BS EN 13230-4:2016

BSI Standards Publication

Railway applications — Track — Concrete sleepers and bearers

Part 4: Prestressed bearers for switches and crossings

bsi.

National foreword

This British Standard is the UK implementation of EN 13230-4:2016. It supersedes BS EN 13230-4:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RAE/2, Railway Applications - Track.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 84808 7

ICS 45.080; 91.100.30; 93.100

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2016.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13230-4

May 2016

ICS 91.100.30; 93.100

Supersedes EN 13230-4:2009

English Version

Railway applications - Track - Concrete sleepers and bearers - Part 4: Prestressed bearers for switches and crossings

Applications ferroviaires - Voie - Traverses et supports en béton - Partie 4 : Supports précontraints pour appareil de voie

Bahnanwendungen - Oberbau - Gleis- und Weichenschwellen aus Beton - Teil 4: Spannbetonschwellen für Weichen und Kreuzungen

This European Standard was approved by CEN on 4 March 2016.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

European foreword

This document (EN 13230-4:2016) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This document supersedes EN 13230-4:2009.

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 November 2016, and conflicting national standards shall be withdrawn at the latest by November 2016.

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 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

This European Standard is one of the EN 13230 series “*Railway applications – Track – Concrete sleepers and bearers*”, which consist of the following parts:

— Part 1: General requirements;

— Part 2: Prestressed monoblock sleepers;

— Part 3: Twin-block reinforced sleepers;

— Part 4: Prestressed bearers for switches and crossings;

— Part 5: Special elements;

— Part 6: Design.

There is a change in the wording of the documents of EN 13230 (series) “design bending moment” is replaced by “characteristic bending moment” and “test bending moment”.

According to the CEN/CENELEC Internal Regulations, the national standards organisations 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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This part of the EN 13230 series defines the specific requirements dedicated to prestressed bearers for switches and crossings.

These are additional requirements to EN 13230-1:2016 that are necessary to have a complete standard dealing with prestressed bearers for switches and crossings.

The document specifies the test arrangements, the test procedures and the corresponding acceptance criteria.

1 Scope

This part of the EN 13230 series defines additional technical criteria and control procedures as well as specific tolerance limits related to manufacturing and testing prestressed bearers for switches and crossings with a maximum length of 8,5 m.

Bearers longer than 8,5 m are considered as special elements and are covered by EN 13230-5:2016.

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

FprEN 10138 (all parts), *Prestressing steels*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13230-1:2016 and the following apply:

3.1.1
prestressed monoblock bearer
bearer manufactured using pre-tensioned or post-tensioned tendons

3.1.2
characteristic positive bending moment
$\boldsymbol{M_{k,pos}}$
positive bending moment at any position of the bearer

3.1.3
characteristic negative bending moment
$\boldsymbol{M_{k,neg}}$
negative bending moment at any position of the bearer

3.2 Symbols

For the purposes of this document, the symbols listed in Table 1 apply.

Table 1 — Symbols

Symbol	Definition	Units
Fb_0	Positive initial reference test load	kN
Fb_{0n}	Negative initial reference test load	kN
Fb_r	Test load which produces first crack at the bottom of the bearer	kN
Fb_{rn}	Test load which produces first crack at the top of the bearer	kN
$Fb_{0,05}$	Maximum test load for which a crack width of 0,05 mm persists at the bottom of the bearer after removal of the load	kN
$Fb_{0,05n}$	Maximum test load for which a crack width of 0,05 mm persists at the top of the bearer after removal of the load	kN
Fb_B	Maximum test load which cannot be increased when the bottom of the bearer is cracked	kN
Fb_{Bn}	Maximum test load which cannot be increased when the top of the bearer is cracked	kN
Fb_u	Lower test load for the fatigue test: $Fb_u = 0,25 \times Fb_0$	kN
k_b	Impact coefficient for positive static test	
k_{bn}	Impact coefficient for negative static test	
k_{bB}	Impact coefficient for fatigue test	
k_t	Factor used for calculation of acceptance criteria for first crack formation in static tests	

4 Special requirement

4.1 Characteristic bending moments

The bearer shall be designed with positive and negative characteristic bending moment capacities with the objective of keeping it straight.

4.2 Positioning of fastening components

An area of the concrete section shall be specified by the purchaser to be free from prestressing tendons for the location of fastening components.

If required by the purchaser, the design of the bearer shall provide for the repair or replacement of the embedded fastening components.

