SIST

SLOVENSKI STANDARD
SIST EN 16272-6:2024

01-februar-2024

Železniške naprave - Infrastruktura - Protihrupne ovire in pripadajoče naprave, ki vplivajo na širjenje zvoka v zraku - Preskusna metoda za ugotavljanje akustičnih lastnosti - 6. del: Posebne karakteristike - Izolacija zvoka v zraku pri usmerjenem zvočnem polju

Railway applications - Infrastructure - Noise barriers and related devices acting on airborne sound propagation - Test method for determining the acoustic performance - Part 6: Intrinsic characteristics - Airborne sound insulation under direct sound field conditions

Bahnanwendungen - Oberbau - Lärmschutzwände und verwandte Vorrichtungen zur Beeinflussung der Luftschallausbreitung - Prüfverfahren zur Bestimmung der akustischen Eigenschaften - Teil 6: Produktspezifische Merkmale - In-situ-Werte zur Luftschalldämmung in gerichteten Schallfeldern

Applications ferroviaires - Infrastructure - Dispositifs de réduction du bruit - Méthode d'essai pour la détermination des performances acoustiques - Partie 6 : Caractéristiques intrinsèques - Isolation aux bruits aériens dans des conditions de champ acoustique direct

Ta slovenski standard je istoveten z: **EN 16272-6:2023**

ICS:

17.140.30	Emisija hrupa transportnih sredstev	Noise emitted by means of transport
93.100	Gradnja železnic	Construction of railways

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EUROPEAN STANDARD
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English Version

Railway applications - Infrastructure - Noise barriers and related devices acting on airborne sound propagation - Test method for determining the acoustic performance - Part 6: Intrinsic characteristics - Airborne sound insulation under direct sound field conditions

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This European Standard was approved by CEN on 8 October 2023.

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European foreword

This document (EN 16272-6:2023) 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of an identical text or by endorsement, at the latest by May 2024 and conflicting national standards shall be withdrawn at the latest by May 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 16272-6:2014.

With respect to the superseded document, the following changes have been made:

— The scanning technique is based on a nine-microphone grid; the use of a single microphone displaced in nine positions has been abandoned.

— A detailed annex on the relationship between low-frequency limit and window width has been added (Annex A).

— The way to evaluate the uncertainty of the measurement method has been improved, basing on reproducibility data from the European project QUIESST (Annex B).

— A detailed example is given, including the evaluation of measurement uncertainty (Annex C).

— a new annex on indoor measurements has been added (Annex D);

EN 16272-6 is part of a series and should be read in conjunction with the other parts. All parts are listed below:

EN 16272-1, *Railway applications — Infrastructure — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 1: Intrinsic characteristics - Sound absorption under diffuse sound field conditions*

EN 16272-2, *Railway applications — Infrastructure — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 2: Intrinsic characteristics - Airborne sound insulation under diffuse sound field conditions* (the present document)

EN 16272-3-1, *Railway applications — Infrastructure — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 3-1: Normalized railway noise spectrum and single number ratings for diffuse sound field applications*

EN 16272-3-2, *Railway applications — Infrastructure — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 3-2: Normalized railway noise spectrum and single number ratings for direct sound field applications*

EN 16272-4, *Railway applications — Track — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 4: Intrinsic characteristics - In situ values of sound diffraction under direct sound field conditions*

EN 16272-5, *Railway applications — Infrastructure — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 5: Intrinsic characteristics - Sound absorption under direct sound field conditions*

EN 16272-6, *Railway applications — Infrastructure — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 6: Intrinsic characteristics - Airborne sound insulation under direct sound field conditions*

CEN/TS 16272-7, *Railway applications — Track — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance — Part 7: Extrinsic characteristics - In situ values of insertion loss*

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

Noise barriers and related devices acting on airborne sound propagation alongside railways should provide adequate sound insulation so that sound transmitted through the device is not significant compared with the sound diffracted over the top. This document specifies a test method for assessing the intrinsic airborne sound insulation performance for noise barriers and related devices designed for railways in non-reverberant conditions. It can be applied indoors or outdoors. Indoors, it can be applied in a purposely built test facilities, e.g. inside a laboratory. Outdoors, it can be applied in a purposely built test facilities, e.g. near a laboratory or a factory, as well as *in situ*, i.e. where the noise barriers and related devices are installed. The method can be applied without damaging the surface of the noise barriers and related devices.

