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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

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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 fields 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:—, *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
$\bar{L}$
<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:

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

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:

$$D = \bar{L}_1 - \bar{L}_2 \text{ dB}$$

where

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

$\bar{L}_2$ 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:

$$D_{nt} = D + k \text{ dB}$$

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 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:

$$L'_{nt} = L_i - k \text{ dB}$$

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 (3.7) 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:

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

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

$$D_{2m,nt} = D_{2m} + k \text{ dB}$$

where k is the reverberation index.

k

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 $L_{XY,nT}$

$$L_{XY,nT} = L_{XY} - k\ \text{dB}$$

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.

$k = 10\lg 1/3\ [(T_{500} + T_{1\,000} + T_{2\,000})/t_0]$ 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 $L_{XY,n}$

$$L_{XY,n} = L_{XY} - k - 10\lg\frac{A_0\, t_0}{0,16\, V} \text{ dB}$$

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] $L_{\text{ASmax},nT}$ [b] $L_{\text{ASmax,n}}$ [c]	L_{CSmax} [a] $L_{\text{CSmax},nT}$ [b] $L_{\text{CSmax,n}}$ [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.