INTERNATIONAL STANDARD

ISO 10052

Second edition
2021-07

Acoustics — Field measurements of airborne and impact sound insulation and of service equipment sound — Survey method

Acoustique — Mesurages in situ de l'isolement aux bruits aériens et de la transmission des bruits de choc ainsi que du bruit des équipements — Méthode de contrôle

Reference number
ISO 10052:2021(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 126, *Acoustic properties of building products and of buildings,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 10052:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

— implementation of ISO 10052:2004/Amd 1:2010;

— references have been updated;

— added to the scope: for heavy/soft impact sound insulation, the results are given as A-weighted maximum levels;

— 2 terms added: maximum impact sound pressure level $L_{\mathrm{i},F\mathrm{max}}$ and A-weighted maximum impact sound pressure level $L_{\mathrm{iA},F\mathrm{max}}$;

— including heavy/soft impact sound test procedure and impact sound pressure level evaluation procedure;

— editorial updating.

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 describes survey field test methods which can be used for surveying the acoustic characteristics of the airborne sound insulation, impact sound insulation and of the sound pressure levels from service equipment. The methods may be used for screening tests of the acoustical properties of buildings. The methods are not intended to be applied for measuring acoustical properties of building elements.

The approach of the survey methods is to simplify the measurement of sound pressure levels in rooms by using a hand-held sound level instrument and by manually sweeping the microphone in the room space. The correction for reverberation time can be either estimated by usage of tabular values or be based on measurements. The measurement of airborne and impact sound insulation is carried out in octave bands. For measuring sound from domestic service equipment, A - or C -weighted sound pressure levels are recorded.

Measurements are performed with specified operation conditions and operation cycles. The operating conditions and operating cycles given in Annex B are only used if they are not opposed to national requirements and regulations.

The measurement uncertainty of the results obtained using the survey method is a priori larger than the uncertainty inherent in the corresponding test methods on engineering level.

NOTE Engineering methods for field measurements of airborne and impact sound insulation are dealt with in ISO 16283-1 and ISO 16283-2. Engineering methods for field measurements of airborne sound insulation of façade elements and façades are dealt with in ISO 16283-3. An engineering method for measurement of service equipment sound is dealt with in ISO 16032.

Acoustics — Field measurements of airborne and impact sound insulation and of service equipment sound — Survey method

1 Scope

This document specifies field survey methods for measuring

a) airborne sound insulation between rooms,

b) impact sound insulation of floors,

c) airborne sound insulation of façades, and

d) sound pressure levels in rooms caused by service equipment.

The methods described in this document are applicable for measurements in rooms of dwellings or in rooms of comparable size with a maximum of 150 m^3.

For airborne sound insulation, impact sound insulation and façade sound insulation the method gives values which are (octave band) frequency dependent. They can be converted into a single number characterising the acoustical performances by application of ISO 717-1 and ISO 717-2. For heavy/soft impact sound insulation, the results also are given as A-weighted maximum impact sound pressure level. For service equipment sound the results are given directly in *A* - or *C* -weighted sound pressure levels.

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 10140-5:2021, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 5: Requirements for test facilities and equipment*

ISO 16283-2:2020, *Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 2: Impact sound insulation*

IEC 61260, *Electroacoustics — Octave-band and fractional-octave-band filters*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
average sound pressure level
$\overline{L}$
<in a room> ten times the logarithm to the base 10 of the ratio of the space and time average of the sound pressure squared to the square of the reference sound pressure, the space average being taken over the entire room with the exception of those parts where the direct radiation of a sound source or the near field of the boundaries (wall, etc.) is of significant influence

Note 1 to entry: It is expressed in decibels as:

$$\overline{L} = 10 \lg \frac{\frac{1}{T_m} \int_0^{T_m} p^2(t)\,dt}{p_0^2} \text{ dB}$$

where

p is the sound pressure level, in Pascal, p_0 = 20 µPa is the reference sound pressure;

T_m is the integration time, in seconds.

3.2
level difference
D
difference in the space and time average sound pressure levels produced in two rooms by one sound source in one of them

Note 1 to entry: It is expressed in decibels as:

$$D = \overline{L}_1 - \overline{L}_2$$

where

$\overline{L}_1$ is the average sound pressure level in the source room, in decibels;

$\overline{L}_2$ is the average sound pressure level in the receiving room, in decibels.

3.3
reverberation index
k
ten times the logarithm to the base 10 of the ratio of the actual reverberation time, *T*, of the receiving room to the reference reverberation time, T_0

Note 1 to entry: It is expressed in decibels.

Note 2 to entry: This quantity is denoted by:

$$k = 10 \lg \frac{T}{T_0} \text{ dB}$$

where T_0 = 0,5 s.

3.4
standardized level difference
D_{nT}
level difference (3.2) corresponding to a reference value of the reverberation time in the receiving room

Note 1 to entry: It is expressed in decibels as:

$$D_{nT} = D + k$$

where

D is the *level difference* (3.2), in decibels;

k is the *reverberation index* (3.3), in decibels.

3.5
normalized level difference
D_n
level difference, D, (3.2) corresponding to the reference absorption area in the receiving room

Note 1 to entry: It is expressed in decibels as:

$$D_n = D + k + 10\lg\frac{A_0\ T_0}{0{,}16\ V}\ \text{dB}$$

where

k is the reverberation index;

T_0 is the reference reverberation time (T_0 = 0,5 s);

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

A_0 is the reference equivalent absorption area, in square metres, (A_0 = 10 m^2);

0,16 has the unit s/m.

3.6
apparent sound reduction index
R'
ten times the logarithm to the base 10 of the ratio of the sound power W_1 which is incident on a partition under test to the total sound power transmitted into the receiving room, if, in addition to the sound power W_2 transmitted through the separating element, the sound power W_3, transmitted through flanking elements or by other components, is significant

Note 1 to entry: It is expressed in decibels as:

$$R' = 10\lg\frac{W_1}{W_2 + W_3}\ \text{dB}$$

Note 2 to entry: The expression "apparent sound transmission loss" is also in use in English-speaking countries. It is equivalent to "apparent sound reduction index".

Under the assumption of diffuse sound fields in the two rooms, the apparent sound reduction index in this document is calculated from:

$$R' = D + k + 10\lg\frac{S\ T_0}{0{,}16\ V}\ \text{dB}$$

where

D is the sound pressure level difference, in decibels;

k is the reverberation index;

S is the area of the partition, in square metres;

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

T_0 is the reference reverberation time (T_0 = 0,5 s);

0,16 has the unit s/m.

