



SLOVENSKI STANDARD

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Železnice - Prehodni sistemi med vozili - 2. del: Meritve akustike

Railway applications - Gangway systems between vehicles - Part 2: Acoustic measurements

Bahnanwendungen - Übergangssysteme zwischen Fahrzeugen - Teil 2: Messung der Akustik

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Applications ferroviaires - Systèmes d'intercirculation entre véhicules - Partie 2: Mesures acoustiques

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17.140.30	Emisija hrupa transportnih sredstev	Noise emitted by means of transport
45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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EUROPEAN STANDARD

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English Version

**Railway applications - Gangway systems between vehicles -
Part 2: Acoustic measurements**Applications ferroviaires - Système d'intercirculations entre
véhicules - Partie 2: Mesures acoustiquesBahnanwendungen - Übergangssysteme zwischen
Fahrzeugen - Teil 2: Messung der Akustik

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Foreword

This document (EN 16286-2:2013) has been prepared by Technical Committee CEN/TC 256 "Railway Applications", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by September 2013, and conflicting national standards shall be withdrawn at the latest by September 2013.

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This series of European Standards EN 16286, *Railway applications — Gangway systems between vehicles*, consists of the following parts:

— *Part 1: Main applications*

— *Part 2: Acoustic measurements*

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Introduction

This European Standard presents a measurement method to collect information about the noise insulation of rail bound vehicle gangway systems. These components need their own measurement procedure as the geometrical sound distribution situation is not in line with the basic assumptions of general standards about noise insulation measurements as provided for building elements, etc.

In this standard, a number of different setups are described, which represent possible approaches to the ideal test situation. As the approaches may contradict the ideal sound fields, the standard includes methods to assess the influence of reflections and other difficulties in order to reduce the uncertainties of these test methods to an acceptable amount in Annex A.

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1 Scope

This European Standard specifies a measurement method and conditions to obtain reproducible and comparable sound reduction indices of all kinds of rail bound vehicles' gangway systems defined in EN 16286-1. The setup should include all components of the system mounted like this is done between two adjacent car bodies within the train, so that a person will be able to use the gangway system, consisting of e.g:

- the bridge system (footplate);
- side panels;
- flexible components (bellows);
- mounting systems;
- elements to couple parts in case of separable gangway systems.

If separable gangway systems shall be measured, the whole system between two adjacent car bodies should be used.

The method is applicable to type testing of gangways.

This method is not applicable to:

- interior noise measurements in vehicles;
- structure borne noise measurements.

The type testing procedures specified in this European Standard are of engineering grade (grade 2) in the frequency range from 100 Hz up to 5 kHz; that is the preferred range for noise declaration purposes, as defined in EN ISO 12001. If test conditions are relaxed, the results are no longer of engineering grade.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ENV 13005, *Guide to the expression of uncertainty in measurement*

EN 60942, *Electroacoustics — Sound calibrators (IEC 60942)*

EN 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications (IEC 61672-1)*

EN 61672-2, *Electroacoustics — Sound level meters — Part 2: Pattern evaluation tests (IEC 61672-2)*

EN ISO 266, *Acoustics — Preferred frequencies (ISO 266)*

EN ISO 3741, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms (ISO 3741)*

EN ISO 9614-1:2009, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1: Measurement at discrete points (ISO 9614-1:1993)*

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

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EN ISO 10140-4:2010, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 4: Measurement procedures and requirements (ISO 10140-4:2010)*

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

EN ISO 15186-1, *Acoustics — Measurement of sound insulation in buildings and of building elements using sound intensity — Part 1: Laboratory measurements (ISO 15186-1)*

3 Terms and definitions

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

3.1**sound pressure**

p

root mean square (RMS) value of a fluctuating pressure superimposed on the static atmospheric pressure measured over a certain time period, expressed in Pa

3.2**sound pressure level**

L_p

level given by the formula:

$$L_p = 10 \log (p/p_0)^2 \text{ dB} \quad \text{iTeh STANDARD PREVIEW} \quad (1)$$

where

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L_p is the sound pressure level in dB;

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p is the RMS sound pressure in Pa; <https://standards.iteh.ai/catalog/standards/sist/0049862f-045d-42e3-9823-1ac65d2c474a/sist-en-16286-2-2013>

p_0 the reference sound pressure; $p_0 = 20 \mu\text{Pa}$

Note 1 to entry Adapted from ISO 1996-1.

3.3**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, 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 to entry This quantity is given in decibels.

Note 2 to entry For a complete definition, see EN ISO 10140-2.

3.4**sound reduction index**

R

ten times the logarithm to the base 10 of the ratio of the sound power W_1 incident on the test specimen to the sound power W_2 transmitted through the specimen:

$$R = 10 \log \left(\frac{W_1}{W_2} \right) \text{ dB} \quad (2)$$

Note 1 to entry The expression "sound transmission loss" is also in use.

