SLOVENSKI STANDARD
SIST EN 16432-3:2022

01-januar-2022

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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ICS:

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

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN 16432-3

November 2021

ICS 93.100

English Version

Railway applications - Ballastless track systems - Part 3: Acceptance

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

Bahnanwendungen - Feste Fahrbahn - Teil 3: Abnahme

This European Standard was approved by CEN on 13 September 2021.

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European foreword

This document (EN 16432-3:2021) 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of an identical text or by endorsement, at the latest by May 2022, and conflicting national standards shall be withdrawn at the latest by May 2022.

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1 Scope

This document specifies 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 13848-6:2014+A1:2020, *Railway applications — Track — Track geometry quality — Part 6: Characterisation of track geometry quality*

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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*

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

EN 16432-1:2017, *Railway applications — Ballastless track systems — Part 1: General requirements*

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 https://www.iso.org/obp

— IEC Electropedia: available at https://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: track gauge, alignment, longitudinal level, twist and cross level

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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 the rail or the track in relative or absolute co-ordinate system

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

3.6
design
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

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

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

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 Symbols and abbreviations

Symbol/Abbreviation	Definition
T_M	Surveying tolerance
T_G	Geodetic tolerance
T_A	Construction tolerance
ITP	Inspection and Testing Plan
WAP	Works Acceptance Plan
$G_x(j)$	Power Spectral Density
dF	Spacial frequency interval

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Symbol/Abbreviation	Definition
D0, D1, D2	Wavelength ranges
E_{v2}	Deformation modulus
CRCP	Continuously Reinforced Concrete Pavement
JPCP	Jointed Plain Concrete Pavement

5 General

5.1 Overview

The following paragraphs provide a short guidance through the standard.

5.2 provides a procedure how to identify whether a ballastless track system design is novel and proposes measures for implementation. For the acceptance of any track system, a Works Acceptance Plan should summarize all steps and criteria for acceptance as described in 5.3 and 5.4.

Clause 6 defines the key acceptance criteria for ballastless track after completion. All criteria defined in the following Clauses 7 and 8 aim to ensure that the overall criteria as defined in Clause 6 are met during construction.

Clause 7 defines criteria for subsystems which are used in various ballastless track systems.

Clause 8 defines criteria for specific types of ballastless track systems.

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

The Common Safety Method for risk assessment, or an equivalent methodology, shall be used to determine the significance of novel aspects of a proposed ballastless track system, (for example, see informative Annex A).

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To determine the significance of novel aspects of a proposed ballastless track system, a risk assessment methodology (e.g. the Common Safety Method or an equivalent method) shall be used.

NOTE 1 National rules can be applied.

NOTE 2 An introduction to risk assessment is provided in the informative Annex A.

Where differences (or new aspects) are identified, then additional requirements shall be agreed between supplier and customer, based on the findings of the evaluation.

If a proposed design is significantly different from any existing design, it should 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 procedure of the 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…);

— Installation test by building a short (50 m) track section to demonstrate the ballastless track system installation. The documentation should also cover the analysis and evaluation of tolerances;

— In case of a positive evaluation of the laboratory test and the installation test, a test section may be built. It is recommended to install the test section along a line, representative of the planned application of the ballastless track system. The test section should be tested and monitored based on

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an agreed testing and monitoring regime. Where appropriate, testing and monitoring should cover a period that represents the characteristic climatic conditions.

5.3 Establishing the criteria for acceptance of works

Criteria for the acceptance of works 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. This set of criteria shall include all the requirements that influence how the ballastless track system interacts with other elements of the railway system.

The acceptance process for the ballastless track system shall be completed before the start of in-service traffic. The different subsystems (see 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 quality controls and evidence, different from those applying to ballasted track, need to be provided.

A failure to meet the defined criteria may be corrected by remedial measures to the track or by a revision of the design considering the achieved as-built parameters.

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5.4 Integration in the assurance process/Works Acceptance Plan (WAP)

To integrate the acceptance criteria 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.

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A WAP shall be created to set out all agreed measurements, tests and reports required to provide evidence that the works have met the specified criteria. Where a System Assurance Plan has been generated in the design phase (see 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 5.2) should be used to decide the tests, inspections and their frequency, to gather the evidence needed to support the acceptance. Reference to national codes of practice or other standards could also be required to define typical frequencies of tests and inspections.

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 criteria in the 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.

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6 Acceptance of works

6.1 Track geometry and position

6.1.1 Introduction

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

6.1.2 Relative track geometry

6.1.2.1 General

Unless otherwise specified, the relative track geometry shall be in accordance with EN 13231-1.

