BS EN ISO 10140-3:2010+A1:2015

BSI Standards Publication

Acoustics — Laboratory measurement of sound insulation of building elements

Part 3: Measurement of impact sound insulation

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National foreword

This British Standard is the UK implementation of EN ISO 10140-3:2010+A1:2015. It supersedes BS EN ISO 10140-3:2010, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to ISO text carry the number of the ISO amendment. For example, text altered by ISO amendment 1 is indicated by [A1] ⟨A1⟩.

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Acoustics - Laboratory measurement of sound insulation of building elements - Part 3: Measurement of impact sound insulation (ISO 10140-3:2010)

Acoustique - Mesurage en laboratoire de l'isolation acoustique des éléments de construction - Partie 3: Mesurage de l'isolation au bruit de choc (ISO 10140-3:2010)

Akustik - Messung der Schalldämmung von Gebäudeteilen im Prüfstand - Teil 3: Messung der Trittschalldämmung (ISO 10140-3:2010)

This European Standard was approved by CEN on 14 August 2010.

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Foreword

This document (EN ISO 10140-3:2010) has been prepared by Technical Committee ISO/TC 43 "Acoustics" in collaboration with Technical Committee CEN/TC 126 “Acoustic properties of building elements and of buildings” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 140-1:1997, EN ISO 140-6:1998, EN ISO 140-3:1995, EN ISO 140-11:2005, EN 20140-10:1992, EN ISO 140-16:2006, EN ISO 140-8:1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of ISO 10140-3:2010 has been approved by CEN as a EN ISO 10140-3:2010 without any modification.

Foreword to amendment A1

This document (EN ISO 10140-3:2010/A1:2015) has been prepared by Technical Committee ISO/TC 43 "Acoustics" in collaboration with the Technical Committee CEN/TC 126 “Acoustic properties of building elements and of buildings” the secretariat of which is held by AFNOR.

This Amendment to the European Standard EN ISO 10140-3:2010 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2015, and conflicting national standards shall be withdrawn at the latest by December 2015.

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Endorsement notice

The text of ISO 10140-3:2010/Amd 1:2015 has been approved by CEN as EN ISO 10140-3:2010/A1:2015 without any modification.

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 10140-3 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

This first edition of ISO 10140-3, together with ISO 10140-1, ISO 10140-2, ISO 10140-4 and ISO 10140-5, cancels and replaces ISO 140-1:1997, ISO 140-3:1995, ISO 140-6:1998, ISO 140-8:1997, ISO 140-10:1991, ISO 140-11:2005 and ISO 140-16:2006, which have been technically revised.

It also incorporates the Amendments ISO 140-1:1997/Amd.1:2004 and ISO 140-3:1995/Amd.1:2004.

ISO 10140 consists of the following parts, under the general title *Acoustics — Laboratory measurement of sound insulation of building elements*:

— *Part 1: Application rules for specific products*

— *Part 2: Measurement of airborne sound insulation*

— *Part 3: Measurement of impact sound insulation*

— *Part 4: Measurement procedures and requirements*

— *Part 5: Requirements for test facilities and equipment*

Introduction

ISO 10140 (all parts) concerns laboratory measurement of the sound insulation of building elements (see Table 1).

ISO 10140-1 specifies the application rules for specific elements and products, including specific requirements for preparation, mounting, operating and test conditions. ISO 10140-2 and this part of ISO 10140 contain the general procedures for airborne and impact sound insulation measurements, respectively, and refer to ISO 10140-4 and ISO 10140-5 where appropriate. For elements and products without a specific application rule described in ISO 10140-1, it is possible to apply ISO 10140-2 and this part of ISO 10140. ISO 10140-4 contains basic measurement techniques and processes. ISO 10140-5 contains requirements for test facilities and equipment. For the structure of ISO 10140 (all parts), see Table 1.

ISO 10140 (all parts) was created to improve the layout for laboratory measurements, ensure consistency and simplify future changes and additions regarding mounting conditions of test elements in laboratory and field measurements. It is intended for ISO 10140 (all parts) to present a well-written and arranged format for laboratory measurements.

