SLOVENSKI STANDARD
SIST EN 16730:2016

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Železniške naprave - Zgornji ustroj proge - Betonski pragi in nosilci s podpragovnimi podlogami

Railway applications - Track - Concrete sleepers and bearers with under sleeper pads

Bahnanwendungen - Infrastruktur - Gleis- und Weichenschwellen aus Beton mit Schwellenbesohlungen

Applications ferroviaires - Voie - Traverses et supports en béton avec semelles sous traverse

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Applications ferroviaires - Voie - Traverses et supports en béton avec semelles sous traverse

Bahnanwendungen - Oberbau - Gleis- und Weichenschwellen aus Beton mit Schwellensohlen

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Contents

Page

European foreword

This document (EN 16730:2016) 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of an identical text or by endorsement, at the latest by December 2016, and conflicting national standards shall be withdrawn at the latest by December 2016.

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Introduction

This European Standard relates to the EN 13230 series when the sleepers or bearers are manufactured with Under Sleeper Pad (USP). The USP is an elastic layer fixed to the bottom surface of the sleepers or bearers. This standard applies to the system constituted of the concrete sleepers or bearers and the Under Sleeper Pad.

1 Scope

This European Standard is applicable to concrete sleepers or bearers with Under Sleeper Pads (USP) physically bonded to concrete used in ballast track and define the test procedures and their evaluation criteria. This standard provides particular information in the following areas:

— test methods, test arrangements and evaluation criteria of Under Sleeper Pads;

— test methods, test arrangements and evaluation criteria of concrete sleepers and bearers with Under Sleeper Pads;

— data supplied by the purchaser and by the supplier;

— definition of general process of design approval tests;

— definition of routine tests.

This standard defines the specific test procedures for design approval tests, routine tests and tests concerning the determination of relevant properties of Under Sleeper Pad with or without concrete sleepers and bearers:

— fatigue tests;

— tests of capability for stacked stocking of concrete sleepers or bearers fitted with USP;

— pull-out test;

— severe environmental condition test.

This standard also sets out procedures for testing fitness for purpose and provides information on quality monitoring as part of quality assurance procedures. This standard does not, however, contain requirements pertaining to the properties of Under Sleeper Pads. It is the responsibility of the purchaser to define these requirements

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

EN 1542, *Products and systems for the protection and repair of concrete structures - Test methods - Measurement of bond strength by pull-off*

EN 10027 (all parts), *Designation systems for steels*

EN 13230-1:2016, *Railway applications - Track - Concrete sleepers and bearers - Part 1: General requirements*

EN 13230-2:2016, *Railway applications - Track - Concrete sleepers and bearers - Part 2: Prestressed monoblock sleepers*

EN 13230-3:2016, *Railway applications - Track - Concrete sleepers and bearers - Part 3: Twin-block reinforced sleepers*

EN 13230-4:2016, *Railway applications - Track - Concrete sleepers and bearers - Part 4: Prestressed bearers for switches and crossings*

EN 13230-5, *Railway applications - Track - Concrete sleepers and bearers - Part 5: Special elements*

EN 13450, *Aggregates for railway ballast*

EN ISO 527 (all parts), *Plastics — Determination of tensile properties (ISO 527, all parts)*

EN ISO 7500-1, *Metallic materials - Calibration and verification of static uniaxial testing machines - Part 1: Tension/compression testing machines - Calibration and verification of the force-measuring system (ISO 7500-1)*

EN ISO 9513:2012, *Metallic materials - Calibration of extensometer systems used in uniaxial testing (ISO 9513:2012)*

EN ISO 22768 (all parts), *Permissible machining variations in dimensions without tolerance indication (ISO 2768, all parts)*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

3 Terms and definitions

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

3.1
track category TC1
track using concrete sleepers or bearers with under sleeper pads designed for urban light rail and some industrial track with a typical axle load between 100 kN and 130 kN, a typical maximum speed of 100 km/h, a typical rail section of 49E1 (as defined in EN 13674-1) and a typical sleeper or support spacing of 650 mm (maximum 750 mm)

3.2
track category TC2
track using concrete sleepers or bearers with under sleeper pads designed for urban light rail and some industrial track with a typical axle load of 160 kN, a typical maximum speed of 140 km/h, a typical rail section of 54E1 (as defined in EN 13674-1) and a typical sleeper or support spacing of 650 mm

3.3
track category TC3
track using concrete sleepers or bearers with under sleeper pads designed for either:

— conventional main line railways with a typical axle load of 225 kN, a typical maximum speed of 200 km/h, a typical rail section of 60E1 (as defined in EN 13674-1) and a typical sleeper or support spacing of 600 mm; or

— track using concrete sleepers or bearers with under sleeper pads designed for lines with large radius curves, often used for high speed trains and having a typical axle load of 200 kN, a typical maximum speed of 320 km/h, a typical rail section of 60E1 (as defined in EN 13674-1), a typical sleeper or support spacing of 600 mm

3.4
track category TC4
track using concrete sleepers or bearers with under sleeper pads designed for mixed traffic line carrying heavy freight trains with a typical axle load of 300 kN, a typical maximum speed of 200 km/h, a typical rail section of 60E1 (as defined in EN 13674-1) and a typical sleeper or support spacing of 600 mm

3.5
ballasted track
track in which the sleepers or bearers are embedded in the ballast

3.6
sleeper
transverse components of the track which control the gauge and transmit loads from the rail to the ballast or other sleeper support

3.7
bearer
transverse components of switches and crossings which control the relative geometry of two or more stretches of running rails and different pieces of special track work, and transmit loads from the rails to the ballast or other sleeper support

