SLOVENSKI STANDARD
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Protihrupne ovire za cestni promet - Preskusna metoda za ugotavljanje akustičnih lastnosti - 6. del: Bistvene karakteristike - Terenske vrednosti izolirnosti pred zvokom v zraku pri usmerjenem zvočnem polju

Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 6: Intrinsic characteristics - In situ values of airborne sound insulation under direct sound field conditions

Lärmschutzvorrichtungen an Straßen - Prüfverfahren zur Bestimmung der akustischen Eigenschaften - Teil 6: Produktspezifische Merkmale - In-situ-Werte der Luftschalldämmung in gerichteten Schallfeldern

Dispositifs de réduction du bruit du trafic routier - Méthode d'essai pour la détermination de la performance acoustique - Partie 6 : Caractéristiques intrinsèques - Valeurs in situ d'isolation aux bruits aériens dans des conditions de champ acoustique di

Ta slovenski standard je istoveten z: **prEN 1793-6**

ICS:

17.140.30	Emisija hrupa transportnih sredstev	Noise emitted by means of transport
93.080.30	Cestna oprema in pomožne naprave	Road equipment and installations

oSIST prEN 1793-6:2023 **en,fr,de**

CEN/TC 226

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Secretariat: AFNOR

Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 6: Intrinsic characteristics - Airborne sound insulation under direct sound field conditions

Lärmschutzvorrichtungen an Straßen — Prüfverfahren zur Bestimmung der akustischen Eigenschaften — Teil 6: Produktspezifische Merkmale — Luftschalldämmung in gerichteten Schallfeldern

Dispositifs de réduction du bruit du trafic routier — Méthode d'essai pour la détermination de la performance acoustique — Partie 6 : Caractéristiques intrinsèques — Isolation au bruit aérien dans des conditions de champ acoustique direct

CCMC will prepare and attach the official title page.

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European foreword

This document (prEN 1793-6:2023) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1793-6:2018+A1:2021.

EN 1793-6:2023 includes the following significant technical changes with respect to EN 1793-6:2018+A1:2021:

- The definitions from 3.1 to 3.8 have been updated to be in accordance to the last version of EN 14388.
- The scanning technique is based on a nine-microphone grid; the use of a single microphone displaced in nine positions has been abandoned.
- The formula to calculate the global single-number rating $DL_{SI,G}$ used in the previous version of this document has been changed.
- The use of categories of single-number rating is no longer permitted.
- One value for the standard deviation of reproducibility and repeatability in each one-third octave frequency band has been retained, in place of three values (min, max and median) as before (see Tables B.1 and B.2).
- The example in C.5 on the declaration of the measurement uncertainty has been updated accordingly.

EN 1793-6:2023 is part of a series and should be read in conjunction with the following:

- EN 1793-1:2023, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 1: Intrinsic characteristics — Sound absorption under diffuse sound field conditions*;
- EN 1793-2:2023, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 2: Intrinsic characteristics — Airborne sound insulation under diffuse sound field conditions*;
- EN 1793 3:2023, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 3: Normalized traffic noise spectrum*;
- EN 1793-4:2023, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 4: Intrinsic characteristics — Intrinsic sound diffraction*;
- EN 1793-5:2023, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 5: Intrinsic characteristics — Sound absorption under direct sound field conditions*;

Introduction

Noise reducing devices alongside roads 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 reducing devices designed for roads 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 road traffic noise reducing devices are installed. The method can be applied without damaging the surface of the road traffic noise reducing device.

The method can be used to qualify products to be installed along roads as well as to verify the compliance of installed road traffic noise reducing devices to design specifications. Regular application of the method can be used to verify the long-term performance of road traffic noise reducing 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 1793-5:2023) and airborne sound insulation (the present document).