In the case of staggered or stepped rooms, S is that part of the area of the partition common to both rooms. If the common area between the stepped or staggered rooms is less than 10 m^2, this shall be indicated in the test report. If V/7,5 is larger than S, insert this value for S where V is the volume in m^3 of the receiving room which should be the smaller room.

In the case that no common area exists the normalized level difference D_n shall be determined.

Note 3 to entry: In the apparent sound reduction index, the sound power transmitted into the receiving room is related to the sound power incident on the common partition irrespective of actual conditions of transmission.

The apparent sound reduction index is independent of the measuring direction between the rooms if the sound fields are diffuse in both rooms.

3.7
impact sound pressure level
L_i
average sound pressure level (3.1) in the receiving room when the floor under test is excited by the standardized tapping machine

Note 1 to entry: It is expressed in decibels.

Note 2 to entry: If more than one position of the tapping machine is used, the impact sound pressure level is calculated by averaging the sound pressure levels $L_{i,n}$ at N positions according to:

$$L_i = 10 \lg \left(\frac{1}{N} \sum_{n=1}^{N} 10^{L_{i,n}/10} \right) \text{ dB}$$

3.8
standardized impact sound pressure level
L'_{nT}
impact sound pressure level L_i, (3.7), reduced by the *reverberation index, k*, (3.3) and expressed in decibels:

$$L'_{nT} = L_i - k$$

3.9
normalized impact sound pressure level
L'_n
impact sound pressure level L_i, (3.7),reduced by a correction term which is given in decibels, being ten times the logarithm to the base 10 of the ratio between the reference equivalent absorption area and the actual equivalent sound absorption area A of the receiving room

Note 1 to entry: The actual equivalent absorption area is calculated from the reverberation index, the reference reverberation time and the room volume:

$$L'_n = L_i - 10 \lg \frac{A_0}{A} \text{ dB} = L_i - k - 10 \lg \frac{A_0 \, T_0}{0,16 \, V} \text{ dB}$$

where

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

k is the reverberation index;

T_0 is the reference reverberation time (T_0 = 0,5 s);

A_0 is the reference absorption area (A_0 = 10 m^2);

0,16 has the unit s/m.

3.10
heavy/soft impact source
standard impact sound source to measure heavy/soft impact sound in dwellings such as a child running and jumping or an adult walking

Note 1 to entry: For more information see ISO 10140-5 and ISO 16283-2.

3.11
maximum impact sound pressure level
$L_{i,Fmax}$
impact sound pressure level measured by Fast time-weighting at receiving points when the *heavy/soft impact source* (3.10) impacts the floor

Note 1 to entry: This quantity is expressed in decibels.

3.12
average sound pressure level
$L_{1,s}$
<on a test surface> ten times the logarithm to the base 10 of the ratio of the surface and time average of the sound pressure squared to the square of the reference sound pressure, the surface average being taken over the entire test surface including reflecting effects from the test specimen and façade

Note 1 to entry: It is expressed in decibels.

3.13
façade level difference
D_{2m}
difference between the outdoor sound pressure level 2 m in front of the façade, $L_{1;2m}$, and the space and time averaged sound pressure level, L_2, in the receiving room

Note 1 to entry: It is expressed in decibels as:

$$D_{2m} = L_{1,2m} - L_2$$

It is also possible to measure in the plane of the façade. In this case the denotation is $L_{1,s}$ instead of $L_{1,2m}$.

If road traffic sound has been used as sound source the notation is $D_{tr,2m}$ and if a loudspeaker has been used it is $D_{ls,2m}$ and is expressed in decibels.

3.14
standardized façade level difference
$D_{2m,nT}$
façade level difference, D_{2m}, (3.13) corresponding to a reference value of the reverberation time in the receiving room.

Note 1 to entry: It is expressed in decibels as

$$D_{2m,nT} = D_{2m} + k$$

where k is the reverberation index.

3.15
normalized façade level difference
$D_{2m,n}$
façade level difference D_{2m} (3.13), corresponding to the reference equivalent absorption area in the receiving room

Note 1 to entry: It is calculated as follows:

$$D_{2m,n} = D_{2m} + k + 10\lg\frac{A_0\,T_0}{0{,}16\,V}\ \text{dB}$$

where

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

k is the reverberation index;

T_0 is the reference reverberation time (T_0 = 0,5 s);

A_0 is the reference equivalent absorption area in square metres (A_0 = 10 m^2);

0,16 has the unit s/m.

3.16
service equipment sound pressure level
average sound pressure level in the room obtained by the procedure described in 6.3.4 and calculated as follows:

$$L_{XY} = 10\lg\left(\frac{10^{L_{XY,1}/10} + 10^{L_{XY,2}/10} + 10^{L_{XY,3}/10}}{3}\right)\text{dB}$$

where

$L_{XY,1}$ is the weighted sound pressure level obtained by the measurement at position 1 close to the corner;

$L_{XY,2}$, $L_{XY,3}$ are the weighted sound pressure levels obtained by the two measurements at position 2 in the reverberant field of the room;

X relates to the frequency weighting used (X can be A or C);

Y characterizes there the temporal weighting (Y can be F, S or equivalent continuous level, L_{eq})

Note 1 to entry: The different measures, L_{XY}, are not comparable. Only measurement results obtained with the same measuring parameters can be compared.

3.17
standardized service equipment sound pressure level
sound pressure level corresponding to a reference of the reverberation time in the receiving room

Note 1 to entry: This quantity is denoted by $L_{XY,nT}$

$$L_{XY,nT} = L_{XY} - k$$

where

L_{XY} is the service equipment sound pressure level;

k is the reverberation index;

in this case, k is calculated from the arithmetic average of the reverberation times measured for the octave-bands 500 Hz, 1 kHz and 2 kHz.

$$k = 10\lg 1/3\ [(T_{500} + T_{1\,000} + T_{2\,000})/T_0]\ \text{dB}$$

3.18
normalized service equipment sound pressure level

service equipment sound pressure level (3.16) corresponding to the reference equivalent absorption area in the receiving room

Note 1 to entry: This quantity is denoted by $L_{XY,\mathrm{n}}$

$$L_{XY,\mathrm{n}} = L_{XY} - k - 10\lg \frac{A_0\ T_0}{0{,}16\ V}\ \ \text{dB}$$

where

L_{XY} is the service equipment sound pressure level;

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

k is the reverberation index;

in this case, k is calculated from the arithmetic average of the reverberation times measured for the octave-bands 500 Hz, 1 kHz and 2 kHz.

