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Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 5: Intrinsic characteristics - In situ values of sound reflection and airborne sound insulation

Lärmschutzeinrichtungen - Prüfverfahren für die Lärmmessung

Dispositifs de réduction du bruit du trafic routier - Méthode d'essai pour la détermination de la performance acoustique - Partie 5: Caractéristiques intrinseques - Valeurs in situ de réflexion acoustique et d'isolation aux bruits aériens

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ICS:

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93.080.30	Cestna oprema in pomožne naprave	Road equipment and installations

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English version

Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 5: Intrinsic characteristics - In situ values of sound reflection and airborne sound insulation

Lärmschutzeinrichtungen an Straßen - Prüfverfahren zur Bestimmung der akustichen Eigenschaften - Teil 5: Produktspezifische Merkmale - In-situ-Werte der Schallreflexion und der Luftschalldämmung

This Technical Specification (CEN/TS) was approved by CEN on 27 October 2002 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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Foreword

This document (CEN/TS 1793-5:2003) has been prepared by Technical Committee CEN/TC 284 “Road equipment”, the secretariat of which is held by AFNOR.

This Technical Specification has been prepared, under the direction of Technical Committee CEN/TC 226 “Road equipment”, by Working Group 6 “Anti noise devices”.

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*

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

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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to anounce this Technical Specification: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This document describes a test method for determining the intrinsic characteristics of sound reflection and airborne sound insulation of traffic noise reducing devices. 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 device 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 method uses the same principles and equipment for measuring sound reflection and airborne sound insulation.

The measurements results of this method for sound reflection are not directly comparable with the results of the laboratory method (EN 1793-1), mainly because the present method uses a directional sound field, while the laboratory method assumes a diffuse sound field. Moreover, 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 a quite good correlation exists between laboratory data, measured according to EN 1793-1 and field data, measured according to the method described in the present document.

The measurements results of this method for airborne sound insulation are comparable but not identical with the results of the laboratory method (EN 1793-2), mainly because the present method uses a directional sound field, while the laboratory method assumes a diffuse sound field. This method introduces a specific quantity, called sound insulation index, to define the airborne sound insulation of a noise reducing device. This quantity should not be confused with the sound reduction index used in building acoustics, sometimes also called transmission loss. Research studies suggest that a very good correlation exists between laboratory data, measured according to EN 1793-2, and field data, measured according to the method described in the present document.

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

1 Scope

The present document describes a test method for measuring two quantities representative of the intrinsic characteristics of traffic noise reducing devices : the reflection index for sound reflection and the sound insulation index for airborne sound insulation.

The test method is intended for the following applications :

— determination of the intrinsic characteristics of sound reflection and airborne sound insulation of noise reducing devices to be installed along roads, to be measured either in situ or in laboratory conditions ;

— determination of the in situ intrinsic characteristics of sound reflection and airborne sound insulation 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 can be applied both in situ and on barriers purposely built to be tested using the method described here. In the second case the sample shall be built as follows (see Figure 1) :

— a part, composed of acoustic elements, that extends 4 m and is 4 m high ;

— a post 4 m high (if applicable for the specific noise reducing device under test) ;

— a part, composed of acoustic elements, that extends at least 2 m and is 4 m high ;

NOTE For qualifying the reflection index only, it is only necessary to have acoustic elements that extend 4 m or more.

NOTE For qualifying the sound insulation index of posts only, it is only necessary to have acoustic elements that extend 2 m or more on either side of the post (see Figure 1).

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 shall be given in the restricted frequency range and the reasons of the restriction(s) shall be clearly reported.

