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Acoustics — Test methods for the qualification of the acoustic environment —

Part 2: Determination of the environmental correction

Acoustique — Méthodes d’essai pour la qualification de l'environnement acoustique —

Partie 2: Détermination de la correction d’environnement

Reference number
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Foreword

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This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 211, *Acoustics,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 26101 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is one of the series ISO 26101, which specify various methods for qualifying the acoustic environment. The methods specified in this document permit the qualification of an acoustic environment that approximates to an acoustic free field near one or more reflecting planes. In other words, an acoustic environment in which the effect of reflected sound on sound pressure level measurements is sufficiently small, so that it can be corrected for with the so-called environmental correction K_2. K_2 can be needed to determine the sound power level, see e.g. ISO 3744 or ISO 3746[3], or the emission sound pressure level, see e.g. ISO 11201[6], ISO 11202[7] and ISO 11204[8].

It is expected that the qualification procedures outlined in this document will be referred to by other International Standards and industry test codes. In such cases, these documents making reference to this document can specify qualification criteria based on the environmental correction K_2 determined according to this document.

Acoustics — Test methods for the qualification of the acoustic environment —

Part 2:
Determination of the environmental correction

1 Scope

This document specifies methods for qualifying an environment that approximates to an acoustic free field near one or more reflecting planes. The goal of the qualification is to determine the environmental correction K_2, which is used to correct for reflected sound when determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping the noise source (machinery or equipment) in such an environment.

In practice, the K_2 value determined will be a function of both the reflected sound from the test environment and the shape and size of the measurement surface used for the K_2 determination. For the purposes of this document and the documents that refer to it, the differences between K_2 values determined with different measurement surfaces are assumed to be included in the stated measurement uncertainty for the test method.

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.

ISO 3744:2024, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3745:2012, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic rooms and hemi-anechoic rooms*

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

ISO 26101-1, *Acoustics — Test methods for the qualification of the acoustic environment — Part 1: Qualification of free-field environments*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3744 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
reverberation time
T
⟨room acoustic parameters⟩ duration required for the space-averaged sound energy density in an enclosure to decrease by 60 dB after the source emission has stopped

Note 1 to entry: Reverberation time, T, is expressed in seconds.

Note 2 to entry: T can be evaluated based on a smaller dynamic range than 60 dB and extrapolated to a decay time of 60 dB. It is then labelled accordingly. Thus, if T is derived from the time at which the decay curve first reaches 5 dB and 25 dB below the initial level, it is labelled T_{20}. If decay values of 5 dB to 35 dB below the initial level are used, it is labelled T_{30}.

[SOURCE: ISO 3382-2:2008[1], 3.5]

3.2
measurement surface
hypothetical surface of area, S, on which the microphone positions are located at which the sound pressure levels are measured, enveloping the noise source under test and terminating on the reflecting plane(s) on which the source is located

[SOURCE: ISO 3744:2024, 3.12]

3.3
environmental correction
K_2
correction applied to the mean (energy average) sound pressure levels over all the microphone positions on the *measurement surface* (3.2), to account for the influence of reflected or absorbed sound

Note 1 to entry: Environmental correction, K_2, is expressed in decibels.

Note 2 to entry: The environmental correction is frequency dependent; the correction in the case of a frequency band is denoted K_{2f}, where f denotes the relevant mid-band frequency, and that in the case of overall A-weighting is denoted K_{2A}, which is determined from A-weighted sound pressure level measurements.

Note 3 to entry: In general, the environmental correction depends on the area of the measurement surface and usually K_2 increases with S.

[SOURCE: ISO 3744:2024, 3.15, modified “determined as described in Annex A or in ISO 26101-2:2024“ and “Note 4 to entry” have been omitted.]

3.4
sound absorption coefficient
α
at a given frequency and for specified conditions, the relative fraction of sound power incident upon a surface which is not reflected

[SOURCE: ISO 3741:2010[2], 3.9, modified — The NOTE has been deleted.]

3.5
equivalent absorption area
A
product of the area and *sound absorption coefficient* (3.4) of a surface

Note 1 to entry: A hypothetical surface area with a sound absorption coefficient of 1,0 that would have the same total sound absorption as the test environment that is being qualified.

[SOURCE: ISO 3741:2010[2], 3.10, modified term “sound” has been omitted and the NOTE has been replaced by a Note 1 to entry with different content.]

4 Qualification procedures for the acoustic environment

4.1 General

Environmental influences shall be evaluated by selecting one of four qualification procedures (see 4.2 to 4.5) used to determine the magnitude of the environmental correction K_2. These qualification procedures shall be used to determine if any undesired environmental influences are present and to qualify a given measurement surface for an actual noise source under test in accordance with this document. Information on the uncertainty of the environmental correction can be found in Annex A.

