

# INTERNATIONAL STANDARD



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## Household electric cooking appliances – Part 2: Hobs – Methods for measuring performance



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# INTERNATIONAL STANDARD



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## Household electric cooking appliances – Part 2: Hobs – Methods for measuring performance

INTERNATIONAL  
ELECTROTECHNICAL  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## HOUSEHOLD ELECTRIC COOKING APPLIANCES –

## Part 2: Hobs – Methods for measuring performance

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International Standard IEC 60350-2 has been prepared by subcommittee 59K: Performance of household and similar electrical cooking appliances, of IEC technical committee TC 59: Performance of household and similar electrical appliances.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

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

- a) terms and definitions revised and new definitions added (see 3);
- b) following the new market trend, requirements related to so-called flexible and free induction zones – in this document named as **cooking areas** – are added;
- c) specification for standardized and alternative cookware is introduced (see 5.6);
- d) measurement procedure reflecting a household-like cooking process for measuring the energy consumption is introduced (see Clause 7 and Annex A);

- e) revision of measurement procedure for determining the accuracy of control (see Clause 8);
- f) new reproducible measurement procedure for assessing the heat distribution (see Clause 9);
- g) additional requirements (according to IEC 62301:2011) on how to measure low-power modes.

In this document, terms in bold characters are defined in Clause 3.

This standard contains attached files in the form of a spreadsheet. These files are intended to be used as a complement and do not form an integral part of the standard.

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

FDIS	Report on voting
59K/293/FDIS	59K/294/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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.

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# HOUSEHOLD ELECTRIC COOKING APPLIANCES –

## Part 2: Hobs – Methods for measuring performance

### 1 Scope

This part of IEC 60350 defines methods for measuring the performance of electric **hobs** for household use.

Appliances covered by this document can be built-in or designed to be placed on a work surface. The **hob** can also be a part of a cooking range.

This document does not apply to portable appliances for cooking, grilling and similar functions (see IEC 61817).

This document defines the main performance characteristics of **hobs** which 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 1 Some of the tests which are specified in this document are not considered to be reproducible since the results can vary between laboratories. They are therefore intended for comparative testing purposes only.

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

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

IEC 60364-5-54, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

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 terminological databases for use in standardization at the following addresses:

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

#### 3.1

##### **cooking range**

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

Note 1 to entry: Methods for measuring performance of ovens are described in IEC 60350-1.

### 3.2

#### **hob**

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: A **hob** is also known as a cooktop.

Note 2 to entry: The **control** unit can be included in the **hob** itself or integrated in a **cooking range**.

### 3.3

#### **cooking zone**

limitative marking on the surface of a hob where one cookware is placed and heated or an attached area to the surface

#### EXAMPLE

A **cooking zone** can be:

- a **single zone** or a **multiple zone** (see 3.4 and 3.5);
- a **solid hotplate** (see 3.6);
- a **tubular hotplate** (see 3.7);
- a **radiant cooking zone** (see 3.8);
- an **induction cooking zone** (see 3.9).

Note 1 to entry: **Cooking zones** which are used without cookware but by positioning the food directly on the surface are not included.

Note 2 to entry: Sometimes there is a decoration symbol, e.g. a cross, to mark the centre of the **cooking zone** additionally.

### 3.4

#### **single zone**

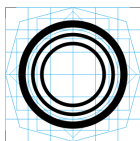
**cooking zone** marked for one cookware size

### 3.5

#### **multiple zone**

cooking zone marked for more than one cookware size and shape which can be circular, elliptical or a combination

EXAMPLE 1 Circular **multiple zone** for three different cookware sizes:



[IEC 60417-Pr17-001]

EXAMPLE 2 Circular and elliptical **multiple zone**:



[IEC 60417-5492:2002-10]

**3.6****solid hotplate**

**cooking zone** having a closed surface, which is usually constructed from cast iron, with an integrated heating element

**3.7****tubular hotplate**

**cooking zone** having a surface which is formed by the configuration of a tubular heated heating element in a substantially flat plane

**3.8****radiant cooking zone**

**cooking zone** on which the pan is heated by means of a radiant heating element below the glass ceramic which could have a heating ribbon, heating spiral or a tungsten wire which is located in a quartz glass bulb or combination of these

**3.9****induction cooking zone**

**cooking zone** on which the pan is heated by means of an induction element below the glass ceramic or similar where the eddy currents are inducted in the bottom of the pan by a magnetic field

**3.10****cooking area without limitative markings**

area where cookware is placed and heated by an inducted magnetic field without limitative markings

EXAMPLE See Figure A.1

Note 1 to entry: **Cooking areas** which are used without cookware but by positioning the food directly on the surface are not included.

Note 2 to entry: Sometimes there are one or more decoration symbols, e.g. a cross, on the **cooking area** to mark the centre position where the cookware is placed.

**3.11****cooking area with limitative markings**

area where cookware is placed and heated by an inducted magnetic field where the area is marked to show the limits where more than one cookware can be used simultaneously while the cookware pieces can be used and controlled separately from each other at the same time

EXAMPLE See Figure A.2

Note 1 to entry: **Cooking areas** which are used without cookware but by positioning the food directly on the surface are not included.

Note 2 to entry: The **cooking area** is also used combined for one cookware, even if there is more than one control.

**3.12****control**

part of the **hob** for adjusting the power or temperature respectively of a **cooking zone** or a **cooking area** for one piece of cookware, independent from technical solution (e.g. knobs, touch controls etc.)

Note 1 to entry: The power is generally indicated as numbers, but also temperature values and symbols are possible.

Note 2 to entry: **Controls** integrated outside of the hob in a separate device or as part of a built-in-oven are also included.

**3.13****warming zone**

**area** used for keeping food warm usually not used for cooking

Note 1 to entry: Normally one power setting exists – on and off.

**3.14****maximum power**

maximum possible power setting while only one cookware is used

Note 1 to entry: Boost function is considered.

**3.15****standardized cookware**

cookware that is in accordance with the specification of 5.6.1

**3.16****alternative cookware**

commercially available cookware that is in accordance with the requirements given in 5.6.2

**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 like for example remove the cookware etc are considered.

Note 2 to entry: For 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 definition of standby mode IEC 62301 is relevant.

**4 List of measurements****4.1 Dimensions and mass**

- overall dimensions (see 6.1);
- cooking zones per hob (see 6.2);
- level of solid hotplates (see 6.3);
- distance between the cooking zones (see 6.4);
- mass of the appliance (see 6.5).

**4.2 Cooking zones and cooking areas**

- energy consumption and time for heating (see Clause 7 and Annex A);
- ability to control the temperature of a load (see Clause 8);
- heat distribution (see Clause 9);
- heat performance of hobs (see Clause 10);
- smallest detected diameter for induction cooking zones (see Clause 11);

### 4.3 Cleaning

- spillage capacity for hobs (see Clause 13).

## 5 General conditions for the measurements

### 5.1 Test room

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

Only for the measurements described in Clause 7 shall an ambient temperature of  $(23 \pm 2) ^\circ\text{C}$  be maintained throughout the entire test.

This ambient temperature is measured at a point that is at the same height as the **hob** positioned at working height and at a distance of 0,5 m diagonally from one of the front edges of the appliance.

NOTE The working height is normally between 800 mm and 1 000 mm.

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

The absolute air pressure shall be between 913 hPa and 1 063 hPa.

### 5.2 Electricity supply

The appliance is supplied at rated voltage with a relative tolerance of  $\pm 1\%$ .

If the appliance has a rated voltage range, the tests are carried out at the nominal voltage of the country where the appliance is intended to be used.

For the test described in Clause 7, the supply voltage shall be maintained at the main terminal at 230 V with a relative tolerance of  $\pm 1\%$  or at 400 V with a relative tolerance of  $\pm 1\%$  as defined by the manufacturer's installation guide, while the heating elements are switched on.

The supply voltage shall be essentially sinusoidal.

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

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.

### 5.3 Instrumentation and measurements

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	Minimum accuracy	Additional requirements
Mass (clause 7)	g	0,5 g	$\leq 1\,000\text{ g} \pm 1\text{ g}$ $> 1\,000\text{ g} \pm 3\text{ g}$	
Temperature				
– ambient temperature	°C	0,1 °C	$\pm 1\text{ K}$	
– temperature of the water load (clause 7)	°C	0,1 °C	$\pm 0,5\text{ K}$	3 mm steel tube
– temperature of the oil (clause 8)	°C	0,1 °C	$\pm 0,5\text{ K}$	
Time	s	1 s	$\pm 1\text{ s}$	
Energy	Wh	-	$\pm 1\%$	Very quick electronic on/off periods shall be taken into account by measurement techniques.
Air pressure	hPa	1 hPa	$\pm 1\%$	

**Table 2 – Measurements**

Parameter	Unit	Minimum resolution	Minimum accuracy	Additional requirements
Voltage	V	-	$\pm 0,5\%$	-
Temperature and energy consumption measurement (Clause 7)		-	-	Sampling rate $\leq 1\text{ s}$ (digital measurement data)
For Clause 12, the power measurement requirements shall be in accordance with IEC 62301		-	-	According to IEC 62301

The required accuracy of temperature measurement in the water load (Clause 7) can be fulfilled by calibrating the temperature measurement or, for instance, by a PT100 sensor according to IEC 60751.

If numbers have to be rounded, they shall be rounded to the nearest number according to ISO 80000-1:2009, B.3, Rule B. If the rounding takes place to the right of the comma, the omitted places shall not be filled with zeros.

#### 5.4 Positioning the appliance

The **hob** or the **cooking range** is installed in accordance with the instructions for its installation.

If no instructions for its installation are given, a **cooking range** is positioned between kitchen cabinets with its back to the wall and tabletop **hobs** are positioned away from sidewalls.

## 5.5 Initial conditions

The appliance shall be at the laboratory's ambient temperature at the beginning of each test. Forced cooling may be used to assist in reducing the temperature.

All tests are carried out with the default factory settings. Ensure that no network is connected to the appliance for the duration of the measurement.

## 5.6 Cookware

### 5.6.1 Standardized cookware

#### 5.6.1.1 General

Cookware is an integral part of the cooking process; it affects different process parameters such as the adaptation of a cooking zone, the required settings and the needed cooking time.

A sufficient degree of reproducibility is only guaranteed if a piece of **standardized cookware** and lid is used as described in 5.6.1.

**Hobs** working exclusively with a piece of supplied cookware and not with household-like cookware shall be tested with its supplied cookware, but it shall be covered with a lid in accordance with Table 3.

NOTE Suppliers for the stainless steel and for the cookware are indicated in Clauses F.3 and F.4.

#### 5.6.1.2 Standardized cookware – bottom material and construction

- Material: stainless steel AISI type 430, non-shiny surface;
- Thickness: 6 mm ± 0.2 mm (see Figure 1);
- Dimensions as specified in Table 3;
- Flatness of bottom plate as specified in Table 3;

A convex shaped bottom plate is not allowed. The flatness of the base has to be checked before starting a measurement.

- Annealing required.

For a sufficient permeability of the cookware bottom, the disc has to be annealed. The annealing should be done for approximately 2 h at approximately 650 °C in a nitriding-furnace.

Grinding for adjustment after alteration is allowed within the given tolerances of (6 ± 0,2) mm.

#### 5.6.1.3 Standardized cookware – sidewall

- Material: stainless steel AISI type 304;
- Thickness: 1 mm ± 0,05 mm;
- Shape: cylindrical without handles or protrusions (see Figure 1).

The sidewall is fixed to the bottom plate with heat resistant glue.

The sidewall of the cookware can be built up of a metal sheet. The metal sheet is rolled and welded to a sheet-metal jacket. The sidewall can be fixed additionally by three welding points to the bottom, but the required bottom flatness has to be checked.

#### 5.6.1.4 Standardized cookware – lid with temperature sensor

- Material: aluminium;
- Thickness: 2 mm ± 0,05 mm;
- Dimensions as specified in Table 3;
- With holes, where each hole on the circle of the lid has diameter of (16 ± 0,1) mm; the holes shall be evenly distributed on the circle (see Figure 1).

NOTE 1 The thermal energy which is needed to keep the water boiling for a real cooking process, including evaporation and the energy absorption of the food during the simmering phase, is considered for the holes.

The flat lid is adapted to accommodate a temperature sensor in the centre. The temperature sensor is positioned (15 ± 1) mm above the inner cookware bottom. To achieve this, place a (15 ± 1) mm reference block on the bottom of the cookware. Mark the sensors and tighten the screws.

NOTE 2 An example how to fix the temperature sensor to the lid is shown in Annex B.

In order to reduce measurement noise generated by the electromagnetic field of an **induction cooking zone** or **cooking area**, the lid of the cookware shall be connected to ground through a clamp (see Figure 1 d)). The ground connection of the electric installation of the testing laboratory shall be according to IEC 60364-5-54.

NOTE 3 An earthed wire of 2 mm<sup>2</sup> cross section and a maximum length of 2 m is welded to the metallic clamp.

#### 5.6.1.5 Standardized cookware – dimensions and water amounts

The standardized cookware sizes and water amounts are defined in Table 3.

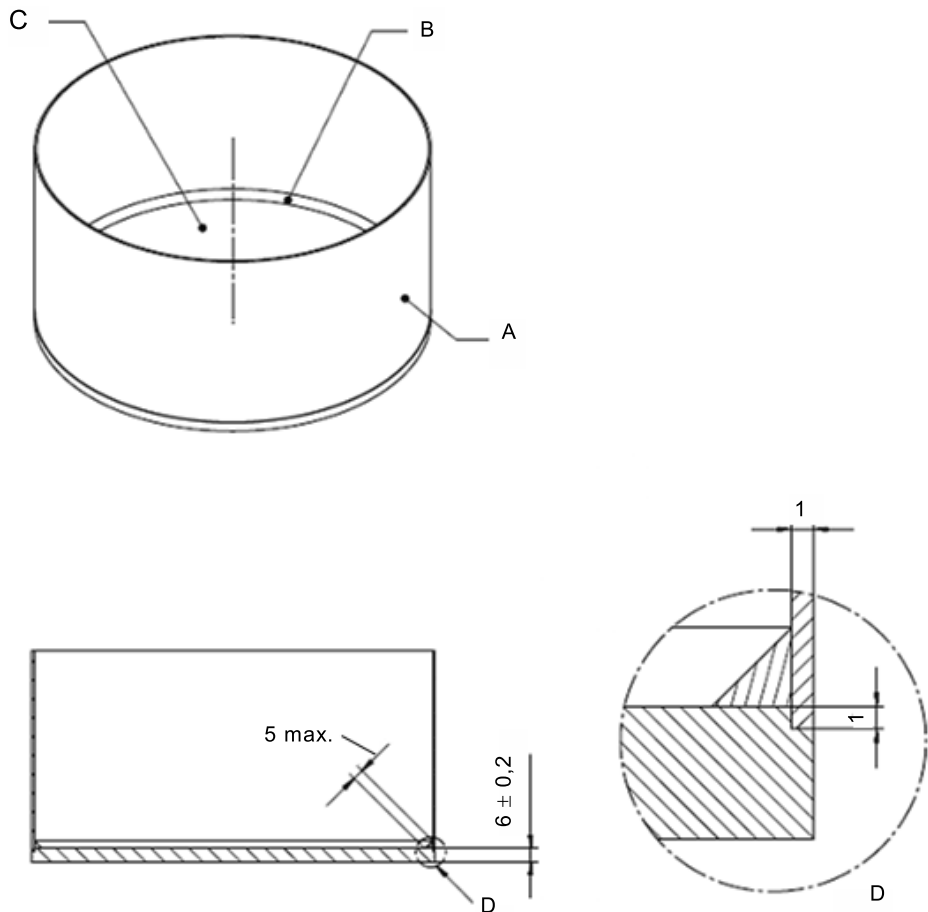
**Table 3 – Sizes of standardized cookware and water amounts**

Diameter of the cookware bottom (outside) mm	Diameter of the lid mm	Lid hole circle diameter mm	Number of holes on the circle	Total cookware height (outside) mm	Flatness of cookware bottom mm	Water load g	Cooking zone size category mm	Standardised cookware categories
120 ± 0,5	130 ± 1	80 ± 1	7	125 ± 0,5	≥ 0 < 0,075	650	≥ 100 < 130	A
150 ± 0,5	165 ± 1	110 ± 1	11	125 ± 0,5	≥ 0 < 0,075	1 030	≥ 130 < 160	
180 ± 0,5	200 ± 1	140 ± 1	16	125 ± 0,5	≥ 0 < 0,075	1 500	≥ 160 < 190	B
210 ± 0,5	230 ± 1	170 ± 1	22	125 ± 0,5	≥ 0 < 0,1	2 050	≥ 190 < 220	C
240 ± 0,5	265 ± 1	200 ± 1	29	125 ± 0,5	≥ 0 < 0,1	2 700	≥ 220 < 250	
270 ± 0,5	300 ± 1	230/210 <sup>a</sup> ± 1	18/18 <sup>a</sup>	125 ± 0,5	≥ 0 < 0,15	3 420	≥ 250 < 280	D
300 ± 0,5	330 ± 1	260/210 <sup>a</sup> ± 1	23/22 <sup>a</sup>	125 ± 0,5	≥ 0 < 0,15	4 240	≥ 280 < 310	
330 ± 0,5	365 ± 1	290/270 <sup>a</sup> ± 1	27/27 <sup>a</sup>	125 ± 0,5	≥ 0 < 0,15	5 140	≥ 310 ≤ 330	

<sup>a</sup> Number of holes are arranged on two hole circles.