The method can be used to qualify products to be installed along railways as well as to verify the compliance of installed noise barriers and related devices to design specifications. Regular application of the method can be used to verify the long-term performance of noise barriers and related devices.

The method requires the averaging of results of measurements taken at different points behind the device under test. The method is able to investigate flat and non-flat products.

The method uses the same principles and equipment for measuring sound reflection (see EN 16272-5) and airborne sound insulation (the present document).

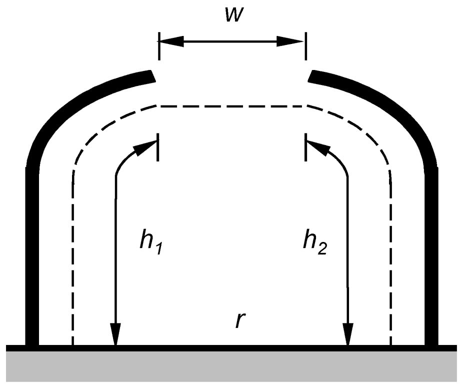
The measurement results of this method for airborne sound insulation are comparable but not identical with the results of the EN 16272-2 method, mainly because the present method uses a directional sound field, while the EN 16272-2 method assumes a diffuse sound field (where all angles of incidence are equally probable). Research studies suggest that good correlation exists between laboratory data, measured according to EN 16272-2 and field data, measured according to the method specified in the present document [4-9], [17-18].

The test method specified in this document should not be used to determine the intrinsic characteristics of airborne sound insulation for noise barriers and related devices to be installed in reverberant conditions, e.g. inside tunnels or deep trenches or under covers.

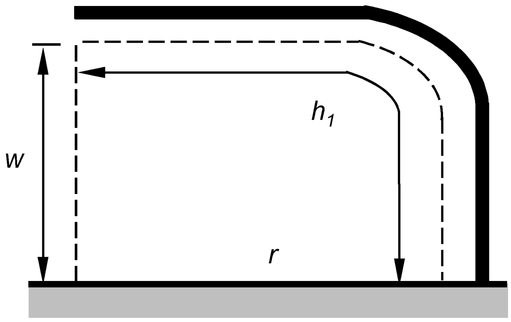
For the purpose of this document, reverberant conditions are defined based on the geometric envelope, *e*, across the road formed by the barriers, trench sides or buildings (the envelope does not include the road surface) as shown by the dashed lines in Figure 1. Conditions are defined as being reverberant when the percentage of open space in the envelope is less than or equal to 25 %, i.e. reverberant conditions occur when $w/e \leq 0{,}25$, where $e = (w+h_1+h_2)$.

This document introduces a specific quantity, called sound insulation index, to define the airborne sound insulation of noise barriers and related devices. This quantity should not be confused with the sound reduction index used in building acoustics, sometimes also called transmission loss.

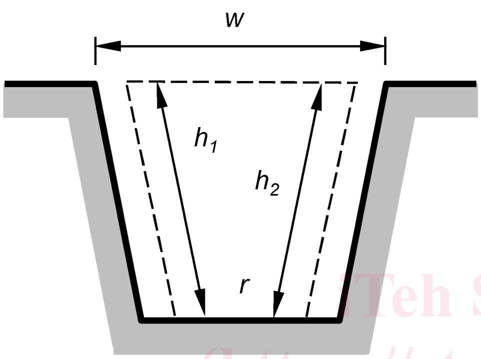
This method may be used to qualify noise barriers and related devices acting on airborne sound propagation for other applications, e.g. to be installed nearby industrial sites. In this case the single-number ratings (see EN 16272-3-2) should be calculated using an appropriate spectrum.