〚A1〛 Text deleted 〚A1〛

Table 1 — Structure and contents of ISO 10140 (all parts)

Relevant part of ISO 10140	Main purpose, contents and use	Detailed content
ISO 10140-1	It indicates the appropriate test procedure for elements and products. For certain types of element/product, it can contain additional and more specific instructions about quantities and test element size and about preparation, mounting and operating conditions. Where no specific details are included, the general guidelines are according to ISO 10140-2 and ISO 10140-3.	Appropriate references to ISO 10140-2 and ISO 10140-3 and product-related, specific and additional instructions on: — specific quantities measured; — size of test element; — boundary and mounting conditions; — conditioning, testing and operating conditions; — additional specifics for test report.
ISO 10140-2	It gives a complete procedure for airborne sound insulation measurements according to ISO 10140-4 and ISO 10140-5. For products without specific application rules, it is sufficiently complete and general for the execution of measurements. However, for products with specific application rules, measurements are carried out according to ISO 10140-1, if available.	— Definitions of main quantities measured — General mounting and boundary conditions — General measurement procedure — Data processing — Test report (general points)
ISO 10140-3	It gives a complete procedure for impact sound insulation measurements according to ISO 10140-4 and ISO 10140-5. For products without specific application rules, it is sufficiently complete and general for the execution of measurements. However, for products with specific application rules, measurements are carried out according to ISO 10140-1, if available.	— Definitions of main quantities measured — General mounting and boundary conditions — General measurement procedure — Data processing — Test report (general points)
ISO 10140-4	It gives all the basic measurement techniques and processes for measurement according to ISO 10140-2 and ISO 10140-3 or facility qualifications according to ISO 10140-5. Much of the content is implemented in software.	— Definitions — Frequency range — Microphone positions — SPL measurements — Averaging, space and time — Correction for background noise — Reverberation time measurements — Loss factor measurements — Low-frequency measurements — Radiated sound power by velocity measurement
ISO 10140-5	It specifies all information needed to design, construct and qualify the laboratory facility, its additional accessories and measurement equipment (hardware).	Test facilities, design criteria: — volumes, dimensions; — flanking transmission; — laboratory loss factor; — maximum achievable sound reduction index; — reverberation time; — influence of lack of diffusivity in the laboratory. Test openings: — standard openings for walls and floors; — other openings (windows, doors, small technical elements); — filler walls in general. Requirements for equipment: — loudspeakers, number, positions; — tapping machine and other impact sources; — measurement equipment. Reference constructions: — basic elements for airborne and impact insulation improvement; — corresponding reference performance curves.

INTERNATIONAL STANDARD ISO 10140-3:2010+A1:2015 (E)

Acoustics — Laboratory measurement of sound insulation of building elements —

Part 3:
Measurement of impact sound insulation

1 Scope

This part of ISO 10140 specifies laboratory methods for measuring the impact sound insulation of floor assemblies.

The test results can be used to compare the sound insulation properties of building elements, classify elements according to their sound insulation capabilities, help design building products which require certain acoustic properties and estimate the *in situ* performance in complete buildings.

The measurements are performed in laboratory test facilities in which sound transmission via flanking paths is suppressed. The results of measurements made in accordance with this part of ISO 10140 are not applicable directly to the field situation without accounting for other factors affecting sound insulation, such as flanking transmission, boundary conditions, and loss factor.

A test method is specified that uses the standard tapping machine (see ISO 10140-5:2010, Annex E) to simulate impact sources like human footsteps when a person is wearing shoes. This part of ISO 10140 is applicable to all types of floors (whether heavyweight or lightweight) with all types of floor coverings. The test method applies only to laboratory measurements.

NOTE When the aim of impact sound insulation measurements is to have a strong correlation between a “real” impact source (e.g. a person walking or children jumping) and an artificial impact source (e.g. a tapping machine), it is intended that both sources apply the same input force spectrum to ensure the correct ranking of floors and floor coverings for the “real” and the artificial source, and it is intended that the impedance spectra of the sources be the same. If the “real” impact source is a walking person without shoes and the artificial source is a standard tapping machine such as that specified in Clause 4, the correlation is not strong.

