SLOVENSKI STANDARD
oSIST prEN 15610:2017

01-november-2017

Železniške naprave - Akustika - Merjenje valovitosti vozne površine tirnice in kolesa, ki povzroča hrup med vožnjo

Railway applications - Acoustics - Rail and wheel roughness measurement related to rolling noise generation

Bahnanwendungen - Akustik - Messung der Schienen- und Radrauheit im Hinblick auf die Entstehung von Rollgeräuschen

Applications ferroviaires - Acoustique - Mesurage de la rugosité des rails et des roues relative à la génération du bruit de roulement

Ta slovenski standard je istoveten z: **prEN 15610**

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

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prEN 15610

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ICS 17.140.30; 93.100

Will supersede EN 15610:2009

English Version

Railway applications - Acoustics - Rail and wheel roughness measurement related to rolling noise generation

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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.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (prEN 15610:2017) 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 EN 15610:2009.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

1 Scope

1.1 This European Standard specifies a direct method for characterizing the surface roughness of the rail and wheel associated with rolling noise ("acoustic roughness"), in the form of a one-third octave band spectrum.

This standard describes a method for:

a) selecting measuring positions along a track or selecting wheels of a vehicle;

b) selecting lateral positions for measurements;

c) the data acquisition procedure;

d) measurement data processing in order to estimate a set of one-third octave band roughness spectra;

e) presentation of this estimate for comparison with limits of acoustic roughness;

f) comparison with a given upper limit in terms of a one-third octave band wavelength spectrum;

g) the measuring system requirements.

1.2 It is applicable to the:

a) performance testing of reference track sections in relation to the acceptance test for noise emitted by railway vehicles;

b) performance testing of track sections in relation to noise emitted by railway vehicles;

c) acceptance of the running surface condition only in the case where the acoustic roughness is the acceptance criterion;

d) assessment of the wheel surface condition as an input for the acoustic acceptance of brake blocks;

e) assessment of the wheel and rail roughness as input to the calculation of combined wheel rail roughness;

f) diagnosis of wheel-rail noise issues for specific tracks or wheels;

g) assessment of the wheel and rail roughness as input to rolling noise modelling;

h) assessment of the wheel and rail roughness as input to noise source separation methods.

1.3 It is not applicable to the:

a) measurement of roughness (rail roughness, wheel roughness or combined roughness) using an indirect method;

b) analysis of the effect of wheel-rail interaction, such as a "contact filter";

c) approval of rail and wheel reprofiling, including rail grinding operations, except for those where the acoustic roughness is specifically the approval criterion (and not the grinding quality criteria as provided in e.g. EN 13231-3);

d) characterization of track and wheel geometry except where associated with noise generation.

2 Normative references

The following referenced documents are indispensable for the application 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 61260-1, *Electroacoustics - Octave-band and fractional-octave-band filters - Part 1: Specifications (IEC 61260-1)*

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

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
acoustic roughness
r(x)
variation in the height of the running surface associated with rolling noise excitation expressed as a function of distance x along the running surface

3.2
acoustic roughness spectrum
$\tilde{r}(\lambda)$
amplitude of the acoustic roughness expressed as a function of the wavelength

3.3
acoustic roughness level
L_r
level expressed in decibels, given by the following equation:

$$L_r = 10 \cdot \log_{10}\left(\frac{r_{RMS}^{\ 2}}{r_0^2}\right) \quad (1)$$

where

L_r is the acoustic roughness level in dB;

r_{RMS} is the root mean square roughness in micro metre (µm);

r_0 is the reference roughness; r_0 = 1 µm.

Note 1 to entry This definition applies to values measured either in the form of a one third octave band wavelength spectrum, or for a specific wavelength band.

3.4
combined roughness
roughness function that excites rolling noise

Note 1 to entry: It is made up of three components: the rail roughness level, the wheel roughness level, and the contact filter .

