BS EN 13230-2:2016

BSI Standards Publication

Railway applications — Track — Concrete sleepers and bearers

Part 2: Prestressed monoblock sleepers

bsi.

National foreword

This British Standard is the UK implementation of EN 13230-2:2016. It supersedes BS EN 13230-2:2009 which is withdrawn.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.

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

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Applications ferroviaires - Voie - Traverses et supports en béton - Partie 2 : Traverses monoblocs précontraintes

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

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European foreword

This document (EN 13230-2:2016) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This document supersedes EN 13230-2:2009.

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of an identical text or by endorsement, at the latest by November 2016, and conflicting national standards shall be withdrawn at the latest by November 2016.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 monoblock sleepers.

These are additional requirements to EN 13230-1 that are necessary to have a complete standard dealing with prestressed monoblock sleepers.

1 Scope

This part of the EN 13230 series defines additional technical criteria and control procedures related to the manufacturing and testing of prestressed monoblock sleepers.

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*

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

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
Pre-tensioned monoblock sleeper
sleeper manufactured using pre-tensioned tendons

3.1.2
post-tensioned monoblock sleeper
sleeper manufactured using post-tensioned tendons

3.2 Symbols

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

Table 1 — Symbols

Symbol	Description	Unit
Fr_0	Positive initial reference test load for the rail seat section	kN
Fr_r	Positive test load which produces first crack formation at the bottom of the rail seat section	kN
$Fr_{0,05}$	Maximum test load for which a crack width of 0,05 mm at the bottom of rail seat section persists after removal of the load	kN
$Fr_{0,5}$	Maximum test load for which a crack width of 0,5 mm at the bottom of the rail seat section persists after removal of the load	kN
Fr_B	Maximum positive test load at the rail seat section which cannot be increased	kN
Fr_u	Lower test load for the rail seat section dynamic test; Fr_u = 50 kN	kN
Fc_0	Positive initial reference test load at the centre section of the sleeper	kN
Fc_{0n}	Negative initial reference test load at the centre section of the sleeper	kN
Fc_r	Positive test load which produces first crack formation at the centre of the sleeper	kN
Fc_{rn}	Negative test load which produces first crack formation at the centre of the sleeper	kN
Fc_B	Maximum positive test load at the centre section which cannot be increased	kN
Fc_{Bn}	Maximum negative test load at the centre section which cannot be increased	kN
L_p	Design distance between the centre line of the rail seat to the edge of the sleeper at the bottom	m
L_r	Design distance between the articulated supports centre lines for the test arrangement at the rail seat section	m
L_c	Design distance between centre lines of the rail seat	m
$M_{k,r,pos}$	Positive characteristic bending moment at rail seat, (see prEN 13230–6:2015)	kNm
$M_{k,c,neg}$	Negative characteristic bending moment at centre section, (see prEN 13230–6:2015)	kNm
$M_{k,c,pos}$	Positive characteristic bending moment at centre section, (see prEN 13230–6:2015)	kNm
k_{1s}	Static coefficient to be used for calculation of $Fr_{0,05}$ test load	-
k_{2s}	Static coefficient to be used for calculation of $Fr_{0,5}$ or Fr_B test load	-
k_{1d}	Dynamic coefficient to be used for calculation of $Fr_{0,05}$ test load	-
k_{2d}	Dynamic coefficient to be used for calculation of $Fr_{0,5}$ or Fr_B test load	-
k_3	Static coefficient to be used for calculation of Fr_B at the end of fatigue test	-
k_t	Factor used for calculation of acceptance criteria for first crack formation in static tests	-

4 Product testing

4.1 General

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

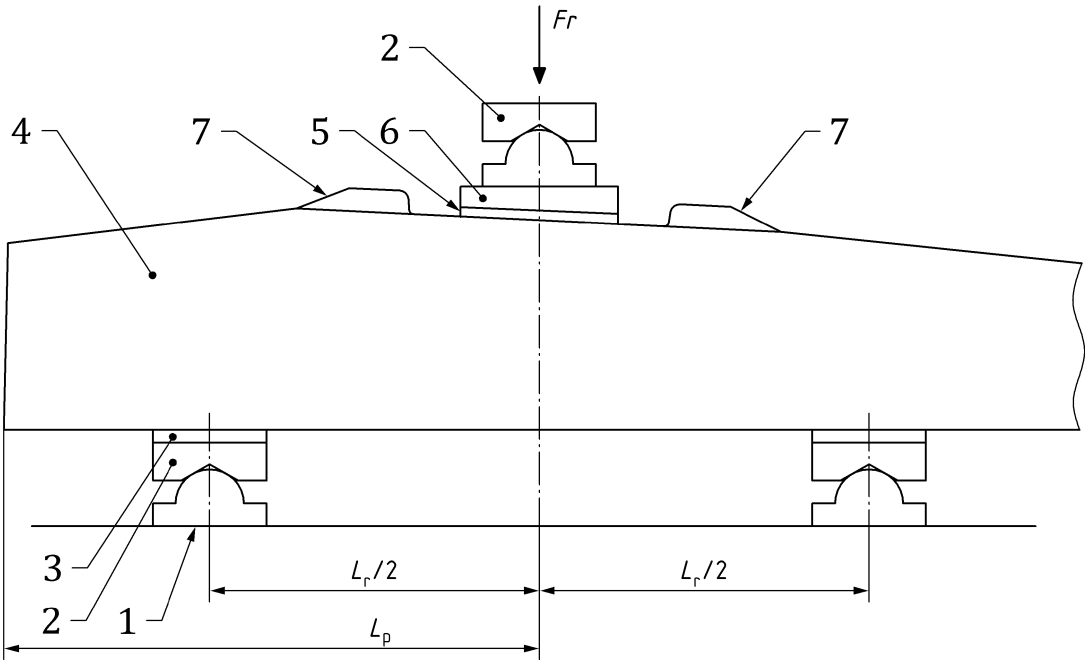
4.2 Test arrangements

4.2.1 Rail seat section

The arrangement for the rail seat positive load test is shown in Figure 1, the value of L_r in relation to L_p is detailed in Table 2.