4.3 Tolerances

4.3.1 General

The maximum tolerances specified in EN 13230-1:2016, 6.1 apply to concrete bearers.

In case of early dimensional inspection of the concrete element, the quality plan shall take into account further shortening of the element. Measurement of tolerances shall be checked not before 48 h after transfer of prestressing forces.

4.3.2 Tolerance of planeness

The maximum deviation of the total rail seat or base plate area is as follows:

— planeness: 1 mm;

— variation of planeness with regard to 2 points 150 mm apart: 0,5 mm.

4.3.3 Tolerances of fastening positioning

The tolerances of the embedded fastening components positioning shall be measured in accordance with Figure 1.

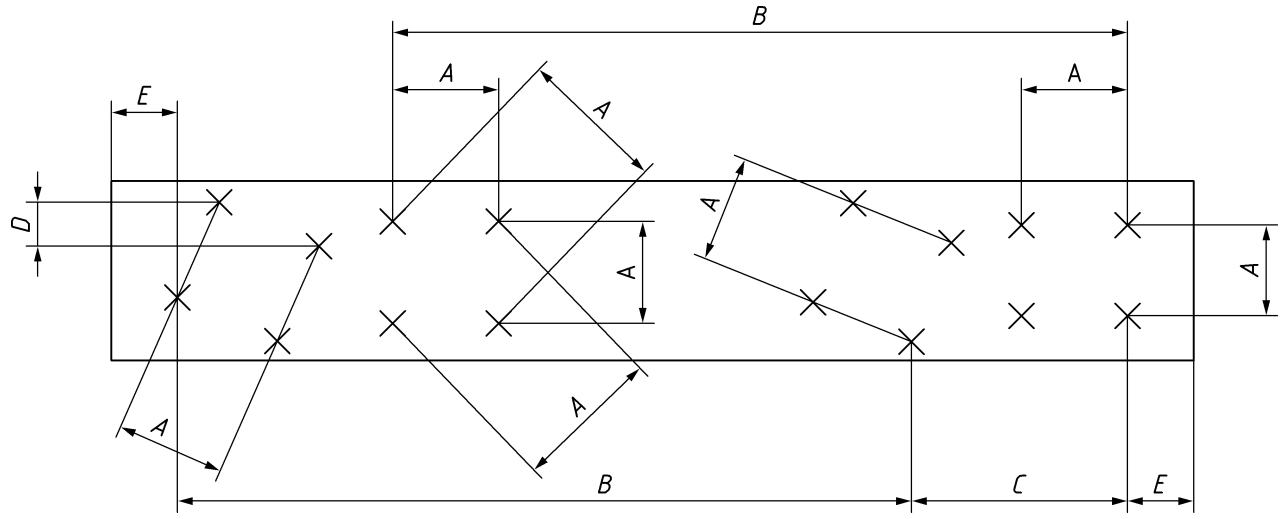


Figure 1 — Measurement of tolerances on fastening components positioning

Tolerance on dimensions *A* and *D* (on the same support area): ±1,0 mm

Tolerance on dimensions *B* and *C* (between two separate support areas): ±1,5 mm

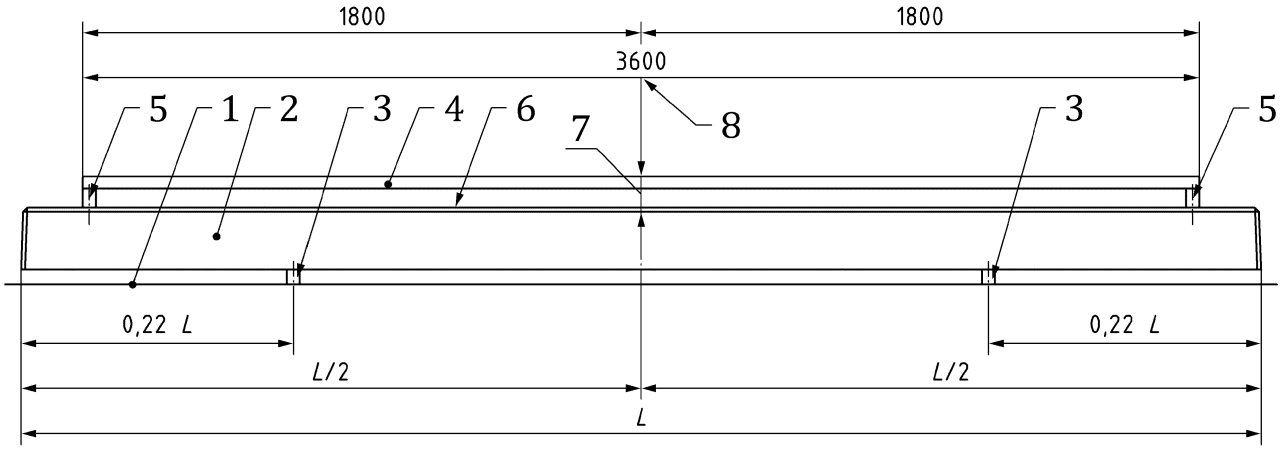
Tolerance between the last cast-in component and the end of the bearer (*E*): ±10 mm