An alternative method, using a heavy/soft impact source for assessing the impact sound insulation of a floor against impact sources with strong low-frequency components, such as human footsteps (bare feet) or children jumping, is given in Annex A. Alternative impact sources (i.e. a proposed modification of the standard tapping machine to make its dynamic source characteristics similar to those of a person walking barefoot and a heavy/soft impact source with dynamic source characteristics similar to those of children jumping) are defined in ISO 10140-5:2010, Annex F.

A method to test floor coverings is described in ISO 10140-1:2010, Annex H, for single- or multi-layer floor coverings installed on specific reference floors. In the case of multi-layer coverings, they can be factory-assembled or assembled at the test site.

2 Normative references

The following referenced documents are indispensable for the application 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 140-2, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 2: Determination, verification and application of precision data*

ISO 717-2, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 2: Impact sound insulation*

ISO 10140-1, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 1: Application rules for specific products*

ISO 10140-4, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 4: Measurement procedures and requirements*

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

IEC 60942, *Electroacoustics — Sound calibrators*

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 purpose of this document, the following terms and definitions apply.

3.1
impact sound pressure level
L_i
energy average sound pressure level in a one-third octave band in the receiving room when the floor under test is excited by the standardized impact source

NOTE 1 L_i is expressed in decibels.

NOTE 2 The energy average sound pressure level in a room is defined in ISO 10140-4.

3.2
normalized impact sound pressure level
L_n
impact sound pressure level, L_i, increased by a correction term which is given in decibels, being ten times the common logarithm of the ratio between the measured equivalent absorption area, A, of the receiving room and the reference equivalent absorption area, A_0

$$L_n = L_i + 10 \lg \frac{A}{A_0} \text{ dB} \quad (1)$$

where $A_0 = 10\ m^2$.

NOTE 1 L_n is expressed in decibels.

NOTE 2 The measured equivalent absorption area, A, of the receiving room is defined in ISO 10140-4.

4 Facilities and equipment

Laboratory test facilities shall comply with the requirements of ISO 10140-5:2010, Annex A.

The tapping machine shall meet the requirements given in ISO 10140-5:2010, Annex E.

Requirements for equipment used to measure the sound level, and for calibration of that equipment, are given in ISO 10140-5.

NOTE Alternative methods using a modified tapping machine or a standard heavy/soft impact source can provide information suitable for assessing the impact sound insulation of a floor or a floor covering against common impact sources, for instance a person walking without shoes or a child jumping. Procedures for measurements using a heavy/soft impact source are given in Annex A, with requirements for alternate impact sources given in ISO 10140-5:2010, Annex F.

5 Test procedure and evaluation

5.1 General procedure

Two vertically adjacent rooms are used, the upper one being designated the “source room” and the lower one the “receiving room”. A floor, which is the test element, separates these two rooms (see Clause 6). The impact source is placed on top of the test element at different positions and the sound pressure levels are measured in the receiving room, normally in the frequency range of 100 Hz to 5 000 Hz (optional down to 50 Hz). The equivalent sound absorption area in the receiving room is calculated from reverberation time measurements. From the sound pressure levels in the receiving room, the quantities described in Clause 3 shall be evaluated by taking into account the equivalent absorption area. The procedures used to determine the energy average sound pressure level corrected for background noise and the reverberation time are specified in ISO 10140-4:2010, 4.2 and 4.3.

Precautions should be taken to verify that airborne sound transmission from the source to the receiving room (including any leakage at the perimeter of the test element) is at least 10 dB below the level of transmitted impact sound in each frequency band.

A method for testing floor coverings is described in ISO 10140-1:2010, Annex H, for single- or multi-layer floor coverings installed on specific reference floors. In the case of multi-layer coverings, they may be factory-assembled or assembled at the test site.

5.2 Generation of sound field

The impact sound shall be generated by the standard tapping machine, as specified in Clause 4. Each set of measurements should be made with as many impact source positions as necessary to yield a reliable mean value.

NOTE When the aim of impact sound insulation measurements is to have a strong correlation between a “real” impact source (e.g. a person walking or children jumping) and an artificial impact source (e.g. a tapping machine), both sources apply the same input force spectrum, to ensure the correct ranking of floors and floor coverings for the “real” and the artificial source, and the impedance spectra of the sources are the same. If the “real” impact source is a walking person without shoes and the artificial source is a standard tapping machine such as that specified in Clause 4, the correlation is not strong.

