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NEPAL STANDARD

Performance Standards for Infrared Hobs

Government of Nepal

Ministry of Industry, Commerce and Supplies

Nepal Bureau of Standards and Metrology (NBSM)

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Foreword

NBSM (Nepal Bureau of Standards and Metrology) is the National Standard Body involved in the development of standards in the country. The standard development process involves committee consisting of multi-stakeholders both from public and private sectors.

This standard is developed by [Name of Technical Committee (TC XXX)] / [Name of sub Committee (SC YYY)] and approved by Nepal Standard Council as per Nepal Standard (Certification) Act, 1980. The procedures used to develop this document and those intended for its further maintenance are described in the NBSM Standard Development Procedure (see www.nbsm.gov.np/workprecedure).

This standard pertains to Infrared Hobs and covers the performance requirements such as construction, energy efficiency.

Performance Standards of Electric Infrared hobs

1. Scope

This standard defines methods for measuring the performance of **electric infrared hobs** for household use suitable for operating at a voltage of 230 610 % V ac with frequency 50 6 2.5 % Hz. Electric infrared hobs covered by this document may be those designed to be placed on a work surface or can be built-in or part of a cooking range.

This Standard defines the main performance characteristics of electric infrared hobs and specifies methods for measuring these characteristics including specially their energy efficiency and energy efficiency grades.

This standard does not specify the safety requirements which are covered in a separate standard NS xxxx – 20xx

2. Normative references

The following standards are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

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

IEC 60751: Industrial platinum resistance thermometers and platinum temperature sensors.

3. Terms and definitions

For the purpose of this standard following definitions shall apply.

3.1. Hob

A hob, also known as cooktop is appliance or part of an appliance which incorporates one or more cooking zones including a control unit. The control unit can be included in the hob itself or integrated in a cooking range.

Note: A hob is also commercially known as cooktop.

3.2. Cooking zone

Limitative marking on the surface of a hob where one cookware is placed and heated. An electric infrared hob may have a single or multiple radiant cooking zones.

The centre of the cooking zone can additionally be marked with a decoration symbol such as a ‘cross’.

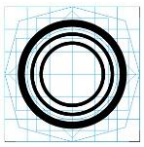
3.3 Single zone

Cooking zone marked for one cookware size.

3.4 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: EXAMPLE 2: Circular and elliptical multiple zone:



3.5. Radiant Cooking Zone

Cooking zone on which the pan is heated by means of 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.

3.6. 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: The power is generally indicated as numbers, but also temperature values and symbols are possible.

3.7. Maximum power

Maximum possible power setting while only one cookware is used. Boost function is also considered for this purpose.

Cookware that is in accordance with the specification of 5.6.1 is standardized cookware whereas commercially available cookware that is in accordance with the requirements given in 5.6.2 is alternative cookware.

3.8. 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: Removing the cookware etc. can be an action to set the hob in off mode.

3.9. 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. In case of infrared hobs, this is the situation when product is switched on but none of the cooking function (soup, frying or BBQ) key is activated.

3.10 Thermal Efficiency

The ratio of the heat received in a heating unit of an appliance at a given time to the energy input to a heating unit.

4. List of measurements

4.1. Dimensions and mass

overall dimensions as indicated in 6.1;

mass of the appliance as indicated in 6.2;

cooking zones per hob as indicated in 6.3;

distance between the cooking zones as indicated in 6.4.

4.2. Cooking zones

- Energy consumption and time for heating (see Clause 7);
- Ability to control the temperature of a load (see Clause 8);
- Heat distribution (see Clause 9);
- Heat performance of hobs (see Clause 10);

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 (25 ± 5) °C except for the measurements described in Clause 7 in which case ambient temperature shall be maintained (23 ± 2) °C throughout the test. The measurement of the ambient temperature shall not be influenced by the appliance itself or by any other appliance.

This ambient temperature is measured at a point that is at the same height as the hob positioned at working height (normally between 800 mm and 1000 mm) and at a distance of 0.5 m diagonally from one of the front edges of the appliance.

The absolute air pressure in hectopascal (hPa) shall be between 913 and 1063.

5.2. Electricity supply

The appliance is supplied at rated voltage with a relative tolerance of ±1 %. If the appliance has a rated voltage range, the tests shall be carried out at nominal voltage.

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 ±1 % while the heating elements are switched on.

The supply voltage shall be essentially sinusoidal and the supply frequency shall be at the 50 Hz ±1 % throughout the test.

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

5.3. Instrumentation 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	≤ 1,000 g ± 1 g > 1,000 g ± 3 g	
Temperature				
Ambient temperature	°C	0.1 °C	± 1 K	
Temperature of the water load (clause 7)	°C	0.1 °C	± 0.5 K	3 mm steel tube
Temperature of the oil (clause 8)	°C	0.1 °C	± 0.5 K	
Time	s	1 s	± 1 s	
Energy	Wh	-	± 1 %	Very quick electronic on/off periods shall be taken into account by measurement techniques.
Air pressure	hPa	1 hPa	± 1 %	

Table 2 – Measurements

Parameter	Unit	Minimum resolution	Minimum accuracy	Additional requirements
Voltage	V	-	± 0.5 %	-

Temperature and energy consumption measurement (Clause 7)		-	-	Sampling rate ≤ 1 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 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 table top 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

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.

