SLOVENSKI STANDARD
SIST EN 16432-1:2017

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Železniške naprave - Progovni sistemi z utrjenimi tirnicami - 1. del: Splošne zahteve

Railway applications - Ballastless track systems - Part 1: General requirements

Bahnanwendungen - Feste Fahrbahn-Systeme - Teil 1: Allgemeine Anforderungen

Applications ferroviaires - Systèmes de voie sans ballast - Partie 1 : Exigences générales

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45.080	Tračnice in železniški deli	Rails and railway components

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Railway applications - Ballastless track systems - Part 1: General requirements

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

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European foreword

This document (EN 16432-1:2017) 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of an identical text or by endorsement, at the latest by January 2018, and conflicting national standards shall be withdrawn at the latest by January 2018.

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For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard is one of the series EN 16432 “*Railway applications - Ballastless track systems*” as listed below:

— *Part 1: General requirements;*

— *Part 2: System design, subsystems and components;*

— *Part 3: Acceptance* (under preparation).

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard is intended to be used by customers, designers and specifiers of ballastless track systems as well as for reference and development by suppliers and construction contractors.

The content and relationship between part 1, 2 and 3 are shown in Figure 1.

This part of the series EN 16432 covers the general requirements for ballastless track systems.

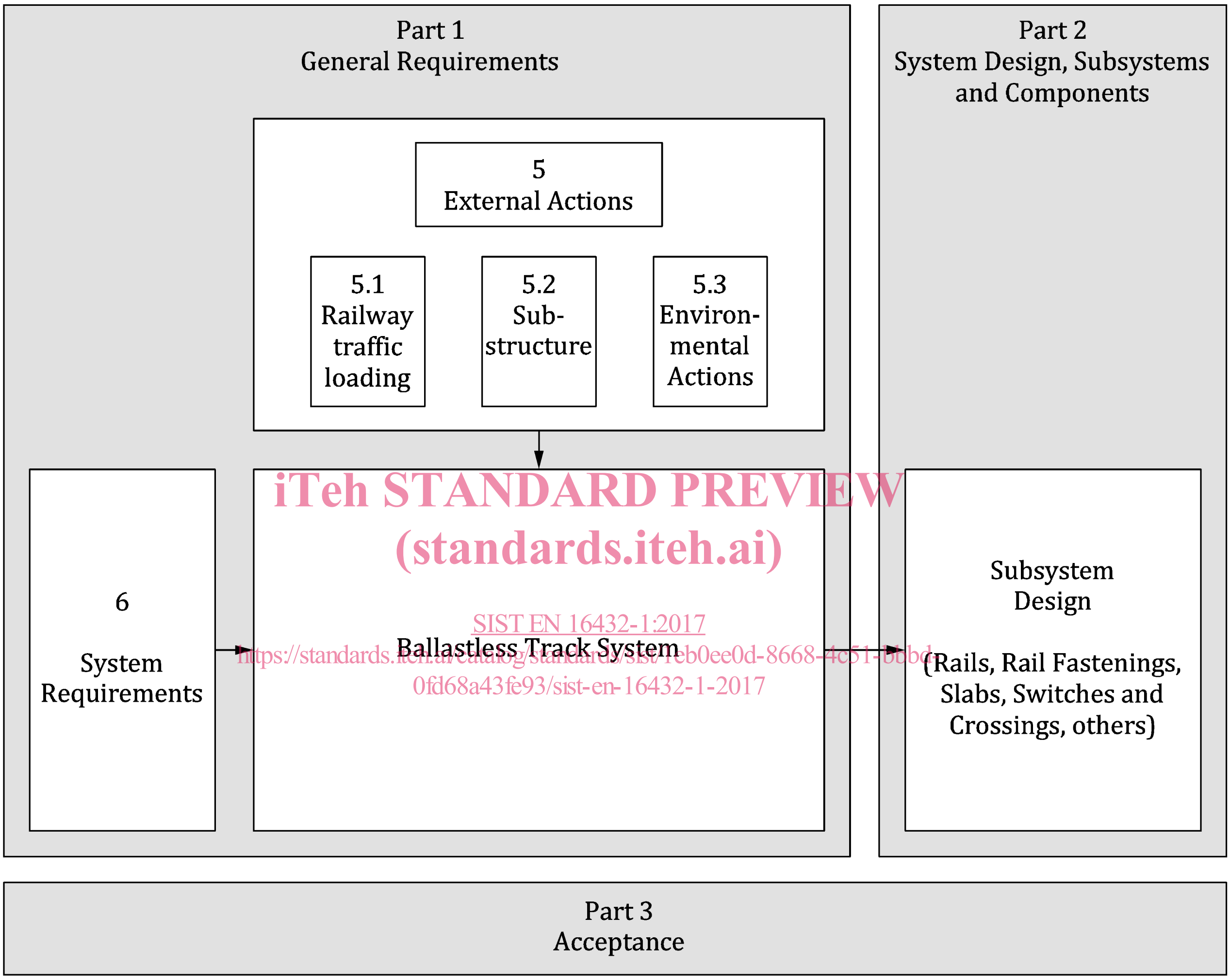

Figure 1 — Structure of EN 16432-1, EN 16432-2 and EN 16432-3

1 Scope

This European Standard defines the general requirements concerning the design of ballastless track systems.