An alternative method, using a heavy/soft impact source for assessing the impact sound insulation of a floor against impact sources with strong low-frequency components, such as human footsteps (bare feet) or children jumping, is given in Annex A. Alternative impact sources (i.e. a proposed modification of the standard tapping machine to make its dynamic source characteristics similar to those of a person walking barefoot and a heavy/soft impact source with dynamic source characteristics similar to those of children jumping) are defined in ISO 10140-5:2010, Annex F.

A1 Also other types of impact sources can be applied, as for example rainfall on roofs and roof elements. Such sources are defined in ISO 10140-5:2010, Annex H, while the specific application is treated in ISO 10140-1:2010, Annex K. A1

When a floor element includes a soft covering, the standard tapping machine shall fulfil special requirements (specified in ISO 10140-5:2010, Annex E). If the test surface is covered with an extremely soft covering or the surface is very uneven, such that the hammers are not able to fall down the requisite 40 mm to the surface on which the supports rest, pads may be used under the supports to ensure the correct falling height of 40 mm.

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

For testing a floor, the tapping machine shall be placed in at least four different positions. The minimum distance between tapping machine positions shall be at least 0,7 m. The distance of the tapping machine from the edges of the floor shall be at least 0,5 m.

For heavyweight homogeneous floors, such as solid concrete, the positions and orientation of the tapping machine shall be randomly distributed over the whole area of the floor under test.

For inhomogeneous floor constructions (such as hollow core concrete slabs or lightweight floors with ribs, beams, joists, etc.) or floors with rough and/or irregular floor coverings, additional positions should be used to yield a reliable mean value. The positions shall be randomly distributed on the floor under test. The line of hammers shall be orientated at 45° to the direction of the beams, ribs or joists (see ISO 10140-1:2010, H.4.6.2).

Additional requirements for positioning the tapping machine when testing floor coverings are given in ISO 10140-1:2010, Annex H. Each set of measurements (bare floor and covered floor) shall be made with as many machine positions as necessary to yield a reliable mean value, but the specific locations and the number of positions depend both on the category of floor covering and on the type of reference floor on which the covering is installed.

The sound field in the receiving room shall not be affected by the presence of people in the source or receiving room during the tests.

5.3 Data processing

Calculate the normalized impact sound pressure levels (as defined in Clause 3) from the measured (and, if necessary, corrected-for-background noise) energy average sound pressure levels in the receiving room and the measured reverberation times, as described in ISO 10140-4:2010, 4.2, 4.3, 4.5 and 4.6.

If normalized impact sound pressure levels are needed in octave bands, these values shall be calculated from the three one-third octave band values in each octave band using Equation (2):

$$L_{\mathrm{n,oct}} = 10 \lg\left(\sum_{j=1}^{3} 10^{L_{\mathrm{n,1/3\,oct},j}/10}\right) \tag{2}$$

Perform all calculations with the appropriate accuracy and present the final results with a precision no higher than the nearest 0,1 dB.

The evaluation of the single-number rating from the results in one-third octave bands shall be done in accordance with ISO 717-2.

A1 5.4 Correction of airborne sound transmission

In case that the airborne sound transmission from the source to the receiving room cannot be neglected (this applies to situations where airborne and impact sound pressure level in the receiving room differ by less than 10 dB, for instance for long reverberation times in the source room or floors with good impact but poor airborne sound insulation) the measured impact sound shall be corrected. Make the correction in the following way: A1

a) Measure the sound levels generated by the tapping machine in the source and the receiving room, L_{TS} and L_i.

b) While running a loudspeaker in the source room, the resulting sound pressure levels in the source and receiving room, L_{LS} and L_{LR}, are measured. From the measured values, calculate the level difference $D = L_{LS} - L_{LR}$. To ensure constant measuring conditions, the loudspeaker shall already be in the source room during the measurement of impact sound. It shall be placed in an edge of the room in a height of 1,0 m and a distance of 1,0 m to the walls (the mentioned distances refer to the centre of the source). Further positions of the loudspeaker are not necessary. If the airborne sound reduction index R of the floor is known, D can be alternatively determined from $D = R - 10 \lg(S/A)$, where S is the floor area and A is the equivalent absorption area in the receiving room.

c) Calculate the normalized impact sound pressure level, L_n, according to Formula (3). If necessary, both L_i and L_{LR} should be corrected for background noise according to ISO 10140-4:2010, 4.3.

$$L_n = 10 \lg\left(10^{L_i/10} - 10^{(L_{TS}-D)/10}\right) + 10 \lg\left(\frac{A}{A_0}\right) \quad (3)$$

where

A is the equivalent absorption area in the receiving room;

A_0 = 10 m^2;

L_{TS} is the sound pressure level generated by the tapping machine in the source room;

L_i is the sound pressure level generated by the tapping machine in the receiving room.

