IEC 60704-2-10

Edition 3.0 2024-09
EXTENDED VERSION

INTERNATIONAL STANDARD

colour inside

This full version of IEC 60704-2-10:2024 includes the content of the references made to IEC 60704-1:2021

Household and similar electrical appliances – Test code for the determination of airborne acoustical noise –
Part 2-10: Particular requirements for ranges, ovens, steam ovens, grills and microwave ovens

IEC 60704-2-10:2024-09 EXV(en)

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This extended version (EXV) of the official IEC Standard provides the user with the full content of the Standard.

IEC 60704-2-10:2024 EXV includes the content of IEC 60704-2-10:2024, and the references made to IEC 60704-1:2021.

The specific content of IEC 60704-2-10:2024 is displayed on a blue background.

IEC 60704-2-10 has been prepared by subcommittee 59K: Performance of household and similar electrical cooking appliances, of IEC technical committee 59: Performance of household and similar electrical appliances. It is an International Standard.

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

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

a) alignment with the fourth edition of IEC 60704-1:2021;
b) alignment with IEC 60350-1:2023 regarding the definitions and settings;
c) introduction of the measurement of the steam function;
d) revision of settings and test parameters.

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

Draft	Report on voting
59K/396/FDIS	59K/398/RVD

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

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

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

This document is intended to be used in conjunction with IEC 60704-1:2021, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 1: General requirements*.

The relevant text of IEC 60704-1:2021 as amended by this publication establishes the test code ranges, ovens, steam ovens, grills and microwave ovens.

This document supplements or modifies the corresponding clauses in IEC 60704-1:2021. When a particular subclause of IEC 60704-1:2021 is not mentioned in this document, that subclause is applicable as far as reasonable. Where this document states "addition", "modification" or "replacement", the relevant requirements, test specifications or explanatory matter in IEC 60704-1:2021 are to be adapted accordingly.

Subclauses, tables and figures that are numbered starting from 101 are additional to those in IEC 60704-1:2021. Additional annexes are lettered AA, BB, etc.

Unless notes are in a new subclause or involve notes in IEC 60704-1:2021, they are numbered starting from 101, including those in a replaced clause or subclause.

In this standard, the following print types are used:

- terms defined in Clause 3: bold type.

A list of all parts in the IEC 60704 series, published under the general title *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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

INTRODUCTION to IEC 60704-1:2021

Although the noise emitted by household appliances does not generally present a hazard to the hearing of the operator and other exposed persons, the need for standardization procedures for the determination of the noise emitted has been recognized for a long time. Such procedures should be specified, not only for special types of appliances, but also the principles should be applicable to the majority of appliances in general use.

Generally, the determination of noise levels is only part of a comprehensive testing procedure covering many aspects of the properties and performances of the appliance. It is therefore important that the requirements for noise measurements (such as test environment, instrumentation, and amount of labour involved) be kept at a modest level.

The results of noise measurements are used for many purposes, for example for noise declaration, as well as for comparing the noise emitted by a specific appliance to the noise emitted by other appliances of the same family. In other cases, the results are taken as a basis for engineering action in the development stages of new pieces of equipment, or in deciding on means for sound insulation. For all purposes, it is important to specify procedures with known accuracy so that the results of measurements taken by different laboratories can be compared.

These conditions have, as far as possible, been taken into account in the preparation of this test code. The acoustic measuring methods are based on those described in ISO 3743-1:2010, ISO 3743-2:2018 and ISO 3744:2010.

The adoption of these methods permits the use of semi-anechoic rooms, special reverberation test rooms and hard-walled test rooms. The result of the measurements is the sound power level of the appliance. Within the measuring uncertainty specific to these methods, the results from the determination under free field conditions over a reflecting plane are equal to those obtained in reverberant fields.

The use of intensity methods as described in ISO 9614-1:1993, ISO 9614-2:1996, and ISO 9614-3:2002 is applicable under special conditions, which are described in specific parts of the IEC 60704-2 series.

This test code is concerned with airborne noise only. In some cases, structure-borne noise, for example transmitted to the adjoining room, can be of importance.

INTRODUCTION to IEC 60704-2-10:2024

The measuring conditions specified in this document provide for sufficient accuracy in determining the noise emitted and comparing the results of measurements taken by different laboratories, whilst simulating as far as possible the practical use of ranges, ovens, steam ovens, grills and microwave ovens.

It is recommended to consider the determination of noise levels as part of a comprehensive testing procedure covering many aspects of the properties and performance of household appliances.

NOTE As stated in the Introduction to IEC 60704-1, this test code is concerned with airborne noise only.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – TEST CODE FOR THE DETERMINATION OF AIRBORNE ACOUSTICAL NOISE –

Part 2-10: Particular requirements for ranges, ovens, steam ovens, grills and microwave ovens

1 Scope

This part of IEC 60704 applies to electric appliances (including their accessories or components) for household and similar use, supplied from mains or from batteries.

By "similar use" is understood the use in conditions similar to those found in households, for example in inns, coffee houses, tea rooms, hotels, barber or hairdresser shops, launderettes, etc., if not otherwise specified in the IEC 60704-2 series.

This document does not apply to

– appliances, equipment, or machines designed exclusively for industrial or professional purposes;
– appliances that are integrated parts of a building or its installations, such as equipment for air conditioning, heating and ventilating (except household fans, cooker hoods, free-standing heating appliances, dehumidifiers, air cleaners, and stand-alone water heaters), oil burners for central heating, pumps for water supply and for sewage systems;
– separate motors or generators and
– appliances exclusively for outdoor use.

For determining and verifying noise emission values declared in product specifications, see IEC 60704-3:2019.

These particular requirements apply to ranges, ovens, steam ovens, **grills** and microwave ovens for household and similar use.

This document does not apply to hobs.

This document does not apply to appliances or parts of appliances that use gas energy.

Requirements for the declaration of noise emission values are not within the scope of this document.

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 60350-1:2023, *Household electric cooking appliances – Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance*

IEC 60704-2 (all parts), *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise*

IEC 60704-3:2019, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 3: Procedure for determining and verifying declared noise emission values*

IEC 60705:–[1], *Household microwave ovens – Methods for measuring performance*

IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

IEC 61672-1:2013, *Electroacoustics – Sound level meters – Part 1: Specifications*

ISO 3743-1:2010, *Acoustics – Determination of sound power levels of noise sources – Engineering methods for small, movable sources in reverberant fields – Part 1: Comparison method for hard-walled test rooms*

ISO 3743-2:2018, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering methods for small, movable sources in reverberant fields – Part 2: Methods for special reverberation test rooms*

ISO 3744:2010, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane*

ISO 9614-1:1993, *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 1: Measurement at discrete points*

ISO 9614-2:1996, *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning*

ISO 9614-3:2002, *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 3: Precision method for measurement by scanning*

ISO 6926:2016, *Acoustics – Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels*

ISO 12001:1996, *Acoustics – Noise emitted by machinery and equipment – Rules for the drafting and presentation of a noise test code*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Terms and definitions pertinent to the determination of sound power levels can be found in ISO 3743-1:2010, ISO 3743-2:2018 and ISO 3744:2010.

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
measurement time interval
portion or a multiple of an operational period or operational cycle for which the sound power levels are determined

[1] Under preparation. Stage at the time of publication: IEC FDIS 60705:2024.

3.2
operational period
interval of time during which a specified process is accomplished by the appliance under test (for example, washing or rinsing or drying for a dishwasher)

3.3
operational cycle
specific sequence of operational periods occurring while the appliance under test performs a complete work cycle

Note 1 to entry: During the operational cycle, each operational period is associated with a specific process that can occur only once, or can be repeated (for example, washing and rinsing and drying for a dishwasher).

3.4
time history
continuous recording of the sound pressure level (for a distinct microphone position) as a function of time, which is obtained during one or more operational periods of an operational cycle

3.5
reference box
hypothetical right parallelepiped terminating on the reflecting plane(s) on which the noise source under test is located, that just encloses the source including all the significant sound radiating components and any test table on which the source is mounted

[SOURCE: ISO 3744:2010, 3.10, modified – The note has been omitted.]

3.6
test enclosure
enclosure used for simulating the typical acoustic built-in or/and mounting conditions

3.101
grill
appliance or part of an appliance in which food is cooked by radiant heating

[SOURCE: IEC 60350-1:2023, 3.6]

3.102
steam function
heat transmission to the food mainly by condensation of steam at ambient pressure (approximately 100 kPa) and with a temperature ≤100 °C

[SOURCE: IEC 60350-1:2023, 3.21]

3.103
hot steam function
heat transmission to the food by generated steam in combination with radiation or convection, or a combination of both, at ambient pressure (approximately 100 kPa) and with a temperature > 100 °C

[SOURCE: IEC 60350-1:2023, 3.9]

3.104
heating function
heat transmission by natural or forced air circulation, or radiation for baking and roasting

EXAMPLE

- Forced air circulation function which heats food mainly by circulating the air with the aid of a fan;

- conventional **heating function** which heats food mainly by natural convection of the air;
- or a combination of both functions.