$k = 10\lg 1/3\ [(T_{500} + T_{1\,000} + T_{2\,000})/T_0]$ dB

T_0 is the reference reverberation time (T_0 = 0,5 s);

A_0 is the reference absorption area (A_0 = 10 m^2);

0,16 has the unit s/m.

4 Single number quantities

The single number quantities of service equipment noise which can be determined according to this document are given in Table 1. When reporting measurement results the notation in Table 1 shall be used. The different quantities can be combined according to e.g. requirements in national building code regulations. Single number quantities of airborne and impact sound insulation can be obtained according to ISO 717-1 and ISO 717-2.

Table 1 — Quantities for service equipment sound pressure level

	A-weighted value	C-weighted value
Maximum sound pressure level, time weighting «*S*»	L_{ASmax} [a] $L_{\mathrm{ASmax},nT}$ [b] $L_{\mathrm{ASmax,n}}$ [c]	L_{CSmax} [a] $L_{\mathrm{CSmax},nT}$ [b] $L_{\mathrm{CSmax,n}}$ [c]
Maximum sound pressure level, time weighting «*F*»	L_{AFmax} [a] $L_{\mathrm{AFmax},nT}$ [b] $L_{\mathrm{AFmax,n}}$ [c]	L_{CFmax} [a] $L_{\mathrm{CFmax},nT}$ [b] $L_{\mathrm{CFmax,n}}$ [c]

[a] No standardization/normalization.

[b] Standardization to a reverberation time of 0,5 s.

[c] Normalization to an equivalent sound absorption area of 10 m^2.

Table 1 *(continued)*

	A-weighted value	C-weighted value
Equivalent sound pressure level	L_{Aeq} [a] $L_{Aeq,nT}$ [b] $L_{Aeq,n}$ [c]	L_{Ceq} [a] $L_{Ceq,nT}$ [b] $L_{Ceq,n}$ [c]

[a] No standardization/normalization.

[b] Standardization to a reverberation time of 0,5 s.

[c] Normalization to an equivalent sound absorption area of 10 m^2.

5 Instrumentation

The measuring service equipment shall comply with the requirements of Clause 6.

The sound source for measuring sound insulation between rooms shall be as omnidirectional as practicable. In façade measurement, the opening angle shall cover the whole façade. The directivity of the sound source and the distance to the façade shall be such that the variations between pressure levels measured in front of the façade, for each frequency band of interest, are less than 5 dB.

The tapping machine shall comply with the requirements given in ISO 10140-5:2021, Annex E and ISO 16283-2:2020, Annex A. The heavy/soft impact source – rubber ball shall comply with the requirements given in ISO 10140-5:2021, Annex F and ISO 16283-2:2020, Annex A.

The accuracy of the sound pressure level measurement equipment shall comply with the requirements of accuracy classes 1 or 2 defined in IEC 61672-1. The complete measuring system including the microphone shall be adjusted before each measurement to enable absolute values of sound pressure levels to be obtained.

For all measurements diffuse field microphones are required. For sound level meters with free field microphones corrections for accounting the diffuse sound field shall be applied.

Filters shall comply with the requirements defined in IEC 61260.

NOTE For pattern evaluation (type testing) and regular verification tests recommended procedures for sound level meters are given in OIML R58 and R88.

6 Test procedure and evaluation

6.1 General

The measurements of airborne sound insulation and of impact sound insulation are made in octave bands. The measurements of service equipment sound pressure levels are made in A-weighted or C-weighted sound pressure levels. The measurements shall be performed with doors and windows closed and shutters normally open. Operating cycles and operating conditions for measuring of service equipment noise shall be given in Annex B. They should only be used if they are not opposed to national requirements and regulations.

6.2 Generation of sound field

6.2.1 General

If the difference between the signal level and the background noise level is less than 6 dB, the measured signal level shall be recorded in the report. A note shall be added to say that the measured receiving room level was affected by background noise and the corresponding level difference has been underestimated or that the measurement level (service equipment) has been overestimated by an unknown amount.

No correction for background noise shall be applied.

For measurements of the airborne sound insulation between rooms and the airborne sound insulation of façades using the loudspeaker method, the sound power of the source should be adjusted so that the sound pressure level in the receiving room (in each frequency band) is at least 6 dB higher than the background noise level. This shall be checked by switching the source on and off before starting the measurement.

When measuring the airborne sound insulation of façades by the traffic sound method, the background noise level in the receiving room cannot easily be assessed. Because of this, steps should be taken to ensure that the noise level in the receiving room due to sources within the building is as low as practicable. Excessive background noise from internal sources will lead to an underestimate of the façade insulation. A comment shall be made in the report if this is thought to have occurred.

6.2.2 Airborne sound insulation between rooms

The sound generated in the source room shall be steady and have a continuous spectrum in the frequency range considered. Filters with a bandwidth of one octave may be used. When using broad-band noise, the spectrum of the sound source may be shaped to ensure an adequate signal-to-noise ratio at high frequencies in the receiving room.

If the sound source enclosure contains more than one loudspeaker operating simultaneously, the loudspeakers shall be driven in phase. Multiple sound sources may be used simultaneously providing they are of the same type and are driven at the same level by similar, but uncorrelated, signals.

Place the sound source in a corner of the room opposite the separating element. The distance from the walls shall be at least 0,5 m. If the source is a single loudspeaker system it should be placed facing the corner.

When testing rooms in a vertical direction, use the lower room as the source room. When testing rooms of unequal size in a horizontal direction, use the larger room as the source room unless it has been previously agreed that the test should be in the other direction.

6.2.3 Impact sound insulation between rooms

The impact sound shall be generated by the standard tapping machine and/or rubber ball (see ISO 10140-5 and ISO 16283-2). The standard impact sound sources; tapping machine and rubber ball, shall be placed in the source room near the centre of the floor (in case of tapping machine on the diagonal direction). This single position is sufficient if the floor and slab are isotropic.

NOTE In complex cases, see numerous examples of room arrangements and measurement positions in ISO 16283-2:2020, Annex E.

