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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 1: General requirements

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 1: General requirements

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60704-1:2010. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60704-1 has been prepared by IEC technical committee 59: Performance of household and similar electrical appliances.

This fourth edition cancels and replaces the third edition published in 2010. This edition constitutes a technical revision.

It includes the following significant changes with respect to the previous edition:

a) update of references (especially to ISO standards);
b) revision of requirements on climatic conditions;
c) revision of requirements on background noise level.

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

FDIS	Report on voting
59/753/FDIS	59/762/RVD

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

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

A list of all the parts in the IEC 60704 series, 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

IMPORTANT – The 'colour inside' logo on the cover page of this publication 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

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) ~~should~~ be kept at a modest level.

The results of noise measurements ~~will be~~ 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 ~~will be~~ 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~~hemi-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 and ISO 9614-2 is subject to a specific part 2.~~

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.

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

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

Part 1: General requirements

1 Scope ~~and object~~

~~1.1 Scope~~

~~1.1.1 General~~

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.

~~1.1.2 Types of noise~~

~~A classification of different types of noise is given in ISO 12001. The method specified in ISO 3744 is suitable for measurements of all types of noise emitted by household appliances. The methods specified in ISO 3743-1 and ISO 3743-2 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 2.~~

~~1.1.3 Size of the source~~

~~The method specified in ISO 3744 is applicable to noise sources of any size. Limitations for the size of the source are given in 1.3 of ISO 3743-1 and ISO 3743-2. This will be taken into account in the preparation of parts 2.~~

~~1.2 Object~~

~~This standard is concerned with objective methods of engineering accuracy (grade 2 according to ISO 12001) 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.~~

~~The following quantities are used:~~

~~– *A*-weighted sound power level, L_{WA}; and~~

~~– octave band sound power levels.~~

~~In general, the described methods are specified for appliances without an operator present. A part 2 can specify that an operator will be present only for the (rare) cases where an appliance can only be operated, or must be fed, by an operator.~~

~~Methods for determining sound power levels with precision accuracy (grade 1 according to ISO 12001), specified for example in ISO 3741 and ISO 3745, are not included in this standard. 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 part will not necessarily correspond with the noise experienced under the operational conditions of practical use.~~

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

~~1.3 Measurement uncertainty~~

~~The estimated values of the standard deviations of reproducibility of sound power levels determined according to this part are given in 1.4 of ISO 3743-1 and of ISO 3743-2, and in 1.4 of ISO 3744. But for a particular family of appliances of similar size with similar operating conditions, the standard deviations of reproducibility may be smaller than these values. Hence, in part 2, standard deviations smaller than those listed in ISO standards may be stated if substantiation is available from the results of suitable interlaboratory tests.~~

~~IEC 60704-3 gives values of standard deviations of reproducibility for several categories of appliances.~~

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

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 60038:2009, *IEC standard voltages*~~

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

IEC 60704-3:~~2006~~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 61260:1995, *Electroacoustics – Octave-band and fractional-octave-band filters*~~

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

IEC 61672-1:~~2002~~2013, *Electroacoustics – Sound level meters – Part 1: Specifications*

~~ISO 3741:1999, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms*~~

ISO 3743-1:~~1994~~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:~~1994~~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:~~1994~~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 3745:2003, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision method for anechoic and hemi-anechoic rooms*~~

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:~~1999~~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 ~~may~~ 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

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~~. During the operational cycle, each operational period is associated with a specific process that may occur only once, or may be repeated (for example, for a dishwasher, washing *and* rinsing *and* drying)~~

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

~~**3.5**~~
~~**standard test operator**~~
~~a person necessary for operating or feeding the appliance under test, not wearing abnormally sound absorptive clothing which might influence the sound measurements~~

~~**3.6**~~
~~**centre of location or position of a source**~~
~~the term used for describing the location or position of the source (appliance) to be tested within the test environment and, in free field environment, with respect to the co-ordinate system of microphone positions~~

~~The centre of location is such that the centre of the appliance coincides with the centre of a parallelepiped drawn around the main part of hand-held, suspended, or stand-type appliances.~~

~~The centre of location is such that the centre of the appliance coincides with the centre of a rectangle drawn around the projection of the main part of the appliance on the floor, for floor-supported appliances, and on the wall, for wall-mounted appliances.~~

~~**3.7**~~
~~**nominal height**~~
~~h_n~~
~~the smallest integer multiple of 5 mm that accommodates the height of the installation opening according to the manufacturer's installation instructions~~

~~**3.8**~~
~~**nominal width**~~
~~w_n~~
~~the smallest integer multiple of 5 mm that accommodates the width of the installation opening according to the manufacturer's installation instructions~~

~~**3.9**~~
~~**nominal depth**~~
~~d_n~~
~~the smallest integer multiple of 5 mm, equal to or greater than 515 mm, that accommodates the depth of the installation opening according to the manufacturer's installation instructions~~

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 ~~essentially~~ 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.

~~This method yields results expressed in A-weighted sound power levels (and in octave-band sound power levels, if required) which are calculated directly from measured sound pressure levels.~~

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.

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.

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.32 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 standard deviations on repeatability and reproducibility of sound power levels determined in accordance with this document are indicated in tables in the IEC 60704-2 series and in

IEC 60704-3. Tables in the IEC 60704-2 series are given in the format shown in Table 1. Values (X,X) are given to one decimal place.

Table 1 – Standard deviations of sound power levels

Standard deviation (dB)	
σ_r (repeatability)	σ_R (reproducibility)
X,X	X,X

Standard deviations (on production, total and reference) for the purpose of determining and verifying declared noise emission values in accordance with IEC 60704-3 are provided in the IEC 60704-2 series and in IEC 60704-3. Tables in the IEC 60704-2 series are given in the format shown in Table 2. Values are given to one decimal place.

Table 2 – Standard deviations for declaration and verification

Standard deviation (dB)		
σ_P (production)	σ_t (total)	σ_M (reference)
X,X	X,X	X,X

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.

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 The appliance is equipped with attachments, accessories, etc. as delivered by the manufacturer for the intended use or function.

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 ~~energy~~ into the test environment or change the sound output of the appliance. ~~Guidelines are given in 6.4 of ISO 3743-1, ISO 3743-2 and ISO 3744.~~ 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 ~~shall indicate~~ indicates the total period for running-in and the rated operating times unless the manufacturer has recommended otherwise.

6.1.4 Immediately before each series of noise measurements, the appliance, equipped as for the intended use, is operated for stabilizing at the highest speed setting, if any, and unless otherwise stated, without load, as indicated in the relevant part of the IEC 60704-2 series or in accordance with the manufacturer's instructions.

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 Appliances with battery-powered electric motor(s) are started, for noise measurements, with full-charged batteries as specified by the manufacturer, and the measurements are interrupted when the battery voltage under load has dropped for lead-acid batteries to 0,9 times, and for other batteries to 0,8 times, the battery voltage under load at the beginning of the test.

The battery voltage is measured at the battery terminals, if applicable.

6.2.3 Appliances incorporating heating, either electric or gas, may be operated without heating, if the heating does not change the noise emission of the appliance.

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.

~~NOTE~~ 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 ~~may~~ can be misleading for the consumer. In this case, additional measurements ~~may~~ 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 t = 23 °C 5 °C~~

~~relative humidity RH = 50 % 20 %~~

~~atmospheric pressure p_s = 96 kPa 10 kPa~~

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 For determining noise emission of an appliance, the loading and operating conditions, if not specified for a particular category of appliances in the relevant part of the IEC 60704-2 series, shall be restricted to one single condition, except for appliances with multiple main functions of long duration and for multi-purpose appliances, where one or several conditions may be specified. However, the specified condition shall be that which produces the highest noise emission value.

The idling condition may be chosen as the sole condition for determining noise emission of the appliance if it is typical and steady and if the reproducibility with the loading condition is poor.

For appliances provided with speed control, in general the highest speed setting is used.

6.4.3 Appliances operated during normal use in operational cycles are operated likewise for determining noise emission, taking measurements during appropriate parts of the operational cycles of the main functions.

~~NOTE~~ It is recommended to record the A-weighted sound pressure level during the operational cycle(s) – time history – at one of the microphone positions, preferably in front of the appliance to be tested.

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 of 6.2 and 6.3 of ISO 3743-1, ISO 3743-2 and ISO 3744 shall be followed. For the purpose of establishing a noise test code The following guidelines are given, unless otherwise specified in part 2.~~ 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.

~~NOTE~~ Sound radiation due to possible vibrations of the piece of floor covering ~~must~~ 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.

6.5.3 Handheld appliances, including their accessories, if any, are resiliently suspended or resiliently mounted in an adequate test fixture at a height of approximately 25 cm.

The base of the test fixture is placed on an intermediate resilient means (having no influence on the airborne noise emitted by the appliance under test), so that structure-borne noise is not transmitted from the appliance, and is located

– 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.

~~NOTE~~ Care should be taken to ensure that the means of suspension or clamping do not change the sound output of the appliance, for example radiated by the floor, or by

suppressing or emphasizing special modes of vibration of the body of the appliance, or by covering radiating surfaces, air intakes, etc.

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 ~~appliance~~ 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)

~~The requirements of 7.1 to 7.4 of ISO 3744 shall be followed. Guidance for the selection of the measurement surface and microphone array in part 2 are 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 part 2.~~

~~**7.1.1** For floor-standing free-standing appliances, including built-in appliances, the measurement surface is a parallelepiped with nine microphone positions, as specified in 7.3.1 of ISO 3744 and in Figure 1 of this standard. Additional measurement positions can be required according to 7.3.2 of ISO 3744. The number of microphone positions can also be reduced according to 7.4.2 of ISO 3744.~~

~~NOTE The front of the appliance, unless otherwise stated in part 2, 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, the microphone position no. 1 is recommended for the nine microphone array.~~

~~**7.1.2** 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 7.3.1 of ISO 3744 and in Figure 2 of this standard. Additional measurement positions can be required according to 7.3.2 of ISO 3744. The number of microphones can also be reduced according to 7.4.2 of ISO 3744.~~

~~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, the microphone position no. 1 is recommended for the six microphone array.~~

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

~~NOTE 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.~~

7.1.3 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 of this standard. The points 9 and 10 are suppressed when not practicable (for example, appliances in contact with the ceiling). Additional measurement positions may be required according to 7.3.2 of ISO 3744. The number of microphones can also be reduced according to 7.4.2 of ISO 3744.

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, the microphone position no. 7 is recommended for the 10 microphone array.

7.1.4 For counter-top or table-type appliances, floor treatment appliances and hand-held appliances (mounted in test fixtures), with each of the dimensions of the reference box not exceeding 0,7 m, and placed during measurements on the horizontal reflecting plane, the measurement surface is a hemisphere with 10 microphone positions, as specified in 7.2.1 of ISO 3744 and shown in Figure 4 of this standard. Additional measurement positions can be required according to 7.2.2 of ISO 3744. In special cases, a different number and arrangement of microphone positions can be used, if the requirements of 7.2.1 of ISO 3744 are satisfied.

If the reference box has a dimension exceeding 0,7 m, the microphone array and measurement surface described in 7.1.1 shall be used.

The radius *r*, of the hemispherical measurement surface preferably shall be equal to 2 m, but in any case not less than 1,5 m.

NOTE The front of the appliance, unless otherwise specified in part 2, is directed in the direction of the *x*-axis. For determining time histories, frequency spectra, etc. of the appliance, the microphone position no. 8 is recommended for the 10 microphone array.

7.1.5 For small floor-standing appliances for placing against a wall (for example shoe-polishers), with the dimensions of the reference box, l_1 and l_3 each not exceeding 0,4 m and l_2 not exceeding 0,8 m, the measurement surface is a quarter-sphere with five microphone positions, as specified in 7.2.1 of ISO 3744 and shown in Figure 5 of this standard.

NOTE For determining time histories, frequency spectra, etc. of the appliance, the microphone position no. 6 is recommended for the five microphone array.

7.1.6 For stand-type appliances, with the height of the geometric centre of the reference box above the floor exceeding in normal use 1,0 m, the measurement surface is a parallelepiped with five microphone positions as specified in Figure 6 of this standard, centred in the centre of the reference box. Four positions are regularly spaced at 1 m from the outlines of the appliance, in a plane going through its geometrical centre and parallel to the reflecting plane; the fifth position shall be situated at a distance of 1 m from the above described plane. The co-ordinate system describing the microphone positions is located with the *x* and *y* axis in the horizontal reflecting plane and the *z* axis at right angles to it.