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

[SOURCE: IEC 60350-1:2023, 3.7]

3.105
microwave function
function using only electromagnetic energy in one or several of the ISM frequency bands between 300 MHz and 30 GHz for heating food and beverages in a cavity

[SOURCE: IEC 60705:–, 3.5]

3.106
combination microwave function
heat transfer by electromagnetic energy simultaneously or consecutively with energy transfer by forced air circulation, conventional heating, by hot steam or by steam

[SOURCE: IEC 60705:–, 3.2, modified – the note has been removed.]

3.107
multiple cavity appliance
appliance that has more than one separate cavity in which food is cooked and which can be controlled independently, but cannot be installed separately

[SOURCE: IEC 60350-1:2023, 3.10]

4 Measurement methods and acoustical environments

4.1 General

This document is concerned with objective methods of engineering accuracy grade 2 in accordance with ISO 12001:1996 for determining sound power levels L_W, expressed in decibels (dB), with reference to a sound power of one picowatt (1 pW), of airborne acoustical noise within the specified frequency range of interest (generally including the octave-bands with centre frequencies from 125 Hz to 8 000 Hz), and for prescribed operating conditions of the appliance to be measured.

Methods for determining sound power levels with precision accuracy grade 1 in accordance with ISO 12001:1996, as specified for example in ISO 3741 and ISO 3745, are not included in this document. They may, however, be applied if the appropriate test environment and instrumentation are available.

NOTE 1 The noise values obtained under the described conditions of this document will not necessarily correspond to the noise experienced under the operational conditions of practical use.

NOTE 2 For quality control during production etc., simplified methods can be appropriate. For noise reduction purposes, other measurement methods employing, for example, narrow-band analysis or intensity techniques usually have to be applied. These methods are not covered by this document.

The total noise emitted by machinery or equipment and radiated in all directions to the space surrounding the machine can be characterized by the sound power of the machine. Within the accuracy range of this document, the sound power of a machine is basically independent of the environment in which the machine is installed

Therefore, the concept of sound power level has been chosen for expressing the noise emission of appliances for household and similar purposes.

The preferred noise emission quantity is the A-weighted sound power level, L_{WA}, in dB (re 1 pW).

According to this document, two principal methods exist, the direct method and the comparison method, as described in 4.2 and 4.3. These two methods can be used alternatively.

Different types of environments, as described in 4.4, may be used. A part of the IEC 60704-2 series may, if necessary, exclude one or several combinations among those available.

4.2 Direct method

The direct method can be used only for measurements in qualified test environments in accordance with ISO 3744:2010 for free field conditions over reflecting plane(s), and in accordance with ISO 3743-2:2018 for special reverberation test rooms.

With this method, the sound power level is determined

– in free field conditions over reflecting plane(s), from time-averaged sound pressure levels (on a mean-square basis) over the measurement surface and from the area of the measurement surface, S, or

– in reverberation and special reverberation test rooms, from averaged sound pressure levels, and from the reverberation time and the volume of the test room.

If for a measurement in a free field, reverberation or special reverberation room is not possible because the appliance cannot be placed or operated in such an environment, the intensity method in accordance with ISO 9614-1:1993, ISO 9614-2:1996, and ISO 9614-3:2002 shall be applied. For the intensity method, the standard deviations given in the parts of the IEC 60704-2 series and IEC 60704-3:2019 are not applicable unless stated explicitly.

These methods yield results expressed in A-weighted sound power levels (and in octave- or 1/3 octave-band sound power levels, if required) that are calculated directly from measured sound pressure levels.

NOTE This method can also be used in conjunction with more precise methods, such as those given in ISO 3741 and ISO 3745.

If pure tone components are present in the noise emitted by the source, the estimated standard deviation of the measured sound pressure levels in the special reverberation room can increase. In such cases additional microphone positions or source positions are necessary as specified in ISO 3743-2.

4.3 Comparison method

The comparison method for measurement is explicitly described in ISO 3743-1:2010 and in ISO 3743-2:2018.

NOTE The term "comparison method" is not explicitly given in ISO 3744:2010, but when applying the "absolute comparison test" for the determination of the environmental correction given in A.3 of ISO 3744:2010, by using a reference sound source, the procedure is, in fact, a comparison method.

With this method, the sound power level is determined by comparing the averaged values (on a mean-square basis) of the sound pressure levels produced by the source in the test room to the averaged values of the sound pressure levels produced in the same room by a calibrated reference sound source (RSS) of known sound power output, complying with the requirements of ISO 6926:2016. The difference in sound pressure levels is equal to the difference in sound power levels when conditions are the same for both sets of measurements.

This method yields results expressed in octave- or 1/3 octave-band sound power levels, and the A-weighted sound power level is calculated from the octave- or 1/3 octave-band sound power levels.

To check whether there is a systematic difference between results obtained in different environments, the use of the comparison method is recommended.

If pure tone components are present in the noise emitted by the source, the estimated standard deviation of the measured sound pressure levels in the hard-walled test room or in the special reverberation room can increase. In such cases additional microphone positions or source positions are necessary as specified in ISO 3743-1 or ISO 3743-2.

4.4 Acoustical environments

4.4.1 General requirements and criterion for adequacy of the test environment

They are given in the following clauses:

– Clause 4 of ISO 3743-1:2010 for hard-walled test rooms;
– Clause 5 of ISO 3743-2:2018 for special reverberation test rooms and
– Clause 4 of ISO 3744:2010 for free-field conditions over a reflecting plane.

A classification of different types of noise is given in ISO 12001:1996. The method specified in ISO 3744:2010 is suitable for measurements of all types of noise emitted by household appliances. The methods specified in ISO 3743-1:2010 and ISO 3743-2:2018 are suitable for all types of noise, except for sources of impulsive noise consisting of short-duration noise bursts. This will be taken into account in the preparation of parts of the IEC 60704-2 series.

The method specified in ISO 3744:2010 is applicable to noise sources of any size. Limitations for the size of the source are given in 4.2 of ISO 3743-1:2010 and in Clause 5 of ISO 3743-2:2018. This will be taken into account in the preparation of parts of the IEC 60704-2 series.

NOTE For free-field conditions over a reflecting plane, the absolute comparison test for the qualification of the environment, described in Clause A.2 of ISO 3744:2010, is preferred.

Guidelines for the design of simple test rooms with free-field conditions are given in Annex C.

Guidelines for the design of a suitable special reverberation test room are given in ISO 3743-2:2018, Annex A.

4.4.2 Criterion for background noise level

Requirements for the background noise level are given in 4.5 of ISO 3743-1:2010, in 6.5 of ISO 3743-2:2018 and in 4.2 of ISO 3744:2010. Averaged over the microphone positions, the background noise level shall be at least 6 dB below, and preferably more than 15 dB below, the sound pressure level to be measured.

NOTE If the difference between the sound pressure levels of the background noise and the appliance noise is less than 6 dB, see 8.2.

4.4.3 Environmental conditions

Environmental conditions having an adverse effect on the microphone used for the measurements (for example, strong electric or magnetic fields, wind, impingement of air discharge from the equipment being tested, high or low temperatures) shall be avoided by proper selection or positioning of the microphone.

The instructions of the manufacturers of the measurement instruments regarding adverse environmental conditions shall be followed. The microphone shall always be oriented in such

a way that the angle of incidence of the sound waves is that for which the microphone is calibrated.

4.5 Measurement uncertainties

4.5.1 General

The estimated values of the standard deviations of reproducibility of sound power levels determined in accordance with this document are given in 9.1 of ISO 3743-1:2010, in 11.1 of ISO 3743-2:2018 and in 9.1 of ISO 3744:2010. But for a particular family of appliances of similar size with similar operating conditions, the standard deviations of reproducibility can be smaller than these values. Hence, in the IEC 60704-2 series, standard deviations smaller than those listed in ISO standards can be stated if substantiation is available from the results of suitable interlaboratory tests.

In the case of discrepancies between the measurements where the results normally remain inside the foreseen standard deviation, it can be helpful to perform measurements according to the upper grade of accuracy: grade 1, laboratory or precision, as described in ISO 3741 or ISO 3745.

4.5.2 Standard deviations on repeatability and reproducibility and standard deviations related to declaration and verification

The estimated values of standard deviations of sound power levels, determined according to this document are given in Table 1.

Table 1 – Standard deviations of sound power levels

Standard deviation dB	
σ_r (repeatability)	σ_R (reproducibility)
estimated 0,4	estimated 1,0

For the purpose of determining and verifying declared noise emission values according to IEC 60704-3, the values in Table 2 apply:

Table 2 – Standard deviations for declaration and verification

Standard deviation dB		
σ_P (production)	σ_t (total)	σ_M (reference)
estimated 1,0 to 1,7	estimated 1,4 to 2,0	2,0

NOTE The standard deviation of repeatability, reproducibility and production and the total standard deviation have not been verified recently. Because of technical development of the appliances it is possible that these values are not correct anymore. Especially for steaming function the correct standard deviations can be different to the values given here.

5 Instrumentation

5.1 Instrumentation for measuring acoustical data

Requirements for the instrumentation system and for its calibration are given in Clause 5 of ISO 3743-1:2010, in Clause 7 of ISO 3743-2:2018 and in Clause 5 of ISO 3744:2010.

