SLOVENSKI STANDARD
SIST-TS CEN/TS 16272-7:2015

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Železniške naprave - Zgornji ustroj proge - Protihrupne ovire in pripadajoče naprave, ki vplivajo na širjenje zvoka po zraku - Preskusna metoda za ugotavljanje akustičnih lastnosti - 7. del: Zunanje značilnosti - Terenske vrednosti dodanega dušenja

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

Bahnanwendungen - Oberbau - Lärmschutzwände und verwandte Vorrichtungen zur Beeinflussung der Luftschallausbreitung - Prüfverfahren zur Bestimmung der akustischen Eigenschaften - Teil 7: Fremdspezifische Merkmale - In-situ-Werte zur Einfügungsdämpfung

Applications ferroviaires - Voie - Dispositifs de réduction du bruit - Méthode d'essai pour la détermination des performances acoustiques - Partie 7 : Caractéristiques extrinsèques - Valeurs in situ de la perte par insertion

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

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TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CEN/TS 16272-7

September 2015

ICS 93.100

English Version

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

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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.

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

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European foreword

This document (CEN/TS 16272-7:2015) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

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.

This Technical Specification is one of the series EN 16272, *Railway applications — Track — Noise barriers and related devices acting on airborne sound propagation — Test method for determining the acoustic performance*, as listed below:

— *Part 1: Intrinsic characteristics — Sound absorption in the laboratory under diffuse sound field conditions*;

— *Part 2: Intrinsic characteristics — Airborne sound insulation in the laboratory under diffuse sound field conditions*;

— *Part 3-1: Normalized railway noise spectrum and single number ratings for diffuse field applications*;

— *Part 3-2: Normalized railway noise spectrum and single number ratings for direct field applications*;

— *Part 4: Intrinsic characteristics — In situ values of sound diffraction under direct sound field conditions* [currently at Enquiry stage];

— *Part 5: Intrinsic characteristics — In situ values of sound reflection under direct sound field conditions*;

— *Part 6: Intrinsic characteristics — In situ values of airborne sound insulation under direct sound field conditions*;

— *Part 7: Extrinsic characteristics — In situ values of insertion loss* [the present document].

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: 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

The purpose of insertion loss measurements is to have an indication of the "efficiency" of the complete installation in attenuating noise from a technical point of view, *as is usually done with calculations.* The insertion loss is not intended to compare products; in fact, it is site-dependent, so that the same product may give different results when installed on different sites.

In order to be representative, these measurements need to be done in well-defined conditions regarding:

— the noise source (number and type of trains, speed, etc.);

— the meteorological window;

— the measurement time;

— the reference time, i.e. the time over which the measured insertion loss is evaluated based on the measurement results.

When it is not possible to carry out measurements before the construction of the noise barrier, an "equivalent" site is used for the "before" measurements.

The assessment of insertion loss limiting values is out of the scope of this Technical Specification.

1 Scope

This Technical Specification specifies methods for the determination of insertion loss of outdoor noise barriers intended to shield railway noise. It specifies detailed procedures for *in situ* measurement of barrier insertion loss including microphone positions, source conditions and acoustic environments of the measurement sites.

This Technical Specification allows one to measure the insertion loss of a given noise barrier at a given site including given meteorological conditions. It does not make it possible to compare insertion loss values of an equivalent barrier at a different site. It can be used for comparing insertion loss values of different types of barriers at the same site under given meteorological conditions by the “direct method”.

This Technical Specification gives a method for determining insertion loss:

a) from the level difference before and after the installation of noise barriers (the “direct method”);

b) when the direct method is not applicable, because a barrier has already been installed, using an "indirect method" to estimate the sound pressure levels before installation of the barrier by measurement at another site which has been judged to be equivalent.

For equivalent sites, a close match is required in source characteristics, microphone locations, terrain profiles ground surface characteristics, surrounding artificial structures and meteorological conditions. This Technical Specification prescribes principles for ensuring that sufficiently equivalent conditions are maintained between “before” and “after” cases to permit certain, reliable and repeatable determination of barrier insertion loss.

This Technical Specification does not cover the determination of the intrinsic acoustic characteristics of the barrier, for example the sound insulation index and the sound absorption coefficient.

The equivalent continuous A-weighted sound pressure level and one-third-octave band sound pressure level are used as noise descriptors.

