm
- e écrou

Figure 7 – Exemple de couple thermoélectrique

Les couples thermoélectriques peuvent être fixés en appliquant une goutte de colle silicone à la surface de la brique ou par un autre moyen adapté.

En raison de la porosité de la brique, veiller à ne pas élargir les trous de la brique lorsque les couples thermoélectriques sont enlevés et réinsérés.

NOTE 2 Une même brique peut être utilisée pour 20 essais environ si celle-ci est manipulée avec précaution.

8.3.3 Préparation

La brique, prétraitée conformément au 8.3.2, doit être préparée pour les besoins des mesurages d'énergie ci-dessous.

NOTE 1 Il n'est pas nécessaire de prétraiter la brique entre chaque utilisation. La brique a approximativement la même teneur en eau chaque fois qu'elle est trempée dans l'eau.

La brique doit être complètement immergée dans un récipient rempli d'eau à moins de 20 °C. Le récipient d'eau qui contient la brique est placé pendant au moins 8 h dans un réfrigérateur et refroidi à une température au centre de la brique (pour les deux couples thermoélectriques) de (5 ± 2) °C.

Une brique chaude doit être refroidie à l'air libre à une température au centre de la brique inférieure à 25 °C avant d'être placée dans l'eau froide.

NOTE 2 Une brique chaude placée directement dans l'eau froide absorbe davantage d'eau en raison de l'effet capillaire et de la viscosité différente de l'eau à différentes températures.

Entre les séries d'essais, il convient de conserver la brique, préférentiellement non imbibée d'eau, dans un réfrigérateur. Il convient de conserver l'eau utilisée pour le trempage de la brique (afin de réduire les processus de dissolution), c'est-à-dire que l'eau de conservation de la brique peut être réutilisée.

Après avoir sorti la brique du récipient d'eau, l'excès d'eau est égoutté pendant 1 min. La brique humide m_w doit ensuite être pesée, et la quantité d'eau absorbée est déterminée en g en tenant compte du poids des couples thermoélectriques, le cas échéant, en calculant $\Delta m = m_w - m_d$ (w signifie "humide" ou "eau"; m_d est mesurée conformément au 8.3.2). La quantité d'eau absorbée doit être celle spécifiée à l'Article D.1.

La température de la brique est mesurée. Les deux couples thermoélectriques doivent indiquer $(5 \pm 2) ^\circ\text{C}$.

8.4 Mesurage

8.4.1 Procédure d'essai

Avant tous les mesurages, l'appareil complet (y compris le matériau et l'isolant) doit être à une température ambiante de $(23 \pm 2) ^\circ\text{C}$. Dans les **appareils à cavités multiples**, mesurer chaque cavité du **four** séparément et mettre sous tension uniquement la cavité mesurée.

Retirer tous les accessoires fournis avec l'appareil, comme les plaques à pâtisserie et les supports latéraux, qui ne sont pas utilisés pour placer la charge.

Mesurer la température de la cavité $T_{c,k}$ dans l'appareil vide en fixant un couple thermoélectrique à la grille fournie avec l'appareil, conformément au 5.3. Placer cette grille dans l'appareil de sorte que le point de soudure du couple thermoélectrique se situe au centre du volume calculé du **four** et du **four à vapeur combiné** à une distance d'au moins 30 mm de la grille. Si aucune grille ne peut être achetée auprès du fabricant de l'appareil, il convient de positionner le couple thermoélectrique au centre d'une manière adaptée.

