

# INTERNATIONAL STANDARD



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



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IEC 60704-1

Edition 4.0 2021-03  
REDLINE VERSION

# INTERNATIONAL STANDARD



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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 13.120; 97.170

ISBN 978-2-8322-9571-7

**Warning! Make sure that you obtained this publication from an authorized distributor.**

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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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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- withdrawn,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.

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## 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 a test object.

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.

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)    |                              |
|----------------------------|------------------------------|
| $\sigma_r$ (repeatability) | $\sigma_R$ (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) |                    |                        |
|-------------------------|--------------------|------------------------|
| $\sigma_P$ (production) | $\sigma_t$ (total) | $\sigma_M$ (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  $\pm 1$  °C.

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

**5.2.3** The absolute air pressure is determined with instruments having an accuracy of  $\pm 0,5$  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  $\pm 1$  % 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  $\pm 2\%$  for voltage and  $\pm 1\%$  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  $240 \text{ kPa} \pm 50 \text{ kPa}$ , the temperature of cold water shall be  $15 \text{ °C} \pm 2 \text{ °C}$  and the temperature of hot water shall be  $55 \text{ °C} \pm 2 \text{ °C}$ , 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:

|                                 |                             |                                                             |
|---------------------------------|-----------------------------|-------------------------------------------------------------|
| <del>ambient temperature</del>  | <del><math>t</math></del>   | <del><math>= 23 \text{ °C} \pm 5 \text{ °C}</math></del>    |
| <del>relative humidity</del>    | <del><math>RH</math></del>  | <del><math>= 50 \% \pm 20 \%</math></del>                   |
| <del>atmospheric pressure</del> | <del><math>p_s</math></del> | <del><math>= 96 \text{ kPa} \pm 10 \text{ kPa}</math></del> |
| ambient temperature             |                             | $18 \text{ °C to } 28 \text{ °C}$                           |
| relative humidity               |                             | $25 \% \text{ to } 70 \%$                                   |
| atmospheric pressure            |                             | $86 \text{ kPa to } 106 \text{ kPa}$                        |

### 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  $D = 10 \text{ cm} \pm 1 \text{ cm}$  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<sub>1</sub> and l<sub>3</sub> each not exceeding 0,4 m and l<sub>2</sub> 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);~~

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

~~$2b$  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:

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

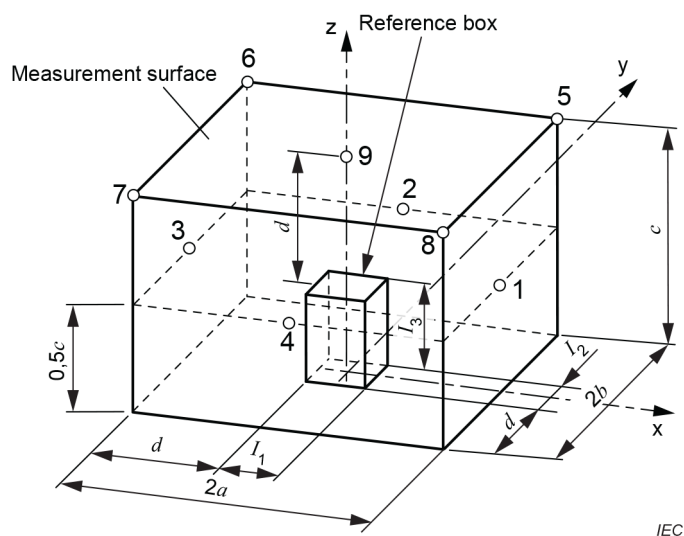


**Figure 1 – Measurement surface – parallelepiped – with key microphone positions, for floor free-standing appliances**

**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:

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

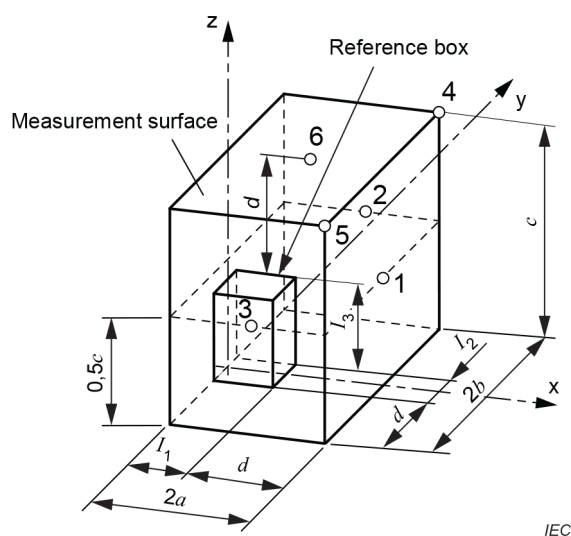


**Figure 2 – Measurement surface – parallelepiped – with key microphone positions, for floor standing appliances placed against a wall**

**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  $2d$ , but less than or equal to  $5d$ , 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.

