SIST

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Protihrupne ovire za cestni promet - Preskusna metoda za ugotavljanje akustičnih lastnosti - 5. del: Bistvene lastnosti - Terenske vrednosti odboja zvoka z uporabo usmerjenega zvočnega polja

Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 5: Intrinsic characteristics - In situ values of sound reflection under direct sound field conditions

Lärmschutzvorrichtungen an Straßen - Prüfverfahren zur Bestimmung der akustischen Eigenschaften - Teil 5: Produktspezifische Merkmale - In-situ-Werte der Schallreflexion in gerichteten Schallfeldern

Dispositifs de réduction du bruit du trafic routier - Méthode d'essai pour la détermination de la performance acoustique - Partie 5: Caractéristiques intrinsèques - Valeurs in situ de réflexion acoustique dans des conditions de champ acoustique direct

Ta slovenski standard je istoveten z: **EN 1793-5:2016**

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

SIST EN 1793-5:2016 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 1793-5

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ICS 17.140.30; 93.080.30

Supersedes CEN/TS 1793-5:2003

English Version

Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 5: Intrinsic characteristics - In situ values of sound reflection under direct sound field conditions

Dispositifs de réduction du bruit du trafic routier - Méthode d'essai pour la détermination de la performance acoustique - Partie 5: Caractéristiques intrinsèques - Valeurs in situ de réflexion acoustique dans des conditions de champ acoustique direct

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

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Contents

European foreword

This document (EN 1793-5:2016) has been prepared under the direction of Technical Committee CEN/TC 226 “Road equipment”, by Working Group 6 “Anti-noise devices”, the secretariat of which is held by AFNOR.

This document supersedes CEN/TS 1793-5:2003.

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 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

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

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

— the rotating loudspeaker/microphone assembly has been replaced by a loudspeaker and a 9-microphone square array (the measurement grid);

— the definition of RI has been changed;

— the geometrical divergence correction factor has been changed;

— a new correction factor for sound source directivity has been introduced;

— a new correction factor for gain mismatch has been introduced;

— the impulse response alignment for signal subtraction has been described in more detail;

— the lowest reliable one-third frequency band has been better defined;

— the way to evaluate the uncertainty of the measurement method from reproducibility data has been introduced (Annex A);

— a detailed example is given (Annex B);

— information on the near-field to far-field relationship has been added (Annex C).

It should be read in conjunction with:

EN 1793-1, *Road traffic noise reducing devices - Test method for determining the acoustic performance – Part 1: Intrinsic characteristics of sound absorption under diffuse sound field conditions*

EN 1793-2, *Road traffic noise reducing devices - Test method for determining the acoustic performance – Part 2: Intrinsic characteristics of airborne sound insulation under diffuse sound field conditions*

EN 1793-3, *Road traffic noise reducing devices - Test method for determining the acoustic performance – Part 3: Normalized traffic noise spectrum*

EN 1793-4, *Road traffic noise reducing devices - Test method for determining the acoustic performance – Part 4: Intrinsic characteristics – In situ values of sound diffraction*

EN 1793-6, *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*

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document describes a test method for determining the intrinsic characteristics of sound reflection of noise reducing devices designed for roads in non-reverberant conditions (a measure of intrinsic performance). It can be applied *in situ*, i.e. where the noise reducing devices are installed. The method can be applied without damaging the surface.

The method can be used to qualify products to be installed along roads as well as to verify the compliance of installed noise reducing devices to design specifications. Regular application of the method can be used to verify the long term performance of noise reducing devices.

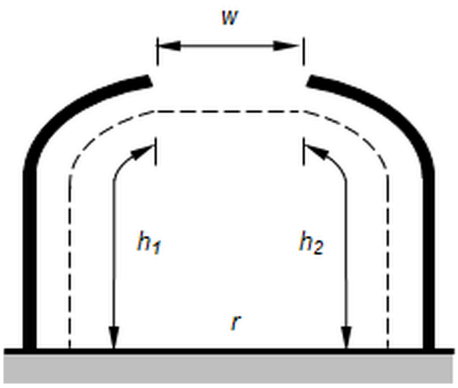
The method requires the average of results of measurements taken in different points in front of the device under test and/or for specific angles of incidences. The method is able to investigate flat and non-flat products.

The measurements results of this method for sound reflection are not directly comparable with the results of the laboratory method (e.g. EN 1793-1), mainly because the present method uses a directional sound field, while the laboratory method assumes a diffuse sound field. The test method described in the present document should not be used to determine the intrinsic characteristics of sound reflection of noise reducing devices to be installed in reverberant conditions, e.g. claddings inside tunnels or deep trenches.