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.

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 of how to fix the temperature sensor to the lid is shown in Annex A.

5.6.1.5. Standardized cookware – dimensions and water amounts

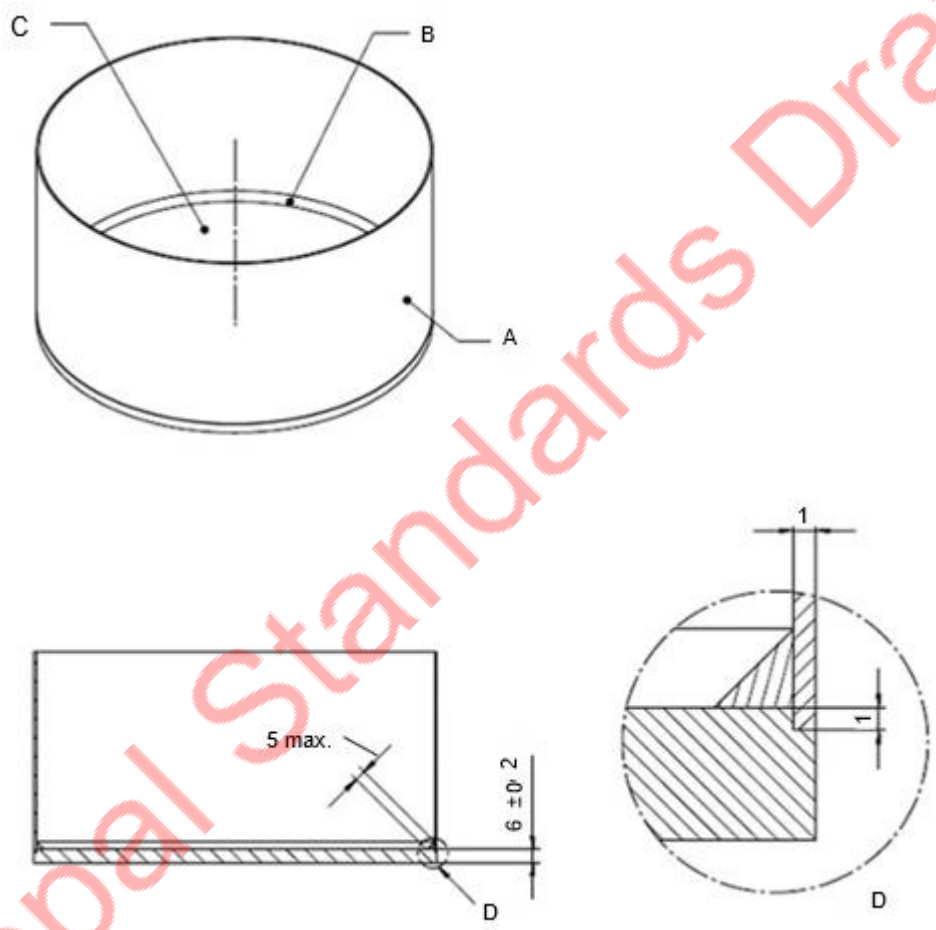
The standardized cookware sizes and water amounts are defined in Table 3.

Table 3 – Sizes of standardized cookware and water amounts

Diameter of the cookware bottom (outside)	Diameter of the lid	Lid hole circle diameter	Number of holes on the circle	Total cookware height (outside)	Flatness of cookware bottom	Water load	Cooking zone size category	Standardised cookware categories
mm	mm	mm		mm	mm	g	mm	
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 a ± 1	18/18 a	125 ± 0.5	≥ 0 < 0.15	3 420	≥ 250 < 280	D

300 ± 0.5	330 ± 1	260/210 a ± 1	23/22 a	125 ± 0.5	≥ 0 < 0.15	4 240	≥ 280 < 310
330 ± 0.5	365 ± 1	290/270 a ± 1	27/27 a	125 ± 0.5	≥ 0 < 0.15	5 140	≥ 310 ≤ 330
a: 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.