In general, the number of measuring points is sufficient if the difference, in decibels, between the maximum and minimum measured sound pressure levels is less than 5 dB. If this condition is not fulfilled, it is necessary to carry out measurements in four additional points 6 to 9, as described in Figure 6.

The area of this measurement surface is given by

$$S = 4\,(ab + bc + ca)$$

where

~~*c* is the height, in metres, of the measurement surface (normally equal to the height of the geometrical centre of the appliance above the reflecting plane, enlarged by 1 m);~~

~~2*a* is the width, in metres, of the measurement surface (normally equal to the width of the appliance, enlarged by 2 m);~~

~~2*b* is the length, in metres, of the measurement surface (normally equal to the maximum dimension of the appliance, enlarged by 2 m).~~

~~NOTE The front of the appliance, unless otherwise specified in part 2, is directed in the direction of the *x*-axis. For determining time histories, frequency spectra, etc. of the appliance, the microphone position no. 1 is recommended.~~

~~**7.1.7** 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 and Annexes B and C of ISO 3744.~~

~~**7.1.8** Guidelines for the location of the RSS are given in Annex A of ISO 3744.~~

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:

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

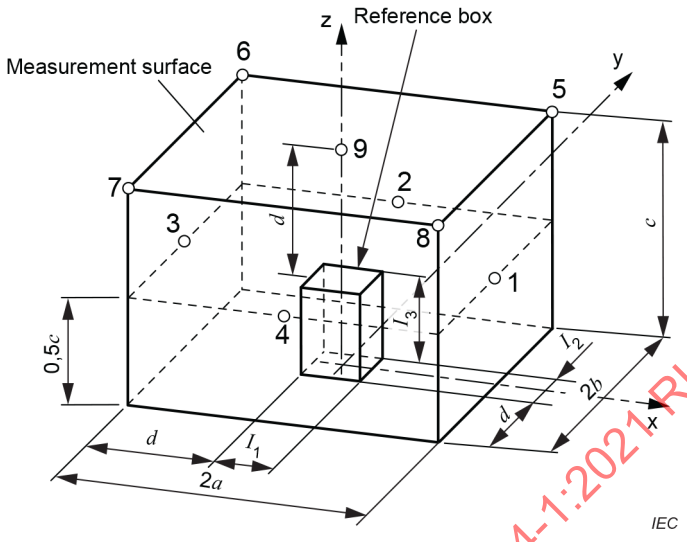


Figure 1 – Measurement surface – parallelepiped – with key microphone positions, for floor free-standing appliances

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:

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

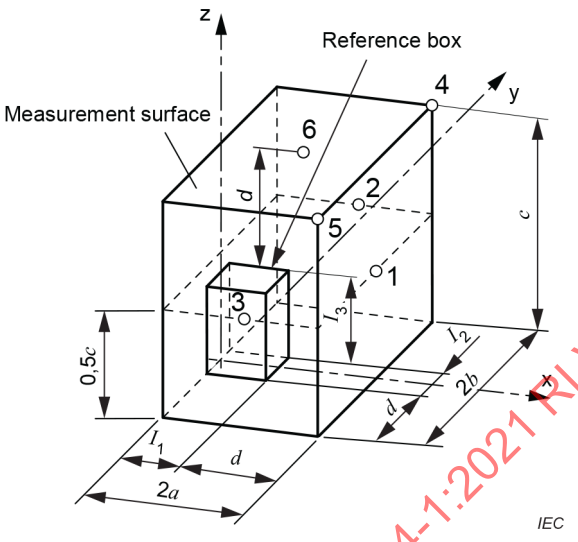


Figure 2 – Measurement surface – parallelepiped – with key microphone positions, for floor standing appliances placed against a wall

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.

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

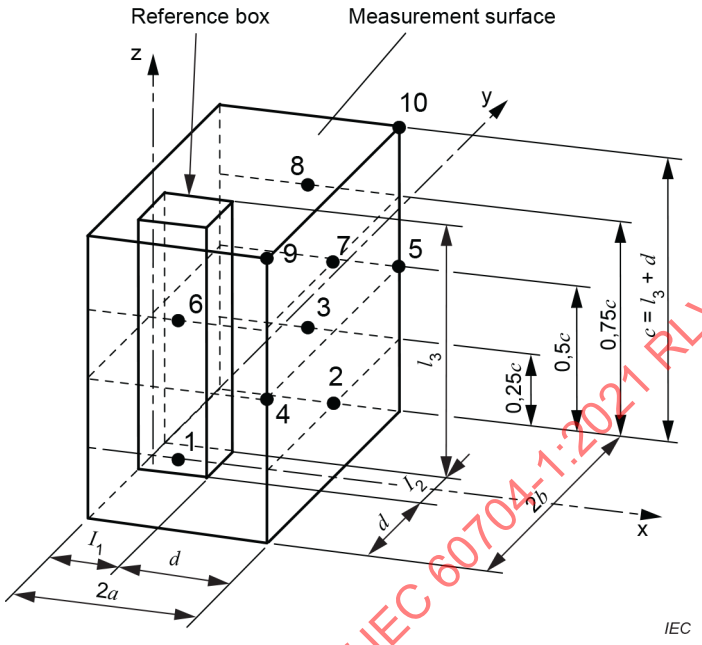


Figure 3 – Measurement surface – parallelepiped – with key microphone positions, for high floor-standing appliances placed against a wall

7.1.5 For counter-top or table-type appliances, floor-treatment appliances and handheld appliances (mounted in test fixtures), with each of the dimensions of the reference box not exceeding 0,7 m, and placed during measurements on the horizontal reflecting plane, the measurement surface is a hemisphere with 10 microphone positions, as specified in 7.2.3 of ISO 3744:2010 and shown in Figure 4 of this document. Additional measurement positions can be required in accordance with 8.1.1 of ISO 3744:2010. In special cases, a different number and arrangement of microphone positions can be used, if the requirements in 8.1.1 of ISO 3744:2010 are satisfied.

If the reference box has a dimension exceeding 0,7 m, the microphone array and measurement surface described in 7.1.2 of this document shall be used.

The radius r, of the hemispherical measurement surface preferably shall be equal to 2 m, but in any case not less than 1,5 m.

NOTE The front of the appliance, unless otherwise specified in the relevant part of IEC 60704-2 series, is directed in the direction of the x-axis. For determining time histories, frequency spectra, etc. of the appliance, microphone position no.8 is recommended for the 10-microphone array.

Coordinates of microphone positions:

No.	*x/R*	*y/R*	*z/R*
1	-0,99	0	0,15
2	0,50	-0,86	0,15
3	0,50	0,86	0,15
4	-0,45	0,77	0,45
5	-0,45	-0,77	0,45
6	0,89	0	0,45
7	0,33	0,57	0,75
8	-0,66	0	0,75
9	0,33	-0,57	0,75
10	0	0	1,0

Measurement surface area:

$S = 2 \cdot \pi \cdot R^2$

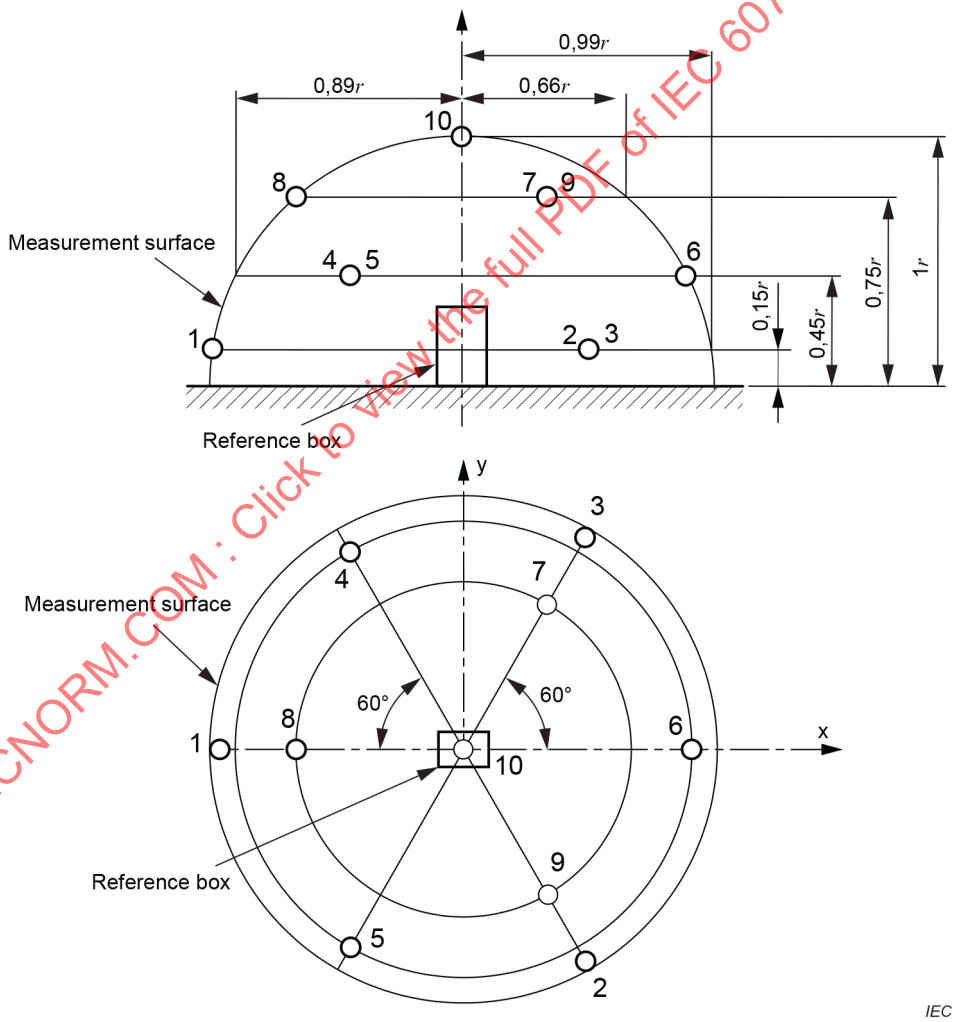


Figure 4 – Measurement surface – hemisphere – with key microphone positions, for hand-held, table type and floor-treatment appliances

7.1.6 For small floor-standing appliances for placing against a wall (for example shoe-polishers), with the dimensions of the reference box, l_1 and l_3 each not exceeding 0,4 m and l_2 not exceeding 0,8 m, the measurement surface is a quarter-sphere with five microphone positions, as specified in 8.1.1 of ISO 3744:2010 and shown in Figure 5 of this document.

For determining time histories, frequency spectra, etc. of the appliance, microphone position no.6 is recommended for the five-microphone array.

Coordinates of microphone positions:

No.	*x/R*	*y/R*	*z/R*
2	0,50	-0,86	0,15
3	0,50	0,86	0,15
6	0,89	0	0,45
7	0,33	0,57	0,75
9	0,33	-0,57	0,75

Measurement surface area:

$S = \pi \cdot R^2$

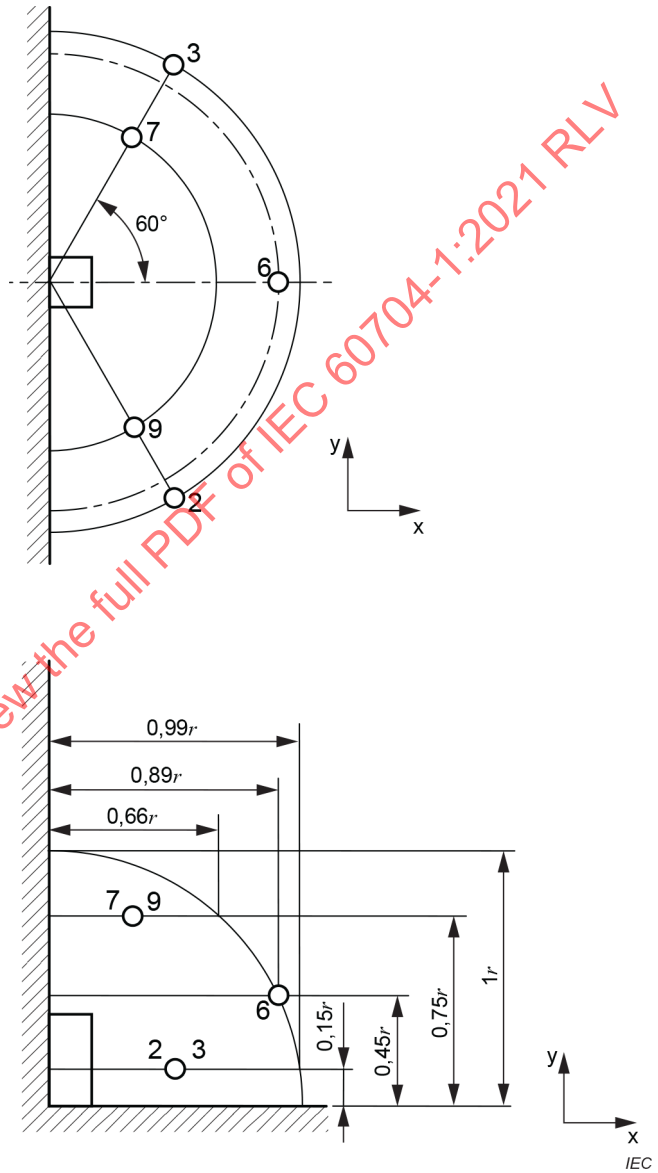


Figure 5 – Measurement surface – quarter-sphere – with key microphone positions, for small floor-standing appliances placed against a wall

7.1.7 For stand-type appliances, with the height of the geometric centre of the reference box above the floor exceeding in normal use 1,0 m, the measurement surface is a parallelepiped with five microphone positions as specified in Figure 6, centred in the middle of the reference box. Four positions are regularly spaced at 1 m from the outlines of the appliance, in a plane going through its geometrical centre and parallel to the reflecting plane; the fifth position shall be situated at a distance of 1 m from the above described plane. The co-ordinate system describing the microphone positions is located with the x- and y-axes in the horizontal reflecting plane and the z-axis at a right angle to it.