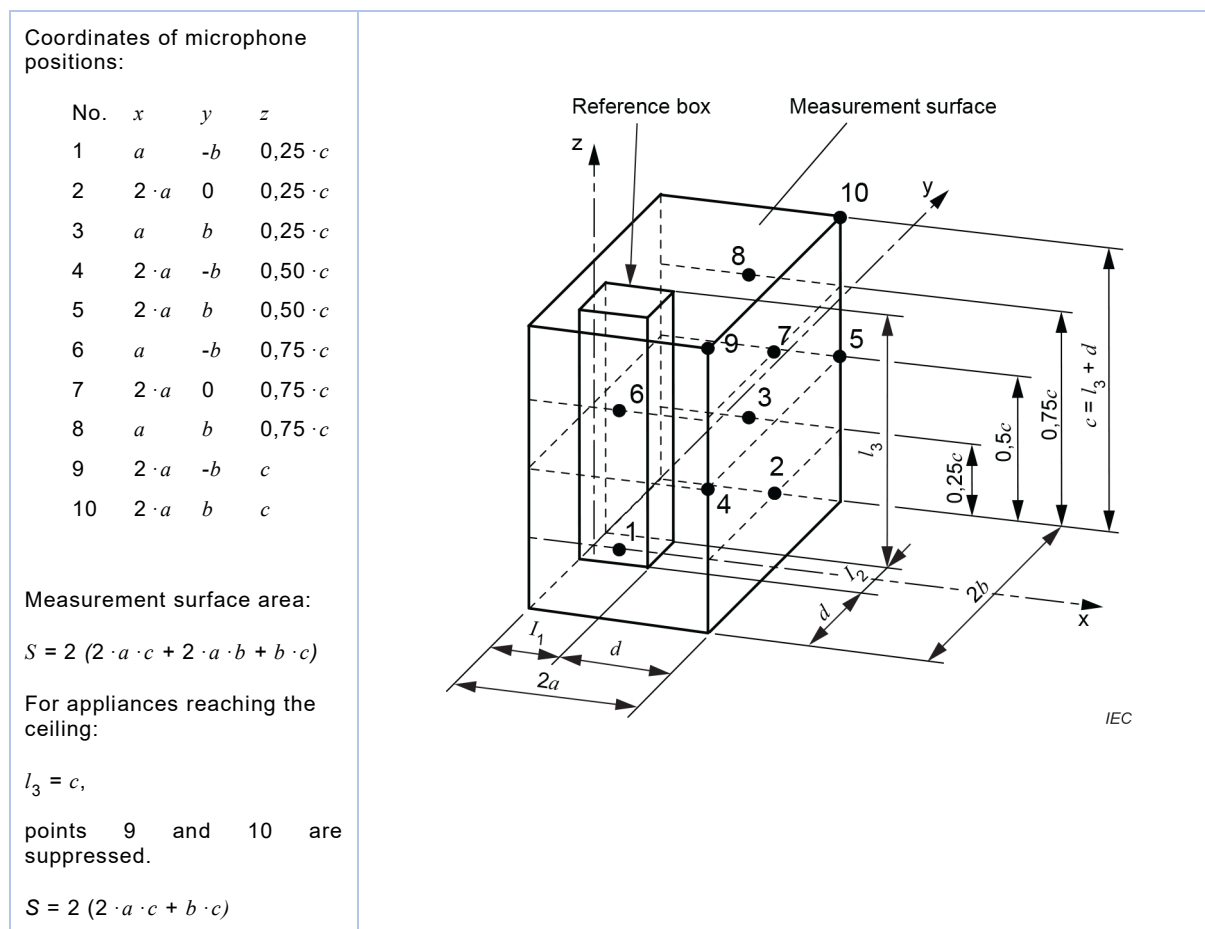


**Figure 3 – Measurement surface – parallelepiped – with key microphone positions, for high floor-standing appliances placed against a wall**

