SLOVENSKI STANDARD
SIST EN 17282:2020

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Železniške naprave - Infrastruktura - Pod balastnimi preprogami

Railway applications - Infrastructure - Under ballast mats

Bahnanwendungen - Infrastruktur - Unterschottermatten

Applications ferroviaires - Infrastructure - Tapis sous ballast

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Bahnanwendungen - Infrastruktur - Unterschottermatten

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 17282:2020) 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of an identical text or by endorsement, at the latest by April 2021, and conflicting national standards shall be withdrawn at the latest by April 2021.

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Introduction

In a track for railway vehicles, the under ballast mat (UBM) is a structural element which is placed between the substructure and the ballast layer. This document applies to the performance-related properties of this mat.

1 Scope

This document is applicable to under ballast mats used in ballasted track and defines the test procedures and their evaluation criteria.

This document provides particular information in the following areas:

— test methods, test arrangements and evaluation criteria of under ballast mats;

— data supplied by the purchaser and by the supplier;

— definition of general process of design approval tests;

— definition of routine tests.

This document defines the specific test procedures for under ballast mats:

— stiffness tests;

— fatigue tests;

— tests for severe environmental conditions.

This document also sets out procedures for testing fitness for purpose and provides information on quality monitoring as part of quality assurance procedures. This document does not, however, contain requirements pertaining to the functions of under ballast mats. It is the responsibility of the purchaser to define these requirements and to choose the optional tests.

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

EN 13450, *Aggregates for railway ballast*

EN 13674-1, *Railway applications - Track - Rail - Part 1: Vignole railway rails 46 kg/m and above*

EN ISO 1856, *Flexible cellular polymeric materials - Determination of compression set (ISO 1856)*

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 22768 (all parts), *General tolerances (ISO 2768, all parts)*

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 http://www.electropedia.org/

3.1
ballasted track
track in which the sleepers or bearers are supported by ballast

3.2
under ballast mat (UBM)
product of elastic material installed in track between substructure and ballast layer including all integral parts of the product

Note 1 to entry: The main objectives of the application of under ballast mats are to reduce stiffness in the track in order to improve the load distribution and/or to reduce vibrations transmitted to the surroundings and, by doing so, provide vibration mitigation.

3.3
stiffness
force per unit deflection, measured under a uniaxial load

3.4
bedding modulus
pressure (force per surface) per unit deflection, measured under a uniaxial load

3.5
static stiffness or bedding modulus
force or pressure per unit deflection measured under a uniaxial static load

3.6
low frequency dynamic stiffness or bedding modulus
force or pressure per unit deflection measured under a uniaxial load which acts periodically at a frequency of (5 to 20) Hz between specific force or pressure levels

Note 1 to entry: This value is determined mainly for calculation of dynamic deformation of tracks.

3.7
higher frequency dynamic stiffness or bedding modulus
force or pressure per unit deflection measured under a uniaxial load or displacement, which acts periodically at a defined test frequency of (10 to 160) Hz at a specific pressure level

Note 1 to entry: This value will be determined as an input characteristic for vibration calculations. In contrast to the determination of low frequency dynamic stiffness or bedding modulus, this test will be determined under static preloading.

3.8
noise mitigation
reduction of secondary air-borne noise radiated by a construction (e.g. bridge)

Note 1 to entry: UBMs do not provide mitigation of airborne noise from the wheel and rail system.

3.9
vibration mitigation
reduction of emission of mechanical vibration and/or structure-borne noise into the surroundings

3.10
geometric ballast plate (GBP)
rigid steel plate with a geometrically structured surface simulating ballast contact

Note 1 to entry: See Annex A.