4.2 Absolute comparison test

The absolute comparison test (see Clause 5) is carried out with a reference sound source (RSS) and may be used outdoors and indoors. This is the preferred procedure for qualifying a test environment according to ISO 3744, particularly if data in frequency bands are required, and if the noise source under test can be removed from the test site. However, it may also be used, if the noise source under test cannot be removed from the test site (see 5.2). This method is expected to yield the most accurate results in typical industrial environments[9].

4.3 Methods based on room absorption

The methods based on room absorption (see Clause 6) require the determination of the equivalent absorption area, A , of the test room and can be less accurate than the absolute comparison test in typical industrial environments. These tests are based on the assumption that the room has approximately a cubic shape, is substantially empty, and that sound is absorbed at the room boundaries only. Three methods are specified in which A is calculated either from measurements of reverberation time (see 6.2), from measurements of sound pressure levels from the noise source under test using a secondary measurement surface (see 6.3) or from measurements on a reference sound source (see 6.4).

4.4 Inverse-square-law qualification of parallelepiped and cylindrical measurement surfaces

This third qualification procedure (see Clause 7) may be used to qualify hemi-anechoic test rooms for parallelepiped or cylindrical measurement surfaces up to a maximum volume (qualification with the goal $K_2 = 0$). It is the preferred method to qualify a hemi-anechoic room and represents the most accurate method. To qualify an anechoic or a hemi-anechoic chamber for hemi-spherical measurement surfaces, see ISO 26101-1 and ISO 3745.

NOTE In hemi-anechoic rooms, the other qualification procedures can yield unreliable results.

4.5 Approximate method based on an estimation of the equivalent absorption area

This method (see Clause 8) is based on an estimation of the equivalent absorption area A of the test room and is considered to be the least accurate method.

Figure 1 is a flowchart which provides guidance for the selection of a method to determine the environmental correction K_2. The method specified in Clause 5 may be used indoors and outdoors, while the methods specified in Clauses 6 and 8 may be used indoors only. As indicated in Figure 1, the inverse-square law method according to Clause 7 may be used in hemi-anechoic chambers only.

NOTE In some industrial buildings, which are of low height and have reflecting surfaces, the sound propagation can be distorted. In these conditions, the qualification procedures according to Clause 6 and Clause 8 might not be applicable.