3.5 sound intensity

I

time-averaged rate of flow of sound energy per unit area oriented normal to the local particle velocity; this is a vectorial quantity which is equal to:

$$\bar{I} = \frac{1}{T} \int_0^T p(t) \times \bar{u}(t) \times dt \quad (3)$$

where

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

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

T is the averaging time, in seconds

Note 1 to entry Sound intensity is measured in watts per square meter.

3.6 normal sound intensity

I_n

component of the sound intensity in the direction normal to a measurement surface defined by the unit normal vector \vec{n} :

$$I_n = \bar{I} \times \vec{n} \quad (4)$$

where

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

3.7 normal sound intensity level

L_{In}

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:

$$L_{In} = 10 \log \frac{I_n}{I_0} \text{ dB} \quad (5)$$

where

$$I_0 = 10^{-12} \text{ W/m}^2 \quad (6)$$

3.8 surface pressure-intensity indicator

F_{pl}

difference between the sound pressure level, L_p , and the normal sound intensity level, L_{In} , on the measurement surface, both being time and surface averaged:

$$F_{pl} = L_p - L_{In} \quad (7)$$

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Note 1 to entry This notation is in accordance with EN ISO 9614-2. In EN ISO 9614-1, the notation F_2 is used.

3.9 pressure-residual intensity index

δ_{pI0}
difference 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

Note 1 to entry δ_{pI0} is expressed in decibels.

Note 2 to entry Details for determining δ_{pI0} are given in EN 61043:

$$\delta_{pI0} = (L_p - L_I)$$

3.10 intensity sound reduction index of a gangway

R_{IG}
index evaluated from Formula (2), assuming that the sound field in the source room is diffuse:

$$R_{IG} = L_{p1} + \Delta L_c - 6 - L_{In} - 10 \log\left(\frac{S_m}{S}\right) \text{ (in dB)} \quad (8)$$

where

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

ΔL_c is the indicator for the diffusivity of the sound field according to Annex A of this standard;

L_{In} is the average sound intensity level over the measurement surface in the receiving room;

S_m is the total area of the measurement surface(s);

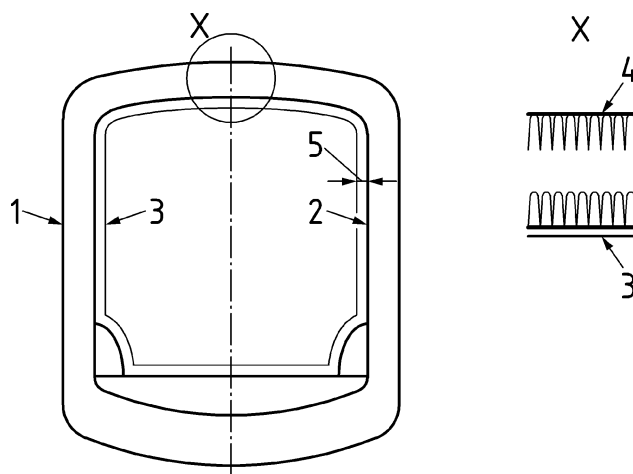
S is the inner respectively outer contour area of the test specimen at the source side (compare Figure 1 and Figure 2)

3.11 source side area of the test specimen

S
contour area of the test specimen at the source side

3.12 measurement surface

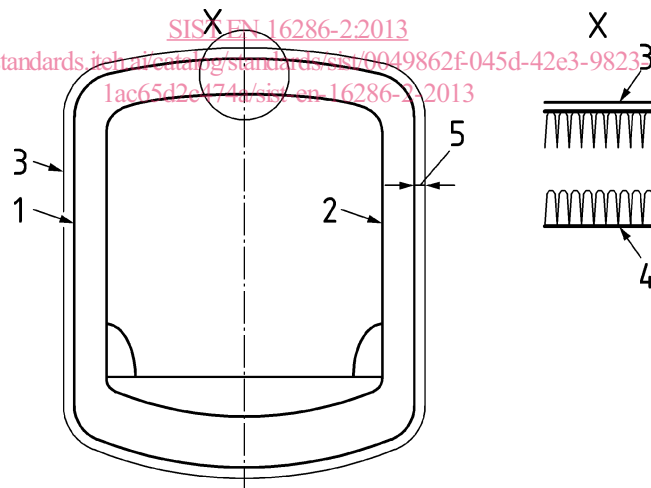
S_m
surface in parallel to the bellow contour totally enclosing the test specimen on the receiving side, scanned or sampled by the probe during the measurements

**Key**

- 1 bellow at source side
- 2 bellow at receiving side
- 3 measurement surface S_m
- 4 contour area of the test specimen at the source side S
- 5 distance d between contour area of the receiving side and the measurement surface S_m

Figure 1 — Measurement surface S_m for intensity measurements inside the gangway and contour area of the outer source side S

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**Key**

- 1 bellow at receiving side
- 2 bellow at source side
- 3 measurement surface S_m
- 4 contour area of the test specimen at the source side S
- 5 distance d between contour area of the receiving side and the measurement surface S_m

Figure 2 — Measurement surface S_m for intensity measurements outside the gangway and contour area of the inner source side S