In general, the number of measuring points is sufficient if the difference, in dB, between the maximum and minimum measured sound pressure levels is less than 5 dB. If this condition is not fulfilled, it is necessary to carry out measurements in four additional points 6 to 9, as described in Figure 6.

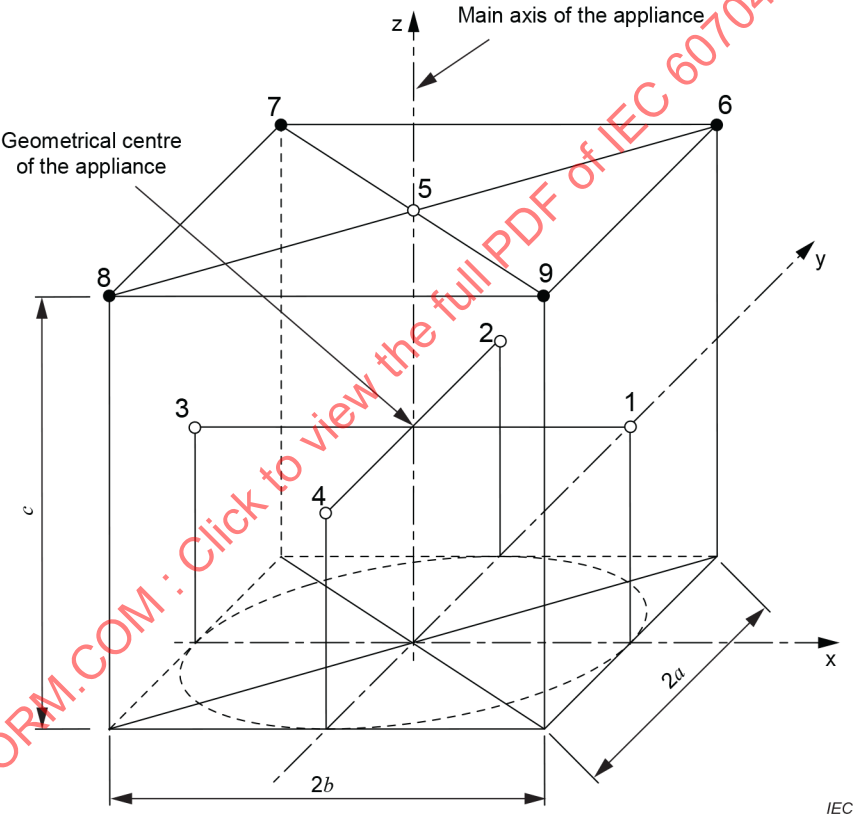
The front of the appliance, unless otherwise specified in the relevant part of IEC 60704-2 series, is directed in the direction of the x-axis. For determining time histories, frequency spectra, etc. of the appliance, microphone position no.1 is recommended.

Coordinates of microphone positions:

No.	x	y	z
1	a	0	c-1m
2	0	b	c-1m
3	-a	0	c-1m
4	0	-b	c-1m
5	0	0	c
6	a	b	c
7	-a	b	c
8	-a	-b	c
9	a	-b	c

Measurement surface area:

$S = 4\ (a \cdot b + b \cdot c + c \cdot a)$



where

c is the height, in m, of the measurement surface (normally equal to the height of the geometrical centre of the appliance above the reflecting plane, enlarged by 1 m);

$2 \cdot a$ is the width, in m, of the measurement surface (normally equal to the width of the appliance, enlarged by 2 m);

$2 \cdot b$ is the length, in m, of the measurement surface (normally equal to the maximum dimension of the appliance, enlarged by 2 m).

Figure 6 – Measurement surface – parallelepiped – with five or nine microphone positions for stand-type appliances

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.

~~NOTE 1~~ In general, at least three microphone positions should be used.

~~NOTE 2 The use of a moving microphone traversing a path, according to 7.4 of ISO 3743-1, will often be more convenient than the use of a number of fixed microphones.~~

~~NOTE 3~~ 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 ~~from~~ to the wall, the RSS ~~must~~ 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 ~~of 7.1 to 7.7~~ in Clause 9 of ISO 3743-2:2018 shall be followed.

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

~~NOTE 2~~ A change of these numbers depends on the results of a preliminary measurement in accordance with ~~7.4~~ 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 ~~might~~ can be preferable.

NOTE ~~3~~ The use of a moving microphone traversing a path, in accordance with ~~7.6~~ 9.6 of ISO 3743-2:2018 ~~will~~ is often ~~be~~ 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 For measurements in free-field conditions over a reflecting plane, the requirements ~~of 7.5~~ in 4.1, Clause 5 and 8.2.1 of ISO 3744:2010 shall be followed; for measurements in hard-walled test rooms, the requirements in Clause 7 of ISO 3743-1:2010 shall be followed; for measurements in special reverberation test rooms, the requirements in Clause ~~7~~ 9 of ISO 3743-2:2018 shall be followed.

The time-average sound pressure level has to be observed at each microphone position over a typical period of operation of the appliance. For noise that varies with time, the period of observation shall be specified carefully.

In the case of a moving microphone, the integration time should include at least one full traverse for measurements in accordance with ISO 3743-1:2010 or ISO 3743-2:2018, and at least two full traverses for measurements in accordance with ISO 3744:2010.

NOTE The measurement time interval can be chosen to be representative of the period of maximum noise level.

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, ~~due~~ owing to simple instrumentation or ~~due~~ 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 ~~of 7.8 and~~ in Clause 8 of ISO 3743-1:2010 shall be followed. For measurements in special reverberation test rooms, the requirements ~~of 7.8 and Clause 8~~ 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

~~$$L_p = 10 \cdot lg\left(10^{0,1 \cdot L_p'} - 10^{0,1 \cdot L_p''}\right)$$ dB (Ref. 20 µPa)~~

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

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_{pA}' and L_{pA}'' 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 ~~Annex A and 8.4 and 8.5~~ 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 ~~8.4~~ 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

~~$L_W = L_{W(RSS)} - \overline{L_{p(RSS)}} + \overline{L_{p(AT)}}$ dB (Ref. 1 pW)~~

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

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

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

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 ~~4~~ 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:

$$L_W = L_{p\mathrm{mc}} + 10 \cdot \lg\left(\frac{S}{S_0}\right) \text{ dB ~~(Ref. 1 pW)~~}$$

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 $L_{W\mathrm{A}}$ 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:

~~$L_{\mathrm{WA}} = L_{\mathrm{pmA}} - 10 \lg \frac{T_{\mathrm{N}}}{T_{\mathrm{o}}} + 10 \lg \frac{V}{V_{\mathrm{o}}} - 13$ dB (Ref. 1 pW)~~

$$L_{W\mathrm{A}} = L_{p\mathrm{mA}} - \left(10 \cdot \lg\left(\frac{T_{\mathrm{N}}}{T_0}\right) + 10 \cdot \lg\left(\frac{V}{V_0}\right) - 13\right) \text{ dB}$$

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

~~The following information, if applicable, shall be compiled and 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, ~~semi~~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 Stabilizing procedure and period.

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 Other energies, supply data.

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

~~Only those data, recorded according to Clause 9, which are of importance for the purpose of the measurements shall be reported. In general, the data of the following subclauses may be important:~~

		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	Supply of other energy	9.7.4
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	9.13

Annex A
(normative)

Standard test table

A suitable design for a standard test table is shown in Figure A.1. The top of the table shall be of bonded laminated wood 0,10 m thick, having a minimum area of 0,5 m^2 and a minimum lateral dimension of 0,7 m. The height of the standard test table shall be 0,75 m.

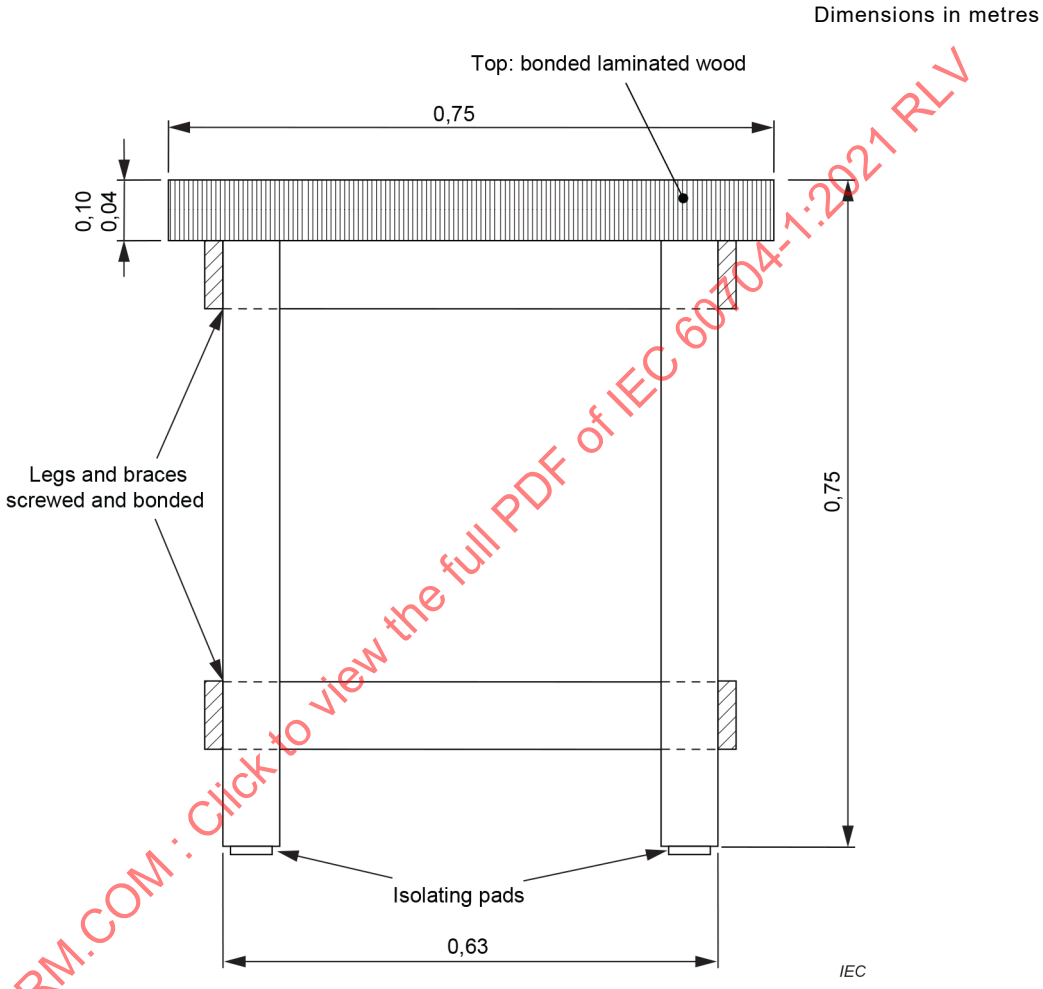
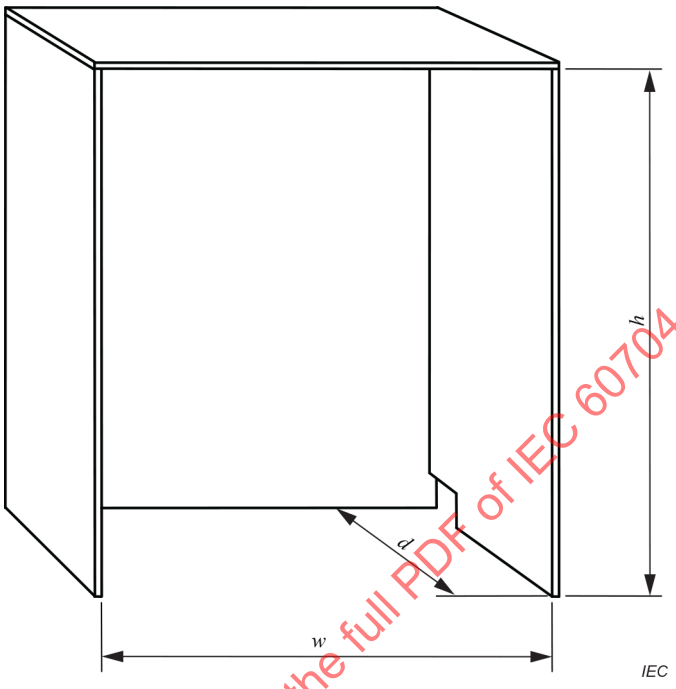