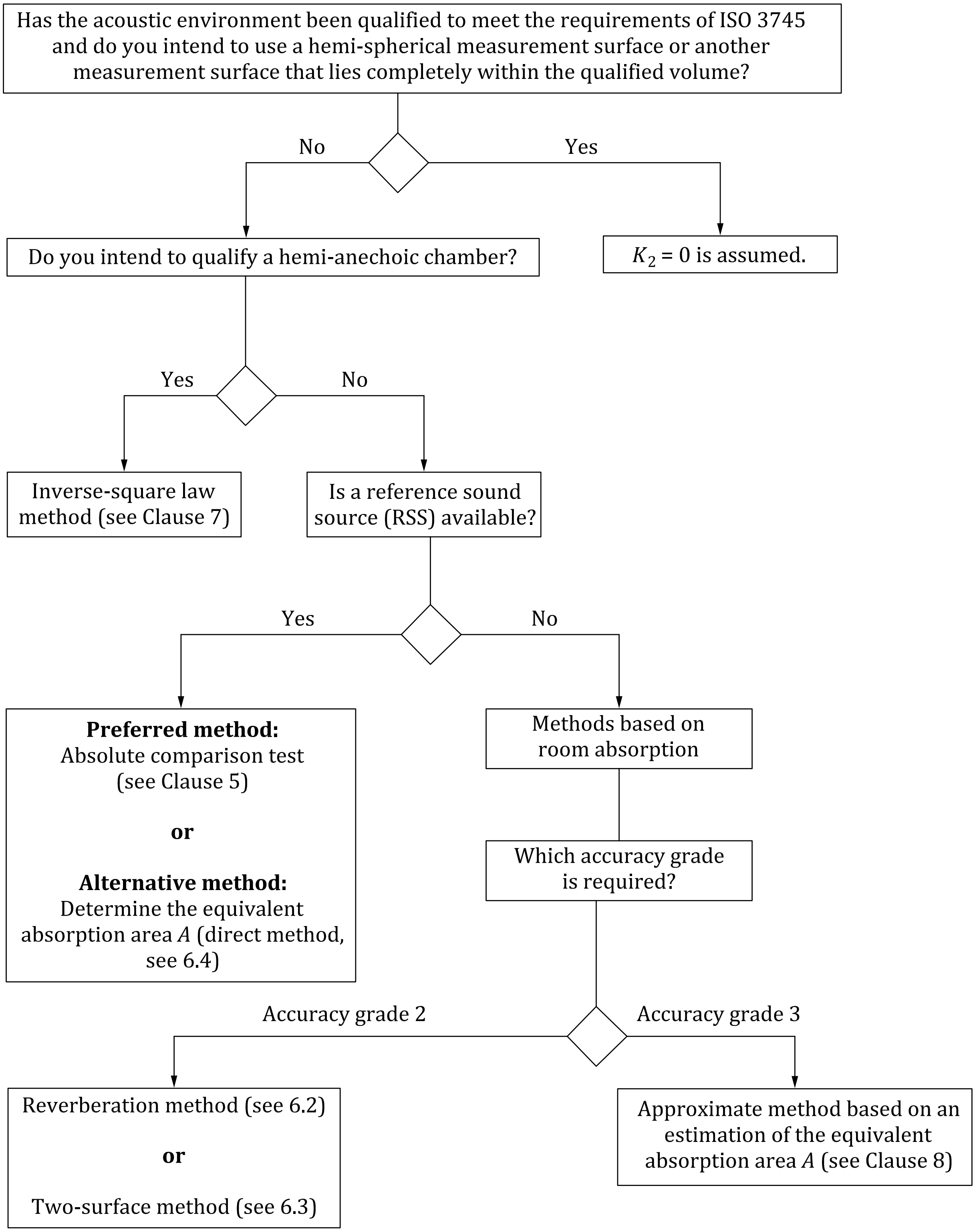


Figure 1 — Flowchart to select a method to determine K_2

5 Absolute comparison test

5.1 General

This method represents the preferred method to determine the environmental correction according to ISO 3744:2024, Annex A.

A reference sound source meeting the requirements of ISO 6926 shall be mounted in the test environment, in essentially the same position as that of the noise source under test. The sound power level of the reference sound source shall be determined in accordance with the procedure of ISO 3744:2024, Clause 8 without the environmental correction, K_2 (i.e. K_2 is initially assumed to be equal to zero). The measurement surface used for the qualification measurements and K_2 determination shall encompass microphone positions on the measurement surface to be used for the measurements of the noise source under test.

The environmental correction, K_2, is given by Formula (1):

$$K_2 = L_W^* - L_{W(\mathrm{RSS})} \tag{1}$$

where

L_W^*	is the environmentally uncorrected sound power level of the reference sound source, determined in accordance with ISO 3744:2024, Clause 8 when using the value 0 for K_2, in decibels;
$L_{W(\mathrm{RSS})}$	is the sound power level of the calibrated reference sound source under the meteorological conditions of the test, in decibels.

This method is applicable to both directly measured A-weighted levels and frequency band levels. If the spectrum of the noise source under test is very different from that of the reference sound source, K_2 values should be determined in each frequency band over the frequency range of interest and the A-weighted levels shall be calculated from the frequency band levels as specified in ISO 3744:2024, Annex G.

5.2 Locations of reference sound source in test environment

If the noise source under test can be removed from the test site, the reference sound source shall be located on the reflecting plane, independent of the height of the noise source under test.

NOTE Normally, the reference sound source is calibrated on the floor at least 1,0 m from the nearest wall. If the reference sound source is used in other positions, unless it has been calibrated specifically in these positions, systematic errors can occur at low frequencies.

A single location is sufficient for small- and medium-sized sources (l_1, l_2, l_3 < 2 m), where l_1, l_2 and l_3 are the length, width and height, respectively, of the reference box (see ISO 3744:2024, 7.1). For larger sources and for those with ratios of length to width greater than 2, the reference sound source shall be operated on the floor at four points. Assuming that the projection of the noise source under test on the floor is approximately rectangular in shape, the four points are located at the middle points of the sides of the rectangle. To obtain L_W, the surface sound pressure level $\overline{L_p}$ shall be calculated with the reference sound source located at each of the four points on the floor. At each point on the measurement surface, the sound pressure level shall be averaged for the four source locations based on an energy average using ISO 3744:2024, Formula (9).

If the noise source under test cannot be removed from the test site, the reference sound source shall be placed at one or more positions in the same environment, different from the position of the noise source under test, but equivalent with respect to room reflections. Positions of the reference sound source on top of the noise source under test or adjacent to it may be used; see for example ISO 3747[4].

With regard to a sufficient number of microphone positions, care should be taken to fulfil the requirements of ISO 3744:2024, 8.1.1, 8.1.2, 8.1.3 or 8.1.4 as appropriate.