The tolerances specified above may be varied by the purchaser in case of special requirements and shall be defined on the drawings submitted by the purchaser.

These tolerances shall apply to all embedded components with either direct or indirect fastening system.

4.3.4 Tolerance of vertical deviation from straight

Figure 2 shows the vertical deviation measurement.



Key

1 rigid support
2 bearer
3 support (50 mm × 50 mm section) across width of bearer
4 straight datum
5 support across width of bearer
6 top surface of bearer
7 vertical deviation measurement area
8 measurement base

Figure 2 — Vertical deviation measurement

Vertical deviation in both directions is measured on a 3,6 m long base as on Figure 2.

Alternative measurement methods can be proposed by the manufacturer and agreed with the purchaser.

Bearers shorter than 4 m need not be checked.

Maximum allowed deviation is 3 mm on a 3,6 m base.

For bearer length above 6 m, maximum allowed deviation is agreed between supplier and purchaser.

4.4 Distance from the end of the bearer to the nearest cast-in component

The supplier defines the prestress anchoring area and special care to be taken into account for cast-in components near to the end of the bearer.

5 Product testing

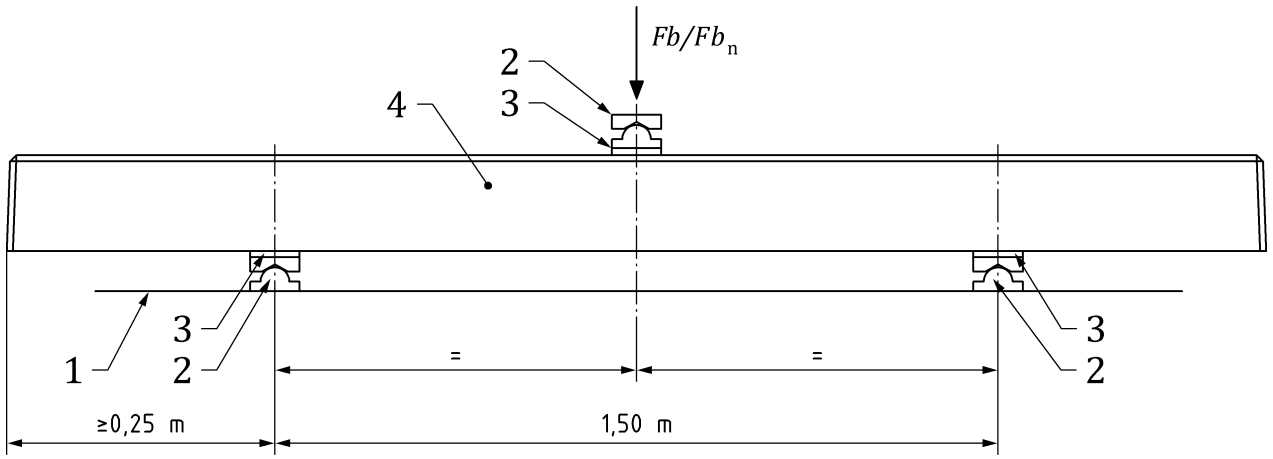
5.1 General

This section defines the testing regime and rules for acceptance of concrete bearers.

The layouts of the test arrangements are defined in this section.

5.2 Test arrangements

The arrangement for the static and fatigue tests is shown in Figure 3.



Key

1 rigid support
2 articulated support (see Annex A for details)
3 resilient pad (see Annex A for details)
4 bearer

Figure 3 — Test arrangement

For the static test, the bearer shall be arranged as in Figure 3.

For the fatigue test, the load *Fb* shall be applied at the centre section of the bearer.