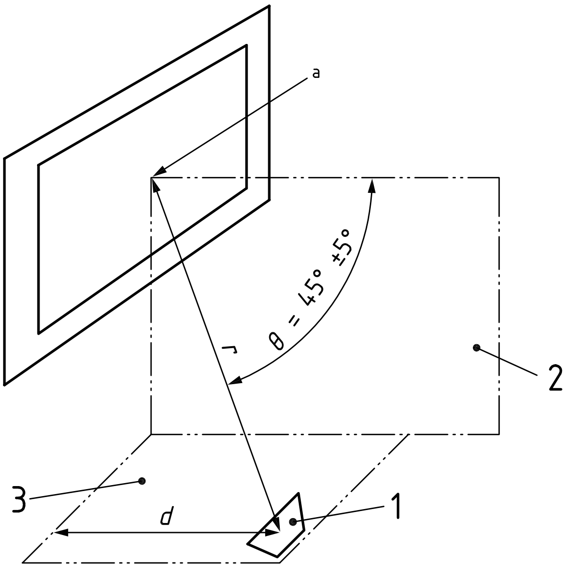
In the case of anisotropic floor constructions (with ribs, beams, etc.) add two positions so that the three positions are randomly distributed over the floor area. The hammer connecting line should be orientated at 45° to the direction of the beams or ribs. In these cases, the distance of the tapping machine from the edges of the floor shall be at least 0,5 m.

6.2.4 Airborne sound insulation of façades

The airborne sound insulation of façades is measured using an outside loudspeaker or road traffic sound. The room behind the façade serves as the receiving room.

6.2.4.1 Loudspeaker method

Place the loudspeaker outside the building at a distance d from the façade with the angle of sound incidence as close as possible to 45° (see Figure 1). Choose the position of the loudspeaker and the distance d to the façade so that the variation of the sound pressure level on the test specimen is minimized. The sound source is preferably placed on the ground. Alternatively place the sound source as high above the ground as practically possible. The distance r from the sound source to the centre of the test specimen shall be at least 7 m ($d > 5$ m) from the façade being tested.



Key

1 loudspeaker

2 vertical plane.

3 horizontal plane.

a Normal to the façade.

Figure 1 — Geometry of the loudspeaker method

The sound generated shall be steady and have a continuous spectrum in the frequency range considered. Filters with a bandwidth of one octave band may be used. When using broad-band noise the spectrum of the sound source may be shaped to ensure an adequate signal-to-noise ratio at high frequencies in the receiving room.

6.2.4.2 Traffic sound method

The traffic sound method with road traffic as sound source may be used if the sound pressure level is high enough in relation to the background noise in the receiving room. If the sound is incident on the façade from different directions and with varying intensity, such as road traffic sound in busy streets, the façade level difference is obtained from the average sound pressure levels measured simultaneously on both sides of the façade.

NOTE Due to background noise the traffic sound method is normally limited to measure $D_{nT,w} < 40$ dB.

6.3 Measurement of sound pressure levels

6.3.1 Airborne and impact sound insulation between rooms

To determine the insulation against airborne sound, measure average sound pressure level in the source and receiving rooms; to determine insulation against impact sound, measure only in the receiving room. In both cases measure the average sound pressure level in each of the specified octave bands using an integrating sound level meter. The measurement time interval shall be approximately 30 s. Stand near the centre of the floor and face away from the loudspeaker in the source room or from the separating element in the receiving room. Hold the sound level meter out at arm's length. Move the microphone four times horizontally through 180°, moving the arm up and down in a gentle movement during the traverse (see Figure 2). Complete the four rotations in a total time of approximately 30 s.

Alternatively, use a rotating microphone on a stand, with an angle of at least 10 degrees to horizontal and a radius of minimum 1 m. If a parallel octave-band or real time octave-band sound level meter is not available, carry out this procedure for each octave band, and read each L_{eq} for 30 s band level from the meter to obtain an estimate of the average octave band levels in the room.

Figure 2 — Example for movement of the sound level meter

6.3.2 Heavy/soft impact sound insulation between rooms

To determine the insulation against impact sound with the rubber ball, measure only in the receiving room. Measure the maximum impact sound pressure level in the specified octave bands by Fast time weighting using a sound level meter. The measurement time shall be approximately 10 s. Stand near the centre of the room and hold the sound level meter out at arm's length or maintain a fixed microphone position using a tripod. Select at least two fixed positions including near the centre position with different height. The distance between the two microphone position shall be longer than 0,7 m. Preferably measure one or more impacts for each fixed position. The measured maximum impact sound pressure level should be averaged over all positions in each frequency band of interest.

Measure the maximum impact sound pressure level in each of the specified octave bands ($L_{i,Fmax}$). If a parallel octave-band or real time octave-band sound level meter is available, select the band maximum level holding mode. The A-weighted maximum impact sound pressure level ($L_{iA,Fmax}$), should be calculated according to ISO 717-2:2020, Annex D. The overall A-weighted maximum impact sound pressure level can be measured directly.

The following separating distances are minimum values and shall be exceeded where practicable:

— 0,5 m between any microphone position and room boundaries;

— 1,0 m between any microphone position and the sound source.

Hearing protectors should be worn by the operator when measuring in the source room.

6.3.3 Airborne sound insulation of façades

Place the outdoor microphone at a distance of (2,0 ± 0,2) m from the plane of the façade or at such a larger distance that the distance to the part of the façade nearest to the road - for instance the balustrade - is at least 1 m. If the sound source is a loudspeaker, measure the outdoor sound pressure level and the indoor level according to 6.3.1. The integration time shall be 30 s.

If the sound source is the prevailing road traffic noise, measure the outdoor level and the indoor level simultaneously. The integration time shall be 60 s and the indoor level is obtained by repeating the procedure of 6.3.1 during this period. During this measurement period at least 15 vehicles shall have passed.

Making sound (e.g. of clothes) should be avoided when moving the sound level meter (Figure 2). Sometimes it can be necessary to use 3 or 5 fixed positions.

6.3.4 Service equipment sound pressure level

When the service equipment sound pressure level in the room is measured, two fixed microphone positions are required. Position 1 shall be close to the apparently acoustically hardest surfaces of room, preferably at a distance of 0,5 m from the walls and from the floor or ceiling (e.g. close to the corner). Position 2 shall be in the reverberant field of the room (central room area). The distance to any sound source (e.g. ventilation outlets) shall be at least 1,5 m.

In total, three measurements shall be performed. Perform one measurement at position 1 close to the corner and two measurements at position 2. The measurement time interval for each of the three measurements shall cover one full cycle of the service equipment working under normal conditions. For each measurement, a separate operation cycle shall be used. The operation cycles shall be given in Annex B. Calculate the average sound pressure level according to 3.16.

6.4 Frequency range of measurements

The sound pressure levels measured using octave band filters shall cover at least the following midband frequencies in hertz, as given in Table 2:

Table 2 — Frequency range of measurements

Impact sound insulation using		Airborne sound insulation Hz
Heavy/soft impact sound Hz	Tapping machine Hz	
63		
125	125	125
250	250	250
500	500	500
	1 000	1 000
	2 000	2 000

Sound from service equipment installed is measured as *A*- or *C*-weighted sound pressure level with the specific time weighting in the frequency range from 63 Hz to 8 000 Hz.