5.3 Information to be recorded and reported

For the qualified measurement surface in the test room the information specified in ISO 3744:2024, Clause 10 shall be recorded, if not already recorded in the test report on the actual source under test in the test room.

6 Determination of the environmental correction based on room absorption

6.1 General

The environmental correction K_2 shall be calculated from Formula (2):

$$K_2 = 10\lg\left(1+\frac{4S}{A}\right)\mathrm{dB} \tag{2}$$

where

A is the equivalent sound absorption area of the room, in square metres;

S is the area of the measurement surface, in square metres.

The methods specified in Clause 6 shall not be used in highly-absorbing environments, e.g. laboratory-quality hemi-anechoic rooms, or for outdoor measurements.

6.2 Reverberation method

This test method shall be used only in rooms of length and width each less than three times the ceiling height.

The equivalent sound absorption area of the room A, in square metres, shall be calculated by the Sabine reverberation time formula. At room temperatures between 15 °C and 30 °C:

$$A = \frac{55{,}3}{c}\frac{V}{T} \tag{3}$$

where

c is the speed of sound, c = 343 m/s;

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

T is the measured reverberation time (see 3.1 and Reference [1]), in seconds, for A-weighting or in frequency bands.

For the purpose of determining $K_{2\mathrm{A}}$ directly from A-weighted measured values, the reverberation time measured in the frequency band with a mid-band frequency of 1 kHz should be used.

6.3 Two-surface method

Two surfaces that surround the noise source shall be selected. The first surface shall be the measurement surface for the determination of the sound power level. The area of the first surface shall be designated S_1. The second surface with area S_2 shall be geometrically similar to the first surface and located further away and symmetrical with respect to the noise source under test. On both surfaces, the background noise criteria specified in ISO 3744:2024, 4.4 shall be fulfilled.

Small errors in the difference $\overline{L_{p1}} - \overline{L_{p2}}$ can lead to large errors in the calculated absorption area, A. Therefore, the measurements shall be executed in a single session, thus avoiding possible changes in environmental conditions. The sound pressure levels on both surfaces shall be measured using the same instrument, or the same set of instrumentation. The intermediate results, e.g. the values $\overline{L_{p1}}$ and $\overline{L_{p2}}$, shall not be rounded.

The microphone locations on the second surface shall correspond to those on the first surface. The ratio S_1 / S_2 shall not be less than 2 and preferably should be greater than 4. The ratio S / A in Formula (2) is calculated from Formula (4):

$$\frac{S}{A} = \frac{1 - M(S_1 / S_2)}{4(M-1)} \tag{4}$$

where

$$M = 10^{0,1(\overline{L_{p1}} - \overline{L_{p2}})/\text{dB}}$$

in which

$\overline{L_{p1}}$ is the mean sound pressure level on S_1, corrected for background noise [see ISO 3744:2024, Formula (12)], but not for the influence of the environment, in decibels,

$\overline{L_{p2}}$ is the mean sound pressure level on S_2, corrected for background noise [see ISO 3744:2024, Formula (12)], but not for the influence of the environment, in decibels;

S_1 is the area of the first measurement surface, in square metres.

S_2 is the area of the second measurement surface, in square metres.

The environmental correction K_2 for A-weighting or in frequency bands is obtained from Formula (2), with the S / A ratio calculated from Formula (4).

6.4 Determination of the equivalent absorption area with a reference sound source (direct method)

A reference sound source meeting the requirements of ISO 6926 shall be mounted in the test environment near the noise source under test. The radius of the hemispherical measurement surface should be preferably 2 m, but shall not be smaller than 1 m in any case and shall not be smaller than two times the largest diameter of the reference sound source. The distance from the source to other reflecting surfaces shall be greater than the diameter of the measurement hemisphere. This method is sensitive to error and shall be executed with utmost care. In case of doubt, or when the difference $\overline{L_{p(\text{in situ})}} - L_{W(\text{RSS})}$ is small, it is beneficial to use microphone positions as specified in ISO 3745:2012, Table E.1.

NOTE Normally the reference sound source is calibrated on the floor at least 1,0 m from the nearest wall. If the reference sound source is used in other positions, unless it has been calibrated specifically in these positions, systematic errors can occur at low frequencies.

The microphone positions shall be on the fixed point array with the coordinates given in ISO 3745:2012, Table E.1 or ISO 3744:2024, Table B.2. At least 10 measurement positions shall be used. Preferably, measurement positions with the coordinates given in ISO 3745:2012, Table E.1 should be used, since these positions include a greater number of different heights (rotational symmetry of the emission of usual RSS) than those in ISO 3744:2024, Table B.2.

