

**Nadomešča:****SIST EN 1793-6:2013**

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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

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

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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 direct

**Ta slovenski standard je istoveten z: EN 1793-6:2018**

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**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

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**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**

Dispositifs de réduction du bruit du trafic routier -  
Méthode d'essai pour la détermination de la  
performance acoustique - Partie 6 : Caractéristiques  
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Lärmschutzvorrichtungen an Straßen - Prüfverfahren  
zur Bestimmung der akustischen Eigenschaften - Teil  
6: Produktspezifische Merkmale - In-situ-Werte der  
Luftschalldämmung in gerichteten Schallfeldern

This European Standard was approved by CEN on 19 February 2018.

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**EN 1793-6:2018 (E)****European foreword**

This document (EN 1793-6:2018) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

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 December 2018, and conflicting national standards shall be withdrawn at the latest by December 2018.

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 1793-6:2012.

With respect to the superseded document, the following changes have been made:

- an improved definition of the test signal and considerations about the Signal to Noise ( $S/N$ ) ratio;
- clarification on the calculation of single number ratings for qualification purposes and other purposes;
- the categories of single number rating have been removed from Annex A; the performance of the noise reducing device is, from now on, only to be reported in terms of the numeric values of the single number rating;
- revised information on the determination of measurement uncertainty.

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

- 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 1793-5, *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*.

This European Standard has been prepared, under the direction of Technical Committee CEN/TC 226 “Road equipment”, by Working Group 6 “Noise reducing devices”.

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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## 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 *in situ*, i.e. where the noise reducing devices are installed. The method can be applied without damaging the surface of the 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 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 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) 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 1793-2 method, mainly because the present method uses a directional sound field, while the EN 1793-2 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 1793-2 and field data, measured according to the method described in the present document [4], [5], [6], [7], [15].

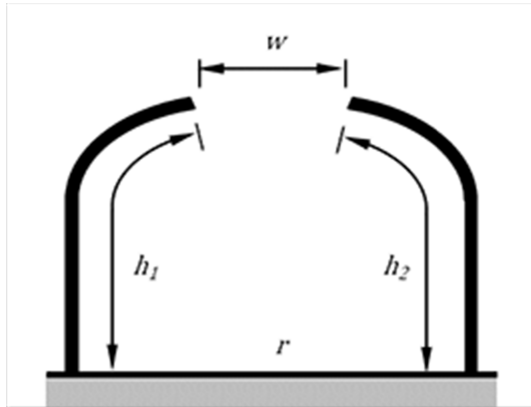
The test method described in this document should not be used to determine the intrinsic characteristics of airborne sound insulation for noise reducing devices to be installed in reverberant conditions, e.g. inside tunnels or deep trenches or under covers.

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  $e = (w+h_1+h_2)$ .

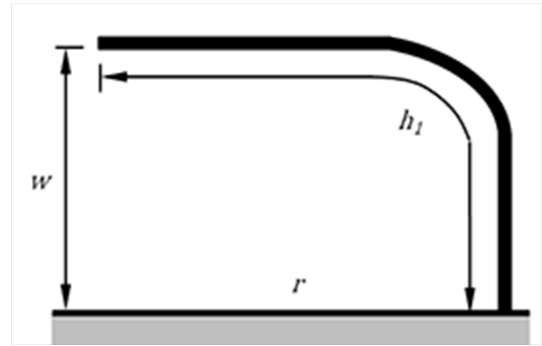
This document introduces a specific quantity, called sound insulation index, to define the airborne sound insulation of a noise reducing device. This quantity should not be confused with the sound reduction index used in building acoustics, sometimes also called transmission loss.

NOTE 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.