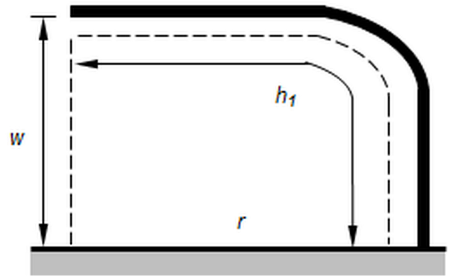
For the purpose of this document reverberant conditions are defined based on the envelope, e, across the road formed by the device under test, trench sides or buildings (the envelope does not include the road surface) as shown by the dashed lines in Figure 1. Conditions are defined as being reverberant 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 method introduces a specific quantity, called reflection index, to define the sound reflection in front of a noise reducing device, while the laboratory method gives a sound absorption coefficient. Laboratory values of the sound absorption coefficient can be converted to conventional values of a reflection coefficient taking the complement to one. In this case, research studies suggest that some correlation exists between laboratory data, measured according to EN 1793-1 and field data, measured according to the method described in the present document [7], [10], [20], [21].

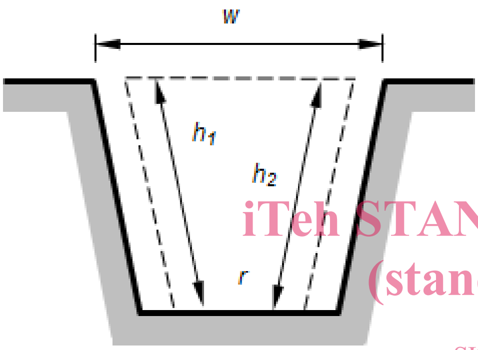
This method may be used to qualify noise reducing devices for other applications, e.g. to be installed nearby industrial sites. In this case the single-number ratings should be calculated using an appropriate spectrum.



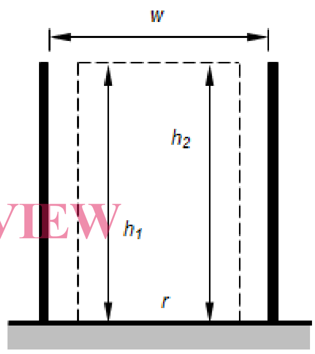
(a) Partial cover on both sides of the road; envelope, $e = w+h_1+h_2$.



(b) Partial cover on one side of the road; envelope, $e = w+h_1$.



(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

NOTE Figure 1 is not to scale.

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

1 Scope

This European Standard describes a test method for measuring a quantity representative of the intrinsic characteristics of sound reflection from road noise reducing devices: the reflection index.

The test method is intended for the following applications:

— determination of the intrinsic characteristics of sound reflection of noise reducing devices to be installed along roads, to be measured either on typical installations alongside roads or on a relevant sample section;

— determination of the *in situ* intrinsic characteristics of sound reflection of 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 noise reducing devices (with a repeated application of the method).

The test method is not intended for the following applications:

— determination of the intrinsic characteristics of sound reflection of noise reducing devices to be installed in reverberant conditions, e.g. inside tunnels or deep trenches.

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

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.

EN 1793-3, *Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 3: Normalized traffic noise spectrum*

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 and definitions

For the purposes of this document the following terms and definitions apply:

3.1

noise reducing device (NRD)

device that is designed to reduce the propagation of traffic noise away from the road environment. This may be a noise barrier, cladding, a road cover or an added device. These devices may include both acoustic and structural elements

3.2
noise barrier
noise reducing device, which obstructs the direct transmission of airborne sound emanating from road traffic

3.3
acoustic element
element whose primary function is to provide the acoustic performance of the device

3.4
structural element
element whose primary function is to support or hold in place acoustic elements

3.5
cladding
noise-reducing device, which is attached to a wall or other structure and reduces the amount of sound reflected

3.6
cover
noise-reducing device, which either spans or overhangs the highway

3.7
added device

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

3.8
roadside exposure

the use of the product as a noise reducing device installed alongside roads

3.9
sound reflection index
quantity, resulting from a sound reflection test, described by Formula (1)

3.10
measurement grid for sound reflection index measurements
vertical 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 Figure 3 and 5.6.

Note 3 to entry Microphones are numbered like in Figure 3.b.

3.11
reference height
height h_S equal to half the height, h_B, of the noise barrier under test: $h_S = h_B/2$

Note 1 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).

Note 2 to entry: See Figures 2 and 3.

3.12

(source and microphone) reference plane for sound reflection index measurements

plane facing the sound source side of the noise reducing device and touching the most protruding parts of the device under test within the tested area

Note 1 to entry See Figures 2 and 4.

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 the horizontal distance of the source front panel to the reference plane is d_S = 1,50 m

Note 1 to entry See Figures 2 and 4.