The mean background noise-corrected sound pressure level from the reference sound source on the hemispherical measurement surface, $\overline{L_{p(\text{in situ})}}$, shall then be determined in accordance with ISO 3744:2024, 8.2.2, 8.2.3 and 8.2.4 with $K_2 = 0$.

The equivalent absorption area, A, is then calculated using Formula (5):

$$A = \frac{4S}{(S / S_0) \times 10^{0,1\left[\overline{L_{p(\text{in situ})}} - L_{W(\text{RSS})}\right]/\text{dB}} - 1} \tag{5}$$

where

S	is the area of the hemispherical measurement surface, in square metres;
$S_0 = 1\ \mathrm{m}^2$;	
$\overline{L_{p(\text{in situ})}}$	is the mean sound pressure level of the reference sound source mounted near to the noise source under test, corrected for background noise but not for the influence of the environment (see ISO 3744:2024, 8.2.4), in decibels;
$L_{W(\text{RSS})}$	is the sound power level of the calibrated reference sound source under the meteorological conditions of the test, in decibels.

If the static pressure or other atmospheric conditions differ significantly from the reference conditions for the determination of the calibrated sound power level of the reference sound source, $L_{W(\text{RSS})}$ should be calculated from the sound power level of the reference sound source under in situ conditions, $L_{W(\text{RSS,in situ})}$, in accordance with the manufacturer's instructions.

If $L_{W(\text{RSS})}$ is not known, or if it is not possible to calculate $L_{W(\text{RSS,in situ})}$ from $L_{W(\text{RSS})}$, the measurements specified above should be repeated with the reference sound source in an acoustic free field over a reflecting plane outdoors to obtain a reference mean sound pressure level, $\overline{L_{p(\text{ref})}}$. From these measurements, the equivalent absorption area in the environment where the noise source under test is mounted is calculated using Formula (6):

$$A = \frac{4S}{10^{0,1\left[\overline{L_{p(\text{in situ})}} - \overline{L_{p(\text{ref})}}\right]/\text{dB}} - 1} \tag{6}$$

6.5 Information to be recorded and reported

For the qualified test room the information specified in ISO 3744:2024, Clause 10 shall be recorded, if not already recorded in the test report on the actual source under test in the test room.

7 Inverse-square-law qualification of parallelepiped and cylindrical measurement surfaces

7.1 General

The performance of a hemi-anechoic room is tested by comparing the spatial decrease of sound pressure emitted from a test sound source with the decrease of sound pressure that would occur in an ideal free sound field. The evaluation of this performance is based on the procedures outlined in ISO 26101-1. This clause contains the qualification criteria and test parameters using the inverse-square-law method to qualify parallelepiped measurement surfaces in test rooms in which K_2 is assumed to be zero. For the qualification of hemi-anechoic rooms for hemi-spherical measurement surfaces, see ISO 26101-1 and ISO 3745.

The following is mainly a comparison of this method with the method specified in ISO 26101-1:

a) This method allows that test rooms are qualified using broadband measurements or discrete-frequency (e.g. pure tone) measurements (discrete-frequency qualification incorporates broadband qualification).

b) This method allows for a qualification of parallelepiped and cylindrical measurement surfaces. The main difference to the qualification of hemispherical measurement surfaces is the traverse paths to be qualified.

c) For the purposes of this method, an evaluation of the position of the sound source is not required.

d) This method follows ISO 26101-1 in that it requires the mathematical origin for evaluation of the inverse square law to be restricted to a point that lies within the physical volume occupied by the test sound source.

7.2 Qualification criteria

7.2.1 General

In order for a space within an environment to be deemed hemi-anechoic for measurements in accordance with this method, the following criteria and test parameters shall be used to qualify the test environment. The qualification measurements of the hemi-anechoic space shall be made using a broadband or discrete-frequency bandwidth source. If the space is qualified using a discrete-frequency bandwidth source, additional qualification using a broadband bandwidth source is not needed, because the discrete-frequency qualification also serves as a broadband qualification for the hemi-anechoic room.

7.2.2 Maximum allowable deviations from inverse square law

The deviations of the measured sound pressure levels from those estimated using the inverse square law obtained according to ISO 26101-1 shall not exceed the values given in Table 1.

Table 1 — Maximum allowable deviation of measured sound pressure levels from theoretical levels using the inverse square law

Type of test room	One-third-octave mid-band frequency Hz	Allowable deviations dB
Hemi-anechoic	≤630	±2,5
	800 to 5 000	±2,0
	≥6 300	±3,0

7.2.3 Frequency range to be qualified

For measurements conducted in accordance with this method, the frequency range of interest for qualification shall be at least 100 Hz to 10 000 Hz. The frequency range may be extended, provided that the test environment shall meet the requirements of Table 1 and the test source shall meet the requirements of ISO 26101-1 and instrument specifications are satisfactory for use over the extended frequency range. Below 125 Hz and above 4 000 Hz, deviations from the inverse square law shall be evaluated in contiguous one-third-octave bands, and between 125 Hz and 4 000 Hz, these deviations shall be determined at frequencies that correspond to the mid-band frequencies of contiguous octave bands (i.e. between 125 Hz and 4 000 Hz, not all one-third-octave bands need to be evaluated).