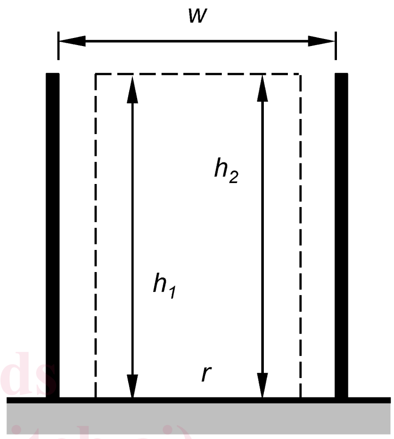
a) Partial cover on both sides of the railway; envelope, $e = w+h_1+h_2$



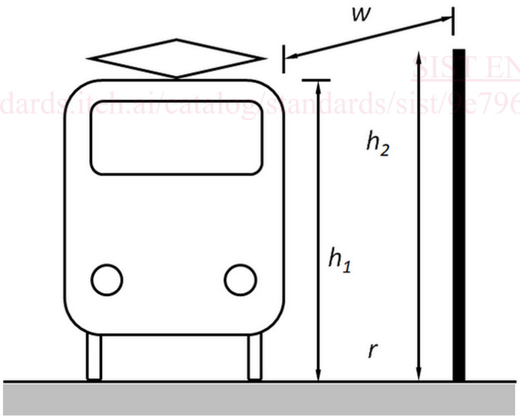
b) Partial cover on one side of the railway; envelope, $e = w+h_1$, $h_2 = 0$



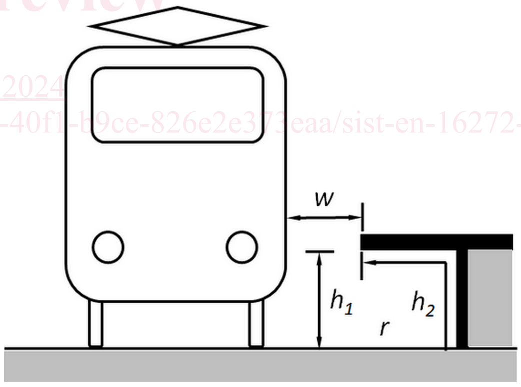
c) Deep trench; envelope, $e = w+h_1+h_2$



d) Tall barriers or buildings; envelope, $e = w+h_1+h_2$



e) Train passing close to a noise barrier; envelope, $e = w+h_1+h_2$



f) Train passing close to a platform at the station. envelope, $e = w+h_1+h_2$

Key

r	rail surface
w	width of open space
h_1	developed length of element, e.g. cover, trench side, barrier or building
h_2	developed length of element, e.g. cover, trench side, barrier or building
NOTE	Figure 1 is not to scale.

Figure 1 — Sketch of the reverberant condition check in some cases

1 Scope

This document describes a test method for measuring a quantity representative of the intrinsic characteristics of airborne sound insulation for rail noise barriers and related devices: the sound insulation index.

The test method is intended for the following applications:

— determination of the intrinsic characteristics of airborne sound insulation of noise barriers and related devices to be installed along railways, to be measured either on typical installations alongside railways or in laboratory conditions;

— determination of the intrinsic characteristics of airborne sound insulation of noise barriers and related devices in actual use;

— comparison of design specifications with actual performance data after the completion of the construction work;

— verification of the long-term performance of noise barriers and related devices (with a repeated application of the method);

— interactive design process of new products, including the formulation of installation manuals.

The test method is not intended for the determination of the intrinsic characteristics of airborne sound insulation of noise barriers and related devices to be installed in reverberant conditions, e.g. inside tunnels or deep trenches or under covers.

Results are expressed as a function of frequency in one-third octave bands, where possible, between 100 Hz and 5 kHz. If it is not possible to get valid measurement results over the whole frequency range indicated, the results need to be given in a restricted frequency range and the reasons for the restriction(s) need to be clearly reported.