The calculation is performed in one-third octave bands. If a correction for airborne sound is applied, this shall be mentioned in the test report. For the case that the condition $L_i - (L_{TS} - D) \geq 10$ dB is valid in all one-third octave bands a correction of airborne sound is not necessary. For $L_i - (L_{TS} - D) \leq 3$ dB sound transmission is dominated by airborne sound and impact sound insulation cannot be measured correctly.

5.5 Expression of results

For the statement of the impact sound insulation of the test element, the normalized impact sound pressure level, L_n, shall be given in decibels at all frequencies of measurement, to one decimal place, both in tabular form and in the form of a curve.

For the statement of the change of impact sound pressure level due to a floor covering, the results shall be given at all frequencies of measurement, to one decimal place, both in tabular form and in the form of a graph.

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:

a) 5 mm for a one-third octave band;

b) 20 mm for 10 dB.

The use of a test report form in accordance with Annex B is preferred. For this short version of the test report, state all information of importance regarding the test element, the test procedure and the test results.

6 Test arrangement

6.1 General

General requirements for the preparation, curing, installation and mounting of test elements are described in this clause. For specific types of elements and products, detailed specifications may be given in related documents; for instance, test codes are covered in ISO 10140-1. When testing the reduction of impact sound pressure level by floor coverings, follow the requirements of ISO 10140-1:2010, Annex H.

6.2 Types of installation

6.2.1 Floor element

The size of the floor is determined by the size of the test opening of the laboratory test facility, as defined in ISO 10140-5.

The floor should be installed in a similar manner to the actual construction using normal connections and sealing conditions at the perimeter and at all joints. The mounting conditions shall be stated in the test report.

The impact sound insulation of heavyweight solid floors depends on structural coupling to the laboratory structure. In order to describe the effect of the mounting, it is recommended that the total loss factor be measured and stated in the test report (see ISO 10140-4:2010, 4.7).

6.2.2 Floor covering

The permissible area and location for installation of floor coverings, and requirements for their installation are specified in ISO 10140-1:2010, Annex H. This defines three categories of floor coverings, for which different installation and testing procedures apply depending on the category of floor covering and the type of reference floor on which it is tested.

7 Limits of performance

The sound radiated by flanking elements should be negligible compared to the sound radiated from the floor under test. The procedure to check this is given in ISO 10140-5:2010, Annex A.

The laboratory shall suppress airborne sound transmission from the source room into the receiving room, such that the level is at least 10 dB below the level of transmitted impact sound in each frequency band.

8 Precision

The measurement procedure shall give satisfactory repeatability. This shall be determined in accordance with the method shown in ISO 140-2 and shall be verified from time to time, particularly when a change is made in the procedure or instrumentation.

NOTE Numerical requirements for repeatability are given in ISO 140-2.

9 Test report

The test report shall include at least the following information:

a) reference to this part of ISO 10140, i.e. ISO 10140-3:2010;

b) name and address of the testing laboratory;

c) manufacturer's name and product identification;