If the frequency range is not at least 100 Hz to 10 000 Hz, measurements taken in this test room shall not assume K_2 is zero. If the test room is qualified over a reduced frequency range, measurements in this space may still be reported to be "in conformity" with this method, provided that:

a) the one-third-octave bands comprising the reduced frequency range are contiguous, and

b) the measurement report clearly states the reduced frequency range.

7.2.4 Maximum qualified volume

The maximum qualified volume is the largest rectangular parallelepiped or cylinder surrounding the mathematical origin of the traverse over which the requirements of 7.2.2 are met concurrently on all applicable traverse paths of 7.3.3 and at all frequencies of 7.2.3. In the evaluation of this volume, any measurement point on each traverse that lies outside the qualified volume may be excluded from consideration. Within each qualified volume, each microphone traverse shall meet the requirements for traverse length of ISO 26101-1.

7.3 Installation of test sound sources and microphone traverses

7.3.1 Test sound source requirements

The design or selection of the test sound source is the responsibility of the laboratory or acoustical expert performing the qualification. Test sound sources that generate broadband signals or discrete-frequency signals may be used. For both cases, the test sound source shall meet corresponding requirements in ISO 26101-1. For the purpose of this method, the directionality measurement may be performed in the hemi-anechoic space that is being qualified. The required microphone positions are specified in the relevant clauses of ISO 26101-1.

7.3.2 Test sound source location

The test sound source shall be located to coincide with the usual position of the noise source under test. This is preferably in the centre of and on the surface of the reflecting plane.

The test sound source shall be located on the plane or in a cavity in the reflecting floor, so that the radiating area of the test sound source is situated as close as possible to the reflecting floor. If possible, the acoustic centre of the test sound source should be within a tenth of a wavelength from the reflecting floor for all frequencies in the frequency range of interest. Therefore, the test sound source should be installed in a cavity in the reflecting floor.

7.3.3 Microphone traverse paths for parallelepiped and cylindrical measurement surfaces

Test laboratories shall determine the maximum size of the parallelepiped or cylindrical measurement surface to be used in order to determine the microphone traverse paths to be used in the qualification measurements. Consideration shall be given to the acoustic properties of the hemi-anechoic room and the maximum size of sources to be measured.

Microphone traverses shall be made along at least five straight paths. These paths should start at the projection of the physical centre of the test sound source onto the reflective plane or from the projection of the primary sound radiating surface of the test sound source onto the reflective plane. The traverse path shall extend at least to the boundary of the largest measurement surface to be qualified. All traverse paths shall have the same mathematical origin and this mathematical origin shall lie within the physical volume occupied by the test sound source.

The traverse paths shall be selected as follows:

a) at least one traverse path shall be towards the centre of one of the side surfaces of the maximum parallelepiped measurement surface intended to be qualified in the test room. The longer traverse path shall be selected in the case the lengths of the prospective paths are not identical.

b) at least one traverse path shall be towards one of four upper corner microphone positions of the maximum dimension of the measurement surface intended to be qualified in the test room;

c) at least one traverse path shall be towards the centre of the environment boundary surface that has the most uniform acoustic treatment properties and is most likely to be representative of the overall free sound field performance;

d) at least one traverse path shall be towards the closest boundary surface;

e) at least one traverse path shall be selected towards other boundary surfaces that contain unique features or non-uniformities in acoustic treatment that are judged to have the most effect on the sound field (e.g. doors, viewing ports, ventilation openings and sound transmission openings).