3.11
design approval test
test performed to demonstrate the compliance of the product properties to the requirements, set by the purchaser

3.12
routine test
test performed to demonstrate the compliance of the product properties to the quality plan, set by the supplier

3.13
purchaser
operator or user of the equipment, or the customer of the material on the user's behalf

3.14
supplier
company / body responsible for the execution of purchaser's requirements

Note 1 to entry: This can be the manufacturer or his designated representative, stockist, distributer, or agent. The supplier is responsible for the use of the EN in response to the purchaser's requirements and will ensure all local conditions of purchase requirements are satisfied.

3.15
manufacturer
organization responsible for blending and processing material constituents, integrating them in the manufacturing process and subsequently cutting, stamping or moulding to final dimensions

4 Symbols and abbreviations

Table 1 — Symbols

Symbols	Characterization	Units
A	area	mm^2
a	acceleration in measurement of higher frequency stiffness	m/s^2
C	bedding modulus	N/mm^3
d	displacement	mm
Δ	variation	-
F	force	kN
f	frequency in measurement	Hz
k	stiffness	N/mm
L	point stiffness level for higher frequency stiffness	dB re 1 N/m
m	mass	kg
η	loss factor	-
N	number of cycles	-
p	pressure	N/mm^2
κ	stiffening ratio between dynamic bedding modulus and static bedding modulus	-
σ	stress (compressive or tensile)	N/mm^2
ω	angular frequency = $2\pi \cdot f$ (for higher frequency stiffness)	s^{-1}

Table 2 — Indices of the symbols

Indices	Characterization
0	for frequency, definition of natural frequency
i Hz	value of frequency in measurement
af	after
av	average
be	before
dyn	low frequency dynamic
H	higher frequency
h	horizontal
max	maximum
min	minimum
'number' or i	sequential number in order to differentiate types of measurements
pre	preload
stat	static
tend	tendency
test	test load
v	vertical

5 Track categories

For track categories, see Table 3.

Table 3 — Definition of track categories (TC) for tracks using under ballast mats according to their typical specifications and application

	Axle load [kN]	**Speed** [km/h]	**Rail profile** as defined in EN 13674-1	**Distance of sleeper supports or rail fastenings** [mm]	**Typical application**
TC1	≥ 100 and ≤ 130	≤ 100	49E1	650 (maximum 750)	Urban rail or industrial tracks
TC2	≤ 160	≤ 140	54E1	650	Urban rail or industrial tracks
TC3	≤ 225	≤ 200	60E1	600	Conventional main lines
	≤ 200	≤ 320	60E1	600	High-speed lines and tracks with large radius
	≤ 250	≤ 120	60E1	600	Freight lines
TC4	≤ 300	≤ 120	60E1	600	Freight with heavy axle loads including Mixed traffic (TC3)

6 Design approval tests and routine tests

6.1 General

This clause defines the objectives of tests and of demanded information about the UBM.

The purchaser may define the test laboratory or validate the one proposed by the supplier.

The purchaser decides the way to choose the test sample units.

In order to be able to identify the UBM at a later date, the following values shall be indicated:

— the mass per area (kg/m²) of the product and all its components, see 6.3.1;

— the results of a suitable material analysis as selected by the manufacturer and approved by the purchaser.

The supplier shall provide sufficient data to satisfy the objectives of the tests and/or the provision of requested information in respect of the UBM including:

— the data sheet as described in Annex B;

— any transportation, storage and installation recommendations and procedures to preserve the material characteristics and original performance.

Compliance with a given TC implies compliance with all lower TC except for results of the bedding modulus measurements.

6.2 Summary of design approval tests and routine tests

The design approval tests and the routine tests are stated in Table 4.

The values determined in product qualification testing shall act as the reference values for quality assurance and quality monitoring procedures.

The frequency of routine tests is defined according to the quality plan of the supplier (see Clause 9).

