SLOVENSKI STANDARD
oSIST prEN 15610:2007

01-marec-2007

Železniške naprave – Hrup – Merjenje valovitosti vozne površine tirnice, ki je vir hrupa med vožnjo

Railway applications - Noise emission - Rail roughness measuement related to rolling noise generation

Bahnanwendungen - Geräuschemission - Messung der Schienenrauheit im Hinblick auf die Entstehung von Rollgeräusch

Applications ferroviaires - Bruit a l'émission - Mesurage de la rugosité des rails relative a 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
45.080	Traļ nice in ģelezniģki deli	Rails and railway components

oSIST prEN 15610:2007 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 15610

December 2006

ICS

English Version

Railway applications - Noise emission - Rail roughness measuement related to rolling noise generation

Applications ferroviaires - Bruit à l'émission - Mesurage de la rugosité des rails relative à la génération du bruit de roulement

Bahnanwendungen - Geräuschemission - Messung der Schienenrauheit in Bezug auf die Lärmentstehung

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.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. prEN 15610:2006: E

Contents

Page

Foreword

This document (prEN 15610:2006) 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 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(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

1 Scope

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

This standard describes a method for:

— data acquisition;

— measurement data processing in order to estimate the one-third octave displacement spectrum ;

— presentation of this estimate for comparison with upper limits of acoustic roughness;

— comparison with a given limit in terms of one-third octave band wavelength spectrum.

It is applicable for:

— performance testing of reference track sections for the measurement of noise emitted by railway vehicles over a period of three months from the test, for acceptance testing purposes;

— quality approval of the rail surfaces only in the case where the acoustic roughness is regarded as an established approval criterion.

It is not applicable:

— to the measurement of rail roughness using an indirect method;

— to the measurement of combined wheel-rail roughness;

— to the analysis of the effect of wheel-rail interaction, such as a “contact filter”;

— to the approval of rail grinding operations, except for those where the acoustic roughness (and not the corrugation) is an established approval criterion;

— to the characterization of track geometry.

Testing and approval of measuring apparatus are not part of the scope of this standard.

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
acoustic roughness
r(x)
variation in the height of the rail running surface associated with rolling noise excitation expressed as a function of distance x along the rail

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

3.3
acoustic roughness level
L_r
level expressed in decibels, referenced at 1,0 µm, given by the following equation:

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

where: L_r is the acoustic roughness level in dB,

r_{RMS} is the root mean square of the roughness in µm,

r_0 is the reference roughness ; r_0 = 1,0 µm.

NOTE This definition applies to values measured either in the form of a wavelength spectrum, or for a specific wavelength band.

3.4
corrugation
periodic wear of the rail running surface

3.5
direct roughness measurement method
refers to an acoustic roughness measurement method for which the measuring sensor has to be applied directly to the rail surface so that the roughness of the rail is measured independently of the roughness of the wheel surface, and independently of any wheel-rail interaction

3.6
indirect roughness measurement method
defines an acoustic roughness measurement method that measures a quantity that is the result of wheel-rail interaction, such as noise, axle box or rail vibration, whereby the original excitation by the combined wheel and rail roughness is inferred

3.7
test section
specific section or track with which a particular set of measurements is associated

3.8
running band
bright surface of the rail head that contains all the running positions of the wheel-rail contact, associated with current traffic

3.9
reference surface
surface of the rail head, within the running band, selected to evaluate the acoustic roughness of the rail

3.10
reference length
dimension of the reference surface in the longitudinal direction of the rail

3.11
reference width
transverse dimension of the reference surface of the rail

4 Symbols and abbreviations

x	variable expressing distance along the rail
x_i	specific position along the rail
r(x)	acoustic roughness function
r'(x)	acoustic roughness function after processing with the spike removal and curvature algorithm
$\tilde{r}(\lambda)$	digital Fourier transform of r(x)
C(x)	circle of radius 0,375 m used for processing the acoustic roughness
λ	wavelength
L_r	level of acoustic roughness

5 Measuring system requirements

5.1 General

Regardless of the fact that this European Standard does not specify any evaluation or approval of a measuring system, the requirements of the measuring system are defined. This is just in terms of output data and parameters relevant to the output data. No specifications are given for the technology providing these results.