The instrumentation system shall meet the requirements for a type 1 instrument laid down in IEC 61672-1:2013, in accordance with the basic standard used. For measurements in octave- and 1/3 octave-bands, the instrumentation system shall meet the requirements of IEC 61260-1:2014.

RSS shall meet the requirements of ISO 6926:2016, and shall be calibrated annually.

The use of a windscreen shall be considered. If necessary, the observed sound pressure level shall be corrected for changes in the microphone sensitivity, in accordance with the instructions accompanying the instrumentation.

5.2 Instrumentation for measuring climatic conditions

5.2.1 The temperature is determined with instruments having an accuracy of ±1 °C.

5.2.2 The relative humidity is determined with instruments having an absolute accuracy of ±2 % within the measuring range.

5.2.3 The absolute air pressure is determined with instruments having an accuracy of ±0,5 kPa.

5.3 Instrumentation for measuring operating conditions

5.3.1 The voltage at the plug of the cable or cord of mains-powered appliances is measured with voltmeters having an accuracy of class 0,5 instruments.

5.3.2 The voltage at the battery terminals of battery-powered appliances is measured with voltmeters having an accuracy of class 0,5 instruments.

5.3.3 The rotational speed of motors, attachments, etc. is measured, if necessary, with speed indicators having an accuracy of ±1 % of full scale.

6 Operation and location of appliances under test

6.1 Equipping and pre-conditioning of appliances

6.1.1 For the measurement of a **heating function** or a **grill**, all accessories shall be removed. Side racks shall be removed if they can be removed without a tool.

For the measurement of a **microwave function**, the appliance shall be equipped with the accessory needed for positioning the water load.

For the measurement of a **steam function**, all accessories are removed. The fresh water tank shall be completely filled. The tank for condensed water shall be empty. If the appliance can be connected to water supply and drainage, these connections shall be used.

For measurement of a function, which can use a rotary spit, the appliance shall be equipped with drive units and accessories that are necessary to run the motor(s).

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

6.1.2 Care shall be taken to ensure that any auxiliary equipment (such as electrical conduits or cables, piping for water supply or drainage, air ducts, etc.) necessary for the operation of the appliance, does not radiate a significant amount of sound into the test environment or change the sound output of the appliance. Guidelines are given in 6.2 of ISO 3743-1:2010, in 8.4 of ISO 3743-2:2018 and in 6.2 ISO 3744:2010.

6.1.3 Prior to noise measurements, the appliance, equipped as for intended use, shall have been in operation long enough to prevent excessive noise due to parts not being run in. Running-in should take place at the highest speed setting, if any, and unless otherwise stated, without load. The relevant part of IEC 60704-2 series indicates the total period for running-in and the rated operating times unless the manufacturer has recommended otherwise.

The appliance is equipped according to 6.1.1. For **heating, grill and steam function** the appliance shall have been in operation for at least 10 min at any setting. For **microwave function** the appliance shall have been in operation for at least 1 min at any setting.

6.1.4 Stabilising is included in the operation, according to 6.4.2.

6.2 Supply of electric energy and of water or gas

6.2.1 Appliances with mains powered electric motor(s) are supplied at rated voltage and at rated frequency. Appliances designed for DC only are supplied with DC. If a voltage range and/or a frequency range are indicated, then the supply voltage and/or frequency shall be the nominal system voltage and/or system frequency of the country in which the appliance is intended to be used. Tolerances shall not exceed ±2 % for voltage and ±1 % for frequency throughout the test.

The nominal system voltage and its values are defined in IEC 60038:2009.

If the rated voltage of a mains supplied appliance differs from the nominal system voltage as common in the country of use, measurements should be carried out at the nominal voltage as common in the country of use.

The supply voltage is measured at the plug of a non-detachable cable or cord, or at the appliance inlet if a detachable cable is provided, but in no case at the entrance of extension cables or cords.

6.2.2 Not applicable.

6.2.3 Not applicable.

6.2.4 The water and/or gas supply, if any, shall be as specified by the manufacturer.

If not specified by the manufacturer, the water supply pressure shall be 240 kPa ± 50 kPa, the temperature of cold water shall be 15 °C ± 2 °C and the temperature of hot water shall be 55 °C ± 2 °C, unless otherwise specified in the relevant part of the IEC 60704-2 series.

When, in some countries, the water supply pressure/temperature differs from the water supply pressure/temperature of the country concerned, measurements carried out at rated pressure/temperature can be misleading for the consumer. In this case, additional measurements can be necessary. If the test pressure/temperature differs from the rated pressure/temperature, this should be reported.

6.3 Climatic conditions

In general, household appliances (unless otherwise specified for a special family) are operated under the following climatic conditions:

ambient temperature	18 °C to 28 °C
relative humidity	25 % to 70 %
atmospheric pressure	86 kPa to 106 kPa

6.4 Loading and operating of appliances during tests

6.4.1 General requirements are given in 6.5 of ISO 3743-1:2010, in 8.5 of ISO 3743-2:2018 and in 6.6 of ISO 3744:2010. For the purpose of establishing a noise test code, the following guidelines are given, unless otherwise specified in the relevant part of the IEC 60704-2 series.

In general, the loading and operating conditions should, as far as practicable, simulate normal use but, in every case, preference has to be given to simple conditions providing satisfactory repeatability and reproducibility.

The presence of an operator should be avoided. An operator shall be present only if the application of the load is not practicable without an operator. This operator shall not wear abnormally sound absorptive clothing that might influence the sound measurements.

6.4.2 Table 101 specifies the setting(s) to be chosen and the measurement time(s).

Table 101 – Settings and measurement time

Function under test	Setting	Measurement time	Additional information
Heating function In general, the highest noise emission occurs for heating functions with forced air circulation when the fan is running.	Temperature setting within the range of 170 °C to 190 °C. If a fast **preheating function** is available, this is activated.	Heat up the appliance 10 min then operate the appliance for a further 30 min. Within these 30 min, 3 measurements are carried out with a measurement period of 5 min each. The time of these 3 measurements is randomly chosen within the 30 min. The final result is the logarithmic mean of these three measurements.	Without any load and without any shelf or grid.
Steam function	Temperature setting at 100 °C If the temperature cannot be set due to the construction of the control, the nearest setting related to the specified temperature is chosen.	Noise measurement starts immediately after the **steam function** has started. The measurement period is 900 s ± 10 s.	Without any load and without any shelf, grid and steaming accessory. Before a noise measurement is done the appliances shall be operated at **steam function** for at least 30 min to ensure that possible calibration is performed. After the calibration cycle, residual water shall be removed in accordance with the manual instructions.
Microwave function	1st measurement with power level MAX. 2nd measurement with a power level MIN. At least the loudest value shall be reported.	Noise measurement starts 30 s ± 5 s after the **microwave function** was started. Measurement periods are 60 s ± 10 s for both measurements. It is not necessary to cool the appliance between these two measurements.	Load: glass container with 1 000 g water. The glass container is positioned on the food support. If the turntable can be switched on/off, it shall be switched on. The glass container specified in IEC 60705:–, Clause 8 can be used. Measurement shall be finished before water starts boiling. Hence, the glass container with water shall be changed between both measurements. A glass rod or similar is placed in the glass container to prevent accidents due to the boiling delay factor.
Grill	Setting at maximum temperature or level	Noise measurement starts 10 min after switching on. The measurement period is 30 s ± 10 s.	Without any load and without any shelf or grid.

No measurement is stated for the **combination microwave function** and **hot steam function**, as the high variety of possible combination is hardly to specify.

Any cleaning mode shall be disregarded.

In the case of **multiple cavity appliances**, the multiple cavities shall be operated simultaneously with settings in accordance with Table 101.

6.4.3 Not applicable.

6.4.4 When applying loading and operating conditions for determining noise emission, care shall be taken to avoid possible overheating of the appliance under test. Rated operating and resting times and/or the manufacturer's instructions shall be followed.

6.5 Location and mounting of appliances

6.5.1 The basic requirements in 6.3 and 6.4 of ISO 3743-1:2010, in 8.2 and 8.3 of ISO 3743-2:2018 and in 6.3 and 6.4 of ISO 3744:2010 shall be followed. The following guidelines are given, unless otherwise specified in the relevant part of the IEC 60704-2 series.

6.5.2 Floor-standing appliances, counter-top or table-type appliances, are placed in their normal position directly, without any resilient means other than those incorporated in the appliance:

– either on the floor of the hard-walled test room or of the special reverberation test room with a minimum distance of 1 m between any surface (including protruding parts) of the appliance and the nearest wall;

– or on the reflecting plane of the free field environment, taking into account the shape and size of the specified measurement surface.

Stand-type appliances (such as appliances designed for use on a stand, for example, hair drying hoods) are placed on the stand supplied with the appliance, or on a stand constructed in accordance with the manufacturer's instructions.

Sound radiation due to possible vibrations of the piece of floor covering shall be prevented. The piece of floor covering is considered to be a part of the appliance under test, and its possible influence on the acoustical characteristics of the test environment is not taken into account.

Table-top appliances, where a table is required for operation, are placed in the centre of the top of the standard test table described in Annex A.

Counter-top and table-type appliances shall be positioned in accordance with 6.5.4 on the floor of the measurement room.