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

e) dates of test (date of construction of the test element, date of test, date of issue of the test report);

f) size, shape and volume of the receiving room;

g) air temperature, relative humidity and static pressure in the measuring rooms;

h) brief description of details of measurement procedure and equipment;

i) description of the test element (with sectional drawing, if available) and mounting and fixing conditions, including size, thickness, mass per unit area, curing time and conditions of components, together with a statement indicating who mounted the test element (test institute, manufacturer or other);

j) statement as to whether the test element suffered visible damage during the test, for example compaction (if appropriate);

k) normalized impact sound pressure level of test element as a function of frequency;

l) single-number rating in accordance with ISO 717-2; it shall be clearly stated that the rating has been based on a result obtained by a laboratory measurement;

m) results which are limits of measurement of the laboratory and are obtained by correcting for the influence of flanking transmission; they shall be given as $L_n < x$ dB; this shall be applied if the sound pressure level in any band is not measurable on account of background noise (acoustic or electrical, see ISO 10140-4:2010, 4.3) and if the measured value has been affected by flanking transmission; the flanking transmission should be given in the same form as L_n, and it should be stated as clearly as possible which part of the transmitted sound is included in the flanking transmission measurement;

n) total loss factor, η_{total}, if measured, (see ISO 10140-4:2010, 4.7) at all frequencies of measurement, both in tabular form and in the form of a curve;

o) additional information required by test codes referring to this part of ISO 10140, i.e. ISO 10140-3:2010.

The recommended form for expressing results is given in Annex B.

Annex A
(informative)

Measurement using heavy and soft impact sources

A.1 General

This annex specifies an alternative method of measuring the impact sound insulation of a floor for heavy and soft impacts, such as from human footsteps (bare feet) or children jumping.

To determine the improvement due to a floor covering, the procedure of this annex shall be followed together with test code requirements for the elements under test given in ISO 10140-1:2010, Annex H.

The quantities to be determined according to this annex are:

— maximum sound pressure level, L_{Fmax}, in decibels: the maximum sound pressure level of an impact sound measured using the Fast Time Constant on a sound level meter at a fixed position in the receiving room.

— impact sound pressure level, $L_{\mathrm{i,Fmax}}$, in decibels: the average of the maximum sound pressure levels measured in the receiving room when the floor under test is excited by the heavy/soft impact source specified in ISO 10140-5:2010, Annex F.

A.2 Equipment

The heavy/soft impact source shall meet the requirements given in ISO 10140-5:2010, Annex F.

The accuracy of the sound level measurement equipment shall comply with the requirements of accuracy class 0 or 1 as defined in IEC 61672-1. The complete measuring system, including the microphone shall be adjusted before each measurement using a sound calibrator that complies with the requirements of accuracy class 1 as defined in IEC 60942. For sound level meters calibrated for measurements in sound fields of progressive plane waves, corrections for the diffuse sound field should be applied.

The filters shall comply with the requirements defined in IEC 61260.

A.3 Test arrangement

The specifications given in Clause 5 shall be followed.

A.4 Test procedure and evaluation

A.4.1 General

The measurements shall be made in one-third octave bands or octave bands according to the aim of the measurement.

A.4.2 Generation of sound field

The impact sound shall be generated by dropping the heavy/soft impact source described in ISO 10140-5:2010, Annex F, from a height of 1 m above the surface of the floor.

The excitation by the heavy/soft impact source shall be made at four or more different positions on the floor under test. For a lightweight floor, one of these positions should be above the joists and one position should be at the centre point of the floor.

A.4.3 Measurement of maximum sound pressure level

The maximum sound pressure level at a set of the microphone positions shall be measured for all excitation positions using the heavy/soft impact source.

A.4.3.1 Microphone positions

At a minimum, four microphone positions should be used. These should be distributed within the maximum permitted space throughout the room.

The following separating distances are minimum values and should be exceeded where possible:

a) 0,7 m between microphone positions;

b) 0,7 m between any microphone position and room boundaries;

c) 0,7 m between any microphone position and diffusers;

d) 1,0 m between any microphone position and the underside of the floor being excited by the impact source.

A.4.3.2 Frequency range of measurements

The sound pressure level shall be measured using one-third octave or octave band filters having at least the following centre frequencies, in hertz.

a) For one-third octave band measurements:

   50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630;

b) For octave band measurements:

   63, 125, 250, 500.

NOTE Guidance is given in ISO 10140-4:2010, Annex A, for measurements in the low-frequency bands for the 50 Hz, 63 Hz and 80 Hz one-third octave bands or the 63 Hz octave band.

A.4.3.3 Correction for background noise

Measurements of background noise levels should be made to ensure that the observations in the receiving room are not affected by extraneous sound, such as noise from outside the test rooms or electrical noise. The background noise levels should be measured and the measured sound pressure level in the room should be corrected for background noise, as described in ISO 10140-4:2010, 4.3.