3.14

measurement grid reference position

position of the measurement grid compliant with all the following conditions: i) the measurement grid is vertical; ii) the measurement grid is on the noise reducing device side to be exposed to noise when the device is in place; iii) the central microphone (microphone n. 5) is located at the reference height h_S ; iv) the horizontal distance of the central microphone to the reference plane is d_M = 0,25 m; v) the line passing through the centre plate of the loudspeaker and the central microphone is horizontal

Note 1 to entry See Figures 2, 3 and 4.

3.15

reference loudspeaker-measurement grid distance

distance between the front panel of the loudspeaker and the central microphone (microphone n. 5) of the measurement grid (kept in vertical position)

Note 1 to entry The reference loudspeaker-measurement grid distance is equal to d_{SM} = 1,25 m (see Figures 2 and 4).

3.16

free-field measurement for sound reflection index measurements

measurement taken with the loudspeaker and the measurement grid in an acoustic free field in order to avoid reflections from any nearby object, including the ground, keeping the same geometry as when measuring in front of the noise reducing device under test

Note 1 to entry See Figure 5.

3.17

maximum sampled area

surface area, projected on a front view of the noise reducing device under test for reflection index measurements, which must remain free of reflecting objects causing parasitic reflections

3.18

Adrienne temporal window

composite temporal window described in 5.5.5

3.19

background noise

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

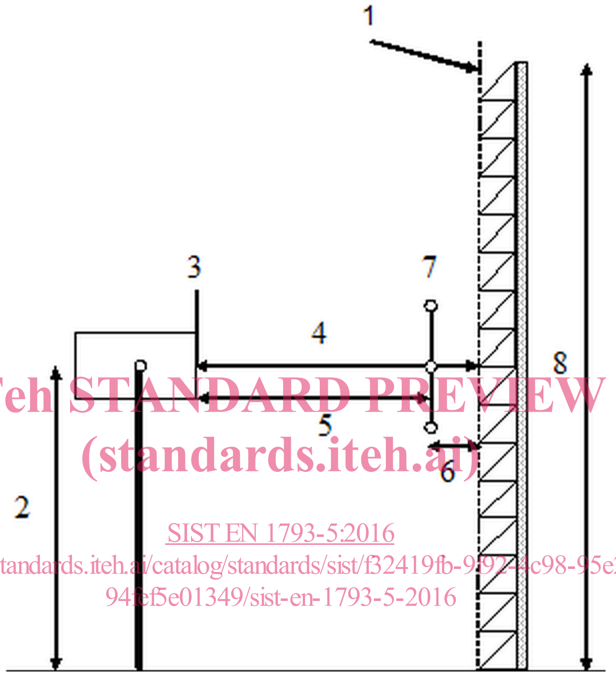
3.20

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 useful event (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. The Dirac function, also called δ function, is the mathematical idealisation of a signal infinitely short in time that carries a unit amount of energy

Note 1 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 Source and microphone reference plane

2 Reference height h_S [m]

3 Loudspeaker front panel

4 Distance between the loudspeaker front panel and the reference plane d_S [m]

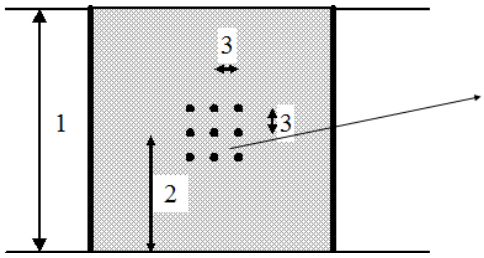
5 Distance between the loudspeaker front panel and the measurement grid d_{SM} [m]

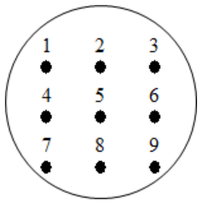
6 Distance between the measurement grid and the reference plane d_M [m]

7 Measurement grid

8 Noise reducing device height h_B [m]

Figure 2 — (not to scale) Sketch of the sound source and the measurement grid in front of the noise reducing device under test for sound reflection index measurements





