SLOVENSKI STANDARD
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Akustika - Terenska merjenja zvočne izolirnosti v stavbah in zvočne izolirnosti stavbnih elementov - 2. del: Izolirnost pred udarnim zvokom (ISO/DIS 16283-2:2019)

Acoustics - Field measurement of sound insulation in buildings and of building elements - Part 2: Impact sound insulation (ISO/DIS 16283-2:2019)

Akustik - Messung der Schalldämmung in Gebäuden und von Bauteilen am Bau - Teil 2: Trittschalldämmung (ISO/DIS 16283-2:2019)

Acoustique - Mesurage in situ de l'isolation acoustique des bâtiments et des éléments de construction - Partie 2: Isolation des bruits d'impacts (ISO/DIS 16283-2:2019)

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Acoustics — Field measurement of sound insulation in buildings and of building elements —

Part 2: Impact sound insulation

Acoustique — Mesurage in situ de l'isolation acoustique des bâtiments et des éléments de construction — Partie 2: Isolation des bruits d'impacts

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

This second edition cancels and replaces the first edition (ISO 16283-2:2015), which has been technically revised.

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

— amended text in 7.3.2 so that the choice of microphone positions applies to any impact source.

A list of all parts in the ISO 16283 series can be found on the ISO website.

Introduction

ISO 16283 (all parts) describes procedures for field measurements of sound insulation in buildings. Airborne, impact and façade sound insulation are described in ISO 16283-1, this document (ISO 16283-2) and ISO 16283-3, respectively.

Field sound insulation measurements that were described previously in ISO 140-4[1)], ISO 140-5[2)], and ISO 140-7[3)] were a) primarily intended for measurements where the sound field could be considered to be diffuse, and b) not explicit as to whether operators could be present in the rooms during the measurement. ISO 16283 (all parts) differs from ISO 140-4, ISO 140-5, and ISO 140-7 in that:

a) it applies to rooms in which the sound field may or may not approximate to a diffuse field;

b) it clarifies how operators can measure the sound field using a hand-held microphone or sound level meter;

c) it includes additional guidance that was previously contained in ISO 140-14[4)].

NOTE Survey test methods for field measurements of airborne and impact sound insulation are dealt with in ISO 10052.

Two impact sources are described: the tapping machine and the rubber ball. These impact sources do not exactly replicate all possible types of real impacts on floors or stairs in buildings.

The tapping machine can be used to assess a variety of light, hard impacts such as footsteps from walkers wearing hard-heeled footwear or dropped objects. A single number quantity can be calculated using the rating procedures in ISO 717-2. This single number quantity links the measured impact sound insulation using the tapping machine to subjective assessment of general impacts in dwellings that occur on floors or stairs in a building. The tapping machine is also well-suited to the prediction of impact sound insulation using ISO 12354-2. These two aspects facilitate the specification of impact sound insulation in national building requirements using only measurements with the tapping machine as an impact source.

The rubber ball can be used to assess heavy, soft impacts such as from walkers in bare feet or children jumping, as well as quantifying absolute values that can be related to human disturbance in terms of a Fast time-weighted maximum sound pressure level. Calculation procedures for a single number quantity do not currently exist in an International Standard.

1) Withdrawn.

2) Withdrawn.

3) Withdrawn.

4) Withdrawn.

Acoustics — Field measurement of sound insulation in buildings and of building elements —

Part 2:
Impact sound insulation

1 Scope

This document specifies procedures to determine the impact sound insulation using sound pressure measurements with an impact source operating on a floor or stairs in a building. These procedures are intended for room volumes in the range from 10 m^3 to 250 m^3 in the frequency range from 50 Hz to 5 000 Hz. The test results can be used to quantify, assess and compare the impact sound insulation in unfurnished or furnished rooms where the sound field can approximate to a diffuse field.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61183, *Electroacoustics — Random-incidence and diffuse-field calibration of sound level meters*

IEC 61260 (all parts), *Electroacoustics — Octave-band and fractional-octave-band filters*

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

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 3382-2, *Acoustics — Measurement of room acoustic parameters — Part 2: Reverberation time in ordinary rooms*

ISO 12999-1, *Acoustics — Determination and application of measurement uncertainties in building acoustics — Part 1: Sound insulation*

ISO 18233, *Acoustics — Application of new measurement methods in building and room acoustics*

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
energy-average impact sound pressure level in a room
L_i
ten times the common logarithm of the ratio of the space and time average of the squared sound pressure to the square of the reference sound pressure where the impact source is the tapping machine and the space average is taken over the central zone of the room where nearfield radiation from the room boundaries has negligible influence

Note 1 to entry: L_i is expressed in decibels (dB).