It does not include any requirements for inspecting, maintaining, repairing and replacing ballastless track systems during operation.

This European Standard is applicable to all railway applications up to 250 kN axle load.

The requirements of this standard apply to:

— plain line track, switches and crossings and rail expansion joints;

— various substructures like embankments and cuttings, tunnels, bridges or similar, with or without floating slabs;

— transitions between different substructures;

— transitions between different ballastless track systems;

— transitions between ballasted and ballastless track systems.

NOTE Requirements for characterization of the substructures listed above are included in this standard. Design of the substructures is covered by other European Standards, e.g. EN 1992–2, EN 1997–1, etc..

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 1991-2:2003, *Eurocode 1: Actions on structures - Part 2: Traffic loads on bridges*

EN 1997-1, *Eurocode 7: Geotechnical design - Part 1: General rules*

EN 50122 (series), *Railway applications - Fixed installations - Electrical safety, earthing and the return circuit*

EN 13481-5, *Railway applications - Track - Performance requirements for fastening systems - Part 5: Fastening systems for slab track with rail on the surface or rail embedded in a channel*

EN 13848-5, *Railway applications - Track - Track geometry quality - Part 5: Geometric quality levels - Plain line*

EN 13848-6, *Railway applications - Track - Track geometry quality - Part 6: Characterisation of track geometry quality*

EN 14363, *Railway applications - Testing and Simulation for the acceptance of running characteristics of railway vehicles - Running Behaviour and stationary tests*

EN 15273-3, *Railway applications - Gauges - Part 3: Structure gauges*

EN 15528, *Railway applications - Line categories for managing the interface between load limits of vehicles and infrastructure*

EN 16207, *Railway applications - Braking - Functional and performance criteria of Magnetic Track Brake systems for use in railway rolling stock*

3 Terms and definitions

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

3.1
design life
assumed period for which a ballastless track system, or part of it, is to be used for its intended purpose with planned maintenance but without major repair

3.2
Electromagnetic Compatibility
EMC
ability of equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

3.3
floating slab
track system where a designed elasticity is introduced between the ballastless track system and substructure

EXAMPLE For vibration mitigation.

3.4
substructure
earthworks (embankment, cutting or at-grade) or bridges (or similar civil structures) or tunnel floor that lie below the ballastless track system

3.5
static action
action that does not cause significant acceleration of the structure or structural members

3.6
quasi-static action
dynamic action represented by an equivalent static action in a static model

3.7
dynamic action
action that causes significant acceleration of the structure or structural members

3.8
exceptional load
infrequent load which exceeds the limit for the relevant operational conditions

3.9
track stability
resistance of the track to buckling

4 Abbreviations

For the purposes of this document, the following abbreviations apply.

CWR Continuous Welded Rail

EMC Electromagnetic Compatibility

UV Ultra Violet (radiation)

ECB Eddy Current Brake

5 External actions

5.1 Railway traffic loading

5.1.1 General

The main function of the track is to safely guide the vehicle and to distribute the loads through the ballastless track system to the substructure. The ballastless track system shall carry the loads from the railway traffic over the design life within the specified operational and safety limits.

Loads are generated by:

— static or quasi static actions;

— dynamic actions;

— exceptional actions.

Other loads associated with construction, maintenance and emergency access shall be considered as necessary. 5.1 of this standard describes the requirements of railway traffic by vehicles that run on the rails of the ballastless track system.

NOTE Other vehicles that run during construction, maintenance or during an emergency or at level crossings on the track surface beside the rails are not in the scope of this standard.

5.1.2 Vertical loads

5.1.2.1 General

If no specific information is available regarding the vertical loading then load model 71 shall be applied as static vertical load for railway traffic to design the rail supporting structure. If specified, the ballastless track system may also be designed for vertical loads which are of short duration or are applied only infrequently during the design life according to the line category. Also models representing real vehicles may be used.

5.1.2.2 Load model 71

The rail traffic covered by load model 71 according to EN 1991-2:2003, 6.3.2, represents all types of vehicles and European standard railway traffic up to 250 kN axle load.

