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**Akustične lastnosti gradbenih elementov in stavb - Laboratorijsko merjenje izoliranosti stopnic in stopniških izolacijskih elementov pred udarnim zvokom**

Acoustic properties of building elements and of buildings - Laboratory measurement of the impact sound insulation of stairs and stair isolating elements

Akustische Eigenschaften von Bauteilen und von Gebäuden - Prüfstandsmessungen der Trittschalldämmung von Treppen und Treppen-Entkopplungselementen

Propriétés acoustiques des éléments de construction et des bâtiments - Mesurage en laboratoire de l'isolation au bruit de choc des escaliers et des éléments isolants d'escalier

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Laboratory measurement of the impact sound insulation of  
stairs and stair isolating elements**

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des bâtiments - Mesurage en laboratoire de l'isolation  
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Gebäuden - Prüfstandsmessungen der  
Trittschalldämmung von Treppen und Treppen-  
Entkopplungselementen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 126.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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<b>Contents</b>	<b>Page</b>
European foreword .....	4
Introduction .....	5
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions .....	7
4 Principle of the method(s).....	12
4.1 Horizontal transmission; case of isolated heavy landings or lightweight stairs connected to walls .....	12
4.2 Horizontal transmission; case of isolated heavy flights of stairs connected to heavy landings .....	13
4.3 Vertical transmission; case of lightweight stairs connected to heavy floors .....	14
4.3.1 General.....	14
4.3.2 Connection to floors (top in Figure 3).....	14
4.3.3 Connection to ceilings (bottom in Figure 3).....	15
5 Test facilities and equipment.....	15
5.1 General.....	15
5.2 Reference wall.....	16
5.2.1 General.....	16
5.2.2 Wall surface .....	16
5.2.3 Openings or recesses to receive the landing .....	16
5.3 Auxiliary wall .....	16
5.4 Reference floor .....	16
5.5 Reference ceiling.....	17
5.6 Reference landing.....	17
5.7 Reference flight .....	18
5.8 Lightweight stair (system).....	18
6 Test arrangement .....	19
6.1 General.....	19
6.2 Erecting the reference wall .....	19
6.3 Isolated installation of reference landing.....	19
6.4 Rigid installation of reference landing .....	20
6.5 Isolated installation of reference flight .....	20
6.6 Rigid installation of reference flight.....	21
6.7 Installation of the lightweight stair system.....	21
7 Test Procedure.....	22
7.1 General.....	22
7.2 Structure-borne sound measurements.....	22
7.3 Generation of sound field.....	23
7.3.1 General.....	23
7.3.2 Excitation of reference wall .....	23
7.3.3 Excitation of reference landing.....	23
7.3.4 Excitation of reference flight .....	23

7.3.5	Excitation of lightweight stair .....	24
7.4	Generation of additional loads .....	24
8	Precision .....	24
9	Evaluation and test report.....	25
9.1	Evaluation.....	25
9.2	Expression of results .....	25
9.3	Test report .....	25
Annex A (normative) Determining the impact sound pressure level difference .....		27
A.1	General .....	27
A.2	Principle of the method.....	27
A.2.1	Horizontal transmission; case of isolated heavy landings connected to walls .....	27
A.2.2	Horizontal transmission; case of isolated heavy flights of stairs connected to heavy landings.....	28
A.3	Test arrangement .....	28
A.4	Procedure .....	28
A.4.1	General .....	28
A.4.2	Excitation of rigidly connected reference landing and reference flight.....	28
A.5	Precision .....	28
A.6	Evaluation and test report.....	29
A.6.1	Evaluation.....	29
A.6.2	Expression of results .....	29
A.6.3	Test report .....	29
Bibliography .....		30

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## **European foreword**

This document (prEN 17823:2022) has been prepared by Technical Committee CEN/TC 126 “Acoustic properties of building elements and of buildings”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

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## Introduction

The procedure for characterizing the impact sound performance of stairs comes from EN ISO 12354-2:2017, Annex F, where the performance is expressed, like the performance of any floor covering, as a reduction of impact sound pressure level. This quantity allows the product comparison of stairs and stair isolating elements and predicting the impact sound of stairs in buildings using EN ISO 12354-2.

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## 1 Scope

This document defines procedures to measure in laboratory the impact sound level reduction of isolated heavy landings connected to a heavy wall, isolated heavy flights of stairs connected to a heavy landing, floor or ceiling, and lightweight stairs connected to a heavy wall, floor or ceiling.

This document also considers the characterization of isolating elements for heavy landings or heavy flights of stairs in terms of an insertion loss expressed as an impact sound level difference. The corresponding procedure is given in a normative annex (Annex A), separated from the other procedures for the sake of clarity.

The tests are performed in defined test configurations and the test results are firstly restricted to the test configurations as described in the test report. The data can be used for comparing the performance of products and as input for EN ISO 12354-2:2017, Annex F, to calculate the sound pressure levels produced by the same stairs and isolating elements when installed in buildings.