Figure A.1 – Example of standard test table

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, ~~may~~ 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

~~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*~~

IEC 60704-1

Edition 4.0 2021-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Household and similar electrical appliances – Test code for the determination of airborne acoustical noise –
Part 1: General requirements

Appareils électrodomestiques et analogues – Code d'essai pour la détermination du bruit aérien –
Partie 1: Exigences générales

IEC 60704-1:2021-03(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 1: General requirements

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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International Standard IEC 60704-1 has been prepared by IEC technical committee 59: Performance of household and similar electrical appliances.

This fourth edition cancels and replaces the third edition published in 2010. This edition constitutes a technical revision.

It includes the following significant changes with respect to the previous edition:

a) update of references (especially to ISO standards);
b) revision of requirements on climatic conditions;
c) revision of requirements on background noise level.

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

FDIS	Report on voting
59/753/FDIS	59/762/RVD

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

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

A list of all the parts in the IEC 60704 series, 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

INTRODUCTION

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.

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

Part 1: General requirements

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.

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 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 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

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

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.

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.

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 standard deviations on repeatability and reproducibility of sound power levels determined in accordance with this document are indicated in tables in the IEC 60704-2 series and in IEC 60704-3. Tables in the IEC 60704-2 series are given in the format shown in Table 1. Values (X,X) are given to one decimal place.

Table 1 – Standard deviations of sound power levels

Standard deviation (dB)	
σ_r (repeatability)	σ_R (reproducibility)
X,X	X,X

Standard deviations (on production, total and reference) for the purpose of determining and verifying declared noise emission values in accordance with IEC 60704-3 are provided in the IEC 60704-2 series and in IEC 60704-3. Tables in the IEC 60704-2 series are given in the format shown in Table 2. Values are given to one decimal place.

Table 2 – Standard deviations for declaration and verification

Standard deviation (dB)		
σ_P (production)	σ_t (total)	σ_M (reference)
X,X	X,X	X,X

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.

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 The appliance is equipped with attachments, accessories, etc. as delivered by the manufacturer for the intended use or function.

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.

6.1.4 Immediately before each series of noise measurements, the appliance, equipped as for the intended use, is operated for stabilizing at the highest speed setting, if any, and unless otherwise stated, without load, as indicated in the relevant part of the IEC 60704-2 series or in accordance with the manufacturer's instructions.

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 Appliances with battery-powered electric motor(s) are started, for noise measurements, with full-charged batteries as specified by the manufacturer, and the measurements are interrupted when the battery voltage under load has dropped for lead-acid batteries to 0,9 times, and for other batteries to 0,8 times, the battery voltage under load at the beginning of the test.

The battery voltage is measured at the battery terminals, if applicable.

6.2.3 Appliances incorporating heating, either electric or gas, may be operated without heating, if the heating does not change the noise emission of the appliance.

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 For determining noise emission of an appliance, the loading and operating conditions, if not specified for a particular category of appliances in the relevant part of the IEC 60704-2 series, shall be restricted to one single condition, except for appliances with multiple main functions of long duration and for multi-purpose appliances, where one or several conditions may be specified. However, the specified condition shall be that which produces the highest noise emission value.

The idling condition may be chosen as the sole condition for determining noise emission of the appliance if it is typical and steady and if the reproducibility with the loading condition is poor.

For appliances provided with speed control, in general the highest speed setting is used.

6.4.3 Appliances operated during normal use in operational cycles are operated likewise for determining noise emission, taking measurements during appropriate parts of the operational cycles of the main functions.

It is recommended to record the A-weighted sound pressure level during the operational cycle(s) – time history – at one of the microphone positions, preferably in front of the appliance to be tested.

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.

6.5.3 Handheld appliances, including their accessories, if any, are resiliently suspended or resiliently mounted in an adequate test fixture at a height of approximately 25 cm.

The base of the test fixture is placed on an intermediate resilient means (having no influence on the airborne noise emitted by the appliance under test), so that structure-borne noise is not transmitted from the appliance, and is located

– 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.

Care should be taken to ensure that the means of suspension or clamping do not change the sound output of the appliance, for example radiated by the floor, or by suppressing or emphasizing special modes of vibration of the body of the appliance, or by covering radiating surfaces, air intakes, etc.

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:

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

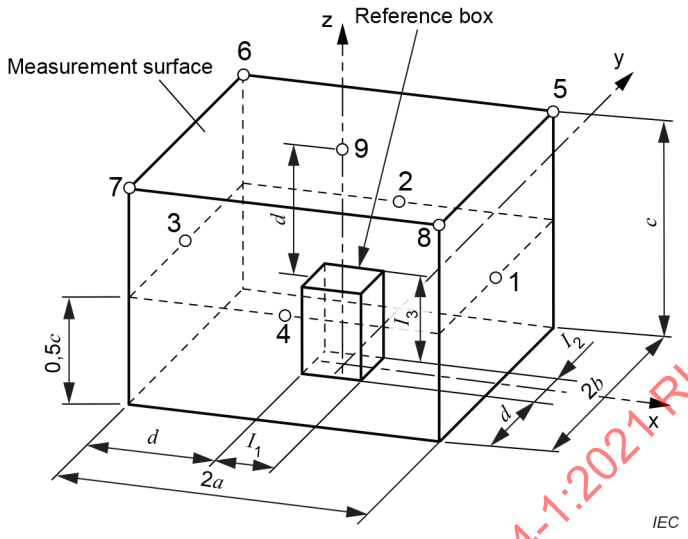


Figure 1 – Measurement surface – parallelepiped – with key microphone positions, for floor free-standing appliances

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:

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

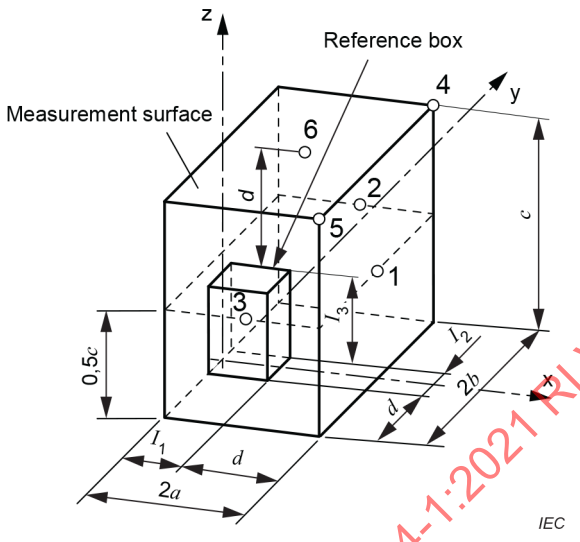


Figure 2 – Measurement surface – parallelepiped – with key microphone positions, for floor standing appliances placed against a wall

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.

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

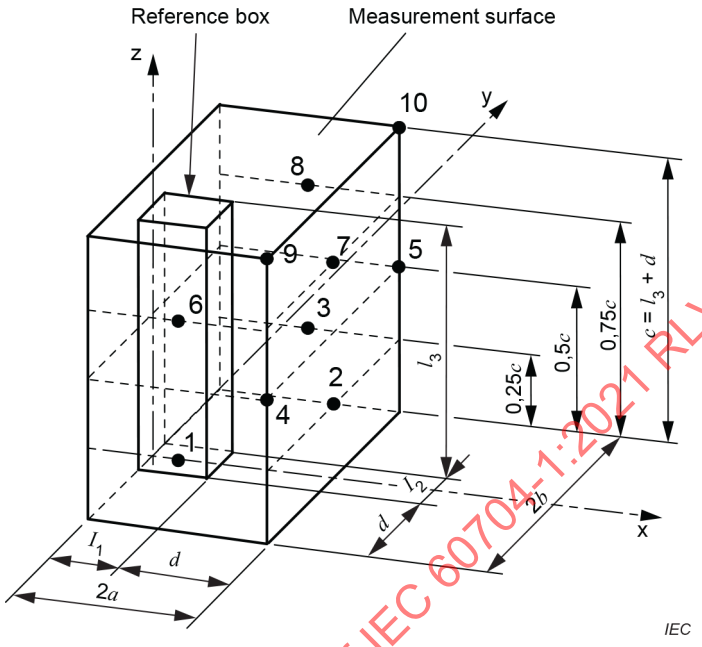


Figure 3 – Measurement surface – parallelepiped – with key microphone positions, for high floor-standing appliances placed against a wall

7.1.5 For counter-top or table-type appliances, floor-treatment appliances and handheld appliances (mounted in test fixtures), with each of the dimensions of the reference box not exceeding 0,7 m, and placed during measurements on the horizontal reflecting plane, the measurement surface is a hemisphere with 10 microphone positions, as specified in 7.2.3 of ISO 3744:2010 and shown in Figure 4 of this document. Additional measurement positions can be required in accordance with 8.1.1 of ISO 3744:2010. In special cases, a different number and arrangement of microphone positions can be used, if the requirements in 8.1.1 of ISO 3744:2010 are satisfied.

If the reference box has a dimension exceeding 0,7 m, the microphone array and measurement surface described in 7.1.2 of this document shall be used.

The radius r, of the hemispherical measurement surface preferably shall be equal to 2 m, but in any case not less than 1,5 m.

NOTE The front of the appliance, unless otherwise specified in the relevant part of IEC 60704-2 series, is directed in the direction of the x-axis. For determining time histories, frequency spectra, etc. of the appliance, microphone position no.8 is recommended for the 10-microphone array.