Key

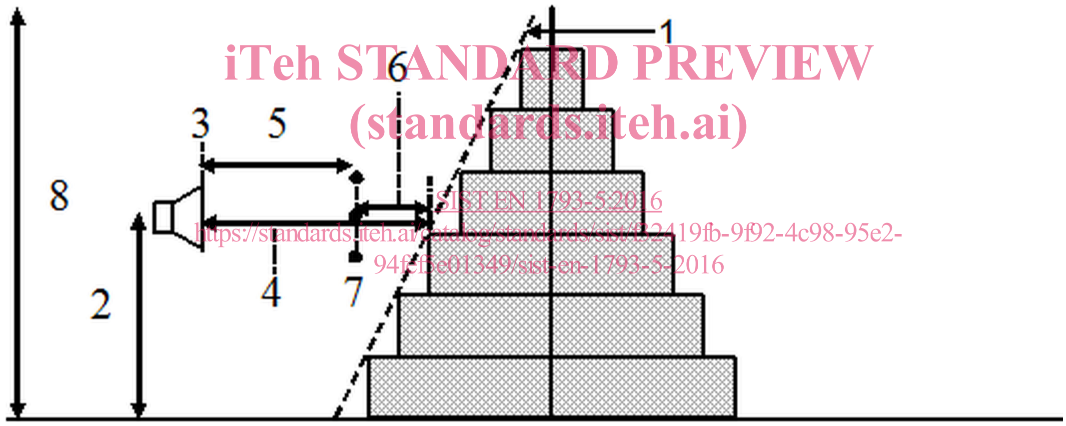
1 Noise reducing device height h_B [m]

2 Reference height h_S [m]

3 Orthogonal spacing between two subsequent microphones s [m]

Figure 3 (a) — (not to scale) Measurement grid for sound reflection index measurements (source side).

Figure 3 (b) — (not to scale) Numbering of the measurement points as seen from the sound source.



Key

1 Source and microphone reference plane

2 Reference height h_S [m]

3 Loudspeaker front panel

4 Distance between the loudspeaker front panel and the reference plane d_S [m]

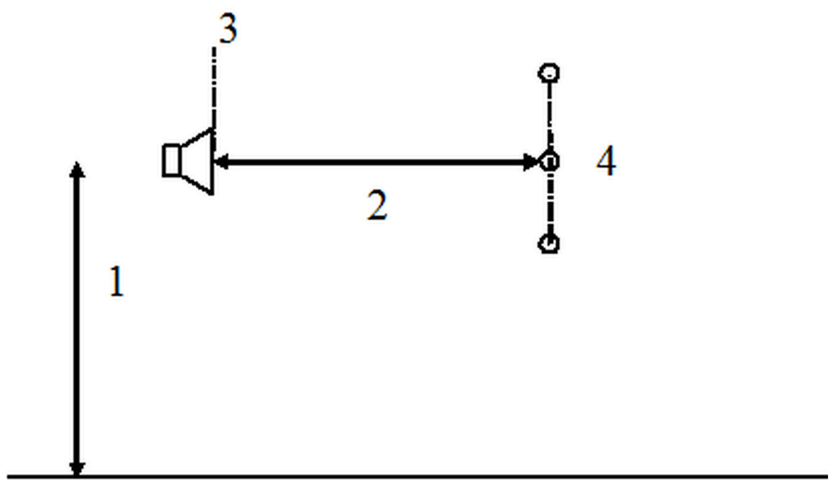
5 Distance between the loudspeaker front panel and the measurement grid d_{SM} [m]

6 Distance between the measurement grid and the reference plane d_M [m]

7 Measurement grid

8 Noise reducing device height h_B [m]

Figure 4 — (not to scale) Placement of the sound source and measurement grid for sound reflection index measurement for an inclined noise reducing device (side view)



Key

1 Reference height h_S [m]

2 Distance between the loudspeaker front panel and the measurement grid d_{SM} [m]

3 Loudspeaker front panel

4 Measurement grid

Figure 5 — (not to scale) Sketch of the set-up for the reference "free-field" sound measurement for the determination of the sound reflection index

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

Table 1 – Symbols and abbreviations

Symbol or abbreviation	Designation	Unit
a	major axis of the ellipsoid of revolution used to define the maximum sampled area at oblique incidence	m
a_0, a_1, a_2, a_3	Coefficient for the expression of the four-term full Blackman-Harris window	-
b_s	Depth of the surface structure of the sample under test	m
b_m	Width of a portion of material of the sample under test	m
c	Speed of sound in air	m/s
$C_{geo,k}$	Correction factor for the geometrical divergence	-
$C_{dir,k}$	Correction factor for the sound source directivity	-
$C_{gain,k}$	Correction factor for changes in the sound source gain	-
d_M	Horizontal distance from the source and microphone reference plane to the measurement grid; it is equal to d_M = 0,25 m	m
d_S	Horizontal distance from the front panel of the loudspeaker to the source and microphone reference plane; it is equal to: d_S = 1,50 m	m
d_{SM}	Horizontal distance from the front panel of the loudspeaker to the measurement grid; it is equal to: d_{SM} = 1,25 m	m
DL_{RI}	Single number rating of sound reflection	dB
δ_i	Any input quantity to allow for uncertainty estimates	-