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

Fig. 1(a) Example for a cookware size of 180 mm in diameter

Dimensions in millimetres

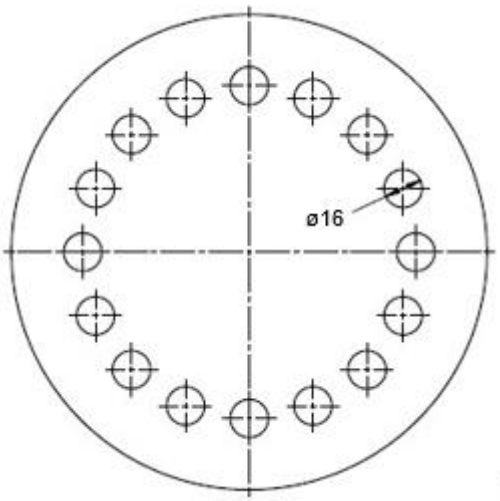


Fig. 1(b) Example – lid with a diameter of 180 mm

Dimensions in millimetres

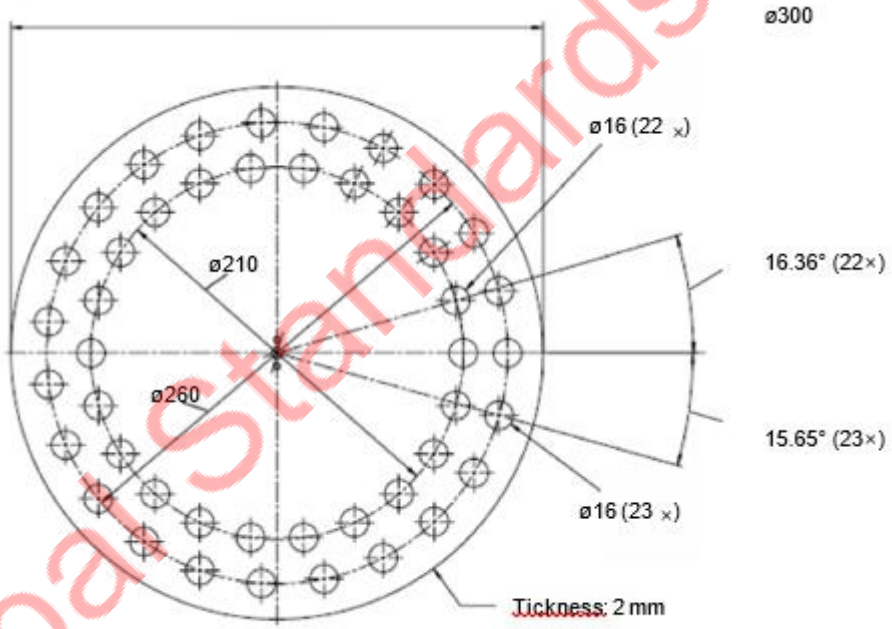
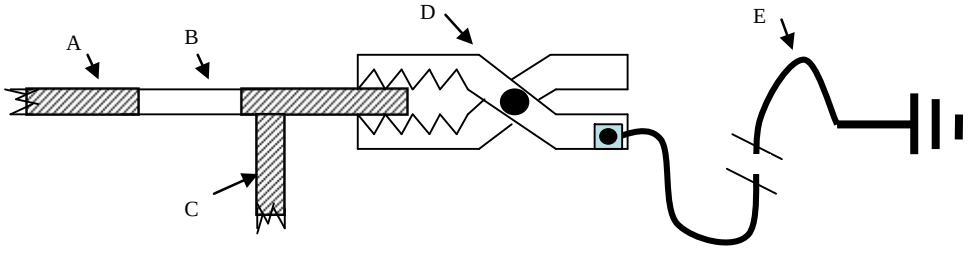


Fig. 1(c) Example – lid with a diameter of 300 mm



Key

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

Fig. 1(d) Ground connection

Figure 1 (a, b, c, d above) – 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 cladded 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: ≥ 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: ≥ 0.8 mm.
- Shape: cylindrical, angle between sidewall and hob surface 80° to 90°.
- 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 electric infrared hob are measured and stated in millimetres.

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

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. The dimensions are indicated in mm. 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.

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 zone is determined by the printing on the surface independently of the size of the heating element.

6.4 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 infrared hob has more than two cooking zones, the distance between each pair is determined.

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 ≤ 330 mm and ≥ 100 mm or where one of the sides' lengths is ≤ 330 mm and ≥ 100 mm.

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 cooking zone or best fit.
2	At least from one standardized cookware category according to Table 3 that are equal to the dimensions of the cooking zones or best fit.
3	At least from two standardized cookware categories according to Table 3 that are equal to the dimensions of the cooking zones 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 cooking zones 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 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 °C ± 0.5 °C (T15). 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, the control is set to maximum power and the measurement shall be started immediately.

NOTE: Water having an initial temperature of 14.5 °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 °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 (ΔT_o) in K, see Figure 5.

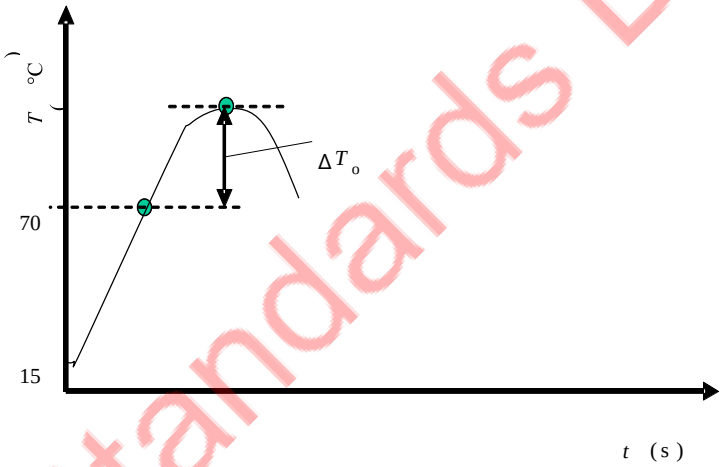


Figure 2 – Overshoot measurement

Note 1: For ΔT_0, 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 ± 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):

$$T_c = 93\,^oC - \Delta T_o \qquad (1)$$

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 ≤ 80 °C, then 80 °C is taken as T_c.