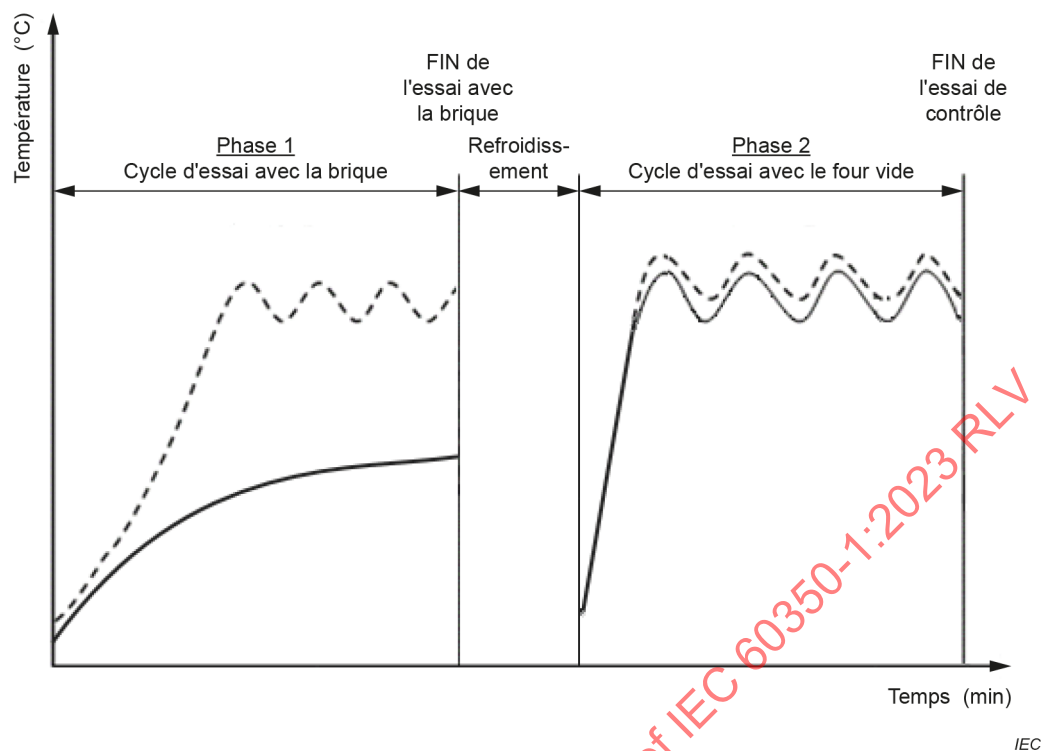
Enregistrer également en continu la température $T_{o,k}$ à proximité du **thermostat du four**. Pour ce faire, fixer un deuxième couple thermoélectrique à proximité du **thermostat du four** à l'intérieur de la cavité, comme cela est décrit à la Figure 9, à la Figure 10 et à la Figure 11. Ce couple thermoélectrique est le "couple thermoélectrique observateur".

Introduire les couples thermoélectriques par l'ouverture de la porte de manière à fermer complètement la porte sans exercer une force supplémentaire.

Pour déterminer la consommation d'énergie d'une **fonction de chauffage** ou d'une **fonction éco**, trois mesurages avec des réglages de température différents sont nécessaires. Chaque mesurage comporte deux phases:

- phase 1: mesurage de l'énergie lorsque la brique se trouve dans le **four**;
- phase 2: détermination de la température de référence et du facteur c (**four** vide).

Le diagramme de la Figure 8 représente le processus de mesurage complet.



Phase 1		Refroidissement	Phase 2	
---	température de l'observateur $T_{o1,k}$		----	température de l'observateur $T_{o2,k}$
—	température au centre de la brique		—	température de la cavité $T_{c2,k}$

Figure 8 – Processus de mesure complet

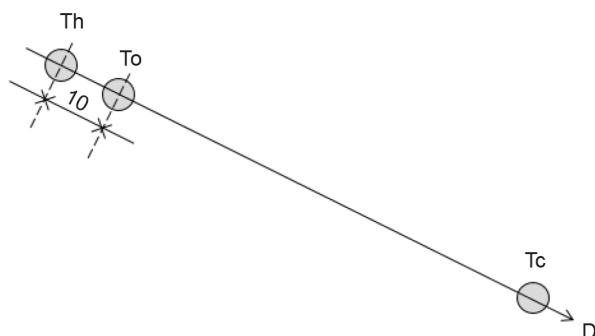
Pour les deux phases, la température $T_{c,k}$ est enregistrée en continu avec un couple thermoélectrique fixé sans contact à une distance ≤ 10 mm du **thermostat du four** à l'intérieur de la cavité. Ce couple thermoélectrique est le couple thermoélectrique observateur; il est fixé symétriquement dans les axes x et y , dans la direction de l'axe z (voir la Figure 10 et la Figure 11). L'axe D est orienté vers le centre de la cavité (voir la Figure 9). Fixer le couple thermoélectrique observateur sur la paroi la plus proche de la cavité au moyen d'un ruban adhésif thermorésistant.