3.2
corner impact sound pressure level in a room
$L_{i,Corner}$
ten times the common logarithm of the ratio of the highest time average squared sound pressure from the set of corner measurements to the square of the reference sound pressure for the low-frequency range (50 Hz, 63 Hz and 80 Hz one-third octave bands) where the impact source is the tapping machine

Note 1 to entry: $L_{i,Corner}$ is expressed in decibels (dB).

3.3
low-frequency energy-average impact sound pressure level in a room
$L_{i,LF}$
ten times the common logarithm of the ratio of the space and time average of the squared sound pressure to the square of the reference sound pressure in the low-frequency range (50 Hz, 63 Hz and 80 Hz one-third octave bands) where the impact source is the tapping machine and the space average is a weighted average that is calculated using the room corners where the sound pressure levels are highest and the central zone of the room where nearfield radiation from the room boundaries has negligible influence

Note 1 to entry: $L_{i,LF}$ is expressed in decibels (dB).

Note 2 to entry: $L_{i,LF}$ is an estimate of the energy-average sound pressure level for the entire room volume.

3.4
energy-average maximum impact sound pressure level in a room
$L_{i,Fmax}$
ten times the common logarithm of the ratio of the space average of the squared maximum sound pressure with Fast time weighting to the square of the reference sound pressure where the impact source is the rubber ball and the space average is taken over the central zone of the room where nearfield radiation from the room boundaries has negligible influence

Note 1 to entry: $L_{i,Fmax}$ is expressed in decibels (dB).

3.5
reverberation time
T
time required for the sound pressure level in a room to decrease by 60 dB after the sound source has stopped

Note 1 to entry: T is expressed in seconds (s).

3.6
background noise level
measured sound pressure level in the receiving room from all sources except the impact source

3.7
fixed microphone
microphone that is fixed in space by using a device such as a tripod so that it is stationary

3.8
mechanized continuously moving microphone
microphone that is mechanically moved with approximately constant angular speed in a circle, or is mechanically swept along a circular path where the angle of rotation about a fixed axis is between 270° and 360°

3.9
manually scanned microphone
microphone attached to a hand-held sound level meter or an extension rod that is moved by a human operator along a prescribed path

3.10
manually held microphone
microphone attached to a hand-held sound level meter or a rod that is hand-held at a fixed position by a human operator at a distance of at least an arm's length from the trunk of the operator's body

3.11
partition
total surface of the floor or stair which is excited by the impact source

Note 1 to entry: For two rooms which are staggered vertically or horizontally, the total surface of the separating partition is not visible from both sides of the partition; hence it is necessary to define the partition as the total surface.

3.12
common partition
part of the floor or stair that is common to both the room in which the impact source is used and the receiving room

3.13
standardized impact sound pressure level
L'_{nT}
energy-average impact sound pressure level, L_i (3.1), reduced by a correction term that is given in decibels, being ten times the common logarithm of the ratio of the measured *reverberation time*, T (3.5), to the reference reverberation time, T_0, which is calculated using Formula (1) when the impact source is the tapping machine:

$$L'_{nT} = L_i - 10 \lg \frac{T}{T_0} \qquad (1)$$

where

T is the reverberation time in the receiving room, in s;

T_0 is the reference reverberation time, in s (for dwellings, T_0 = 0,5 s).

Note 1 to entry: L'_{nT} is expressed in decibels (dB).

Note 2 to entry: The impact sound pressure level is referenced to a *reverberation time* (3.5) of 0,5 s because, in dwellings with furniture, the reverberation time has been found to be reasonably independent of volume and frequency and to be approximately equal to 0,5 s.

Note 3 to entry: L'_{nT} provides a straightforward link to the subjective impression of impact sound insulation.

3.14
equivalent absorption area
A
hypothetical area of a totally absorbing surface without diffraction effects which, if it were the only absorbing element in the room, would give the same *reverberation time* (3.5) as the room under consideration and is calculated using Sabine's formula in Formula (2):

$$A = \frac{0{,}16V}{T} \quad (2)$$

where

V is the receiving room volume, in m^3;

T is the reverberation time in the receiving room, in s.

Note 1 to entry: A is expressed in square metres (m^2).

