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Železniške naprave - Zgornji ustroj proge - Analiza kakovosti tirne geometrije

Railway applications - Track - Survey of track geometry quality

Bahnanwendungen - Oberbau - Überblick über die geometrische Gleislagequalität

Applications ferroviaires - Voie - Analyse de la qualité de la géométrie de la voie

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English Version

Railway applications - Track - Survey of track geometry quality

Applications ferroviaires - Voie - Analyse de la qualité de la géométrie de la voie

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Foreword

This document (CEN/TR 16513:2014) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

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1 Scope

CEN/TC 256/SC 1/WG 28 "Railway applications/Infrastructure/Track geometry quality" conducted a survey of the geometric quality of track across European railway networks. This was to get an understanding and overview of the track geometry across Europe in order to support the definition of track geometric quality classes for the writing of EN 13848-6.

This Technical Report describes the methodology used for the survey and gives the results.

2 Terms and definitions

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

2.1
track quality index
TQI
value that characterises track geometry quality of a track section based on parameters and measuring methods compliant with the EN 13848 series

2.2
track quality class
TQC
characterisation of track geometry quality as a function of speed and expressed as a range of *TQI*s

2.3
re-colouring
algorithm which converts one signal into a different signal and which is used in the EN 13848 series to convert a chord measurement signal into a *D*1 or *D*2 measurement signal

3 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

Table 1 — Symbols and abbreviations

Symbol	Designation	Unit
AL	Alignment	mm
*D*1	Wavelength range 3 m < λ ≤ 25 m	m
*D*2	Wavelength range 25 m < λ ≤ 70 m	m
λ	Wavelength	m
LL	Longitudinal level	mm
QN1	50 % quality level according to EN 14363:2005	mm
QN2	90 % quality level according to EN 14363:2005	mm
SD	Standard deviation	mm
TQI	Track Quality Index	–
ETQS	European track quality survey	–
TQC	Track Quality Class	–
V	Speed	km/h

NOTE In this Technical Report, "AL" stands for “alignment” and is not to be confused with *AL* standing for “alert limit” as defined in EN 13848-5.

4 Methodology

4.1 General considerations and confidentiality

The objective of the European track quality survey (ETQS) was to get an understanding and overview of the track geometry quality across Europe assessed as standard deviations. In order to achieve this objective without an exchange of an enormous amount of raw data, an approach was agreed based on the evaluation of quality data of thirteen participating networks. The quality data of each network was provided in the form of cumulative frequency distributions of alignment and longitudinal level.

Each of the participating networks provided quality data for a representative part of their network according to the technical specification described below in 4.2. With the help of a standardized inquiry form, the cumulative frequency distributions of the quality data were determined and were sent to the CEN/TC 256/SC 1/WG 28 clearing office.

In order to make the data anonymous, the clearing office assigned a random network number to the quality data of each network and summarized the track geometry quality data in an anonymous comparison table. This was supplied to CEN/TC 256/SC 1/WG 28 only.

Without agreement of all participating networks neither the clearing office nor CEN/TC 256/SC 1/WG 28 may disclose or publish any of the quality data or the assignment between quality data and participating networks as a whole or in parts to anyone else.

4.2 Collected data

4.2.1 Scope of survey

The survey collected data for all main lines, main tracks in stations and isolated switches or group of switches situated in plain line and run at line speed. All side tracks, station tracks or other less important tracks were excluded.

The survey was based on measurements of track taken typically at 25 cm spacing which results in a large volume of data. For example, a network length of 10 000 km track would result in a cumulative frequency distribution comprising of over 40 million measuring points.

The survey was conducted using the most recent measurement value for each location. This was summarized in a cumulative frequency distribution.

Where it was not possible for a participating network to do the calculation over their whole network, the calculation was done for at least 5 % of the network while the track layout and track quality considered in the sample had to be as representative as possible for the network. The track length considered for each speed class had to be quoted in the standardized inquiry form.

4.2.2 Speed classes applied

The survey was done in five speed classes according to the EN 13848 series:

— 230 km/h < V ≤ 300 km/h

— 160 km/h < V ≤ 230 km/h

— 120 km/h < V ≤ 160 km/h

— 80 km/h < V ≤ 120 km/h

— V ≤ 80 km/h

Speeds higher than 300 km/h were not taken into account due to the lack of sufficient data.

In order to ensure anonymity of networks with high speed tracks, the network lengths of the participating networks were not disclosed in the final comparison table. They were just used as weighting factors to calculate a 'European Track Quality'.

4.2.3 Calculation of standard deviation

The survey was done using standard deviations of longitudinal level SD_{LL} and alignment SD_{AL} in the domain $D1$ (3 m < λ ≤ 25 m) in accordance with EN 13848-1. Where the origin of the measurement data was chord based, they were re-coloured to obtain $D1$.

Data of left and right rail were combined as a mean of the standard deviations of each rail as follows:

$$SD_{LL} = \frac{SD_{LL,left} + SD_{LL,right}}{2} \quad (1)$$

$$SD_{AL} = \frac{SD_{AL,left} + SD_{AL,right}}{2} \quad (2)$$

The calculation of the standard deviation was specified as follows:

— calculation length: 200 m to 250 m;

— calculation step: preferably at every measurement databreak, e.g. 0,25 m. If not possible, a calculation step up to 250 m may be chosen.

Slightly different definitions of standard deviations were allowed if it was proven that the statistical influence on the cumulative frequency was small.

4.2.4 Calculation of cumulative frequency distributions

Once these parameters had been calculated the cumulative frequency distribution was determined in steps of 0,01 mm for each speed class.

4.3 Data processing

The cumulative frequency distributions of all participating networks for the five speed classes were produced and a weighted average was calculated for each step of the frequency distribution. The line length of each participating network in the considered speed class was used as weighting factor. In this way 'European Track Quality distributions' were determined for the five speed classes and both SD_{LL} and SD_{AL}. These cumulative frequency distributions are represented in Figures 1 and 3 and in Table A.1.

5 Participating networks and involvement

5.1 Participating networks

The following alphabetic list gives the networks that provided data to the survey:

Austria	ÖBB Infrastruktur
Belgium	Infrabel
Czech Republic	SZDC
Denmark	Rail Net Denmark
Finland	FTA
France	SNCF / RFF
Germany	DB Netz

Italy	RFI
Netherlands	ProRail
Portugal	REFER
Switzerland	SBB
Sweden	Trafikverket
United Kingdom	Network Rail

5.2 Sample size of track data

The survey comprised data for approximately 60 000 km of track. This represents a 37 % sample of the participating networks. The total track length of all the participating networks is about 160 000 km, this is more than half of the track length of the European Union member states.

Some networks provided data for nearly all the lines, others provided smaller samples. In any case, they have been chosen carefully as representative for the speed class in the whole network. Table 2 shows the coverage of the individual speed classes related to the respective track length.

Table 2 — Sample size of track data for each speed class

Speed range	Network length	Sample size	Percentage
230 km/h < V ≤ 300 km/h	6 368,3 km	3 237,0 km	45 %
160 km/h < V ≤ 230 km/h	16 631,9 km	7 554,1 km	45 %
120 km/h < V ≤ 160 km/h	68 548,5 km	17 357,6 km	25 %
80 km/h < V ≤ 120 km/h	36 012,5 km	16 643,1 km	46 %
V ≤ 80 km/h	31 959,5 km	14 897,8 km	47 %

6 Results

6.1 Results for standard deviation of longitudinal level

The distributions of the standard deviation of longitudinal level for each speed class are given in Figure 1. A detailed table can be found in Annex A.