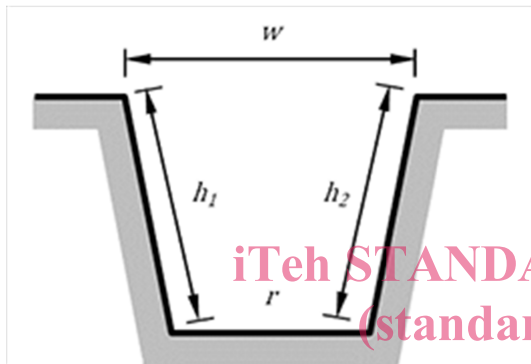




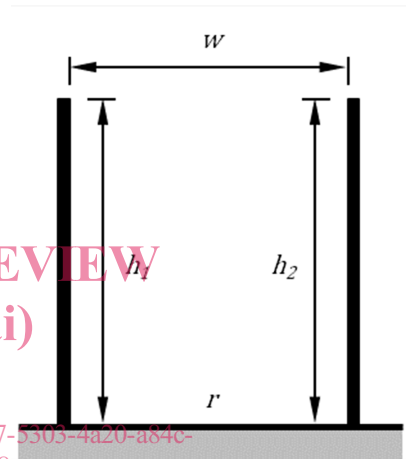
a) Partial cover on both sides of the road;  
envelope,  $e = w + h_1 + h_2$



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



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**

**EN 1793-6:2018 (E)****1 Scope**

This document describes a test method for measuring a quantity representative of the intrinsic characteristics of airborne sound insulation for 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 *in situ* or in laboratory conditions;
- determination of the *in situ* intrinsic characteristics of 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);
- 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 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 will be given in a restricted frequency range and the reasons for the restriction(s) will 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, *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.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

**3.1****noise reducing device**

device that is designed to reduce the propagation of traffic noise away from the road environment

Note 1 to entry: 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****acoustical 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 acoustic elements

**3.4****sound insulation index**

result of airborne sound insulation 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 Figures 2 and 3)

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 4.5.8).

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**3.6****source reference plane**

<for sound insulation 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 (see Figures 2, 4 and 9)

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Note 1 to entry: The device under test includes both structural and acoustic elements.

**3.7****microphone reference plane**

plane facing the receiver side of the noise reducing device and touching the most protruding parts of the device under test within the tested area (see Figures 4 and 9)

Note 1 to entry: The device under test includes both structural and acoustic elements.

**3.8****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 plane is  $d_S = 1$  m (see Figures 2, 5, 8 and 9)

Note 1 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).

**EN 1793-6:2018 (E)****3.9****measurement grid for sound insulation index measurements**

vertical measurement grid constituted of nine equally spaced points

Note 1 to entry: A microphone is placed at each point (see Figures 3, 5, 6, 8, 9 and 4.5.4 and 4.5.5).

**3.10****barrier thickness**

<for sound insulation index measurements> distance  $t_B$  between the source reference plane and the microphone reference plane at a height equal to the reference height  $h_S$  (see Figures 4, 8 and 9)

**3.11****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 (see Figure 6)

**3.12****Adrienne temporal window**

composite temporal window described in 4.5.6

**3.13****background noise**

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

**3.14****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)

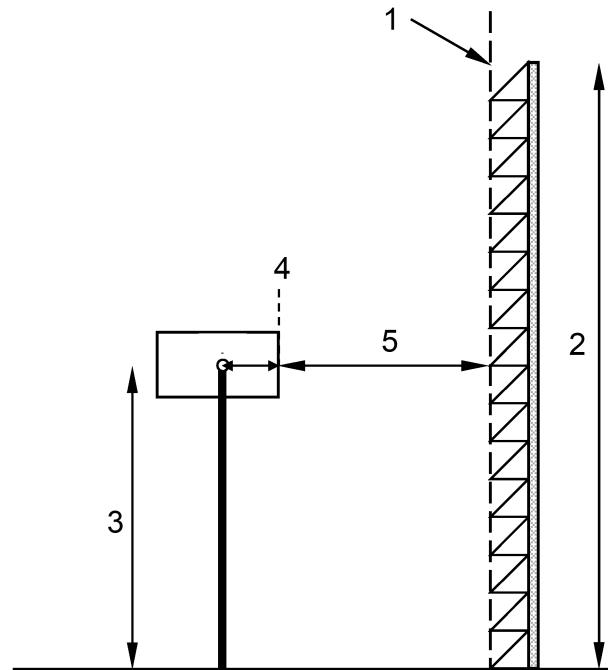
**3.15****impulse response**

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  $\delta$  function, is the mathematical idealization of a signal that is infinitely short in time which carries a unit amount of energy.