## 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.

EN ISO 12354-2:2017, *Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 2: Impact sound insulation between rooms (ISO 12354-2:2017)*

prEN 12354-5:2022, *Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 5: Sounds levels due to the service equipment*

EN 14366, *Laboratory measurement of noise from waste water installations*

EN ISO 717-2, *Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation (ISO 717-2:2020)*

EN ISO 10140-2, *Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation (ISO 10140-2:2021)*

EN ISO 10140-3, *Acoustics - Laboratory measurement of sound insulation of building elements - Part 3: Measurement of impact sound insulation (ISO 10140-3:2021)*

EN ISO 10140-4, *Acoustics - Laboratory measurement of sound insulation of building elements - Part 4: Measurement procedures and requirements (ISO 10140-4:2021)*

EN ISO 10140-5:2021, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 5: Requirements for test facilities and equipment*

EN ISO 10848-1, *Acoustics - Laboratory and field measurement of flanking transmission for airborne, impact and building service equipment sound between adjoining rooms - Part 1: Frame document (ISO 10848-1:2017)*

EN ISO 12999-1, *Acoustics - Determination and application of measurement uncertainties in building acoustics - Part 1: Sound insulation (ISO 12999-1:2020)*

EN ISO 16283-2, *Acoustics - Field measurement of sound insulation in buildings and of building elements - Part 2: Impact sound insulation (ISO 16283-2:2020)*



### 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:

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

#### 3.1

##### **heavyweight stair**

stair made of reinforced concrete, consisting of flights of stairs, landings and optionally isolating elements between stair elements and building elements. In buildings heavyweight stairs are usually located in stairwells and not inside dwellings

Note 1 to entry: In this standard a heavyweight reference stair is defined that forms a transmission system, together with the reference wall as part of which the stair and isolating elements are subjected to testing.

#### 3.2

##### **lightweight stair**

stair made of components like steps, string boards, handrails that are made of steel/wood/stone or glass (for typical examples see 0, 0) and optionally isolating elements. In buildings lightweight stairs are usually located inside dwellings

Note 1 to entry: In this standard a lightweight stair (system) is defined by all its components and forms a transmission system, together with the reference wall, reference floor and reference ceiling as part of which the stair is subjected to testing.

#### 3.3

##### **stair isolating element**

component of a stair that reduces the impact sound transmission of the stair into building elements (walls, floors and ceilings)

#### 3.4

##### **reference wall**

wall, where the stair is attached to and by which the impact sound is radiated to the receiving room when the reference heavy landing or the reference heavy flight or the lightweight stair is excited (see Figure 6 and Figure 7)

#### 3.5

##### **auxiliary wall**

wall opposite of the reference wall by which the reference landing is supported (see Figure 6 and Figure 7)

#### 3.6

##### **reference floor**

floor, where the stair is attached to and by which the sound is radiated to the receiving room when the lightweight stair is excited (see Figure 8)

Note 1 to entry: A receiving room underneath the reference floor is not necessarily required, see Clause 5.

## prEN 17823:2022 (E)

## 3.7

**reference ceiling**

ceiling where the stair is attached to and by which the sound is radiated to the receiving room when the lightweight stair is excited (see Figure 8)

Note 1 to entry: A receiving room above the ceiling is not necessarily required, see Clause 5.

## 3.8

**reference landing**

heavyweight landing in the source room which, together with the reference wall, forms a transmission system as part of which the stair and isolating elements are subjected to testing (see Figure 6)

## 3.9

**reference flight**

heavyweight stair flight in the source room which, together with the reference wall and the reference landing, forms a transmission system as part of which the stair and isolating elements are subjected to testing (see Figure 7)

## 3.10

**receiver impact sound pressure level**

$L_{i,receiver}$

energetically averaged sound pressure level in a 3rd octave band in the receiving room due to radiation of the reference wall ( $L_{i,wall}$ ) reference floor ( $L_{i,floor}$ ), reference ceiling ( $L_{i,ceiling}$ ), when excited by the tapping machine according to EN ISO 10140-5:2021, Annex E

Note 1 to entry:  $L_{i,receiver}$  is expressed in decibels.

Note 2 to entry: See EN ISO 10140-4 for definition of the energetically averaged sound pressure level.

Note 3 to entry: The impact sound pressure level of the reference wall  $L_{i,wall}$  is determined according to prEN 12354-5:2022, Annex B, from a transfer function measurement according to EN ISO 10848-1 and the theoretical force spectrum of the standard tapping machine according to 0.

## 3.11

**normalized receiver impact sound pressure level**

$L_{n0,receiver}$

sum of the receiver impact sound pressure level,  $L_{i,receiver}$ , and a correction term, expressed in decibels, where the correction term is equal to ten times the common logarithm of the ratio of the measured equivalent sound absorption area,  $A$ , of the receiving room to that of the reference equivalent sound absorption area,  $A_0$

$$L_{n0,receiver} = L_{i,receiver} + 10 \lg \frac{A}{A_0} \quad (1)$$

Where  $A_0 = 10 \text{ m}^2$

Note 1 to entry:  $L_{n0,receiver}$  is expressed in decibels.