Tc is stated.

A Tc value of 85 °C is representative and they can substitute the result of 7.5.2.1 as a fixed value.

7.5.2.2 Determine the simmering setting

A second preliminary test is carried out to determine the lowest level to set to achieve ≥ 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 ≥ 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 A).

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 4, 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**.

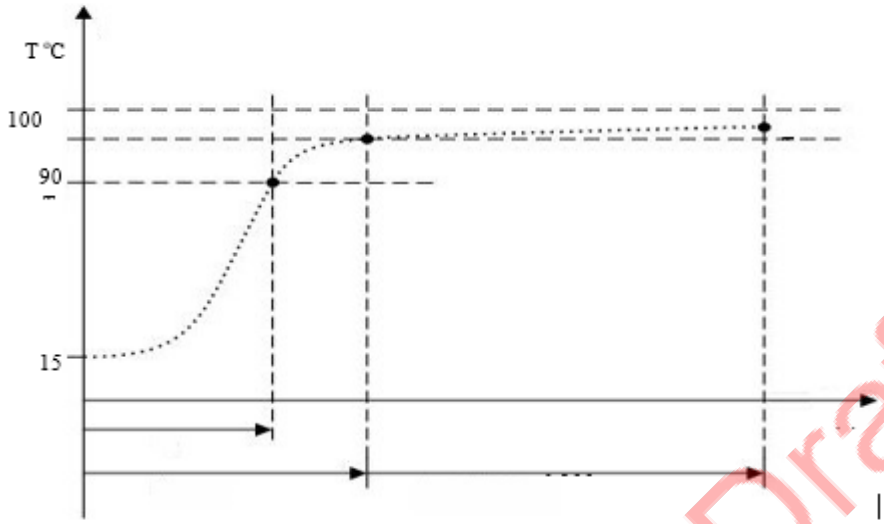


Figure 3 – Energy consumption measurement process for a cooking process

Where:

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

t_C in seconds is the time when the setting is reduced,

$t_{s\ in\ seconds}$ is the simmering time, in s;

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

T_S in °C is the water temperature at the end of the process,

The following data shall be recorded:

- Continuously, the energy consumption starting at t_0 and ending at t_s + 1 min, in Wh;
- tC and t90, in min and s;
- initial temperature of water, TC, and the temperature TS of the water in °C;
- average power during the simmering time ts, 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 smoothened with a time interval of t_{mov} = 40 s.

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

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

where

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

i is the sample index;

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

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

NOTE n is rounded off.

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 smoothened final water temperature, is stated.

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

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_{cw} and shall be noted with the cookware size under the test normalized to 1 000 g.

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

The energy consumption E_{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).

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

Where

*E*hob is the energy consumption of a **hob** calculated per 1000 g water in Wh;

*E*cw is the energy consumption with a single cookware under test in Wh;

*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 D. An Excel 97-2003 data calculation program, which corresponds directly to Annex D, 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 ± 0.5) °C. The **standardized cookware** covered with the lid is positioned centrally on the **cooking zone.**

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 nearest 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 ± 0.5) mm is used. When selecting a piece of **alternative cookware**, the diameter of this cookware shall be 150 +20/-10mm.

If the hob has no **cooking zone** ≥ 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 ± 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 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: The oil should be Solvent extracted sunflower oil of refined grade as per NS 378-2054. 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)	**Amount of sunflower oil**	**Cooking zone size category**
mm	**g**	**mm**
150 ± 0.5	450 ± 5	≥ 130 and < 160
180 ± 0.5	650 ± 5	≥ 160 and < 190

8.1.3 Procedure

The **cooking zone** 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:

If the temperature reaches (50 ± 0.5) °C in ≤ 30 min, the oil is further heated for 15 min with an unchanged setting. Then the **control** is set to off.

If (50 ± 0.5) °C is reached after > 30 min and ≤ 45 min, the oil is further heated with an unchanged setting until the test reaches a total duration of 45 min.

If (50 ± 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 analysed.

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.

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**. Therefore, a steel disc is spread with a thin layer of fat and flour, positioned on the **cooking zone** and heated up. The browned surface of the disc after a certain time is representative for the heat distribution of a **cooking zone**.

The test is applicable to cooking zones with a diameter ≤ 330 mm and ≥ 100 mm or where one of the sides' lengths is ≤ 330 mm and ≥ 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 ± 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

Cooking zone size category (mm)	Diameter of the discs (outside) (mm)	Flatness of discs (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.