NOTE The standardised cookware categories in Table 3 are only relevant for the standardized cookware. Categories are necessary to make sure that different cookware sizes – as relevant in a household – are considered.

*Dimensions in millimetres*



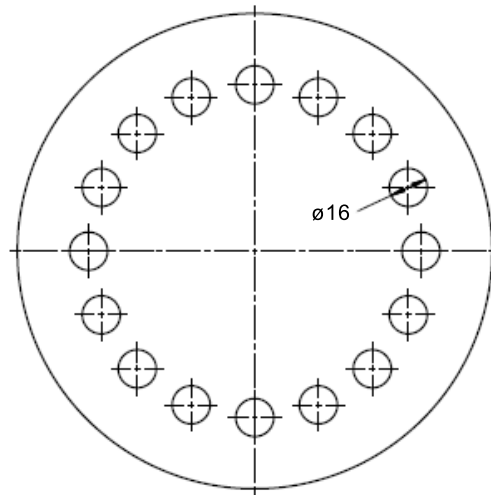
IEC

**Key**

- A side wall
- B heat-resistant glue
- C bottom plate
- D detail of the edge

**a) Example for a cookware size of 180 mm in diameter**

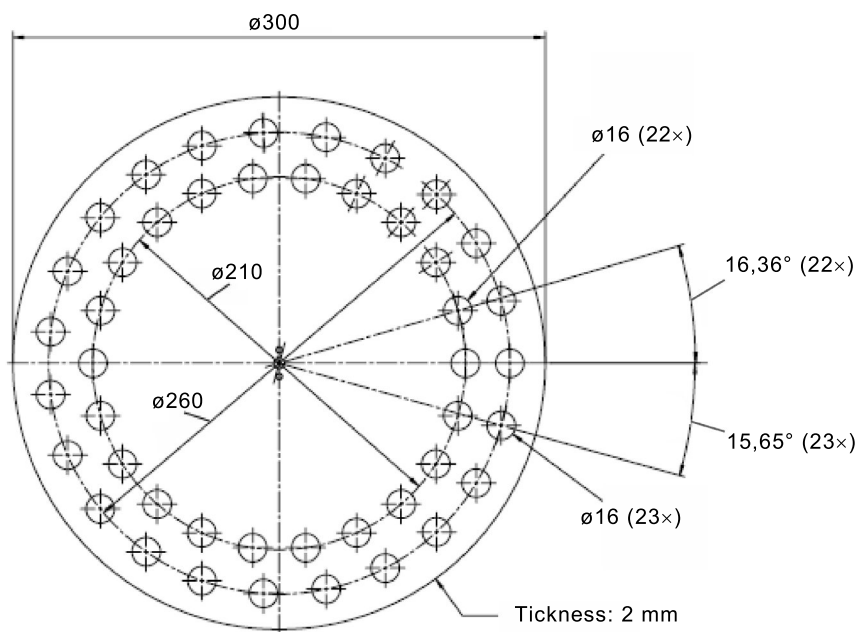
*Dimensions in millimetres*



IEC

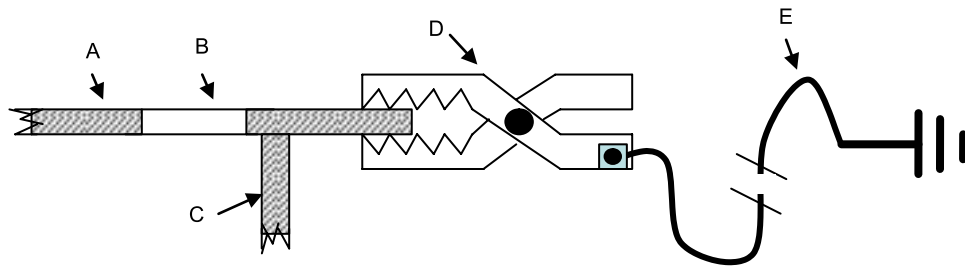
**b) Example – lid with a diameter of 180 mm**

*Dimensions in millimetres*



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**c) Example – lid with a diameter of 300 mm**



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**Key**

- A lid
- B hole
- C cookware
- D clamp
- E ground wire

d) Ground connection

**Figure 1 – Standardized cookware**

**5.6.2 Alternative cookware**

**5.6.2.1 General**

For comparative testing, **alternative cookware** may be used.

The cookware used is noted. For comparative testing, for example on different sizes of cooking zones, always the same cookware samples shall be used.

**5.6.2.2 Alternative cookware – bottom material and construction**

- Material: stainless steel bottom clad with several layers, which typically clad a stainless steel layer (e.g. AISI 430 or AISI 439 steel), an aluminium layer and a ferromagnetic layer (often also called "sandwich layer bottom" or "aluminium clad").
- Flatness:  $< 0,003 a$ , where  $a$  is the outer diameter of the cookware's bottom.

A convex shaped bottom plate is not allowed. The flatness of the base has to be checked before starting a measurement.

- Thickness:  $\geq 3$  mm.
- No aluminium or copper spots in the surface.
- Without an aluminium ring outside.
- No ferromagnetic coating or sputtering.
- Without reliefs and stamps. Except one smaller stamp (ferromagnetic material) with a diameter less than 30 % of the outer flat bottom diameter and a depth  $< 0,8$  mm in the centre.
- Uncoated.

**5.6.2.3 Alternative cookware – sidewall**

- Material: non-ferromagnetic stainless steel, e.g. AISI type 304.
- Thickness:  $\geq 0,8$  mm.
- Shape: cylindrical, angle between sidewall and hob surface  $80^\circ$  to  $90^\circ$ .
- Uncoated.

#### 5.6.2.4 Alternative cookware – dimensions

The size of cookware shall match the size of the **cooking zone** (see 6.3.2) as well as possible. However, it may vary by a maximum of +20 mm and –10 mm.

For **cooking areas**, the sizes of the cookware under test are described in the test procedures.

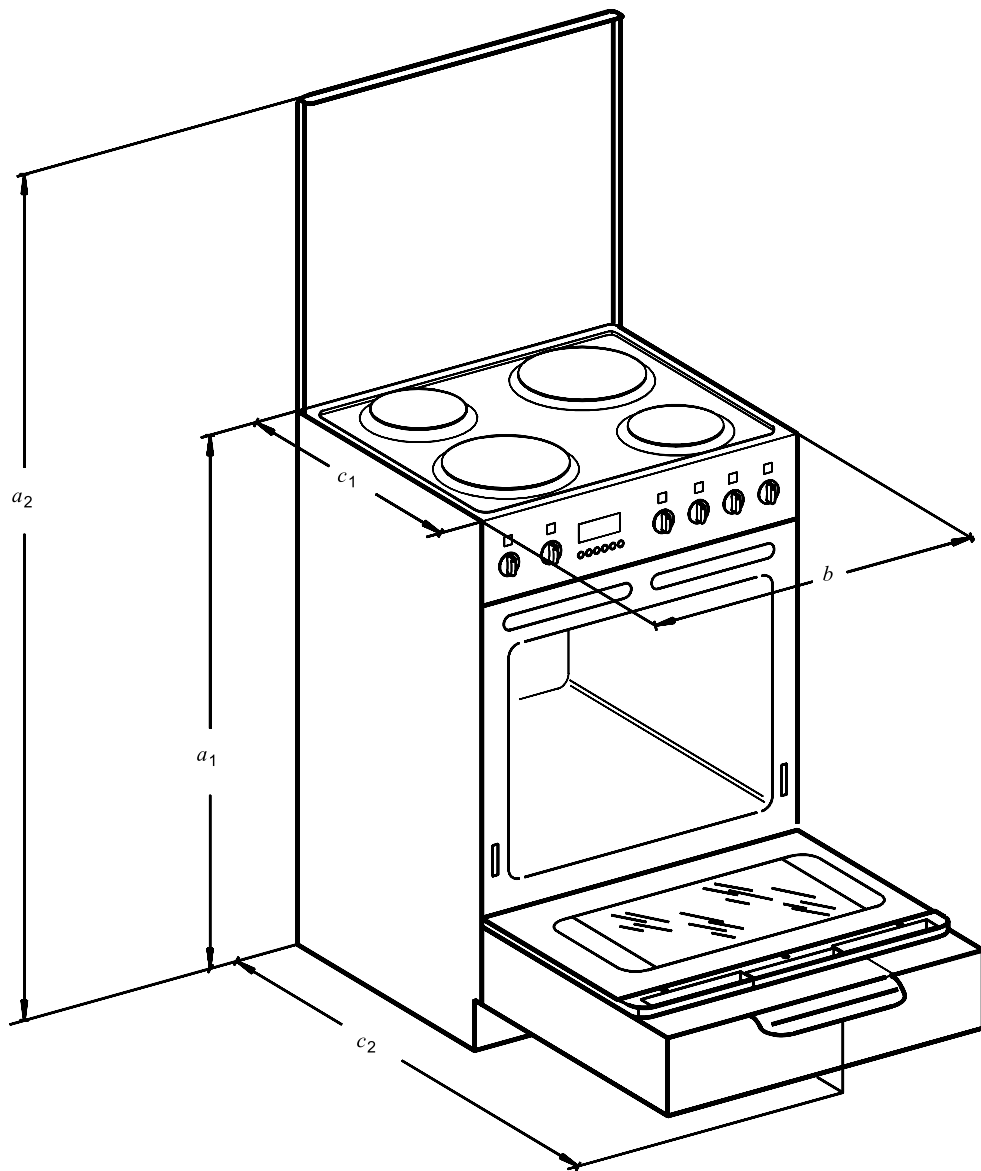
For determining the size of the cookware, the outer diameter of the flat bottom of the cookware ( $a$ ) is measured.

## 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 **hobs** are measured as shown in Figure 3.



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**Key**

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

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

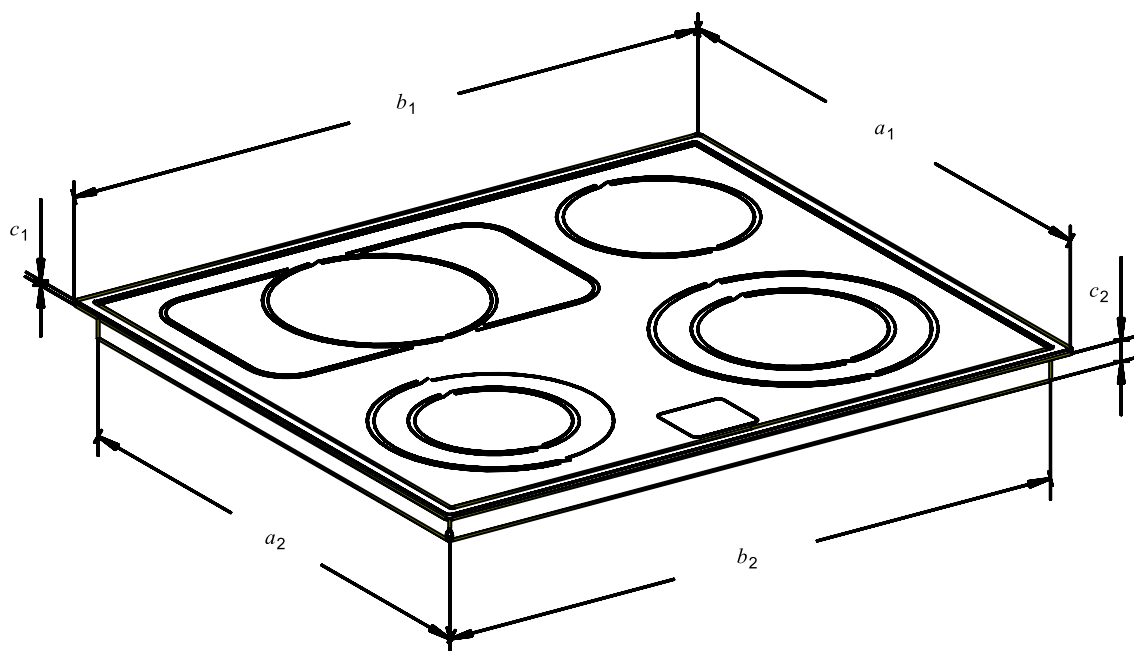
$b$  overall width of the appliance

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

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

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

**Figure 2 – Dimensions of appliances**



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**Key**

- $a_1$  depth of the **hob**
- $b_1$  width of the **hob**
- $c_1$  height of the **hob** on the outside of the kitchen furniture
- $c_2$  height of the **hob** on the inside of the kitchen furniture
- $a_2$  depth of the **hob** on the inside of the kitchen furniture
- $b_2$  width of the **hob** on the inside of the kitchen furniture

**Figure 3 – Dimensions of built-in hobs****6.2 Mass of the appliance**

The mass of the appliance is determined and expressed in kg, rounded to the nearest kg.

**6.3 Cooking zones and cooking areas****6.3.1 Number of cooking zones per hob**

The number of **cooking zones** is determined by the maximum number of **controls** that can be operated independently all at the same time.

**6.3.2 Dimensions of cooking zones**

The dimension of a **cooking zone** is determined by measuring the marked area on the surface.

For a circular **cooking zone**, the outside diameter of the largest marked circle is measured.

For a **multiple zone**, the dimension for each size is measured.

For a **solid hotplate**, the diameter of the surface intended to come into direct contact with the bottom of the saucepan is measured.

For a **tubular hotplate**, the diameter of the largest periphery excluding any leading section is measured.

If the **cooking zone** is not circular, the dimensions are determined as follows:

- for rectangular and similar shapes, the lengths of the sides are measured;
- for elliptical and similar shapes, the major and minor dimensions are measured.

The dimension of a radiant or induction **cooking zone** is determined by the printing on the surface independently of the size of the heating element.

The dimensions are indicated in mm.

### 6.3.3 Dimensions of cooking areas

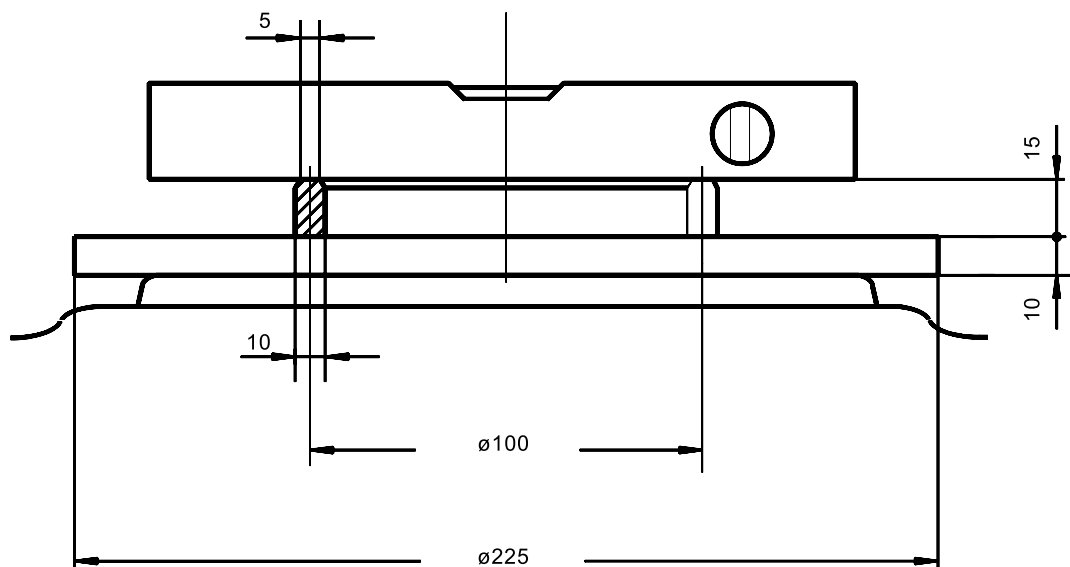
For a **cooking area** that is marked to show the limits where more than one item of cookware can be used simultaneously, the maximum length and maximum width of the marked surface is noted.

## 6.4 Level of solid hotplates

**Cooking ranges** with adjustable feet and **hobs** are installed with the perimeter of the hob surface horizontal.

A device consisting of a disc and an annular ring is placed centrally on the **solid hotplate**. A spirit level is placed centrally on the ring, as shown in Figure 4.

*Dimensions in millimetres*



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**Figure 4 – Device for checking the level of solid hotplates**

A mass of 3 kg is placed on each of the remaining **solid hotplates**.

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.

The measurement is carried out on each **solid hotplate**.

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

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

### 6.5 Distance between cooking zones

The shortest distance between the edges of adjacent **cooking zones** is measured and indicated in mm, rounded to the nearest mm. If the **hob** has more than two **cooking zones**, the distance between each pair is determined.

The result may be shown by means of a sketch.

## 7 Energy consumption and heating up time

### 7.1 General

To guarantee reproducible results, the tests in Clause 7 shall be carried out with **standardized cookware**.

The tests described in Clause 7 are applicable to **cooking zones** with a diameter  $\leq 330$  mm and  $\geq 100$  mm or where one of the sides' lengths is  $\leq 330$  mm and  $\geq 100$  mm.

