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Railway applications — Track — Hollow sleepers and bearers

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National foreword

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

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Foreword

This document (EN 16431:2014) 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of an identical text or by endorsement, at the latest by January 2015 and conflicting national standards shall be withdrawn at the latest by January 2015.

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1 Scope

This European Standard defines technical criteria and control procedures which are satisfied by hollow sleepers and bearers used in ballasted track with Vignole rails. The hollow sleepers and bearers designed for ballasted track can also be used in ballastless track. In this case, the requirements are defined by the customer.

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 13481 (all parts), *Railway applications - Track - Performance requirements for fastening systems*

EN 13146-3, *Railway applications - Track - Test methods for fastening systems - Part 3: Determination of attenuation of impact loads*

EN 13146-5, *Railway applications - Track - Test methods for fastening systems - Part 5: Determination of electrical resistance*

EN 13146-6, *Railway applications - Track - Test methods for fastening systems - Part 6: Effect of severe environmental conditions*

EN 13146-9, *Railway applications - Track - Test methods for fastening systems - Part 9: Determination of stiffness*

EN 50125-3, *Railway applications - Environmental conditions for equipment – Part 3: Equipment for signalling and telecommunications*

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

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1
hollow sleepers
sleepers and bearers with hollow structure, with support for Vignole rails on ballasted or ballastless track, including the fastenings systems and all components, with a minimum of 50 % of the cross sectional-area hollow throughout its length

3.1.2
body
hollow structure which is in contact with the ballast/slab and supports the fastening system and other components

3.1.3
interface
any device used to fix the fastening system or any equipment to the hollow sleeper or bearer body

3.1.4
top width
maximum width of the hollow sleepers at the top (including the body and the fastening system)

3.1.5
bottom width
maximum width of the hollow sleepers at the bottom level of the body (in the tamping area)

3.1.6
tamping area
distance on each side to the rail centre where the ballast has to be tamped

3.1.7
bending moment
moment applied on the hollow sleeper or bearer which produces tension and compression in the element

3.1.8
positive bending moment
moment which produces tension or reduces compression at the bottom of the hollow sleeper or bearer

3.1.9
negative bending moment
moment which produces tension or reduces compression at the top of the hollow sleeper or bearer

3.2 Abbreviations

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

MGT	Mass Gross Tons
USP	Under Sleeper Pad
FEM	Finite Element Method
f_{yk}	Characteristic value of yield strength

4 Requirements

4.1 General

The main requirement of hollow sleepers and bearers is the transmission of vertical, lateral and longitudinal loads of the wheel from the rail to the ballast. In addition, a minimum of 50 % of the cross-sectional area is hollow to permit containment of the following devices and/or systems for example:

— switch and crossing actuation, detection and locking (in the case of bearers);

— wheel detection;

— rods, bars, cables, pipes, etc.

A sufficient space for maintenance of these devices and/or systems shall be considered.

In this standard electrical, mechanical, chemical and corrosion tests for approval are defined which provide assurance of the capability of hollow sleepers and bearers to resist repetitive loading and provide sufficient durability.

Additional controls during the manufacturing process are not part of this standard and shall follow the corresponding material test standards.

4.2 General requirements

The body of the hollow sleepers and bearers shall be designed in order to support the bending moments due to the traffic load.

NOTE Test load, given in Table 1 and Table 2, correspond to the category C of EN 13481 and category E limited to a maximum axle load of 300 kN.

4.3 Functional requirements

All types of hollow sleepers and bearers shall meet the following requirements:

— the height between the top of the rail and the bottom of the hollow sleeper or bearer shall be defined by the customer. This height is usually the same as the neighbouring sleepers or bearers. The bottom of the hollow sleeper or bearer should be aligned at the same level as the bottom of the adjacent sleepers and bearers in order to guarantee stability (mounting on same ballast level);

— the tamping area shall be defined by the customer;

— the weight of the hollow sleeper (including rail fastening, cover plates) shall be ≥ 100 kg/m;

— the maximum bottom width shall be 350 mm, and flat part of the bottom shall represent minimum 80 % of the bottom width (see Figure 1);

— the fastening system and the mechanical resistance of the body shall be checked according to Clauses 5 and 6 of this standard, the fastening system shall only use components from homologated fastening systems according to EN 13481 series.

— the electrical resistance shall be checked according to 5.4, 6.3 and 7.2 of this standard.