6.5 Reverberation index data

In the survey method described in this document, the reverberation time (the correction for reverberation time) may either be based on measurements or estimated with the aid of Table 3 and Table 4.

To make the estimate for unfurnished rooms, Table 3 shall be used to classify the room according to the type of walls, floor, ceiling and floor covering. Table 4 is then used to find the reverberation index which corresponds to this classification. For furnished rooms Table 3 can be used directly. Reverberation indices are given for octave bands and also for *A*- and *C*-weighted sound pressure levels.

Table 4 takes account of room volume, and is valid for rooms typical of those in dwellings. However, it may also be used for comparable rooms in other types of buildings.

NOTE 1 Table 4 is based on a statistical evaluation of reverberation times obtained in dwellings, as typically constructed in several European countries in the period 1960 to 1980. The standard deviation of the reverberation indices calculated from these data is approximately 1 dB. Changed construction methods or habitation habits can give rise to systematic deviations.

Alternatively, the reverberation time may be measured according to the specifications for the survey method described in ISO 3382-2:2008, 5.2 in octave bands and the reverberation index may be calculated by using the measured reverberation times according to 3.3. Measurement of reverberation time can be advantageous if performed only once in a typical room of a building under test which has a large number of identical rooms (for instance in hotels). For noise measurement of service equipment realised in terms of global weighted levels, the reverberation index *k* is calculated from the averaged reverberation time in the octave bands of 500 Hz, 1 000 Hz and 2 000 Hz.

The tabular values of the reverberation indices are listed in Table 4. Table 4 is valid for a reference reverberation time T_0 = 0,5 s and for room sizes of up to 150 m^3. Furnished rooms like living rooms, sleeping rooms and rooms of similar volume and furniture are considered in one group. Furnished kitchens and bathrooms are considered separately. Concerning unfurnished rooms the reverberation index depends on the type of construction as listed in Table 3.

Table 3 — List of symbols representing the type of construction

Unfurnished	Soft floor covering		Hard floor covering	
Floor type	light	heavy	light	heavy
Light walls/ceiling	a	b	c	d
Heavy walls/ceiling	e	f	g	h
"Light wall" is typically a plasterboard or wooden wall mounted on studs. Heavy walls covered with plasterboard linings shall be considered as light walls. "Heavy wall" is typically a masonry or concrete block wall without lining. "Light floor" is typically a floor of wooden planks or boards on timber beams. "Heavy floor" is typically a concrete slab with or without floating concrete covering. "Floor covering" is typically carpet (soft), tiles or timber flooring (hard).				

If the type of construction is not the same throughout the room, but the areas of different construction are approximately equal, use the average of the values given for the different construction types. For example: if a room has a heavy floor with a carpet, three heavy walls, one light wall and a light ceiling, use the average of b and f. If the areas of different construction are not approximately equal, use the value for the type of construction having the largest area.

NOTE 2 The reverberation indices for *A*- and *C*-weighting were derived by averaging the data in the octave bands between 500 Hz and 2 000 Hz. This method is appropriate in the cases of receiving room levels without strong components in the low frequency range. This applies to the measurement of broad-band equipment sound spectra.

Table 4 — Reverberation index data in dB in octave bands and corresponding to *A*- or *C*-weighted sound pressure levels

Volume *V* in m³		*V* < 15						15 ≤ *V* < 35					
Octave bands in Hz		125	250	500	1 000	2 000	*A*, *C*	125	250	500	1 000	2 000	*A*, *C*
Furnished rooms:													
kitchens		0	0	0	0	0	0	0	0,5	0	0	0	0
bathrooms		1	1	0	0	-0,5	0	1,5	1,5	0,5	0,5	0	0,5
others		0	0	- 0,5	- 0,5	- 1	- 0,5	0	0	0	0	- 0,5	0
Unfurnished rooms:													
type:	a	0	1	1	1	0	0,5	1	1,5	1,5	1	0,5	1
	b	1	2,5	3	2,5	2	2	1	3	3,5	3	2,5	2,5
	c	0	2,5	3,5	4	4	4	1	3	4	4,5	4	4,5
	d	0	2,5	3	4	4	4	1	3	3,5	4,5	4	4,5
	e	3,5	3,5	3,5	3,5	1,5	3,5	3,5	4	4	4	2	4
	f	4,5	4,5	4,5	3,5	2,5	3,5	4,5	4,5	4,5	4	3	4
	g	3,5	4	4,5	5	5	5	4	5	5	5	5	5,5
	h	4	4,5	5	5	4,5	5	4,5	5	5,5	5,5	5	5
Mixed type:	a+e	2	2,5	2,5	2,5	1	2	2,5	3	3	2,5	1,5	2,5
	b+f	3	3,5	4	3	2,5	3	3	4	4	3,5	3	3,5
	c+g	2	3,5	4	4,5	4,5	4,5	2,5	4	4,5	5	4,5	5
	d+h	2	3,5	4	4,5	4,5	4,5	3	4	4,5	5	4,5	5

Volume V in m^3		$35 \leq V < 60$						$60 \leq V < 150$					
Octave bands in Hz		125	250	500	1 000	2 000	*A*, *C*	125	250	500	1 000	2 000	*A*, *C*
Furnished rooms (except bathrooms and kitchens)		0,5	0,5	0,5	0	0	0	0,5	0,5	0,5	0,5	0	0,5
Unfurnished rooms:													
type:	a	1	2	2	1,5	1	1,5	1	2,5	2,5	2	1,5	2
	b	2	3,5	4	3,5	2,5	3	2,5	4	4,5	3,5	2,5	3,5
	c	1,5	3,5	4,5	5	4,5	5	2	4	5	5,5	5	5,5
	d	1,5	3,5	4	5	5	5	2	4	4,5	5,5	5,5	5,5
	e	4	4	4,5	4	2,5	4	4	4	5	4,5	3	4,5
	f	4,5	4,5	4,5	4	3	5	4,5	5	5	4	3	5
	g	4,5	5	5,5	5,5	5,5	5,5	5	5,5	6	6	6	6
	h	5	5,5	6	5	5,5	5,5	5,5	6	6,5	5,5	6	6
mixed type:	a+e	2,5	3	3,5	3	2	3	2,5	3,5	4	3,5	2,5	3,5
	b+f	3,5	4	4,5	4	3	4	3,5	4,5	5	4	3	4,5
	c+g	3	4,5	5	5,5	5	5,5	3,5	5	5,5	6	5,5	6
	d+h	3,5	4,5	5	5	5,5	5,5	4	5	5,5	5,5	6	6

6.6 Precision

It is required that the measurement procedure gives satisfactory reproducibility. This can be determined in accordance with the method shown in ISO 12999-1 and shall be checked from time to time, particularly when a change is made in procedure or instrumentation.