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 16272-3-2, *Railway applications – Infrastructure – Noise barriers and related devices acting on airborne sound propagation – Test method for determining the acoustic performance – Part 3-2: Normalized railway noise spectrum and single number ratings for direct sound field applications*

EN 16951-1, *Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Procedures for assessing long term performance - Part 1: Acoustic characteristics*

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

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms, definitions, symbols and abbreviations

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

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

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp/

NOTE For the purpose of this document, the following definitions take precedence over other definitions from the above websites.

3.1 Terms and definitions

3.1.1
noise barrier
noise reducing device, which obstructs the direct transmission of airborne sound emanating from railways and which will typically span between posts and also may overhang the railway

Note 1 to entry: Noise barriers are generally made of acoustic and structural elements (see 3.1.3 and 3.1.4).

3.1.2
cladding
noise reducing device, which is attached to a wall or other structure and reduces the amount of sound reflected

Note 1 to entry: Claddings are generally made of acoustic and structural elements (see 3.1.3 and 3.1.4).

3.1.3
acoustic element
element whose primary function is to provide the acoustic performance of the device

3.1.4
structural element
element whose primary function is to support or hold in place acoustic elements

3.1.5
added device
added component that influences the acoustic performance of the original noise-reducing device (acting primarily on the diffracted energy)

Note 1 to entry: In some noise barriers, the acoustic function and the structural function cannot be clearly separated and attributed to different components.

3.1.6
railway side exposure
use of the product as a noise reducing device installed alongside railways

3.1.7
sound insulation index
quantity representing the amount of sound transmitted through the device under test, specified by Formula (1)

Note 1 to entry: This is the result of an airborne sound insulation test according to the present document.

3.1.8
reference height

height h_S equal to half the height, h_B, of the noise barrier or related device under test: $h_S = h_B/2$

Note 1 to entry: See Figures 2, 4, 6, 7 and 8.

Note 2 to entry: When the height of the device under test is greater than 4 m and, for practical reasons, it is not advisable to have a height of the source $h_S = h_B/2$, it is possible to have h_S = 2 m, accepting the corresponding low frequency limitation (see 4.5.7).

3.1.9
source reference surface for sound insulation index measurements

ideal, smooth surface facing the sound source side of the noise barrier or related device under test and just touching the most protruding and significant parts of it within the tested area

Note 1 to entry: The reference surface is as smooth as possible, and follows the inclination or curve of the device under test within the tested area. For vertical and flat noise barriers and related devices, the reference surface is a vertical plane. For inclined and flat noise barriers and related devices, the reference surface is a plane with the same inclination. For curve and flat noise barriers and related devices, the reference surface is a curve surface with the same curvature.

Note 2 to entry: See Figures 2, 7 and 8.

Note 3 to entry: The device under test includes both structural and acoustic elements.

3.1.10
microphone reference surface

ideal, smooth surface facing the receiver side of the noise barrier or related device under test and just touching the most protruding and significant parts of it within the tested area

Note 1 to entry: The reference surface is as smooth as possible, and follows the inclination or curve of the device under test within the tested area. For vertical and flat noise barriers and related devices, the reference surface is a vertical plane. For inclined and flat noise barriers and related devices, the reference surface is a plane with the same inclination. For curve and flat noise barriers and related devices, the reference surface is a curve surface with the same curvature.

Note 2 to entry: See Figures 2, 7 and 8.

Note 3 to entry: The device under test includes both structural and acoustic elements.

3.1.11
source reference position

position facing the side to be exposed to noise when the device is in place, located at the reference height h_S and placed so that its horizontal distance to the source reference surface is d_s = 1 m

Note 1 to entry: See Figures 2, 4, 6, 7 and 8.

Note 2 to entry: The actual dimensions of the loudspeaker used for the background research on which this document is based are: 0,40 m × 0,285 m × 0,285 m (length × width × height).

3.1.12
measurement grid for sound insulation index measurements
measurement grid constituted of nine equally spaced microphones in a 3x3 squared configuration

Note 1 to entry: The orthogonal spacing between two subsequent microphones, either vertically or horizontally, is s = 0,40 m.