5.3 Test procedures

5.3.1 Test loads

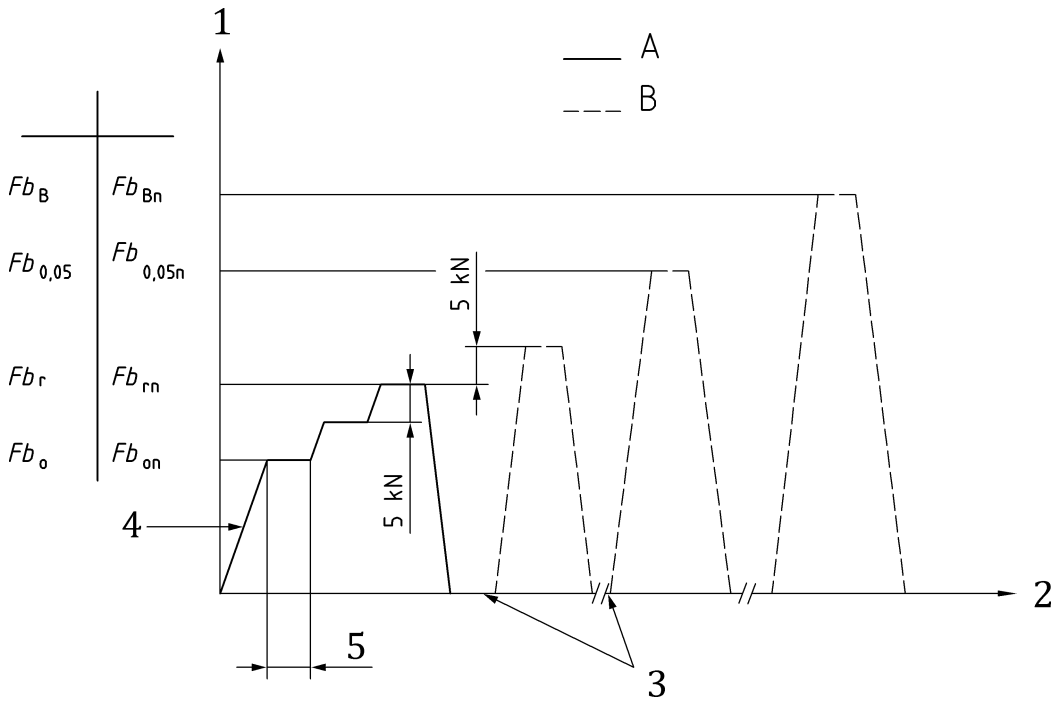
Fb_0 and Fb_{0n} are calculated from the geometry given in Figure 3 using Formula (1) and Formula (2):

$$Fb_0 = \frac{M_{k,pos}}{0,35} \text{ in kN} \quad (1)$$

$$Fb_{0n} = \frac{M_{k,neg}}{0,35} \text{ in kN} \quad (2)$$

5.3.2 Static test

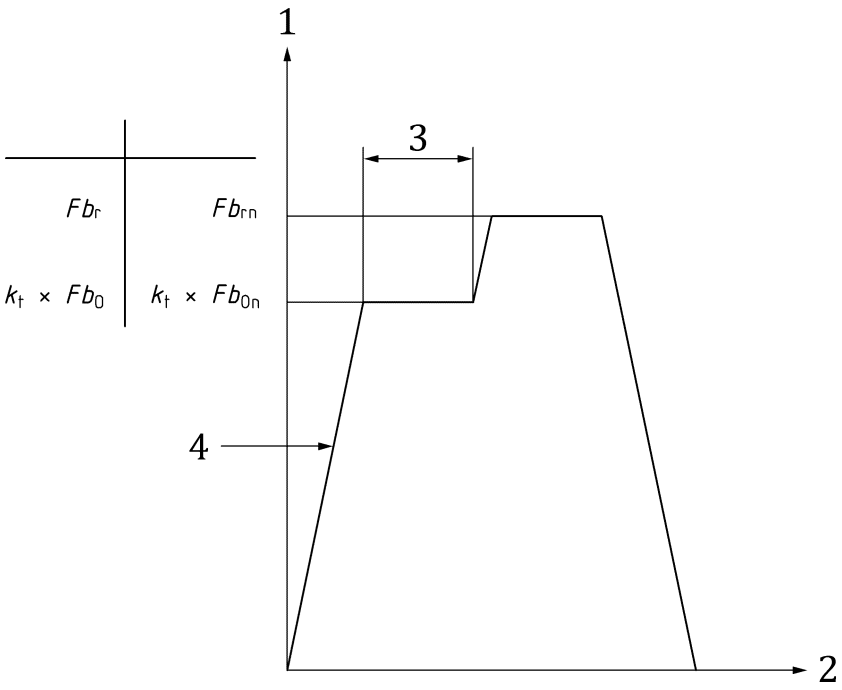
The static test procedure is shown in Figures 4 and 5 for the positive and negative bending moments. The maximum load applied is $Fb_{0,05}$ or Fb_B whichever is reached first.