The following requirements apply.

5.2 Precision of the output signal

It shall be shown that the measuring system is capable of producing valid measurements in the wavelength range and for the relevant acoustic roughness levels for the test site to be characterized.

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

5.3 Dimensions of the probe

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

In the case of a non-contact sensor, its effective width shall be less than the distance between the samples to be measured.

5.4 Tracking of the probe

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

5.5 Sample rate

The measuring system shall provide data with a sampling interval less than or equal to 1mm.

5.6 Record length

The system shall be capable of taking records of length ≥ 1 m.

NOTE To obtain wavelengths greater than 0,25 m, it is essential to obtain recordis of length greater than that specified in 5.6.

6 Data acquisition

6.1 General

The aim of the data acquisition procedure is to obtain digitized records of the acoustic roughness of the two rails in the test section measured at a sufficiently high sampling rate per unit of length of rail, and with a record length sufficient to derive from it the acoustic roughness spectrum. Record lengths of at least 1 m are required to estimate the acoustic roughness spectrum covering the wavelength range up to the 0,25 m one-third octave band.

6.2 Requirements of the test section

6.2.1 Track structure

The track structure shall be constant along the test section, at least in terms of the following parameters: rail cross-section, inclination of the rail and rail supporting structure. In the case of a ballasted track, the rail supporting structure parameters are: the type of rail pad, the fasteners, the type of sleeper, the sleeper spacing and the ballast.

NOTE If there is a change in the structure of the track, separate test sections should be defined, with the acoustic roughness of each having to be assessed and presented.

6.2.2 Localized geometric features

From the strict point of view of acoustic roughness data acquisition, there is no specific requirement for the test section. However, it may be the case that the rail test section contains localized geometrical features

(e.g.: rail defects, wheel burns, etc.), that should not be included in the assessment of the acoustic roughness related to the rolling noise.

NOTE The localized rail defects contribute to the total noise emitted by the wheel-rail system, but they are not significant in the assessment of the acoustic roughness related to the rolling noise component.

6.3 Data sampling

6.3.1 General

If the conditions of 6.2.1 are met, a reduced sample representative of the data may be produced by measuring the acoustic roughness of the two rails over a given length (reference length) and a given width (reference width) of the rail running surface. In view of the fact that existing measuring systems record the acoustic roughness over lines along the rail, the transverse change in the acoustic roughness of the rails shall be assessed at a limited number of discrete positions.

The following data sampling techniques of the rail reference surface shall be applied in the longitudinal and transverse directions simultaneously.

6.3.2 Sampling in the longitudinal direction

The acoustic roughness of the reference section shall be assessed using a number of measuring samples distributed over the whole reference length. To obtain a reliable assessment of the roughness up to a given wavelength, a minimum record length is required.

If acoustic roughness is sampled in such a way as it forms less than 80 % of the total length of the test section, the following criteria are applicable for the sample to be representative of the total length of the test section:

— the samples shall be assessed over at least 5 measuring positions for each rail, each at least 1 m long, distributed over the test section;

— depending on the wavelength range of interest, the samples shall total a length of at least:

  — 15 m for each rail, if the wavelength range involved does not exceed the 0,25 m one-third octave band;

  — 7,2 m for each rail, if the wavelength range involved does not exceed the 0,1 m one-third octave band.

6.3.3 Sampling in the transverse direction

For a given width of the rail head surface, the acoustic roughness shall be assessed independently of the actual range of positions of the contact point associated with a given category of rolling stock, and shall be regarded as being valid just for the part conditioned by running wear. Therefore, an important aspect of the acquisition process is to define the transverse position of the valid reference surface of the rail.

The measuring team is responsible for defining the width and position of the reference surface and shall justify its choice.

To acquire the roughness for acceptance testing of rolling stock, any one of the three following cases shall be applied for this justification:

— case 1: the running band on the rail head is clearly visible and is known to be produced by the rolling stock under test;

NOTE In view of the fact that the wheel-rail contact area is approximately 10 mm wide, any partially conditioned area on the edges of the running band, less than half this width, shall not be regarded as part of the running band.