5.1.2.3 Load model according to line category

If specified by the customer, vertical load models according to the line categories in EN 15528 shall be applied for the design of the ballastless track system.

5.1.2.4 Real vehicle model

If specified by the customer, a real vehicle load model representing the conditions of traffic operation for the line (e.g. for specially dedicated rolling stock running on self-contained railways with uniform traffic and limited variation in vehicle type over the design life) shall be used for the design of the ballastless track system.

5.1.2.5 Additional vertical loads

Vertical static loads act unequally on the inner and outer rails due to centrifugal effects in curves or non-uniform load distribution. Such effects shall be determined on the basis of the applied vehicle model, taking into account of track alignment parameters such as cant and cant deficiency.

If track alignment parameters are not specified, the load distribution between inner and outer wheel shall be a maximum of ± 25 %, equivalent to factor k_q = 1,25 (±20 % equivalent to factor k_q = 1,20 if tilting vehicles are excluded).

NOTE 1 k_q is the factor to increase the static wheel loads by additional vertical load (additional quasi static wheel load acting on outside rail along curves).

NOTE 2 For more information, see EN 16432–2:2017, Annex A.

5.1.2.6 Dynamic vertical loads

Dynamic vertical loads are dependent on vehicle speed, the condition of the vehicle and of the track quality, see EN 13848-5 and EN 13848-6.

The dynamic vertical load is obtained from multiplication of the static load from the applied load model and the factor, e.g. k_d × load model 71.

Unless otherwise specified a factor of k_d = 1,5 shall be applied to all static and quasi-static loads, see 5.1.2.2, 5.1.2.3 and 5.1.2.4.

NOTE 2 The factor 1,5 is set also according to the maximum safety limit of 5,0 m/s² vertical car body acceleration of EN 14363.

Alternative models to determine the dynamic loads or the dynamic factor k_d are:

— track quality characterized by normal distribution using deviation from the intended vertical profile of the loaded rail within the following limits:

  a) coefficient of variation should be limited to 10 %;

  b) confidence level 99,7 % unless otherwise specified;

— Power Spectral Density (PSD) function describing vehicle response (e.g. by Multi-Body-Simulation) according to specified limits;

— other models describing vehicle-track-substructure interaction in combination with acceptance criteria.

5.1.2.7 Exceptional vertical loads

Exceptional loads shall be checked taking into account the low frequency of occurrence.

5.1.3 Lateral loads

5.1.3.1 General

Lateral loads always act in combination with the corresponding vertical loads, see 5.1.2.

5.1.3.2 Static and quasi static train guiding loads

Unless otherwise specified a sum of lateral guidance forces (including centrifugal forces) according to the safety limit $\Sigma\, Y_{max,lim}$ of EN 14363 shall be applied.

$$Y_l = k_1 \times (10 + 2 \times Q / 3) \quad (1)$$

where

- Y_l is the sum of lateral guidance forces acting on the rail head in kN;
- k_1 is 1,0 for all kinds of vehicle on ballastless track;
- Q is the vertical static wheel load in kN.

If specified by the customer alternative models to determine the static and quasi-static lateral loads shall be applied.

5.1.3.3 Exceptional lateral loads

The exceptional lateral load shall be able to be resisted by the track system at any point. It should not be used in addition to the quasi-static lateral load.

The exceptional lateral load shall be taken as $Y_{ls} = 1,2 \times Q$ according to EN 14363 acting on a single wheel.

5.1.4 Longitudinal loads

5.1.4.1 Braking and acceleration

Longitudinal loads caused by braking and acceleration shall be considered equivalent to the force generated by at least 2,5 m/s² in combination with the corresponding vertical loads. If specified by the customer higher accelerations shall be considered according to EN 1991-2:2003, 6.5.3.

5.1.4.2 Eddy current braking

Where applicable, effects due to eddy current braking shall be considered. Effects of eddy current braking systems, if used for regular service braking are dependent on the activated brake force and the sequence of trains. Effects activated by emergency braking are significantly higher and should be handled as exceptional loading, according to 5.1.2.7 and 5.1.4.3 for magnetic rail brakes. The effects of eddy current brake systems in terms of operational track loading are:

— a vertical attraction force between the brake and ferromagnetic components of the ballastless track system and track equipment;

  a) maximum vertical attraction force activated by magnets shall be determined and specified from the rolling stock. The attraction force interferes with movable track components, e.g. turnouts-lift of tongue rail, and track equipment;

  b) attraction forces between the braking system and the CWR are insignificant in terms of ballastless track system loading unless the force exceeds 40 kN/bogie and per rail due to emergency braking;