NOTE Numerical requirements for reproducibility of the engineering methods for airborne and impact sound insulation are given in ISO 12999-1. It is estimated that the results from the survey test method and the corresponding engineering method differ within ± 2 dB.

7 Expression of results

7.1 Airborne sound insulation

For the statement of the airborne sound insulation, the values of the standardized level difference, D_{nT}, the normalized level difference, D_n, the standardized facade level difference, $D_{2m,nT}$, the normalized facade level difference $D_{2m,nT}$ or the apparent sound reduction index R', $R'_{45°}$, $R'_{tr,s}$ shall be given at all frequencies of measurement, to one decimal place, in tabular form and in the form of a curve. Graphs in the test report shall show the value in decibels plotted against frequency on a logarithmic scale, and the following dimensions shall be used:

— 15 mm for an octave band;

— 20 mm for 10 dB.

The use of a form in accordance with Annex A is preferred. Being a short version of the test report it shall include all information of importance regarding the test object, the test procedure and the test results.

For the evaluation of single-number ratings from the octave-band results, see ISO 717-1. It shall be clearly stated that the evaluation has been based on a result obtained by a field survey method.

7.2 Impact sound insulation

For the statement of the impact sound insulation, the values of the standardized impact sound pressure level L'_{nT} or the normalized impact sound pressure level L'_n shall be given at all frequencies of measurement, to one decimal place, in tabular form and in the form of a curve. For the statement of the heavy/soft impact sound insulation, the values of the A-weighted maximum impact sound pressure level $L_{iA,Fmax}$ should be given at all frequencies of measurement, to one decimal place, in tabular form and in the form of a curve. Directly measured overall A-weighted maximum impact sound pressure levels $L_{iA,Fmax}$ should be given to one decimal place in tabular form. Graphs in the test report shall show the value in decibels plotted against frequency on a logarithmic scale, and the following dimensions shall be used:

— 15 mm for an octave band;

— 20 mm for 10 dB.

The use of a form in accordance with Annex A is preferred. Being a short version of the test report it shall include all information of importance regarding the test object, the test procedure and the test results.

For the evaluation of single-number ratings from the octave-band results, see ISO 717-2. It shall be clearly stated that the evaluation has been based on a result obtained by a field survey method.

7.3 Service equipment sound pressure level

For the statement of the sound pressure level from housing service equipment quantities given in Table 1 shall be given *A*- or *C*-weighted rounded to one dB.

Being a short version of the test report it shall include all information of importance regarding the test object, the test procedure and the test results.

8 Test report

The test report shall include at least the following:

a) reference to this document (i.e. ISO 10052:2021);

b) name of the organization which has performed the measurements;

c) name and address of the organization or person who ordered the test (client);

d) date of test;

e) identification (location of the building, identification of the rooms, description of the test arrangement);

f) description of the building construction;

g) volumes of the rooms tested;

h) room type which was used (the reference reverberation time, if different from 0,5 s);

i) area of the separating element tested (where appropriate);

j) relevant quantity describing the acoustical property of the building:

— standardized level difference, D_{nT} or the normalized level difference, D_n or the apparent sound reduction index R', $R'_{45°}$, $R'_{tr,s}$, or the standardized facade level difference, $D_{2m,nT}$ or the normalised facade level difference, $D_{2m,n}$, as a function of frequency;

— normalized impact sound pressure level L'_n or the standardized impact sound pressure level L'_{nT} as a function of frequency;

— maximum impact sound pressure level $L_{i,Fmax}$ for each frequency band i;

4) standardized service equipment sound pressure level $L_{XY,nT}$;

— normalized service equipment sound pressure level $L_{XY,n}$;

— single-number quantity;

k) for service equipment:

— description of the relevant aspects of the service equipment and its operating condition (quantitatively and qualitatively);

— location of the corner position;

— note on the check of background noise, if necessary;

l) for water installations:

1) normative:

— position of stop cocks;

— description of all relevant aspects of the water installation and the operating conditions;

2) optional:

— flow pressure (cold and warm water system);

— flow rate/refilling time for cisterns;
— manufacture and destination of the valve or device;
— sound class and flow rate for valves or devices classified according to ISO 3822-1;
— flow rate, static pressure and flow pressure of the valves during the test;
— volume and filling time of the flush tank (if possible).

Annex A
(informative)

Forms for the expression of results

This annex gives examples for the expression of results for the field measurements of airborne and impact sound insulation using the survey method.

The curves of reference values shown in the forms are taken from ISO 717-1 and ISO 717-2. The reference curves should be supplemented or at least replaced by the shifted reference curves according to the procedure described in ISO 717-1 or ISO 717-2.

Normalized level difference according to ISO 10052

Field measurements of airborne sound insulation between rooms

Client:

Date of test:

Description and identification of the building construction and test arrangement, direction of measurement:

Source room volume: m^3

Receiving room volume: m^3

···· Frequency range according to the curve of reference values

— Curve of reference values (ISO 717-1)

Frequency f Hz	D_n (octave) dB
125	
250	
500	
1 000	
2 000	

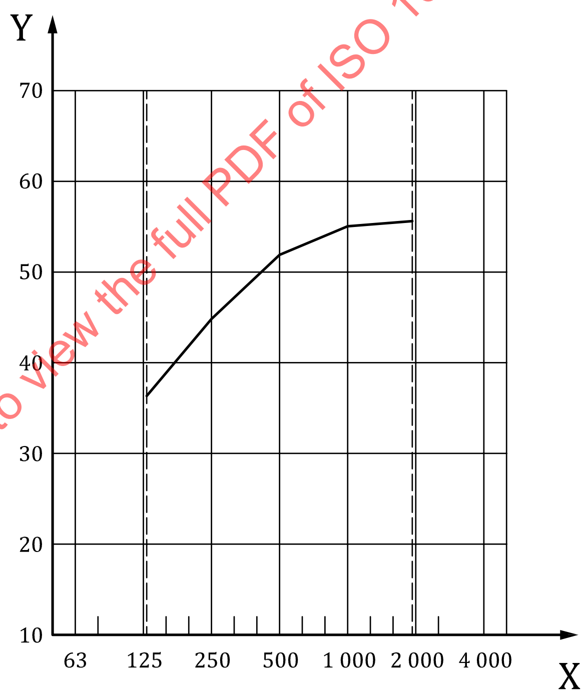


Figure A.1

Key

X frequency f, Hz

Y normalized level difference, D_n, dB

Rating according to ISO 717-1:

$D_{n,w}$ (C; C_{tr}) = (   ) dB

Evaluation based on field measurement results obtained by a survey method.

