

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

Part 2: Field measurements

ICS 91.120.20

National foreword

This British Standard is the UK implementation of EN ISO 15186-2:2010. It is identical to ISO 15186-2:2003. It supersedes BS ISO 15186-2:2003, which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee EH/1, Acoustics, to Subcommittee EH/1/6, Building acoustics.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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English Version

Acoustics - Measurement of sound insulation in buildings and of
building elements using sound intensity - Part 2: Field
measurements (ISO 15186-2:2003)

Acoustique - Mesurage par intensité de l'isolation
acoustique des immeubles et des éléments de construction
- Partie 2: Mesurages in situ (ISO 15186-2:2003)

Akustik - Bestimmung der Schalldämmung in Gebäuden
und von Bauteilen aus Schallintensitätsmessungen - Teil 2:
Messungen am Bau (ISO 15186-2:2003)

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Foreword

The text of ISO 15186-2:2003 has been prepared by Technical Committee ISO/TC 43 “Acoustics” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 15186-2:2010 by 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of an identical text or by endorsement, at the latest by March 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

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Endorsement notice

The text of ISO 15186-2:2003 has been approved by CEN as a EN ISO 15186-2:2010 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.

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ISO 15186-2 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

ISO 15186 consists of the following parts, under the general title *Acoustics — Measurement of sound insulation in buildings and of building elements using sound intensity*:

- *Part 1: Laboratory measurements*
- *Part 2: Field measurements*
- *Part 3: Laboratory measurements at low frequencies*

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

Part 2: Field measurements

1 Scope

1.1 General

This part of ISO 15186 specifies a sound intensity method to determine the *in-situ* sound insulation of walls, floors, doors, windows and small building elements. It is intended for measurements that have to be made in the presence of flanking transmission. It can be used to provide sound power data for diagnostic analysis of flanking transmission or to measure flanking sound insulation parameters.

This part of ISO 15186 can be used by laboratories that could not satisfy the requirements of ISO 15186-1, which deals with laboratory measurements with no or little flanking transmission. ISO 15186-3 deals with measurements under laboratory conditions, at low frequencies.

This part of ISO 15186 also describes the effect of flanking transmission on measurements made using the specified method, and how intensity measurements can be used

- to compare the *in-situ* sound insulation of a building element with laboratory measurements where flanking has been suppressed (i.e. ISO 140-3),
- to rank the partial contributions for building elements, and
- to measure the flanking sound reduction index for one or more transmission paths (for validation of prediction models such as those given in EN 12354-1).

This method gives values for airborne sound insulation, which are frequency dependent. They can be converted into a single number, characterizing the acoustic performance, by application of ISO 717-1.

1.2 Precision

The reproducibility of this intensity method is estimated to be equal to or better than that of the methods of ISO 140-10 and ISO 140-4, when measuring a single small and large building element, respectively.

NOTE 1 If sound reduction measures made using this method are to be compared with those made using the conventional reverberation room method in various parts of ISO 140, then it will be necessary to introduce an adaptation term that reflects the bias between the test methods. This term is given in Annex A.

NOTE 2 Some information about the accuracy for this part of ISO 15186 and its relationship to the sound reduction index measured according to ISO 140-3 and ISO 140-4 is given in Annex B.

NOTE 3 Flanking transmission is discussed in Annex C.

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 140-3:1995, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 3: Laboratory measurements of airborne sound insulation of building elements*

ISO 140-4:1995, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 4: Field measurements of airborne sound insulation between rooms*

ISO 140-10:1991, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 10: Laboratory measurement of airborne sound insulation of small building elements*

ISO 717-1:1996, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation*

IEC 60942:1991, *Sound calibrators*

IEC 61043:1993, *Instruments for the measurement of sound intensity*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. The subscripts are defined in Table 1.

NOTE In this part of ISO 15186, quantities that represent the average over the measurement surface are explicitly identified using a bar over the measured quantity. For example, $\bar{I}_n$ is the average normal intensity over the measurement surface, whereas the quantity, I_n , without the bar, is the normal intensity obtained at a single point on the measurement surface. This explicit identification of surface average quantities is intended to help the user quickly identify surface average quantities and to make the nomenclature consistent with the ISO 9614 series. This may make some definitions appear different from those in ISO 15186-1 and ISO 15186-3 although they are functionally identical.

3.1 average sound pressure level in a source room

L_{p1}
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 (20 μ Pa), 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, window, etc.) is of significant influence

NOTE 1 This quantity is given in decibels.

NOTE 2 Adapted from the complete definition given in ISO 140-4.