Key

1 load
2 time
3 crack checking (maximum duration: 5 min)
4 120 kN/min maximum
5 from 10 s minimum to 5 min maximum
A required part of test
B optional part of test

Figure 4 — Static test procedure for design approval test



Key

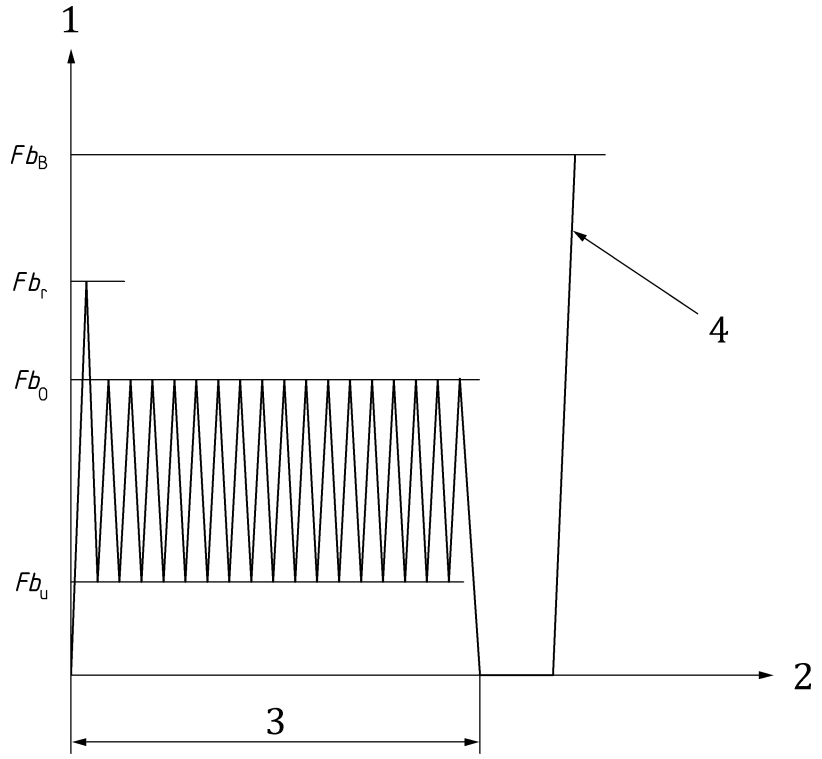
1 load
2 time
3 crack checking (duration from 10s minimum to 5 min maximum)
4 120 kN/min maximum

Figure 5 — Static test procedure for the routine test

Value of k_t is adjusted according to the age of bearer at the time of testing.

5.3.3 Fatigue test

The fatigue test procedure is shown in Figures 6 and 7.



Key

1 load

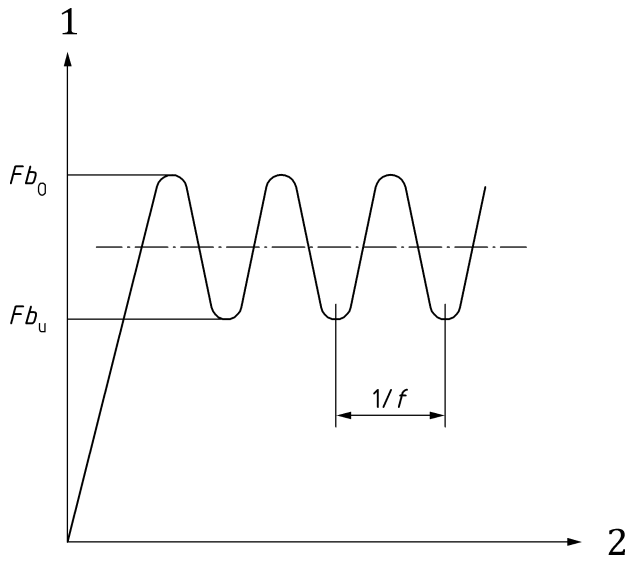
2 time

3 frequency (f) between 2 Hz and 10 Hz (identical frequency maintained during duration of test) for 2 million cycles

4 increase of load at 120 kN/min

NOTE First cycle as in Figure 4.