Note 2 to entry: See Figures 2, 3, 4, 6, 7, 8 and 4.5.4.

3.1.13
measurement grid reference position
position facing the receiver side of the device under test, located at the reference height h_S and placed so that its horizontal distance to the microphone reference surface is d_M = 0,25 m

Note 1 to entry: See Figures 2, 6, 7 and 8.

3.1.14
barrier thickness for sound insulation index measurements
distance t_B between the source reference surface and the microphone reference surface at a height equal to the reference height h_S

Note 1 to entry: See Figures 2, 6, 7 and 8.

3.1.15
free-field measurement for sound insulation index measurements
measurement taken with the loudspeaker and the microphone in an acoustic free field in order to avoid reflections from any nearby object, including the ground, keeping the same geometry as when measuring across the noise reducing device under test

Note 1 to entry: See Figure 6.

3.1.16
Adrienne temporal window
composite temporal window having a leading edge with a left-half Blackman-Harris shape and a fixed length of 0,5 ms, followed by a flat portion and a trailing edge having a right-half Blackman-Harris shape, so that the lengths of the flat portion and the right-half Blackman-Harris portion have a ratio of 7/3

Note 1 to entry: This type of window is specified in 4.5.5.

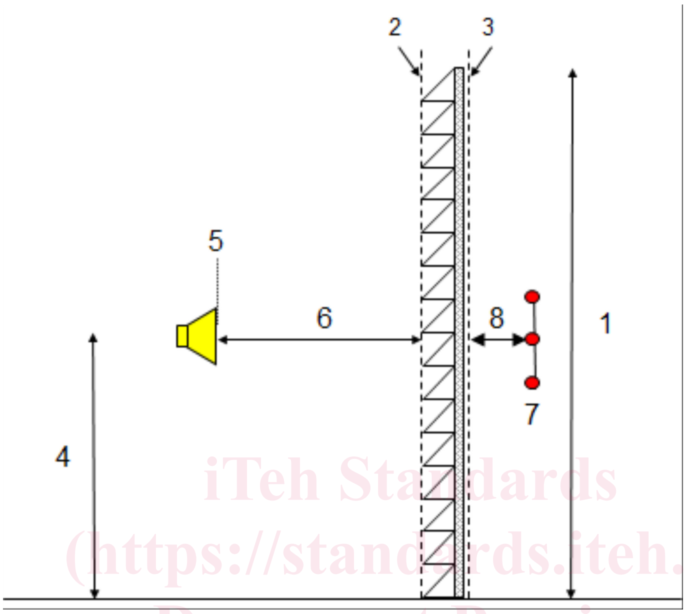
3.1.17
background noise
noise coming from sources other than the source emitting the test signal

3.1.18
signal-to-noise ratio
difference in decibels between the level of the test signal and the level of the background noise at the moment of detection of the test signal (within the Adrienne temporal window)

3.1.19
impulse response
time signal at the output of a system when a Dirac function is applied to the input

Note 1 to entry: The Dirac function, also called δ function, is the mathematical idealisation of a signal that is infinitely short in time which carries a unit amount of energy.

Note 2 to entry: It is impossible in practice to create and radiate true Dirac delta functions. Short transient sounds can offer close enough approximations but are not very repeatable. An alternative measurement technique, generally more accurate, is to use a period of deterministic, flat-spectrum signal, like maximum-length sequence (MLS) or exponential sine sweep (ESS), and transform the measured response back to an impulse response.



Key

1 noise barrier or related device height, h_B [m]
2 source reference surface
3 microphone reference surface
4 reference height, h_S [m]
5 loudspeaker front panel
6 distance between the loudspeaker front panel and source reference surface, d_S [m]
7 microphone grid
8 distance between the microphone grid and the microphone reference surface [m]

Figure 2 — (not to scale) Sketch of the loudspeaker and the microphone grid close to the noise barrier or related device under test for sound insulation index measurements