Table 4 — Tests for UBM

Tests	Clause	Design approval tests	Routine tests
Dimensions and mass	6.3.1	Mandatory	Mandatory
Static and low frequency dynamic vertical bedding modulus determined with GBP	6.3.2	Mandatory for static, 5 and 10 Hz, optional for 20 Hz	Mandatory for static and 5 Hz at (23 ± 5)°C
Higher frequency dynamic vertical bedding modulus	6.3.3	Optional (but recommended if UBM is used for noise and vibration mitigation)	Not Applicable
Fatigue test with ballast	6.3.4	Mandatory	Not Applicable
Fatigue test with GBP	6.3.5	Optional (but recommended if UBM is used for noise and vibration mitigation)	Not Applicable
Compression set test	6.3.6	Optional	Not Applicable
Static horizontal bedding modulus	6.3.7	Optional	Not Applicable
Water resistance and freeze–thaw resistance	6.3.8	Optional	Not Applicable
Ageing test with high temperatures	6.3.9	Optional	Not Applicable
Resistance to chemical agents	6.3.10	Optional	Not Applicable
Resistance to hydrocarbon	6.3.10	Optional	Not Applicable
Resistance to ozone	6.3.10	Optional	Not Applicable
Resistance to fire	6.3.10	Optional	Not Applicable
Environment and end of life	6.3.11	Optional	Not Applicable

6.3 Requirements for specification of UBM

6.3.1 Dimensions and mass

The supplier shall indicate the range of available dimensions with tolerances of the UBM and type of joint (joint closing method as per supplier recommendation).

The thickness and mass per area (kg/m²) of UBM shall be indicated in order to enable identification.

Test arrangement:

Thickness and mass are measured with suitable instruments.

Design approval:

All the UBM samples for design approval shall be checked according to technical documentations on thickness and mass.

The purchaser shall approve the technical documentation on thickness and mass given by supplier.

The values determined in design approval tests shall be the reference values for routine tests.

6.3.2 Static and low frequency dynamic vertical bedding modulus determined with GBP

The static and the low frequency dynamic vertical bedding modulus determined with the GBP are considered as key performance properties of the UBM.

Test arrangement:

The static and low frequency dynamic vertical bedding modulus of UBM with GBP shall be measured in accordance with Annex C.

The low frequency dynamic bedding modulus is measured at (5 ± 1) Hz and (10 ± 1) Hz (and optional frequency tests at (20 ± 2) Hz).

Design approval:

The test method shall be applied on three UBM samples. For profiled UBM with geometric elements (e.g. dimples, cones, grooves, tubes) reasonable deviations from the standard sample size (300 mm × 300 mm) are permitted, but shall be duly justified by the supplier and accepted by the purchaser.

The alternative sample size shall not exceed the size of the testing area (300 mm × 300 mm) of the GBP, in order to enable execution of all relevant GBP tests.

If the difference between the static bedding modulus with alternative size and sample of (300 mm × 300 mm) is ≤ 5 %, the further tests shall be performed with the same amount and size of samples as non-profiled UBM (300 mm × 300 mm).

The same UBM samples shall be tested for the static and for the low-frequency dynamic bedding modulus.

If this test is performed at other temperatures than (23 ± 5) °C, then the median value sample ($C_{dyn\text{-}5Hz}$) obtained at (23 ± 5) °C shall be selected for performing this test.

The purchaser shall define the following evaluation criteria for the design approval test for a track category:

— minimum value ≤ C_{stat} ≤ maximum value;

— minimum value ≤ $C_{dyn\ 5Hz}$ or $C_{dyn\ 10Hz}$ ≤ maximum value.

NOTE 1 $C_{dyn\ 20Hz}$ is an informative value.

The supplier shall provide the reference values for the static and the low frequency dynamic bedding modulus for routine test, based on the values of the design approval tests, in the range of the purchaser acceptance criteria.

NOTE 2 The relationship between values measured between flat plates (FP) and Geometrical Ballast Plate (GBP) is not linear and differs for static and dynamic bedding modulus values. Therefore, a direct comparison between the values measured using the flat plates and geometric ballast plates GBP is not possible.