Figure 6 — Fatigue test procedure



Key
1 load
2 time

Figure 7 — Dynamic load application for fatigue test

5.4 Acceptance criteria

5.4.1 General

The tests are managed according to the requirements of EN 13230-1:2016, Clause 7. The crack width is measured following the rules of EN 13230-1:2016, 7.2.

5.4.2 Static test

The acceptance criteria for the static design approval and routine tests are defined as follows:

— $Fb_r > k_t \times Fb_0$

— $Fb_{rn} > k_t \times Fb_{0n}$

— Fb_B or $Fb_{0,05} > k_b \times Fb_0$

— Fb_{Bn} or $Fb_{0,05n} > k_{bn} \times Fb_{0n}$

The coefficients k_b and k_{bn} shall be provided by the purchaser.

5.4.3 Fatigue test

The acceptance criteria for the fatigue test after 2×10^6 cycles are as follows:

— crack width is ≤ 0,1 mm when loaded at Fb_0;

— crack width is ≤ 0,05 mm when unloaded;

— $Fb_B > k_{bB} \times Fb_0$ when load continuously increased at a rate of 120 kN/min from unloaded condition until failure Fb_B. The coefficient k_{bB} shall be provided by the purchaser.

5.5 Design approval tests

5.5.1 General

The design approval tests to be carried out on the bearer and concrete comprise the tests already defined in this standard. All test results shall meet the acceptance criteria.

Each bearer shall be used for one test only.

5.5.2 Bending moments evaluation

5.5.2.1 General

The design approval tests should approve the design bending capacity for the defined cross section.

These tests are carried out in accordance with the test arrangement shown in Figure 3 and the test procedure shown in Figure 4. The maximum length of the bearer for fatigue test shall be 3,0 m.

5.5.2.2 Static tests

Static tests are carried out on two bearers for positive bending moments and two bearers for negative bending moments (5.3.2, Figure 4).

5.5.2.3 Fatigue test

Fatigue test is carried out on one bearer for positive test (5.3.3, Figures 6 and 7).

Optional test at the request of the purchaser.

5.5.3 Concrete

The properties of the concrete shall be established in accordance with EN 206.

5.5.4 Product inspection

Product inspection shall be carried out on all bearers required for design approval tests including dimensions and tolerances in accordance with EN 13230-1:2016, Table 1 and the surface finish of the bearer in accordance with EN 13230-1:2016, 6.3.

5.6 Routine tests

5.6.1 General

The routine tests shall be carried out in order to find any variation in the quality of the concrete element, leading to an unacceptable quality level.

The number and the length of samples and rates of tests are given by the quality plan of the manufacturing unit.

5.6.2 Positive or negative bending moment evaluations for static test

This test shall be carried out in accordance with the test arrangement shown in Figure 3 and the test procedure shown in Figure 5 and acceptance criteria defined in 5.4.

For testing bearers longer than 3,0 m, account shall be taken of the self-weight of the overhanging parts.

5.6.3 Concrete

Tests shall be carried out according to EN 13230-1:2016, 7.4.

5.6.4 Product checking

The position of the embedded components and the vertical deviation of the bearer shall be checked in accordance with 4.3.2 and 4.3.3, respectively at the frequency detailed in the quality plan of the manufacturing unit.

The position of the tendons shall be checked in accordance with EN 13230-1:2016.

6 Manufacturing

6.1 Manufacturing rules

Before starting production, the supplier shall complete a production file for manufacturing data, which shall be submitted in confidence to the purchaser and shall include:

a) water/cement ratio and tolerance;

b) weight of each component of concrete plus tolerance;

c) grading curves for each component of concrete plus tolerance;

d) properties of concrete after seven days and after 28 days;

e) maximum relaxation for prestressing tendons after 1 000 h according to EN 10138 standard;

f) description of the prestressing system including prestressing force and tolerance on each tendon;

g) methods of concrete vibration;

h) curing time and temperature cycle;

i) minimum concrete compressive strength before releasing prestressing tendons;

j) method used for releasing prestressing force;

k) stacking rules after manufacturing.

The sample bearers submitted for design tests shall comply with the manufacturing data.

6.2 Additional marking

In addition to EN 13230-1:2016, 6.4, there shall be sufficient permanent marking to identify layout position of the bearer in the track as required by the purchaser.

7 Data to be supplied

7.1 Data supplied by the purchaser

All data specified in EN 13230-1:2016, 4.4.2 with the addition of the following:

a) coefficients: k_{b}, k_{bn} and k_{bB} if required;

b) geometrical layout of each individual cast in component for each bearer.