N° of test report:

Name of test institute:

Date:

Signature:

Standardized level difference according to ISO 10052

Field measurements of airborne sound insulation between rooms

Client:

Date of test:

Description and identification of the building construction and test arrangement, direction of measurement:

Source room volume: m^3

Receiving room volume: m^3

— Frequency range according to the curve of reference values

— Curve of reference values (ISO 717-1)

Frequency *F* Hz	D_{nT} (octave) dB
125	
250	
500	
1 000	
2 000	

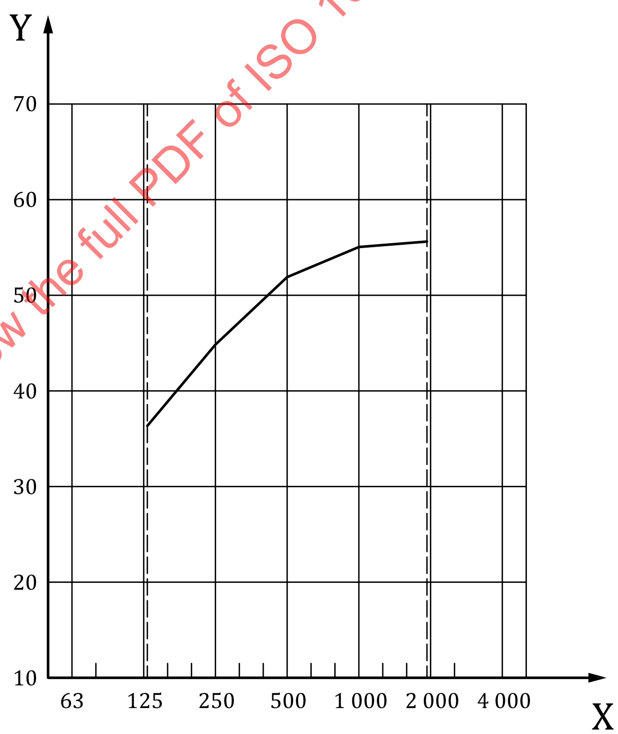


Figure A.2

Key

X frequency *f*, Hz

Y standardized level difference, D_{nT}, dB

Rating according to ISO 717-1:

$D_{nT,w}$ (C; C_{tr}) = (   ) dB

Evaluation based on field measurement results obtained by a survey method.

N° of test report:

Name of test institute:

Date:

Signature:

Apparent sound reduction index according to ISO 10052

Field measurements of airborne sound insulation between rooms

Client:

Date of test:

Description and identification of the building construction and test arrangement, direction of measurement:

Area *S* of separating element: m^2

Source room volume: m^3

Receiving room volume: m^3

···· Frequency range according to the curve of reference values

— Curve of reference values (ISO 717-1)

Frequency *F* Hz	*R'* (octave) dB
125	
250	
500	
1 000	
2 000	

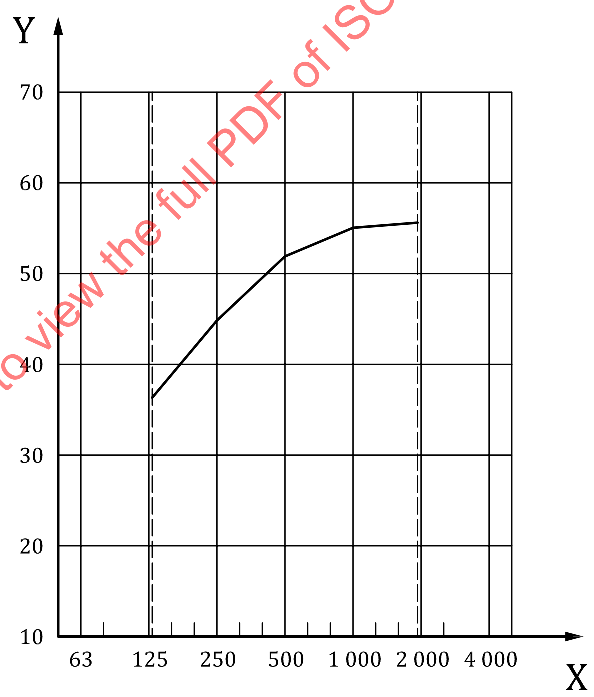


Figure A.3

Key

X frequency *f*, Hz

Y apparent sound reduction index, *R'*, dB

Rating according to ISO 717-1:

R'_w (C; C_{tr}) = ( ) dB

Evaluation based on field measurement results obtained by a survey method.

N° of test report:

Name of test institute:

Date:

Signature:

Normalized impact sound pressure levels according to ISO 10052

Field measurements of impact sound insulation of floors

Client:

Description and identification of the building construction and test arrangement:

Receiving room volume: m^3

Date of test:

···· Frequency range according to the curve of reference values

— Curve of reference values $L'_{n,w}$ = 60 dB (ISO 717-2)

Frequency *F* Hz	L'_n (octave) dB
125	
250	
500	
1 000	
2 000	

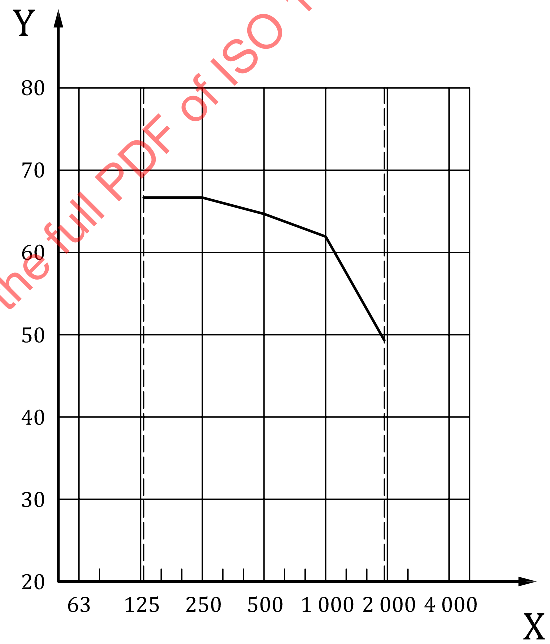


Figure A.4

Key

X frequency *f*, Hz

Y normalized impact sound pressure level L'_n, dB

Rating according to ISO 717-2:

$L'_{n,w}$ (C_1) = ( ) dB

Evaluation based on field measurement results obtained by a survey method.