The load *Fr* is applied perpendicularly to the base of the sleeper.

The end of the sleeper opposite to the end being tested shall be unsupported.



Key

1 rigid support
2 articulated support (see Annex A for details)
3 resilient pad (see Annex A for details)
4 prestressed monoblock sleeper
5 standard rail pad as defined by the purchaser
6 tapered packing (see Annex A for details)
7 lateral stop and base plate, only when required by the purchaser

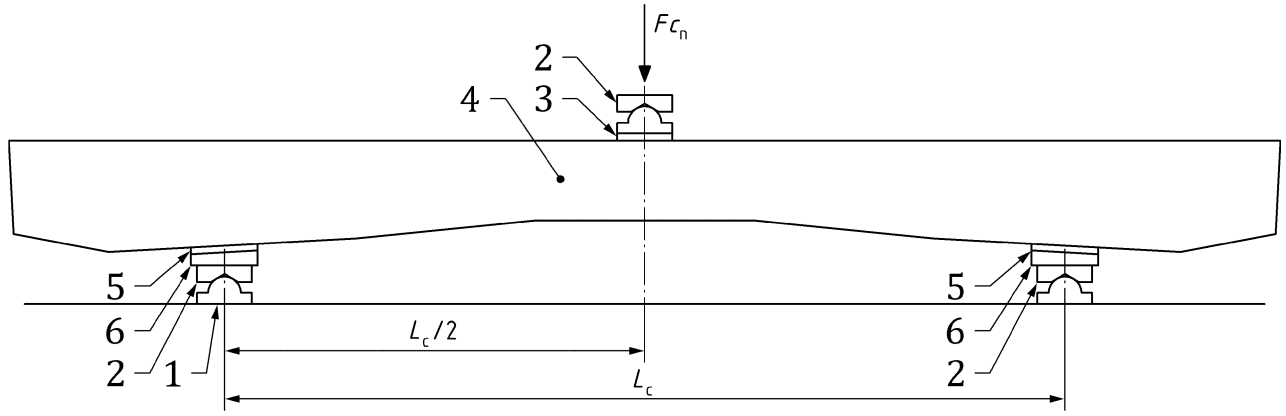
Figure 1 — Test arrangement at the rail seat section for the positive load test

Table 2 — Value of L_r in relation to L_p

L_p in m	L_r in m
$L_p < 0{,}349$	0,3
$0{,}350 \leq L_p < 0{,}399$	0,4
$0{,}400 \leq L_p < 0{,}449$	0,5
$L_p \geq 0{,}450$	0,6

4.2.2 Centre section

The arrangement for the negative centre load test is shown in Figure 2.

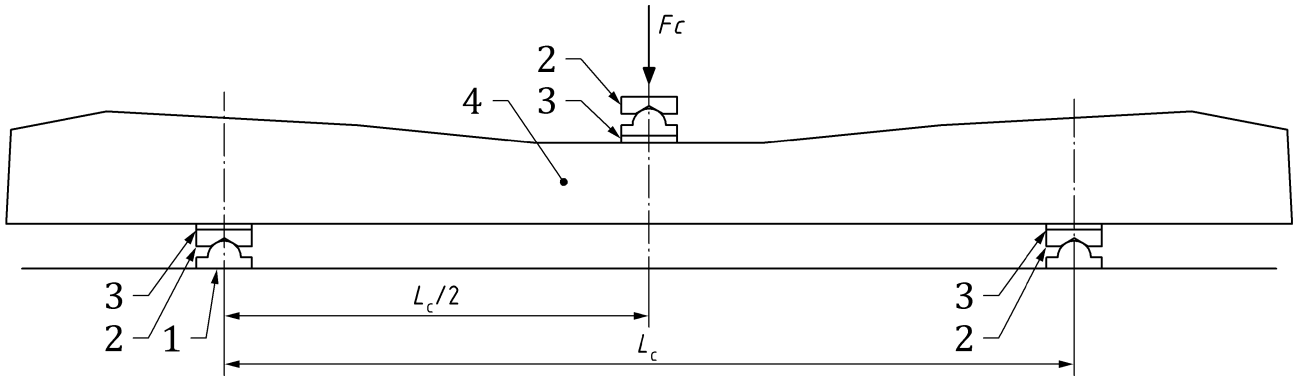


Key

1 rigid support
2 articulated support (see Annex A for details)
3 resilient pad (see Annex A for details)
4 prestressed monoblock sleeper
5 standard rail pad as defined by the purchaser
6 tapered packing (see Annex A for details)

Figure 2 — Test arrangement at the centre section for the negative load test

The test arrangement for the positive centre load test 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 prestressed monoblock sleeper