In addition, tests are applicable to **cooking areas**. Further requirements concerning **cooking areas** are described in Annex A.

For **multiple zones** that include a circular and an elliptical or rectangular part, only the circular part is tested.

### 7.2 Purpose

In the first place, the purpose is to determine the energy consumption for heating up a defined water load and keep it at a defined temperature level for 20 min.

In a second measurement, the heating up time of a defined water load can be determined.

NOTE 1 Heating up and keeping the temperature for a defined period represents a typical household cooking process. Additionally, the quality of the **control** is measured by keeping an amount of water at a defined temperature as exactly as possible.

NOTE 2 The simmering time of 20 min represents an average household cooking duration. Additionally, at least 20 min further simmering time is necessary to assess the quality of a **control** that influences the energy consumption.

### 7.3 Determine a cookware set to assess a hob with cooking zones

The number of pieces of cookware needed to assess a **hob** shall correspond to the number of **controls** which can be used simultaneously and independently.

The sizes and number of cookware pieces are selected according to Table 4.

**Table 4 – Criteria for selecting the cookware set regarding cooking zones**

Number of cookware used for tests according to Clause 7	Criteria for selecting a cookware set regarding cooking zones
1	From one standardized cookware category according to Table 3 that is equal to the dimensions of the <b>cooking zone</b> or best fit.
2	At least from one standardized cookware category according to Table 3 that are equal to the dimensions of the <b>cooking zones</b> or best fit.
3	At least from two standardized cookware categories according to Table 3 that are equal to the dimensions of the <b>cooking zones</b> or next best fit cookware category.
4 or more	At least from three standardized cookware categories according to Table 3 that are equal to the dimensions of the <b>cooking zones</b> or next best fit cookware category.

For circular **multiple zones**, the biggest diameter determined according to 6.3.2 is considered.

For non-circular **cooking zones**, the cookware size is determined by the short axis measured according to 6.3.2.

If on an induction **hob** cookware is not detected, the next biggest cookware diameter is chosen independent from the cookware category.

If a standardized cookware category A-D has to be substituted, the next best-fitting cookware is selected. The cookware with the closest bottom diameter compared to the **cooking zone** diameter is chosen. As a result, cookware can be smaller or bigger than the **cooking zone**. Therefore, also smaller diameters of **multiple zones** can be considered. Each **cooking zone** is taken into account only once. The one with the closest diameter to the **cooking zone** is the best fitting cookware size.

If a selected cookware size is out of the range of the sizes allowed by the user manual, then the closest diameter compatible with the defined range shall be chosen.

If it is not clear which cookware size is best fitting, all possibilities are considered in the measurement.

NOTE As mentioned in 7.1, for **multiple zones** which include a circular and an elliptical or rectangular part, only the circular part is tested.

#### **7.4 Positioning the cookware on a cooking zone**

On a **cooking zone**, the cookware is used in the centre.

The centre of an elliptical or similar shaped **cooking zone** is determined in the intersection of the shortest and longest axis.

The centre of a rectangular or similar **cooking zone** is determined in the intersection of the two diagonals.

If two **cooking zones** with the same size are available and cookware pieces with different sizes have to be placed there, then the position for the bigger cookware size will be made in accordance with the following order of precedence:

- a) **cooking zones** having highest **maximum power**;
- b) **cooking zones** being located at the rear of the **hob**;
- c) **cooking zones** being located on the left.

## 7.5 Procedure for measuring the energy consumption of a cooking process

### 7.5.1 Preparation

Before the first measurement is taken, all cooking zones have to be operated for at least 10 min at maximum setting. This is only necessary once to make sure that residual water in the components is vaporized. Afterwards, the hob has to be cooled down to approximately ambient temperature before starting measuring the energy consumption.

For measuring the energy consumption, only one **control** and one cookware shall be used.

The appliance and the **standardized cookware** shall be at ambient temperature.

The empty **standardized cookware** is filled with the quantity of potable water specified in Table 3. To avoid lime sediment, distilled water may be used.

The water is stirred to ensure a uniform temperature and the temperature of the water is measured when the average temperature of cookware and water has stabilized. The initial temperature shall be in the range of  $15\text{ °C} \pm 0,5\text{ °C}$  ( $T_{15}$ ). The filled cookware should not be stored in the fridge to avoid the rims getting too cold.

The **standardized cookware** covered with the lid is positioned centrally on the **cooking zone** or according to A.3 on the **cooking area**, the **control** is set to **maximum power** and the measurement shall be started immediately.

NOTE Water having an initial temperature of  $14,5\text{ °C}$  minimises the stirring time.

If the smaller diameter of **multiple zones** is considered, the corresponding power is used.

### 7.5.2 Preliminary measurements

#### 7.5.2.1 Determine $T_c$

A preliminary test is carried out to determine the appropriate water temperature for reducing the power setting ( $T_c$ ).

The procedure described in 7.5.1 shall be followed.

The power shall be switched off when the water temperature reaches  $70\text{ °C}$  ( $T_{70}$ ).

The temperature rising is recorded continuously (see Table 2). The difference between the highest temperature value and  $T_{70}$  is stated as temperature overshoot ( $\Delta T_o$ ) in K, see Figure 5.

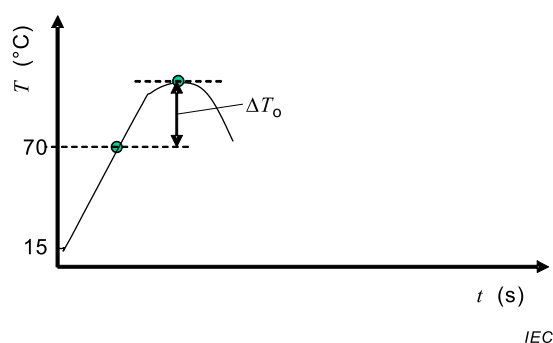


Figure 5 – Overshoot measurement

NOTE 1 For  $\Delta T_o$ , the value stated on the temperature measuring instrument is taken.

A valid temperature  $T_{70}$  is determined by the average of the recorded temperature between  $t_{70} - 10$  s and  $t_{70} + 10$  s. If the result is within the tolerance of  $(70 \pm 0,5)$  °C, then this temperature is noted. If not, the test is repeated by adjusting the switch-off temperature.

$T_c$ , the temperature for reducing the power setting, is calculated according to the following Formula (1):

$$T_c = 93 \text{ °C} - \Delta T_o \quad (1)$$

where  $T_c$  is rounded to the nearest integer.

In the event that the temperature limiter of a **radiant cooking zone** switches down the power during the  $t_c$  period, i.e. the time when the setting is reduced, a 2 K higher  $T_c$  is allowed.

If the calculated  $T_c$  is  $\leq 80$  °C, then 80 °C is taken as  $T_c$ .

$T_c$  is stated.

NOTE 2 Empirical tests show that **induction cooking zones / cooking areas**, **radiant cooking zones** and **solid plates** have each a similar  $T_c$ . The following values are representative and they can substitute the result of 7.5.2.1 as fixed values:

- **induction cooking zones** and **cooking areas**  $T_c = 89$  °C;
- **radiant cooking zones**  $T_c = 85$  °C;
- **solid plates**  $T_c = 80$  °C.

### 7.5.2.2 Determine the simmering setting

A second preliminary test is carried out to determine the lowest level to set to achieve  $\geq 90$  °C during the remaining cooking period.

The procedure stated in 7.5.1 is followed.

If  $T_c$  is reached, the setting is reduced to achieve the water simmering at a temperature  $\geq 90$  °C and as close as possible to 90 °C. A further change of setting is not allowed. For  $T_c$ , the tolerances are +1,0 K / -0,5 K.

At first, the lowest simmering setting is selected. If the temperature of the water is  $< 90$  °C during the simmering time, the energy consumption measurement has to be repeated with an increased setting – provided that the temperature of the water is  $< 90$  °C after the measured data  $T$  are evaluated according to 7.5.4.1.

When the water temperature reaches 90 °C for the first time ( $T_{90}$ ), the simmering time starts independently of  $T_c$ .

The simmering time is 20 min.

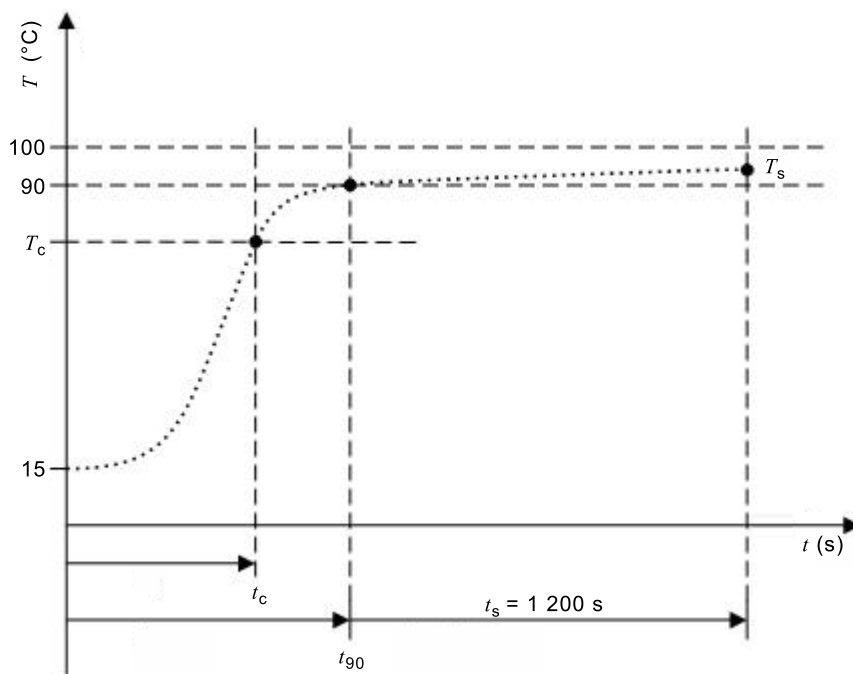
The lowest possible simmering setting is noted.

For **control** units without detent, the knob position should be marked. The simmering setting could differ if a knob is turned from a higher position to a lower position compared to turning from a lower position to a higher position.

NOTE For a clear marking of the lowest possible simmering setting, a polar coordinate paper can be useful (see Annex B).

### 7.5.3 Measuring the energy consumption

The procedure stated in 7.5.1 is followed. The results from 7.5.2.1 and 7.5.2.2, illustrated in Figure 6, are applied. After finishing, the appliance is **set to off mode**. If the appliance doesn't offer an off mode, it is **set to standby mode**.



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where

$t_{90}$  is the time when the temperature of 90 °C is reached and the simmering period starts, in s;

$t_c$  is the time when the setting is reduced, in s;

$t_s$  is the simmering time, in s;

$T_c$  is the water temperature when the setting is reduced, in °C;

$T_s$  is the water temperature at the end of the process, in °C.

**Figure 6 – Energy consumption measurement process for a cooking process**

The following data shall be recorded:

- Continuously, the energy consumption starting at  $t_0$  and ending at  $t_s + 1$  min, in W·h;
- $t_c$  and  $t_{90}$ , in min and s;
- initial temperature of water,  $T_c$ , and the temperature  $T_s$  of the water in °C;
- average power during the simmering time  $t_s$ , in W;
- ambient temperature in °C at the start of the test (when the **hob** is switched on) and at the end of the test (after 20 min of simmering time);
- relative air pressure at the start of the test and at the end of the test, in hPa.

The test is performed three times if the **hob** is tested only with one or two cookware pieces.

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

## 7.5.4 Evaluation and calculation

### 7.5.4.1 Evaluation

Temperature measurement noise can be caused by the convection of water and by measurement noise of the measurement setup itself. As a consequence, minor oscillations of the measured temperature occur. In order to determine the actual crossing of 90 °C – excluding possible measurement noise – the measured data  $T$  is smoothed with a time interval of  $t_{\text{mov}} = 40$  s.

First, the measured data  $T$  are considered using an averaging algorithm, see Formula (2), giving the new data  $\bar{T}$ .

$$\bar{T}_i = \frac{1}{2n+1} \cdot \sum_{j=-n}^n T_{i+j} \quad (2)$$

where

$\bar{T}_i$  is the smoothed temperature data;

$i$  is the sample index;

$n$  is defined by  $n = \left\lfloor \frac{t_{\text{mov}} \times f_s - 1}{2} \right\rfloor$  and where  $t_{\text{mov}} = 40$  s;

$f_s$  is the sampling rate in  $\frac{1}{s}$ .

NOTE  $n$  is rounded.

Secondly,  $\bar{T}_c$  is checked and shall be within the tolerance of +1,0 K / -0,5 K.

Thirdly, the time  $t_{90}$  is determined according to  $\bar{T}(t_{90}) = 90$  °C .

Fourthly, the data  $\bar{T}$  are controlled,  $\bar{T} > 90$  °C from  $t_{90}$  to  $t_s$ .  $\bar{T}_s$ , the smoothed final water temperature, is stated.

Finally, the energy consumption during the time  $t_{90} + t_s$  is determined and stated in W·h.

### 7.5.4.2 Calculation of the result for a hob

To calculate the result for a **hob**, the calculated energy consumption according to 7.5.4.1 is used.

The energy consumption per **cooking zone** is equal to  $E_{\text{cw}}$  and shall be noted with the cookware size under the test normalized to 1 000 g.

The energy consumption per **cooking area** is the arithmetic mean of the energy consumption values of the pieces of cookware considered according to Table A.1 and Table A.2 on this type of **cooking area** normalized to 1 000 g.

The single results according to 7.5.3 and Annex A are determined for a **hob** as follows.

The energy consumption  $E_{\text{hob}}$  is calculated as follows:

- The result of each cookware is normalised to 1 000 g of water; the energy consumption is divided by the quantity of water used for the cookware under test.
- The average of the normalised energy consumption of the **hob** is calculated considering all cookware pieces under test, see Formula (3).

$$E_{hob} = \frac{1000g}{n_{cw}} \times \sum_{cw=1}^{n_{cw}} (E_{cw} / m_{cw}) \quad (3)$$

where

- $E_{hob}$  is the energy consumption of a **hob** calculated per 1000 g water in W·h;
- $E_{cw}$  is the energy consumption with a single cookware under test in W·h;
- $m_{cw}$  is the quantity of water used for the test of the respective cookware piece in g;
- $n_{cw}$  is the number of cookware pieces on the **hob**.

For an example data and calculation sheet, see Annex E. An Excel 97-2003 data calculation program, which corresponds directly to Annex E, is available with this document for the automatic calculation of the energy consumption. These calculations may be also made in any other spreadsheet programs that lead to equal results.

## 7.6 Procedure for measuring the heating up time

Before the first measurement is taken, all cooking zones have to be operated for at least 10 min. This is only necessary once to make sure that residual water in the components is vaporized. Afterwards, the hob has to be cooled down to approximately ambient temperature before starting measuring the heating up time.

For measuring the heating up time, only one **control** and one cookware shall be used.

The **standardized cookware** is filled with the quantity of potable water specified in Table 3. The water has a temperature of  $(15 \pm 0,5) ^\circ\text{C}$ . The **standardized cookware** covered with the lid is positioned centrally on the **cooking zone** or according to A.3 on the **cooking area**.

The **cooking zone** or **cooking area** is heated with **maximum power**.

NOTE If the smaller diameter of **multiple zones** is considered, the corresponding power is used.

The time taken for the water temperature to rise by 75 K is measured.

The test is performed three times and the average value of the results is determined.

The time is stated in min and s, rounded to 10 s.

## 8 Ability to control the temperature of a load

### 8.1 Lower control position

#### 8.1.1 Purpose

The purpose of this test is to check the function of a **control** for a lower setting, like melting chocolate.

NOTE For increasing the repeatability, oil is used instead of chocolate. In pre-tests it was proven that the behaviour of melting chocolate can be reflected by warming up a quantity of oil.

### 8.1.2 Cookware, positioning and ingredients

For reproducible results, the **standardized cookware** shall be used.

For comparative testing, **alternative cookware** may be used.

A piece of **standardized cookware** with a bottom of a diameter (outside) of  $(150 \pm 0,5)$  mm is used. When selecting a piece of **alternative cookware**, the diameter of this cookware shall be  $150^{+20}_{-10}$  mm.

If the hob has no **cooking zone**  $\geq 130$  mm and  $< 160$  mm, the test is carried out with a piece of **standardized cookware** that has a bottom of a diameter (outside) of  $(180 \pm 0,5)$  mm. For comparative testing, a piece of **alternative cookware** can be used with a diameter of  $180^{+20}_{-10}$  mm.

The cookware is used without a lid.

On **cooking areas**, the cookware is positioned in accordance with the manufacturer's instructions for positioning this diameter. If no instruction is given, it is positioned in accordance with the requirements for this cookware size stated for measuring the energy consumption (see Annex A). On a **hob with cooking zones**, the cookware is placed centrally on a fitting **cooking zone**.

The **standardized cookware** is filled with fresh sunflower oil at room temperature using the amounts stated in Table 5. For **alternative cookware**, the amount of oil has to be adapted accordingly, so that the filling height is approximately 30 mm.

NOTE Sunflower oil is considered to be fresh if it has not been used more than three times.