3.5
corrugation
periodic wear pattern of the rail running surface

3.6
direct roughness measurement method
refers to an acoustic roughness measurement method for which the transducer has to be applied directly to the running surface so that either the rail or the wheel roughness is measured independently of any effect of wheel-rail interaction

3.7
indirect roughness measurement method
refers to an acoustic roughness measurement method that measures a quantity that is the result of wheel-rail interaction, such as noise, rail or axle box vibration, whereby the original excitation by the combined wheel and rail roughness is inferred

3.8
test section
specific section of track associated with a particular set of measurements

3.9
RMS
where averaging of spectra is required, an r.m.s average is required in the standard

Note 1 to entry: This is defined for each spectral band as:

$$RMS = \sqrt{\frac{a_1^2 + a_2^2 + \cdots + a_N^2}{N}} \tag{2}$$

Where:

a is a spectral amplitude; and

N is the number of spectral band value from which the average is being calculated.

Note 2 to entry: In terms of levels, this is equivalent to:

$$L_{average} = 10\log_{10}\left(\frac{10^{L_1/10} + 10^{L_2/10} + \cdots + 10^{L_N/10}}{N}\right) \tag{3}$$

3.10
running surface
refers either to that part of the wheel tread, or of the rail head, along which the wheel-rail contact passes during rolling

Note 1 to entry: In the case of the rail this is the bright band of the surface of the rail head that contains all the running positions of the wheel-rail contact, associated with current traffic

3.11
partially conditioned surface
That part of the rail head outside the rail running surface that nevertheless may appear to have been affected by the passage of vehicles

3.12
reference surface
surface of the rail head, within the running surface, that is chosen for the acoustic roughness assessment

3.13
reference length
dimension of the reference surface in the longitudinal rail direction

3.14
reference width
w_{ref}
dimension of the reference surface across the rail

Note 1 to entry: Figure 1 shows an example of some of the defined terms:

Key

1 running surface

2 reference surface

3 partially conditioned surface

Figure 1 — Example showing defined parameters

4 Symbols

Symbol	Meaning
$C(x)$	circular curve used for the acoustic roughness processing
d_{ref}	position, relative to the outer surface of the rail head, of the longitudinal axis of symmetry of the reference surface
h	height of a spike
L_{r}	acoustic roughness level
$r(x)$	acoustic roughness
$r'(x)$	acoustic roughness processed with the spike removal and curvature algorithm
w	width of a spike
w_{ref}	width of the reference surface
x	variable of the distance along the rail
x_i	particular position along the rail

z	mean value of height over a given interval
$\tilde{r}(\lambda)$	discrete Fourier Transform of $r(x)$
λ	wavelength

5 Rail roughness

5.1 Measuring system requirements

5.1.1 General

This section summarizes the requirements of the measuring system and its calibration. The measuring devices shall be checked and calibrated regularly.

5.1.2 Accuracy of the output signal

The measuring system shall be capable of making valid measurements in the wavelength range and at the relevant acoustic roughness levels for the test site being characterized.

However, where it is required simply to show that the estimated acoustic roughness does not exceed a given upper limit, the measuring system shall effect valid measurements for one-third octave band acoustic roughness levels equal to or greater than this limit. This case applies particularly for test section approval.

5.1.3 Dimensions of the probe

If a contact probe is used, the probe tip shall be spherical and its radius shall not exceed 7 mm.

In the case of a non-contacting sensor, its effective width shall be less than the sampling interval.

5.1.4 Tracking of the probe

The measuring system probe shall follow a line on the rail head parallel to the field (outer) face of the rail head, with a tolerance of ± 1 mm.

5.1.5 Sampling interval

The measuring system shall provide data with a sampling interval less than or equal to 1 mm to an accuracy of no worse than 3 %.

5.1.6 Record length

The system shall provide records of length ≥ 1 m.

5.1.7 Calibration and traceability to a national measurement standard

The calibration shall verify the accuracy and the compliance of the sensors for the acoustic roughness and the sampling distance measurement system with the requirements to their relevant standards.

The calibration shall include the traceability to a national measurement standard or a primary standard. This shall be done in terms of a reference roughness standard (e.g. a section of a reference rail or beam). The surface geometry of the reference roughness standard shall be measured by a national or primary standards laboratory. For comparing the measurement values to a limit curve, the roughness of this reference roughness standard shall be of a measureable value and shall be no greater than 10 dB above the respective limit curve over the whole wavelength range of the limit curve.

The calibration procedure shall be documented. The documentation shall justify the calibration and the checking of all aspects of the instrument including the electronics and processing.