6.5.3 Not applicable.

6.5.4 Floor standing appliances, including cabinets or counters or test enclosures for building-in or under counter types, for placing against a wall, are placed in normal position, with a distance of D = 10 cm ± 1 cm between the back of the appliance and a vertical wall or plane, directly, without any resilient means other than those incorporated in the appliance:

– either on the floor of the hard-walled test room or of the special reverberation test room with the mentioned distance from a wall and with a minimum distance of 1,5 m between any other surface of the appliance or of the cabinet or the counter from the nearest corner of the room;

– or on a horizontal reflecting plane in the free-field environment and with the mentioned distance between the back of the appliance and the vertical reflecting plane. The minimum size of this vertical plane shall be at least equal to the size of the projection of the measurement surface. The acoustic absorption coefficient of the vertical reflecting plane shall be smaller than 0,06 in the frequency range of interest.

The distance between the vertical reflecting plane and the appliance shall be established by placing the appliance in direct contact with the vertical reflecting plane and then moving it away to the distance D. Care should be taken to avoid any direct contact between the

appliance (including protruding parts, worktops, spacers, etc.) and the vertical reflecting plane.

6.5.5 Wall-mounted appliances, including their accessories, if any, are fastened or held by an appropriate fixture in close contact, without any resilient means other than those incorporated in the appliance:

– either on a wall of the hard-walled test room or of the special reverberation test room;

– or on a vertical reflecting plane in the free field environment. The minimum size of this vertical plane shall be at least equal to the size of the projection of the measurement surface. The acoustic absorption coefficient of the vertical reflecting plane shall be smaller than 0,06.

The height of the lowest edge of the appliance from the floor shall be fixed in accordance with the manufacturer's instructions.

The location of the appliance (fastened or held in an appropriate fixture) as for floor-standing appliances (see 6.5.2) may be adopted, if preliminary investigation has shown that the resulting sound power level value is not significantly different from that determined with the location prescribed in this subclause.

6.5.6 Appliances to be built-in are built-in in accordance with the manufacturer’s installation instructions in an appropriate test enclosure in accordance with Annex B.

The manufacturer’s instructions regarding installation and use of the appliance shall be followed. The front edge of the appliance (including the door) shall be aligned with the front edge of the test enclosure. If the manufacturer’s installation instructions provide for a skirting board at the lower front side of the appliance, the test enclosure shall be provided with a skirting board of the maximum height compatible with the door assembly and of the same material and thickness as the test enclosure.

Care should be taken to ensure that no structure-borne noise is transmitted to the test enclosure.

If an appliance is provided with spacers, strips, or other special means of solid or resilient material for closing the gap(s) between the contours of the appliance and the cabinet or enclosure, these means shall be used accordingly. If such means are not provided, the gap(s) are left open.

At the rear left-hand or right-hand corner of the test enclosure, a cut-out at a minimum size shall be provided to enable, for example, power supply, water supply and drainage. This cut-out shall be sealed to avoid any noise leakage.

If necessary, the test enclosure shall be provided with ventilation openings in accordance with the manufacturer’s instructions.

The test enclosure with the appliance shall be placed in accordance with 6.5.2, 6.5.4 or 6.5.5. If doors are protruding, the test enclosure shall be provided with a base shelf lying on the reflecting plane. The thickness of the base shelf shall be adapted to allow the opening of the protruding door. Care shall be taken that the base shelf does not transmit any structure-borne noise to the test enclosure.

Appliances to be integrated shall be installed in the same conditions as built-in appliances. In addition, they shall be equipped, in accordance with the manufacturer’s instructions, with a door assembly of the maximum surface allowed by the manufacturer, and of the same material and thickness as the test enclosure.

7 Measurement of sound pressure levels

7.1 Microphone array, measurement surface and RSS location for essentially free field conditions over reflecting plane(s)

7.1.1 The requirements in 7.1 to 7.2 of ISO 3744:2010 shall be followed. Guidance for the selection of the measurement surface and microphone array in the relevant part of IEC 60704-2 series is given below; care shall be taken to use only one of the following two shapes and one of the possible microphone arrays for a particular family of appliances, unless otherwise specified in the relevant part of the IEC 60704-2 series.

7.1.2 For floor-standing free-standing appliances, including built-in appliances, the measurement surface is a parallelepiped with nine microphone positions, as specified in 7.2.4 of ISO 3744:2010 and in Figure 1. Additional measurement positions can be required in accordance with 8.1.2 of ISO 3744:2010 and Annex C of ISO 3744:2010. The number of microphone positions can also be reduced in accordance with 8.1.2 of ISO 3744:2010 and Annex C of ISO 3744:2010.

The preferred value of the measurement distance d is 1 m.

For determining time histories, frequency spectra, etc. of the appliance, microphone position no. 1 is recommended for the nine-microphone array.

NOTE The front of the appliance, unless otherwise stated in the relevant part of the IEC 60704-2 series, is directed in the direction of the x-axis.

Coordinates of microphone positions:

No.	x	y	z
1	a	0	$0{,}5 \cdot c$
2	0	b	$0{,}5 \cdot c$
3	$-a$	0	$0{,}5 \cdot c$
4	0	$-b$	$0{,}5 \cdot c$
5	a	b	c
6	$-a$	b	c
7	$-a$	$-b$	c
8	a	$-b$	c
9	0	0	c

Measurement surface area:

$S = 2\,(2 \cdot b \cdot c + 2 \cdot a \cdot c + 2 \cdot a \cdot b)$

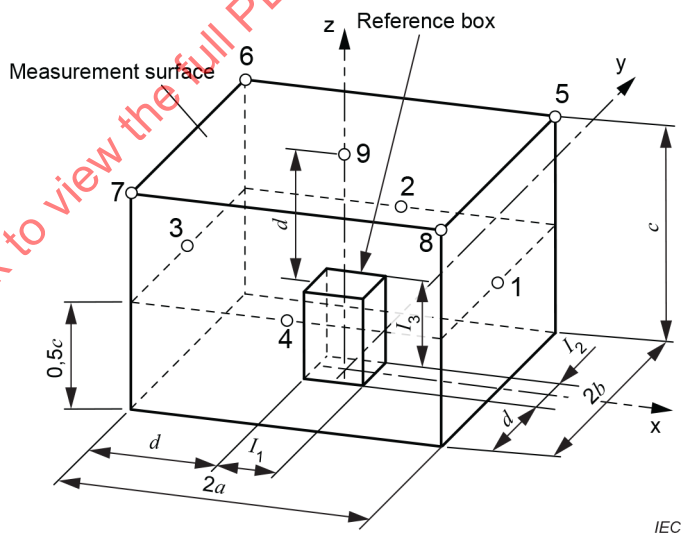


Figure 1 – Measurement surface – parallelepiped – with key microphone positions, for floor free-standing appliances

7.1.3 For floor-standing or counter-type appliances for placing against a wall, including built-in appliances, the measurement surface is a parallelepiped, with six microphone positions, as specified in 7.2.4 of ISO 3744:2010 and in Figure 2 of this document. Additional measurement positions can be required in accordance with 8.1.2 of ISO 3744:2010 and Annex C of ISO 3744:2010. The number of microphones can also be reduced in accordance with 8.1.2 of ISO 3744:2010 and Annex C of ISO 3744:2010.

The preferred value of the measurement distance d is 1 m.

For determining time histories, frequency spectra, etc. of the appliance, microphone position no. 1 is recommended for the six-microphone array.

This measurement surface can also be used for wall-mounted appliances.

NOTE 1 The front of the appliance is directed in the direction of the x-axis.

NOTE 2 In this case, the x and y axes are located in the vertical reflecting plane, with the x-axis directed vertically upwards and the front of the appliance being directed in the direction of the z-axis.

Coordinates of microphone positions:

No.	x	y	z
1	$2 \cdot a$	0	$0{,}5 \cdot c$
2	a	b	$0{,}5 \cdot c$
3	a	$-b$	$0{,}5 \cdot c$
4	$2 \cdot a$	b	c
5	$2 \cdot a$	$-b$	c
6	a	0	c

Measurement surface area:

$S = 2\,(2 \cdot a \cdot c + 2 \cdot a \cdot b + b \cdot c)$

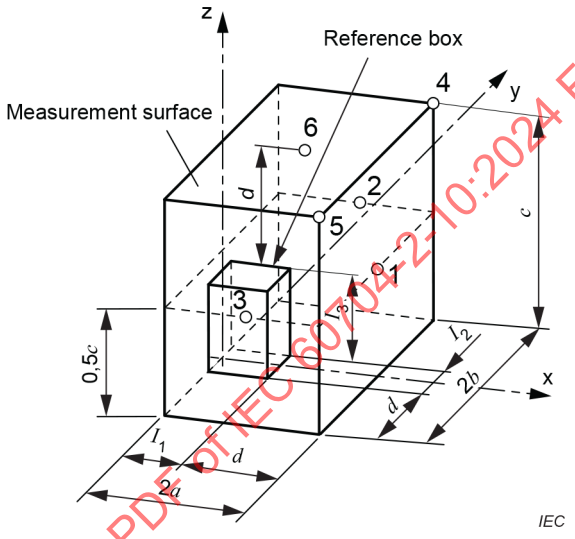


Figure 2 – Measurement surface – parallelepiped – with key microphone positions, for floor standing appliances placed against a wall

7.1.4 For floor-standing cabinet-type appliances for placing against a wall, including built-in appliances of larger size with a height exceeding 2 d, but less than or equal to 5 d, the measurement surface is a parallelepiped with 10 microphone positions as specified in Figure 3. The points 9 and 10 are suppressed when not practicable (for example, appliances in contact with the ceiling). Additional measurement positions can be required in accordance with 8.1.2 ISO 3744:2010 and Annex C of ISO 3744:2010. The number of microphones can also be reduced in accordance with 8.1.2 of ISO 3744:2010 and Annex C of ISO 3744:2010.