3.15
normalized impact sound pressure level
L'_n
energy-average impact sound pressure level, L_i (3.1), increased by a correction term that is given in decibels, being ten times the common logarithm of the ratio between the measured *equivalent absorption area, A* (3.14), of the receiving room and the reference equivalent absorption area, A_0, which is calculated using Formula (3) when the impact source is the tapping machine:

$$L'_n = L_i + 10\lg\frac{A}{A_0} \quad (3)$$

where

A is the equivalent absorption area in the receiving room, in m^2;

A_0 is the reference equivalent absorption area, in m^2 (for dwellings, $A_0 = 10\ m^2$).

Note 1 to entry: L'_n is expressed in decibels (dB).

3.16
standardized maximum impact sound pressure level
$L'_{i,Fmax,V,T}$
energy-average maximum impact sound pressure level, $L_{i,Fmax}$ (3.4), increased by a correction term for room volume and reduced by a correction term for reverberation time and Fast time weighting, which is calculated using Formulae (4), (5) and (6) when the impact source is the rubber ball:

$$L'_{i,Fmax,V,T} = L_{i,Fmax} + 10\lg\frac{V}{V_0} - 10\lg\left[\frac{1-C_0^{-1}}{1-C^{-1}}\left(\frac{C^{(1-C)^{-1}} - C^{-\left(1-C^{-1}\right)^{-1}}}{C_0^{(1-C_0)^{-1}} - C_0^{-\left(1-C_0^{-1}\right)^{-1}}}\right)\right] \quad (4)$$

$$C_0 = \frac{T_0}{1{,}7275} \quad (5)$$

$$C = \frac{T}{1{,}7275} \quad (6)$$

where

T is the reverberation time in the receiving room, in s;

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

V is the receiving room volume, in m^3;

V_0 is the reference receiving room volume, in m^3 (for dwellings, V_0 = 50 m^3).

Note 1 to entry: $L'_{\text{i,Fmax},V,T}$ is expressed in decibels (dB).

Note 2 to entry: Background information can be found in Reference[1].

4 Instrumentation

4.1 General

The instruments for measuring sound pressure levels, including microphone(s) as well as cable(s), windscreen(s), recording devices and other accessories, if used, shall meet the requirements for a class 0 or 1 instrument in accordance with IEC 61672-1 for random incidence application.

Filters shall meet the requirements for a class 0 or 1 instrument in accordance with IEC 61260 (all parts).

The reverberation time measurement equipment shall comply with the requirements defined in ISO 3382-2.

The impact sources shall meet the requirements given in Annex A.

4.2 Calibration

At the beginning and at the end of every measurement session and at least at the beginning and the end of each measurement day, the entire sound pressure level measuring system shall be checked at one or more frequencies by means of a sound calibrator meeting the requirements for a class 0 or 1 instrument in accordance with IEC 60942. Each time the calibrator is used, the sound pressure level measured with the calibrator should be noted in the field documentation of the operator. Without any further adjustment, the difference between the readings of two consecutive checks shall be less than or equal to 0,5 dB. If this value is exceeded, the results of measurements obtained after the previous satisfactory check shall be discarded.

4.3 Verification

Conformance of the sound pressure level measuring instrument, the filters and the sound calibrator with the relevant requirements shall be verified by the existence of a valid certificate of conformance. If applicable, random incidence response of the microphone shall be verified by a procedure from IEC 61183. All conformance testing shall be conducted by a laboratory meeting the requirements of ISO/IEC 17025 and ensuring metrological traceability to the appropriate measurement standards.

The sound calibrator should be calibrated at intervals not exceeding one year, the conformance of the instrumentation system with the requirements of IEC 61672-1 should be verified at intervals not exceeding two years, and the conformance of the filter set with the requirements of IEC 61260 (all parts) should be verified at intervals not exceeding two years.

5 Frequency range

5.1 Tapping machine as the impact source

All quantities shall be measured using one-third octave band filters having at least the following centre frequencies, in hertz: 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1 000, 1 250, 1 600, 2 000, 2 500, 3 150.

If additional information in the low-frequency range is required, use one-third octave band filters with the following centre frequencies, in hertz: 50, 63, 80.

If additional information in the high-frequency range is required, use one-third octave band filters with the following centre frequencies, in hertz: 4 000, 5 000.

NOTE Measurement of additional information in the low- and high-frequency ranges is optional.

5.2 Rubber ball as the impact source

All quantities shall be measured using one-third octave or octave band filters.

One-third octave band filters shall have at least the following centre frequencies, in hertz: 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630.

6 General

To determine the impact sound insulation, one room shall be chosen as the receiving room into which sound is radiated due to an impact source operating on a partition. The room or space in which the impact source is operated is referred to as the source room.