**Table 5 – Amount of oil**

Diameter of the standardized cookware bottom (outside) mm	Amount of sunflower oil g	Cooking zone size category mm
$150 \pm 0,5$	$450 \pm 5$	$\geq 130$ and $< 160$
$180 \pm 0,5$	$650 \pm 5$	$\geq 160$ and $< 190$

### 8.1.3 Procedure

The **cooking zone** or **cooking area** is heated in accordance with the manufacturer's instructions for melting chocolate. If no instructions are given, the **control** is set at the lowest possible setting. The temperature at the centre of the oil is recorded continuously by means of a thermocouple in accordance with 5.3, which is located 15 mm above the inner cookware bottom centrally.

The oil is not stirred and is heated up:

- 1) If the temperature reaches  $(50 \pm 0,5)$  °C in  $\leq 30$  min, the oil is further heated for 15 min with an unchanged setting. Then the **control** is set to off.
- 2) If  $(50 \pm 0,5)$  °C is reached after  $> 30$  min and  $\leq 45$  min, the oil is further heated with an unchanged setting until the test reaches a total duration of 45 min.
- 3) If  $(50 \pm 0,5)$  °C is not reached within 45 min, the **control** is set to off after 45 min.

In any case, the total test duration of 45 min shall not be exceeded.

#### 8.1.4 Assessment

The recorded temperature during the heating phase is analyzed.

Certain temperature requirements – the same for both cookware sizes – have to be fulfilled so that the lower setting of the **control** is adequate for melting processes. These requirements take into account the following steps:

- an increase in temperature not too high at the beginning in order, for example, not to burn the chocolate before it is melted;
- a sufficient temperature after a certain time, adequate, for example, for melting the chocolate in an appropriate time;
- a limited temperature after a certain time, which, for example, keeps the chocolate melted for a certain time.

An example for the analysis of the temperature curve is given in Annex G that is based on the **standardized cookware**, which allows an exact assessment.

### 8.2 Temperature overshoot of hotplates

#### 8.2.1 Purpose

The purpose of this test is to assess the heat retention of the **hotplate**.

NOTE This test is applicable for comparative testing only.

#### 8.2.2 Ingredients and cookware

For reproducible results, the **standardized cookware** shall be used.

For comparative testing, **alternative cookware** may be used.

The cookware is used without a lid.

The cookware is selected and filled with fresh sunflower oil at room temperature following the requirements in 8.1.2 and it is placed on the **hotplate**.

#### 8.2.3 Procedure

The **hotplate** is heated with the control set at the maximum position. The temperature at the centre of the oil is recorded continuously by means of a thermocouple. The oil is not stirred.

When the oil temperature reaches  $(80 \pm 0,5) ^\circ\text{C}$ , the supply is switched off. The temperature in the oil is recorded continuously until the temperature starts declining.

#### 8.2.4 Assessment

The temperature overshoot is the difference between the highest recorded temperature and the temperature of the oil and the temperature of  $80 ^\circ\text{C}$ .

The temperature increase from  $80 ^\circ\text{C}$  to the highest measured temperature is stated in K.

## 9 Heat distribution and heat supply

### 9.1 Measuring the heat distribution

#### 9.1.1 Test purpose

The purpose of this test is to measure the heat distribution of **cooking zones** and **cooking areas**. Therefore, a steel disc is spread with a thin layer of fat and flour, positioned on the **cooking zone** or **cooking area** and heated up. The browned surface of the disc after a certain time is representative for the heat distribution of a **cooking zone** or **cooking area**.

The test is applicable to cooking zones with a diameter  $\leq 330$  mm and  $\geq 100$  mm or where one of the sides' lengths is  $\leq 330$  mm and  $\geq 100$  mm.

For **multiple zones** that include a circular and an elliptical or rectangular part, only the circular part is tested.

#### 9.1.2 Discs

The material of the disc is stainless steel AISI type 430 of thickness  $(6 \pm 0,2)$  mm. To guarantee a sufficient permeability of the cookware bottom, the disc has to be annealed.

NOTE 1 The annealing is done for approximately 2 h at approximately 650 °C in a nitriding-furnace.

The flatness of the disc is specified in Table 6 for different sizes.

Top and bottom surfaces of the discs shall be sandblasted in the following conditions:

- pressure of 3 bar;
- high-class corundum type 054;
- particle size: 0,25 mm to 0,36 mm.

NOTE 2 This treatment is required to guarantee that enough flour is attached.

NOTE 3 A possible supplier is indicated in Clause F.5.

The sandblasting process can be repeated if tenacious stains caused by fat and flour occur which cannot be removed by cleaning or bleaching.

The discs are specified in Table 6.

**Table 6 – Specifications for discs used for measuring the heat distribution**

<b>Cooking zone size category</b>	<b>Diameter of the discs (outside)</b>	<b>Flatness of discs</b>
mm	mm	mm
≥ 100 < 130	120 ± 0,5	≥ 0 < 0,2
≥ 130 < 160	150 ± 0,5	≥ 0 < 0,2
≥ 160 < 190	180 ± 0,5	≥ 0 < 0,2
≥ 190 < 220	210 ± 0,5	≥ 0 < 0,5
≥ 220 < 250	240 ± 0,5	≥ 0 < 0,5
≥ 250 < 280	270 ± 0,5	≥ 0 < 0,5
≥ 280 < 310	300 ± 0,5	≥ 0 < 0,7
≥ 310 ≤ 330	330 ± 0,5	≥ 0 < 0,7

To select the best-fitting disc, the **cooking zone** diameter is determined in accordance with 6.3 and the determined diameter is assigned to the adequate **cooking zone** size category in accordance with Table 6. The second column of Table 6 indicates the appropriate disc diameter. The third column specifies the allowed tolerances for the flatness.

For circular, elliptical or rectangular **multiple zones**, always the biggest possible diameter according to 6.3 is tested.

For **cooking areas** the discs are selected and positioned according to Annex A.

If, on an induction **hob**, a disc is not detected, the next biggest disc diameter is chosen.

If a selected disc size is out of the range of the cookware sizes allowed by the user manual, then the closest diameter compatible with the defined range shall be chosen.

### 9.1.3 Pre-test for determining the setting

The heat distribution test shall be conducted with a power density  $q$ , where  $q$  is defined as the heat capacity per area unit of the disc in  $W/cm^2$ . The power density shall be  $0,9 W/cm^2 \leq q \leq 1,2 W/cm^2$ . For an adequate setting, a preliminary test is carried out by following these steps:

- place the disc (without greasing and flouring) selected according to Table 6 centrally on the cooking zone; for cooking areas, follow the selecting and positioning procedure described in Annex A;
- switch on the cooking zone or cooking area with a setting where the power density  $0,9 W/cm^2 \leq q \leq 1,2 W/cm^2$  is expected;
- measure the mean energy consumption ( $EC_m$ ) of the **cooking zone** or **cooking area** within 10 min;
- switch off the cooking zone or cooking area and note the energy consumption  $EC_m$  in Wh;
- calculate the mean power  $\bar{P}$  with Formula (4):

$$\bar{P} = \frac{6 \times EC_m}{1h} \quad (4)$$

- calculate the power density  $q$  with Formula (5):

$$q = \frac{\bar{P}}{a_d} \quad (5)$$

where:

- $\bar{P}$  is the mean power in W;
- $EC_m$  is the energy consumption in Wh within 10 min;
- $q$  is the power density in W/cm<sup>2</sup>;
- $a_d$  is the surface area of the disc in cm<sup>2</sup>.

If the determined power density  $q$  is not in range of  $0,9 \text{ W/cm}^2 \leq q \leq 1,2 \text{ W/cm}^2$ , the pre-test is repeated with an adapted setting of the **control**.

If no setting can be determined in the range of  $0,9 \text{ W/cm}^2 \leq q \leq 1,2 \text{ W/cm}^2$ , the setting next to the upper limit of the range is determined.

NOTE If the determined power density is close to  $0,9 \text{ W/cm}^2$ , within the main test the power density can drop below the limit for those technologies which show an unsteady power input.

#### 9.1.4 Preparation of the disc for the main test

##### 9.1.4.1 Ingredients

The following ingredients are used for preparing the disc:

- flour: wheat flour without raising agent, unbleached, mineral content: maximum 0,5 % (dry substance);
- fat: coconut fat with a fat content of 100 %.

##### 9.1.4.2 Procedure

For the main test, the disc is greased and floured according to following procedure:

- Temper the disc at  $40 \pm_{-5}^{+10} \text{ }^\circ\text{C}$  for at least 20 min. A preheated oven may be used if the required temperature can be maintained.
- Take the disc out of the oven and grease the upper surface with fat by using a cosmetic sponge. First spread the fat radially and afterwards vertically along the whole surface. The fat film shall be very thin.
- Put the disc back into the oven with the greased surface facing up and warm at  $40 \pm_{-5}^{+10} \text{ }^\circ\text{C}$  at least for a further 15 min, so the fat layer becomes very even.
- Remove the disc again.
- Fix a suction lifter on the lower surface of the disc for better handling.
- Sieve the flour on the upper surface of the disc using a sieve with a mesh size between 300  $\mu\text{m}$  and 800  $\mu\text{m}$  (diameter).
- Beat the edge of the floured disc twice onto a wooden board to remove the surplus flour.

NOTE 1 Take care that the edge of the floured disc doesn't touch the flour knocked off before. If the disc dip into this pile of flour knocked off before the even layer can be affected.

- Flour the disc again, rotate it by  $90^\circ$  and beat it on the wooden board twice. Repeat the flouring until the layer of flour is very even.

NOTE 2 Normally 4 times flouring is enough to reach a thin even layer of flour.

- Check if the flour achieves a smooth, even and thin layer. Otherwise clean the disc and repeat the procedure.
- The suction lifter is removed.

### 9.1.5 Main test

The **cooking zone** or **cooking area** shall be at ambient temperature.

Place the evenly floured disc centred on the **cooking zone**. Switch on the **cooking zone** with the appropriate setting determined in 9.1.3. For **cooking areas** place the disc according Annex A.

Heat up the disc without any change of setting until the main part of the flour is browned up to NCS level 10 to 12 according to Annex D. The browning is checked visually by the shade charts according to Annex F.

When the required browning matching NCS 10 – 12 according to Annex D is reached, the **cooking zone** or **cooking area** is switched off and the disc is shifted from the hot **cooking zone** or **cooking area** immediately.

Stop the test in advance if the first parts of the disc have match NCS 15 according to Annex D before the required average browning of NCS 10 – 12 according to Annex D is reached.

The time  $t$  from switch on the **control** up to switch off is stated in s.

The energy consumption during the time  $t$  is stated in Wh.

The position of the disc used on the **cooking area** is stated.

### 9.1.6 Assessment

#### 9.1.6.1 General

Start the assessment after the disc has cooled down to approximately ambient temperature, at the latest within 24 h.

Take care not to damage the sensitive flour layer. In case the surface is damaged, the test has to be discarded.

For the assessment, only the part of the disc, which covers the cooking zone, is defined as the area to be assessed.

EXAMPLE 1 A cooking zone with a diameter of 130 mm is tested using a disc with a diameter of 150 mm (see Table 6), so the diameter of both differs by 20 mm. For the assessment, these 20 mm of the disc are not considered.

For **cooking areas**, not the entire area of the used disc is relevant but only the area of the used disc minus 15 mm of the outer radius. In this way, the impact of an active rim of a pan is considered, which can influence the activation of coils.

EXAMPLE 2 A disc with a diameter of 180 mm is positioned on a cooking area according Annex A. In a pre-test, the power density is calculated taking into account the area of 180 mm in diameter. For the assessment, only the inner 150 mm diameter is considered.

Alternatively the floured disc can be evaluated visually, but for comparative testing only. By using the shade charts described in Annex D, the assessment can be made based on the criteria in 9.1.6.3 and 9.1.6.4.

### 9.1.6.2 Requirements to the digital measurement system

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

NOTE 1 The requirements to the digital measurement system correspond to those described in IEC 60350-1.

#### 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 biggest disc.

The shade chart shall be coloured in shade number 10, which is defined in Annex D.

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

The entire surface is divided into sections of 1 cm<sup>2</sup>. None of the mean values of the 1 cm<sup>2</sup> sections shall deviate by more than  $\pm 5$  % of the mean value of the entire surface.

#### b) Recognition of the shade numbers

The shade numbers defined in Table D.1 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 D are placed at a height of 28 mm. The reflection value  $R_Y$  of the calibrated colour samples shall be measured in the outermost points of the area to be assessed, as well as in the centre.

The reflection value  $R_Y$  of the calibrated colour samples shall be measured with the tolerances given in Table D.1.

The  $H$  values of the limiting samples  $H_{\text{limit}}$  and  $H_{\text{lower}}$  which are specified in Table D.2 are measured in the outermost points of the area to be assessed, as well as in the centre. Therefore, flat circular colour samples with a diameter of 70 mm in shade numbers 5 and 6 (defined in Annex D) are placed at a height of 28 mm.  $H_{\text{limit}}$  and  $H_{\text{lower}}$  shall be distinguishable from each other concerning their  $H$  values in all positions of the surface to be assessed.

NOTE 2 Squared colour samples with a length of 70 mm and width of 70 mm could be used as well.

NOTE 3 Technical details are not fixed in order to be open for technical progress (e.g. camera, software).

NOTE 4 The hue value refers to the HSL colour model.

#### c) 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 5 Suppliers for suitable lamps are indicated in Clause F.6.

NOTE 6 Suppliers of colour measuring systems, which meet these requirements, are given in Clause F.7.

#### d) Minimum requirement to the resolution of the digital measurement system

To ensure a sufficient resolution use a test chart showing at least three pairs of black and white lines with a thickness of 1 mm each. The black lines shall show a reflection value  $R_Y$  of maximum 10 %, the white lines shall show a reflection value  $R_Y$  of at least 90 %. The reflection value of each single line is to be measured and stated once in horizontal direction and once under an angle of 45°. The resolution is sufficient if the measured reflection value  $R_Y$  of each black line doesn't exceed 20 % and the measured reflection value  $R_Y$  of each white line exceeds 80 %.

NOTE 7 If the resolution is not sufficient, it can be helpful to use a higher zoom resolution.

NOTE 8 A possible supplier for adequate test charts is indicated in Clause F.7.

### 9.1.6.3 Criteria of validity

Criteria of validity ensure an adequate comparison of different main tests.

Results of the main test according to 9.1.5 are valid and shall only be accepted if following criteria are fulfilled.

- Time  $t \leq t_{\max}$  according to Table 7;
- Table 7 shows  $t_{\max}$  for each diameter of the disc.

**Table 7 – maximum time  $t_{\max}$  for each size of disc**

Cooking zone size category mm	Diameter of the discs (outside) mm	$t_{\max}$ min
$\geq 100$ < 130	$120 \pm 0,5$	42
$\geq 130$ < 160	$150 \pm 0,5$	42
$\geq 160$ < 190	$180 \pm 0,5$	37
$\geq 190$ < 220	$210 \pm 0,5$	34
$\geq 220$ < 250	$240 \pm 0,5$	32
$\geq 250$ < 280	$270 \pm 0,5$	32
$\geq 280$ < 310	$300 \pm 0,5$	30
$\geq 310$ $\leq 330$	$330 \pm 0,5$	30

- Used setting

For checking the setting the actually used setting is calculated by the energy consumption and time stated in 9.1.5. The actual setting shall work with the power density  $0,9 \text{ W/cm}^2 \leq q \leq 1,2 \text{ W/cm}^2$ .

- Browning intensity

For checking the browning intensity the average lightness is determined using a digital evaluation system according to 9.1.6.2. The browning intensity shall show an average reflection value within  $R_y$  16,4 and 26,5.

NOTE For visual check, NCS 10 -12 according to Annex D is required. The stated ranges for the digital evaluation and the visual assessment differ due to the fact that the shade charts and the floured discs have different spectral radiation characteristics.

If one of these three criteria is not fulfilled, the main test shall be repeated depending on the unfilled criteria with an increase of time or an adaption of the setting.

### 9.1.6.4 Criteria for assessment

- Change of browning along diametral lines

Divide the floured disc diameter into 128 sections and determine the average shade numbers  $\overline{SN}_i$  for each section according to Annex D. Consider the represented area of each line section by weighing the average shade numbers  $\overline{SN}_i$  with the distance to the centre section, plus one. As a measure for the change of browning along this line calculate the gradient sum square  $GS_{\text{line } j}$  according to Formula (6).

$$GS_{\text{line } j} = \sqrt{\frac{\sum_{i=1}^{127} (\overline{SN}_i - \overline{SN}_{i+1})^2 \cdot (|64 - i| + 1)}{127}} \quad (6)$$

where

$i$  is the respective section per line;

$j$  is the number of rotations of the line (see below), here  $j = 1$ ;

$\overline{SN}_i$  is the average shade number of each section;

$GS_{\text{line } j}$  is the gradient sum square, line  $j$ .