Figure 3 — Test arrangement at the centre section for the positive load test

4.3 Test procedures

4.3.1 Test loads

Fr_0 is calculated from the geometry given in Figure 1 and values from Table 3 using Formula (1):

$$Fr_0 = \frac{4\,M_{k,r,pos}}{L_r - 0{,}1} \text{ in kN} \quad (1)$$

Table 3 — Value of Fr_0 in relation to L_r

L_r in m	0,3	0,4	0,5	0,6
Fr_0 in kN	20 $M_{k,r,pos}$	13 $M_{k,r,pos}$	10 $M_{k,r,pos}$	8 $M_{k,r,pos}$

Fc_0 and Fc_{0n} are calculated from the geometry given in Figures 2 and 3 using Formula (2) and Formula (3):

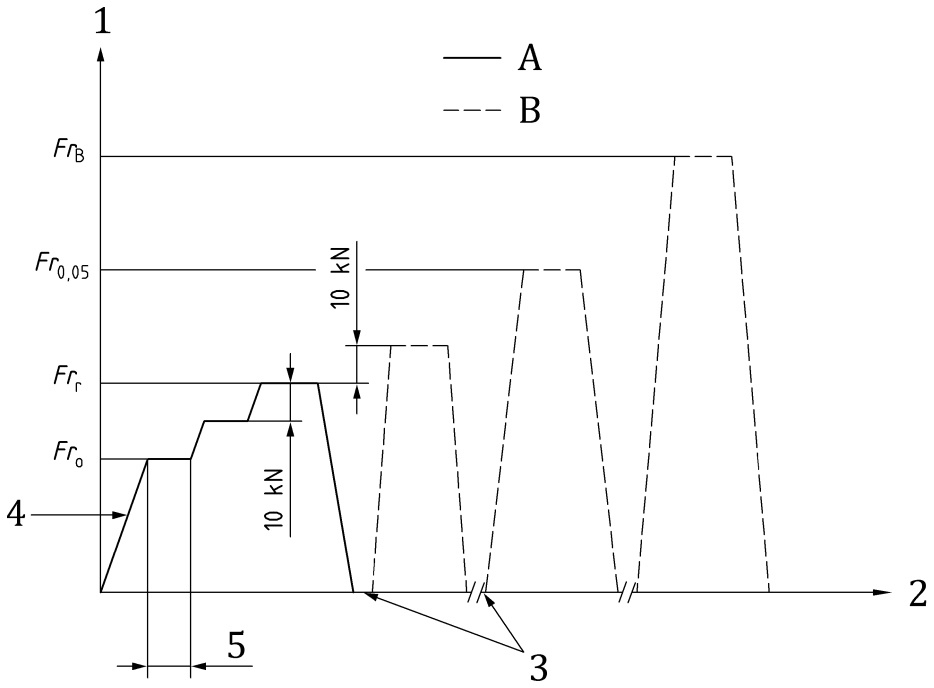
$$Fc_0 = \frac{4\,M_{k,c,pos}}{L_c - 0{,}1} \text{ in kN} \quad (2)$$

$$Fc_{0n} = \frac{4\,M_{k,c,neg}}{L_c - 0{,}1} \text{ in kN} \quad (3)$$

4.3.2 Static test

4.3.2.1 Rail seat section

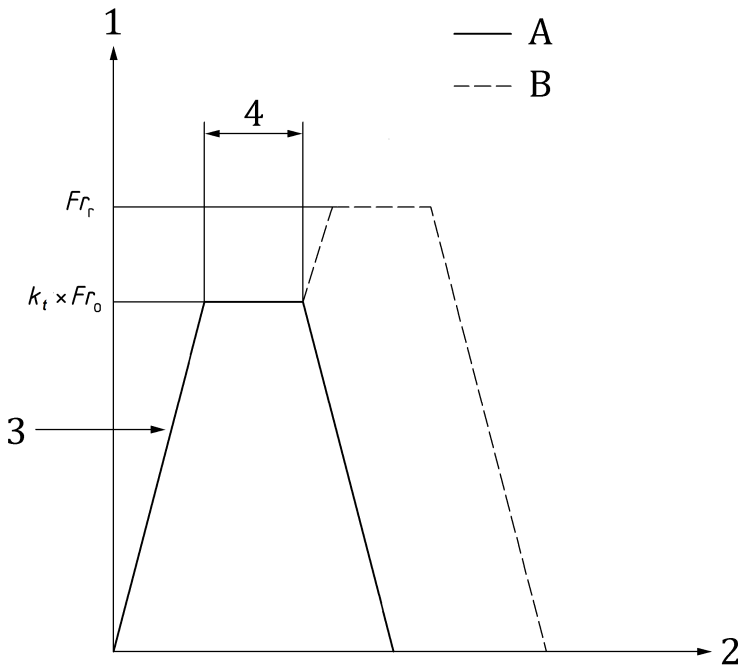
The static test procedure at the rail seat section for design approval test and routine test is shown in Figures 4 and 5.



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 at the rail seat section for positive design approval test