Hollow bearers shall fulfil the following additional requirements:

— the maximum top width in the tamping area shall be 425 mm (see Figure 1);

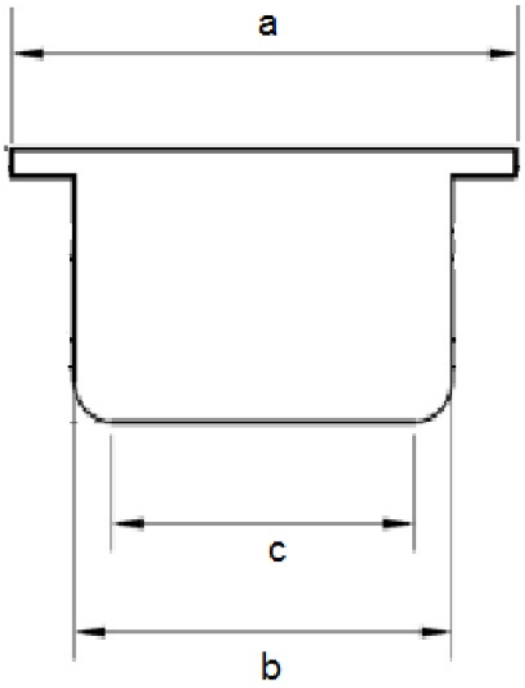
— the length of the hollow bearers shall be defined by the customer (regarding, transportation and installation limits or regulations);

— the position of the tamping area and the dimensions of the hollow bearer body shall be agreed between supplier and customer.

Hollow sleepers in track shall fulfil the following additional requirements:

— the maximum top width shall not exceed 350 mm (see Figure 1);

— the length of the hollow sleeper shall be the same as neighbouring sleepers.



Key

a Maximum top width

b maximum bottom width

c flat part of the bottom

Figure 1 – Dimensions of hollow sleeper or bearer

4.4 Design requirements

Cover plates on both end faces and on the top of the hollow sleepers and bearers shall be installed to prevent ballast penetration. Cover plates shall also be designed to withstand aerodynamic effects.

If there are two (or more) consecutive hollow sleepers or bearers, the lateral track resistance shall be considered.

If an USP is used, the USP shall be fixed on flat part of bottom area. The connection between USP and the bottom of the hollow sleeper or bearer shall be verified on the principle of the relevant USP standard (pull off test).

Sufficient drainage shall be incorporated in to the design.

Hollow bearers shall be designed to ensure that the normal operation of actuation, locking and detection equipment is not adversely affected by temperature, ice formation, snow or water penetration.

4.5 Materials

Metallic body materials shall be specified by the supplier with their relevant standards and agreed by the customer.

If using other body materials, the supplier shall specify their relevant standards or their mechanical and environmental characteristics in case of the non-existence of a standard.

The materials used for the others components shall be agreed between customer and supplier.

4.6 Environmental requirements

4.6.1 Environmental test standards

Hollow bearers (including fastening system) shall fulfil environmental tests only as part of the integrated system with actuating, locking and detection devices according to EN 50125-3. The customer shall define the tests amongst the list of tests of this standard and the corresponding criteria.

4.6.2 Hot and cold temperature

The equipment shall operate in ambient air temperatures within the range of −25 °C to +40 °C for indefinite periods. For materials other than steel, the supplier shall verify (by calculation or testing) in this temperature range that the gauge modification shall not exceed 2 mm.

4.6.3 Flammability

The equipment in a hollow sleeper or bearer shall be, where practicable, manufactured from non-combustible materials. Where this cannot be achieved, the supplier shall give a data sheet of the toxic gases and smoke emissions of the material. The used materials shall be agreed by the customer;

4.6.4 Effect of exposure to severe environmental conditions (optional)

If requested by the customer, following exposure to the salt spray test in accordance with EN 13146-6, the fastening assembly shall be capable of being dismantled, without failure of any component and re-assembled using manual tools provided for this purpose.

4.7 Requirements for interfaces with mechanical equipments in case of integrated system (optional)

If requested by the customer, interfaces to mechanical equipment shall be tested according to EN 50125-3 (only the clauses of this document concerning vibration).

5 Test methods

5.1 General

The following tests are part of the homologation process.

5.2 Tests for fastening system and interface

5.2.1 Effect of repeated loading

This test is used for assessing the long term performance of the fastening system and interface. A load is applied with repeated cycles representative of the repeated loads caused by traffic on railway track.