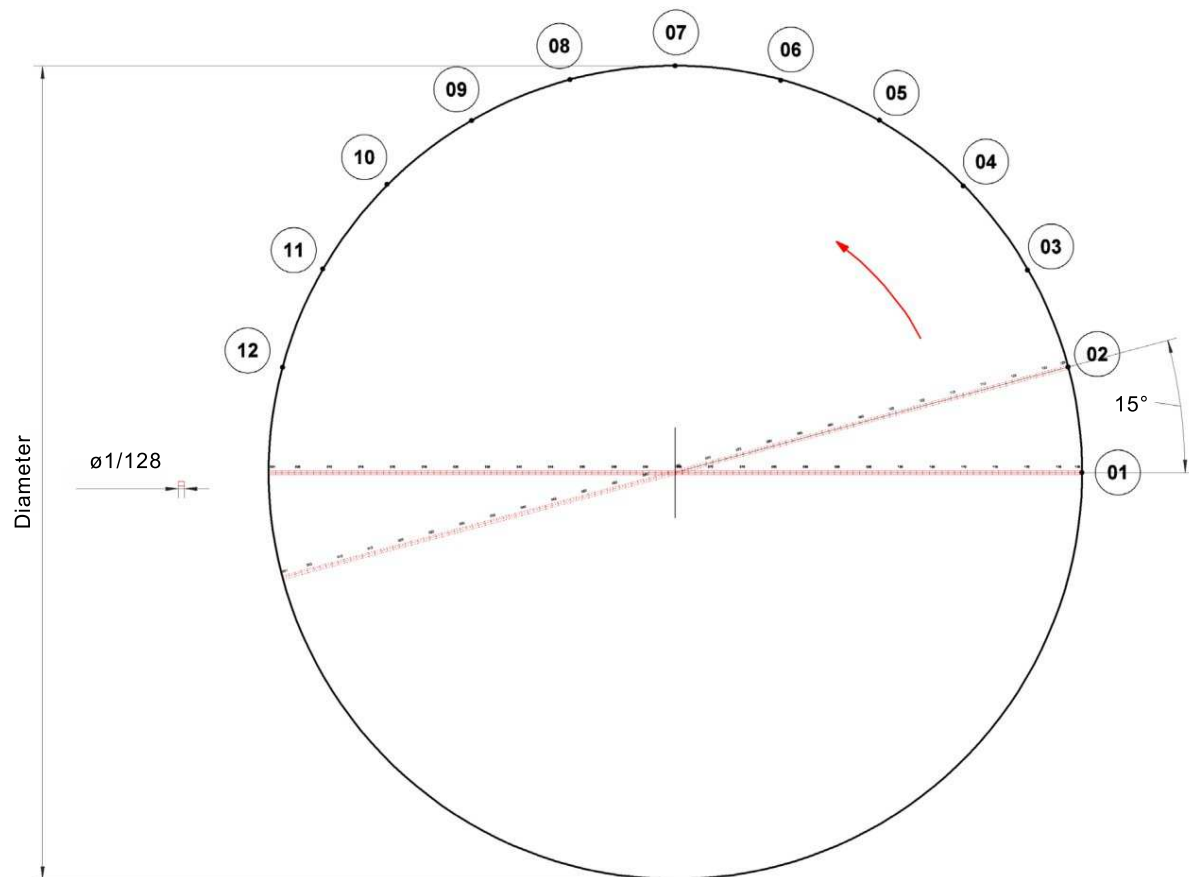
Rotate the line by 15° eleven times and calculate  $GS_{\text{line } j}$  for each line as shown in Figure 7.

As a measure of the change of browning of the whole disc, calculate the overall gradient sum square of all twelve lines using Formula (7).

$$GS = \frac{\sum_{j=1}^{12} GS_{\text{line } j}}{\sqrt[12]{12}} \quad (7)$$

where

$GS$  is the overall gradient sum square.



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Figure 7 – Diametral lines

- Rotation symmetry
 

Determine the distance between the geometrical centre of the area to be assessed and the centre of mass of the image.
- Standard deviation
 

Determine the standard deviation of the area to be assessed using the shade numbers according to Annex D of the smallest detectable area.
- Browning difference
 

The browning difference within the area to be assessed is calculated by the 95<sup>th</sup> percentile minus the 5<sup>th</sup> percentile of occurring shade numbers for the smallest detectable areas.
- Not browned areas
 

Determine the percentage of not browned areas. Areas with a hue value  $H \leq H_{\text{limit}}$  (specified in Table D.2) may be considered as not browned areas.
- Dark centre
 

Determine if the floured disc shows a dark centre. The diameter of the centre is calculated by 0,3 times the diameter of the area to be assessed. The centre is considered as too dark if the average browning intensity is at least 2 shade numbers higher than the average browning intensity of the area to be assessed.

## 9.2 Measuring the continuous frying

### 9.2.1 Purpose

The purpose of this test is to determine whether the **cooking zone** can steadily maintain a moderately high temperature when frying continuously.

NOTE 1 This test is applicable for comparative testing only.

NOTE 2 Currently this test is only applicable for cooking zones. Necessary adoptions for **cooking areas** are under consideration.

### 9.2.2 Specification of the frying pan

The assessment is made by frying a batch of pancakes in a frying pan.

- Material: stainless steel bottom clad with several layers, which typically clad a stainless steel layer (e.g. AISI 430 or AISI 439 steel), an aluminium layer and a ferromagnetic layer – often also called "sandwich layer bottom" or "aluminium clad".
- Flatness:  $< 0,003 a$  at ambient temperature, where  $a$  is the outer diameter of the pan bottom. A convex shaped bottom plate is not allowed. The flatness of the base has to be checked before starting a measurement.
- Thickness of the bottom:  $> 3$  mm.
- No aluminium or copper spots on the surface and without an aluminium ring on the outside.
- No ferromagnetic disc bottom, ferromagnetic coating or sputtering.
- Without reliefs and stamps, except one smaller stamp with a diameter less than 30 % from the flat bottom diameter in the centre.
- No magnetic sidewall.
- Inner surface of the pan with non-stick surface coating, e.g. polytetrafluoroethylene (PTFE)
- Dimension: the size of pan shall match the size of the **cooking zone** (see 6.2) as well as possible. However, it may vary by a maximum of +20 mm and –10 mm.

For determining the size of cookware, the outer diameter ( $a$ ) of the flat bottom of the pan is measured.

The used frying pan is stated. For comparative results, always the same design shall be used, even if different sizes are tested.

### 9.2.3 Recipe for pancakes

The quantities of ingredients and approximate cooking durations corresponding to the diameter of the cooking zone are given in Table 8.

**Table 8 – Ingredients and cooking durations**

Ingredients	Diameter of the cooking zone mm			
	$\geq 130$ and $< 160$	$\geq 160$ and $< 190$	$\geq 190$ and $\leq 220$	$> 220$ and $\leq 280$
White wheat flour, without raising agent	140 g	140 g	200 g	280 g
Fresh milk, fat content 3 % to 4 %	270 g	270 g	400 g	540 g
Egg (without shell)	110 g	110 g	160 g	220 g
Salt	3 g	3 g	4 g	6 g
Batter quantity for each pancake	45 ml	55 ml	85 ml	140 ml
Cooking duration for the first side	40 s to 60 s	50 s to 70 s	60 s to 80 s	70 s to 90 s

#### 9.2.4 Procedure

Whisk milk and egg together, sieve the flour and salt together and add to the milk and egg mixture.

Leave the batter to rest for one hour at room temperature before baking the pancakes.

For the first pancake grease the frying pan only with a thin layer of vegetable oil. Heat the pan until the centre of the base has reached a temperature of  $(200 \pm 5)$  °C measured by a contact probe. Pour the relevant quantity of batter into the pan.

Fry the pancake until bubbles appear in the upper surface and the batter has set (approximate times are shown in Table 8). Turn the pancake and fry until the second side is golden brown. Fry a total of eight pancakes, maintaining the same setting and the same orientation between the frying pan and the cooking zone.

A preliminary test may be necessary to determine the setting in order to achieve the specified range of cooking duration for each pancake stated (see Table 8).

#### 9.2.5 Assessment

The evenness of browning of the side which is fried first is evaluated for each pancake – except the first one – by using the shade chart of Annex D.

The average browning of each pancake is determined. The maximum difference between these average values is stated.

### 10 Heat performance of cooking zones

#### 10.1 Purpose

Electronic components in **hobs** are used for thermal protection. Temperature sensors are integrated into the **hob**. The power to the **cooking zones** can be cut off when temperatures reach critical limits. Also, the electronic **control** system itself can require thermal protection. This design characteristic can alter the ability to heat food. The purpose of the test method is to determine the heating performance of **hobs** that have thermal protection.

NOTE 1 This test is applicable for comparative testing only.

NOTE 2 Currently, this test is only applicable for **cooking zones**. Necessary adoptions for **cooking areas** are under consideration.

#### 10.2 Procedure

Select pieces of **alternative cookware** according to 5.6.2. Use the cookware with oil on the cooking zone that has the maximum diameter according to Table 9. On the other cooking zones, fill the cookware with water as indicated in Table 3. The water and the oil shall be at ambient temperature. The potato chips shall be frozen at  $(-18 \pm 2)$  °C.

**Table 9 – Quantities for heat performance test**

Quantity of fresh sunflower oil in the cookware			
Diameter of cooking zone	Quantity of oil	Quantity of potato chips	Minimum volume of the cookware
mm	l	g	l
≥ 130 and < 160	1	200	≥ 2,0
≥ 160 and < 190	2	350	≥ 3,6
≥ 190 and ≤ 220	3	500	≥ 5,5

The pieces of cookware filled with water are covered with glass lids. The temperature of the oil is recorded continuously by means of a thermocouple used as a sensor for the temperature measurement. The position of the thermocouple shall be 10 mm above the bottom of the cookware and at a distance of 10 mm from the side of the cookware. The cookware shall be centred on the cooking zones.

Set the power level for all pieces of cookware to **maximum power**.

For a **cooking range** equipped with an oven, the oven is to be operated. Set the thermostat so that the mean oven temperature is  $(180 \pm 5)$  °C for ovens with forced air circulation and  $(200 \pm 5)$  °C for ovens with natural convection. Operate the oven with the door closed and be sure it is empty. When the oven reaches the temperature, or after a maximum time of 20 min, set power level for all pieces of cookware to **maximum power**.

An oven with a “cooling” fan can have a favourable influence on the thermal characteristics of the hob; in this case, the oven is not operated. A cooling fan is not the same as a convection fan. A convection fan is visible in the rear of the oven cavity.

After the water starts to boil, adjust the **controls** so that the water boils gently during the relevant test time.

When the temperature of the oil reaches  $(180 \pm 5)$  °C, remove one portion of potato chips according to Table 9 from the freezer and transfer it to the oil immediately. Fry for the time specified in Table 10.

**Table 10 – Frying times for potato chips**

Diameter of cooking zone	Time
mm	min
≥ 130 and < 160	4
≥ 160 and < 190	5
≥ 190 and ≤ 220	7

If the temperature of the oil has dropped below  $(180 \pm 5)$  °C during frying, wait after the potato chips are taken out until the oil is heated up again at maximum setting to  $(180 \pm 5)$  °C before putting the next portion of potato chips into the oil. This is to prevent the oil from cooling down gradually during the test.

If the oil temperature rises over  $(180 \pm 5)$  °C, reduce the setting.

This procedure is continued for 45 min after the **cooking zones** are switched on.

The following values should be recorded:

- the heat-up time for the oil to reach 180 °C, in min;
- the heat-up time for the oil to reach 180 °C again, after taking out a portion of potato chips, in min;
- the number of potato chip portions fried during the test.

## 11 Smallest detected diameter for induction cooking zones

### 11.1 Purpose

Induction **cooking zones** may incorporate an electronic cookware detection means which automatically cuts off the power to the **cooking zone** concerned when no cookware or cookware with too small a diameter is placed on the **cooking zone**, or a detected piece of cookware is removed from the **cooking zone**.

The purpose of the test method is to determine the smallest diameter that is detected on the **cooking zone** under test.

NOTE 1 The detected diameter – measured with a disc – may not be identical to the base diameter of a piece of cookware. This depends from the design and material of cookware.

NOTE 2 The purpose of this test is not to grant a specific power to this smallest diameter.

### 11.2 Procedure

Discs as defined in Figure 8 are used, each being at ambient temperature at the beginning of the test. The test is started with a disc with a diameter that definitely will not be detected by the **cooking zone** to be tested.

The disc is made from steel with the chemical composition in weight %: 0,42-0,50 % C, <0,40 % Si, 0,50-0,80 % Mn, <0,045 % S, <0,045 % P, 0,40 % Ni, <0,40 % Cr, <0,10 % Mo, Cr+Mo+Ni ≤ 0,63 %.

NOTE This steel is for example equivalent to EN C45 (defined in EN 10277-2) and SAE 1045. A possible supplier is mentioned in Clause F.2.

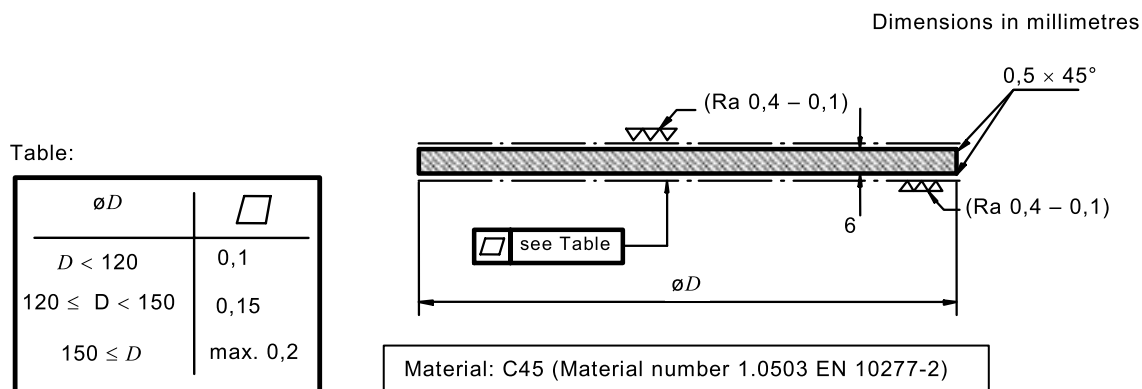
Place the disc in the centre of the cooking zone marked on the appliance. Set the **control** to the lowest power level. If the disc is not detected by the cookware detection means, the test is to be done with a disc having a diameter 5 mm larger. This procedure is to be repeated until a disc is detected and is working continuously for at least 1 min.

The detected diameter shall be verified in the hot condition. To do this: bring up the amount of water according to Table 3 to the boiling point at maximum possible power level simultaneously on all **cooking zones** available on the **hob**. For that test any suitable cookware which covers the size of the **cooking zone** should be used. Remove all pieces of cookware after the water on one **cooking zone** has started boiling. Set the **control** to the lowest power level again and then check on one **cooking zone** after the other separately if the disc that was determined before is still detected over the whole voltage range of 230 (1  ${}_{-6}^{+10}$  %) V within 2 min.

If verifying fails, the test is to be repeated with the next largest disc diameter.

The smallest detected diameter is defined as the smallest diameter of the disc that was detected under all conditions mentioned above.

The test is repeated for all **cooking zones** in a **hob**.



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**Figure 8 – Disc to determine the smallest detected diameter**

## 12 Power measurement of low power modes

In addition to IEC 62301, the following requirements for measuring the power of low power modes are given.

For an appliance composed of a combination of separate units, which may consist of one of a variety of different **hobs** and one of a variety of different ovens, the recommended combination as declared in the manual instruction is used for the test.

If appliance A (e.g. **hob**) can only be operated combined with appliance B (e.g. oven), first the low power for appliance B without appliance A is measured and noted. Afterwards, the low power for the appliance B combined with the appliance A is measured. The low power of appliance A is calculated by the difference between these two measurements.

When preparing the test report for an appliance composed of a combination of separate units, the combination of types of main powered parts (**hobs**, ovens, grills, warming plates, griddles, etc.) used for the measurement shall be recorded. The low power shall be noted for each unit A and B separately.

NOTE The measurement procedure for the energy consumption of ovens is described in IEC 60350-1.

If testing appliances fitted with a clock, the clock shall be adjusted to the current time and date following the manufacturer's instructions.

In case the low power level is influenced by the continuous changing of the displayed time of a clock, a measurement period of 24 h is necessary. The value of 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 modes are to be tested and recorded.

## 13 Spillage capacity of hobs

The purpose of this test is to evaluate the capability of the **hob** to retain spillage.

NOTE This test is considered to give reproducible results.

The appliance is positioned so that the perimeter of the **hob** surface is horizontal. A cookware which has the smallest diameter required to cover the **cooking zone** is placed on one of the

**cooking zones** and completely filled with water. An additional quantity of 0,5 l of water is poured steadily into it within 1 min. The effect of this spillage is determined and stated. If the **hob** does not hold the excess quantity, it is stated which way the water runs.

The quantity of water that the **hob** will retain before it overflows is measured and stated in ml.

## Annex A (normative)

### Further requirements for measuring the energy consumption and heating up time for cooking areas

#### A.1 General

For **cooking areas**, the following requirements are in addition to those in Clause 7.

#### A.2 Hob with cooking area

##### A.2.1 General

For a **hob** with a **cooking area**, the cookware set is selected depending on the layout.

If a **hob** is a combination of A.2.2 and A.2.3, then these areas will be tested separately.

If a **hob** has more than one **cooking area with limitative marking** (see A.2.3), each **cooking area** is tested separately.

