# SVENSK STANDARD
# SS-EN 13848-6:2014

Fastställd/Approved: 2014-03-30
Publicerad/Published: 2014-03-31
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 93.100

## Järnvägar – Spår – Spårlägeskvalitet –
## Del 6: Karakterisering för spårlägeskvalitet

## Railway applications – Track – Track geometry quality –
## Part 6: Characterisation of track geometry quality

# Standarder får världen att fungera

*SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.*

**Delta och påverka**
Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

**Ta del av det färdiga arbetet**
Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standard-paket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

**Utveckla din kompetens och lyckas bättre i ditt arbete**
Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

**Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på www.sis.se eller ta kontakt med oss på tel 08-555 523 00.**

# Standards make the world go round

*SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.*

**Take part and have influence**
As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

**Get to know the finished work**
We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

**Increase understanding and improve perception**
With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

**If you want to know more about SIS, or how standards can streamline your organisation, please visit www.sis.se or contact us on phone +46 (0)8-555 523 00**

Europastandarden EN 13848-6:2014 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 13848-6:2014.

The European Standard EN 13848-6:2014 has the status of a Swedish Standard. This document contains the official version of EN 13848-6:2014.



*Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.*

*Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.*

Denna standard är framtagen av kommittén för Järnvägar, SIS/TK 254.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 13848-6

March 2014

ICS 93.100

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 - Qualität der Gleisgeometrie - Teil 6: Charakterisierung der geometrischen Gleislagequalität

This European Standard was approved by CEN on 3 February 2014.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists 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 CEN-CENELEC Management Centre has the same status as the official versions.

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

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

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



Ref. No. EN 13848-6:2014 E

# Contents

Page

# Foreword

This document (EN 13848-6:2014) 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 September 2014, and conflicting national standards shall be withdrawn at the latest by September 2014.

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

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This European Standard 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*

— *Part 6: Characterisation of track geometry quality*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

# 1 Scope

This European Standard characterizes the quality of track geometry based on parameters defined in EN 13848-1 and specifies the different track geometry classes which should be considered.

This European Standard covers the following topics:

— description of track geometry quality;

— classification of track quality according to track geometry parameters;

— considerations on how this classification can be used;

— this European Standard applies to high-speed and conventional lines of 1 435 mm and wider gauge;

— this European Standard forms an integral part of EN 13848 series.

# 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, *Railway applications - Track - Track geometry quality - Part 1: Characterisation of track geometry*

# 3 Terms, definitions, symbols and abbreviations

## 3.1 Terms and definitions

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

**3.1.1**
**re-colouring**
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 re-colouring is used in EN 13848 series to convert a chord measurement signal into a *D1* or *D2* measurement signal.

**3.1.2**
**track quality class (TQC)**
characterization of track geometry quality as a function of speed and expressed as a range of TQIs

**3.1.3**
**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

## 3.2 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 |
| *ATQI* | Alternative Track Quality Index | |
| *CL* | Cross level | mm |
| *CoSD* | Combined standard deviation | mm |
| *D1* | Wavelength range 3 m < $\lambda$ ≤ 25 m | m |
| *D2* | Wavelength range 25 m < $\lambda$ ≤ 70 m | m |
| *D3* | Wavelength range 70 m < $\lambda$ ≤ 150 m for longitudinal level<br>Wavelength range 70 m < $\lambda$ ≤ 200 m for alignment | m |
| $\lambda$ | Wavelength | m |
| *G* | Track gauge | mm |
| *LL* | Longitudinal level | mm |
| *MBS* | Multi Body System | |
| *NTQI* | National Track Quality Index | |
| *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 European Standard, *AL* stands for “alignment” and is not to be confused with *AL* standing for “alert limit” as defined in EN 13848–5:2008+A1:2010.

# 4 Basic principles

## 4.1 Introduction

It is necessary to standardize the way that track geometry quality is assessed in order to permit safe and cost-effective railway traffic by focusing on the functional requirements of both track and vehicle.

Basic 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.

## 4.2 Transparency

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

### 4.3 Complexity

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

### 4.4 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 Assessment of track geometry quality: state-of-the-art

### 5.1 General

Track geometry quality can be characterized by various *TQI*s according to the level of aggregation they are used for. The *TQI*s described in the following sub-clauses are used by at least one of the European Railway Networks. They represent the current state-of-the-art of description of track geometry quality.

### 5.2 Standard deviation (*SD*)

The standard deviation is one of the most commonly used *TQI*s 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 5.6 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;