A.4.4 Calculation of impact sound pressure level

The maximum sound pressure levels measured at the different microphone positions shall be averaged for each excitation position using Equation (A.1).

$$L_{\mathrm{i,Fmax,j}} = 10 \lg\left(\frac{1}{m}\sum_{k=1}^{m} 10^{L_{\mathrm{F\,max},k}/10}\right) \quad \text{(A.1)}$$

where $L_{\mathrm{Fmax},k}$ is the maximum sound pressure level at the kth microphone position ($k = 1$ ... to m) in the receiving room.

Then, the impact sound pressure level should be calculated by averaging the values obtained above for all excitation positions by using Equation (A.2).

$$L_{\mathrm{i,Fmax}} = 10 \lg\left(\frac{1}{n}\sum_{j=1}^{n} 10^{L_{\mathrm{i,Fmax},j}/10}\right) \quad \text{(A.2)}$$

where $L_{\mathrm{Fmax},j}$ is the (room-averaged) maximum impact sound pressure level determined for the jth excitation position ($j = 1$ ... to n) according to Equation (A.1).

A1 A.4.5 Standardized maximum impact sound pressure level $L_{\mathrm{i,Fmax},V,T}$

The room-averaged maximum impact sound pressure level, $L_{\mathrm{i,Fmax}}$, in the octave or one-third octave frequency band that is measured in the receiving room below the floor depends on the volume of the receiving room and its reverberation time. Therefore, for comparison of laboratory measurements with results from other laboratories or actual buildings, the result should be corrected to give $L'_{\mathrm{i,Fmax},V,T}$ using Formula (A.3):

$$L'_{\mathrm{i,Fmax},V,T} = L_{\mathrm{i,Fmax}} + 10\lg\frac{V}{V_0} - 10\lg\left[\frac{1-C_0^{-1}}{1-C^{-1}}\left(\frac{C^{(1-C)^{-1}} - C^{-\left(1-C^{-1}\right)^{-1}}}{C_0^{(1-C_0)^{-1}} - C_0^{-\left(1-C_0^{-1}\right)^{-1}}}\right)\right] \quad \text{(A.3)}$$

where

$$C_0 = \frac{T_0}{1{,}7275} \quad \text{(A.4)}$$

$$C = \frac{T}{1{,}7275} \quad \text{(A.5)}$$

where

T is the reverberation time for the octave or one-third octave frequency band in the receiving room;

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

V is the receiving room volume, in cubic metres;

V_0 is the reference receiving room volume, for dwellings, V_0 = 50 m^3;

The standardized maximum impact sound pressure level, $L_{\mathrm{i,Fmax,V,T}}$, should be calculated using Formula (A.3) for the octave or one-third octave frequency bands specified in A.4.3.2. A1

A.5 Precision

See Clause 8.

A.6 Expression of results

Specifications such as those given in 5.3 and Annex B should be followed, with adaptations for the different measurement quantities and measurement frequencies.

A.7 Test reports

Specifications such as those given in Clause 9 should be followed, with adaptations for the different measurement quantities and measurement frequencies.

Annex B
(informative)

Form for the expression of results

Figure B.1 gives an example of the form for the expression of results obtained by laboratory measurements of the impact sound transmitted by a floor assembly. Users are permitted to copy this form.

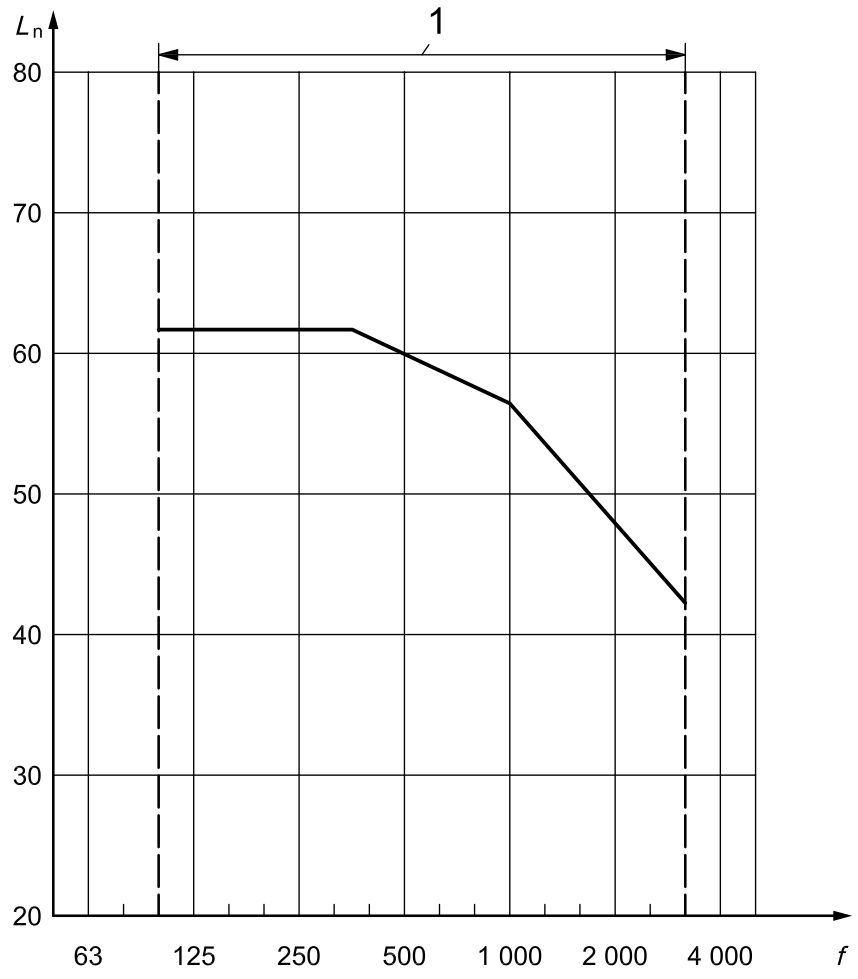
Figure B.1 — Example of form for the expression of results

Normalized impact sound pressure level, L_n, in accordance with ISO 10140-3

Laboratory measurements of impact sound insulation of floors

Manufacturer:		Product identification:	
Client:		Test room identification:	
Test element mounted by:		Date of test:	
Description of test facility, test element and test arrangement:			
Mass per unit area:	kg/m^2		
Curing time:	h		
Air temp. in source room:	°C;	in receiving room:	°C
Relative humidity in source room:	%;	in receiving room:	%
Static pressure:	Pa		
Receiving room volume:	m^3		

Frequency f Hz	L_n one-third octave dB
50	
63	
80	
100	
125	
160	
200	
250	
315	
400	
500	
630	
800	
1 000	
1 250	
1 600	
2 000	
2 500	
3 150	
4 000	
5 000	



Key

L_n normalized impact sound pressure level, in dB

f frequency, in Hz

1 frequency range in accordance with the curve of reference values (ISO 717-2)

Rating in accordance with ISO 717-2:

$L_{n,w}(C_l) =$ ( ) dB $C_{l,50\text{-}2\,500} =$ dB

Evaluation based on laboratory measurement results obtained by an engineering method.

No. of test report:	Name of test institute:
Date:	Signature:

Bibliography

[1] ISO 140-4, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 4: Field measurements of airborne sound insulation between rooms*

[2] ISO 140-5, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 5: Field measurements of airborne sound insulation of façade elements and façades*

[3] ISO 140-7, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 7: Field measurements of impact sound insulation of floors*

[4] ISO 140-14, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 14: Guidelines for special situations in the field*

[5] ISO 140-18, Acoustics — *Measurement of sound insulation in buildings and of building elements — Part 18: Laboratory measurement of sound generated by rainfall on building elements*

[6] HOPKINS, C. *Sound insulation*. Amsterdam: Elsevier/Butterworth-Heinemann, 2007, 622 pp.

[7] INOUE, K., YASUOKA, M., TACHIBANA, H. New heavy impact source for the measurement of floor impact sound insulation of building, *Proc. Inter-noise 2000*, 2000, pp. 1493-1496

[8] INOUE, K., YASUOKA, M., TACHIBANA, H. Reduction of floor impact sound on floor finishing for wooden floor structure, *Proc. Inter-noise 2001*, 2001, pp. 1161-1166

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