Test shall be performed according to Annex A. Test loads and positions are specified in Table 1:

Table 1 – Test loads and positions for fastening system and interface test

Item		Up to 260 kN axle load	Between 260 kN and 300 kN axle load
		Values	
X	position of the line of application of P_L below the centre of curvature of the gauge corner of the rail head, in mm	15	75
α	angle between the load line and a line normal to the running surface of the rails, in degrees	33	40
$2Pv$	component of load normal to the running surface of the rails, in kN	140	166
Frequency, in Hz		4 ± 1	
Number of cycles		3 million	

NOTE Compared to EN 13481–2:2012, Table 3, the load $2Pv$ has been reduced as a maximum axle load of 300 kN in this standard.

5.2.2 Fixation of the fastening system on body

A vertical load test shall be performed on the fixation elements using the procedure described in EN 13481-2:2012, Annex A.

The verification shall be given by a structural analysis. The calculation shall be based on an existing design standard.

5.2.3 Attenuation of impact loads (Optional test)

If requested by the customer, attenuation of dynamic loads shall be measured. Test procedure is defined by the customer (on the basis of EN 13146-3).

5.2.4 Pad and assembly stiffness (Optional test)

If requested by the customer, the assembly and pads static stiffness and assembly and pads low frequency dynamic stiffness shall be measured. Test procedure is defined by the customer (on the basis of EN 13146-9).

5.3 Bending test for the body

This test is used for assessing the long term performance of the body only. A load is applied with repeated displacement cycles representative of the displacements caused by traffic on railway track.

Test shall be performed according to Annex B. Test loads and positions are specified in Table 2.

Table 2 – Test loads and positions for body test

	Definition	Test values
F_{cu}	Lower amplitude of oscillating load, in kN	10
F_{co}	Upper amplitude of oscillating load, in kN	71
f	Frequency, in Hz	5 ± 3
nc	Number of cycles	2 million
L_c	Design distance between centre lines of the rail seat, in mm	1 500

NOTE $F_{co} = 4xM/(L_c - 0,1)$

where:

L_c in m

M is the bending moment, in kNm.

The test upper value 71 kN corresponds to a bending moment of 25 kNm. If L_c is different from 1 500 mm (narrow or broad gauge), F_{co} shall be recalculated to generate a centre section bending moment of 25 kNm.

5.4 Electrical resistance

The aim of this test is to determine the electrical resistance, in wet conditions, between the running rails provided by a fastening system fitted to hollow sleepers and bearers.

The electrical test shall be performed according to EN 13146-5.

5.5 Field test

Availability shall be assessed by field test during one year minimum. The field test shall be done with minimum three pieces and monitored by the customer. The customer shall define the test parameters in a protocol (MGT, gauge widening, availability, etc.).

6 Acceptance criteria for homologation

6.1 Fastening system and interface acceptance criteria

6.1.1 Effect of repeated loading

No damage or cracks in the fastening system and interface components shall have occurred. The welds shall be subjected to a visual and dye penetrant inspection.

If not specified by the customer, after the fatigue test the rail foot lateral displacement shall be less than 1 mm, where a zero reference is taken after 1 000 cycles.

6.1.2 Fixation of the fastening system on body (optional test)

After removal of the load, there shall be no visible cracks revealed by dye penetrant inspections.

6.1.3 Attenuation of impact loads (optional test)

For fastening systems described as having medium or high attenuation of dynamic loads this shall be measured by the procedure in EN 13146-3. The result shall comply with the following limits:

— medium attenuation: ≥ 15 % ≤ 30 %;

— high attenuation: > 30 %.

6.1.4 Pad and assembly stiffness (optional test)

The customer shall define the acceptance criteria for pad and assembly stiffness.

6.2 Body acceptance criteria

6.2.1 Bending test acceptance criteria

After the bending test according to 5.3, the difference of the vertical deflection at the centre of the body under 10 kN load and the zero reference measuring shall be less than 0,5 mm (the zero is taken after 1 000 cycles with 10 kN vertical load).

6.2.2 Other acceptance criteria checked by FEM calculation

6.2.2.1 Service fatigue design

The determination of bending moments at the sleeper centre and under the rail seats is the responsibility of the customer.

Unless otherwise specified, hollow sleepers and bearers shall assume:

— a positive bending moment of 25 kNm;

— a rail seat load of 100 kN.

A verification by FEM calculation in fatigue for these configurations shall be done (stress shall be below fatigue limit of the material).

6.2.2.2 Maximum load

The determination of the maximum rail seat load is the responsibility of the customer.