##### A.2.2 Cooking area without limitative marking

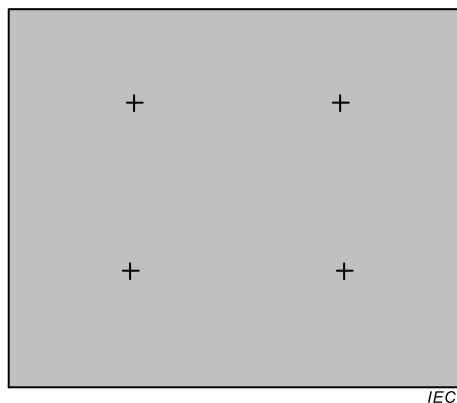


Figure A.1 – Layout for a hob with cooking area  
without limitative marking – Example

The number of **controls** determines the number of cookware pieces.

The number of **controls** is defined by the number of pieces of cookware that can be used independently on the **cooking area** all together at the same time.

**Table A.1 – Criteria for the cookware set for measuring cooking areas without limitative marking**

Number of controls	Selected cookware set (standardized cookware)
1	One cookware with a diameter of 210 mm
2	Two cookware pieces with a diameter of 180 mm and 210 mm
3	Three cookware pieces with a diameter of 150 mm, 180 mm and 210 mm
4	Four cookware pieces with a diameter of 150 mm, 180 mm and 210 mm twice
5	Five cookware pieces with a diameter of 150 mm, 180 mm, 210 mm twice and 240 mm
6	Six cookware pieces with a diameter of 150 mm, 180 mm twice, 210 mm twice and 240 mm

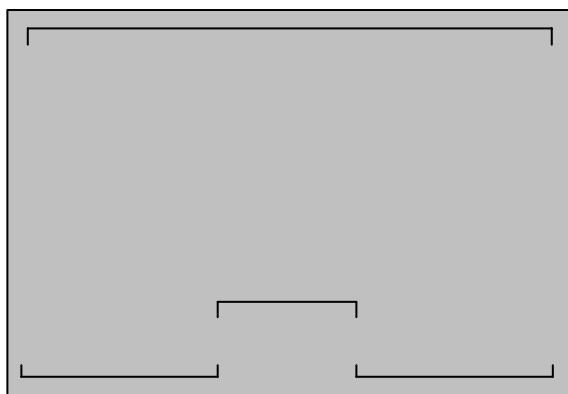
NOTE Further specification (lid, height etc.) for cookware pieces are fixed in 5.6.1.

If a piece of cookware is not detected, the next biggest cookware diameter is chosen independently of the cookware category (see Table 3).

If a selected cookware size is out of the range of the sizes allowed by the user manual, then the closest diameter compatible with the defined range shall be chosen.

### A.2.3 Hob with cooking area with limitative marking

Example 1



IEC

Example 2



IEC

**Figure A.2 – Layouts for a hob with a cooking area with limitative marking – Examples**

If the **cooking area** has a limitative marking that marks the area where more than one cookware can be used simultaneously, the cookware set is selected according to Table A.2.

**Table A.2 – Criteria for the cookware set for measuring cooking areas with limitative marking**

Number of controls	Selected cookware set (standardized cookware)
≤ 3	Three cookware pieces with a diameter of 150 mm, 180 mm and 210 mm
> 3	Five cookware pieces with a diameter of 150 mm 180 mm 210 mm twice and 240 mm

NOTE Further specifications (lid, height etc.) for the cookware are fixed in 5.6.1.

If a piece of cookware is not detected, the next biggest cookware diameter is chosen independently of the cookware category (see Table 3).

If a selected cookware size is out of the range of the sizes allowed by the manual instruction, then the closest diameter compatible with the defined range shall be chosen.

The number of **controls** is defined by the number of pieces of cookware that can be used independently on the **cooking area** all together at the same time.

#### **A.2.4 Hob with cooking zones and cooking areas**

The cookware for the **cooking zones** and the **cooking areas** in one **hob** is selected independently.

The cookware set for a combination of **cooking areas** and **cooking zones** in one **hob** is selected for the **cooking zones** according to Clause 7 and for the **cooking area** according to Annex A.

### **A.3 Positioning on a cooking area**

#### **A.3.1 General**

All **hob** markings/centre positions are considered in the test.

Symbols on **controls** should be considered to define the cookware position.

#### **A.3.2 Positioning on a cooking area without limitative markings**

The biggest cookware piece has to be placed on a **cooking area without limitative markings** in accordance with the following order of precedence:

- a) having highest **maximum power**;
- b) being located at the rear of the **hob**;
- c) being located at the left.

NOTE Different sizes of markings are not considered.

The other pieces of cookware are positioned following the same order of precedence.

### A.3.3 Positioning on a cooking area with limitative markings

#### A.3.3.1 Cooking area with limitative marking and with $\leq 3$ controls

The largest piece of cookware is positioned in the centre of the **cooking area**.

To find the centre the longest vertical and horizontal line within the marking is determined. In this case the wording "horizontal" and "vertical" refer to the drawing layer, see Figure A.3.



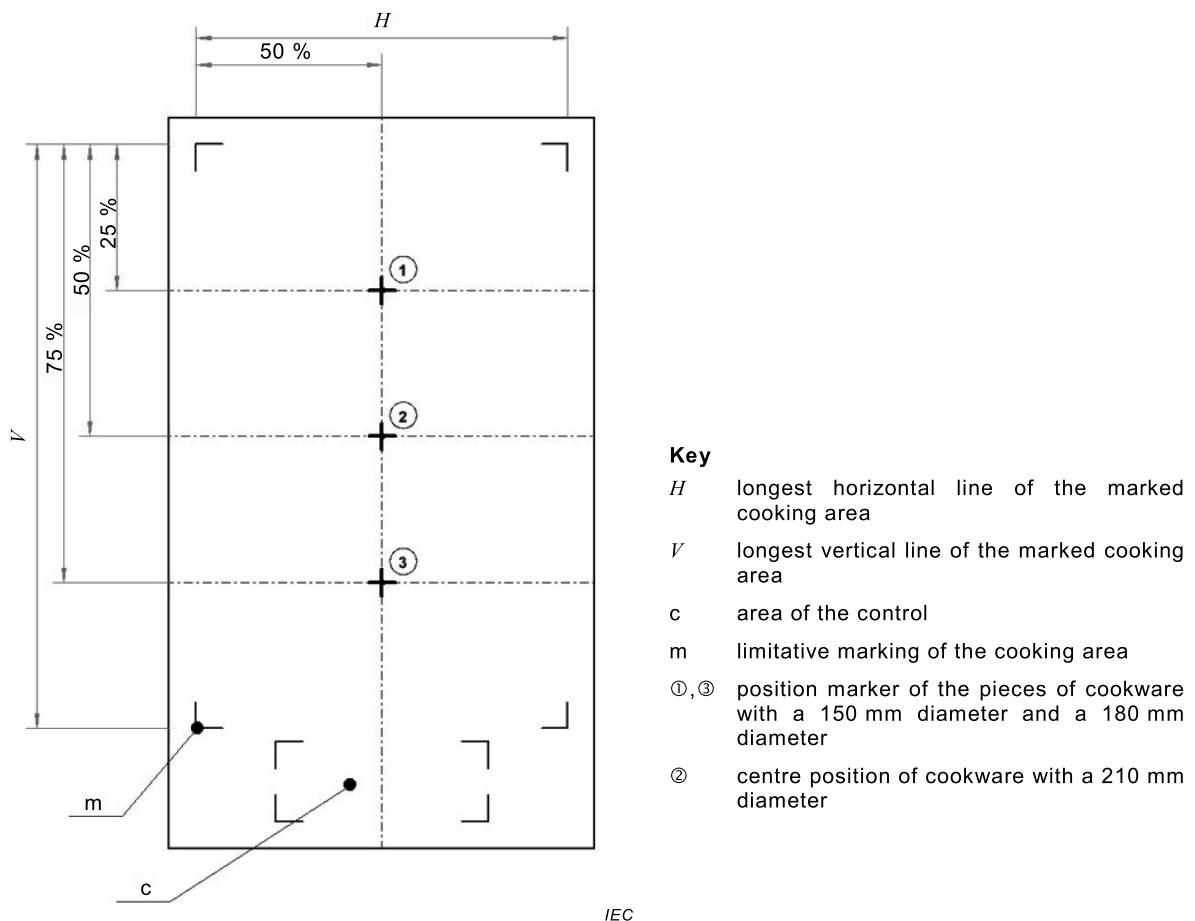
**Figure A.3 – Drawing layer**

Bisect the shorter line and move the longer line parallel to this half distance point.

Intersect the longest possible line at 25 %, 50 % and 75 %. 25 % determines the position marker ① in Figure A.3, 50 % determines the position marker ② and 75 % determines position marker ③.

The position marker ② determines the centre for the largest piece of cookware. If it is written in the manual instruction that in this position ② only non circular cookware can be used this position and related cookware size is not tested.

The smaller pieces of cookware are positioned centrally on the position marker ① and ③, (see Figure A.4).



**Figure A.4 – Position a cookware set on a cooking area with limitative markings  $\leq 3$  controls – Example**

The next biggest cookware piece has to be placed in accordance with the following order of precedence:

- a) position marker being located at the rear of the **hob**;
- b) position marker being located at the left.

If a cookware is not detected at the described position, for this position the next biggest cookware diameter is chosen independently of the cookware category (see Table 3).

The positions and sizes of the pieces of cookware used for measuring shall be noted.

**A.3.3.2 Cooking area with limitative marking and with > 3 controls**

First the longest possible horizontal and vertical lines within the marked area which shows the limits where the cookware is used are determined. Bisect the vertical line and move the horizontal line parallel to this half distance point.

Intersect the horizontal line (longest possible) at 20 %, 50 % and 80 %. 20 % determines the position marker ① in Figure A.5, 50 % determines the position marker ② and 80 % determines position marker ③.

The position marker ② determines the centre for the largest piece of cookware.

The smaller pieces of cookware are positioned tangentially (the outer radius of the cookware bottom touches the position markers) one above and one below the horizontal line at the position markers ① and ③ (see Figure A.4).

The two pieces of cookware with the diameter of 210 mm are positioned one below the position marker ① and one above the position marker ③. The cookware with the diameter of 180 mm is set above the position marker ① and the cookware with a 150 mm diameter is below the position marker ③.

If a piece cookware is not detected at the described position, for this position the next biggest cookware diameter is chosen independently of the cookware category (see Table 3).

If the position of the specified cookware causes the cookware to partially cover the control, then the cookware shall be moved away until the cookware no longer covers the control. Moreover, all pieces of cookware shall be as far as possible within the marked area. If necessary, the biggest piece of cookware on position marker ② is shifted first vertically, then horizontally. The other pieces of cookware are shifted first horizontally, then vertically.

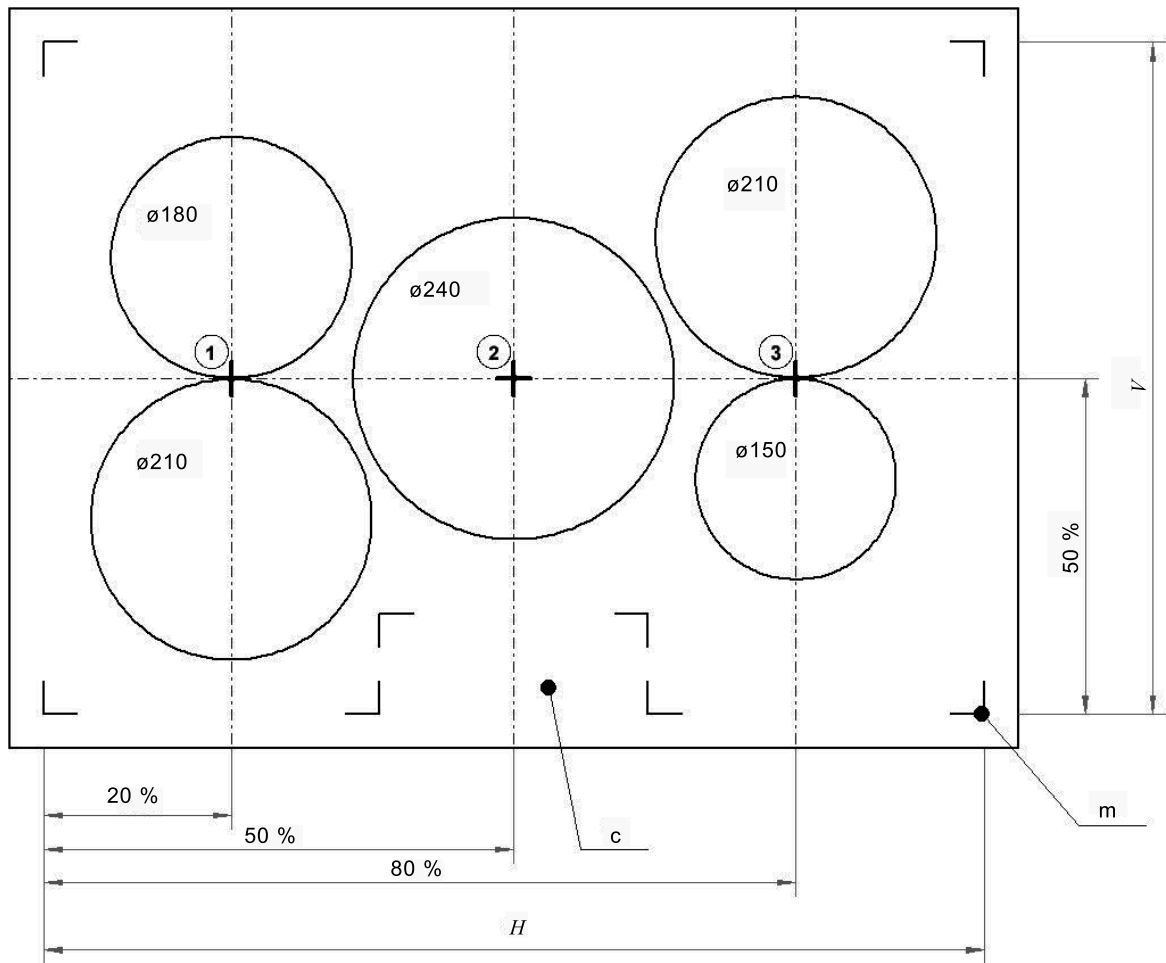
The pieces of cookware should be shifted as little as possible. If the shifting in the first direction is not effective, it can be skipped.

The positions and sizes of the pieces of cookware used for measuring shall be noted.

If it is not clear which cookware position is correct, all possibilities are considered.

An example is shown in Figure A.5.

Dimension in millimetres



IEC

**Key**

- H* longest horizontal line of the marked cooking area
- V* longest vertical line of the marked cooking area
- c* area of the control
- m* limitative marking of the cooking area
- ①,③ position markers of the pieces of cookware with 150 mm, 180 mm and 210 mm diameter
- ② centre position of cookware with 240 mm diameter

**Figure A.5 – Position a cookware set on a cooking area with limitative markings > 3 controls – Example**

The area of the control, *c*, can also be on the side, the position of the cookware set is the same. Examples for positioning the pieces of cookware are shown in Annex C.

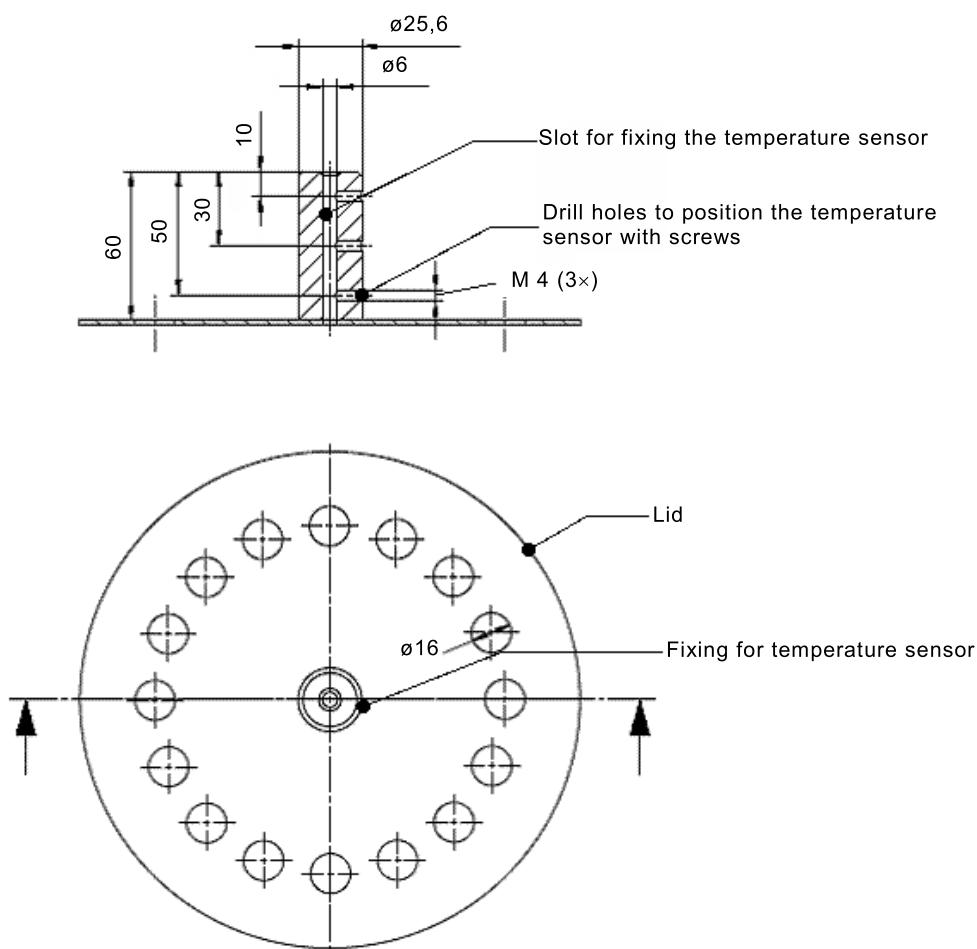
## Annex B (informative)

### Aids for measuring the energy consumption according to Clause 7

#### B.1 Fixing the temperature measurement instrument to the lid – Example

The temperature measurement instrument according to 5.3 should be fixed in the centre of the lid (see 5.6.1) as shown in Figure B.1. The mounting part shall be made of plastic material. Screws are used in order to position the temperature sensor correctly.

