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Acoustics — Measurement of sound insulation in buildings and of building elements —

Part 11: Laboratory measurements of the reduction of transmitted impact sound by floor coverings on lightweight reference floors

Acoustique — Mesurage de l'isolement acoustique des immeubles et des éléments de construction —

Partie 11: Mesurage en laboratoire de la réduction de la transmission des bruits de choc par les revêtements de sol sur les planchers de référence légers

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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 140-11 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

ISO 140 consists of the following parts, under the general title *Acoustics — Measurement of sound insulation in buildings and of building elements*:

— *Part 1: Requirements for laboratory test facilities with suppressed flanking transmission*

— *Part 2: Determination, verification and application of precision data*

— *Part 3: Laboratory measurements of airborne sound insulation of building elements*

— *Part 4: Field measurements of airborne sound insulation between rooms*

— *Part 5: Field measurements of airborne sound insulation of façade elements and façades*

— *Part 6: Laboratory measurements of impact sound insulation of floors*

— *Part 7: Field measurements of impact sound insulation of floors*

— *Part 8: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor*

— *Part 9: Laboratory measurements of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it*

— *Part 10: Laboratory measurement of airborne sound insulation of small building elements*

— *Part 11: Laboratory measurements of the reduction of transmitted impact sound by floor coverings on lightweight reference floors*

— *Part 12: Laboratory measurement of room-to-room airborne and impact sound insulation of an access floor*

— *Part 13: Guidelines*

— *Part 14: Guidelines for special situations in the field*

— *Part 16: Laboratory measurement of the sound reduction index improvement by additional lining*

The following parts are under preparation:

— *Part 17: Evaluation of the total loss factor*

— *Part 18: Laboratory measurement of sound generated by rainfall on building elements*

Acoustics — Measurement of sound insulation in buildings and of building elements —

Part 11: Laboratory measurements of the reduction of transmitted impact sound by floor coverings on lightweight reference floors

1 Scope

This part of ISO 140 specifies methods for measuring the acoustic properties of floor coverings from the viewpoint of reducing impact sound transmission. The purpose of this part of ISO 140 is to establish a method for determining the impact sound insulation of a floor covering under standard test conditions. The test is limited to the specification of procedures for the physical measurement of sound originating from an artificial impact source (tapping machine) under laboratory conditions and is not directly related to the subjective significance of the results.

In this part of ISO 140, a test method is described using the standard tapping machine to simulate impact sources like human footsteps with shoes. In addition, methods using a modified tapping machine and a heavy/soft impact source are also introduced in informative Annexes C and E for the assessment of impact sound insulation of a floor covering against impact sources with strong components at low frequencies, such as human footsteps or children jumping. As a simplified method for the measurement of the reduction of floor impact sound pressure level by soft and resilient floor coverings, the method using a wooden mock-up floor is introduced in Annex D.

This part of ISO 140 is applicable to all floor coverings, whether single or multi-layered, as installed on lightweight floors. In the case of multi-layered coverings, they can be factory-assembled or assembled at the test site. The test method is applicable only to laboratory measurements. It does not contain any provision that permits an assessment of the effectiveness of a floor covering *in situ*.

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 140-1:1997, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 1: Requirements for laboratory test facilities with suppressed flanking transmission*

ISO 140-2:1991, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 2: Determination, verification and application of precision data*

ISO 140-6:1998, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 6: Laboratory measurements of impact sound insulation of floors*

ISO 140-8:1997, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 8: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor*

ISO 354:2003, *Acoustics — Measurement of sound absorption in a reverberation room*

ISO 9052-1:1989, *Acoustics — Determination of dynamic stiffness — Part 1: Materials used under floating floors in dwellings*

ISO 9053:1991, *Acoustics — Materials for acoustical applications — Determination of airflow resistance*

IEC 61672-1:2002, *Electroacoustics — Sound level meters — Part 1: Specifications*

IEC 60942:2003, *Electroacoustics — Sound calibrators*

IEC 61260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters*

3 Terms and definitions

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

3.1
average sound pressure level in a room
L
ten times the common logarithm 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 If a continuously moving microphone is used, L is determined by

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

where

$p(t)$ is the sound pressure, in pascals;

p_0 is the reference sound pressure and is equal to 20 µPa;

T_m is the integration time, in seconds.