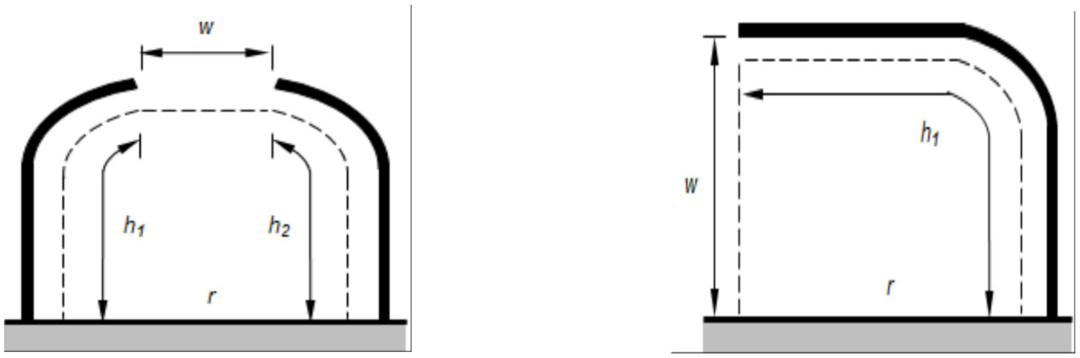
The measurement results of this method for airborne sound insulation are comparable but not identical with the results of EN 1793-2:2023 method, mainly because the present method uses a directional sound field, while EN 1793-2:2023 method assumes a diffuse sound field (where all angles of incidence are equally probable). Research studies suggest that good correlation exists between laboratory data, measured according to EN 1793-2:2023 and field data, measured according to the method described in the present document [4-9].

The test method described in this Document should not be used to determine the intrinsic characteristics of airborne sound insulation for road traffic noise reducing 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 a road traffic noise reducing device. This quantity should not be confused with the sound reduction index used in building acoustics, sometimes also called transmission loss.

This method can be used to qualify noise reducing devices for other applications, e.g., to be installed nearby industrial sites. In this case, the single-number ratings can preferably be calculated using an appropriate spectrum.

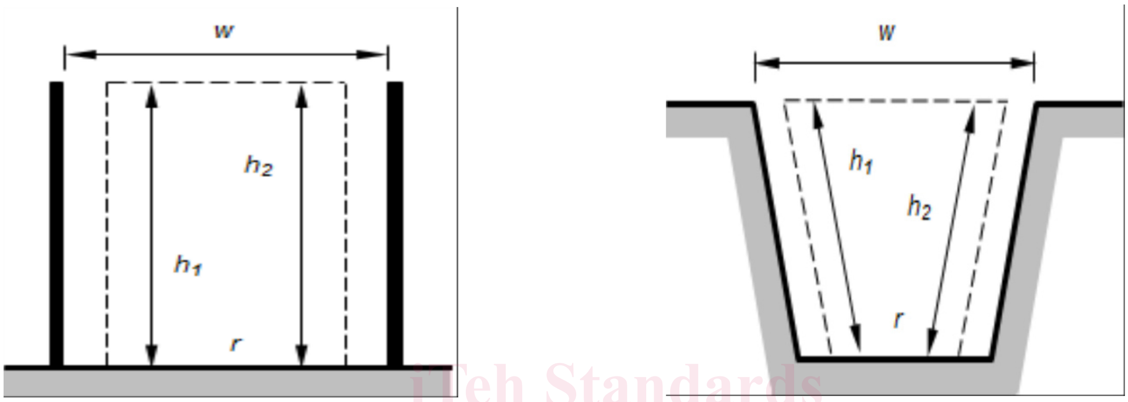


a) Partial cover on both sides of the road;

envelope, $e = w+h_1+h_2$

b) Partial cover on one side of the road;

envelope, $e = w+h_1$, $h_2 = 0$



c) Deep trench;

envelope, $e = w+h_1+h_2$

d) Tall barriers or buildings;

envelope, $e = w+h_1+h_2$

Key

r	road 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 four cases

1 Scope

This document describes a test method for measuring a quantity representative of the intrinsic characteristics of airborne sound insulation for road traffic noise reducing 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 reducing devices to be installed along roads, to be measured either on typical installations alongside roads or or in laboratory conditions;
- determination of the intrinsic characteristics of airborne sound insulation of road traffic noise reducing 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 road traffic noise reducing 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 road traffic noise reducing 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 1793-3:2023, *Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 3: Normalized traffic noise spectrum*

EN 14389:2023, *Road traffic noise reducing devices - Procedures for determining long-term performance*

EN 61672-1:2013, *Electroacoustics — Sound level meters — Part 1: Specifications (IEC 61672-1)*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement —Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

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:

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

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

3.1
road traffic noise reducing device
RTNRD
device designed to reduce the propagation of traffic noise away from the road environment

Note 1 to entry: An RTNRD can comprise acoustic elements (3.2) only or both structural (3.3) and acoustic elements.