**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.

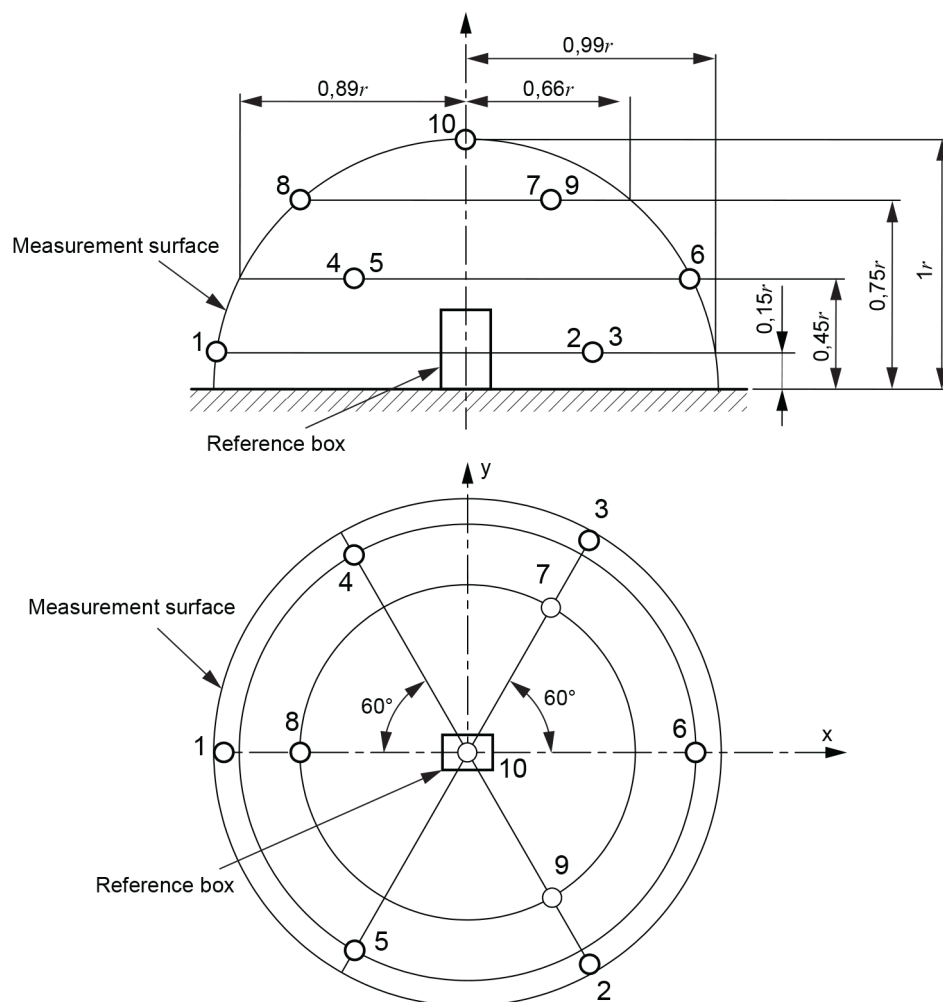
NOTE The front of the appliance, unless otherwise specified in the relevant part of IEC 60704-2 series, is directed in the direction of the  $x$ -axis. For determining time histories, frequency spectra, etc. of the appliance, microphone position no.8 is recommended for the 10-microphone array.

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:

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



IEC

**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:

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

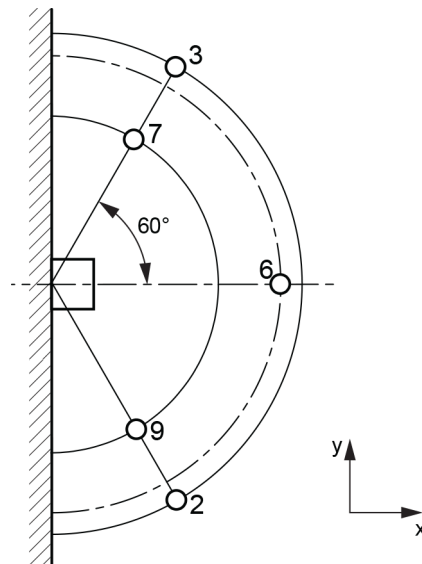
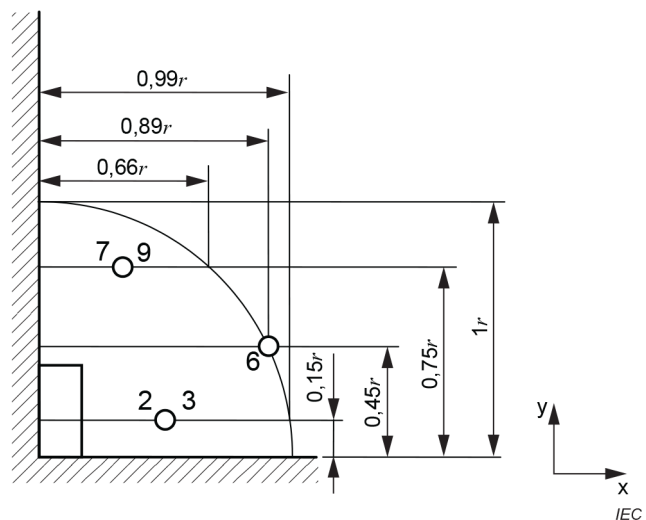