Note 2 to entry: See EN ISO 10140-4 for definition of the measured equivalent sound absorption area,  $A$ , of the receiving room.

**3.12****stair impact sound pressure level** **$L_{i,\text{stair}}$** 

energetically averaged sound pressure level in a 3rd octave band in the receiving room due to radiation of the reference wall, reference floor or reference ceiling, when reference landing ( $L_{i,\text{landing}}$ ), reference flight ( $L_{i,\text{flight}}$ ) or lightweight stair ( $L_{i,\text{S}}$ ) is excited by the tapping machine according to EN ISO 10140-5:2021, Annex E

Note 1 to entry:  $L_{i,\text{stair}}$  is expressed in decibels.

Note 2 to entry: See EN ISO 10140-4 for definition of the energetically averaged sound pressure level.

**3.13****normalized stair impact sound pressure level** **$L_{n0,\text{stair}}$** 

sum of the stair impact sound pressure level,  $L_{i,\text{stair}}$ , and a correction term, expressed in decibels, where the correction term is equal to ten times the common logarithm of the ratio of the measured equivalent sound absorption area,  $A$ , of the receiving room to that of the reference equivalent sound absorption area,  $A_0$

$$L_{n0,\text{stair}} = L_{i,\text{stair}} + 10 \lg \frac{A}{A_0} \quad (2)$$

Where  $A_0 = 10 \text{ m}^2$

Note 1 to entry:  $L_{n0,\text{stair}}$  is expressed in decibels.

Note 2 to entry: See EN ISO 10140-4 for definition of the measured equivalent sound absorption area,  $A$ , of the receiving room.

**3.14****landing impact sound pressure level reduction** **$\Delta L_{\text{landing}}$** 

difference of the normalized wall impact sound pressure level and the normalized landing impact sound pressure level of the isolated landing

$$\Delta L_{\text{landing}} = L_{n0,\text{wall}} - L_{n,\text{landing}} \quad (3)$$

Where

$L_{n0,\text{wall}}$  is the normalized impact sound pressure level of the reference wall;

$L_{n,\text{landing}}$  is the normalized impact sound pressure level of the isolated reference landing.

Note 1 to entry:  $\Delta L_{\text{landing}}$  is expressed in decibels.

Note 2 to entry: The landing impact sound pressure level reduction,  $\Delta L_{\text{landing}}$ , characterizes the sound insulation improvement due to the junction landing/wall and the landing isolating element, compared to the direct excitation of the wall. This quantity is required for the prediction of the impact sound transmission by isolated landings in buildings, as described in EN ISO 12354-2:2017, Annex F.

## prEN 17823:2022 (E)

## 3.15

**flight impact sound pressure level reduction**

$$\Delta L_{\text{flight}}$$

difference of the normalized landing impact sound pressure level with the landing rigidly connected to the reference wall and the normalized flight impact sound pressure level of the isolated flight

$$\Delta L_{\text{flight}} = L_{n0,\text{landing}} - L_{n,\text{flight}} \quad (4)$$

Where

$L_{n0,\text{landing}}$  is the normalized impact sound pressure level of the reference landing rigidly connected to the reference wall;

$L_{n,\text{flight}}$  is the normalized impact sound pressure level of the isolated flight.

Note 1 to entry:  $\Delta L_{\text{flight}}$  is expressed in decibels.

Note 2 to entry: The flight impact sound pressure level reduction,  $\Delta L_{\text{flight}}$ , characterizes the sound insulation improvement due to the junction flight/landing and the flight isolating element, compared to the direct excitation of the landing. This quantity is required for the prediction of the impact sound transmission by isolated flights in buildings, as described in EN ISO 12354-2:2017, Annex F.

## 3.16

**stair impact sound pressure level reduction**

$$\Delta L_{\text{stair}}$$

difference of the normalized receiver (reference wall/reference ceiling/reference floor) impact sound pressure level without stair and with the lightweight stair connected to the reference wall, reference ceiling and reference floor

$$\Delta L_{\text{stair}} = L_{n0,\text{receiver}} - L_{n,\text{stair}} \quad (5)$$

Where

$L_{n0,\text{receiver}}$  is the normalized impact sound pressure level of the receiver (reference wall, reference floor, reference ceiling) with respect to the direction of the transmission;

$L_{n,\text{stair}}$  is the normalized impact sound pressure level of the lightweight stair with respect to the direction of the transmission.

Note 1 to entry:  $\Delta L_{\text{stair}}$  is expressed in decibels.

Note 2 to entry: The stair impact sound pressure level reduction,  $\Delta L_{\text{stair}}$ , characterizes the sound insulation improvement due to the stair construction and isolating elements, compared to the direct excitation of the receiver (wall/ceiling/floor). This quantity is required for the prediction of the impact sound transmission by lightweight stairs in buildings, as described in EN ISO 12354-2:2017, Annex F.