



SLOVENSKI STANDARD

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Merilna metoda za oceno kompatibilnosti indukcijskih kuhališč in kuhinjske posode

Measurement method for assessing the compatibility of induction hob and cookware

Messmethode zur Bewertung der Kompatibilität von Induktionskochfeldern und Kochgeschirr

Méthode de mesure pour évaluer la compatibilité des tables de cuisson et des ustensiles de cuisine

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Comité Européen de Normalisation Electrotechnique
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European foreword

This document EN 50723:2023 has been prepared by CLC/TC 59X “Performance of household and similar electrical cooking appliances”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2024-07-24
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2026-07-24

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EN 50723:2023 (E)**Introduction**

To ensure that induction hobs designed by household industry and cookware designed by cookware manufacturers are compatible a common platform for future innovations on both sides is needed. This document provides measurements to assess the compatibility / interoperability within the system cooking.

Manufacturers of cookware and hobs can use the measurements to identify various properties of induction hobs and cookware.

Standards application business, e.g. testing laboratories, can use this document for product test clearly to identify the compatibility of cookware and induction hobs.

Finally, the consumer benefit is on the one hand a better-harmonized product range (cookware/hob) and on the other hand, a clear product information regarding compatibility based on a standardized method.

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1 Scope

This document describes a method which determines the electrical parameters for **compatibility** of cookware and induction hobs for household use. Cookware is an integral part of the cooking system; electrical parameters can affect the cooking process regarding the required power setting, speed of heating up, sufficient power for different cooking processes etc.

For determining the compatibility of a cookware to an induction cooking zone and cooking area, a measurement device and a measurement procedure is specified in this document. It allows measuring the resistivity and/or impedance of the cookware under test (**CUT**) in a repeatable and reproducible way. The measured electric properties indicate the compatibility characteristics of a cookware on an induction cooking zones and cooking area.

For determination the compatibility of an induction cooking zone or cooking area with a cookware, this document describes the measurement how to determine the power generated by the **cooking zone under test (ZUT)** in combination with the selected cookware.

NOTE 1 For definitions of induction hob, induction cooking zone and cooking area EN 60350-2 is relevant.

Further performance characteristics of hobs which are of interest to the user, like energy consumption, heating up time or heat distribution are not addressed. This document does not deal with safety requirements.

NOTE 2 Further performance characteristics for hobs are covered in EN 60350-2.

NOTE 3 Further performance characteristics for cookware are covered in EN 12983-1 and EN 12983-2.

NOTE 4 Safety requirements are covered in IEC 60335-2-6 and IEC 60335-2-9.

Appliances covered by this document can be built-in or portable induction hobs. The hob can also be a part of a cooking range.

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.

EN ISO 80000-1:2022, *Quantities and units — Part 1: General (ISO 80000-1:2022)*

EN 60350-2:2018, *Household electric cooking appliances — Part 2: Hobs — Methods for measuring performance*

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:

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

3.1

compatibility

capability of an induction hob and a cookware to perform together adequately assessed by the measured electrical parameters derived in the measurements

Note 1 to entry: The relevant electric parameters are defined in 3.2 to 3.7. This document describes the measurement of these electrical parameters but does not provide limits.

EN 50723:2023 (E)**3.2****resistivity**

value obtained by measuring the up taken input power, divided by the square of rms current of the coil

3.3**active power** P_{act}

power supplied to the measuring device by the mains (average power during mains cycle)

3.4**target input power** P_{req}

requested power determined by the inner diameter of the cookware

3.5**reference frequency**

working frequency at resonant power

3.6**peak current** I_{peak}

maximum current in each mains cycle

3.7**rms current** I_{rms}

root-mean-square of the current flowing in coil during a mains cycle

3.8**cookware under test****CUT**

cookware sample undergoing examination

3.9**cooking zone under test****ZUT**

cooking zone undergoing examination

3.10**boost position setting**

marked control setting at maximum power, which is automatically limited in duration

Note 1 to entry: Marked setting on the appliance, which is described in the instructions for use.

3.11**maximum power**

maximum possible power setting while only one cookware is used

Note 1 to entry: Boost position setting is not considered.

4 General conditions for the measurement**4.1 Test room**

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

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 from one of the front edges of the appliance.

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

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

4.2 Electricity supply

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

The supply voltage shall be maintained at the main terminal at 230 V with a relative tolerance of $\pm 1 \%$ while the heating elements are switched on.

The supply voltage shall be essentially sinusoidal; the total harmonic distortion shall be less than 3 %.

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

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

The mains frequency shall be at the rated frequency 50 Hz with a relative tolerance of $\pm 1 \%$ throughout the test.

4.3 Instrumentation and measurements

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

Table 1 — Instruments

Parameter	Unit	Minimum resolution	accuracy	Additional requirements
dimensions	mm		1 mm	
time	s	1 s	$\pm 1 \text{ s}$	
coil current	A		$\pm 0,5 \%$	Current value is measured within a bandwidth of at least 5 MegaSamples and filter bandwidth of 500 kHz.
voltage	V		$\pm 0,5 \%$	Voltage value is measured within a bandwidth of at least 20 KiloSamples.
power	W	-	$\pm 1 \%$	Mains power value is measured within a bandwidth of at least 20 KiloSamples and filter bandwidth of 2 kHz.
temperature of the inductor coils	$^{\circ}\text{C}$		$\pm 2 \text{ K}$	
temperature of the water	$^{\circ}\text{C}$		$\pm 1 \text{ K}$	
Energy consumption ZUT	Wh		$\pm 1 \%$	Very quick electronic on/off periods shall be taken into account by measurement techniques

Table 2 — Measurements

Parameter	Unit	accuracy
Voltage	V	$\pm 0,5 \%$
rms voltage	V_{rms}	$\pm 0,5 \%$
Current	A	$\pm 0,5 \%$
rms current	A_{rms}	$\pm 0,5 \%$
Power, average	W	$\pm 1 \%$
Energy consumption measurement ZUT	Wh	Sampling rate < 1 s (digital measurement data)

If numbers have to be rounded, they shall be rounded to the nearest number according to EN ISO 80000-1:2022, 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 Dimensions

5.1 Dimensions of a cooking zone

The dimension of a cooking zone is determined by measuring the marked area on the surface. The measurement procedure described in EN 60350-2 is applied. The dimension of a cooking zone is reported rounded to mm.

5.2 Dimensions of cookware

For the purpose of this document the diameter of the inner bottom of the cookware is relevant. The inner bottom diameter of a cookware corresponds to the usable surface of the inner base.

Follow the instruction of the cookware manufacturer regarding the inner bottom diameter of the cookware. If no instructions are given, the inner diameter is measured with a flexible tape. For this the flexible tape is positioned on the inner bottom surface, see Figure 1, searching the maximum measurable diameter.

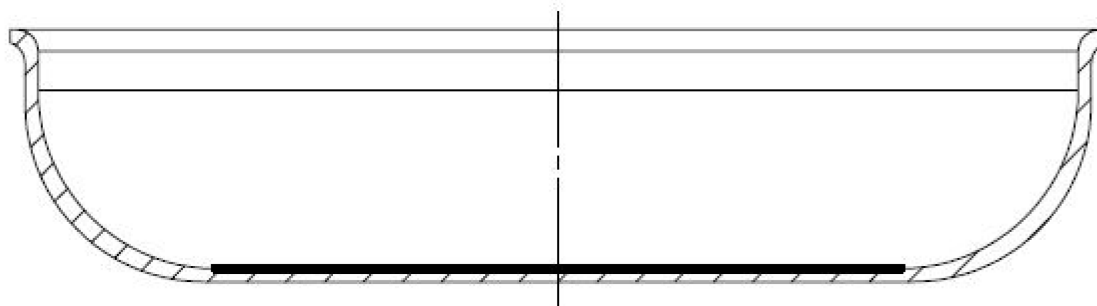


Figure 1 — Inner bottom surface

6 Specification of the measurement device for cookware

6.1 Converter design

Half bridge series resonant converter with a maximum power of 3 700 W shall be used.

The **reference frequency** of the converter including the coil shall be (20 ± 2) kHz at maximum power, while the reference cookware is fully covering the coil. The maximum power per coil shall be in accordance to Table 3.

The required converter design is given in Annex B.

The working frequency range shall be from 19 kHz to 45 kHz.

For the measurement device means for protection shall be provided to avoid exceeding a **peak current** $\geq 100 A_{pk}$.

An overview about the measurement device (see Figure C.2) and the measurement position (See Figure C.1) is given in Annex C.

6.2 Converter operation

Induction coil current is controlled by frequency. The duty cycle is fixed 50 % (= symmetric control of high and low switch). The converter shall limit the current for each coil size including frequency de-rating, limit is $45 A_{rms}$.

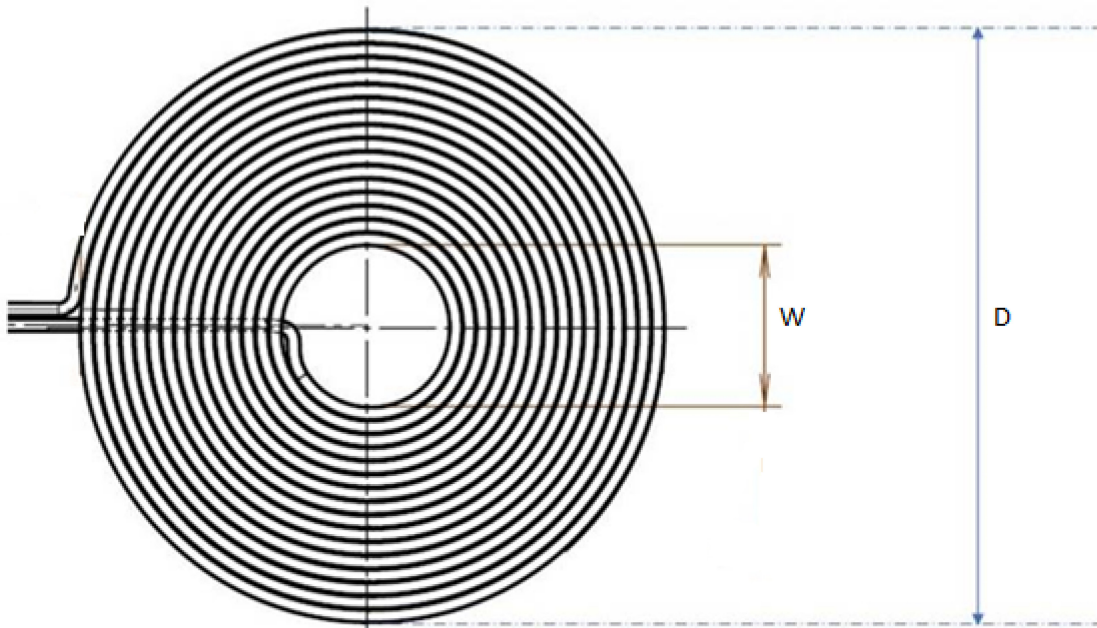
NOTE Annex E gives the information on the control loop of the measurement device.

The glass temperature in the centre of the coils is measured and monitored. The glass temperature shall be ≥ 70 °C during measurement, since the measurement shall not be done in cold conditions. Blowers are needed in order to cool down coils and electronics.

6.3 Induction coils

Induction coils used for the measurement device shall satisfy the following requirements:

- diameter of test coils are defined by outer diameter of electrical winding;
- the winding has neutral design with constant gaps between the turns;
- continuous winding made from stranded copper wire, bar ferrites, no full ferritic coverage;
- number of turns and surface of the ferrites defined in Annex A;
- inner diameter for coil with the diameter of 160 mm shall be (25 ± 1) mm; for all the other inner diameter shall be coils are of (45 ± 5) mm; see Figure 2;
- coils are placed on an aluminium carrier and spring loaded to the glass and this aluminium carrier shall be earthed;
- distance between the upper surface of the windings of the inductors and the upper glass ceramic surface shall be $(6,5 \pm 0,2)$ mm;
- minimum inductivity for coils placed on the aluminium carrier with a diameter ≤ 210 mm is $63 \mu H$ and for coils with a diameter > 210 mm until ≤ 270 mm is $59 \mu H$ and for > 270 mm the minimum inductivity is $55 \mu H$. (Conditions: measured at 10 kHz, 1 V and 20 °C, with no coverage);
- the maximum power of the coil shall be reached with the reference cookware with fitting diameter at a **reference frequency** of (20 ± 2) kHz;
- PT100 sensor mounted in the centre of the coil for measuring the temperature of the bottom side of the glass;
- electrical insulation layer shall be mounted above the induction coil.

**Key**

- W is the inner diameter
D is the diameter of the coil

Figure 2 — Coil with inner diameter

The required coil design is given in Annex A.

In Table 3 the coil diameter and related maximum power is stated.

Table 3 — Coil diameter and related maximum power

coil diameter in mm	power density in W/cm ²	max power in W
160	10,7	2 148
180	10,7	2 718
210	10,7	3 700
240	8,2	3 700
270	6,5	3 700
300	5,2	3 700

6.4 Reference cookware

For the purposes of this document, the specification for the standardized cookware given in EN 60350-2 applies.

6.5 Glass ceramic and printing

The maximum glass temperature – measured below – shall be up to 240 °C. For the test procedure, the maximum glass temperature shall be limited by software to maximum 160 °C (to avoid empty pot boiling).

Each cooking zone shall be printed on the glass ceramic as follows:

- printed circle with the same diameter as the coil;

- marked circles in 10 mm steps up to diameter equal to the nominal coil diameter + 20 mm (see Figure 3).

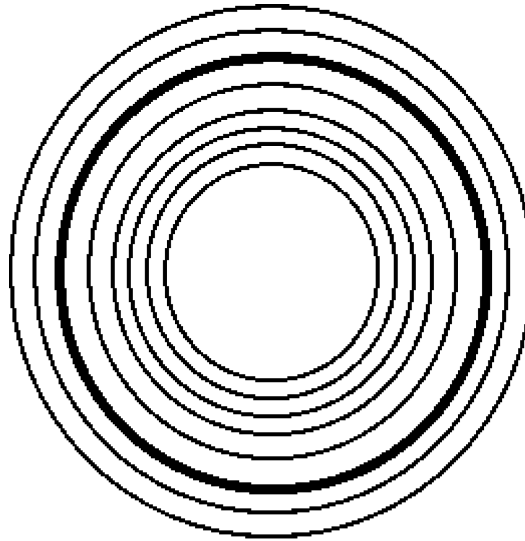


Figure 3 — Marked circle with the same diameter as the coil (thick line) and smaller and larger circles in 10 mm steps

NOTE An example for a printing is shown in Annex D.

7 Method for determining the compatibility of a cookware

7.1 Measuring of electrical properties

The test procedures of this document allow determining electrical properties of cookware on typical domestic induction hobs. The physical effect of coupling between induction coil and cookware is similar on typical domestic induction hobs, but the scaling of the determined values varies from technology to technology according to their individual design, e.g. number of turns and ferrite bars of the inductor coil, distance coil to cookware.

The Cookware Under Test (**CUT**) is operated for the tests described in 7.4 in a clearly defined operating point and compared to the reference cookware operated at the same operating point, e.g. at the same **active power** or at the same operating frequency.

The **CUT** is relatively compared to the reference cookware with similar or slightly smaller diameter and the delta between **CUT** and reference is the measurement result.

The following values are measured for each test described in 7.4:

- U_{AC} mains input voltage behind shunt and before rectifier;
- I_{AC} mains current through shunt;
- I_{HF} high frequency current through induction coil;
- f_{op} operating frequency of half bridge converter (frequency of coil current).

One measurement cycle takes 20 ms, which is related to a complete mains sine period of 50 Hz. Therefore, nonlinear properties of cookware in different operating points during a half wave of the mains voltage are included.