7.2 Data provided by the supplier

All data specified in EN 13230-1:2016, 4.4.3.

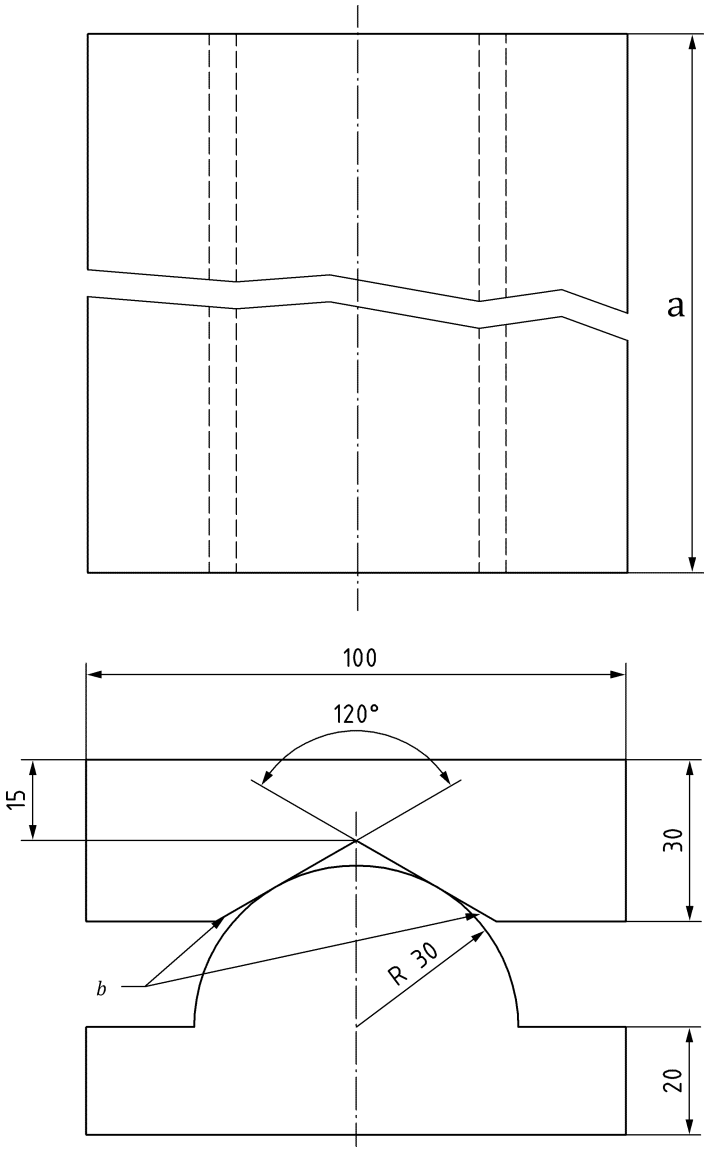
Annex A
(normative)

Detailed drawings of the test arrangements

A.1 Articulated support

This shall be as shown in Figure A.1.