N° of test report:

Date:

Name of test institute:

Signature:

Standardized impact sound pressure levels according to ISO 10052

Field measurements of impact sound insulation of floors

Client:

Description and identification of the building construction and test arrangement:

Receiving room volume: m^3

Date of test:

···· Frequency range according to the curve of reference values

— Curve of reference values $L'_{nT,w}$ = 60 dB (ISO 717-2)

Frequency F Hz	L'_{nT} (octave) dB
125	
250	
500	
1 000	
2 000	

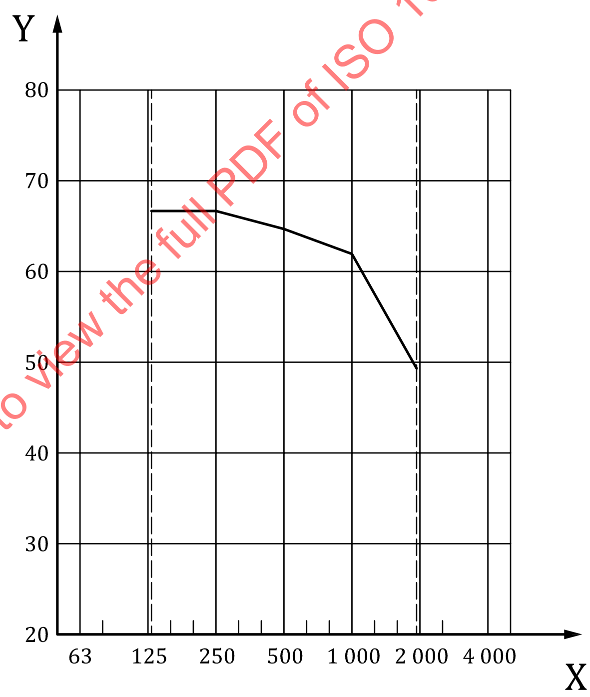


Figure A.5

Key

X frequency f, Hz

Y standardized impact sound pressure level, L'_{nT}, dB

Rating according to ISO 717-2:

$L'_{nT,w}$ (C_1) = ( ) dB

Evaluation based on field measurement results obtained by a survey method.

N° of test report:

Date:

Name of test institute:

Signature:

Maximum impact sound pressure levels, $L_{i,Fmax}$ according to ISO 10052
sound insulation of floors using the rubber ball

Client: Date of test:

Description and identification of the building construction and test arrangement, etc.

Receiving room volume: m^3

Frequency *f* Hz	$L_{i,Fmax}$ (octave) dB
63	
125	
250	
500	

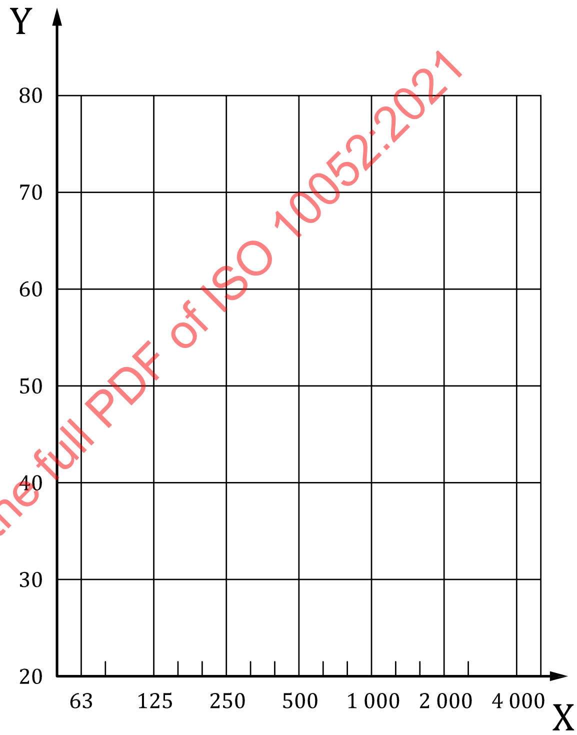


Figure A.6

Key

X frequency *f*, Hz

Y maximum impact sound pressure level, $L'_{i,Fmax}$, dB

Rating according to ISO 717-2:
$L'_{iA,Fmax}$ = ( ) dB
Evaluation based on field measurement results obtained by a survey method.

N° of test report:	Name of test institute:
Date:	Signature:

Annex B
(normative)

Operating conditions and operating cycles for measuring the maximum sound pressure level and the equivalent continuous sound pressure level

B.1 General principles

B.1.1 General

In the following, operating conditions and operating cycles are given for the most common service equipment in buildings. They shall only be used if they are not opposed to national requirements and regulations. However, service equipment not mentioned in the following can be measured according to the principles stated in this document. The chosen operating conditions and operating cycle shall then be reported in detail.

B.1.2 Maximum sound pressure level (L_{max})

In this Annex L_{max} is used as a general symbol for the respective quantities given in Table 1. The basic principle for measuring the maximum sound pressure level is that the service equipment under test during the measurement is operated - automatically or manually - within the limits of normal practical use. For service equipment with a constant sound level the maximum sound pressure level is determined during a measurement period of approximately 30 s. For service equipment with sound varying with time the maximum sound pressure level is determined for a typical operation, e.g. during the period of opening and closing a water tap.

B.1.3 Equivalent continuous sound pressure level (L_{eq})

In this annex, L_{eq} is used as a general symbol for the respective quantities given in Table 1. The basic principle for measuring the equivalent continuous sound pressure level is that the integration time corresponds to a typical operating cycle of the service equipment under test.

For water taps the equivalent continuous sound pressure level is measured with the tap fixed at the position causing the highest sound pressure level.

B.2 Water installations

B.2.1 General operating conditions

For sound measurements on water taps, normally the water shall be drained off the sink, shower cabin or tub during the measurement.

It shall be ensured that all functions are in normal operation (water pressure, flow rate etc.). For water installations the stop cocks shall be completely open, or when this is not the case the position shall be reported. Measurement and reporting of the flow pressure and the flow rate of the valve are optional.

Normally the sound pressure level from sanitary installations is not measured in the room where the installation is mounted, but exclusively in surrounding rooms (e.g. neighbouring dwellings).