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 ≤ q ≤ 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;
- switch on the cooking zone or cooking area with a setting where the power density 0.9 W/cm2 ≤ q ≤ 1.2 W/cm2 is expected;
- measure the mean energy consumption (ECm) of the cooking zone within 10 min;
- switch off the cooking zone and note the energy consumption ECm in Wh;
- calculate the mean power P with Formula (4):

$$\bar{P} = \frac{6 \times E\ C_m}{1h} \qquad (4)$$

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

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

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^2;

a_d = is the surface area of the disc in cm^2.

If the determined power density q is not in range of 0.9 W/cm^2 ≤ q ≤ 1.2 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 W/cm^2 ≤ q ≤ 1.2 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 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 $^{+10}_{-5}$ °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 +−105 °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 µm and 800 µm (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 °C 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** 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.

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 C. The browning is checked visually by the shade charts according to Annex F.

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

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

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.

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 C.

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

The entire surface is divided into sections of 1 cm^2. None of the mean values of the 1 cm^2 sections shall deviate by more than ±5 % of the mean value of the entire surface.

b) Recognition of the shade numbers

The shade numbers defined in Table C.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 C 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 C.1.

The H values of the limiting samples H_{limit} and H_{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. So, flat circular colour samples with a diameter of 70 mm in shade numbers 5 and 6

(defined in Annex C) are placed at a height of 28 mm. H_{limit} and H_{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.

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.

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

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	**Diameter of the discs (outside)**	***t*max**
mm	mm	min

≥ 100 < 130	120 ± 0.5	42
≥ 130 < 160	150 ± 0.5	42
≥ 160 < 190	180 ± 0.5	37
≥ 190 < 220	210 ± 0.5	34
≥ 220 < 250	240 ± 0.5	32
≥ 250 < 280	270 ± 0.5	32
≥ 280 < 310	300 ± 0.5	30
≥ 310 ≤ 330	330 ± 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 W/cm^2 ≤ q ≤ 1.2 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 are 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 SS_i for each section according to Annex D. Consider the represented area of each line section by weighing the

average shade numbers SS_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).

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

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 5.

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).

$$GS = \frac{\sum_{j=1}^{12} GS_{line\ j}}{\sqrt[2]{12}} \tag{7}$$

where

GS is the overall gradient sum square.

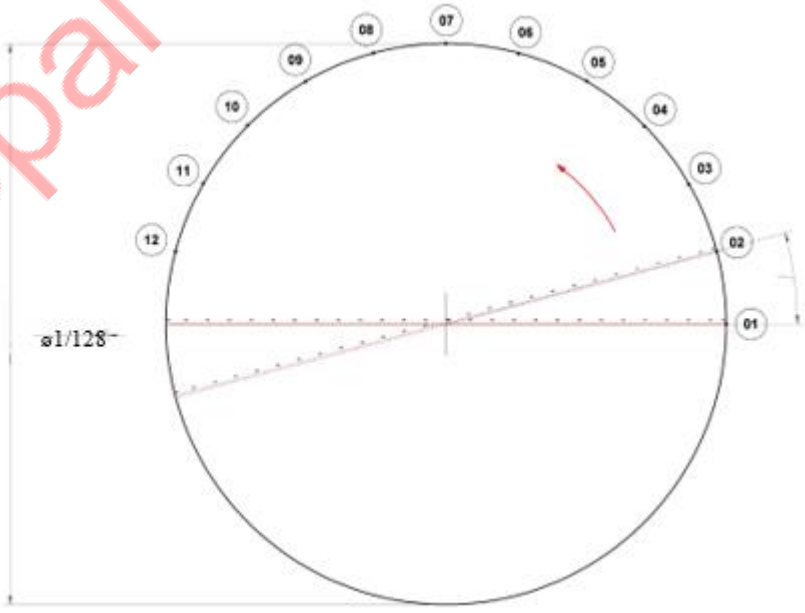


Figure 4 – Diametral lines

- 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 95th percentile minus the 5th 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 $H \leq H_{limit}$ (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.

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 cladded 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**			
	≥ 130 and < 160	**≥ 160 and < 190**	**≥ 190 and ≤ 220**	**> 220 and ≤ 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 ± 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 C.

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.

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 ± 2) °C.

The oil should be Solvent extracted sunflower oil of refined grade as per NS 378-2054.

Table 9 – Quantities for heat performance test

Diameter of cooking zone	**Quantity of fresh sunflower oil in the cookware**		**Minimum volume of the cookware**
	Quantity of oil	**Quantity of potato chips**	
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 ± 5) °C for ovens with forced air circulation and (200 ± 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 ± 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 **mm**	**Time** **min**
≥ 130 and < 160	4
≥ 160 and < 190	5
≥ 190 and ≤ 220	7

If the temperature of the oil has dropped below (180 ± 5) °C during frying, wait after the potato chips are taken out until the oil is heated up again at maximum setting to (180 ± 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 ± 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.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) 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.

12.Procedure for Evaluating Thermal Efficiency and Standby Power

12.1 Procedure for evaluating the thermal efficiency

Determine thermal efficiency for infrared hobs according to the test method in Annex E.

12.2 Procedure for evaluating Standby Power

The standby power measurement is carried out as per IEC 62301.