Coordinates of microphone positions:

No.	*x/R*	*y/R*	*z/R*
1	-0,99	0	0,15
2	0,50	-0,86	0,15
3	0,50	0,86	0,15
4	-0,45	0,77	0,45
5	-0,45	-0,77	0,45
6	0,89	0	0,45
7	0,33	0,57	0,75
8	-0,66	0	0,75
9	0,33	-0,57	0,75
10	0	0	1,0

Measurement surface area:

$S = 2 \cdot \pi \cdot R^2$

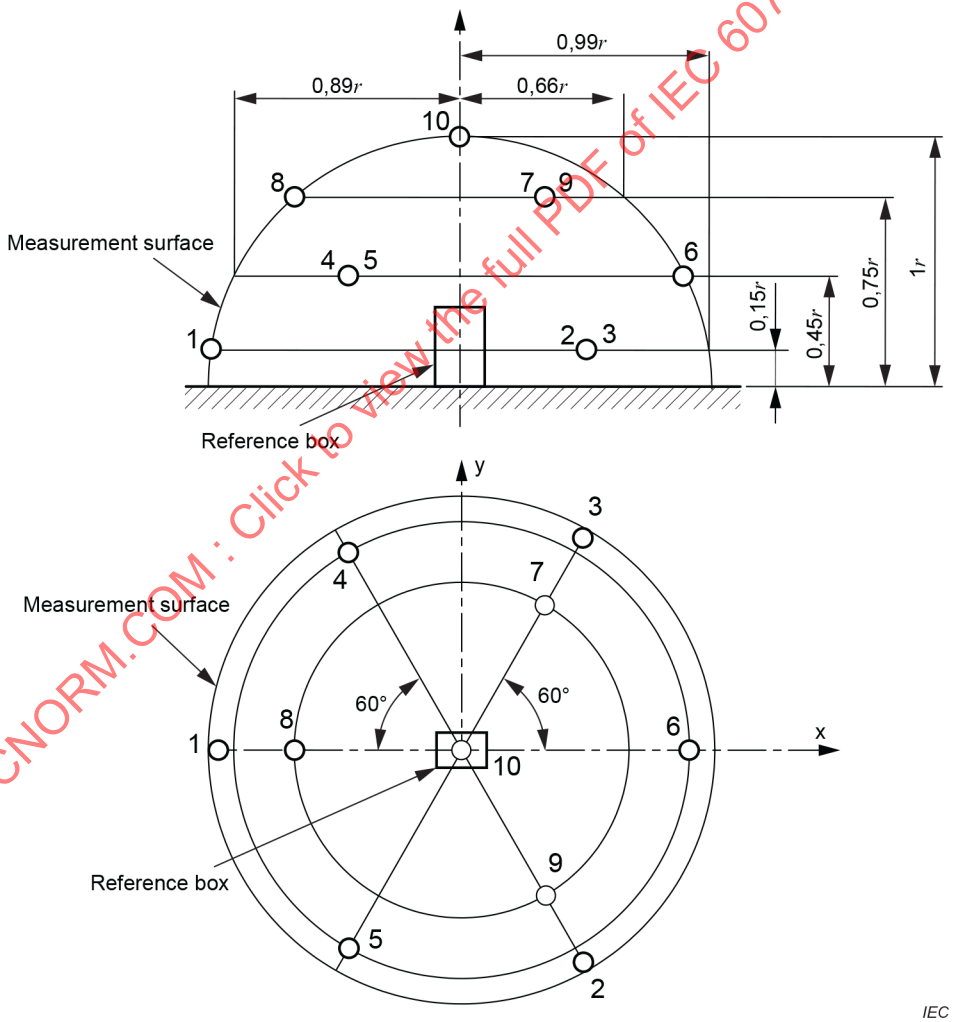


Figure 4 – Measurement surface – hemisphere – with key microphone positions, for hand-held, table type and floor-treatment appliances

7.1.6 For small floor-standing appliances for placing against a wall (for example shoe-polishers), with the dimensions of the reference box, l_1 and l_3 each not exceeding 0,4 m and l_2 not exceeding 0,8 m, the measurement surface is a quarter-sphere with five microphone positions, as specified in 8.1.1 of ISO 3744:2010 and shown in Figure 5 of this document.

For determining time histories, frequency spectra, etc. of the appliance, microphone position no.6 is recommended for the five-microphone array.

Coordinates of microphone positions:

No.	*x/R*	*y/R*	*z/R*
2	0,50	-0,86	0,15
3	0,50	0,86	0,15
6	0,89	0	0,45
7	0,33	0,57	0,75
9	0,33	-0,57	0,75

Measurement surface area:

$S = \pi \cdot R^2$

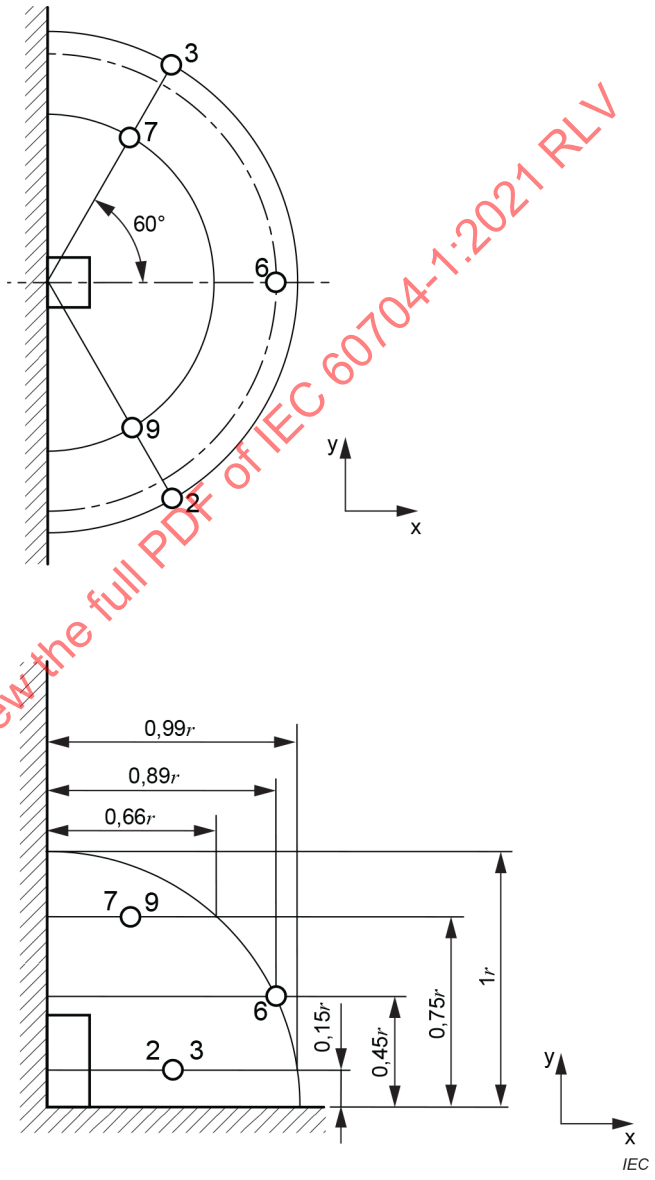


Figure 5 – Measurement surface – quarter-sphere – with key microphone positions, for small floor-standing appliances placed against a wall

7.1.7 For stand-type appliances, with the height of the geometric centre of the reference box above the floor exceeding in normal use 1,0 m, the measurement surface is a parallelepiped with five microphone positions as specified in Figure 6, centred in the middle of the reference box. Four positions are regularly spaced at 1 m from the outlines of the appliance, in a plane going through its geometrical centre and parallel to the reflecting plane; the fifth position shall be situated at a distance of 1 m from the above described plane. The co-ordinate system describing the microphone positions is located with the x- and y-axes in the horizontal reflecting plane and the z-axis at a right angle to it.

In general, the number of measuring points is sufficient if the difference, in dB, between the maximum and minimum measured sound pressure levels is less than 5 dB. If this condition is not fulfilled, it is necessary to carry out measurements in four additional points 6 to 9, as described in Figure 6.

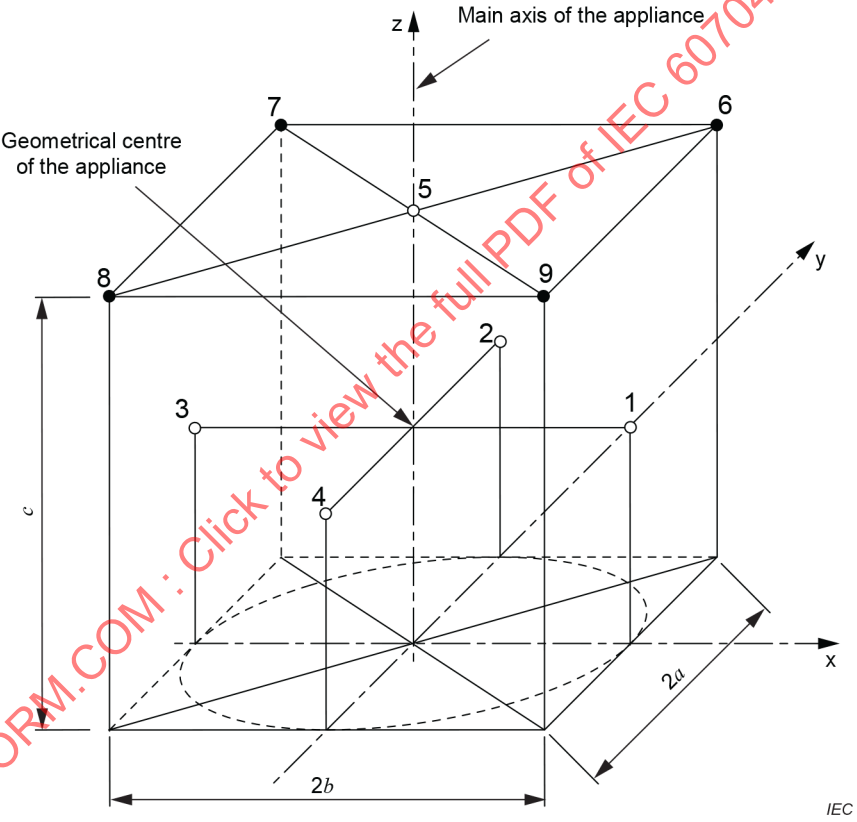
The front of the appliance, unless otherwise specified in the relevant part of IEC 60704-2 series, is directed in the direction of the x-axis. For determining time histories, frequency spectra, etc. of the appliance, microphone position no.1 is recommended.

Coordinates of microphone positions:

No.	x	y	z
1	a	0	c-1m
2	0	b	c-1m
3	-a	0	c-1m
4	0	-b	c-1m
5	0	0	c
6	a	b	c
7	-a	b	c
8	-a	-b	c
9	a	-b	c

Measurement surface area:

$S = 4\ (a \cdot b + b \cdot c + c \cdot a)$



where

c is the height, in m, of the measurement surface (normally equal to the height of the geometrical centre of the appliance above the reflecting plane, enlarged by 1 m);

$2 \cdot a$ is the width, in m, of the measurement surface (normally equal to the width of the appliance, enlarged by 2 m);

$2 \cdot b$ is the length, in m, of the measurement surface (normally equal to the maximum dimension of the appliance, enlarged by 2 m).

Figure 6 – Measurement surface – parallelepiped – with five or nine microphone positions for stand-type appliances

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 For measurements in free-field conditions over a reflecting plane, the requirements in 4.1, Clause 5 and 8.2.1 of ISO 3744:2010 shall be followed; for measurements in hard-walled test rooms, the requirements in Clause 7 of ISO 3743-1:2010 shall be followed; for measurements in special reverberation test rooms, the requirements in Clause 9 of ISO 3743-2:2018 shall be followed.

The time-average sound pressure level has to be observed at each microphone position over a typical period of operation of the appliance. For noise that varies with time, the period of observation shall be specified carefully.

In the case of a moving microphone, the integration time should include at least one full traverse for measurements in accordance with ISO 3743-1:2010 or ISO 3743-2:2018, and at least two full traverses for measurements in accordance with ISO 3744:2010.

NOTE The measurement time interval can be chosen to be representative of the period of maximum noise level.

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_{pA}' and L_{pA}'' 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:

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

where

L_{pm} 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

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

where

$L_{W(\text{RSS})}$ 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

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

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 $L_{W\mathrm{A}}$ 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:

$$L_{W\mathrm{A}} = L_{p\mathrm{mA}} - \left(10 \cdot \lg\left(\frac{T_\mathrm{N}}{T_0}\right) + 10 \cdot \lg\left(\frac{V}{V_0}\right) - 13\right) \text{ dB}$$

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 Stabilizing procedure and period.

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 Other energies, supply data.

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	Supply of other energy	9.7.4
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	9.13

Annex A
(normative)

Standard test table

A suitable design for a standard test table is shown in Figure A.1. The top of the table shall be of bonded laminated wood 0,10 m thick, having a minimum area of 0,5 m^2 and a minimum lateral dimension of 0,7 m. The height of the standard test table shall be 0,75 m.

