SLOVENSKI STANDARD
oSIST prEN 13848-6:2024

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Železniške naprave - Zgornji ustroj proge - Kakovost tirne geometrije - 6. del: Karakterizacija kakovosti tirne geometrije

Railway applications - Track - Track geometry quality - Part 6: Characterisation of track geometry quality

Bahnanwendungen - Oberbau - Gleislagequalität - Teil 6: Charakterisierung der geometrischen Gleislagequalität

Applications ferroviaires - Voie - Qualité géométrique de la voie - Partie 6 : Caractérisation de la qualité géométrique de la voie

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45.080	Tračnice in železniški deli	Rails and railway components
93.100	Gradnja železnic	Construction of railways

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English Version

Railway applications - Track - Track geometry quality - Part 6: Characterisation of track geometry quality

Applications ferroviaires - Voie - Qualité géométrique de la voie - Partie 6: Caractérisation de la qualité géométrique de la voie

Bahnanwendungen - Oberbau - Gleislagegüte - Teil 6: Charakterisierung der geometrischen Gleislagequalität

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

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Contents

European foreword

This document (prEN 13848-6:2024) 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 13848-6:2014+A1:2020.

The main changes compared to EN 13848-6:2014+A1:2020 are listed below:

— *change of the structure of the document;*

— *revision of Annex A;*

— *revision of Annex B.*

In this document, the Annex C is normative and the Annexes A, B and D are informative.

This document is one of the series EN 13848 "*Railway applications — Track — Track geometry quality*" as listed below:

— *Part 1: Characterisation of track geometry;*

— *Part 2: Measuring systems — Track recording vehicles;*

— *Part 3: Measuring systems — Track construction and maintenance* machines;

— *Part 4: Measuring systems — Manual and lightweight devices;*

— *Part 5: Geometric quality levels — Plain line, switches and crossings;*

— *Part 6: Characterisation of track geometry quality.*

1 Scope

This document provides the method to characterize and classify the quality of track geometry based on parameters defined in EN 13848-1.

This document also specifies different track geometry classes.

This document does not:

— apply to lines with a nominal gauge less than 1 435 mm;

— specify requirements for Urban Rail Systems.

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 13848-1:2019, *Railway applications — Track — Track geometry quality — Part 1: Characterization of track geometry*

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

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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/

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

3.1.1
decolouring
algorithm which modifies the spectral content of a signal aimed to compensate or apply the characteristics of a specific measuring system

Note 1 to entry: The decolouring is used in EN 13848 series to convert a chord measurement signal into a *D1* or *D2* measurement signal.

3.1.2
track quality index (TQI)
value that characterises track geometry quality of a track section based on parameters and measuring methods compliant with EN 13848 series

3.1.3
track quality class (TQC)
characterization of track geometry quality as a function of speed and expressed as a range of TQIs

3.2 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in Table 1 apply.

Table 1 — Symbols and abbreviations

Symbol	Designation	Unit
AL	Alignment	mm
ATQI	Alternative Track Quality Index	
CL	Cross level	mm
CoSD	Combined standard deviation	mm
cr	Curvature	1/m
D0	Wavelength range $1 < \lambda \leq 5$	m
D1	Wavelength range $3 < \lambda \leq 25$	m
D2	Wavelength range $25 < \lambda \leq 70$	m
D3	Wavelength range $70 < \lambda \leq 150$ for longitudinal level Wavelength range $70 < \lambda \leq 200$ for alignment	m
λ	Wavelength	m
G	Track gauge	mm
LL	Longitudinal level	mm
MBS	Multi Body System	
PMA	Point Mass Acceleration (method)	
PSD	Power Spectral Density	$m^2/(1/m)$
SD	Standard deviation	mm
SD_{LL}	Standard deviation longitudinal level	mm
SD_{AL}	Standard deviation alignment	mm
TQI	Track Quality Index	
TQI_{ref}	Reference Track Quality Index	
TQC	Track Quality Class	
V	Speed	km/h
VRA	Vehicle Response Analysis (method)	

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

4 General principles

4.1 Introduction

In order to provide a sufficient level of safety, ride quality and cost-effective railway traffic, track geometry quality is assessed.

This document d deals with track geometry quality classification regarding ride quality through TQIs. The safety aspect on the other hand is covered in EN 13848-5.

TQIs can be calculated using different methods. The ones described in Clause 5 are applied by at least one European network. The reference method for calculating comparable TQIs is detailed in Clause 7.

4.2 Parameters for track geometry quality assessment

As track geometry measurement, vehicles present their outputs in accordance with the parameters specified in EN 13848-1, any standardized assessment method shall be based on these parameters.