Si le **thermostat du four** n'est pas accessible, suivre les instructions du fabricant pour la position du couple thermoélectrique.

Si le **four** propose plusieurs **thermostats**, des informations relatives au **thermostat de four** en ce qui concerne la commande de température de la cavité étudiée peuvent être obtenues dans les instructions du fabricant.

Ne pas modifier la position du couple thermoélectrique observateur lors de la phase 1 et de la phase 2.

Dimensions en millimètres



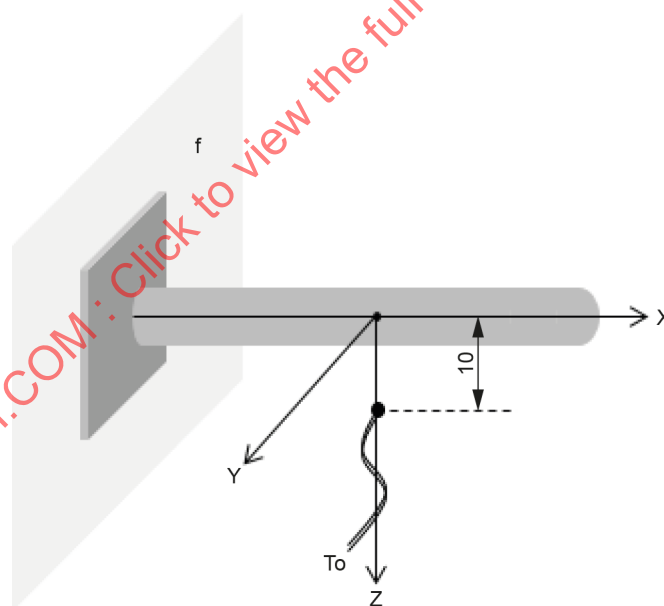
IEC

Légende

- Th thermostat du four
- To couple thermoélectrique observateur
- Tc couple thermoélectrique au centre du four
- D direction vers le centre du four

Figure 9 – Installation du couple thermoélectrique observateur

Dimensions en millimètres



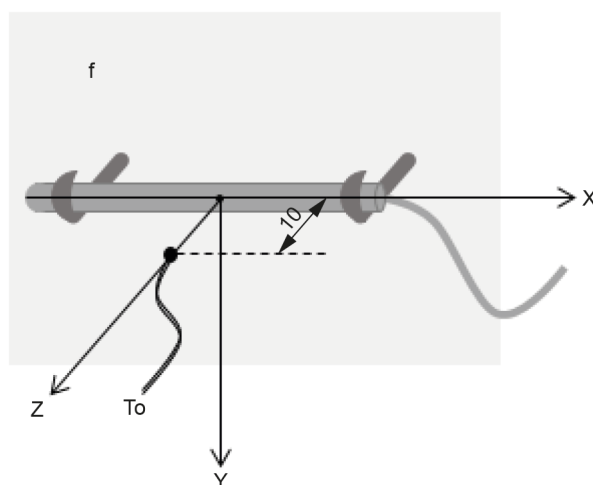
IEC

Légende

- f mur de fixation – position du thermostat par rapport au mur de fixation (le corps du thermostat est perpendiculaire à la surface du mur de fixation)
- To couple thermoélectrique observateur
- Z direction – sous le thermostat

Figure 10 – Installation verticale du couple thermoélectrique observateur

Dimensions en millimètres

**Légende**

f mur de fixation – position du thermostat par rapport au mur de fixation (le corps du thermostat est parallèle à la surface du mur de fixation)

To couple thermoélectrique observateur

Z direction – face au thermostat

Figure 11 – Installation horizontale du couple thermoélectrique observateur

8.4.2 Réglages du four

Une **fonction de chauffage** ou une **fonction éco** doit être utilisée pour le mesurage de la consommation d'énergie. Si plusieurs **fonctions de chauffage** ou **fonctions éco** sont disponibles, les recommandations figurant dans les instructions du fabricant sont prises en compte.