12.3 Assessment

Energy efficiency classification of infrared hobs are divided into 4 classes, among which Class 1 is the highest energy efficiency, and the Class 5 as the minimum. The thermal efficiency values of each class shall not be less than the provisions of Table 11 and Table 12, the standby power shall not be greater than the provisions of Table 11 and Table 12. For infrared hobs with multiple cooking zones, the machine standby power shall be not more than 2 W.

Table 11 Energy efficiency grades for heating units with rated power greater than 1200 W

Energy efficiency grade	Thermal efficiency (%)	Standby power (W)
1	70	1
2	67	1
3	64	2
4	61	2
5	58	2

Table 12 Energy efficiency grades for heating units with rated power less than or equal to 1200 W

Energy efficiency grade	Thermal efficiency (%)	Standby power (W)
1	67	1
2	64	1
3	61	2
4	58	2
5	55	2

12.4 Minimum allowable values of energy efficiency

The minimum allowable value of energy efficiency of infrared hobs is Grade 5 shown in Table 11 and Table 12. All cooking zones in the infrared hobs shall meet corresponding requirements. For infrared hobs with multiple cooking zones, the machine standby power shall be not more than 2 W.

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Annex A

(Normative)

Aids for measuring the energy consumption according to Clause 7

A.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 A.1. The mounting part shall be made of plastic material. Screws are used in order to position the temperature sensor correctly.

Dimensions in millimetres

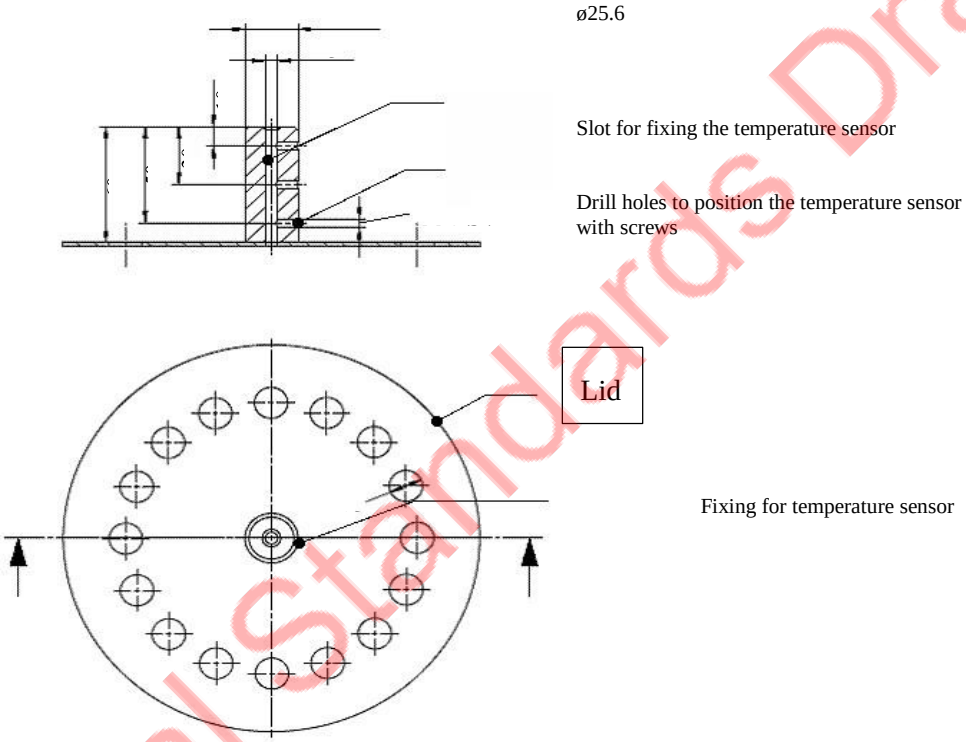

Figure 5 – Position of the temperature measurement instrument

A.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 A.2 can be useful. Polar coordinate paper has concentric circles divided into small arcs to allow an exact marking around a knob.