Key

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

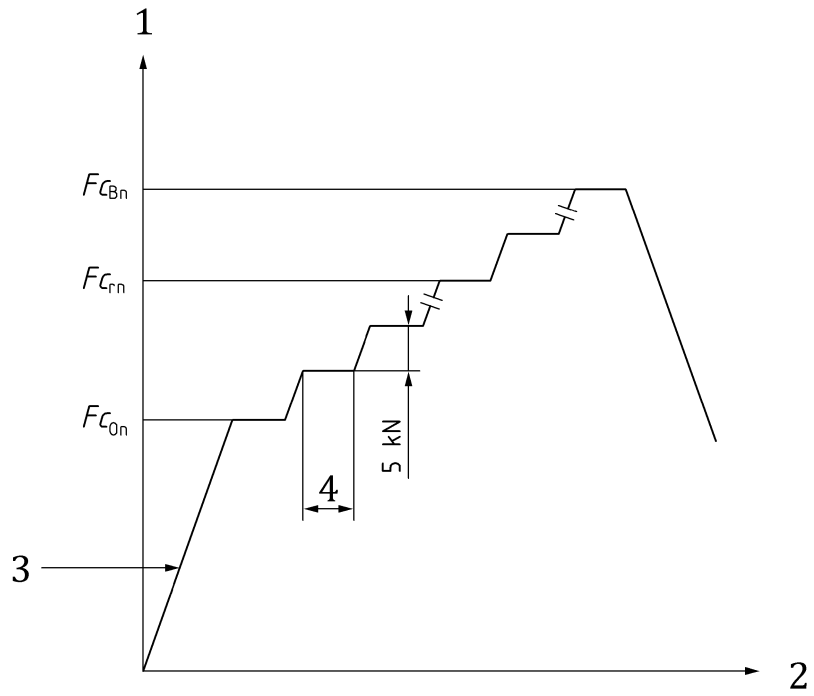
Figure 5 — Static test procedure at the rail seat section for positive routine test

Loading in the routine test may be continued to first crack to determine Fr_r and provide information on the margin between Fr_0 and Fr_r. This is not part of the pass/fail criteria.

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

4.3.2.2 Centre section

The static test procedure at the centre section for negative design approval test is shown in Figure 6.

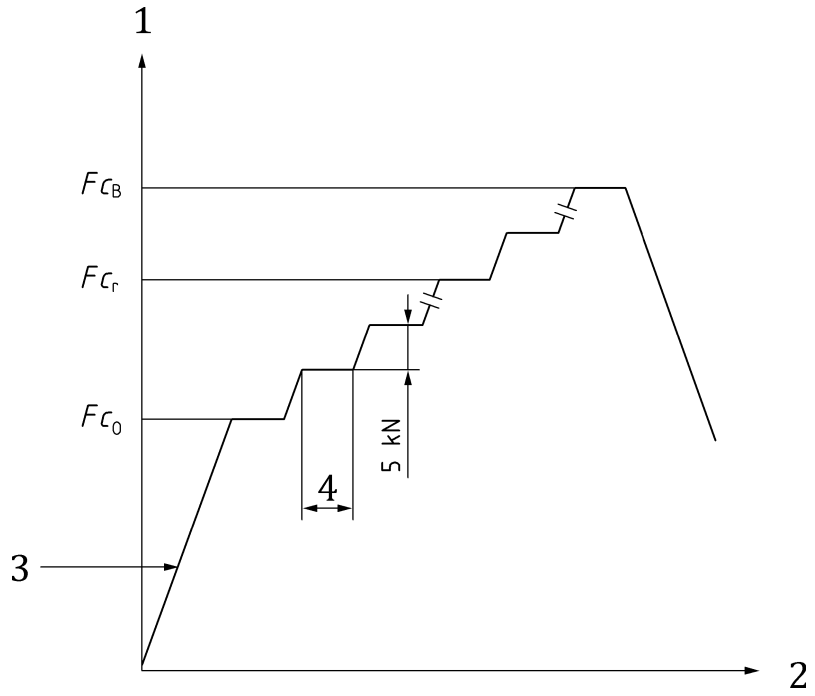


Key

1 load
2 time
3 120 kN/min maximum
4 from 10 s minimum to 5 min maximum

Figure 6 — Static procedure at the centre section for negative design approval test

The test procedure at the centre section for positive design approval test is shown in Figure 7.



Key

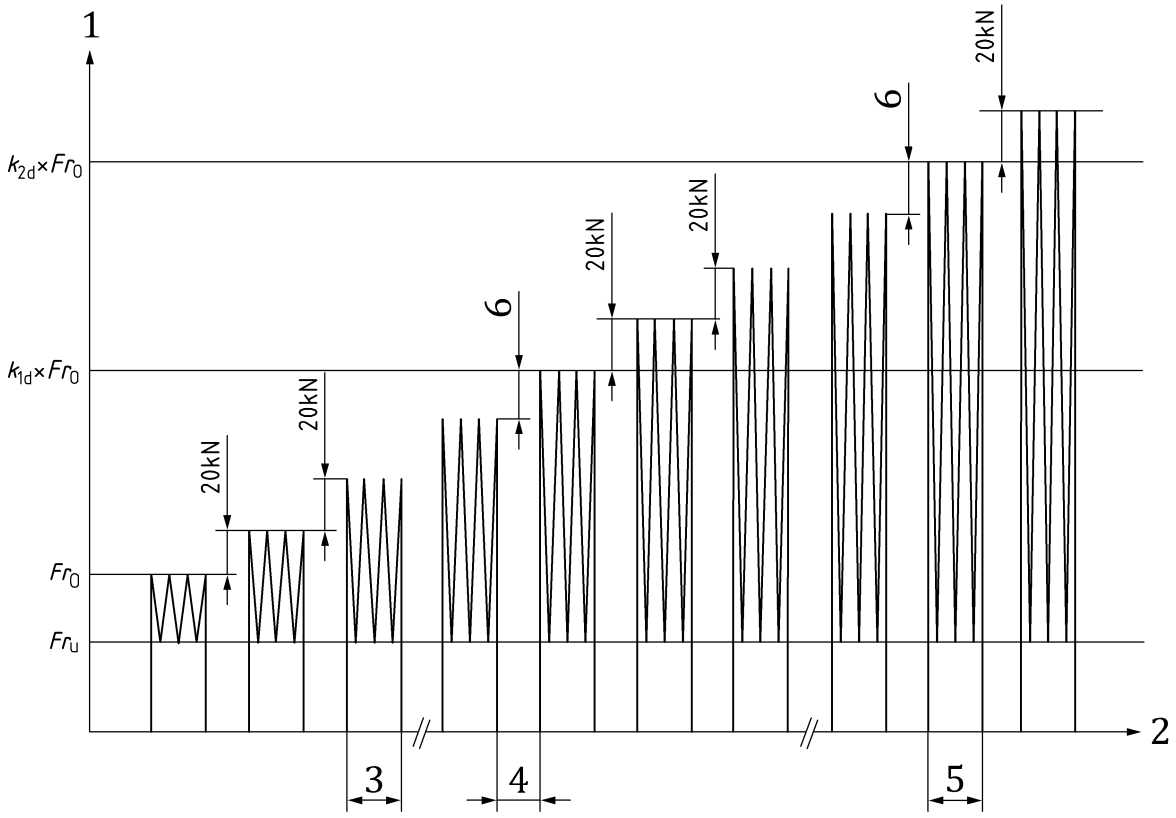
1 load
2 time
3 120 kN/min maximum
4 from 10 s minimum to 5 min maximum