The measurements that shall be performed include the sound pressure levels in the receiving room with the impact source operating, the background noise levels in the receiving room when the impact source is switched off and the reverberation times in the receiving room.

Two impact sources are described: the tapping machine and the rubber ball.

Two measurement procedures are described that shall be used for the sound pressure level, the reverberation time and the background noise: a default procedure and an additional low-frequency procedure.

For the sound pressure level and the background noise, the default procedure requires measurements to be taken in the central zone of a room at positions away from the room boundaries. With the tapping machine as the impact source, the default procedure for all frequencies is to obtain the energy-average sound pressure level using a fixed microphone or a manually held microphone moved from one position to another, an array of fixed microphones, a mechanized continuously moving microphone or a manually scanned microphone. With the rubber ball as the impact source, the default procedure for all frequencies is to obtain the energy-average sound pressure level using a fixed microphone or a manually held microphone moved from one position to another or an array of fixed microphones.

For the sound pressure level and the background noise with the tapping machine as the impact source, the low-frequency procedure shall be used for the 50 Hz, 63 Hz and 80 Hz one-third octave bands in the receiving room when its volume is smaller than 25 m^3 (calculated to the nearest cubic metre). This procedure should be carried out in addition to the default procedure and requires additional measurements of the sound pressure level in the corners of the receiving room using either a fixed microphone or a manually held microphone.

NOTE 1 The low-frequency procedure is necessary in small rooms due to large spatial variations in the sound pressure level of the modal sound field. In these situations, corner measurements are used to improve the repeatability, reproducibility and relevance to room occupants.

NOTE 2 The low-frequency procedure is not used with the rubber ball because no link has yet been shown between any combination of measurements from the corners and central zone of a room for the maximum Fast time-weighted sound pressure level and the maximum Fast time-weighted sound pressure level that is spatially averaged over the entire room volume.

For the reverberation time, the low-frequency procedure shall be used for the 50 Hz, 63 Hz and 80 Hz one-third octave bands in the receiving room when its volume is smaller than 25 m^3 (calculated to the nearest cubic metre).

If the methods of signal processing for reverberation times described in ISO 18233 are applied, the measurements shall be carried out using fixed microphones and shall not use a mechanized continuously moving microphone, a manually held microphone or a manually scanned microphone.

The sound fields in typical rooms rarely approximate to a diffuse sound field over the entire frequency range from 50 Hz to 5 000 Hz. The default and low-frequency procedures allow for measurements to be taken without any knowledge as to whether the sound field can be considered as diffuse or non-diffuse. For this reason, the sound field should not be modified for the purpose of the test by temporarily introducing additional furniture or diffusers into the receiving room.

NOTE 3 If measurements with additional diffusion are required, for example due to regulatory requirements or because the test result is to be compared with a laboratory measurement on a similar test element, the introduction of three diffusers, each with an area of at least 1,0 m^2, is usually sufficient.

All measurement methods for the default procedure or the low-frequency procedure are equivalent. In case of dispute, the impact sound insulation determined using measurement methods without an operator inside the receiving room shall be taken to be the reference result.

NOTE 4 A reference result is defined because the background noise level with manual scanning is prone to variation in the self-generated noise from the operator. Significant variation does not tend to occur with fixed microphones or a mechanized continuously moving microphone.

7 Default procedure for sound pressure level measurement

7.1 General

Sound pressure level measurements shall be used to determine the average level in the central zone of the receiving room with the impact source in operation and the background noise level in the receiving room when the impact source is not operational.

7.2 Generation of sound field

7.2.1 General

The impact sound shall be generated using the tapping machine or the rubber ball as the impact source.

7.2.2 Impact source positions for the tapping machine as impact source

The tapping machine shall be placed in at least four different positions randomly distributed on the floor under test. The distance of the tapping machine from the edges of the floor shall be at least 0,5 m. In the case of anisotropic floor constructions with beams, ribs, etc., more positions can be necessary. The hammer connecting line should be orientated at 45° to the direction of the beams or ribs.

The impact sound pressure levels can reveal a time dependency after the tapping is started. In such a case, the measurements should not begin until the noise level has become steady. If stable conditions are not reached after 5 min, then the measurements should be carried out over a well-defined measurement period. The measurement period shall be reported.

NOTE Time dependency sometimes occurs with soft or fragile floor surfaces as, during each impact, the hammers can change the contact stiffness or damage the surface directly underneath the hammers.

