BS EN 13848-6:2026

BSI Standards Publication

Railway applications — Track — Track geometry quality

Part 6: Characterization of track geometry quality



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National foreword

This British Standard is the UK implementation of EN 13848-6:2026. It supersedes BS EN 13848-6:2014+A1:2020, which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Contents

Page

European foreword **4**

1 Scope **5**

2 Normative references **5**

3 Terms, definitions, symbols and abbreviations **5**
3.1 Terms and definitions **5**
3.2 Symbols and abbreviations **6**

4 General principles **6**
4.1 Introduction **6**
4.2 Parameters for track geometry quality assessment **7**
4.3 Transparency **7**
4.4 Complexity **7**
4.5 Track-vehicle interaction **7**

5 Methods of assessment of track geometry quality **7**
5.1 General **7**
5.2 Reference method: TQI_{ref} - Standard deviation (*SD*) **7**
5.3 Other methods **8**
5.3.1 General **8**
5.3.2 Number of isolated defects **8**
5.3.3 Combined standard deviation (*CoSD*) **9**
5.3.4 Standard deviation of the combinations of parameters **9**
5.3.5 Point mass acceleration method (PMA) **10**
5.3.6 Methods based on vehicle response **11**
5.3.7 Power spectral density (*PSD*) **12**

6 Levels of aggregation and calculation methods **13**

7 Classes of track geometry quality **13**
7.1 General **13**
7.2 Description of track quality classes (*TQC*) **13**
7.3 Values of track quality classes **15**
7.4 Assignment of *TQC*s **16**
7.5 Possible application of *TQC*s **16**

Annex A (informative) Point mass acceleration method (PMA) **18**

A.1 Introduction **18**

A.2 Calculation of the PMA-assessment figure **18**

Annex B (informative) Vehicle response analysis methods (VRA) **20**

B.1 Introduction **20**

B.2 Determination of the assessment tables **20**

B.3 Application of the assessment tables **24**

Annex C (normative) Method for calculating reference *TQI*s (TQI_{ref}) **27**

C.1 Introduction **27**

C.2 Description of the method **27**

Annex D (informative) Method of classification of alternative *TQI* using the *TQC*s **28**

D.1 Introduction **28**

AVA Documents
Document Sharing Hub

Full document details: BS EN 13848-6:2026 Railway applications — Track — Track geometry quality — Part 6: Characterization of track geometry quality

D.2 Description of the conversion method 28
Bibliography 30

Documents
Document Sharing Hub

Full document details: BS EN 13848-6:2026 Railway applications — Track — Track geometry quality — Part 6: Characterization of track geometry quality

European foreword

This document (EN 13848-6:2026) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2027, and conflicting national standards shall be withdrawn at the latest by January 2027.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13848-6:2014+A1:2020.

EN 13848-6:2026 includes the following significant technical changes with respect to EN 13848-6:2014+A1:2020:

— 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.

The EN 13848 series, under the general title *Railway applications — Track — Track geometry quality*, consists of the following parts:

— *Part 1: Characterization 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: Characterization of track geometry quality.*

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1 Scope

This document specifies the method to characterize and classify the quality of track geometry based on parameters specified 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 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.

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 characterizes track geometry quality of a track section based on parameters and measuring methods in conformity with the 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

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Full document details: BS EN 13848-6:2026 Railway applications — Track — Track geometry quality — Part 6: Characterization of track geometry quality

3.2 Symbols and abbreviations

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

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 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.

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4.2 Parameters for track geometry quality assessment

As track geometry measurement systems 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 *TQI*s 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 subclauses 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.

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

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.

The standard deviation is linked to the energy of the signal in a given wavelength range $[\lambda 1, \lambda 2]$ according to the following relationship:

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Full document details: BS EN 13848-6:2026 Railway applications — Track — Track geometry quality — Part 6: Characterization of track geometry quality

$$SD^2 = 2\int_{\lambda 1}^{\lambda 2} S_{xx}(\nu)d\nu \quad (2)$$

where

S_{xx} is the *PSD* described in 5.3.7 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 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 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;

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— track gauge;

— cross level.

It can also be counted for the following parameters:

— longitudinal level *D2*;

— alignment *D2*.

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

$$CoSD = \sqrt{w_{\overline{AL}} SD_{\overline{AL}}^{\ 2} + w_G SD_G^{\ 2} + w_{\overline{CL}} SD_{\overline{CL}}^{\ 2} + w_{\overline{LL}} SD_{\overline{LL}}^{\ 2}} \quad (3)$$

where

SD_x is the standard deviation of the geometry parameter x;

w_x is the weighting factor of the geometry parameter x;

with the indices

$\overline{AL}$ is the average of left and right alignments;

G is the track gauge;

CL is the cross level;

$\overline{LL}$ is the average of left and right longitudinal levels.

It is up to the infrastructure manager to determine the weighting factors according to the purpose of the assessment.

Another method might be to transform the standard deviations of geometry parameters or their combinations into a dimensionless number that can be used without distinction of line category, speed range and track geometry parameter.

5.3.4 Standard deviation of the combinations of parameters

Standard deviation for a combination of track geometry parameters may be evaluated. This is based on the observation that the level of the combined signals can better reflect the vehicle behaviour than the individual signals.

For example, a standard deviation, over a sliding 200 m length of track, can be evaluated for the sum of alignment and cross level filtered in the same wavelength range (e.g. *D1*) as follows:

— the alignments of left and right rails are combined into one signal $\bar{y}$, in curves by choosing the outer rail and on tangent track by either averaging or choosing one of the two rails;

— cross level and alignment signals are combined together to a signal, s, by using a sign convention so that an alignment defect to the right is added with the same sign to a cross level defect where right rail is lower than the left rail.

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