Figure 7 — Static procedure at the centre section for positive design approval test

A centre routine test is not required.

4.3.3 Dynamic test

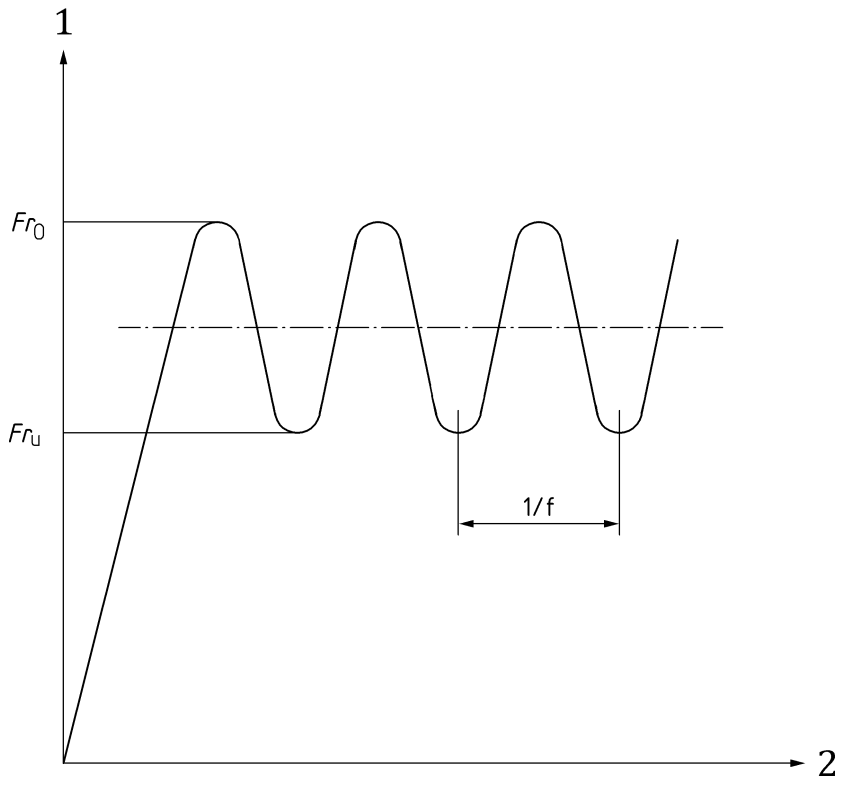
The dynamic test procedure at the rail seat section is shown in Figure 8 and Figure 9.



Key

1 load
2 time
3 5 000 load cycles
4 maximum examination time 5 min
5 frequency (f) between 2 Hz and 10 Hz (identical frequency maintained during duration of test)
6 load step before $k_{1d} \times Fr_0$ and $k_{2d} \times Fr_0$ smaller than 20 kN