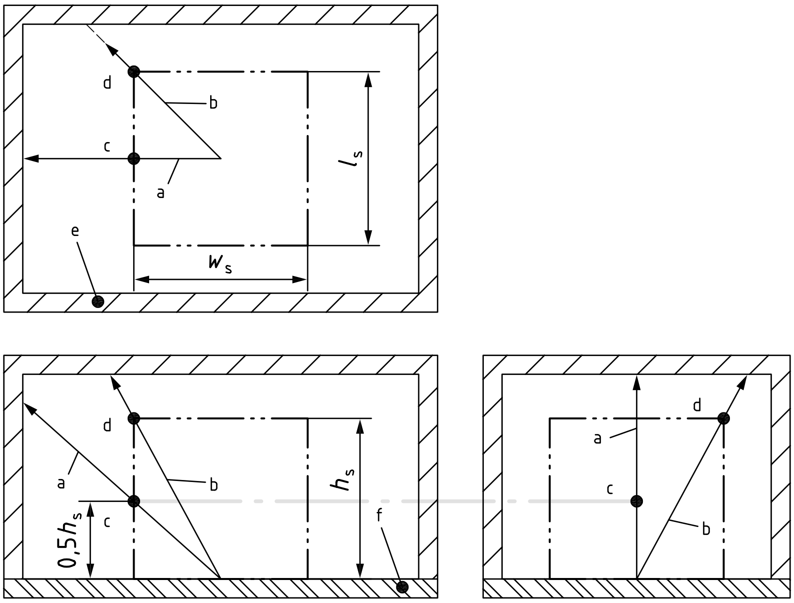
If, some of the traverse paths a) to e) are overlapping, the following path may be selected to fulfil the requirement of a minimum of five traverse paths:

f) traverse path towards the centre of one of the side surfaces of the maximum dimension of the measurement surface intended to be qualified in the test room other than the path overlapping a).

Figure 2 illustrates traverse paths a) and b) which shall be used for parallelepiped measurement surfaces only.

For qualification of cylindrical measurement surfaces, traverse paths c) to e) shall still be used, but two new paths, g) and h) shall replace paths a) and b). If paths overlap, path f) should continue to be an option to fulfil the minimum of five traverse paths.

g) at least one traverse path shall be towards the mid height of the side surface of the maximum cylindrical measurement surface intended to be qualified in the test room. The traverse path towards the furthest wall of the hemi-anechoic room shall be selected. If the room has multiple sides that are equidistant from the origin, select the one that is most likely to be representative of the overall free sound field performance.



Key

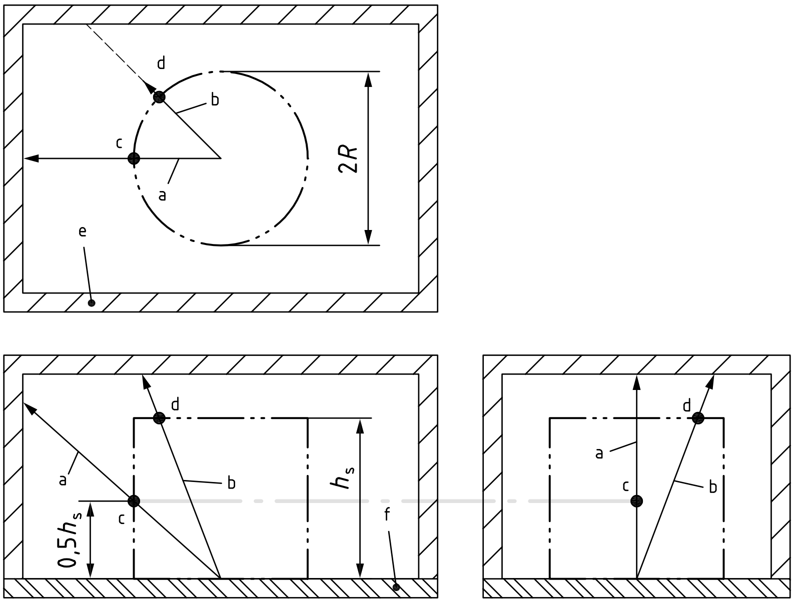
a	path a) in 7.3.3 toward the centre of the side of the measurement surface	e	absorptive side walls and ceiling
b	path b) in 7.3.3 toward the corner of the measurement surface	f	ground reflecting plane
c	intersection of path a) and the measurement surface	h_s	height of the measurement surface
d	intersection of path b) and the measurement surface	w_s, l_s	width and length of the measurement surface

Figure 2 — Top, side, and front views of a right parallelepiped measurement surface with the two microphone traverse paths specific to that surface type

h) at least one traverse path shall pass through the circular edge connecting the top and side cylindrical measurement surfaces, corresponding to the maximum dimension of the measurement surface intended to be qualified in the test room. This point shall be selected by finding the intersection of the measurement surface and the path to the furthest corner of the floor, then extending upward to the top of the cylindrical measurement surface. If the floor has multiple corners that are equidistant from the origin, select the one that is most likely to be representative of the overall free sound field performance.

Figure 3 illustrates traverse paths g) and h) which shall be used for cylindrical measurement surfaces only.

NOTE An example of traverse paths in a hemi-anechoic room for a parallelepiped measurement surface is given in Reference [10].