NOTE 2 If fixed microphone positions are used, L is determined by

$$L = 10 \lg \frac{\sum_{j=1}^{n} {p_j}^2}{n \cdot {p_0}^2} \text{ dB} \quad (2)$$

where p_j is the r.m.s. sound pressure at n different positions in the room.

NOTE 3 In practice, the sound pressure levels L_j are usually measured. In this case L is determined by

$$L = 10 \lg \left(\frac{1}{n} \sum_{j=1}^{n} 10^{L_j/10} \right) \text{ dB} \quad (3)$$

where L_j is the sound pressure level L_1 to L_n at n different positions in the room.

NOTE 4 Sound pressure level is expressed in decibels.

3.2
impact sound pressure level
L_i
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 It is expressed in decibels.

3.3
normalized impact sound pressure level
L_n
impact sound pressure level L_i increased by a correction term 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

$$L_n = L_i + 10 \lg \frac{A}{A_0} \text{ dB} \quad (4)$$

with A_0 = 10 m^2

NOTE It is expressed in decibels.

3.4
reduction of normalized impact sound pressure level
improvement of normalized impact sound insulation
ΔL_t
for a given one-third-octave band, the reduction in normalized impact sound pressure level resulting from installation of the test floor covering on a lightweight reference floor

$$\Delta L_t = L_{n,t,0} - L_{n,t} \text{ dB} \quad (5)$$

where

$L_{n,t,0}$ is the normalized impact sound pressure level of the lightweight reference floor without the floor covering;

$L_{n,t}$ is the normalized impact sound pressure level of the lightweight reference floor with the floor covering.

NOTE 1 If the receiving room absorption is unchanged during the test, it is assumed that the reduction in impact sound pressure level is equivalent to the reduction in normalized impact sound pressure level.

NOTE 2 The subscript “t” refers to timber floors as the type of base floor.

NOTE 3 In this part of ISO 140, three types of lightweight reference floors are specified in Annex B. When it is necessary to specify the reference floor used in the measurement, $\Delta L_{t,1}$, $\Delta L_{t,2}$ and $\Delta L_{t,3}$ may be used for the reference floors No. 1, No. 2 and No. 3, respectively.

NOTE 4 The reduction of normalized impact sound pressure level is expressed in decibels.

3.5
top floor
lightweight floor construction, mounted on top of the sub-floor, on which the floor covering under test is mounted

3.6
sub-floor
standard heavyweight test floor as specified in ISO 140-8

3.7
test floor
combined floor consisting of the top floor mounted on the sub-floor and the sub-floor

3.8
maximum sound pressure level
L_{Fmax}
maximum sound pressure level of an impact sound measured by the dynamic characteristic of F of the sound level meter

NOTE It is expressed in decibels.

3.9
impact sound pressure level
$L_{i,Fmax}$
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 Annex F

NOTE It is expressed in decibels.

3.10
reduction of impact sound pressure level
improvement of impact sound insulation
ΔL_r
for a given one-third-octave or octave band, the reduction in the impact sound pressure level resulting from the installation of the test floor covering on a lightweight reference floor

$$\Delta L_r = L_{i,Fmax,0} - L_{i,Fmax} \quad (6)$$

where

$L_{i,Fmax,0}$ is the impact sound pressure level of the lightweight reference floor without floor covering;

$L_{i,Fmax}$ is the impact sound pressure level of the lightweight reference floor with floor covering under test.

NOTE It is expressed in decibels.

3.11
impact force
$F(t)$
instantaneous force acting on the floor under test when the heavy/soft impact source is dropped on the floor

NOTE It is expressed in newtons.

