
**Building acoustics — Estimation of
acoustic performance of buildings
from the performance of elements —**

**Part 4:
Transmission of indoor sound to the
outside**

*Acoustique du bâtiment — Calcul de la performance acoustique des
bâtiments à partir de la performance des éléments —*

Partie 4: Transmission du bruit intérieur à l'extérieur

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the European Committee for Standardization (CEN) Technical Committee CEN/TC 126, *Acoustic properties of building elements and of buildings*, in collaboration with ISO Technical Committee TC 43, *Acoustics*, SC 2, *Building acoustics*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces ISO 15712-4:2005, which has been technically revised.

A list of all the parts in the ISO 12354 series can be found on the ISO website.

Introduction

This document is part of a series specifying calculation models in building acoustics.

Although this document covers the main types of building construction it cannot as yet cover all variations in the construction of buildings. It sets out an approach for gaining experience for future improvements and developments.

The accuracy of this document alone is difficult to specify since it forms just one link in the chain of inside sound level, sound radiation and sound propagation outdoors; the first and last item are not covered by this document. The accuracy can only be specified after widespread comparisons with field data in combination with other prediction standards, i.e. those for outdoor sound propagation. It is the responsibility of the user (i.e. a person, an organization, the authorities) to address the consequences of the accuracy, inherent for all measurement and prediction methods, by specifying requirements for the input data and/or applying a safety margin to the results or applying some other correction.

It is intended for acoustical experts and provides the framework for the development of application documents and tools for other users in the field of building construction, taking into account local circumstances.

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Building acoustics — Estimation of acoustic performance of buildings from the performance of elements —

Part 4: Transmission of indoor sound to the outside

1 Scope

This document specifies a calculation model to estimate the sound power level radiated by the envelope of a building due to airborne sound inside that building, primarily by means of measured sound pressure levels inside the building and measured data which characterize the sound transmission by the relevant elements and openings in the building envelope. These sound power levels, together with those of other sound sources in or in front of the building envelope, form the basis for the calculation of the sound pressure level at a chosen distance from a building as a measure for the acoustic performance of buildings.

The prediction of the inside sound pressure level from knowledge of the indoor sound sources is outside the scope of this document.

The prediction of the outdoor sound propagation is outside the scope of this document.

NOTE For simple propagation conditions an approach is given for the estimation of the sound pressure level in [Annex E](#).

This document describes the principles of the calculation model, lists the relevant quantities and defines its applications and restrictions.

2 Normative references

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

ISO 7235, *Acoustics — Laboratory measurement procedures for ducted silencers and air-terminal units — Insertion loss, flow noise and total pressure loss*

ISO 10140-1:2016, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 1: Application rules for specific products*

ISO 16283-3, *Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 3: Airborne sound insulation of façades*

3 Terms and definitions

For the purposes of this document, the following terms and definitions, and the symbols and units listed in [Annex A](#), apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Quantities to express building performance

3.1.1

sound power level

L_W

sound power level of a substitute point sound source

3.1.2

directivity correction

D_c

deviation in decibels between the sound pressure level of a point sound source in a specified direction and the level of an omni-directional point source producing the same sound power level

3.2 Quantities to express element performance

NOTE For the calculations, additional information on constructions could be necessary; for example, the shape of the building envelope, areas, etc.

3.2.1

sound reduction index

R

ten times the common logarithm of the ratio of the sound power W_1 incident on a test specimen to the sound power W_2 transmitted through the specimen, which is evaluated from

$$R = \left(10 \lg \frac{W_1}{W_2} \right) \text{dB}$$

Note 1 to entry: This quantity shall be determined in accordance with ISO 10140-1:2016, Annexes A, B, C and D or ISO 16283-1.

3.2.2

element normalized level difference

$D_{n,e}$

difference in the space and time average sound pressure level produced in two rooms by a source in one room, where sound transmission is only due to a small technical element (e.g. transfer air devices, electrical cable ducts, transit sealing systems), which is evaluated from

$$D_{n,e} = L_1 - L_2 - \left(10 \lg \left(\frac{A}{A_0} \right) \right) \text{dB}$$

where A is the equivalent sound absorption area in the receiving room, in square metres.

Note 1 to entry: $D_{n,e}$ is normalized to the reference equivalent sound absorption area (A_0) in the receiving room; $A_0 = 10 \text{ m}^2$.

Note 2 to entry: This quantity shall be determined in accordance with ISO 10140-1:2016, Annex E.

3.2.3

insertion loss

D

<of an element> reduction in sound power level at a given location behind the element due to the insertion of the element into the duct in place of a hard-walled duct section

Note 1 to entry: This quantity shall be determined in accordance with ISO 7235.

Note 2 to entry: For elements where this document does not apply equivalent methods should be used.

3.3 Other terms and quantities

3.3.1

sound pressure level

L_p

measure of sound at a specified reception point outside a building, due to the sound produced inside the building and by sources associated with the building as normally determined by measurements according to local requirements (specifying relevant positions, integration period and source conditions)

Note 1 to entry: The sound pressure level is normally A-weighted.

3.3.2

total attenuation due to propagation

A_{tot}

level difference between the radiated sound power and the sound pressure at a position at distance d from the building envelope due to the total of all propagation effects

Note 1 to entry: Propagation effects include geometrical divergence, air absorption, ground effect, screening, etc.

3.3.3

diffusivity term

C_d

level difference between the sound pressure level at 1 m to 2 m from the inside face of the relevant building element and the intensity level of the incident sound perpendicular to that element

Note 1 to entry: For a diffuse field and reflecting walls, the diffusivity term is $C_d = -6$ dB; for other situations it can have a value between 0 dB and -6 dB.

3.3.4

inside sound pressure level

$L_{p,\text{in}}$

sound pressure level inside the building, 1 m to 2 m from the considered element or segment of the building envelope

Note 1 to entry: In the case of a diffuse sound field, this corresponds to the average sound pressure level in the diffuse sound field.

3.3.5

substitute point source

point source for which the radiated sound is the same as that of a segment of the building envelope

Note 1 to entry: The segment can be composed of one or more building elements or of one or more openings.

4 Calculation model

4.1 General principles

The total sound pressure level at a reception point that is a chosen distance from a building is determined by the following contributions:

- the sound radiated by the elements of the building envelope due to the sound pressure level inside;
- the sound radiated by individual sound sources, fixed in or onto the outside of the building;
- the outdoor sound propagation (effects of distance, air absorption, ground effect, screening, reflections, etc.).

The sound radiation by the building envelope may be represented by the radiation of one or more substitute point sources. Each point source can represent the contribution of a segment of the building envelope or a group of individual sound sources. The number of point sources required to adequately