The tolerances in EN 13231-1:2013, Table 1 and Table 2, 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 than the tolerances for loaded track measurements.

6.1.2.2 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, the following criteria and limits shall be applied:

— Maximum 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;

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and

— Maximum allowable deviation of versine ≤ 10 mm 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.

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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 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 includes *D0* (wavelength 1 m ≤ λ ≤ 5 m), *D1* (wavelength 3 m ≤ λ ≤ 25 m) and *D2* (wavelength 25 m ≤ λ ≤ 70 m) according to EN 13848-1.

Track deviations shall be determined based on wavelength (inverse of spatial frequency) and evaluated e.g. using Power Spectral Density PSD (see EN 13848-6:2014+A1:2020, 5.6).

The Power Spectral Density $G_x(j)$ is determined by the squared effective value of the track deviation divided by the spatial frequency interval dF.

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 spatial frequency range of 0,015 [1/m] to 1 [1/m].

If peaks of a determined PSD exceed the limit in Figure 1, the specific root cause should be investigated and the required actions agreed between supplier and customer.

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

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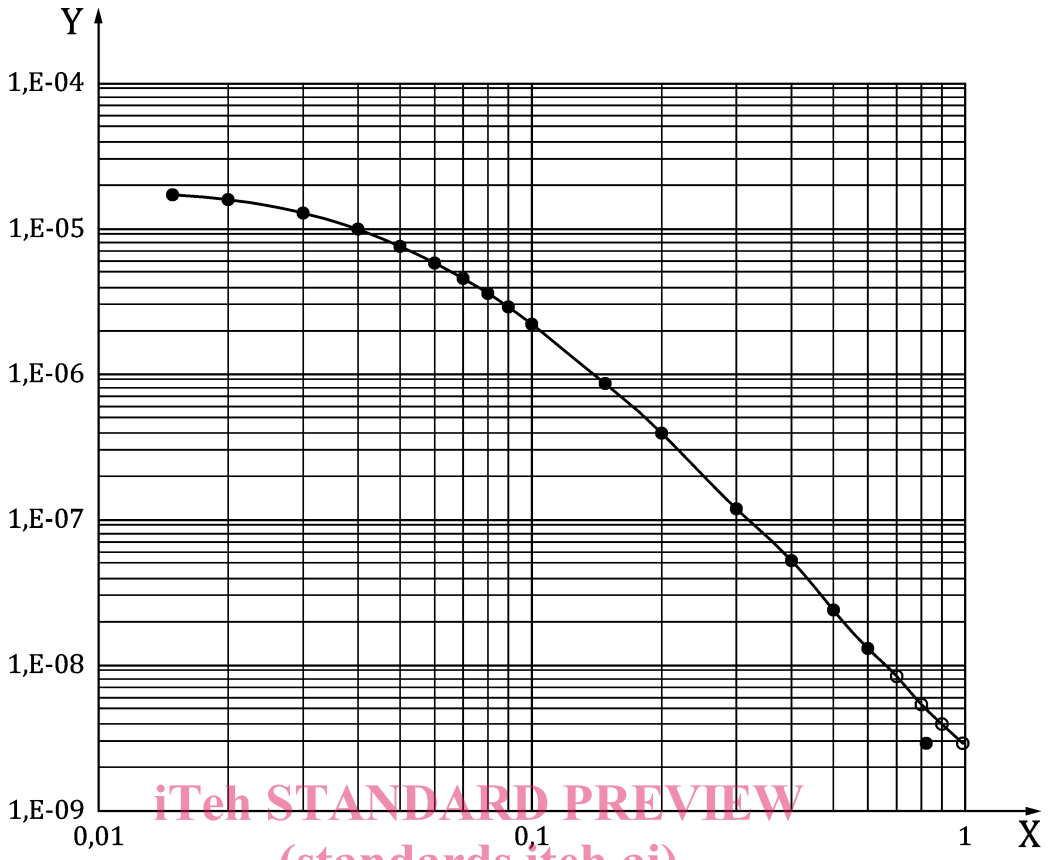

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Key

X Spatial frequency [1/m]

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

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

6.1.3 Absolute track position

The absolute track position shall be in accordance with EN 13231-1.

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

6.2 Track stiffness

6.2.1 Vertical track stiffness

The vertical stiffness performance of the subsystems and components providing the designed vertical track stiffness of the ballastless track system shall be specified during track design and verified prior to the track construction. Therefore, no on-site testing is required to demonstrate the vertical track stiffness.