**Figure 5 – Measurement surface – quarter-sphere – with key microphone positions, for small floor-standing appliances placed against a wall**

**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.

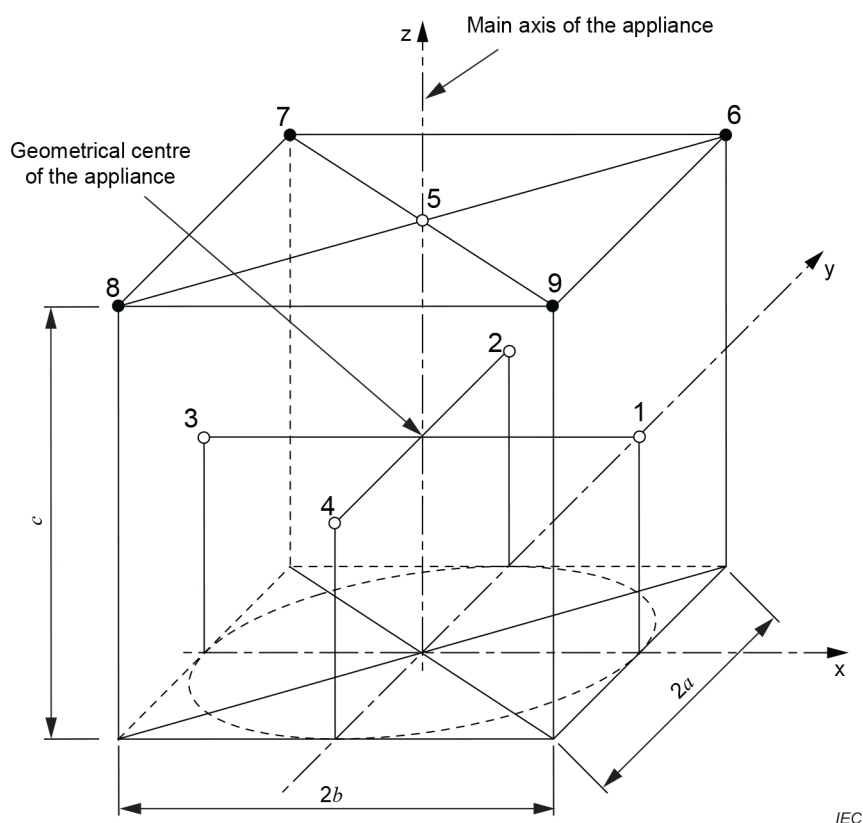
The front of the appliance, unless otherwise specified in the relevant part of IEC 60704-2 series, is directed in the direction of the  $x$ -axis. For determining time histories, frequency spectra, etc. of the appliance, microphone position no.1 is recommended.

Coordinates of microphone positions:

| No. | $x$  | $y$  | $z$           |
|-----|------|------|---------------|
| 1   | $a$  | 0    | $c-1\text{m}$ |
| 2   | 0    | $b$  | $c-1\text{m}$ |
| 3   | $-a$ | 0    | $c-1\text{m}$ |
| 4   | 0    | $-b$ | $c-1\text{m}$ |
| 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

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

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

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:

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

where

$L_{pm}$  is the sound pressure level averaged over the microphone positions or over the measurement surface, in dB, re 20  $\mu$ Pa;

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

$N$  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

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



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

where

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

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

$\overline{L_{p(AT)}}$  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

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

where

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

$A_j$  is the A-weighted value of the midband frequency of octave- or 1/3 octave-band  $j$ , as given in Table 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:

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

where

$L_{p_{mc}}$  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<sup>2</sup>;

$S_0$  is 1 m<sup>2</sup>.

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

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

$$L_{WA} = L_{p_{mA}} - 10 \cdot \lg \frac{T_N}{T_0} + 10 \cdot \lg \frac{V}{V_0} - 13 \text{ dB (Ref. 1 pW)}$$

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

where

- $L_{p\text{mA}}$  is the A-weighted sound pressure level averaged in dB over the microphone positions in accordance with 8.4 in dB (re 20  $\mu\text{Pa}$ );
- $T_N$  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  $\text{m}^3$ .

## 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.