SLOVENSKI STANDARD
oSIST prEN 16891:2027

Nadomešča:
SIST-TP CEN/TR 16891:2016

Železniške naprave - Akustika - Metode merjenja kombinirane hrapavosti, stopenj upadanja tirnice in prenosnih funkcij

Railway applications - Acoustics - Measurement method for combined roughness, track decay rates and transfer functions

Bahnanwendungen - Akustik - Messverfahren für kombinierte Rauheit, Gleisabklingraten und Übertragungsfunktionen

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ICS:

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

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 16891

November 2026

ICS 17.140.30; 93.100

Will supersede CEN/TR 16891:2016

English Version

Railway applications - Acoustics - Measurement method for combined roughness, track decay rates and transfer functions

Applications ferroviaires - Acoustique - Méthode de mesurage pour la rugosité combinée, les taux de décroissance de la voie et les fonctions de transfert

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

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European foreword

This document (prEN 16891:2026) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede CEN/TR 16891:2016.

In comparison with the previous edition, the following technical modifications have been made:

— the previous corresponding technical report has been revised and updated to a European standard;

— update of definitions and reference to other standards where applicable;

— corrections and clarifications on installation aspects and on the iteration procedure;

— the clause on reporting has been expanded;

— an annex on signal quality has been added;

— the Annexes B (Benchmark examples) and C (slope method) have been deleted.

Background information on the method and its applications can be found in [1], [2], [3], [4], [5], [6], [7], [8].

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Introduction

This document describes the methodology to derive combined wheel-rail roughness, track decay rates and transfer functions from train pass-by measurements.

The track decay rate is a vibration quantity that characterizes the attenuation of rail vibration along the track for a given wheel/rail contact excitation, and thereby affects the amount of sound radiation from the track.

Combined roughness, which includes the effect of the contact filter, is a quantity that determines the level of excitation of wheel-rail rolling noise. It can be determined from vertical rail vibration during a train pass-by and the vertical track decay rate. The transfer function between combined roughness and track-side sound pressure can be used to characterize the vibro-acoustic behaviour of the vehicle-track system for a given roughness excitation and in relation to rolling noise. Combined roughness, track decay rates and transfer functions are determined as one-third octave band spectra.

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1 Scope

The method described in this document is used to determine combined wheel-rail roughness and track decay rates from rail vibration during the pass-by of a train. By combining sound pressure measurement from the same pass-by, a vibro-acoustic transfer function for rolling noise is determined.

This document describes a method for the following purposes:

— to measure track decay rates under operational conditions;

— to characterize the effectiveness of noise control measures in terms of combined roughness, transfer function and track decay rate;

— to compare the combined roughness before and after noise control measures are implemented (thereby quantifying the effect of any change in wheel or rail roughness);

— to monitor wheel roughness during a pass-by, either of whole trains or parts of trains;

— to separate rolling noise from other sources;

— to assess a threshold for the rail roughness, by measuring multiple pass-bys;

— to obtain combined roughness and transfer functions for input to environmental noise calculations.

The method is not for approval of sections of reference track in terms of acoustic rail roughness and track decay rates, which are covered by EN 15610:2019+A1:2025 [9] and EN 15461:2008+A1:2010 [10], respectively.

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The method is applicable to trains on conventional tracks, i.e. normal ballasted tracks with wooden or concrete sleepers and on slab tracks.

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Annex A and Formula (A.1) give guidance on the calculation of the A_2 factor, if the method is applied to:

— non-standard wheel types such as small wheels, resilient tram wheels;

— non-standard track types such as embedded rail or grooved rail.

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.

IEC 61260-1, *Electroacoustics - Octave-band and fractional-octave-band filters - Part 1: Specifications*

EN ISO 266:1997, *Acoustics - Preferred frequencies (ISO 266:1997)*

EN ISO 266, *Acoustics - Preferred frequencies (ISO 266:1997)*

EN 17343, *Railway applications - General terms and definitions*

EN IEC 60263:2020, *Scales and sizes for plotting frequency characteristics and polar diagrams*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in EN 17343, and the following 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/

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

3.1
pass-by time
T_p
duration of vehicle pass-by from buffer to buffer

Note 1 to entry: Measured in seconds (s).

3.2
number of axles
N_{ax}
number of axles in the selected train or part of train

3.3
one-third octave band frequency
f_c
centre frequency of a one-third octave band

Note 1 to entry: For presentation, the preferred values can be used. The exact values can be calculated as set out in EN ISO 266 [11]

Note 2 to entry: Measured in hertz (Hz).

3.4
one-third octave band wavelength
λ
centre wavelength of a one-third octave wavelength band

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Note 1 to entry: For presentation, the preferred values in centimetres can be used

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Note 2 to entry: The one-third octave band wavelength shall be calculated in accordance with EN ISO 266

Note 3 to entry: Measured in metres (m).

3.5
sound pressure
sound pressure signal
$\boldsymbol{p(t)}$
time signal of the sound pressure measured at a fixed point

Note 1 to entry: Measured in Pascals (Pa).

3.6
equivalent sound pressure level spectrum
$L_{peq,Tp}(f_c)$
spectrum in one-third octave bands of the sound pressure energy averaged over pass-by time (Tp)

Note 1 to entry: Measured in (dB re 2.10^{-5} [Pa])

3.7
acceleration signal
$a(t)$
time signal of acceleration measured on the rail

Note 1 to entry: Measured in meters per second squared (m/s^2).

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3.8
equivalent vertical rail vibration level spectrum
$L_{aeq,Tp}(f_c)$
spectrum in one-third octave bands of the rail head acceleration energy averaged over pass-by time (Tp)

Note 1 to entry: Measured in (dB re 10^{-6} [m/s^2]).

3.9
decay exponent
β
decay exponent characteristic for the vibration decay in the rail

Note 1 to entry: Measured per metre (m^{-1}).

3.10
vertical track decay rate
$D_z(f_c)$
decay rate of vertical rail vibration along the rail in one-third octave bands

Note 1 to entry: Measured in decibels per metre (dB/m).

3.11
lateral track decay rate
$D_y(f_c)$
decay rate of lateral rail vibration along the rail head in one-third octave bands

Note 1 to entry: Measured in decibels per metre (dB/m).

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3.12
combined effective roughness wavelength spectrum
$L_{Rtot}(\lambda)$
wavelength spectrum in one-third octave bands of the combined effective wheel-rail roughness including the contact filter

Note 1 to entry: Measured in (dB re 10^{-6} [m]).

3.13
combined effective roughness frequency spectrum at speed v
$L_{Rtot}(f_c,v)$
frequency spectrum in one-third octave bands of the combined effective wheel-rail roughness including the contact filter, for a given speed

Note 1 to entry: Measured in (dB re 10^{-6} [m]).

3.14
rolling noise transfer function
$L_{HpR,tot,nl}(f_c)$
transfer function in one-third octave bands between the sound pressure at a fixed point, 7,5 m, and the combined effective roughness frequency spectrum, normalised to the axle density (N_{ax}/l)

Note 1 to entry: Measured in (dB re 20 [Pa/√m]).

3.15
receptance
α
transfer function between the excitation force and the resulting displacement at the same position

Note 1 to entry: Measured in metres per newton (m/N).

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