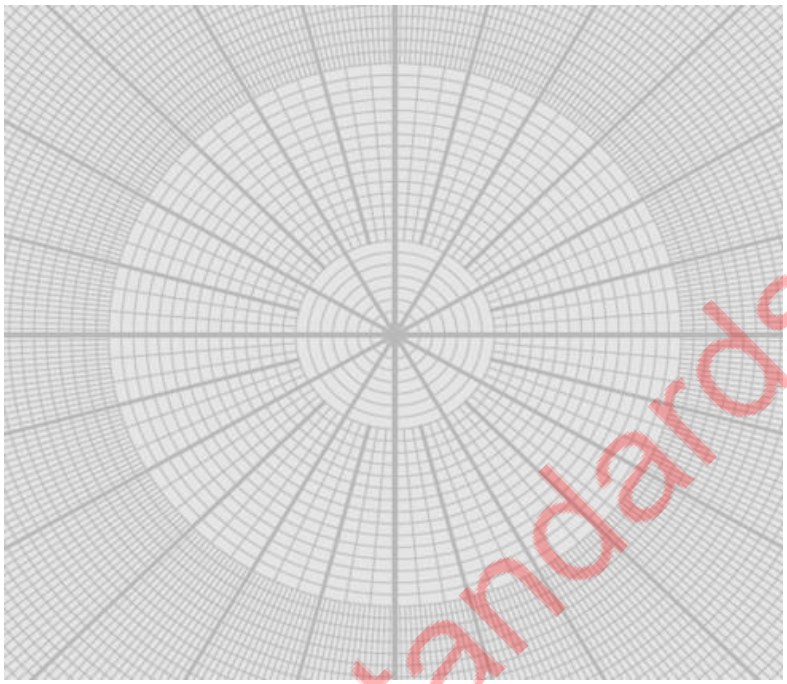

Figure 6 – Polar coordinate paper – Example

Annex B

(Informative)

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

B.1 Example 1 – Cooking zones

Figure B.1 illustrates a **hob** with **cooking zones**. (*Dimensions in millimetres)*

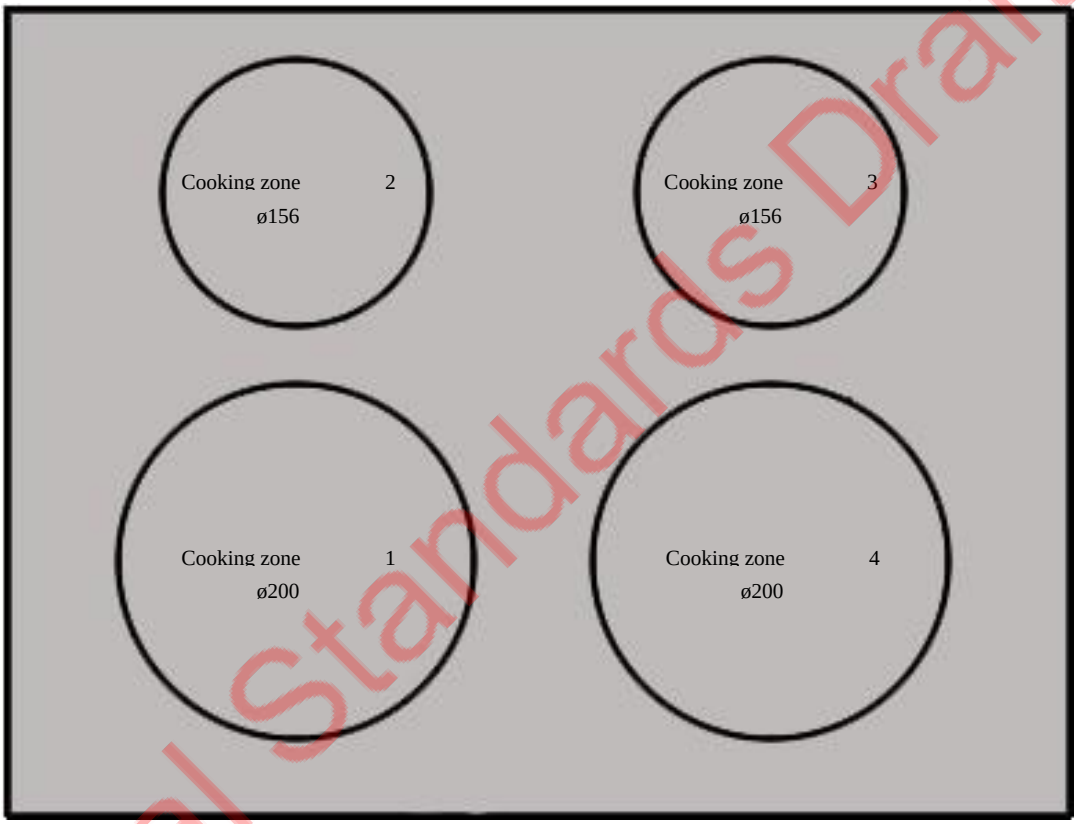

Figure 7 – Example 1: radiant cooking zone

Annex C

(Normative)

Shade chart

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

Table 13 – Classification of shade numbers regarding R_y

Measured reflection value R_y		Tolerances	Shade number
≥	<		
	7.2	±14 %	17
7.2	9.3	±13 %	16
9.3	12.2	±12 %	15
12.2	16.4	±11 %	14
16.4	20.1	±10 %	13
20.1	22.9	±10 %	12
22.9	26.5	±9 %	11
26.5	31.7	±9 %	10
31.7	38.5	±8 %	9
38.5	46.9	±8 %	8
46.9	54.2	±8 %	7
54.2	64.3	±8 %	6
64.3	75.2	±8 %	5
75.2		±8 %	4

Table C.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 14 – Examples for the shade charts regarding L^*, R_y and the specification of the limiting samples H_{limit} and H_{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*lower
S 0530-Y10R	88.1	72.3	*H*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.

Annex D

(Informative)

Brand & Fcatory:					Hob Type / Model:			Testlab:				
Rated Voltage:	V				Supply Voltage:	V		Operator:				
Rated Power:	kW				Number of Controls:			Date:				
Cooking Zone:			Cooking area:			Cooking diameter:	mm					
Type of Cooking Zone:			Without limitave marking:	□		Water load (m_cp)	g					
Cooking Zone Dimenssion:		mm	With limitative marking:	□		Cookware position:						
					Cookware ID no:							
	Determine Tc according 7.5.2.1											
	no.	ambielnt air pressure (hPa)	ambient temperature (◦C)	Start Water temperature (◦C)	time when power level is switched off (min:sec)	T_{70} °C	Highest temperatur e value (◦C)	Overshoot $\Delta T_0\ K$	Result T_c°C	Fixed T_c°C used		
								calc.	calc.			
Measuring energy consumption												
no.	ambielnt air pressure (hPa)	ambient temperature (◦C)	Initial water temperature T_{15}(°C) acc. 7.5.4.1	T_c(°C) acc. 7.5.4.1	Continous power level	average power (W) during t_s	T_{90} (min:s)	E_{cw} energy consumption at $t_{90}(wh)$	T_s(°C) acc. 7.5.4.1	total test time (min:s) $t_{90}+t_s$	E_{cw} energy consumption at $T_{90}+t_s$	
												calc.

Energy Consumption when using one cookware under test, normalised to 1000 g water (Wh)

Annex E

(Informative)

Example for assessing the lower control position

E.1. General

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

E.2. Criteria

Entire maximum heating-up time: 45 min

1) First criteria: oil temperature ≤ 53°C after 18 min
   - Empirical tests show that the chocolate is burned if the temperature is > 53°C after 18 min.
2) Second criteria: oil temperature ≥ 40°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 ± 1) min after the temperature of the oil reaches (50 ± 0.5) ºC, the oil temperature shall be ≤ 75 ºC.
   - If (50 ± 0.5) ºC 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.

Annex F

(Normative)

Test method for thermal efficiency of Infrared hobs

F.1. Test conditions

The test conditions are as follows:

a)ambient temperature: 25 °C ± 5 °C;
b) relative humidity: 45% ~ 85%;
c) atmospheric pressure: 86 kPa ~ 106 kPa;
d) the power supply voltage is 230 ± 1% V, the frequency is (50 ± 1%) Hz;
e)there is no significant air convection in the test area.

F.2 Technical indicators for test instruments, meters and equipment

The technical indicators of test instruments, meters and equipment are as follows:

a) the total harmonic distortion of the voltage of the test power supply is less than 3%;
b) energy meters are capable of measuring energy consumption at a minimum of 20 mW · h;
c) a thermometer for measuring temperature, the resolution is not more than 0.1 °C;
d) the resolution of the measurement of mass is not less than 5 g;
e) the accuracy of the timer is ± 1 s/h.

F.3 Test method for thermal efficiency

Under the specified test conditions, select the minimum size of standard cookware (the diameter of standard pan bottom is greater than the effective diameter of cooking zone) that can cover the cooking zone by referring to Table 3 (5.6.1.5); measure the mass m_2 of the standard pan with a lid; place the corresponding standard pan in cold-state heating unit center of the measured induction hob; fill the pan with water m_1 of specified mass in Table 3, the water temperature is 15 °C ± 1 °C; cover the lid; put the thermometer from the hole on the pan lid into the pan's center position; immerse the thermometer's temperature-sensing part in water at a distance of 10 mm from the bottom; read the reading t_1 of thermometer; turn on the infrared hob and quickly adjust to the maximum power mode (the manufacturer specified in the instructions); when the temperature reaches 85 °C, turn off the hob; record the electric energy consumed E; read the maximum temperature reading t_2 after 1 min; the temperature rise Δt is valid in the range of (75 ± 1) K; calculate the thermal efficiency of induction hobs in accordance with the calculation method in G.4.

Based on the electric energy E recorded in the initial test, repeat the above test procedure twice, and calculate the average value of 3 measurements of thermal efficiency as the thermal efficiency value of the product. When the hob has multiple cooking zones, the test is performed one by one according to the heating unit.

The thermal efficiency test of Infrared hobs can adopt platinum resistance thermometers or mercury thermometers; when the test results are controversial, the test data by platinum resistance thermometers shall prevail.

F.4 Calculation method for thermal efficiency

Calculate the thermal efficiency of infrared hob according to formula (G.1):

$$\eta = \frac{(C_1 m_1 + c_2 m_2)\Delta t}{3600 \times 1000 \times E} \times 100 \qquad \text{(G.1)}$$

where:

η - The thermal efficiency, %;

c_1 - The specific heat capacity of water, taking 4.18, in kilojoules per kilogram Kelvin [kJ/(kg · K)];

m_1 - The mass of water, in grams (g);

c_2 - The specific heat capacity of pan body and pan lid, taking 0.46, in kilojoules per kilogram Kelvin [kJ/(kg · K)];

m_2 - The total mass of pan body and pan lid, in grams (g);

E - The electric energy consumption, in kilowatt hour (kW · h);

Δt - The temperature rise, in Kelvin (K), $\Delta t = t_2 - t_1$.

360- Heat equivalent to 1 kWh of electrical energy.