This Technical Specification can be used for routine determination of barrier performance or for engineering or diagnostic evaluation. It can be used in situations where the barrier is to be installed or has already been installed.

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 60942, *Electroacoustics — Sound calibrators (IEC 60942)*

EN 61260, *Electroacoustics — Octave-band and fractional-octave-band filters (IEC 61260)*

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 purpose of this document, the following terms and definitions apply.

3.1
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 3.3 and 3.4).

3.2
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 3.3 and 3.4).

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
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.

3.6
sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the sound pressure to the square of the reference sound pressure, in decibels

Note 1 to entry: The reference sound pressure is 20 µPa. The frequency weighting or the width of the frequency band used will be indicated.

3.7
equivalent continuous sound pressure level
L_{peqT}
sound pressure level, in decibels, of a continuous steady sound that, within a measurement time interval T_p, has the same mean-square sound pressure as a sound under consideration whose level varies with time, and that is given by the following formula:

$$L_{peq,T_p} = 10\lg\left[\frac{1}{T_p}\int_{t_1}^{t_2}\frac{p^2(t)}{p_0^2}dt\right] \quad \text{dB} \tag{1}$$

where

t_1 and t_2	are times corresponding to the beginning and end of the train pass-by time interval, or the measurement duration in the case of source Type C (loudspeaker);
T_p	= t_2- t_1;
$p(t)$	is an instantaneous sound pressure;
p_0	is the reference sound pressure (20 µPa)

Note 1 to entry: The frequency weighting or the width of the frequency band used is to be indicated; for example, equivalent continuous A-weighted sound pressure level L_{pAeqT}, equivalent continuous one-third-octave band sound pressure level, etc.

3.8
insertion loss of barriers
***D*$_{IL}$**
difference, in decibels, in sound pressure levels at a specified receiver position before and after the installation of a barrier provided that the noise source, terrain profiles, interfering obstructions and reflecting surfaces, if any, ground and meteorological conditions have not changed

Note 1 to entry: The frequency weighting or the width of frequency band and the time weighting used need to be indicated; for example, insertion loss of barrier corresponding to equivalent continuous A-weighted sound pressure levels (D_{ILA}).

3.9
background noise level
sound pressure level, in decibels, at a reference position or receiver position without any noise source in operation

3.10
source position
point at which the source is located (for stationary source), an area in which sources are located or move (for stationary and mobile sources), or a line along which sources are located or move (for stationary and mobile sources)

3.11
reference position
point at which the sound from the source is, or will be, minimally influenced by the installed barrier or planned barrier

Note 1 to entry: The reference position will be used to monitor the source level.

3.12
receiver position
point at which an insertion loss is to be determined

3.13
far field
region in which the sound pressure level for a simple point source decays six decibels per doubling of distance and, for an incoherent line source, three decibels per doubling of distance, without ground attenuation

3.14
train pass-by time period
time interval during which a train is passing in front of a location; it is equal to the time window between the instant t_1 when the train nose passes in front of the location, and the instant t_2 when the tail of the train passes in front of the same location

Note 1 to entry: The initial and final time instants of the train pass-by time interval can be detected by optical devices.

Note 2 to entry: The pass-by time window is given by Formula (2):

$$T_p = 3,6\frac{L}{v} \tag{2}$$

where

L is the train length in metres;

v is the train speed in km/h

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
$L_{peq,Tp}$	equivalent continuous sound pressure level during the train pass-by time interval	dB
D_{IL}	insertion loss of barriers	dB
H_S	source height	m
H_R	receiver height	m
H_B	barrier height	m
d_1	horizontal distance between source and barrier	m
d_2	horizontal distance between barrier and receiver	m
t_1	initial instant of the train pass-by time interval	s
t_2	final instant of the train pass-by time interval	s
T_p	train pass-by time interval	s
L	train length	m
v	train speed	km/h
$L_{ref,B}$	“before” sound pressure level at the reference position	dB
$L_{r,B}$	“before” sound pressure level at the receiver position	dB
$L_{ref,A}$	“after” sound pressure level at the reference position	dB
$L_{r,A}$	“after” sound pressure level at the receiver position	dB
C_r	correction factors for “hemi free-field” at receiver position	dB
C'_r	correction factors for “on reflecting surfaces” at receiver position	dB