NOTE The front of the appliance is directed in the direction of the x-axis.

The preferred value of the measurement distance d is 1 m.

For determining time histories, frequency spectra, etc. of the appliance, microphone position no. 7 is recommended for the 10-microphone array.

Coordinates of microphone positions:

No.	x	y	z
1	a	$-b$	$0{,}25 \cdot c$
2	$2 \cdot a$	0	$0{,}25 \cdot c$
3	a	b	$0{,}25 \cdot c$
4	$2 \cdot a$	$-b$	$0{,}50 \cdot c$
5	$2 \cdot a$	b	$0{,}50 \cdot c$
6	a	$-b$	$0{,}75 \cdot c$
7	$2 \cdot a$	0	$0{,}75 \cdot c$
8	a	b	$0{,}75 \cdot c$
9	$2 \cdot a$	$-b$	c
10	$2 \cdot a$	b	c

Measurement surface area:

$S = 2\ (2 \cdot a \cdot c + 2 \cdot a \cdot b + b \cdot c)$

For appliances reaching the ceiling:

$l_3 = c$,

points 9 and 10 are suppressed.

$S = 2\ (2 \cdot a \cdot c + b \cdot c)$

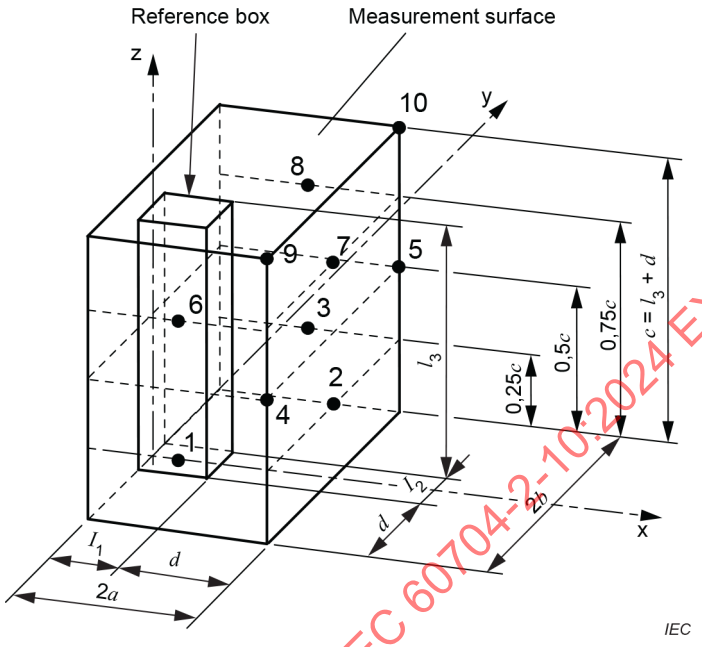


Figure 3 – Measurement surface – parallelepiped – with key microphone positions, for high floor-standing appliances placed against a wall

7.1.5 For counter-top or table-type appliances, 7.1.3 applies.

7.1.6 Not applicable.

7.1.7 Not applicable.

7.1.8 If the appliance under test emits steady noise, it is permissible to measure the surface sound pressure level by traversing a microphone along measurement paths, instead of at individual microphone positions, as described in 7.4.3 of this document and in Annex B and Annex C of ISO 3744:2010.

7.1.9 Guidelines for the location of the RSS are given in Annex A of ISO 3744:2010.

7.2 Microphone array and RSS location in hard-walled test rooms

The requirements in Clause 7 of ISO 3743-1:2010 shall be followed.

In general, at least three microphone positions should be used.

According to 7.2 of ISO 3743-1:2010, the hard-walled test room is more suitable for sources not designed to be placed on the floor against a wall or to be wall-mounted. Should the source under test be closer than 1 m to the wall, the RSS shall not be placed at the position of the source, but at a position on the floor 1 m from the wall.

7.3 Microphone array and RSS location in special reverberation test rooms

The requirements in Clause 9 of ISO 3743-2:2018 shall be followed.

In general, the number of microphone positions N_m = 6 and the number of source locations N_s = 1.

A change of these numbers depends on the results of a preliminary measurement in accordance with 9.4 of ISO 3743-2:2018.

When, according to these preliminary investigations, the standard deviation s_M is above 4,0 dB, in order to reduce the effort of measuring in a special reverberation test room, the use of a moving microphone instead of 12 individual microphone positions is recommended; alternatively, measurements under free field conditions can be preferable.

NOTE The use of a moving microphone traversing a path, in accordance with 9.6 of ISO 3743-2:2018, is often more convenient than the use of a number of fixed microphones.

In general, the RSS used for the comparison method is measured with the same microphone array and with the same number of source locations as used for the appliance under test. The RSS is located on the floor so that the projection of the centre of its reference box coincides with the projection of the centre of the reference box of the appliance under test.

7.4 Measurements

7.4.1 The measurement time interval shall be as specified in 6.4.2.

7.4.2 The following data shall be measured and considered when using the comparison method in hard-walled test rooms, or in special reverberation test rooms:

– time-averaged octave- or 1/3 octave-band sound pressure levels at each microphone position (or each traverse) during operation of the appliance under test;

– time-averaged octave- or 1/3 octave-band sound pressure levels at each microphone position (or each traverse) when the RSS is operating;

– time-averaged octave- or 1/3 octave-band sound pressure levels produced by the background noise.

7.4.3 The following data shall be measured and considered for measurements in free field conditions over a reflecting plane, or when using the direct method in special reverberation test rooms:

– A-weighted or octave- or 1/3 octave-band time-averaged sound pressure levels during operation of the appliance under test;

– A-weighted or octave- or 1/3 octave-band time-averaged sound pressure levels produced by the background noise.

7.4.4 If, owing to simple instrumentation or owing to the properties of the appliance under test, an observer has to be present, he shall be at least 0,5 m from the microphone in use, on the side away from the appliance under test.

8 Calculation of sound pressure and sound power levels

8.1 General

For measurements in hard-walled test rooms, the requirements in Clause 8 of ISO 3743-1:2010 shall be followed. For measurements in special reverberation test rooms, the requirements in Clause 10 of ISO 3743-2:2018 shall be followed. For measurements in free-field conditions over a reflecting plane, the requirements in 8.2 of ISO 3744:2010 shall be followed.

8.2 Corrections for background noise levels

If the background noise levels, L_{p}'', are more than 6 dB below the measured sound pressure levels, L_{p}', the values of L_{p}' shall be corrected to take into account the influence of background noise. The corrected value, L_{p} is given by

$$L_{p} = 10 \cdot lg\left(10^{0,1 \cdot L_{p}'} - 10^{0,1 \cdot L_{p}''}\right) \text{ dB (re 20 µPa)} \quad (2)$$

For measurements in hard-walled test rooms or in special reverberation test rooms, this formula applies to the sound pressure levels measured at each microphone position, before calculating the sound pressure level averaged over the microphone positions.

For measurements in free-field conditions over a reflecting plane, Formula (2) applies to the sound pressure level averaged over the microphone positions (see 8.4).

When the background noise levels are more than 15 dB below the sound pressure levels with the source operating, no correction is made.

Even if the measurement is invalid for one or more frequency bands, it can still be valid for the A-weighted value, provided that the difference between $L_{p\mathrm{A}}'$ and $L_{p\mathrm{A}}''$ is greater than 6 dB.

If it can be demonstrated that the absolute criteria for background noise is fulfilled and the background noise levels in the test room at the time of the measurements are less than or equal to those given in 4.2.2 of ISO 3744:2010 for all bands within the frequency range of interest, the measurements can be taken as having met the background noise requirements of this document, even if the 6 dB requirement is not met for all bands. It can be assumed that the source emits little or no measurable noise in these frequency bands, and that the data reported represent an upper bound to the sound power level in these bands.

If the 6 dB criterion is not satisfied and the absolute criteria for background noise is not fulfilled, the accuracy of the result(s) is reduced. No correction for those levels is allowed if the measurements are made in hard-walled rooms or in special reverberation test rooms, and for measurements made in free field over a reflecting plane, a maximum correction of 1,3 dB can be subtracted from the measured values. The results may, however, be reported and may be useful in determining an upper bound to the sound power level of the appliance under test. If such data are reported, it shall be clearly stated in the text of the report, as well as in the graphs and tables of results, that the background noise requirements of this document have not been fulfilled.