La commande de température est réglée sur une position à laquelle les échauffements moyens $\Delta \bar{T}_{c2,k}$ indiqués dans le Tableau 4 peuvent être attendus. $\Delta \bar{T}_{c2,k}$ est la différence entre la température ambiante moyenne et la température moyenne de la cavité mesurées lors de la phase 2; $k = 1, 2, 3$ (k est l'indice de sommation).

Le réglage de température T_s , qui est le réglage affiché par le bouton ou par l'affichage de la commande (s est le réglage), doit être noté. Si les paliers de température ne sont pas clairement marqués, il convient de déterminer le réglage de température en fonction des marques visibles sur le bouton à l'aide d'une feuille de papier à coordonnées polaires (voir l'Annex E).

Si la température est réglée par un bouton, le bouton doit toujours être tourné de zéro vers le réglage exigé.

Tableau 4 – Échauffement pour trois réglages

Échauffement	
$\Delta \bar{T}_{c2,1}$	(135 ± 15) K
$\Delta \bar{T}_{c2,2}$	(165 ± 15) K
$\Delta \bar{T}_{c2,3}$	(195 ± 15) K ^a
^a Ou l'échauffement maximal si cette valeur ne peut pas être atteinte.	

Préciser la **fonction de chauffage** ou la **fonction éco** utilisée, ainsi que le réglage de température $T_{s,k}$ pour chaque mesurage.

8.4.3 Phase 1

- Retirer tous les accessoires fournis avec l'appareil, comme les plaques à pâtisserie et les supports latéraux, qui ne sont pas utilisés pour placer la brique.
- Placer la brique, préparée conformément au 8.3.3, au centre géométrique de la cavité calculée en centrant la surface la plus grande de la brique sur la grille livrée avec l'appareil et en plaçant les couples thermoélectriques sur la face supérieure. Si aucune grille ne peut être achetée auprès du fabricant de l'appareil, il convient d'utiliser toute grille adaptée, à l'exclusion cependant d'une plaque à pâtisserie, d'un moule ou objet similaire.
- Insérer la grille au niveau du support de l'étagère de l'appareil de sorte que le centre de la brique soit aussi près que possible du centre et non pas à un niveau plus haut que le centre de la cavité calculée. L'axe le plus long de la brique doit être parallèle à la partie avant de l'appareil. Si la grille peut être insérée à deux positions différentes (par exemple, le positionnement à l'envers donne une hauteur différente), il convient de choisir la position qui permet à la partie centrale de la brique d'être au plus près du centre de la cavité, mais pas à un niveau plus haut. Le centre de la brique peut être placé à un niveau plus haut que le centre de la cavité seulement si la grille est déjà placée au niveau le plus bas.
- Si l'appareil est préparé avec les couples thermoélectriques, ne pas le faire fonctionner avec une fonction combinée avec énergie à micro-ondes. L'énergie à hyperfréquence couplée en sortie aux bornes des couples thermoélectriques peut endommager les appareils de mesure.

NOTE 1 Voir l'Annex D.

- Commencer le mesurage dans les 3 min qui suivent la sortie de la brique du réfrigérateur en mettant l'appareil sous tension conformément aux exigences de réglage.

Les données suivantes sont mesurées:

- la ou les consommations d'énergie E_k mesurées en kWh et le ou les temps t_k en min et en s lorsque le dernier des deux couples thermoélectriques de la brique atteint un échauffement de 55 K, $k = 1, 2$ et 3;
- les températures au centre de la brique, en °C;
- la température $T_{o1,k}$ mesurée en continu par le couple thermoélectrique observateur, en °C;
- la température ambiante $T_{a1,k}$ entre le début (lorsque l'appareil est mis sous tension) et la fin de l'essai (c'est-à-dire lorsque le dernier des deux couples thermoélectriques de la brique a atteint un échauffement de 55 K) en °C.

NOTE 2 La consommation d'énergie des composants, comme les lampes et ventilateurs qui se mettent automatiquement sous tension en même temps que l'appareil, est comprise dans le mesurage.