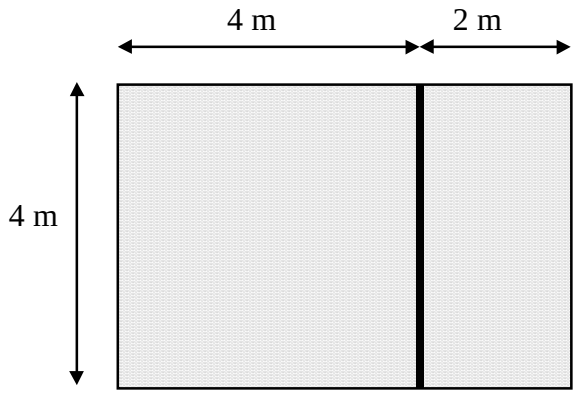


Figure 1 (a)

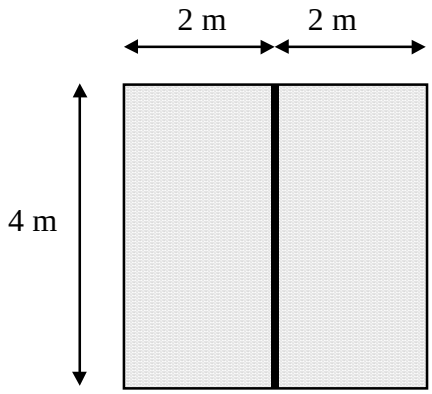


Figure 1 (b)

Figure 1 — Sketch of the sample required for measuremnts in laboratoy conditions - (a) : Reflection index and sound insulation index measurements (elements and posts) - (b) : sound insulation index measurements in front of a post only

2 Normative references

This Technical Specification incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this Technical Specification only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication applies (including amendments).

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

EN 60651, *Sound level meters.*

3 Terms and definitions

For the purposes of this Technical Specification the following terms and definitions apply.

3.1
structural elements
those elements whose primary function is to support or hold in place acoustic elements

3.2
acoustical elements
those elements whose primary function is to provide the acoustic performance of the device

3.3
roadside exposure
use of the product as a noise reducing device installed alongside roads

3.4
reflection index
result of a sound reflection test described by formula (1)

3.5
reference height
height h_S equal to half the height h_B of the noise reducing device under test : $h_S = h_B/2$ (see Figure 2)

3.6
reference axis of rotation-front panel distance for the loudspeaker
distance between the centre of rotation of the loudspeaker cabinet and its front panel ; it is equal to : d_{RS} = 0,15 m (see Figure 2)

NOTE The actual dimensions of the loudspeaker used for the background research on which this Technical Specification is based are : 0,40 x 0,285 x 0,285 m (length x width x height)

3.7
reference loudspeaker-microphone distance
distance between the front panel of the loudspeaker and the microphone ; it is equal to : d_{SM} = 1,25 m (see Figure 2)

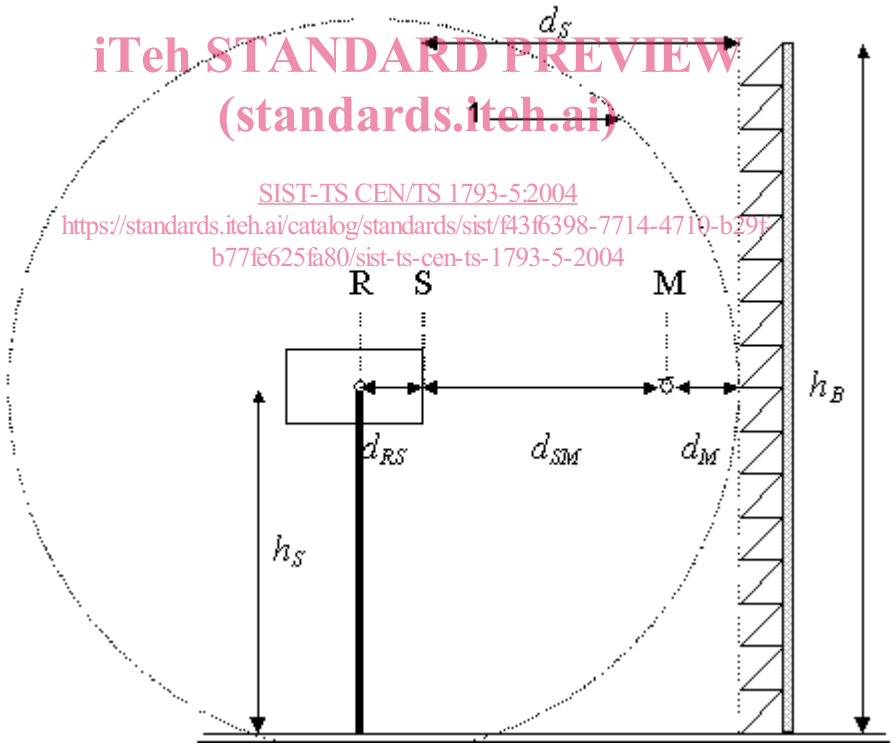
3.8
reference circle for reflection index measurements
circle of radius equal to 1,65 m (= $d_{RS} + d_{SM} + d_M$) with centre at the reference height, drawn so that is just touches the noise reducing device under test. The centre of the circle lies on the axis of rotation of the sound source (see Figure 2)