8.3 Corrections for the test environment

For measurements in free-field conditions over a reflecting plane, the environmental correction K_2 (see 8.2.4 and Annex A of ISO 3744:2010) is applied to the sound pressure level averaged over the measurement surface, calculated according to the equation given in 8.2.4 of ISO 3744:2010.

The environmental correction is assumed to be zero for measurements made in hemi-anechoic rooms which meet the requirements of ISO 3745.

8.4 Calculation of sound pressure level averaged over the microphone positions

For the A-weighted sound pressure level or the level in each band of interest, an averaged sound pressure level over the microphone positions is calculated from the measured sound pressure levels, using the following equation:

$$L_{p\mathrm{m}} = 10 \cdot \lg\left(\frac{1}{N}\sum_{i=1}^{N} 10^{0,1 \cdot L_{p,i}}\right) \text{ dB} \quad \text{(re 20 µPa)}$$

where

$L_{p\mathrm{m}}$ is the sound pressure level averaged over the microphone positions or over the measurement surface, in dB, re 20 µPa;

$L_{p,i}$ is the sound pressure level resulting from the i-th microphone position, in dB, re 20 µPa;

N is the number of microphone positions (multiplied if necessary in reverberant field conditions by the number of source locations).

8.5 Calculation of sound power levels with the comparison method

For measurements in hard-walled test rooms or in special reverberation test rooms, the sound power level of the appliance under test, L_W, is calculated in each octave- or 1/3 octave-band within the frequency range of interest, using the equation

$$L_W = L_{W(\mathrm{RSS})} + (\overline{L_{p(\mathrm{AT})}} - \overline{L_{p(\mathrm{RSS})}})$$

where

$L_{W(\mathrm{RSS})}$ is the calibrated sound power level of the RSS, in dB (re 1 pW);

$\overline{L_{p(\mathrm{RSS})}}$ is the sound pressure level of the RSS averaged (energy basis) over the microphone positions or the microphone path, in dB (re 20 µPa);

$\overline{L_{p(\mathrm{AT})}}$ is the sound pressure level of the appliance under test averaged (energy basis) over the microphone positions or the microphone path, in dB (re 20 µPa).

Then, the A-weighted sound power level is calculated from the equation

$$L_{W\mathrm{A}} = 10 \cdot \lg\left(\sum_{j} 10^{0,1 \cdot (L_{W,j} + A_j)}\right) \text{ dB (re 1 pW)}$$

where

$L_{W,j}$ is the octave-band level, in band j, in dB (re 1 pW);

A_j is the A-weighted value of the midband frequency of octave- or 1/3 octave-band j, as given in Table B.1 of ISO 3743-1:2010.

8.6 Calculation of sound power levels in free field conditions over a reflecting plane

The sound power level of the appliance under test L_W is calculated from the value of the surface sound pressure level determined in accordance with 8.4, corrected from K_1 and K_2 (see 8.2 and 8.3) and from the area of the measurement surface, S, as follows:

$$L_W = L_{p\mathrm{mc}} + 10 \cdot \lg\left(\frac{S}{S_0}\right) \text{ dB}$$

where

$L_{p\mathrm{mc}}$ is the A-weighted or frequency band surface sound pressure level in accordance with 8.4, corrected from background noise and from environmental correction K_2, in dB (re 20 µPa);

S is the area of the measurement surface in m^2;

S_0 is 1 m^2.

8.7 Calculation of A-weighted sound power level with the direct method in special reverberation test rooms

The A-weighted sound power level of the appliance under test L_{WA} is calculated from the value of the mean sound pressure level over the microphone positions determined in accordance with 8.4 and the properties of the reverberation test room, as follows:

$$L_{WA} = L_{p\mathrm{mA}} - \left(10 \cdot \lg\left(\frac{T_N}{T_0}\right) + 10 \cdot \lg\left(\frac{V}{V_0}\right) - 13\right) \quad \mathrm{dB}$$

where

$L_{p\mathrm{mA}}$ is the A-weighted sound pressure level averaged in dB over the microphone positions in accordance with 8.4 in dB (re 20 µPa);

T_N is the nominal reverberation time of the test room in seconds;

T_0 is 1 s;

V is the volume of the test room in cubic metres;

V_0 is 1 m^3.

9 Information to be recorded

9.1 General data

9.1.1 Name and address of the laboratory where measurements are carried out.

9.1.2 File number and date(s) of measurements.

9.1.3 Name and address of the company, organisation, or person, who ordered the measurements.

9.1.4 Purpose of the measurements.

9.1.5 Statement of compliance with this document and the appropriate part of the IEC 60704-2 series.

9.2 Description of appliance under test

9.2.1 Category: for example, vacuum cleaner, washing machine, etc.

9.2.2 Design characteristics: for example, hand-held, table-type, floor-standing.

9.2.3 Manufacturer or dealer, trademark.

9.2.4 Model or type designation (name of product).

9.2.5 Serial number or production date.

9.2.6 Rating data (name plate data): for example, voltage, input capacity, water supply pressure, etc.

9.2.7 Power source and motor data: for example, mains-powered, battery-powered, induction motor, commutator motor, motor speed, etc.

9.2.8 Supplied and/or advertised attachments and/or accessories.

9.3 Measurement method

9.3.1 Direct method and/or comparison method.

9.3.2 Basic ISO standards used.

9.4 Acoustical test environment

9.4.1 Hard-walled test room and/or special reverberation test room and/or free field over reflecting plane.

9.4.2 Test room characteristics: for example, hemi-anechoic laboratory room, outdoor area, ordinary room with or without acoustical treatment, special reverberation test room, hard-walled test room.

9.4.3 Room inner (free) dimensions, volume.

9.4.4 Acoustical treatment of surfaces.

9.4.5 Room qualification, method and data.

9.5 Instrumentation

9.5.1 Instrumentation for measuring acoustical data: name, type, serial number, accuracy, manufacturer of equipment and auxiliaries, date of latest calibration.

9.5.2 Reference sound source with calibration data, manufacturer.

NOTE Calibration date can be according ISO 6926:2016.

9.5.3 Instrumentation for measuring climatic conditions: name, type, serial number, accuracy, manufacturer (if known).

9.5.4 Instrumentation for measuring operating conditions: name, type, serial number, accuracy, manufacturer (if known).

9.6 Equipment and pre-conditioning of appliance under test

9.6.1 Equipment, attachments, accessories selected for measurements.

9.6.2 Running-in procedure and period.

9.6.3 Not applicable.

9.7 Electric supply, water supply, etc.

9.7.1 Mains supply voltage with tolerances, AC, DC, frequency.

9.7.2 Battery type and capacity, fully or partly charged.

9.7.3 Water supply, pressure and temperature with tolerance.

9.7.4 Not applicable.

9.8 Climatic conditions

9.8.1 Temperature.

9.8.2 Relative humidity.

9.8.3 Atmospheric pressure.

9.9 Operation of the appliance under test

9.9.1 Idling and/or loading conditions; description of the applied load(s).

9.9.2 Selected operation procedure(s): for example, period(s), cycle(s), speed of motor(s), position of controls, etc.

9.9.3 Description of period(s) or cycle(s) used for measurements.

9.10 Location and mounting of the appliance under test

9.10.1 Description of the location of the appliance under test and of the RSS in the test environment: for example, distances from floor and wall(s) (if necessary by making a sketch).

9.10.2 Description of the mounting of the appliance under test: for example, fixtures, built-in cabinets, resilient support(s), floor covering(s), etc.

9.11 Microphone array

9.11.1 Description of the array: for example, number of microphone positions, co-ordinates, measurement distance, radius of the hemisphere, area of the measurement surface, etc.

9.11.2 Description of the location of the microphone array in the test environment: for example, distances from the environment boundaries, etc.

9.11.3 Microphone angle of incidence and orientation with respect to the source.

9.11.4 Fixed microphone(s) or moving microphone, transfer of a single microphone or scanning of the output from all microphones of the array, scanning procedure.

9.11.5 Attachments for microphones: for example, wind shielding accessories with correction data, etc.

9.12 Measurement data

9.12.1 Measured octave- or 1/3 octave-bands and/or A-weighted sound pressure levels for each microphone position and for each of the selected load and operation conditions of the appliance under test, and the periods or cycles used for measurements.

9.12.2 Measured octave- or 1/3 octave-bands sound pressure levels for each microphone position of the RSS.

9.12.3 Measured octave- or 1/3 octave-bands and/or A-weighted sound pressure levels of the background noise before and after each series of measurements.

9.12.4 Applied corrections to the measured values for the appliance under test and for the reference sound source (influence of the background noise and microphone attachments, environmental correction).

9.12.5 Determined time histories (preferably A-weighted sound pressure levels versus time) for selected loads and operation conditions and the periods or cycles used for measurements.

9.12.6 Determined frequency spectra.

9.12.7 Remarks on subjective impression of noise.

9.13 Calculated sound pressure and sound power levels

See Clause 8.

9.14 Reporting

Only those data, recorded in accordance with this clause, which are of importance for the purpose of the measurements, shall be reported. In general, the data of Clause 10 is important.

10 Information to be reported

		Subclause
10.1	**General data**	9.1
10.2	**Appliance under test**	9.2
10.2.1	Category	9.2.1
10.2.2	Design characteristics	9.2.2
10.2.3	Manufacturer, dealer, trademark	9.2.3
10.2.4	Model or type, designation	9.2.4
10.2.5	Serial number, production date	9.2.5
10.2.6	Rating data	9.2.6
10.2.7	Power source	9.2.7
10.2.8	Attachments, accessories	9.2.8

10.3 Test conditions for the appliance

		Subclause
10.3.1	Selected attachments, accessories	9.6.1
10.3.2	Supply from mains	9.7.1
10.3.3	Supply from batteries	9.7.2
10.3.4	Water supply	9.7.3
10.3.5	Not applicable	
10.3.6	Temperature	9.8.1
10.3.7	Relative humidity	9.8.2
10.3.8	Atmospheric pressure	9.8.3
10.3.9	Applied load	9.9.1
10.3.10	Operation procedure	9.9.2

10.3.11	Periods, cycles	9.9.3
10.3.12	Location in the test room	9.10.1
10.3.13	Mounting	9.10.2

10.4 Acoustical data

		Subclause
10.4.1	Direct and/or comparison method	9.3.1
10.4.2	Basic ISO standard(s) used	9.3.2
10.4.3	Reference sound source (RSS)	9.5.2
10.4.4	Test environment	9.4.1
10.4.5	Microphone array	9.11.1
10.4.6	Scanning procedure	9.11.4
10.4.7	Measured sound pressure levels of the appliance	9.12.1
10.4.8	Measured sound pressure levels of the RSS	9.12.2
10.4.9	Applied corrections	9.12.4
10.4.10	Time history of operation procedure	9.12.5
10.4.11	Frequency spectra	9.12.6
10.4.12	Calculated sound power levels. For **microwave function**, at least the loudest value shall be reported.	9.13

Annex A
(normative)

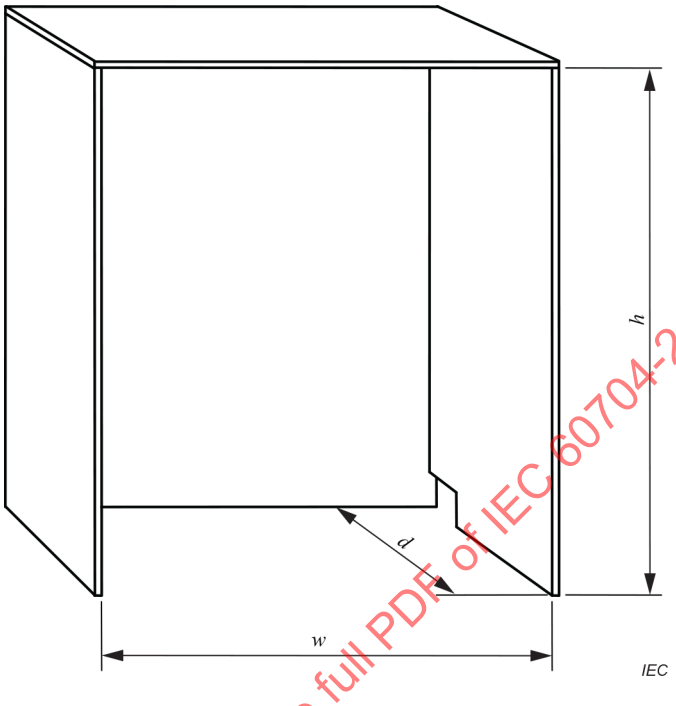
Standard test table

This annex of IEC 60704-1:2021 is not applicable.

Annex B
(normative)

Test enclosure

The test enclosure is shown in Figure B.1.



h is the inner height of the test enclosure $h = h_n + (3 \pm 1)$ mm

where
the nominal height, h_n, is the smallest integer multiple of 5 mm that accommodates the height of the installation opening in accordance with the manufacturer's installation instructions; calculated by:

$h_n = i \cdot 5$ mm with $i \cdot 5$ mm $\geq z > (i - 1) \cdot 5$ mm, $i = 1, 2, 3, \ldots$; where

z is the height of the installation opening given in the manufacturer's installation instructions. If a range is given, z shall be the smallest value of the range.

w is the inner width of the test enclosure $w = w_n + (5 \pm 1)$ mm

where
the nominal width, w_n, is the smallest integer multiple of 5 mm that accommodates the width of the installation opening in accordance with the manufacturer's installation instructions; calculated by:

$w_n = i \cdot 5$ mm with $i \cdot 5$ mm $\geq x > (i - 1) \cdot 5$ mm, $i = 1, 2, 3, \ldots$; where

x is the width of the installation opening given in the manufacturer's installation instructions. If a range is given, x shall be the smallest value of the range.

d is the inner depth of the test enclosure $d = d_n + (35 \pm 15)$ mm (i.e. $d \geq 550$ mm)

where
the nominal depth, d_n, is the smallest integer multiple of 5 mm, equal to or greater than 515 mm, that accommodates the depth of the installation opening in accordance with the manufacturer's installation instructions; calculated by:

$d_n = i \cdot 5$ mm with $i \cdot 5$ mm $\geq y > (i - 1) \cdot 5$ mm, $i = 1, 2, 3, \ldots$; where

y is the depth of the installation opening given in the manufacturer's installation instructions. If a range is given, y shall be the smallest value of the range.

NOTE 1 The addition offers the laboratory personal the possibility to centre the appliance in the enclosure and ensures that the appliance does not contact the test enclosure.

NOTE 2 The front of the appliance is aligned parallel.

Material of the enclosure: (19 ± 1) mm thick untreated particleboard (chipboard) or untreated plywood, having a density between 600 kg/m^3 and 750 kg/m^3.

Figure B.1 – Test enclosure

Annex C
(informative)

Guidelines for the design of simple test rooms with essentially free field conditions

The inner volume and the dimensions of the test room with essentially free field conditions depend on the size and the shape of the measurement surface used in the test. The measurement surface shall be at least 0,9 m distant from the absorptive surfaces of the test room

The floor of the test room shall be a hard, smooth, plane where the average sound absorption coefficient shall not exceed 0,06 over the 1/3 octave-band centre frequency range 100 Hz to 10 000 Hz. Usually, floors of painted poured concrete, or floors with asphalt or ceramic tiles, are satisfactory. If the floor is not a ground plane or integral with the building structure with adequate thickness, care shall be exercised that it does not radiate any appreciable sound due to vibrations.

The applicability of the test room for the purpose of this test code depends essentially on the quality of the acoustical treatment of its walls and ceiling.

A common treatment, consisting of wedges of absorptive material mounted (with a small airgap behind them) on the walls and on the ceiling of the building structure, will be extremely expensive, can be easily damaged in practical use, and will be hard to keep clean.

A very simple treatment consists of three layers of mineral wool (felt), each layer with a thickness of at least 80 mm, with different densities, the first layer being in contact with the building structure and having a density of approximately 55 kg/m^3, the second layer having a density of approximately 33 kg/m^3 and the third layer, forming the inner boundary of the test room, having a density of approximately 23 kg/m^3.

The three layers are fastened together to the walls and to the ceiling of the building structure by a mesh with a size of approximately 50 mm of galvanized steel wires with a diameter of approximately 1 mm.

This treatment is not expensive, the risk of damage is small, and the room can be cleaned easily.

Bibliography

IEC 60038:2009, *IEC standard voltages*

ISO 3741:2010, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms*

ISO 3745:2012, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision method for anechoic and hemi-anechoic rooms*
ISO 3745:2012/AMD:2017

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IEC 60704-2-10

Edition 3.0 2024-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Household and similar electrical appliances – Test code for the determination of airborne acoustical noise –
Part 2-10: Particular requirements for ranges, ovens, steam ovens, grills and microwave ovens

Appareils électrodomestiques et analogues – Code d'essai pour la détermination du bruit aérien –
Partie 2-10: Exigences particulières pour les cuisinières, les fours, les fours à vapeur, les grils et les fours à micro-ondes

IEC 60704-2-10:2024-09(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – TEST CODE FOR THE DETERMINATION OF AIRBORNE ACOUSTICAL NOISE –

Part 2-10: Particular requirements for ranges, ovens, steam ovens, grills and microwave ovens

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60704-2-10 has been prepared by subcommittee 59K: Performance of household and similar electrical cooking appliances, of IEC technical committee 59: Performance of household and similar electrical appliances. It is an International Standard.

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

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

a) alignment with the fourth edition of IEC 60704-1:2021;
b) alignment with IEC 60350-1:2023 regarding the definitions and settings;
c) introduction of the measurement of the steam function;
d) revision of settings and test parameters.

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

Draft	Report on voting
59K/396/FDIS	59K/398/RVD

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

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

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

This document is intended to be used in conjunction with IEC 60704-1:2021, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 1: General requirements*.

The relevant text of IEC 60704-1:2021 as amended by this publication establishes the test code ranges, ovens, steam ovens, grills and microwave ovens.

This document supplements or modifies the corresponding clauses in IEC 60704-1:2021. When a particular subclause of IEC 60704-1:2021 is not mentioned in this document, that subclause is applicable as far as reasonable. Where this document states "addition", "modification" or "replacement", the relevant requirements, test specifications or explanatory matter in IEC 60704-1:2021 are to be adapted accordingly.