*Dimensions in millimetres*

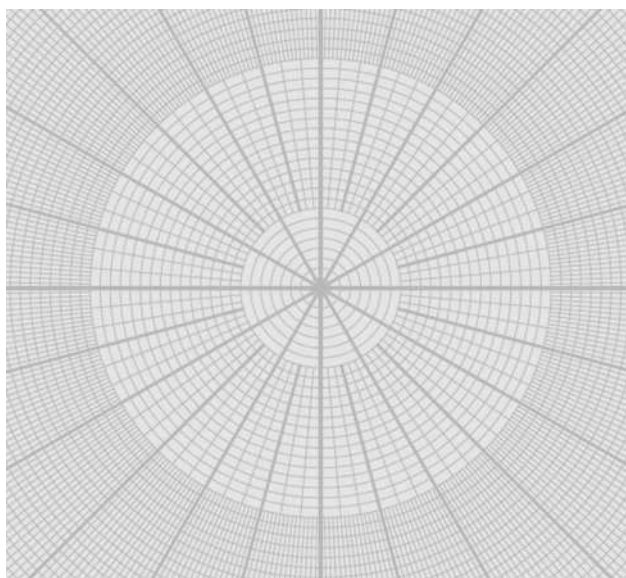


IEC

**Figure B.1 – Position of the temperature measurement instrument**

#### B.2 Marking the lowest possible simmering power setting

For marking the lowest possible simmering power setting on the panel, a polar coordinate paper as shown in Figure B.2 can be useful. Polar coordinate paper has concentric circles divided into small arcs to allow an exact marking around a knob.



IEC

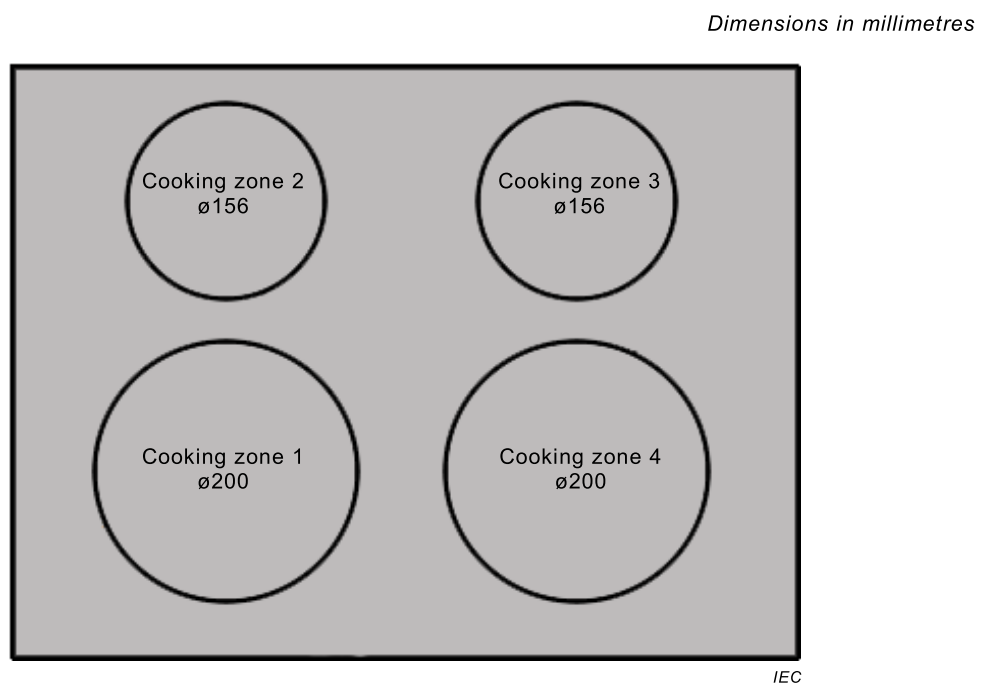
**Figure B.2 – Polar coordinate paper – Example**

## Annex C (informative)

### Examples how to select and position the cookware for measurements according to Clause 7 and Annex A

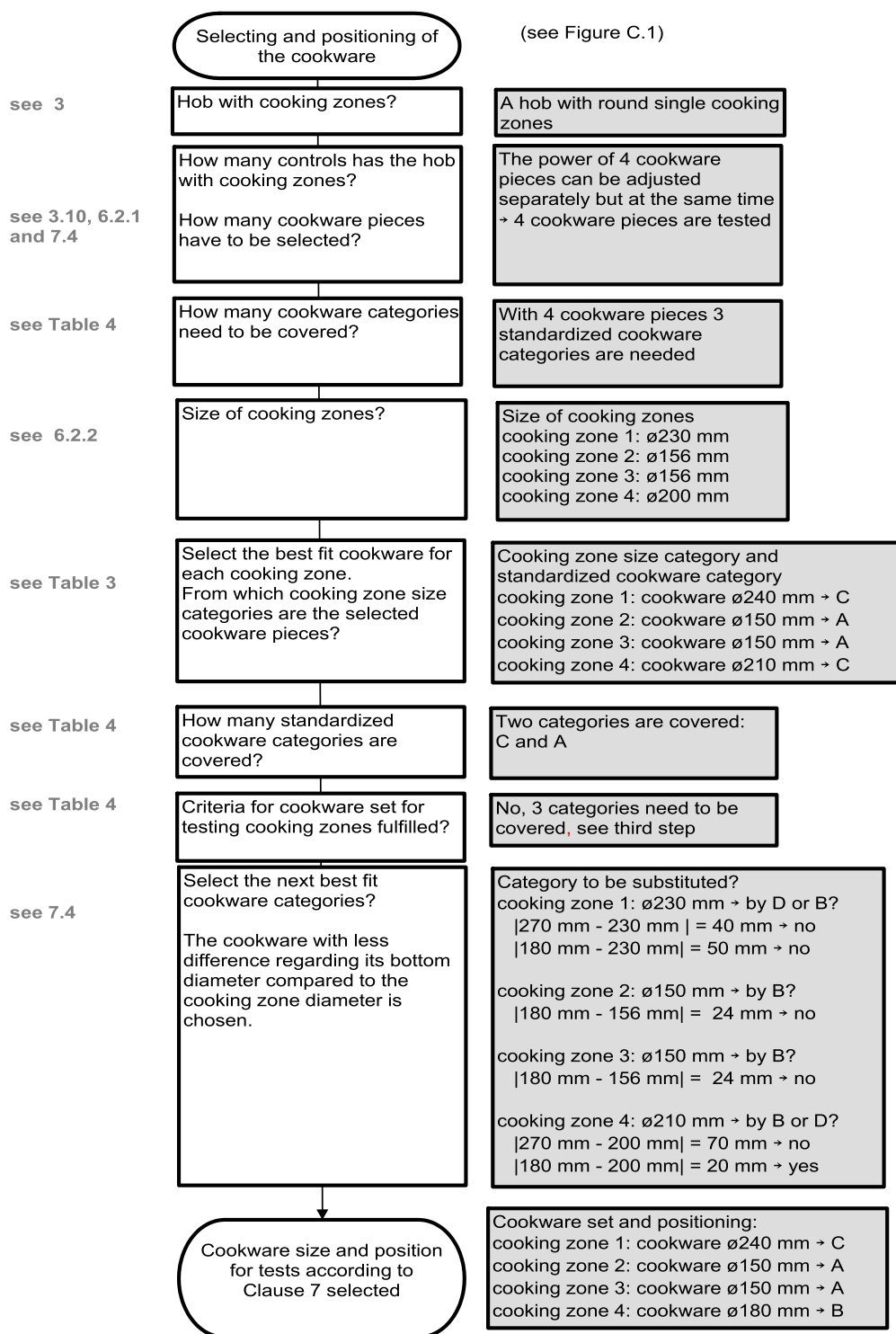
#### C.1 Example 1 – Cooking zones

Figure C.1 illustrates a **hob** with **cooking zones**.



**Figure C.1 – Example 1: tubular hotplates, solid hotplates,  
radiant cooking zone or induction cooking zone**

Figure C.2 provides guidance for selecting and positioning cookware on a **hob** with **cooking zones**.



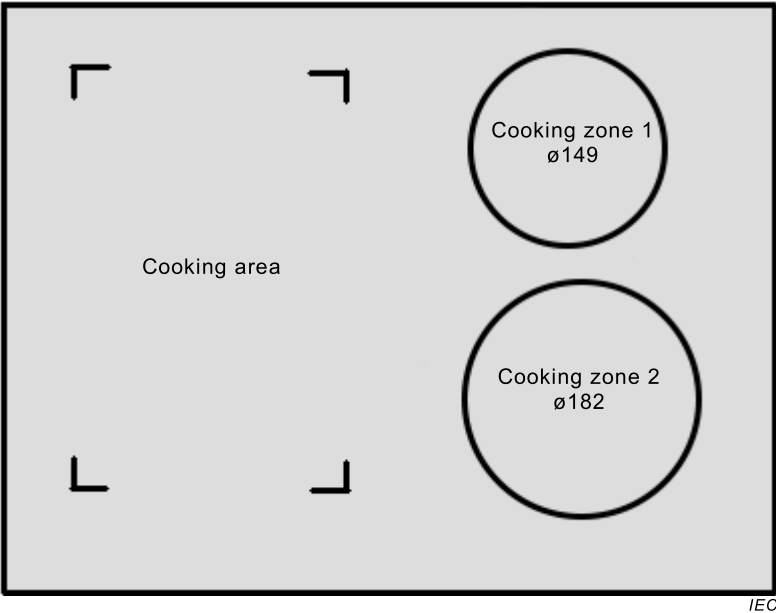
IEC

Figure C.2 – Example 1: selecting and positioning of cookware

## C.2 Example 2 – cooking zones combined with cooking area with limitative markings

Figure C.3 illustrates a **hob** with one **cooking area** and two **cooking zones**.

*Dimensions in millimetres*



**Figure C.3 – Example 2: induction or radiant cooking zones combined with a cooking area with limitative markings**

Figure C.4 provides guidance for selecting and positioning cookware on a **hob** with a **cooking area** and **cooking zones**.

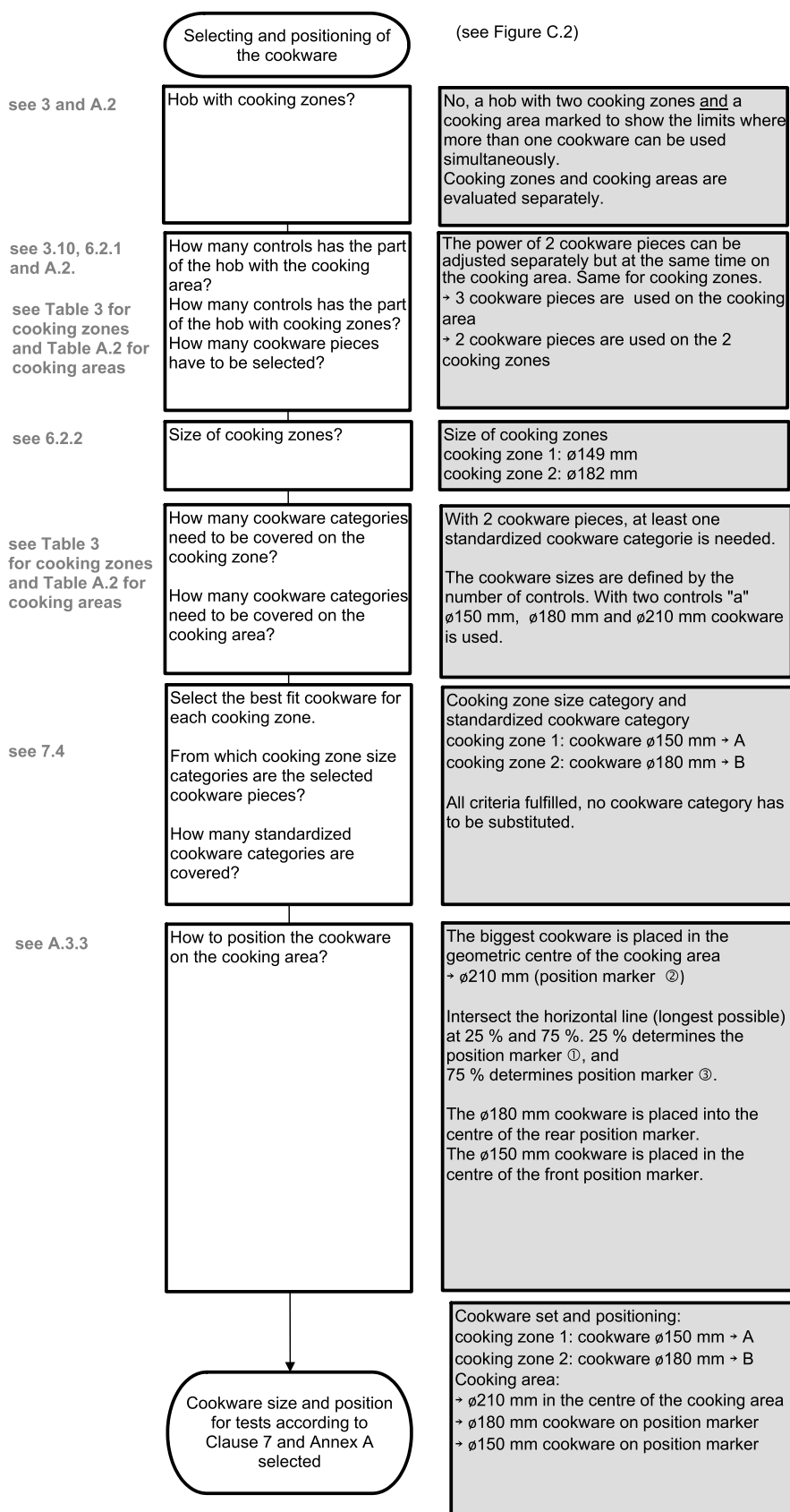
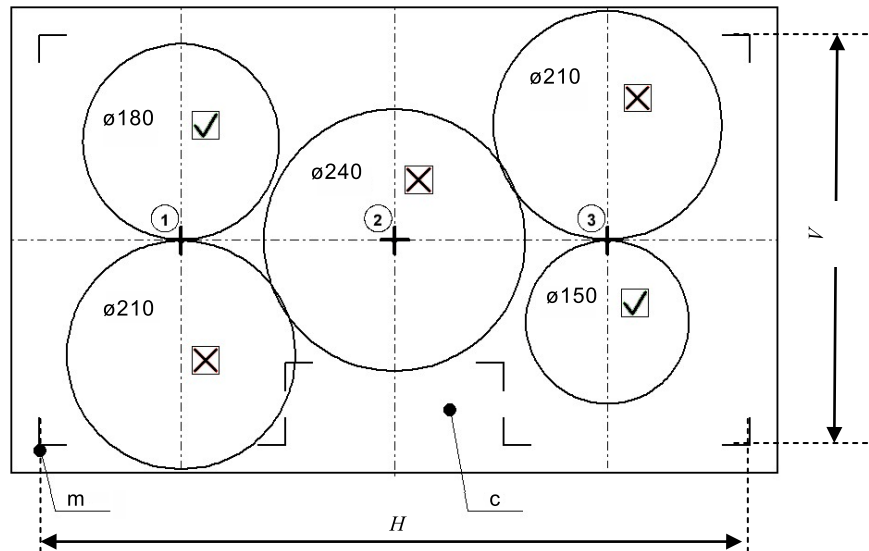


Figure C.4 – Example 2: selecting and positioning of cookware

### C.3 Example 3 – cooking area with limitative markings > 3 controls with the area of control in front

Dimensions in millimetres



IEC

#### Key

- $H$  longest horizontal line of the marked cooking area
- $V$  longest vertical line of the marked cooking area
- $c$  area of the control
- $m$  limitative marking of the cooking area
- ①, ③ position marker of the pieces of cookware with 150 mm, 180 mm and 210 mm diameter
- ② centre position of cookware with 240 mm diameter
- ☑ correct position
- ☒ wrong position, cookware has to be shifted

**Figure C.5 – Example 3: Cooking area with limitative markings > 3 controls with the area of the control in front**

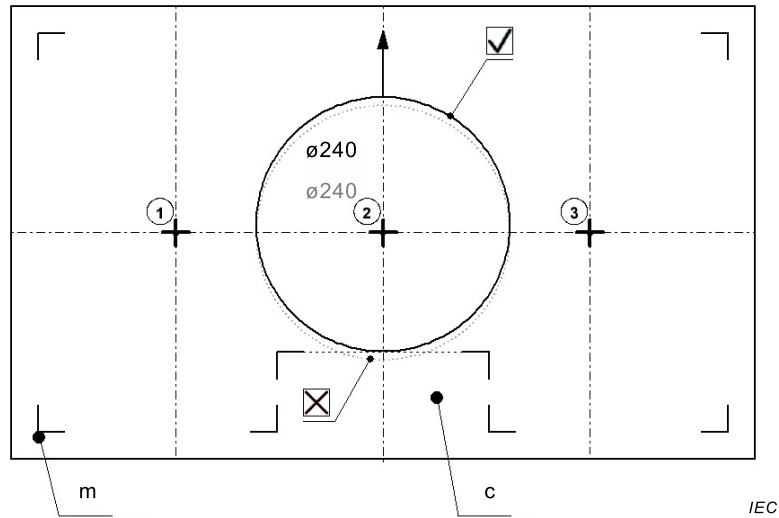
Five cookware pieces with a diameter of 150 mm, 180 mm, 210 mm twice and 240 mm are applied and positioned as shown in Figure C.5.