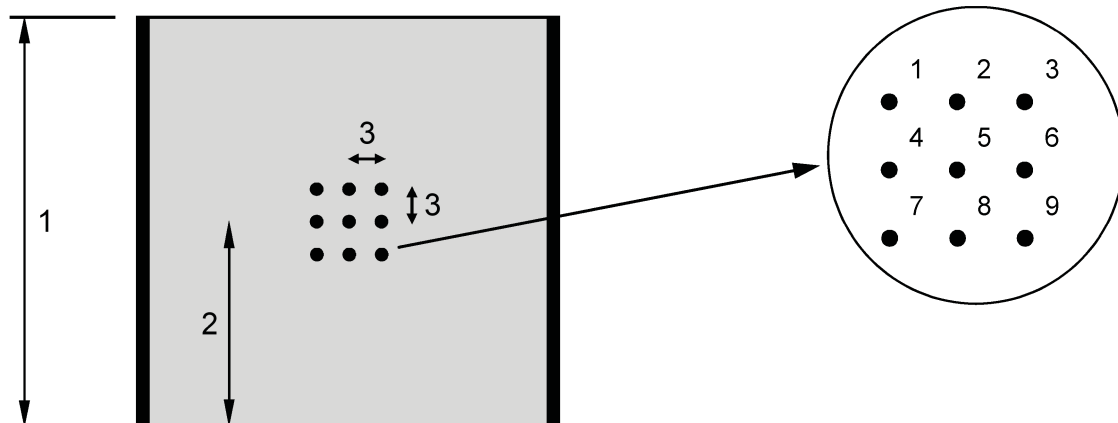
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**Key**

- |   |                                         |   |                                                                                    |
|---|-----------------------------------------|---|------------------------------------------------------------------------------------|
| 1 | source reference plane                  | 4 | loudspeaker front panel                                                            |
| 2 | noise reducing device height, $h_B$ [m] | 5 | distance between the loudspeaker front panel and source reference plane, $d_S$ [m] |
| 3 | reference height, $h_S$ [m]             |   |                                                                                    |

**Figure 2 — Sketch of the loudspeaker-microphone assembly in front of the noise reducing device under test for sound insulation index measurements (not to scale)**



**a) Measurement grid for sound insulation index measurements as seen from the receiver (not to scale)**

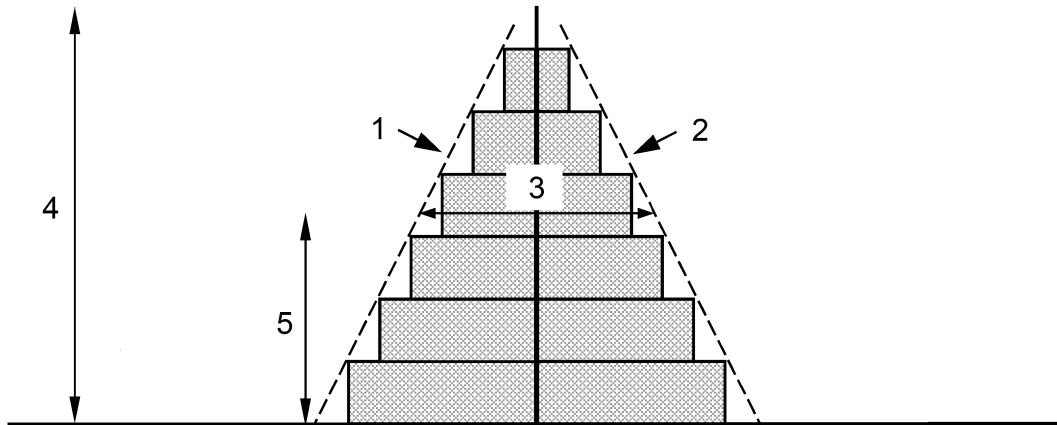
**b) Numbering of the measurement points as seen from the receiver (not to scale)**

**Key**

- |   |                                                              |
|---|--------------------------------------------------------------|
| 1 | noise reducing device height, $h_B$ (m)                      |
| 2 | reference height, $h_S$ (m)                                  |
| 3 | orthogonal spacing between two adjacent microphones, $s$ (m) |