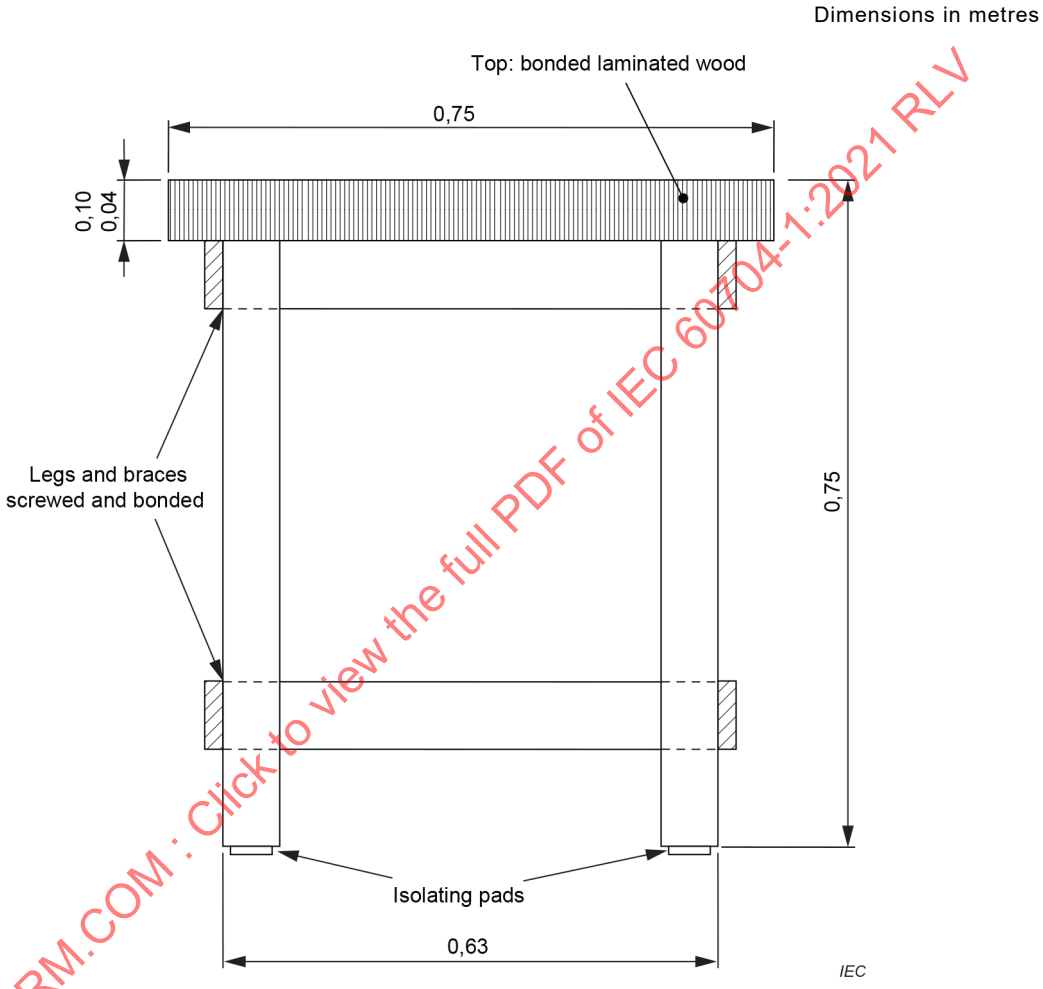
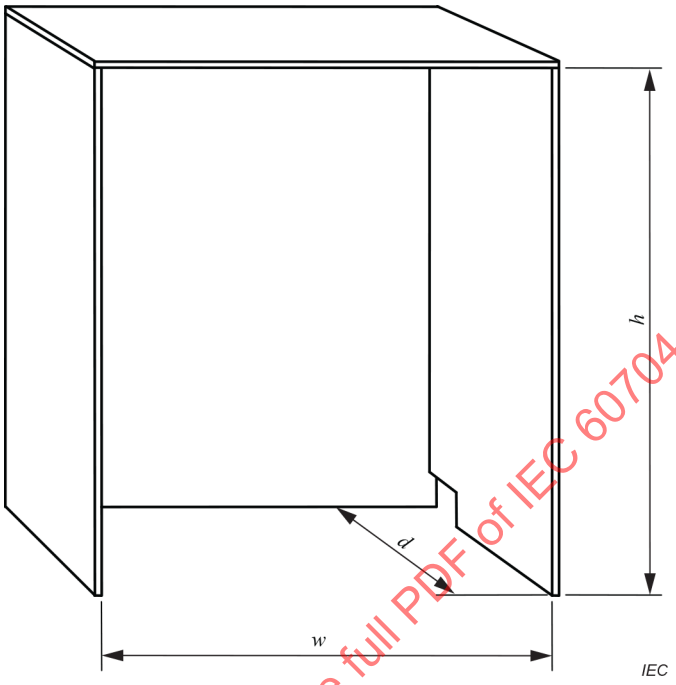


Figure A.1 – Example of standard test table

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

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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APPAREILS ÉLECTRODOMESTIQUES ET ANALOGUES – CODE D'ESSAI POUR LA DÉTERMINATION DU BRUIT AÉRIEN –

Partie 1: Exigences générales

AVANT-PROPOS

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La Norme internationale IEC 60704-1 a été établie par le comité d'études 59 de l'IEC: Aptitude à la fonction des appareils électrodomestiques et analogues.

Cette quatrième édition annule et remplace la troisième édition parue en 2010. Cette édition constitue une révision technique.

Elle inclut les modifications majeures suivantes par rapport à l'édition précédente:

a) mise à jour des références (notamment aux normes ISO);
b) révision des exigences relatives aux conditions climatiques;
c) révision des exigences relatives au niveau de bruit de fond.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
59/753/FDIS	59/762/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Le présent document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60704, publiées sous le titre général *Appareils électrodomestiques et analogues – Code d'essai pour la détermination du bruit aérien*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu du présent document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

Bien que les niveaux de bruit émis par les appareils électrodomestiques ne présentent pas, en général, un danger pour l'oreille de l'opérateur ou d'autres personnes exposées, la nécessité de disposer de méthodes normalisées pour la détermination du bruit émis a été reconnue depuis longtemps. Il convient donc de spécifier de telles méthodes, non seulement pour des types particuliers d'appareils, mais également pour la majorité des appareils couramment utilisés auxquels il convient d'appliquer ces principes.

En général, la détermination des niveaux de bruit est une partie seulement d'un ensemble de méthodes d'essai couvrant les nombreux aspects de propriétés et caractéristiques d'aptitude à la fonction de l'appareil. Il est donc important que les exigences pour les mesures de bruit (à savoir, environnement d'essai, appareils de mesure, quantité de travail nécessaire) soient maintenues à un niveau raisonnable.

Les résultats des mesures de bruit sont utilisés à des fins diverses, par exemple pour la déclaration du bruit ou pour comparer le bruit émis par un appareil spécifique au bruit émis par d'autres appareils de la même famille. Dans d'autres cas, les résultats servent de base pour des études d'ingénierie, par exemple pour le développement de nouveaux équipements ou pour décider des moyens à adopter pour une insonorisation. Dans tous les cas, il est important de spécifier des procédures ayant une exactitude connue de telle sorte que les résultats des mesures effectuées par différents laboratoires puissent être comparés.

Ces conditions ont, dans la mesure du possible, été prises en considération lors de l'établissement du présent code d'essai. Les méthodes de mesure acoustiques sont basées sur celles décrites dans les normes ISO 3743-1:2010, ISO 3743-2:2018 et ISO 3744:2010.

Ces méthodes autorisent l'utilisation de salles semi-anéchoïques, de salles d'essai réverbérantes spéciales et de salles d'essai à parois dures. Le résultat des mesures est le niveau de puissance acoustique de l'appareil. Dans les limites de l'incertitude de mesure qui caractérise ces méthodes, les résultats de la détermination dans les conditions de champ libre sur plan réfléchissant sont égaux à ceux obtenus en champ réverbéré.

L'utilisation des méthodes par intensimétrie spécifiées dans les normes ISO 9614-1:1993, ISO 9614-2:1996 et ISO 9614-3:2002 est applicable dans des conditions spéciales qui sont décrites dans les parties correspondantes de la série IEC 60704-2.

Le présent code d'essai ne concerne que le bruit aérien. Dans certains cas, le bruit solidien, transmis par exemple à la pièce voisine, peut avoir de l'importance.

APPAREILS ÉLECTRODOMESTIQUES ET ANALOGUES – CODE D'ESSAI POUR LA DÉTERMINATION DU BRUIT AÉRIEN –

Partie 1: Exigences générales

1 Domaine d'application

La présente partie de l'IEC 60704 s'applique aux appareils électriques pour usages domestiques et analogues, y compris leurs accessoires ou composants, alimentés à partir du réseau ou par piles ou accumulateurs.

L'expression "usages analogues" s'entend des usages dans des conditions similaires à celles des foyers domestiques, par exemple dans les restaurants, cafés, salons de thé, hôtels, salons de coiffure, laveries, etc. sauf spécification contraire dans la série IEC 60704-2.

Le présent document ne s'applique pas

– aux appareils, équipements ou machines conçus exclusivement pour des usages industriels ou professionnels;
– aux appareils qui font partie intégrante d'un bâtiment ou de ses installations, tels que les équipements de climatisation, de chauffage ou de ventilation (à l'exception des ventilateurs domestiques, des hottes de cuisine et des appareils de chauffage indépendants, des déshumidificateurs, des épurateurs d'air et des chauffe-eau indépendants), aux brûleurs à mazout pour le chauffage central, aux pompes pour l'alimentation en eau et pour les systèmes d'eaux usées;
– aux moteurs ou générateurs individuels; et
– aux appareils exclusivement destinés à une utilisation à l'extérieur.

Pour déterminer et vérifier les valeurs d'émission acoustique déclarées dans les spécifications de produit, voir l'IEC 60704-3:2019.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60704-2 (toutes les parties), *Appareils électrodomestiques et analogues – Code d'essai pour la détermination du bruit aérien*

IEC 60704-3:2019, *Appareils électrodomestiques et analogues – Code d'essai pour la détermination du bruit aérien – Partie 3: Méthode de détermination et de vérification des valeurs déclarées d'émission sonore*

IEC 61260-1:2014, *Electroacoustique – Filtres de bande d'octave et de bande d'une fraction d'octave – Partie 1: Spécifications*

IEC 61672-1:2013, *Electroacoustique – Sonomètres – Partie 1: Spécifications*

ISO 3743-1:2010, *Acoustique – Détermination des niveaux de puissance acoustique et des niveaux d'énergie acoustique émis par les sources de bruit à partir de la pression acoustique – Méthodes d'expertise en champ réverbéré applicables aux petites sources transportables – Partie 1: Méthode par comparaison en salle d'essai à parois dures*

ISO 3743-2:2018, *Acoustique – Détermination des niveaux de puissance acoustique émis par les sources de bruit à partir de la pression acoustique – Méthodes d'expertise en champ réverbéré applicables aux petites sources transportables – Partie 2: Méthodes en salle d'essai réverbérante spéciale*

ISO 3744:2010, *Acoustique – Détermination des niveaux de puissance acoustique et des niveaux d'énergie acoustique émis par les sources de bruit à partir de la pression acoustique – Méthodes d'expertise pour des conditions approchant celles du champ libre sur plan réfléchissant*

ISO 9614-1:1993, *Acoustique – Détermination par intensimétrie des niveaux de puissance acoustique émis par les sources de bruit – Partie 1: Mesurages par points*

ISO 9614-2:1996, *Acoustique – Détermination par intensimétrie des niveaux de puissance acoustique émis par les sources de bruit – Partie 2: Mesurage par balayage*

ISO 9614-3:2002, *Acoustique – Détermination par intensimétrie des niveaux de puissance acoustique émis par les sources de bruit – Partie 3: Méthode de précision pour mesurage par balayage*

ISO 6926:2016, *Acoustique – Prescriptions relatives aux performances et à l'étalonnage des sources sonores de référence pour la détermination des niveaux de puissance acoustique*

ISO 12001:1996, *Acoustique – Bruit émis par les machines et équipements – Règles pour la préparation et la présentation d'un code d'essai acoustique*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent. Les termes et définitions relatifs à la détermination des niveaux de puissance acoustique peuvent être trouvés dans l'ISO 3743-1:2010, l'ISO 3743-2:2018 et l'ISO 3744:2010.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
durée de mesure
fraction ou multiple d'une phase opératoire ou d'un cycle de fonctionnement sur lequel sont déterminés les niveaux de puissance acoustique

3.2
phase opératoire
intervalle de temps pendant lequel un processus spécifié est accompli par l'appareil en essai (par exemple, pour un lave-vaisselle, le lavage, le rinçage ou le séchage)

3.3
cycle de fonctionnement
succession spécifique de phases opératoires réalisées pendant que l'appareil en essai exécute un cycle de travail complet

Note 1 à l'article: Chaque phase opératoire est associée à un processus spécifique qui peut ne se produire qu'une seule fois ou être répété pendant le cycle de fonctionnement (par exemple, pour un lave-vaisselle, le lavage, le rinçage et le séchage).