3.9
reference microphone position for reflection index measurements
point where the microphone is located when the loudspeaker-microphone assembly is horizontal normal to the noise reducing device under test at the reference height (see Figure 2) and as far as possible from the edges of the sample ; additional reference positions can be defined for non flat or non homogeneous samples (see 4.5.2.2 and 4.5.2.3)

3.10
rotation of the loudspeaker-microphone assembly
set of nine measurement positions, including the reference position, reached rotating the loudspeaker-microphone assembly, around the axis of rotation R (see Figure 2), on the same plane in steps of 10° (Figure 4.a, 5, 6)

3.11
free-field measurement for reflection index measurements
measurement taken moving and/or rotating the loudspeaker-microphone assembly in order to avoid to face any nearby object, including the ground (Figure 4.b)

3.12
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



1 Reference circle

Figure 2 — (not to scale) Sketch of the loudspeaker-microphone assembly in front of the noise reducing device under test for reflection index measurements - R : axis of rotation. S : loudspeaker front panel. M : microphone

3.13
sound insulation index
result of airborne sound insulation test described by formula (7)

3.14
measurement grid for sound insulation index measurements
vertical measurement grid constituted by nine equally spaced points. This measurement grid shall be squared, with a side length 2 *s* of 0,80 m. Its centre shall be located at the reference height. The grid shall be placed facing the

side of the noise reducing device under test opposite to the side to be exposed to noise when the device is in place, so that its horizontal distance to the closest point of the device is 0,25 m (see Figure 3). The grid shall be placed at a distance as large as possible from the edges of the noise reducing device under test

3.15
source reference position for sound insulation index measurements
position facing the side to be exposed to noise when the device is in place, located at the reference height and placed so that its horizontal distance to the closest point of the device is d_s = 1 m (see Figure 3)

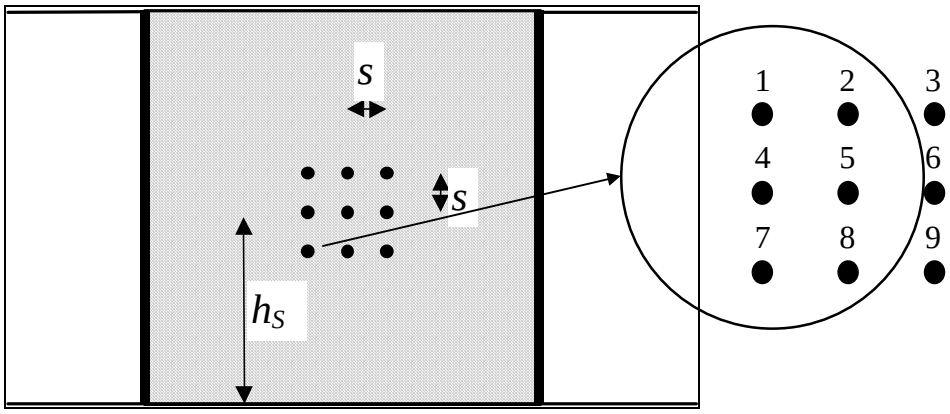


Figure 3 (a) Figure 3 (b)