3.8
Under Sleeper Pad
USP

elastic layer fixed to the bottom surface of the sleepers or bearers including technologies of bonding between sleepers or bearers and under sleeper pad

3.9
stiffness
force per unit deflection measured under a uniaxial force

3.10
bedding modulus
pressure (force per surface) per unit deflection and measured under a uniaxial load

3.11
stiffness or bedding modulus
stiffness or bedding modulus in vertical direction measured normal to the base of the sleeper where the support is a slab, between two specified applied loads

3.12
static stiffness or bedding modulus
force or pressure per unit deflection measured under a uniaxial static load

3.13
dynamic stiffness or bedding modulus
force or pressure per unit deflection measured under a cyclic uniaxial load

Note 1 to entry: Low frequency dynamic stiffness or bedding modulus: stiffness or bedding modulus measured within the frequency range (2 to 30) Hz (without preloading between defined pressures, see Figure 1).

Note 2 to entry: Higher frequency dynamic stiffness or bedding modulus: stiffness or bedding modulus measured within the frequency range (20 to 450) Hz (under preloading conditions see Table H.1, see Figure 1).

3.14
vibration mitigation
reduction in emission of mechanical vibration and/or structure-borne noise into the surroundings

3.15
geometric ballast plate
GBP
rigid steel plate with a geometrically structured surface simulating ballast contact

Note 1 to entry: See Annex A.

3.16
design approval test
homologation procedure with description of the product properties and test results

3.17
routine test
quality control test in terms of regular manufacturing

3.18
purchaser
operator or user of the equipment, or the customer of the material on the user's behalf

3.19
supplier
body responsible for the use of the EN in response to the purchaser's requirement and also for requirements which apply to the producer or manufacturer

Note 1 to entry: Generally the supplier is the manufacturer of the concrete sleepers and has a sub-contractor for the USPs.

3.20
USP on concrete block
USP bonded on concrete block

Note 1 to entry: See Annex B.

4 Symbols

Table 1 — Symbols

Symbols	Characterization	Units
A	area	mm^2
a	acceleration in measurement of higher frequency bedding modulus	m/s^2
C	bedding modulus	N/mm^3
d	displacement	mm
Δ	variation	-
F	force	N
f	frequency in measurement	Hz
k	stiffness	N/mm
L_H	vibration level related to reference value of 5×10^{-8} m/s	dB
m	mass	kg
N	number of cycles	-
η	loss factor	-
p	pressure	N/mm^2
κ	stiffening coefficient between low frequency dynamic bedding modulus and static bedding modulus	-
σ	stress (pressure or tensile)	N/mm^2
ω	angular frequency = $2\pi \cdot f$ (for higher frequency bedding modulus)	s^{-1}

Table 2 — Indice of the symbols

Indices	Characterization
0	for frequency, definition of natural frequency
5 Hz, 10 Hz, 20 Hz, 30 Hz	value of frequency in measurement
af	after
av	average
be	before
dyn	low frequency dynamic
H	higher frequency
max	maximum
min	minimum
number	sequential number in order to differentiate types of measurements
pre	preload
stat	static
tend	tendency
test	test load

5 Design approval tests and routine tests

5.1 General

This clause defines the objectives of tests or of required information about the system (sleeper with USP), USP and concrete sleepers and bearers.

The data sheets and the general processes of USP and sleeper with USP are described in Annex F and Annex G.

If a tested USP is used with different concrete sleepers or bearers (different types or different manufacturing process), the purchaser shall state, as a selection of in Tables 3 to 5 given tests, which tests shall be performed.

5.2 Summary of design approval tests and routine tests

The design approval tests and the routine tests consist of the following three stages:

— Tests of USP alone and of USP on concrete block (see Table 3);

— Tests of concrete sleepers and bearers without USP (see Table 4);

— Tests of USP on concrete sleepers and bearers (see Table 5).

The frequency of routine tests is defined according to the quality plan of the suppliers (see Clause 8).

Table 3 — Tests of USP alone and of USP on concrete block

Tests	Subclause	Design approval tests	Routine tests
Tensile strength of USP material	5.3.1	Optional	Optional
Static and low frequency dynamic bedding modulus of USP on concrete block with GBP	5.3.2	Mandatory for static, 5 and 10 Hz, optional for 20 and 30 Hz	1 of 2 is Mandatory
Static and low frequency dynamic bedding modulus of USP alone with GBP	5.3.3	Optional	
Higher frequency dynamic bedding modulus of USP on concrete block	5.3.4	Optional (but recommended if USP is used for vibrations attenuation)	Not Applicable
Fatigue test of USP on concrete block	5.3.5	Mandatory	Not Applicable
Fatigue test of USP on concrete block with GBP	5.3.6	Optional (but recommended if USP is used for vibrations attenuation)	Not Applicable
Capability for stacked stocking of sleepers with USP on concrete block	5.3.7	Optional	Not Applicable
Effect of severe environmental conditions on USP on concrete block	5.3.8	Optional	Not Applicable
Resistance to water (Hydrolysis)	5.3.9	Optional	Not Applicable
Resistance to chemical agents related to the manufacture of sleepers or bearers	5.3.9	Optional	Not Applicable
Resistance to fire	5.3.9	Optional	Not Applicable
Resistance to hydrocarbon	5.3.9	Optional	Not Applicable
Resistance to ozone	5.3.9	Optional	Not Applicable

Table 4 — Tests of concrete sleepers and bearers without USP

Tests	Subclause	Design approval tests	Routine tests
Requirements of concrete sleepers and bearers	5.4	Mandatory	Mandatory