Note 2 to entry: Applications of RTNRDs include noise barriers (3.6), claddings (3.6), covers (3.7) and added devices (3.8).

3.2
acoustic element
element whose primary function is to provide the acoustic performance of the device

3.3
structural element
element whose primary function is to support or hold in place the parts of the RTNRD

3.4
self-supporting acoustic element
acoustic element including its own structural element to support itself

3.5
noise barrier
road traffic noise reducing device which obstructs the direct transmission of airborne sound emanating from road traffic

3.6
cladding
road traffic noise reducing device which is attached to a wall or other structure and reduces the amount of sound reflected

3.7
cover
road traffic noise reducing device which either spans or overhangs the road

3.8
added device
additional component that influences the acoustic performance of the original road traffic noise reducing device

Note 1 to entry: The added device is acting primarily on the diffracted energy.

3.9
sound insulation index
quantity representing the amount of sound transmitted through the device under test

Note 1 to entry: Formula (1) specifies how to calculate the sound insulation index

Note 2 to entry: The sound insulation index values in one-third octave bands are the result of a test according to the present document

3.10
reference height

height h_S equal to half the height, h_B, of the road traffic noise reducing 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 5.5.7).

3.11
source reference surface for sound insulation index measurements

ideal, smooth surface facing the sound source side of the road traffic noise reducing 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 road traffic noise reducing devices, the reference surface is a vertical plane. For inclined and flat road traffic noise reducing devices, the reference surface is a plane with the same inclination. For curve and flat road traffic noise reducing devices, the reference surface is a curve surface with the same curvature.

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

3.12
microphone reference surface

ideal, smooth surface facing the receiver side of the road traffic noise reducing 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 road traffic noise reducing devices, the reference surface is a vertical plane. For inclined and flat road traffic noise reducing devices, the reference surface is a plane with the same inclination. For curve and flat road traffic noise reducing devices, the reference surface is a curve surface with the same curvature.

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

3.13
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 x 0,285 m x 0,285 m (length x width x height).

3.14
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.

3.15
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

3.16
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

3.17
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 (see Figure 6)

3.18
Adrienne temporal window

Analysis window in the time domain to be used for the data processing

Note 1 to entry: Processing in accordance with this document

Note 1 to entry: The Adrienne temporal window is described in 5.5.5

3.19
background noise

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

3.20
signal-to-noise ratio, S/N

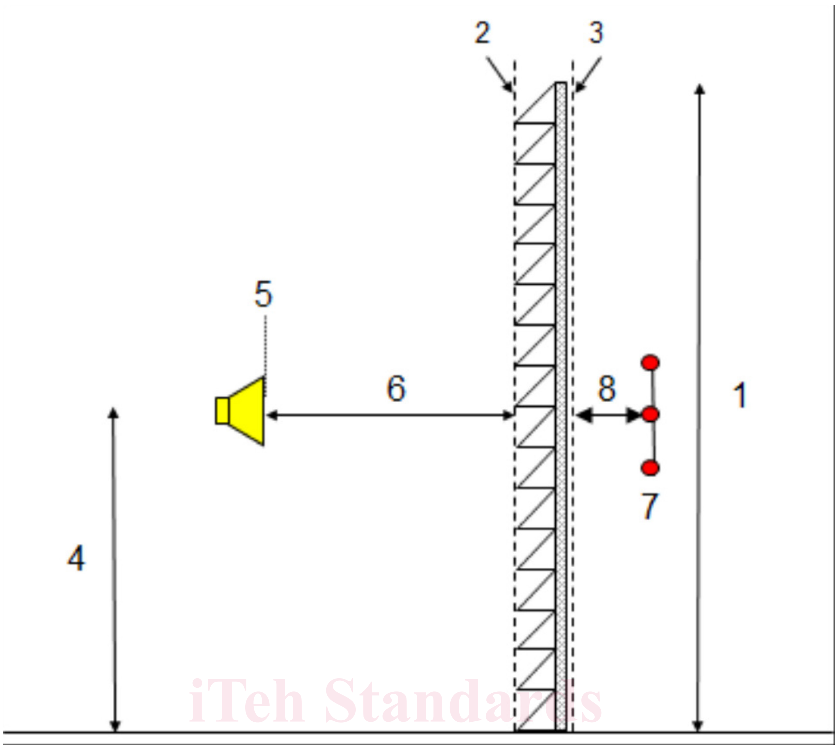
difference in decibels between the level of the test signal and the level of the background noise at the moment of detection of the test signal (within the Adrienne temporal window)