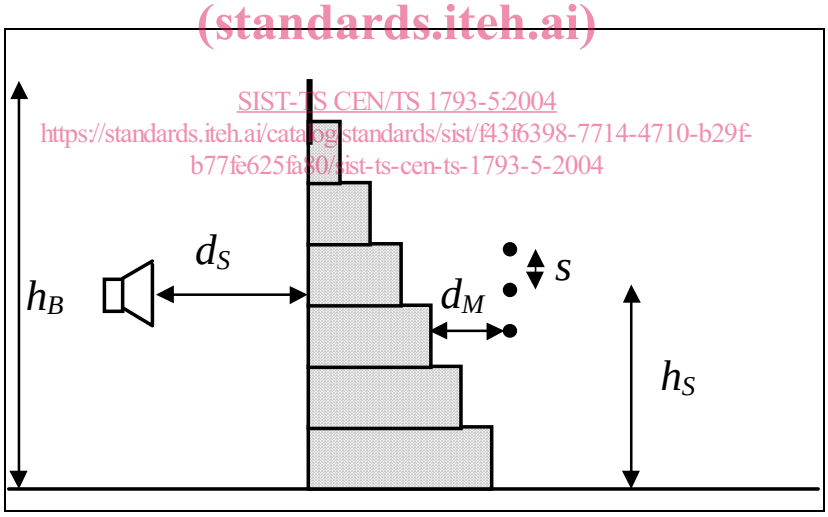


Figure 3 (c)

Figure 3 — (not to scale) (a) : Measurement grid for sound insulation index measurements (front view, receiver side) - (b) : Numbering of the measurement points - (c) : placement of the measurement grid (side view)

3.16
free-field measurement for sound insulation index measurements
measurement taken displacing the loudspeaker and the microphone in the free field in order to avoid to face any nearby object, including the ground (Figure 13.b)

3.17
adrienne temporal window
composite temporal window described in 4.4.5

3.18
background noise
noise coming from sources other than the source emitting the test signal

3.19
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)

3.20
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

4 Reflection index measurements

4.1 General principle

The sound source emits a transient sound wave that travels past the microphone position to the device under test and is then reflected on it (Figures 4.a, 5, 6). The microphone placed between the sound source and the device under test receives both the direct sound pressure wave travelling from the sound source to the device under test and the sound pressure wave reflected (including scattering) by the device under test. The power spectra of the direct and the reflected components, corrected to take into account the path length difference of the two components, gives the basis for calculating the reflection index.

The measurement must take place in an essentially free field in the direct surroundings of the device, i.e. a field free from reflections coming from surfaces other than the surface of the device under test. For this reason, the acquisition of an impulse response having peaks as sharp as possible is recommended : in this way, the reflections coming from other surfaces than the tested device can be identified from their delay time and rejected.

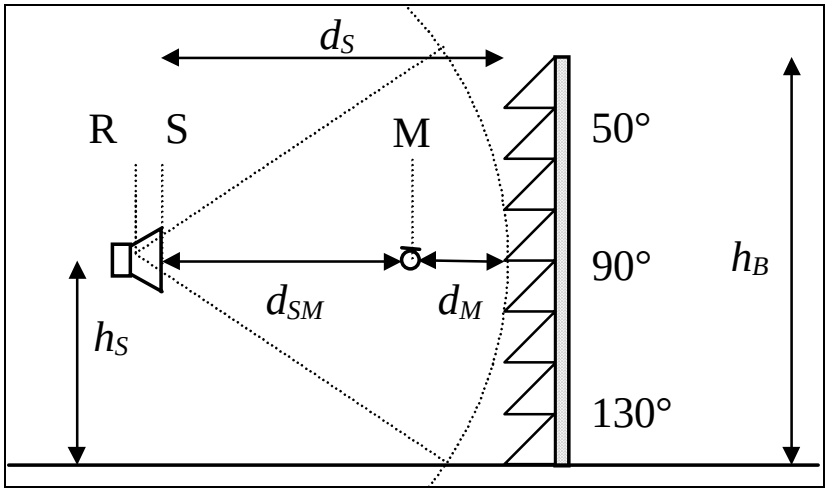


Figure 4 (a)

Figure 4 (b)

Figure 4 — Sketch of the set-up for the reflection index measurement (example for rotation in vertical direction) - R : axis of rotation - S : loudspeaker front panel - M : microphone - (a) : Reflected sound measurements, from 50° to 130° in step of 10° on the same rotation plane, in front of a non flat noise reducing device - (b) : Reference “free-field” sound measurement