Figure 8 — Dynamic test procedure at the rail seat section



Key

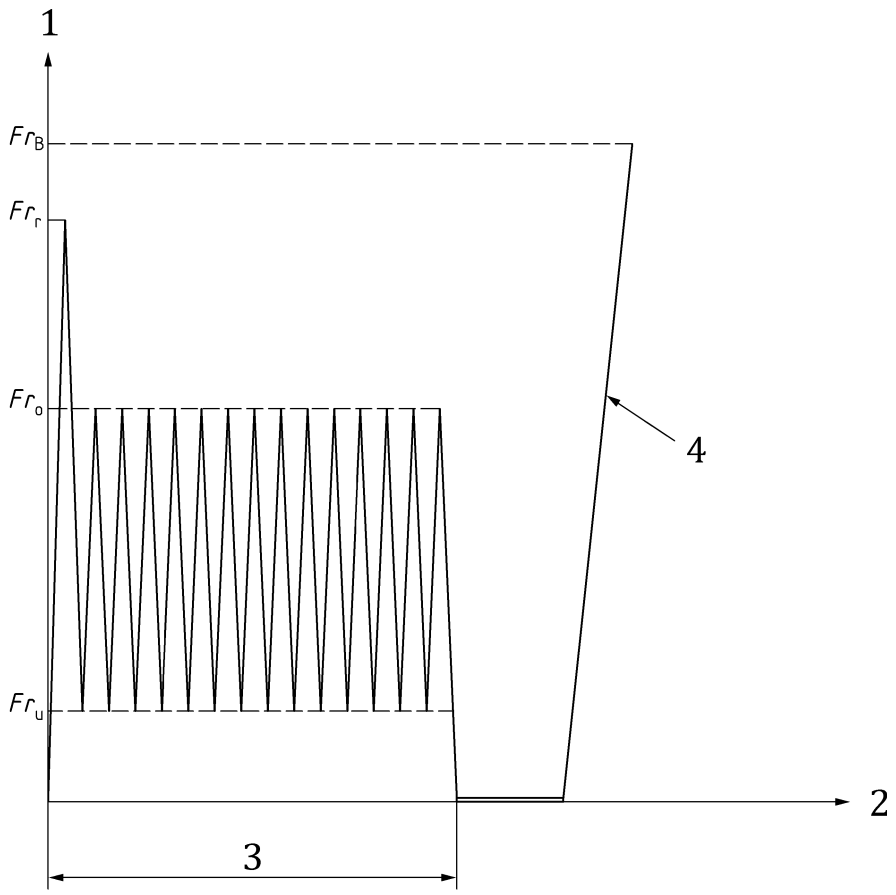
1 load

2 time

Figure 9 — Dynamic load application for dynamic test

4.3.4 Fatigue test

The fatigue test procedure at the rail seat section is shown in Figures 10 and 11.

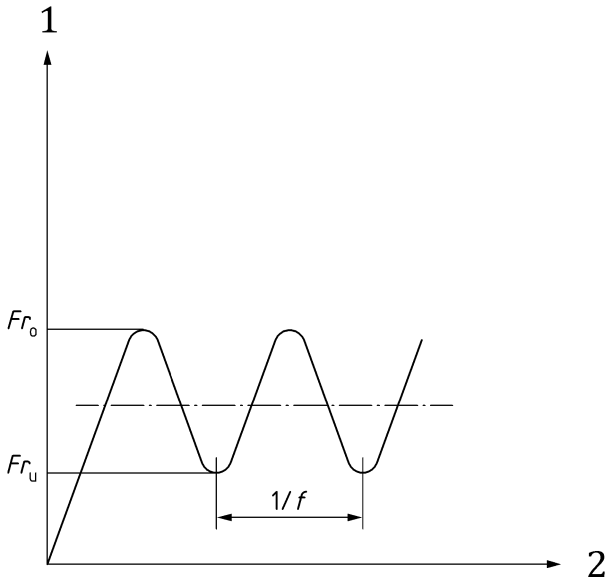


Key

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 10 — Fatigue test procedure at the rail seat section



Key
1 load
2 time

Figure 11 — Dynamic load application for fatigue test

4.4 Acceptance criteria

4.4.1 General

The tests are managed according to the requirements of FprEN 13230-1:2015, Clause 7. The crack width is measured following the rules of FprEN 13230-1:2015, 7.2.

4.4.2 Static test

4.4.2.1 General

The acceptance criteria for the static test are as follows.

4.4.2.2 Rail seat section

The acceptance criterion is: $Fr_r > k_t \times Fr_0$

If the non-mandatory part of the test is carried out, then: $Fr_{0,05} > k_{1s} \times Fr_0$

$Fr_B > k_{2s} \times Fr_0$

4.4.2.3 Centre section

The acceptance criterion is: $Fc_{r\,n} > k_t \times Fc_{0n}$

If the non-mandatory test for positive bending moment at the centre section is required, the purchaser shall specify the acceptance criteria.

4.4.3 Dynamic test

The acceptance criteria for the dynamic test at the rail seat section are as follows:

a) $Fr_{0,05} > k_{1d} \times Fr_0$;

b) $Fr_B > k_{2d} \times Fr_0$ or $Fr_{0,5} > k_{2d} \times Fr_0$ (according to the requirements of the purchaser).

4.4.4 Fatigue test

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

a) crack width is ≤ 0,1 mm when loaded at Fr_0;

b) crack width is ≤ 0,05 mm when unloaded;

c) $Fr_B > k_3 \times Fr_0$.

When load at the rail seat section is continuously increased at a rate of 120 kN/min from unloaded condition until failure Fr_B, coefficient k_3 shall be provided by the purchaser.

4.5 Design approval tests

4.5.1 General

The design approval tests to be carried out on the sleeper and concrete comprise the tests already defined in this standard.

All test results shall meet the acceptance criteria.

Each sleeper shall be used for one test only.

4.5.2 Bending moments evaluation

4.5.2.1 General

These tests are carried out in accordance with the test arrangements in 4.2 and the test procedures in 4.3.

4.5.2.2 Static tests

a) rail seat section: on six sleepers (one rail seat per sleeper), for the positive bending moment;

b) centre section: three sleepers for the negative bending moment;

three sleepers for the positive bending moment (optional test carried out at the request of the purchaser).

4.5.2.3 Dynamic test

— Rail seat section: on six sleepers (one rail seat per sleeper), for the positive bending moment.

4.5.2.4 Fatigue test (optional test carried out at the request of the purchaser)

— Rail seat section: one rail seat for the positive bending moment.

4.5.3 Concrete

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

4.5.4 Product inspection

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

4.5.5 Fastening system

Test shall be carried out in accordance with the European standards on fastenings systems as referenced in EN 13230-1 or as required by the purchaser (see EN 13230-1:2016, 7.5).

4.6 Routine tests

4.6.1 General

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

The number of samples and rates of tests shall be given in the quality plan for the manufacturing unit.

The routine tests to be carried out on the product and concrete are defined in this standard.