4.3 Transparency

Any algorithm for track geometry quality assessment complying with this document shall be fully documented, reproducible and available in the public domain.

4.4 Complexity

Track geometry quality should be assessed by as few *TQIs* as possible and the algorithm should be understandable by the user.

4.5 Track-vehicle interaction

Track quality assessment should reflect the principles of track-vehicle interaction. For example, the track geometry defects of the same amplitude but different wavelengths lead to different vehicle responses and the required wavelength range will be different depending on the track-vehicle interaction parameters to be assessed.

5 Methods of assessment of track geometry quality

5.1 General

Considering their wide use across European Railway Networks and the need to have a single, easily understandable *TQI*, standard deviation (*SD*) of longitudinal level and alignment defined in 5.2 is taken as the reference method to describe track geometry quality. It will be referred to as TQI_{ref} in the following and is specified in Annex C.

Establishing a TQI by other means may be used providing that complete documentation is available about the method and how it relates to the reference method as described in Annex D.

The methods described in the following sub-clauses can be applied to any track geometry data of interest. Switches may be included.

5.2 Reference method: TQI_{ref} - Standard deviation (SD)

The standard deviation is the most commonly used aggregation method to calculate *TQI* by European railway networks. It represents the dispersion of a signal over a given track section, in relation to the mean value of this signal over the considered section.

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}}$$

where

N	is the number of values in the sample;
x_i	is the current value of a signal;
$\bar{x}$	is the mean value of a signal;
SD	is the standard deviation.

NOTE 1 Standard deviation is linked to the energy of the signal in a given wavelength range [$\lambda 1$, $\lambda 2$] according to the following relationship: $SD^2 = 2\int_{\lambda 1}^{\lambda 2} S_{xx}(\nu)d\nu$, where S_{xx} is the *PSD* described in 5.3.8 below.

SD is commonly calculated for the following parameters:

— longitudinal level *D1*;

— alignment *D1.*

It is also calculated for other parameters such as:

— twist;

— track gauge;

— cross level;

— longitudinal level *D2*;

— alignment *D2*.

When calculating SD, attention should be paid to the possible influence of the quasi-static part (e.g. track design) of the signals especially for twist, track gauge and cross level.

For longitudinal level and alignment it is recommended to calculate *SD* separately for each rail. It may also be calculated differently (for example: mean of both rails, worst or best of either rail or outer rail in curves).

Length of track section used for standard deviation has influence on the result. If comparable results are expected, only one length should be used. Commonly, for maintenance reasons standard deviation is calculated over a length of 200 m. It may be calculated either at fixed distances without overlap or with overlap, as a sliding standard deviation. Calculation of standard deviation is also done over longer distances such as 1 km, an entire line or an entire network.

NOTE 2 Distinction between specific track sections, such as plain lines, stations and switches and crossings, can also be made.

5.3 Other methods

5.3.1 General

Other possible methods to calculate *TQI* used by some European railway networks are described in the following subclauses.

5.3.2 Number of isolated defects

Isolated defects may present a derailment risk; however counting the number of isolated defects exceeding a specified threshold such as intervention limit and alert limit on a given fixed length of track can be representative of the track geometry quality. This method is used by several European Railway Networks.

The number of isolated defects per unit of track length is commonly counted for the following parameters:

— longitudinal level *D1*;

— alignment *D1*;

— twist;

— track gauge;

— cross level.

It can be also counted for the following parameters:

— longitudinal level *D2*;

— alignment *D2*.

Commonly, the number of isolated defects is counted over 1 km or more. It may also be counted over 100 m or 200 m of track.

The number of isolated defects can be counted over 100 m or more according to the Infrastructure Manager.

If required, distinction between specific track sections can be made, such as plain lines, stations and switches and crossings.

Alternatively, a calculation can be made to specify what percentage of a line exceeds a certain threshold level.

5.3.3 Combined standard deviation (*CoSD*)

Assessment of the overall track geometry quality of a track section (200 m, 1 000 m...) can be done by a combination of weighted standard deviations of individual geometric parameters. An example of such a *TQI* is given below.

$$CoSD = \sqrt{w_{\overline{AL}} SD_{\overline{AL}}^2 + w_G SD_G^2 + + w_{CL} SD_{CL}^2 + w_{\overline{LL}} SD_{\overline{LL}}^2}$$

where

SD is the standard deviation of the individual geometry parameters;

w is the weighting factor of the individual geometry parameters;

with the indices:

$\overline{AL}$ alignment, average of left and right rails;

G track gauge;

CL cross level;