3.4
signature temporelle
enregistrement continu du niveau de pression acoustique (pour une position précise de microphone) en fonction du temps, effectué pendant une ou plusieurs phases opératoires d'un cycle de fonctionnement

3.5
parallélépipède de référence
parallélépipède rectangle fictif limité par le(les) plan(s) réfléchissant(s) sur lequel(lesquels) est placée la source de bruit en essai, qui entoure la source au plus près, y compris tout élément à rayonnement acoustique significatif et toute table d'essai sur laquelle la source est montée

[SOURCE: ISO 3744:2010, 3.10, modifiée – La note a été ignorée.]

3.6
enceinte d'essai
enceinte utilisée pour simuler les conditions acoustiques habituelles en situation d'encastrement et/ou de montage

4 Méthodes de mesure et environnements acoustiques

4.1 Généralités

Le présent document concerne des méthodes objectives de degré de précision "expertise" de classe 2 conformément à l'ISO 12001:1996, destinées à déterminer les niveaux de puissance acoustique L_W, exprimés en décibels (dB) par rapport à une puissance acoustique d'un picowatt (1 pW), d'un bruit aérien situé à l'intérieur de la plage de fréquences d'intérêt (comprenant généralement les bandes d'octave ayant des fréquences médianes comprises entre 125 Hz et 8 000 Hz), dans les conditions de fonctionnement prescrites pour l'appareil à mesurer.

Les méthodes de détermination des niveaux de puissance acoustique avec un degré de précision "laboratoire" de classe 1 conformément à l'ISO 12001:1996, spécifiées par exemple dans l'ISO 3741 et l'ISO 3745, ne figurent pas dans le présent document. Elles peuvent cependant être appliquées si l'environnement et l'instrumentation d'essai appropriés sont disponibles.

NOTE 1 Les valeurs de bruit obtenues dans les conditions décrites dans le présent document ne correspondent pas nécessairement au bruit constaté dans les conditions de fonctionnement pratique.

NOTE 2 Pour les contrôles de qualité en production, etc., des méthodes simplifiées peuvent convenir. D'autres méthodes de mesure faisant appel, par exemple, à une analyse en bande étroite ou à des techniques intensimétriques, doivent généralement être appliquées pour réduire le bruit. De telles méthodes ne sont pas couvertes par le présent document.

La totalité du bruit émis par un appareil ou un équipement et rayonné dans toutes les directions de l'espace entourant l'appareil peut être caractérisée par la puissance acoustique de l'appareil. Dans les limites de la plage d'exactitude du présent document, la puissance acoustique d'un appareil ne dépend pas, pour l'essentiel, de l'environnement dans lequel l'appareil est installé.

Par conséquent, le concept de niveau de puissance acoustique a été choisi pour exprimer l'émission acoustique des appareils électrodomestiques et analogues.

La quantité préférentielle d'émission acoustique est le niveau de puissance acoustique pondéré A, L_{WA}, en dB (réf 1 pW).

Conformément au présent document, il existe deux méthodes principales, la méthode directe et la méthode comparative, décrites respectivement en 4.2 et en 4.3. L'une ou l'autre des deux méthodes peut être utilisée.

Différents types d'environnements, décrits en 4.4, peuvent être utilisés. Une partie de la série IEC 60704-2 peut, si nécessaire, exclure une ou plusieurs combinaisons parmi celles offertes.

4.2 Méthode directe

La méthode directe ne peut être utilisée que pour des mesures effectuées dans des environnements d'essai qualifiés conformément à l'ISO 3744:2010 pour des conditions de champ libre sur un ou plusieurs plan(s) réfléchissant(s) et conformément à l'ISO 3743-2:2018 pour les salles d'essai réverbérantes spéciales.

Avec cette méthode, le niveau de puissance acoustique est déterminé

– dans des conditions de champ libre sur un ou plusieurs plan(s) réfléchissant(s), à partir des niveaux de pression acoustique temporels moyens (sur la base d'une moyenne quadratique) sur la surface de mesure et de la superficie de la surface de mesure, S; ou
– dans les salles d'essai réverbérantes spéciales, à partir des niveaux de pression acoustique moyens, du temps de réverbération et du volume de la salle d'essai.

La méthode par intensimétrie selon l'ISO 9614-1:1993, l'ISO 9614-2:1996 et l'ISO 9614-3:2002 doit être utilisée si une mesure dans un champ libre ou dans une salle réverbérante ou réverbérante spéciale est impossible parce que l'appareil ne peut pas être placé ou fonctionner dans un tel environnement. Les écarts-types indiqués dans la série IEC 60704-2 et dans l'IEC 60704-3:2019 ne sont pas applicables à la méthode par intensimétrie, sauf indication explicite.

Ces méthodes produisent des résultats exprimés en niveaux de puissance acoustique pondérés A (et en niveaux de puissance acoustique par bandes d'octave ou de 1/3 d'octave, si cela est exigé) qui sont calculés directement à partir des niveaux de pression acoustique mesurés.

NOTE Cette méthode peut également être utilisée conjointement avec des méthodes plus précises (celles décrites dans l'ISO 3741 et l'ISO 3745, par exemple).

4.3 Méthode comparative

La méthode comparative pour la mesure est décrite explicitement dans l'ISO 3743-1:2010 et dans l'ISO 3743-2:2018.

NOTE Le terme "méthode comparative" n'est pas explicitement donné dans l'ISO 3744:2010, mais en appliquant "l'essai par comparaison absolue" pour déterminer la correction d'environnement donné en A.3 de l'ISO 3744:2010 en utilisant une source sonore de référence, le mode opératoire devient, de fait, une méthode comparative.

Avec cette méthode, le niveau de puissance acoustique est déterminé en comparant les moyennes quadratiques des niveaux de pression acoustique produits par la source dans la salle d'essai aux moyennes quadratiques des niveaux de pression acoustique produits dans la même salle par une source sonore de référence (SSR) étalonnée dont le niveau de puissance acoustique émise est connu, conforme aux exigences de l'ISO 6926:2016. La différence entre les niveaux de pression acoustique est égale à la différence entre les niveaux de puissance acoustique lorsque les conditions dans lesquelles sont réalisées les deux séries de mesures sont les mêmes.

Cette méthode produit des résultats exprimés en niveaux de puissance acoustique par bandes d'octave ou de 1/3 d'octave, et le niveau de puissance acoustique pondéré A est calculé à partir des niveaux de puissance acoustique par bandes d'octave ou de 1/3 d'octave.

L'utilisation de la méthode comparative est recommandée pour vérifier s'il y existe une différence systématique entre les résultats obtenus dans des environnements différents.

4.4 Environnements acoustiques

4.4.1 Exigences générales et critères d'aptitude de l'environnement d'essai

Les exigences et les critères sont donnés dans les articles suivants:

– article 4 de l'ISO 3743-1:2010 pour les salles d'essai à parois dures;
– article 5 de l'ISO 3743-2:2018 pour les salles d'essai réverbérantes spéciales; et
– article 4 de l'ISO 3744:2010 pour les conditions de champ libre sur plan réfléchissant.

Une classification de différents types de bruits est donnée dans l'ISO 12001:1996. La méthode spécifiée dans l'ISO 3744:2010 convient pour les mesures de tous les types de bruits émis par les appareils électroménagers. Les méthodes spécifiées dans l'ISO 3743-1:2010 et l'ISO 3743-2:2018 conviennent pour tous les types de bruits, à l'exception des sources de bruit impulsif consistant en des rafales d'impulsions de courte durée. Cela sera en compte dans l'établissement des parties de la série IEC 60704-2.

La méthode spécifiée dans l'ISO 3744:2010 est applicable aux sources de bruit de toute taille. Les limitations relatives à la taille de la source sont données en 4.2 de l'ISO 3743-1:2010 et à l'Article 5 de l'ISO 3743-2:2018. Cela sera pris en compte dans l'établissement des parties de la série IEC 60704-2.

NOTE Pour les conditions de champ libre sur un plan réfléchissant, il est préférable, pour la qualification de l'environnement d'essai, d'utiliser l'essai par comparaison absolue décrit à l'Article A.2 de l'ISO 3744:2010.

Des lignes directrices pour la conception de salles d'essai simples approchant les conditions de champ libre sont données à Annexe C.

Des lignes directrices pour la conception d'une salle d'essai réverbérante spéciale appropriée sont données à l'Annexe A de l'ISO 3743-2:2018.

4.4.2 Critères pour le niveau de bruit de fond

Les exigences relatives au niveau de bruit de fond sont données en 4.5 de l'ISO 3743-1:2010, en 6.5 de l'ISO 3743-2:2018 et en 4.2 de l'ISO 3744:2010. La valeur moyenne du niveau du bruit de fond, sur l'ensemble des positions de microphones, doit être inférieure d'au moins 6 dB, mais de préférence se trouver à plus de 15 dB au-dessous du niveau de pression acoustique à mesurer.

NOTE Si la différence entre les niveaux de pression acoustique du bruit de fond et du bruit produit par l'appareil est inférieure à 6 dB, voir 8.2.

4.4.3 Conditions environnementales

Des conditions environnementales défavorables pour le microphone utilisé pour les mesures (par exemple champ électrique ou magnétique intense, vent, impact du soufflage d'air provenant de l'équipement en essai, température élevée ou basse) doivent être évitées en choisissant convenablement le type de microphone ou son emplacement.

Les instructions des fabricants d'instruments de mesure relatives à des conditions d'environnement défavorables doivent être suivies. Le microphone doit toujours être orienté de façon que l'angle d'incidence des ondes sonores soit celui pour lequel il a été étalonné.

4.5 Incertitudes de mesure

4.5.1 Généralités

Les valeurs estimées des écarts-types de la reproductibilité des niveaux de puissance acoustique déterminés selon le présent document sont indiquées en 9.1 de l'ISO 3743-1:2010, en 11.1 de l'ISO 3743:2:2018 et en 9.1 de l'ISO 3744:2010. Mais pour une famille particulière d'appareils de même taille avec des conditions de fonctionnement similaires, les écarts-types de la reproductibilité peuvent être inférieurs à ces valeurs. Des valeurs inférieures à celles indiquées dans les normes ISO peuvent donc être spécifiées dans la série IEC 60704-2, si elles sont justifiées par des résultats d'essais interlaboratoires appropriés.

En cas de divergences entre les mesures dont les résultats demeurent cependant dans les limites de l'écart-type prévu, il peut s'avérer utile de réaliser des mesures conformément à la classe de précision supérieure: classe 1, laboratoire, comme décrit dans l'ISO 3741 ou l'ISO 3745.

4.5.2 Ecarts-types sur la répétabilité et la reproductibilité et écarts-types liés à la déclaration et la vérification

Les écarts-types sur la répétabilité et la reproductibilité des niveaux de puissance acoustique déterminés selon le présent document sont indiqués dans les tableaux de la série IEC 60704-2 et dans l'IEC 60704-3. Les tableaux de la série IEC 60704-2 sont donnés au format indiqué au Tableau 1. Les valeurs (X,X) sont indiquées à deux chiffres après la virgule.

Tableau 1 – Ecarts-types des niveaux de puissance acoustique

Ecart-type (dB)	
σ_r (répétabilité)	σ_R (reproductibilité)
X,X	X,X

Les écarts-types (sur la production, le total et la référence) utilisés pour déterminer et vérifier les valeurs déclarées d'émission acoustique selon l'IEC 60704-3 sont indiqués dans la série IEC 60704-2 et dans l'IEC 60704-3. Les tableaux de la série IEC 60704-2 sont donnés au format indiqué au Tableau 2. Les valeurs sont indiquées à un chiffre après la virgule.

Tableau 2 – Ecarts-types pour la déclaration et la vérification

Ecart-type (dB)		
σ_P (production)	σ_t (total)	σ_M (référence)
X,X	X,X	X,X

5 Appareillage

5.1 Appareillage pour la mesure des données acoustiques

Les exigences relatives au système d'appareillage et son étalonnage sont données à l'Article 5 de l'ISO 3743-1:2010, à l'Article 7 de l'ISO 3743-2:2018 et à l'Article 5 de l'ISO 3744:2010.

Le système d'appareillage doit satisfaire aux exigences définies pour les instruments de classe 1 dans l'IEC 61672-1:2013, conformément à la norme de base utilisée. Pour les mesures par bandes d'octave ou de 1/3 d'octave, le système d'appareillage utilisé doit satisfaire aux exigences de l'IEC 61260-1:2014.