Subclauses, tables and figures that are numbered starting from 101 are additional to those in IEC 60704-1:2021. Additional annexes are lettered AA, BB, etc.

Unless notes are in a new subclause or involve notes in IEC 60704-1:2021, they are numbered starting from 101, including those in a replaced clause or subclause.

In this standard, the following print types are used:

- terms defined in Clause 3: bold type.

A list of all parts in the IEC 60704 series, published under the general title *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The measuring conditions specified in this document provide for sufficient accuracy in determining the noise emitted and comparing the results of measurements taken by different laboratories, whilst simulating as far as possible the practical use of ranges, ovens, steam ovens, grills and microwave ovens.

It is recommended to consider the determination of noise levels as part of a comprehensive testing procedure covering many aspects of the properties and performance of household appliances.

NOTE As stated in the Introduction to IEC 60704-1, this test code is concerned with airborne noise only.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – TEST CODE FOR THE DETERMINATION OF AIRBORNE ACOUSTICAL NOISE –

Part 2-10: Particular requirements for ranges, ovens, steam ovens, grills and microwave ovens

1 Scope

Addition:

These particular requirements apply to ranges, ovens, steam ovens, **grills** and microwave ovens for household and similar use.

This document does not apply to hobs.

This document does not apply to appliances or parts of appliances that use gas energy.

Requirements for the declaration of noise emission values are not within the scope of this document.

2 Normative references

Addition:

IEC 60350-1:2023, *Household electric cooking appliances – Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance*

IEC 60705:–[1], *Household microwave ovens – Methods for measuring performance*

3 Terms and definitions

Addition:

3.101
grill
appliance or part of an appliance in which food is cooked by radiant heating

[SOURCE: IEC 60350-1:2023, 3.6]

3.102
steam function
heat transmission to the food mainly by condensation of steam at ambient pressure (approximately 100 kPa) and with a temperature ≤100 °C

[SOURCE: IEC 60350-1:2023, 3.21]

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1 Under preparation. Stage at the time of publication: IEC FDIS 60705:2024.

3.103
hot steam function
heat transmission to the food by generated steam in combination with radiation or convection, or a combination of both, at ambient pressure (approximately 100 kPa) and with a temperature > 100 °C

[SOURCE: IEC 60350-1:2023, 3.9]

3.104
heating function
heat transmission by natural or forced air circulation, or radiation for baking and roasting

EXAMPLE

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

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

[SOURCE: IEC 60350-1:2023, 3.7]

3.105
microwave function
function using only electromagnetic energy in one or several of the ISM frequency bands between 300 MHz and 30 GHz for heating food and beverages in a cavity

[SOURCE: IEC 60705:–, 3.5]

3.106
combination microwave function
heat transfer by electromagnetic energy simultaneously or consecutively with energy transfer by forced air circulation, conventional heating, by hot steam or by steam

[SOURCE: IEC 60705:–, 3.2, modified – the note has been removed.]

3.107
multiple cavity appliance
appliance that has more than one separate cavity in which food is cooked and which can be controlled independently, but cannot be installed separately

[SOURCE: IEC 60350-1:2023, 3.10]

4 Measurement methods and acoustical environments

4.2 Direct method

Addition:

If pure tone components are present in the noise emitted by the source, the estimated standard deviation of the measured sound pressure levels in the special reverberation room can increase. In such cases additional microphone positions or source positions are necessary as specified in ISO 3743-2.

4.3 Comparison method

Addition:

If pure tone components are present in the noise emitted by the source, the estimated standard deviation of the measured sound pressure levels in the hard-walled test room or in the special reverberation room can increase. In such cases additional microphone positions or source positions are necessary as specified in ISO 3743-1 or ISO 3743-2.

4.5 Measurement uncertainty

4.5.2 Standard deviations on repeatability and reproducibility and standard deviations related to declaration and verification

Replacement:

The estimated values of standard deviations of sound power levels, determined according to this document are given in Table 1.

Table 1 – Standard deviations of sound power levels

Standard deviation dB	
σ_r (repeatability)	σ_R (reproducibility)
estimated 0,4	estimated 1,0

For the purpose of determining and verifying declared noise emission values according to IEC 60704-3, the values in Table 2 apply:

Table 2 – Standard deviations for declaration and verification

Standard deviation dB		
σ_P (production)	σ_t (total)	σ_M (reference)
estimated 1,0 to 1,7	estimated 1,4 to 2,0	2,0

NOTE The standard deviation of repeatability, reproducibility and production and the total standard deviation have not been verified recently. Because of technical development of the appliances it is possible that these values are not correct anymore. Especially for steaming function the correct standard deviations can be different to the values given here.

5 Instrumentation

5.1 Instrumentation for measuring acoustical data

Addition:

The use of a windscreen shall be considered. If necessary, the observed sound pressure level shall be corrected for changes in the microphone sensitivity, in accordance with the instructions accompanying the instrumentation.

6 Operation and location of appliance under test

6.1 Equipping and pre-conditioning of appliances

6.1.1

Replacement:

For the measurement of a **heating function** or a **grill**, all accessories shall be removed. Side racks shall be removed if they can be removed without a tool.

For the measurement of a **microwave function**, the appliance shall be equipped with the accessory needed for positioning the water load.

For the measurement of a **steam function**, all accessories are removed. The fresh water tank shall be completely filled. The tank for condensed water shall be empty. If the appliance can be connected to water supply and drainage, these connections shall be used.

For measurement of a function, which can use a rotary spit, the appliance shall be equipped with drive units and accessories that are necessary to run the motor(s).

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

6.1.3

Addition:

The appliance is equipped according to 6.1.1. For **heating, grill and steam function** the appliance shall have been in operation for at least 10 min at any setting. For **microwave function** the appliance shall have been in operation for at least 1 min at any setting.

6.1.4

Replacement:

Stabilising is included in the operation, according to 6.4.2.

6.2 Supply of electrical energy and of water or gas

6.2.2 and **6.2.3** Not applicable.

6.4 Loading and operating of appliances during test

6.4.2

Replacement:

Table 101 specifies the setting(s) to be chosen and the measurement time(s).

Table 101 – Settings and measurement time

Function under test	Setting	Measurement time	Additional information
Heating function In general, the highest noise emission occurs for heating functions with forced air circulation when the fan is running.	Temperature setting within the range of 170 °C to 190 °C. If a fast **preheating function** is available, this is activated.	Heat up the appliance 10 min then operate the appliance for a further 30 min. Within these 30 min, 3 measurements are carried out with a measurement period of 5 min each. The time of these 3 measurements is randomly chosen within the 30 min. The final result is the logarithmic mean of these three measurements.	Without any load and without any shelf or grid.
Steam function	Temperature setting at 100 °C If the temperature cannot be set due to the construction of the control, the nearest setting related to the specified temperature is chosen.	Noise measurement starts immediately after the **steam function** has started. The measurement period is 900 s ± 10 s.	Without any load and without any shelf, grid and steaming accessory. Before a noise measurement is done the appliances shall be operated at **steam function** for at least 30 min to ensure that possible calibration is performed. After the calibration cycle, residual water shall be removed in accordance with the manual instructions.
Microwave function	1st measurement with power level MAX. 2nd measurement with a power level MIN. At least the loudest value shall be reported.	Noise measurement starts 30 s ± 5 s after the **microwave function** was started. Measurement periods are 60 s ± 10 s for both measurements. It is not necessary to cool the appliance between these two measurements.	Load: glass container with 1 000 g water. The glass container is positioned on the food support. If the turntable can be switched on/off, it shall be switched on. The glass container specified in IEC 60705:–, Clause 8 can be used. Measurement shall be finished before water starts boiling. Hence, the glass container with water shall be changed between both measurements. A glass rod or similar is placed in the glass container to prevent accidents due to the boiling delay factor.
Grill	Setting at maximum temperature or level	Noise measurement starts 10 min after switching on. The measurement period is 30 s ± 10 s.	Without any load and without any shelf or grid.

No measurement is stated for the **combination microwave function** and **hot steam function**, as the high variety of possible combination is hardly to specify.

Any cleaning mode shall be disregarded.

In the case of **multiple cavity appliances**, the multiple cavities shall be operated simultaneously with settings in accordance with Table 101.

6.4.3 Not applicable.

6.5 Location and mounting of appliances

6.5.2

Addition:

Counter-top and table-type appliances shall be positioned in accordance with 6.5.4 on the floor of the measurement room.

6.5.3 Not applicable.

7 Measurement of sound pressure levels

7.1 Microphone array, measurement surface and RSS location for essentially free-field conditions over reflecting plane(s)

7.1.5

Replacement:

For counter-top or table-type appliances, 7.1.3 applies.

7.1.6 to **7.1.7** Not applicable.

7.4 Measurements

7.4.1

Replacement:

The measurement time interval shall be as specified in 6.4.2.

9 Information to be recorded

9.6.3 Not applicable.

9.7.4 Not applicable.

10 Information to be reported

10.3.5 Not applicable.

10.4.12

Addition:

For **microwave function**, at least the loudest value shall be reported.

Annex A

This annex of IEC 60704-1:2021 is not applicable.

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SOMMAIRE