**Figure 3 — Measurement points as seen from the receiver**

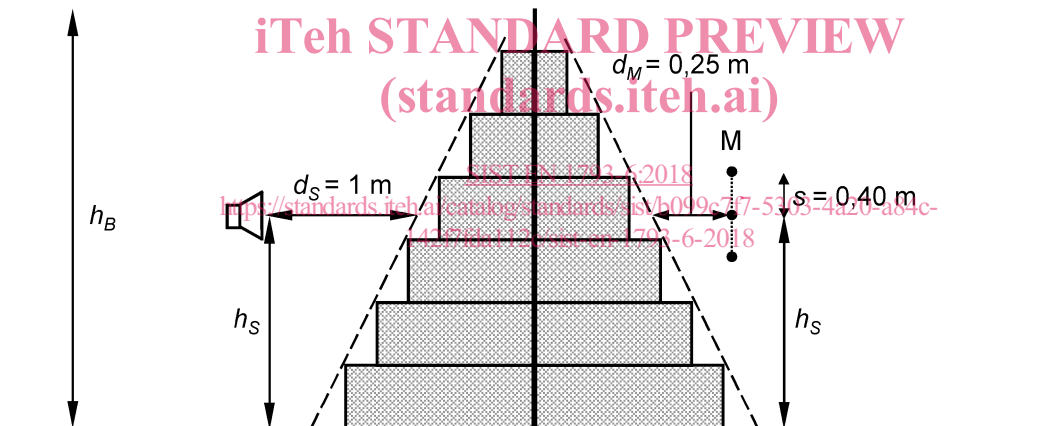
## EN 1793-6:2018 (E)



## Key

1	sound source reference plane	4	noise reducing device height, $h_B$ [m]
2	microphone reference plane	5	reference height, $h_S$ [m]
3	noise reducing device thickness, $t_B$ , at height $h_S$ [m]		

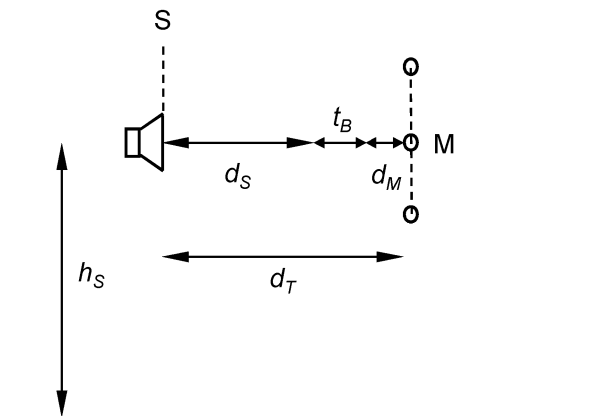
Figure 4— Sound source and microphone reference planes (side view, not to scale)



## Key

M	measurement grid	$h_B$	noise reducing device height (m)
s	distance between two vertical or horizontal microphones in the grid	$d_S$	horizontal distance [loudspeaker - source reference plane] at height $h_S$
$h_S$	reference height	$d_M$	horizontal distance [microphone 5 - microphone reference plane] at height $h_S$

Figure 5 — Placement of the sound source and measurement grid for sound insulation index measurement (side view, not to scale)

**Key**

S	loudspeaker front panel	$t_B$	noise reducing device thickness at height $h_S$
M	measurement grid	$d_M$	horizontal distance [microphone 5 - microphone reference plane] at height $h_S$
$h_S$	reference height	$d_T$	horizontal distance [loudspeaker - microphone 5] at height $h_S$
$d_S$	horizontal distance [loudspeaker - source reference plane] at height $h_S$		

NOTE  $d_T = d_S + t_B + d_M$ ; see Formula (3).

**Figure 6 — Sketch of the set-up for the reference “free-field” sound measurement for the determination of the sound insulation index (not to scale)**

## 4 Sound insulation index measurements

### 4.1 General principle

The sound source emits a transient sound wave that travels toward the device under test and is partly reflected, partly transmitted and partly diffracted by it. The microphone placed on the other side of the device under test receives both the transmitted sound pressure wave travelling from the sound source through the device under test, and the sound pressure wave diffracted by the top edge of the device under test (for the test to be meaningful the diffraction from the lateral edges should be sufficiently delayed). If the measurement is repeated without the device under test between the loudspeaker and the microphone, the direct free-field wave can be acquired. The power spectra of the direct wave and the transmitted wave give the basis for calculating the sound insulation index.

The sound insulation index shall be the logarithmic average of the values measured at nine points placed on the measurement grid (scanning points). See Figure 3 and Formula (1).

The measurement shall take place in a sound field free from reflections within the Adrienne temporal window. 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 can be identified from their delay time and rejected.

### 4.2 Measured quantity

The expression used to compute the sound insulation index  $SI$  as a function of frequency, in one-third octave bands, is: