SLOVENSKI STANDARD
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Železniške naprave - Progovni sistemi z utrjenimi tirnicami - 3. del: Prevzem

Railway applications - Ballastless track systems - Part 3: Acceptance

Bahnanwendungen - Feste Fahrbahn-Systeme - Teil 3: Annahme

Applications ferroviaires - Systèmes de voie sans ballast - Partie 3 : Réception

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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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Railway applications - Ballastless track systems - Part 3: Acceptance

Applications ferroviaires - Systèmes de voies sans ballast - Partie 3 : Approbation

Bahnanwendungen - Feste Fahrbahn-Systeme - Teil 3: Annahme

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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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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.

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

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Contents

Page

European foreword

This document (prEN 16432-3:2020) 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 document specifies the methods for the implementation of ballastless track system designs and the criteria for the acceptance of works concerning construction of ballastless track systems. It does not include any criteria for inspecting, maintaining, repairing and replacing ballastless track systems during operation.

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 206, *Concrete — Specification, performance, production and conformity*

EN 12390-5, *Testing hardened concrete — Part 5: Flexural strength of test specimens*

EN 13231-1:2013, *Railway applications — Track — Acceptance of works — Part 1: Works on ballasted track — Plain line, switches and crossings*

EN 13848-2, *Railway applications — Track — Track geometry quality — Part 2: Measuring systems — Track recording vehicles*

EN 13877-2, *Concrete pavements — Part 2: Functional requirements for concrete pavements*

EN 14587 (all parts), *Railway applications — Infrastructure — Flash butt welding of new rails*

EN 14730 (all parts), *Railway applications — Track — Aluminothermic welding of rails*

EN 16432-2:2017, *Railway applications — Ballastless track systems — Part 2: System design, subsystems and components*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

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

3.1
tolerance
permissible deviation from reference or specified value

3.2
relative track geometry
group of parameters defining the position of the rails, usually the following: gauge, alignment, longitudinal level, twist and cross level

Note 1 to entry: As described in EN 13848 series.

3.3
absolute track position
position of the track when measured from external absolute references

Example: Network of geodetic reference points.

3.4
alignment
horizontal position of e.g. the track in relative or absolute co-ordinate system

3.5
longitudinal level
vertical position of e.g. the track in relative or absolute co-ordinate system

3.6
design
comprises the calculations, drawings, evidence and specifications relating to the materials and configuration of ballastless track for a specific project or location within the project

3.7
system design
process of applying a systematic approach to ensure that all elements specified will work together to fulfil the performance requirements

3.8
ballastless track system
entire structure of a ballastless track from rail to substructure interface and not just a proprietary sub-system or components

Note 1 to entry: See Figure 2 of EN 16432-2:2017.

3.9
substructure
earthworks (embankment, cutting or at-grade) or bridges (or similar civil structures) or tunnel floor that lie below the ballastless track system

4 General

4.1 Overview

The following paragraph provides a short guidance through the standard.

Subclause 4.2 provides a general guidance how to identify whether a ballastless track system is novel and proposes measures necessary to implement it. For the acceptance of any track system a work acceptance plan should summarize all steps and criteria for acceptance as described in 4.3.

Clause 5 defines the key acceptance criteria for the completed track. All criteria defined in the following Clauses 6 and 7 aim to ensure that the overall criteria as defined in Clause 5 are met during construction.

Clause 6 defines parameters for subsystems which are used in various ballastless track system designs.

Clause 7 defines particular requirements for specific types of ballastless track systems.

4.2 Validation of fitness for construction of a novel ballastless track system design

A method shall be used (example see Annex A) that will determine whether a proposed ballastless track system design is similar enough to an in-service system.

Acceptance can be agreed without further action if the proposed design was already implemented such that it is proven to fulfil the customers' requirements.

Where differences (or new aspects) are identified, then additional requirements for implementation shall be established, based on the findings of the evaluation.

If a proposed design is significantly different from any existing design it will be considered a new design.

Unless otherwise specified a new ballastless track system design (for the design itself see part 2) can be accepted based on the acceptance of the subsystems and an agreed step-by step testing procedure of following tests (but not limited to):

— Laboratory tests designed to study especially the behaviour and the load transfer performance of the interfaces in-between different subsystems under design load combinations (mechanical, thermal…);

— A short (50 m) track section built outside the rail infrastructure to demonstrate the ballastless track installation. The documentation should also cover the analysis and evaluation of tolerances;

— In case of a positive evaluation of laboratory testing and of demonstrator, a test section shall be built. It is recommended to install the test section along a line, which receives high annual tonnage representing the planned application of the ballastless track system. The test section shall be tested and monitored based on an agreed testing and monitoring regime. Where appropriate, Testing, monitoring and documentation shall cover a period that represents the characteristic climatic conditions.

4.3 Establishing the criteria for acceptance of work

The acceptance criteria shall be developed from the detailed system design and specifications in accordance with EN 16432-2. The complete set of criteria thus developed shall encompass all identified performance risks for the specified design life and define how they shall be inspected, checked or tested and thereby verified prior to acceptance. This shall include all the requirements that influence how the ballastless track system interfaces with other elements of the railway system.

The completed ballastless track system shall be accepted before start of in-service traffic. The different subsystems as stated in EN 16432-2 shall be validated prior to installation of the subsequent subsystem.

The long term (designed) performance required for a safe and economically sustainable ballastless track is, in part, dependent on the quality of installation. There is a need during construction for rigorous inspection, monitoring and, where appropriate, testing.

In view of the more permanent nature and higher performance to be expected from a ballastless track certain different quality controls and evidence need to be provided.

A failure to meet the defined criteria may be corrected by reparative measures to the track or by a revision of the design considering the achieved as-built parameters. The second approach does not relieve the executing contractor from its general obligation to meet the defined criteria.

4.4 Integration in assurance process/Works Acceptance Plan

To integrate the acceptance requirements into a project assurance process, a form of documentation to plan all the necessary tests and inspection work during and after construction should be prepared.

A Works Acceptance Plan (WAP) shall be created to set out all agreed measurements tests and reports required to provide evidence that the works have met the specified requirements. Where a System Assurance Plan has been generated in the design phase (EN 16432-2:2017, 6.2) this may be developed to form or incorporate the WAP.

The final WAP should implement a risk-based approach to decide what level of verification is necessary. The degree of novelty and level of risk (uncertainty and consequence, see 4.2) should be used to decide the actual checks, tests and trials applied and their frequency, to gather the evidence needed to support the acceptance. Reference to national codes of practice or other standards may also be required to define typical frequencies of testing or inspection.

The WAP should detail all the requisite inspection and testing plans (ITP) that define both the applicable tests and the stage in construction to provide a progressive assurance process. This should recognize the linear and layered nature of track construction work and ensure that required tests are instigated and checked from the commencement of works and applied in an ongoing process to avoid the incorporation of hidden defects. The verification should be defined based on quantifiable measures and include pass/fail criteria that have a reasonable basis and defined method of measurement, including methodology and number of tests.

The requirements of a suitable ITP/WAP shall ensure that the various subsystems (as defined in EN 16432-2) have been accepted on a progressive basis prior to installation of subsequent subsystems.

All the acquired evidence shall be validated against requirements before the acceptance can be considered complete.

5 Acceptance of works, measurements, checks and related documentation

5.1 Track geometry and position

5.1.1 Introduction

The relative track geometry and the absolute track position shall be checked and documented after completion of the work.

5.1.2 Relative track geometry

5.1.2.1 General

Unless otherwise specified, the relative track geometry shall be according to EN 13231-1:2013.

The tolerances in Table 1 and Table 2 of EN 13231 1:2013 are for loaded track measurements. For unloaded track measurements, the customer can specify the tolerances for the relative track geometry parameters, which can be stricter.

5.1.2.2 Additional requirements for $V > 160$ km/h

To avoid deviations of track geometry in the long wavelength range, the unloaded track geometry shall be checked before final fixation of track alignment and longitudinal level (e.g. before concreting). Unless otherwise specified following criteria and limits shall be applied:

— Max. allowable deviation of versine ≤ 2 mm using a 30 m chord for track alignment and longitudinal level (overlap of chords 5 m). This check shall be done for all rail seats;

and

— Max. allowable deviation of versine ≤ 10mm using a 300 m chord for track alignment and longitudinal level (overlap of chords 150 m). This check shall be done for all rail seats.

To avoid negative effects of wavelike deviations of loaded track geometry up to 50 m on the running behaviour of rail vehicles the waviness of track alignment and longitudinal level shall be checked separately.

The loaded track geometry data shall be recorded using track recording car and measurement and signal processing procedures according to EN 13848-2. The track recording car shall be able to measure the track geometry according to the required wavelength range of at least 1 m to 70 m.

NOTE 1 This wavelength range is including the wavelength ranges *D0* (wavelength $1\ m \le \lambda \le 5\ m$), *D1* (wavelength $3\ m \le \lambda \le 25\ m$) and *D2* (wavelength $25\ m \le \lambda \le 70\ m$) according to EN 13848-1.

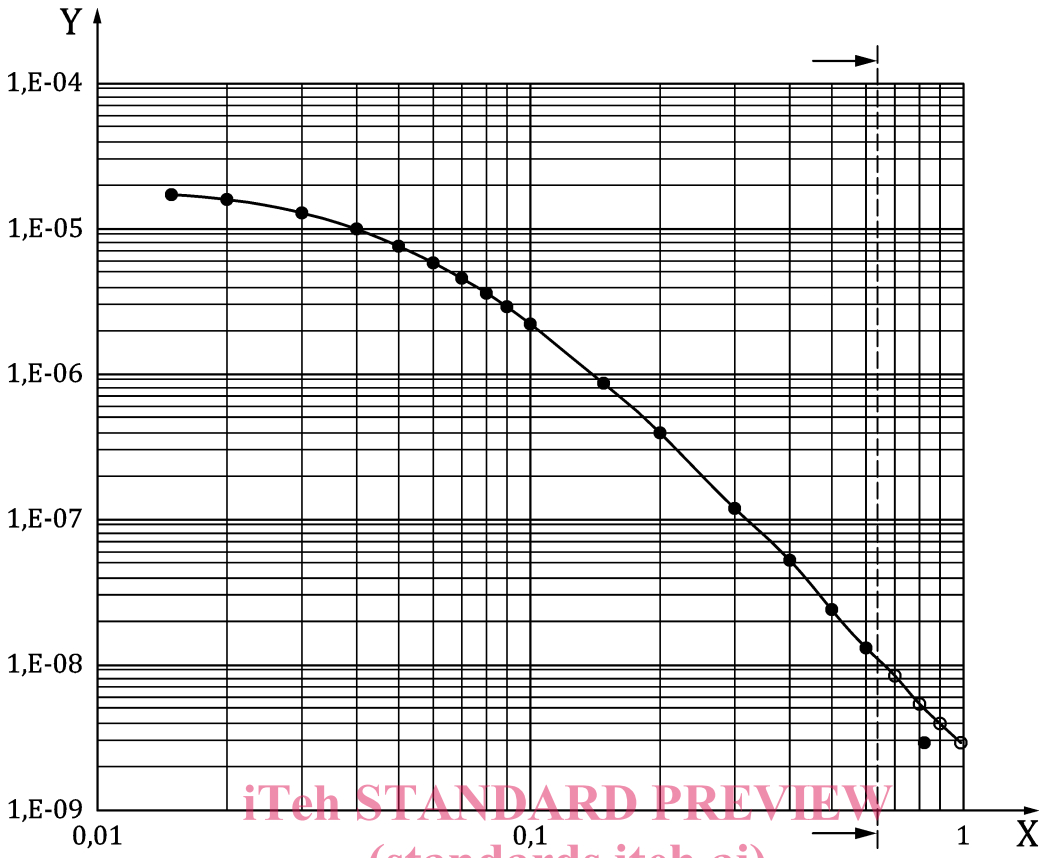
Track deviations shall be determined according to wavelength (invers of distance frequency) and evaluated e.g. using power spectral density PSD (see EN 13848-6:2014; 5.6).

The power spectral density $G_x(j)$ is determined by the squared effective value of the track deviation divided by the distance frequency interval d*F*.

The power spectral density of track deviations for both, the track alignment and the longitudinal level should not exceed the limit shown in Figure 1 in a distance frequency range of 0,015 [1/m] to 1 [1/m].

In case peaks of a determined PSD exceed the limit in Figure 1 the specific root cause should be investigated and the required actions agreed with the client.

NOTE 2 For calculating PSD of the track geometry parameters "track horizontal alignment" and "longitudinal level" an equidistant distance frequency spacing of 0,000 5 [1 / m] and a rectangular window function can be used.



Key

X Distance frequency [1/m]

Y G_x [(m^2)/(1/m)]

Figure 1 — Limit for power spectral density for track horizontal alignment and longitudinal level

5.1.3 Absolute track position

The absolute track position shall be according to EN 13231-1:2013.

Unless otherwise specified, the unloaded track shall comply with Class AP 1 of EN 13231-1:2013, see Table 1.

Table 1 — Tolerances for the deviation from design track position

Class	Vertical position **mm**	Lateral position **mm**	Longitudinal position of the switches and crossings **mm**
AP 1	±10	±10	±10