3.21
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.

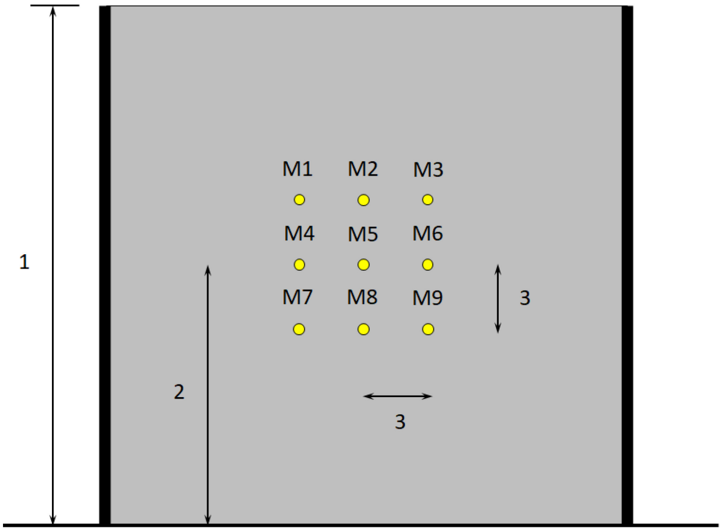
Note 2 to entry: It is impossible in practice to create and radiate true Dirac delta functions. Short transient sounds can offer close enough approximations but are not very repeatable. An alternative measurement technique, generally more accurate, is to use a period of deterministic, flat-spectrum signal,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



Key

1	road traffic noise reducing device height, h_B [m]	5	loudspeaker front panel
2	source reference surface	6	distance between the loudspeaker front panel and source reference surface, d_S [m]
3	microphone reference surface	7	microphone grid
4	reference height, h_s [m]	8	distance between the microphone grid and the microphone reference surface [m]

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



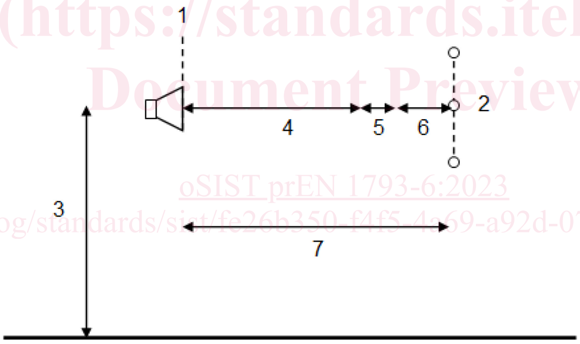
Key

1 Road traffic noise reducing device height h_B [m]

2 Reference height h_S [m]

3 Orthogonal spacing between two subsequent microphones s [m

Figure 3 — (not to scale) Measurement grid for sound insulation index measurements in front of the device under test (receiver side); the yellow circles indicate the microphone positions, labelled from M1 to M9



Key

1 loudspeaker front panel

2 measurement grid

3 reference height h_S [m]

4 horizontal distance loudspeaker - source reference surface d_S at height h_S [m]

5 Road traffic noise reducing device thickness t_B at height h_S [m]

6 horizontal distance microphone 5 - microphone reference surface d_M at height h_S [m]

7 Horizontal distance loudspeaker - microphone 5 d_T at height h_S [m]

Note: $d_T = d_S + t_B + d_M$; see Formula (5).

Figure 4 — (not to scale) Sketch of the set-up for the reference “free-field” sound measurement for the determination of the sound insulation index