4.6.2 Static rail seat positive load test

This test shall be carried out in accordance with the test arrangement shown in Figure 1 and the test procedures in 4.3.

4.6.3 Concrete

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

5 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 the following:

a) water/cement ratio and tolerance;

b) weight of each component of concrete plus tolerance;

c) grading curves for each aggregate of the concrete plus tolerance;

d) properties of concrete after 7 days and after 28 days;

e) maximum relaxation for prestressing tendons after 1 000 h according to FprEN 10138 (all parts);

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 sleepers submitted for design tests shall comply with the manufacturing data.

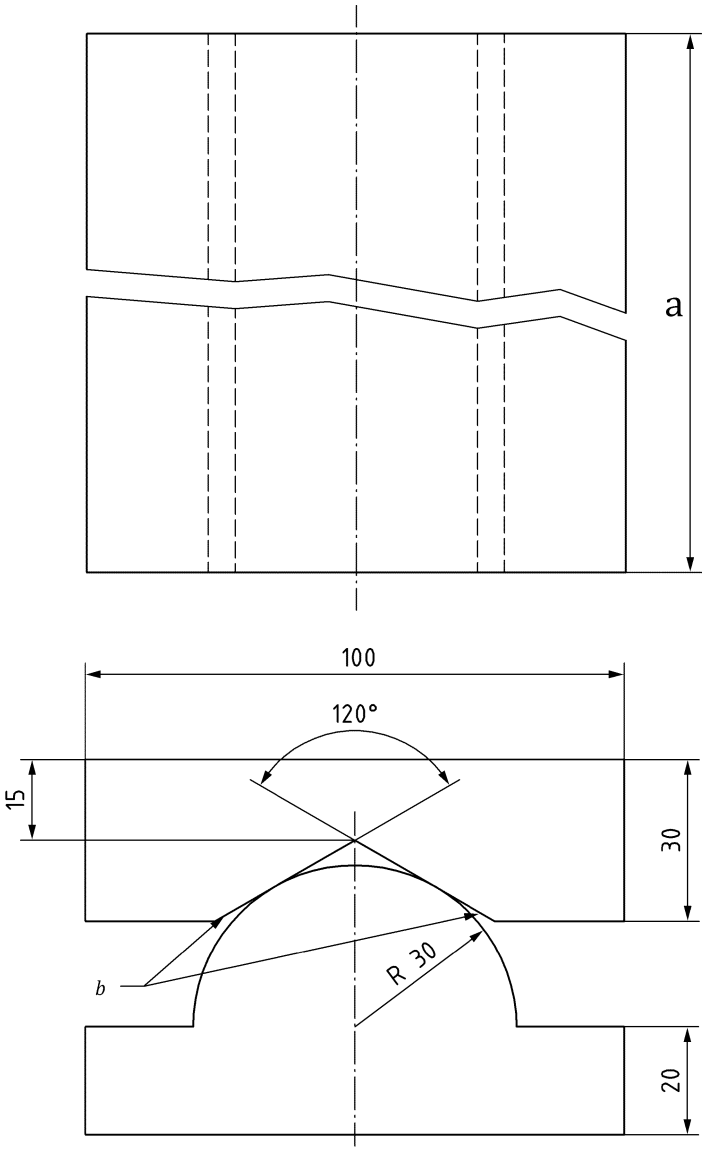
Annex A
(normative)

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 sleeper at the rail seat + 20 mm