Les SSR doivent satisfaire aux exigences de l'ISO 6926:2016 et doivent être étalonnées une fois par an.

5.2 Appareillage pour la mesure des conditions climatiques

5.2.1 La température est déterminée avec des appareils de mesure ayant une exactitude de ±1 °C.

5.2.2 L'humidité relative est déterminée avec des appareils de mesure ayant une exactitude absolue de ±2 % dans les limites de la plage de mesure.

5.2.3 La pression atmosphérique absolue est mesurée avec des appareils ayant une exactitude de ±0,5 kPa.

5.3 Appareillage pour la mesure des conditions de fonctionnement

5.3.1 La tension à la fiche du câble ou du cordon des appareils alimentés par le réseau est mesurée avec des voltmètres ayant l'exactitude des appareils de classe 0,5.

5.3.2 La tension aux bornes des piles et accumulateurs des appareils alimentés par piles ou accumulateurs est mesurée avec des voltmètres ayant l'exactitude des appareils de classe 0,5.

5.3.3 La vitesse de rotation des moteurs, fixations, etc. est mesurée, si nécessaire, au moyen d'indicateurs de vitesse ayant une exactitude de ±1 % sur la pleine échelle.

6 Fonctionnement et emplacement des appareils en essai

6.1 Equipement et conditionnement préalable des appareils

6.1.1 L'appareil est équipé de ses fixations, accessoires, etc. dans les conditions de livraison du fabricant pour l'usage ou la fonction auquel(le) il est destiné.

6.1.2 Il faut veiller à ce que tous les équipements auxiliaires (les conduits ou les câbles électriques, les tuyaux d'alimentation en eau ou d'écoulement, les conduits d'air, etc.) nécessaires au fonctionnement de l'appareil ne diffusent pas de quantité notable de bruit dans l'environnement d'essai ou ne modifient pas le bruit émis par l'appareil. Des lignes directrices sont données en 6.2 de l'ISO 3743-1:2010, en 8.4 de l'ISO 3743-2:2018 et en 6.2 de l'ISO 3744:2010.

6.1.3 Avant les mesures acoustiques, l'appareil, équipé comme pour l'usage auquel il est destiné, doit avoir été mis en fonctionnement suffisamment longtemps pour éviter le bruit excessif produit par les parties non rodées. Il convient de procéder au rodage, s'il y a lieu, à la vitesse la plus élevée et, sauf spécification contraire, sans charge. La partie correspondante de l'IEC 60704-2 indique la période totale de rodage et les durées de fonctionnement assignées, sauf recommandation différente du fabricant.

6.1.4 Immédiatement avant chaque série de mesures acoustiques, l'appareil, équipé comme pour l'usage auquel il est destiné, est mis en fonctionnement pour stabilisation à la vitesse la plus élevée, s'il y a lieu et, sauf spécification contraire, sans charge, comme indiqué dans la partie correspondante de la série IEC 60704-2 ou selon les instructions du fabricant.

6.2 Alimentation en énergie électrique et en eau ou gaz

6.2.1 Les appareils équipés d'un ou de plusieurs moteurs alimentés par le réseau électrique sont alimentés à la tension assignée et à la fréquence assignée. Les appareils conçus seulement pour courant continu sont alimentés en courant continu. Si une plage de tensions et/ou une plage de fréquences sont indiquées, alors la tension et/ou la fréquence d'alimentation doivent être la tension nominale du réseau et/ou la fréquence du réseau du pays dans lequel l'appareil est destiné à être utilisé. Pendant l'essai, les tolérances ne doivent pas dépasser ±2 % pour la tension et ±1 % pour la fréquence.

La tension nominale du réseau et ses valeurs sont définies dans l'IEC 60038:2009.

Si la tension assignée d'un appareil alimenté par le réseau diffère de la tension nominale du réseau couramment employée dans le pays d'utilisation, il convient d'effectuer les mesures sous la tension nominale couramment employée dans le pays d'utilisation.

La tension d'alimentation est mesurée au niveau de la fiche d'un câble ou d'un cordon d'alimentation non détachable, ou au niveau de l'entrée de l'appareil s'il est équipé d'un câble d'alimentation détachable, mais en aucun cas à l'entrée de câbles prolongateurs.

6.2.2 Pour les appareils équipés d'un ou de plusieurs moteurs électriques alimentés par piles ou accumulateurs, les mesures de bruit commencent avec des piles ou des accumulateurs entièrement chargés dans les conditions spécifiées par le fabricant, et les mesures sont interrompues lorsque la tension en charge des piles ou accumulateurs est tombée à 0,9 fois la tension en charge au début de l'essai pour les piles ou accumulateurs au plomb, et à 0,8 fois pour les autres types.

La tension des piles ou accumulateurs est mesurée à leurs bornes, le cas échéant.

6.2.3 Les appareils comportant des éléments chauffants, électriques ou à gaz, peuvent être mis en fonctionnement sans l'élément chauffant si ce dernier n'a aucune incidence sur l'émission acoustique de l'appareil.

6.2.4 L'alimentation en eau et/ou en gaz éventuelle doit être telle que spécifiée par le fabricant.

En l'absence de spécification du fabricant, la pression d'eau doit être de 240 ± 50 kPa, la température de l'eau froide doit être de 15 ± 2 °C et la température de l'eau chaude doit être de 55 ± 2 °C, sauf spécification contraire dans la partie correspondante de la série IEC 60704-2.

Lorsque, dans certains pays, la pression et/ou la température de l'eau diffèrent de la pression et/ou de la température de l'eau du pays concerné, les mesures effectuées à la pression et/ou à la température assignée peuvent être source d'erreurs pour le consommateur. Dans ce cas, des mesures complémentaires peuvent être nécessaires. Si la pression et/ou la température d'essai diffèrent de la pression et/ou de la température assignée, il convient de consigner cette information.

6.3 Conditions climatiques

En général, les appareils domestiques (sauf spécification contraire pour une famille particulière d'appareils) sont mis en fonctionnement dans les conditions climatiques suivantes:

température ambiante	18 °C à 28 °C
humidité relative	25 % à 70 %
pression atmosphérique	86 kPa à 106 kPa

6.4 Charge et fonctionnement des appareils lors des essais

6.4.1 Des exigences générales sont données en 6.5 de l'ISO 3743-1:2010, en 8.5 de l'ISO 3743-2:2018 et en 6.6 de l'ISO 3744:2010. Les lignes directrices suivantes sont fournies dans le but d'établir un code d'essai acoustique, sauf spécification contraire dans la partie correspondante de la série IEC 60704-2.

En général, il convient que les conditions de charge et de fonctionnement, dans la mesure du possible, simulent l'utilisation normale mais, dans tous les cas, la préférence doit être accordée à des conditions simples assurant une répétabilité et une reproductibilité satisfaisantes.

Il convient d'éviter la présence d'un opérateur. Un opérateur ne doit être présent que si l'application de la charge n'est pas réalisable sans opérateur. Cet opérateur ne doit pas porter de vêtements absorbant anormalement le son susceptibles d'influencer les mesures du bruit.

6.4.2 Pour déterminer l'émission acoustique d'un appareil, si les conditions de charge et de fonctionnement ne sont pas spécifiées dans la partie correspondante de la série IEC 60704-2 pour une catégorie particulière d'appareils, elles doivent être limitées à une condition unique, sauf pour les appareils qui remplissent plusieurs fonctions principales de longue durée et pour les appareils à fonctions multiples, pour lesquels une ou plusieurs conditions peuvent être spécifiées. Toutefois, la condition spécifiée doit être celle qui produit la valeur la plus élevée d'émission acoustique.

La marche à vide, sans charge, peut être choisie comme la condition unique pour déterminer le bruit émis par l'appareil si elle est typique et stable et si la condition en charge n'assure pas une bonne reproductibilité.

Pour les appareils équipés d'un dispositif de commande de la vitesse, le réglage correspondant à la vitesse la plus élevée est généralement utilisé.

6.4.3 Les appareils faisant l'objet de cycles de fonctionnement en usage normal sont mis en fonctionnement de la même manière pour déterminer l'émission acoustique, en procédant aux mesures pendant des parties appropriées des cycles de fonctionnement des fonctions principales.

Il est recommandé de consigner le niveau de pression acoustique pondéré A au cours du/des cycles de fonctionnement (signature temporelle) pour l'une des positions de microphones, de préférence en face de l'appareil en essai.

6.4.4 En appliquant les conditions de charge et de fonctionnement pour déterminer l'émission acoustique, il faut veiller à éviter un éventuel échauffement de l'appareil en essai. Les durées assignées de fonctionnement et de repos et/ou les instructions du fabricant doivent être respectées.

6.5 Emplacement et montage des appareils

6.5.1 Les exigences fondamentales de 6.3 et 6.4 de l'ISO 3743-1:2010, de 8.2 et 8.3 de l'ISO 3743-2:2018 et de 6.3 et 6.4 de l'ISO 3744:2010 doivent être satisfaites. Les lignes directrices suivantes sont fournies, sauf spécification contraire dans la partie correspondante de la série IEC 60704-2.

6.5.2 Les appareils posés sur le sol, sur un plan de travail ou sur une table sont placés en position normale, directement, sans autres moyens élastiques que ceux incorporés dans l'appareil:

– soit sur le sol de la salle d'essai à parois dures ou de la salle d'essai réverbérante spéciale en respectant une distance minimale de 1 m entre une surface de l'appareil (parties protubérantes incluses) et la paroi la plus proche;

– soit sur le plan réfléchissant de l'environnement en champ libre, en tenant compte de la forme et des dimensions de la surface de mesure spécifiée.

Les appareils montés sur un support (appareils conçus pour être utilisés sur un support, casques sèche-cheveux, par exemple) sont placés sur le support fourni avec l'appareil ou sur un support construit selon les instructions du fabricant.

Le rayonnement acoustique dû aux vibrations possibles du morceau de revêtement de sol doit être empêché. Le morceau de revêtement de sol est considéré comme une partie de l'appareil en essai, et son influence éventuelle sur les caractéristiques acoustiques de l'environnement d'essai n'est pas prise en considération.

Les appareils destinés à être posés sur une table, lorsqu'une table est exigée pour le fonctionnement, sont placés au centre de la table d'essai normalisée décrite à l'Annexe A.

6.5.3 Les appareils tenus à la main, y compris leurs accessoires éventuels, sont suspendus par des moyens élastiques ou montés de façon élastique dans un dispositif d'essai approprié, à une hauteur de 25 cm environ.

La base du dispositif d'essai est placée sur un système intermédiaire en matière élastique (n'ayant aucune influence sur le bruit aérien émis par l'appareil en essai) de façon que le bruit solidien ne soit pas transmis à partir de l'appareil, et est disposée

– soit sur le sol de la salle d'essai à parois dures ou de la salle d'essai réverbérante spéciale en respectant une distance minimale de 1 m entre une surface de l'appareil (parties protubérantes incluses) et la paroi la plus proche;

– soit sur le plan réfléchissant de l'environnement en champ libre, en tenant compte de la forme et des dimensions de la surface de mesure spécifiée.

Il convient de veiller à s'assurer que les moyens de suspension ou de serrage ne modifient pas le bruit émis par l'appareil (rayonné par le sol, par exemple) en supprimant ou en renforçant certains types de vibrations du corps de l'appareil, ou en recouvrant les surfaces d'émission, arrivées d'air, etc.

6.5.4 Les appareils destinés à être placés sur le sol contre un mur, y compris les meubles, les plans de travail ou les enceintes d'essai des appareils encastrés, sont placés en position normale en ménageant une distance D = 10 ± 1 cm entre l'arrière de l'appareil et un mur ou plan vertical, directement, sans autres moyens élastiques que ceux incorporés dans l'appareil:

– soit sur le sol de la salle d'essai à parois dures ou de la salle d'essai réverbérante spéciale, avec la distance mentionnée par rapport au mur, et avec une distance minimale de 1,5 m entre toute autre surface de l'appareil ou du meuble ou plan de travail et le coin de la salle le plus proche;

– soit sur un plan horizontal réfléchissant de l'environnement en champ libre et avec la distance mentionnée entre l'arrière de l'appareil et le plan vertical réfléchissant. La dimension minimale de ce plan vertical doit être au moins égale à la dimension de la projection de la surface de mesure. Le coefficient d'absorption acoustique du plan vertical réfléchissant doit être inférieur à 0,06 dans la plage de fréquences d'intérêt.