3.2 apparent sound reduction index

R'
ten times the logarithm to the base 10 of the ratio of the sound power incident on the building element under test to the total sound power radiated into the receiving room by direct transmission and all flanking paths

NOTE 1 Unless special efforts have been made to suppress flanking transmission (i.e. those defined in ISO 140-1), the measured sound power will contain a flanking component. Annex C provides more details.

NOTE 2 The expression sound transmission loss, which is equivalent to sound reduction index is also in use.

NOTE 3 Adapted from the complete definition given in ISO 140-4.

3.3 sound intensity

$\vec{I}$

time-averaged rate of flow of sound energy per unit area in the direction of the local particle velocity, in watts per square metre, which is a vector quantity and is equal to

$$\vec{I} = \frac{1}{T} \int_0^T p(t) \cdot \vec{u}(t) \, dt \quad (1)$$

where

$p(t)$ is the instantaneous sound pressure at a point, in pascals;

$\vec{u}(t)$ is the instantaneous particle velocity at the same point, in metres per second;

T is the averaging time, in seconds.

NOTE This quantity is measured in watts per square metre.

3.4 normal sound intensity

I_n

component of the sound intensity, in watts per square metre, in the direction normal to a measurement surface defined by the unit normal vector $\vec{n}$

$$I_n = \vec{I} \cdot \vec{n} \quad (2)$$

where $\vec{n}$ is the unit normal vector directed out of the volume enclosed by the measurement surface

3.5 normal sound intensity level

L_{I_n}

ten times the logarithm to the base 10 of the ratio of the unsigned value of the normal sound intensity to the reference intensity I_0 as given by

$$L_{I_n} = 10 \lg \frac{|I_n|}{I_0} \quad (3)$$

where

$$I_0 = 10^{-12} \text{ W/m}^2$$

3.6 surface pressure-intensity indicator

F_{pI_n}

difference, in decibels, between the sound pressure level, $\bar{L}_p$, and the normal sound intensity level, $\bar{L}_{I_n}$, on the measurement surface, both being time- and surface-averaged, given by

$$F_{pI_n} = \bar{L}_p - \bar{L}_{I_n} \quad (4)$$

where

$$\bar{L}_p = 10 \lg \left(\frac{1}{S_M} \sum_{i=1}^N S_{M_i} 10^{0,1 \bar{L}_{p_i}} \right) \text{ dB} \quad (5)$$

and

$$\bar{L}_{I_n} = 10 \lg \left| \frac{1}{S_M} \sum_{i=1}^N \frac{S_{M_i} \bar{I}_{n_i}}{I_0} \right| \text{ dB} \quad (6)$$

where

$\bar{L}_{p_i}$ is the time- and surface-averaged sound pressure level measured on the i th sub-area;

$\bar{I}_{n_i}$ is the time- and surface-averaged signed normal intensity measured on the i th sub-area, and there are N sub-areas having a total area of S_M

$$S_M = \sum_{i=1}^N S_{M_i} \quad (7)$$

NOTE In the limit of equal sub-areas, this indicator corresponds to the negative partial power indicator F_3 defined in ISO 9614-1 and signed pressure-intensity indicator, F_{pI_n} , defined in ISO 9614-3.

3.7 pressure-residual intensity index

δ_{pI0}
 difference, in decibels, between the indicated sound pressure level, L_p , and the indicated sound intensity level, L_I , when the intensity probe is placed and oriented in a sound field such that the sound intensity is zero

$$\delta_{pI0} = (L_p - L_{I\delta}) \quad (8)$$

where $L_{I\delta}$ is the level of the residual intensity and is given by

$$L_{I\delta} = 10 \lg \frac{|I_\delta|}{I_0} \text{ dB} \quad (9)$$

NOTE This definition is consistent with that given in the ISO 9614 series. Details for determining δ_{pI0} are given in IEC 61043.

3.8 apparent intensity sound reduction index

R'_I
 index, in decibels, for a building element that separates one source room and one receiving room, which also may be the outside, defined as

$$R'_I = \left[L_{p1} - 6 + 10 \lg \left(\frac{S}{S_0} \right) \right] - \left[\bar{L}_{I_n} + 10 \lg \left(\frac{S_M}{S_0} \right) \right] \quad (10)$$

where the first term relates to the incident sound power in the source room and the second term relates to the sound power radiated from the building element(s) contained within the measurement volume in the receiving room, and

L_{p1} is the average sound pressure level in the source room;

S is the area of the separating building element under test or, in the case of staggered or stepped rooms, that part of the area common to both the source and receiving rooms;