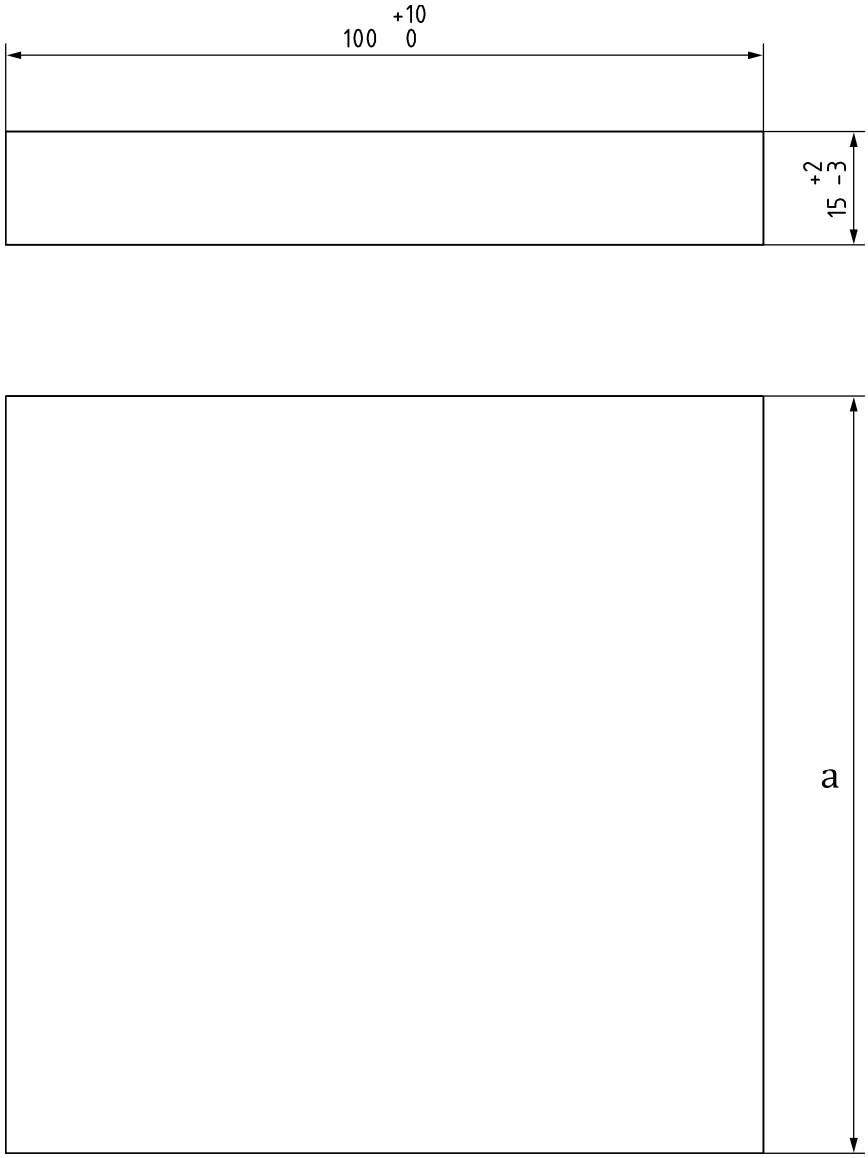
b high pressure lubricant

Figure A.1 — Articulated support

A.2 Resilient pad

This shall be as shown in Figure A.2.

Dimensions in millimetres



Key

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

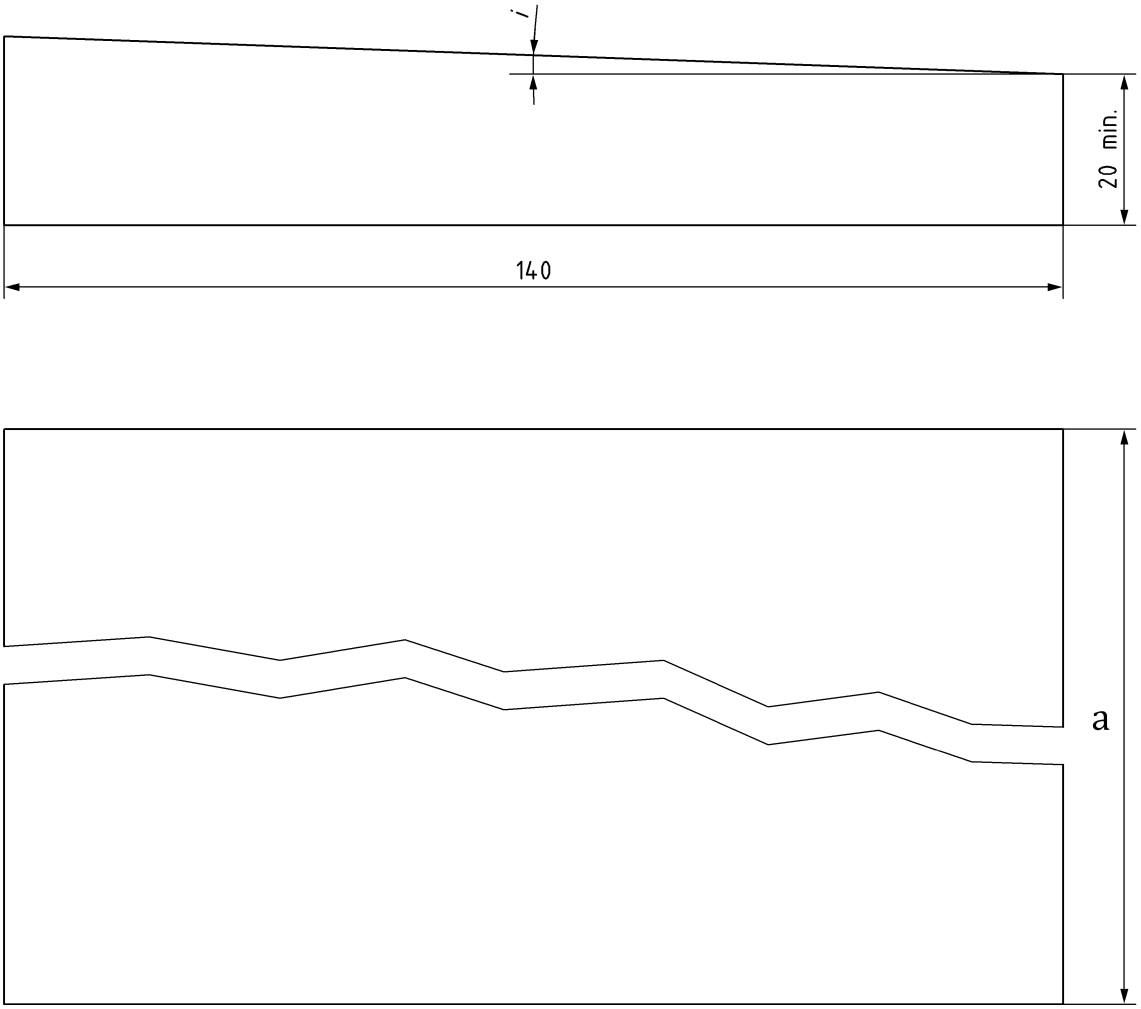
a minimum length = bottom width of the concrete sleeper at the rail seat + 20 mm

Figure A.2 — Resilient pad

A.3 Tapered packing

This shall be as shown in Figure A.3.

Dimensions in millimetres



Key

Steel: Minimum hardness Brinell: HBW > 240

General tolerances: ± 0,1 mm

i: inclination of rail seat – see EN 13230-1:2016

a minimum length = length of the standard rail pad + 20 mm

Figure A.3 — Tapered packing

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 to 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)*

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