Key

a path g) in 7.3.3 toward the mid-height of the side of the measurement surface

b path h) in 7.3.3 toward the circular edge of the measurement surface

c intersection of path g) and the measurement surface

d intersection of path h) and the measurement surface

e absorptive side walls and ceiling

f ground reflecting plane

h_s height of the measurement surface

R radius of the measurement surface

Figure 3 — Top, side, and front views of a cylindrical measurement surface with the two microphone traverse paths specific to that surface type

7.4 Test procedure

7.4.1 Analysis bandwidth

In general, the test room shall be qualified for broadband measurements or discrete-frequency measurements. Discrete-frequency qualification may be accomplished by using either a single pure tone or multiple simultaneous pure tones that are each analysed separately in the frequency domain. For both broadband and discrete-frequency measurements, at each frequency of interest, the measurement bandwidth is preferably one-third octave or narrower. For discrete-frequency qualification, there shall be no more than one tone in each analysed band.

7.4.2 Generation of sound

The test sound source and test signals specified in ISO 26101-1 shall be used.

7.4.3 Spatial resolution of the measurement points

Sound pressure levels shall be measured along each microphone traverse specified in 7.3.3 using equally spaced measurement points at each frequency. At least 50 total measurement points are required within the qualified volume (see 7.2.4) with at least 10 measurement points on each traverse. The spacing between points shall not exceed a tenth of a wavelength at each frequency of interest below 250 Hz and shall not exceed 100 mm at frequencies above 250 Hz.

Alternatively, for signals consisting of pure tone(s), the microphone may be moved slowly and continuously along the traverse and the sound pressure levels recorded. Sound pressure level versus distance data shall be determined using the spatial sampling requirements for discrete-point measurements.

A spatial resolution of a tenth of a wavelength can be needed to fully characterize the spatial patterns in the reflections and to ensure that peak deviations are detected. If a 100 mm spatial resolution traverse indicates that the measured sound pressure level deviation, in decibels, at any point on the traverse is within 10 % of the criteria in Table 1, then additional measurements should be made near that point to ensure that the maximum deviation is detected.

7.5 Information to be recorded and reported

For test rooms qualified in accordance with this method, laboratories shall document all items specified in ISO 26101-1.

8 Approximate method based on an estimation of the equivalent absorption area

8.1 General

This approximate method for A-weighted quantities shall be used only in rooms of length and width each less than three times the ceiling height and should only be used for survey grade measurements.

In order to ascertain the acoustic characteristics of the test environment, $K_{2\mathrm{A}}$ shall be determined from Formula (2) using a value of A given by Formula (7):

$$A = \alpha S_V \tag{7}$$

where

α is the mean sound absorption coefficient, given for A-weighted quantities in Table 2,

S_V is the total area, of the boundary surfaces (walls, ceiling and floor) of the test room, in square metres.

Table 2 — Approximate values of the mean sound absorption coefficient, α

Mean sound absorption coefficient, α	Description of room
0,05	Nearly empty room with smooth hard walls made of concrete, brick, plaster or tile
0,10	Partly empty room; room with smooth walls
0,15	Right cuboid room with furniture; right cuboid machinery room or industrial room
0,20	Irregularly shaped room with furniture; irregularly shaped machinery room or industrial room
0,25	Room with upholstered furniture; machinery or industrial room with sound-absorbing material on part of ceiling or walls
0,30	Room with sound-absorbing ceiling, but no sound-absorbing materials on walls
0,35	Room with sound-absorbing materials on both ceiling and walls
0,50	Room with large amounts of sound-absorbing materials on ceiling and walls

From the estimated equivalent absorption area A and the surface area S of the measurement surface one shall calculate the environmental correction using Formula (2) (see 6.1).

NOTE In practice, estimating α based on Table 2 can be very imprecise.

8.2 Information to be recorded and reported

For the purposes of documentation the calculated equivalent absorption area, A, the selected mean sound absorption coefficient α ,the total area of the boundary surfaces of the test room S_V, the surface area of the measurement surface S and the environmental correction $K_{2\mathrm{A}}$ shall be recorded.

Annex A
(informative)

Uncertainty of the environmental correction

A.1 Absolute comparison test and methods based on room absorption

Information on the uncertainty of the determined environmental correction K_2 and its influence on the uncertainty of the determined sound power level can be found in ISO 5114-1:2024, A.6[4]. The information there applies to K_2 determined according to either Clause 5 or Clause 6, as applicable.

A.2 Inverse square-law method

This method represents a pure qualification test. If this test is passed, the environmental correction is assigned the value 0 ($K_2 = 0$, see 7.1). For the purposes of this document, it is assumed that K_2 does not contribute to the uncertainty of the determined sound power level, if the test according to Clause 7 is passed.

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