The cookware with 240 mm covers partially the area of the **control** and also the cookware with 210 mm below the horizontal line. Additionally both pieces of cookware with 210 mm diameters are outside the marked area.

Correct the position of the pieces of cookware with 240 mm and 210 mm diameters shown in example 3 in the following 2 steps:

- 1) Step – Example 3: move the cookware 240 mm vertically until the area of **control** is no longer covered (direction shown by arrow in Figure C.6).

*Dimensions in millimetres*



**Key**

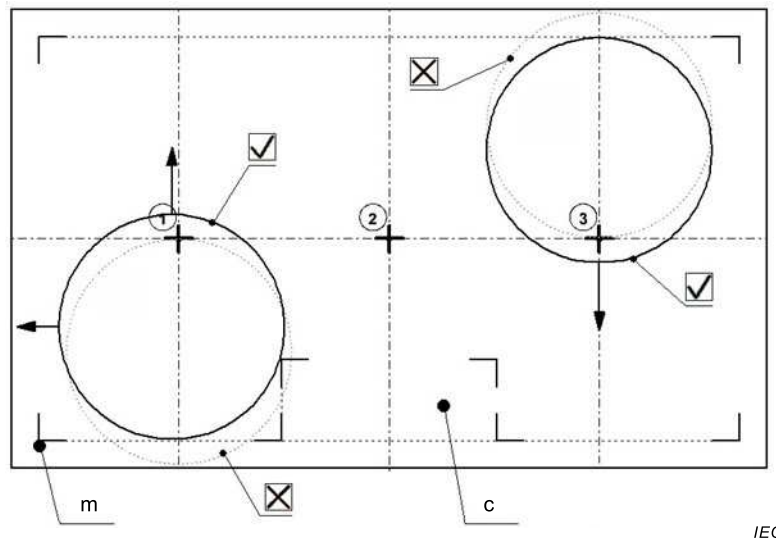
- c area of the control
- m limitative marking of the cooking area
- ①,③ position marker of the pieces of cookware with 150 mm, 180 mm and 210 mm in diameter
- ② centre position of cookware with 240 mm in diameter
- ☑ correct position
- ☒ wrong position, cookware has to be shifted

**Figure C.6 – Example 3: procedure how to shift the cookware into the correct position – Step 1**

- 2) Step – Example 3: move the cookware (210 mm) below the horizontal line horizontally until the area of **control** is no longer covered. Additionally, this piece of cookware is moved vertically until the complete cookware is within the marked area.

For the cookware (210 mm) above the horizontal line, a horizontal movement is not effective. Move this cookware vertically until the cookware is within the marked area (refer to Figure C.7).

*Dimensions in millimetres*



IEC

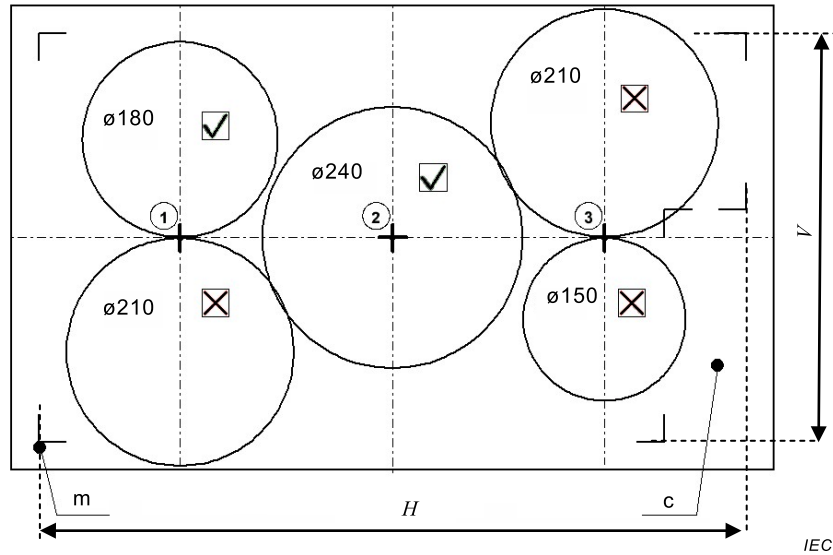
#### Key

- c area of the control
- m limitative marking of the cooking area
- ①,③ position marker of the pieces of cookware with 150 mm, 180 mm and 210 mm in diameter
- ② centre position of cookware with 240 mm in diameter
- ☑ correct position
- ☒ wrong position, cookware has to be shifted

**Figure C.7 – Example 3: Procedure how to shift the cookware into the correct position – Step 2**

**C.4 Example 4 – cooking area with limitative markings > 3 controls with the area of control at the side**

*Dimensions in millimetres*



**Key**

- H* longest horizontal line of the marked cooking area
- V* longest vertical line of the marked cooking area
- c* area of the control
- m* limitative marking of the cooking area
- ①, ③ position marker of the pieces of cookware with 150 mm, 180 mm and 210 mm in diameter
- ② centre position of cookware with 240 mm in diameter
- ☑ correct position
- ☒ wrong position, cookware has to be shifted

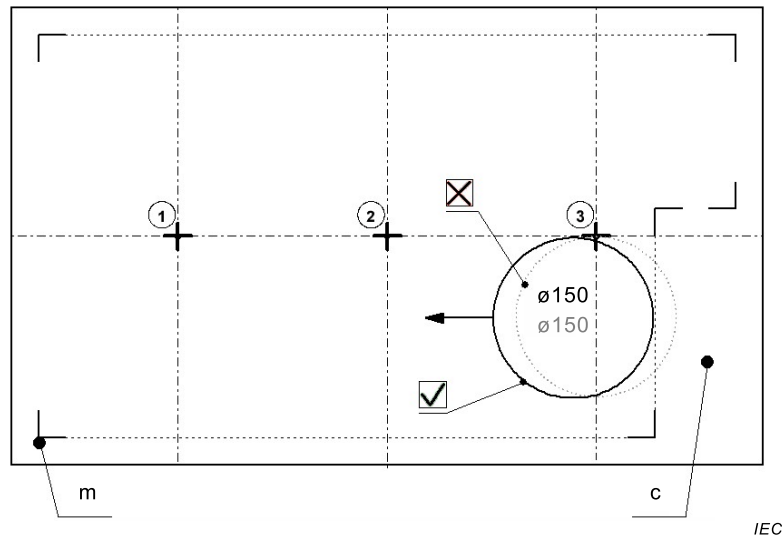
**Figure C.8 – Example 4: Cooking area with limitative markings > 3 controls with the area of the control at the side**

The 150 mm piece of cookware partially covers the area of the **control**, as does the piece of 210 mm cookware above the horizontal line; additionally, both pieces of cookware with a 210 mm diameter are outside the marked area (refer to Figure C.8).

Correct the position of the pieces of cookware with 240 mm and 210 mm diameters as shown in example 4 in the following 2 steps:

Step 1 – Example 4: move the 150 mm piece of cookware horizontally until the area of the **control** is no longer covered (direction shown by arrow in Figure C.9).

*Dimension in millimetres*



**Key**

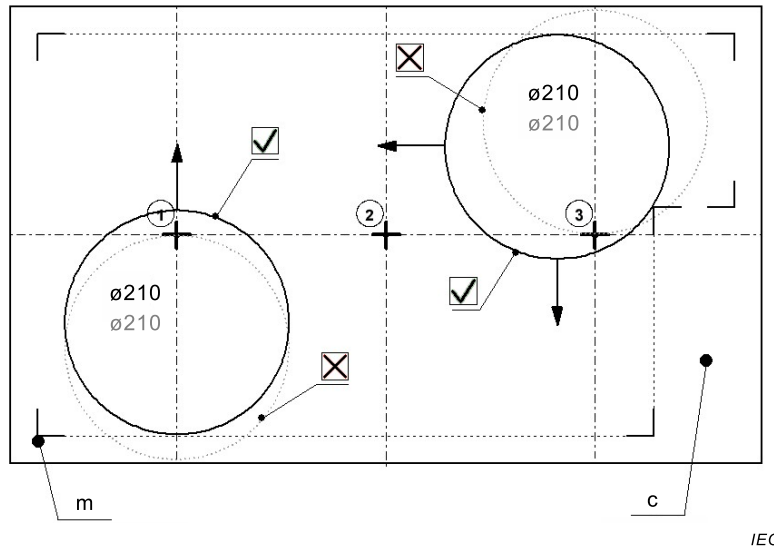
- c area of the control
- m limitative marking of the cooking area
- ①, ③ position marker of the pieces of cookware with 150 mm, 180 mm and 210 mm in diameter
- ② centre position of cookware with 240 mm in diameter
- ☑ correct position
- ☒ wrong position, cookware has to be shifted

**Figure C.9 – Example 4: procedure how to shift the cookware into the correct position – Step 1**

Step 2 – Example 4: move the piece of cookware (210 mm) above the horizontal line horizontally until the area of the **control** is no longer covered. Additionally, this piece of cookware is moved vertically until its entirety is within the marked area (refer to Figure C.10).

For the piece of cookware (210 mm) below the horizontal line, a horizontal movement is not effective. Move this cookware vertically until the cookware is within the marked area.

*Dimension in millimetres*



IEC

**Key**

- c area of the control
- m limitative marking of the cooking area
- ①, ③ position marker of the pieces of cookware with 150 mm, 180 mm and 210 mm in diameter
- ② centre position of cookware with 240 mm in diameter
- ✓ correct position
- ✗ wrong position, cookware has to be shifted

**Figure C.10 – Example 4: procedure how to shift the cookware into the correct position – Step 2**

## Annex D (normative)

### Shade chart

Table D.1 specifies the relation between reflection value  $R_y$  and shade numbers.

**Table D.1 – Classification of shade numbers regarding  $R_y$**

Measured reflection value $R_y$		Tolerances	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 D.2 shows examples for the shade charts and their values for  $L^*$  and for the reflection value  $R_y$ . Additionally, the fourth column specifies the limiting samples for the colour measurement.

**Table D.2 – Examples for the shade charts regarding  $L^*$ ,  $R_y$  and the specification of the limiting samples  $H_{\text{limit}}$  and  $H_{\text{lower}}$**

NCS			
Shade chart	$L^*$	$R_y$	Limiting sample
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	$H_{\text{lower}}$
S 0530-Y10R	88,1	72,3	$H_{\text{limit}}$
S 0520-Y10R	90,9	78,3	

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

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

NOTE 3 The NCS shade charts can be ordered at official NCS Centres all over the world. The following address shows a potential distributor.

Sweden (**Head Office**)  
 Scandinavian Colour Institute AB  
 Address: P.O. Box 49022, S -100 28 Stockholm  
 Internet: [www.ncscolour.com](http://www.ncscolour.com)  
 E-mail: [info@ncscolour.com](mailto:info@ncscolour.com)Post

## Annex E (informative)

### Data and calculation sheet: energy consumption of a cooking process (see Clause 7 and Annex A)

<b>Brand &amp; Factory:</b>		<b>Hob Type / Model:</b>		<b>Testlab:</b>	
<b>Rated Voltage:</b>	V	<b>Supply Voltage:</b>	V	<b>Operator:</b>	
<b>Rated Power:</b>	kW	<b>Number of Controls:</b>		<b>Date:</b>	
<b>Cooking zone:</b>		<b>Cooking area:</b>		<b>cookware diameter:</b>	mm
<b>Type of cooking zone:</b>		<b>without limitave marking:</b>	<input type="checkbox"/>	<b>water load (<math>m_{cw}</math>)</b>	g
<b>Cooking Zone Dimension:</b>		mm	<b>with limitative marking:</b>	<input type="checkbox"/>	<b>cookware position:</b>
					<b>cookware ID no.:</b>

Determine Tc according 7.5.2.1									
no.	ambient air pressure (hPa)	ambient temperature (°C)	start water temperature (°C)	time when power level is switched off (min:s)	T <sub>70</sub> (°C)	Highest temperature value (°C)	Overshoot ΔT <sub>0</sub> (K)	Result Tc (°C)	Fixed Tc (°C) used
							calc.	calc.	

Measuring energy consumption											
no.	ambient air pressure (hPa)	ambient temperature (°C)	initial water temperature T <sub>15</sub> (°C) acc. 7.5.1	$\bar{T}_c$ (°C) acc. 7.5.4.1	continous power level	average power (W) during t <sub>s</sub>	t <sub>90</sub> (min:s) $\bar{T}(t_{90}) = 90^\circ C$	E <sub>cw</sub> energy consumption at t <sub>90</sub> (Wh)	$\bar{T}_s$ (°C) acc. 7.5.4.1	total test time (min:s) t <sub>90</sub> + t <sub>s</sub>	E <sub>cw</sub> energy consumption (Wh) at t <sub>90</sub> + t <sub>s</sub>
<b>Energy consumption when using one cookware under test, normalized to 1000 g water (Wh)</b>											<b>calc.</b>



IEC60350-2\_Data  
sheet.xls

calc: calculated

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## **Annex F** (informative)

### **Addresses of suppliers**

#### **F.1 General**

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

#### **F.2 Disc material (C45) for measuring the smallest detected diameter**

(see Clause 11)

ThyssenKrupp Schulte GmbH  
Truderinger Str. 41  
81677 München

#### **F.3 Stainless steel for bottom material of the standardized cookware**

(see Clause 7)

Tad Inox Service B.V.  
Ewald Renz Straße 1  
76669 Bad Schönborn / Germany  
<http://www.tadinox.de>

#### **F.4 Cookware for measuring the energy consumption and heating up time**

(see Clause 7 and Annex A)

RYBU GmbH  
Allmending 27  
75203 Königsbach- Stein / Germany  
<http://www.rybu.de>

#### **F.5 Disc for measuring the heat distribution**

(see Clause 9)

RYBU GmbH  
Allmending 27  
75203 Königsbach- Stein / Germany  
<http://www.rybu.de>

#### **F.6 Lamp for digital measurement systems**

(see Clause 9)

A possible supplier is:

Narva Typ Bio Vital 958  
NARVA – Lichtquellen GmbH + Co. KG  
www.narva-bel.de  
office@nava-bel.de  
Erzstraße 22  
Germany 09618 Brand-Erbisdorf  
Telephone: +49 37322/17200  
Fax: +49 37322/17203

## **F.7 Digital measurement system**

(see Clause 9)

1. SLG Prüf- und Zertifizierungs GmbH  
Burgstädterstraße 20  
Germany – 09232 Hartmannsdorf  
<http://www.slg.de.com>  
[service@slg.de.com](mailto:service@slg.de.com)
2. Ing.-Büro W. Neubauer  
Paradiesweg 4  
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## **F.8 Testcharts for checking the resolution of the imaging system**

(see Clause 9)

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## Annex G (informative)

### Example for assessing the lower control position

#### G.1 General

Provided the measurement regarding 8.1 is conducted using **standardized cookware**, the following criteria are relevant.

#### G.2 Criteria

- Entire maximum heating-up time: 45 min
  - 1) First criteria: oil temperature  $\leq 53^{\circ}\text{C}$  after 18 min
    - Empirical tests show that the chocolate is burned if the temperature is  $> 53^{\circ}\text{C}$  after 18 min.
  - 2) Second criteria: oil temperature  $\geq 40^{\circ}\text{C}$  after 30 min
    - Empirical tests show that longer melting times than 30 min are not acceptable.

If one or both of the criteria 1 and 2 are not fulfilled, the setting is considered as not adequate for applications such as the melting of chocolate.

- 3) Third criteria:  $(15 \pm 1)$  min after the temperature of the oil reaches  $(50 \pm 0,5)^{\circ}\text{C}$ , the oil temperature shall be  $\leq 75^{\circ}\text{C}$ .

If  $(50 \pm 0,5)^{\circ}\text{C}$  is never reached, the total test duration of 45 min is relevant.

If the third criterion is not fulfilled, the setting is considered as not adequate for applications such as the melting of chocolate.

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