Dimensions in millimetres



Key

Steel: Minimum hardness Brinell: *HBW* > 240

General tolerances: ± 0,1 mm

a minimum length = bottom width of the concrete bearer at the rail seat + 20 mm

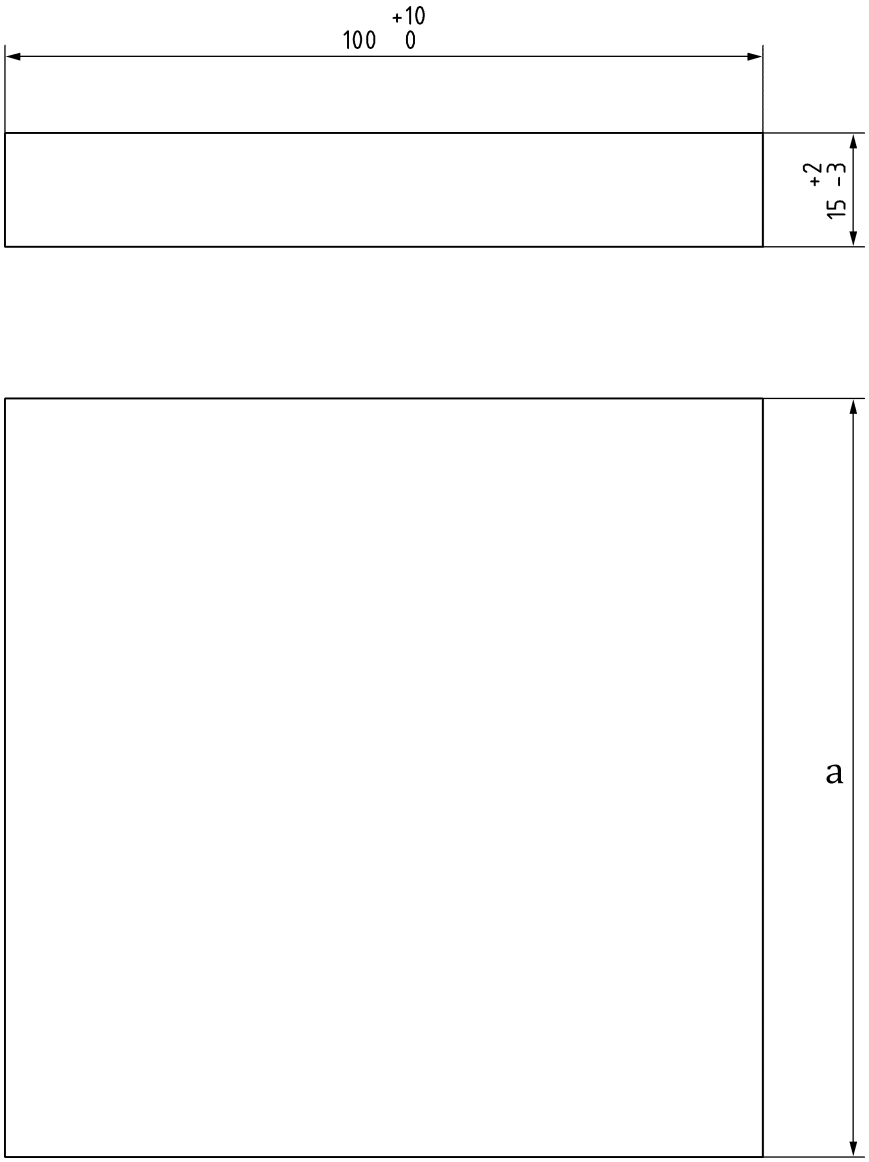
b high pressure lubricant

Figure A.1 — Articulated support

A.2 Resilient pad

This shall be as shown in Figure A.2.

Dimensions in millimetres



Key

Material: Elastomer

Static secant stiffness measured between 0,3 MPa and 2 MPa: $1 \leq C \leq 4$ N/mm^3

a minimum length = bottom width of the concrete bearer at the rail seat + 20 mm

Figure A.2 — Resilient pad

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2008/57/EC [1)].

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 for Infrastructure confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

[1)] This Directive 2008/57/EC adopted on 17th June 2008 is a recast of the previous Directives 96/48/EC 'Interoperability of the trans-European high-speed rail system' and 2001/16/EC 'Interoperability of the trans-European conventional rail system' and revisions thereof by 2004/50/EC 'Corrigendum to Directive 2004/50/EC of the European Parliament and of the Council of 29 April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system'.

Table ZA.1 — Correspondence between this European Standard, the Commission Regulation N° 1299/2014 of 18 November 2014 on the technical specifications for interoperability relating to the 'infrastructure' subsystem of the rail system in the European Union (published in the Official Journal L 356, 12.12.2014, p.1) and Directive 2008/57/EC

Clause(s)/ sub-clause(s) of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard is applicable	6.Assessment of conformity of interoperability constituents and EC verification of the subsystems 6.1.Interoperability constituents 6.1.2.Application of modules 6.1.4.EC declaration of conformity for interoperability constituents 6.1.4.4.EC declaration of conformity for track sleepers 6.1.5.Particular assessment procedures for interoperability constituents 6.1.5.2.Assessment of sleepers Appendix A – Assessment of interoperability constituents Table 36: Assessment of interoperability constituents for the EC declaration of conformity – 5.3.3 Track sleepers	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.2, 1.1.3 1.5 Technical compatibility	According 5.3.3 of the TSI track sleepers are interoperability constituents. According to part 1 of the standard, the purchaser has to define the L_1 dimension in order to ensure the required track gauge. Assessment of the sleeper is based on L_1 dimension.

Warning – Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN ISO 9001, *Quality management systems - Requirements (ISO 9001)*

[2] EN 13230-5:2016, *Railway applications – Track – Concrete sleepers and bearers – Part 5: Special elements*

[3] prEN 13230-6:2015, *Railway applications – Track – Concrete sleepers and bearers – Part 6: Design*

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services
Tel: +44 345 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 345 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.