3.12
impact force exposure level
L_{FE}
ten times the common logarithm of the ratio of the time-integrated value of the impact force squared to the square of the reference force

$$L_{FE} = 10 \lg \left[\frac{1}{T_0} \int_{t_1}^{t_2} \frac{F^2(t)}{{F_0}^2} dt \right] \text{ dB} \quad (7)$$

where

$F(t)$ is the impact force, in newtons;

F_0 is the reference force (= 1 N);

$t_2 - t_1$ is the time duration of the impact force, in seconds;

s is the reference time interval (= 1 s).

NOTE The impact force exposure level is expressed in decibels.

4 Equipment

The equipment shall comply with the requirements of Clause 6.

The tapping machine shall meet the requirements given in Annex A.

The accuracy of the sound level measurement equipment shall comply with the requirements of accuracy Class 1 defined in IEC 61672-1:2002. 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 defined in IEC 60942:2003. For sound level meters calibrated for measurements in sound fields of progressive plane waves, corrections for the diffuse sound field shall be applied.

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

The reverberation time measurement equipment shall comply with the requirements given in ISO 354.

NOTE 1 For pattern evaluation (type testing) and regular verification tests, recommended procedures for sound level meters are given in OIML R58 [3] and OIML R88 [4].

NOTE 2 A method using a modified tapping machine and that using a standard heavy/soft impact source are also introduced in Annex C (informative) and Annex E (informative), respectively, for the assessment of impact sound insulation of a floor covering against real impact sources such as human walking and stepping.

5 Test arrangement

5.1 General arrangement

Two vertically adjacent rooms shall be used, the upper one being designated the “source room” and the lower one the “receiving room”. They shall be separated by a lightweight reference floor on which the floor covering under test is installed.

The airborne sound from the tapping machine that is transmitted to the receiving room shall be such that the level will be at least 10 dB below the level of transmitted impact sound in each frequency band.

5.2 Details of test arrangement

5.2.1 Source room

There are no specific requirements for the size and shape of the source room.

5.2.2 Receiving room

The receiving room shall comply with the requirements of ISO 140-1.

5.2.3 Lightweight reference floor

The reference floor on which the test covering is to be installed shall be chosen from the reference floors described in Annex B.

The surface area, viewed from the receiving room, shall be at least 10 m^2. On the source side, the permissible test area for installation of floor coverings of category I (see 5.3.1.2) will be the region at least 0,5 m from the edges of the reference floor.

5.2.4 Condition of reference floor surface

It shall be ensured that the surface of the reference floor is flat to within ± 2 mm in a horizontal distance of 200 mm, and sufficiently hard to endure the impacts of the tapping machine.

5.3 Preparation and installation of test specimen

5.3.1 Classification

5.3.1.1 General

Depending upon the type of floor covering, the test specimens should be either slightly larger than the tapping machine including supports or equal to the floor area (see 6.6).

5.3.1.2 Category I (small specimens)

This category includes flexible coverings (plastics, rubber, cork, matting, or combinations thereof) that may be installed loosely or by adhesion to the floor surface. The method of installation shall be clearly described in the test report.

5.3.1.3 Category II (large specimens)

This category includes rigid homogeneous surface materials or complex floor coverings of which at least one constituent is rigid. The assembled floor covering may be tested under load. Normal furnishing should be simulated with a uniformly distributed load of 20 kg/m^2 to 25 kg/m^2. The distributed load should be arranged with at least one weight-piece per square metre of the flooring area.

5.3.1.4 Category III (stretched materials)

This category includes flexible coverings that cover the floor from wall to wall. Large specimens should be tested, but loading is not required.

5.3.1.5 Materials of uncertain classification

In the case of uncertainty as to the appropriate category for a material, the testing laboratory should decide whether small or large specimens will be tested.

5.3.2 Installation

Follow strictly the manufacturer's installation instructions, paying special attention to the edges of the specimen.

Install coverings to be mounted with adhesive with great care, normally with the adhesive covering the entire surface. If the adhesive is applied in isolated patches, describe the exact procedure. Follow strictly the manufacturer’s instructions for use of the adhesive, especially with regard to the amount and the bonding-time. Report the type of adhesive and the bonding-time.

5.3.3 Size and number of specimens

5.3.3.1 Category I

Install three samples, preferably of different production runs but from the same source. Each sample shall be large enough to support the tapping machine.