Unless otherwise specified, hollow sleepers and bearers shall assume a maximum load of 150 KN (due to exceptional shock loads such as wheel flats). In this case, a verification by FEM calculation shall be done to check the maximum equivalent stress is below 0,8 fyk (yield strength).

6.3 Electrical acceptance criteria

If the customer requires electrical isolation, a homologation test according to EN 13146-5 shall be done on three hollow sleepers. One of these is the test specimen of the fatigue test according to 5.2.1.

For hollow sleepers and bearers, the minimal value of electrical acceptance criterion shall fulfil the requirement of EN 13481-7.

6.4 Field test acceptance criteria

The customer shall define the acceptance criteria, corresponding to the test parameters.

A field test report shall be established with the following elements:

— the initial settlement;

— the successive visits (every 3 months);

— cumulated MGT;

— acceptance criteria (cracks, gauge, etc.);

— every failure (missing availability, etc.)

7 Tests and tolerance for quality control

7.1 Dimension tolerances

The dimensions of each hollow sleeper and bearer shall be checked. Permitted tolerances are specified in Table 3.

These tolerances are for quality control during homologation tests and routine tests.

Table 3 – Permitted tolerances

Item	Tolerance
nominal height	±5 mm
weight	±5 %
top width	±5 mm
bottom width	±5 mm
body thickness	according to the customer approved design drawing
position of characteristic points for interface of fastening, actuation and control device	according to the customer approved design drawing

7.2 Electrical resistance

The assembly of hollow sleeper and bearer shall be checked with an electrical resistance test.

The test method and the acceptance criteria are part of the quality plan.

For this test, measuring equipment is required that is able to measure electrical insulation at a voltage of 500 V d.c.. The equipment shall be able to measure accurately in the range of up to 5 MΩ. The test probes shall have minimum contact area of 1 mm^2.

The measurement points shall be located:

— one on the body (near the plate);

— the other on the assembled plate.

The test shall be made in dry conditions on both sides of the track.

Electrical resistance in dry conditions shall be more than 1 MΩ.

8 Quality

8.1 General

The supplier shall operate a quality system which is defined and maintained in a quality manual. This manual shall address all actions, functions and resources, procedures and practices concerned with archiving and providing documentary evidence that the quality of the delivered sleepers and services that the supplier provides are to the agreed requirements.

The quality manual shall include a quality plan for sleepers which defines and details the following:

— the organisation, structure and responsibilities;

— all the materials, processes and procedures for manufacturing, storing and transporting of the sleepers;

— all testing requirements including definition of testing equipment, method of testing, frequency of tests, etc.;

— all other quality control procedures to ensure and verify that the sleepers and services provided are to the agreed requirements.

The purchaser shall have access to the quality manual at the premises of the supplier.

NOTE Guidance on quality systems is given in EN ISO 9000.

8.2 Quality control during homologation tests

The supplier shall provide to the purchaser all quality documents in relation with the elements to be submitted to homologation tests.

This includes:

— functional drawings of the element and components included;

— procedure showing how all testing requirements are fulfilled:

— this includes geometrical tests with description of the gauge and measurement method for each dimension;

— this includes load tests on sleeper with the description of the measurement means and method;

— general description of the manufacturing process;

— test report showing compliance of the sleepers submitted to Clause 7 with the dimensions and maximum tolerances defined.

8.3 Quality control during manufacturing (Routine tests)

Prior to start of manufacturing the supplier shall provide to the purchaser a quality plan including all quality documents in relation to the acceptance of materials and manufacturing of the elements.

For routine tests, alternative test arrangements can be used if the manufacturer can provide evidence of results complying with test arrangements defined in Clause 7.

Quality plan shall detail:

— frequency of testing for each dimensional requirement;

— mechanism used to increase the gauging frequency when defects are identified;

— actions to be taken in the case of defects being found to ensure recheck for compliance.

At the request of the purchaser, the supplier can be asked to carry out at certain moments controls consisting of non-routine tests included in this standard, and verification of the homogeneity in routine test results.

9 Traceability

Each sleeper shall have the following permanent marking:

— year of manufacture;

— identification mark of the production plant.

In addition, if requested by the customer, the date of manufacture shall be marked on each sleeper.

The purchaser may require additional information to be marked on the sleepers.

Annex A
(normative)

Effect on repeated loading on fastening system and interface

A.1 General

This annex specifies a laboratory test procedure for applying repeated displacement cycles representative of the displacements caused by traffic on railway track. It is used for assessing the long-term performance of the fastening system and interface.

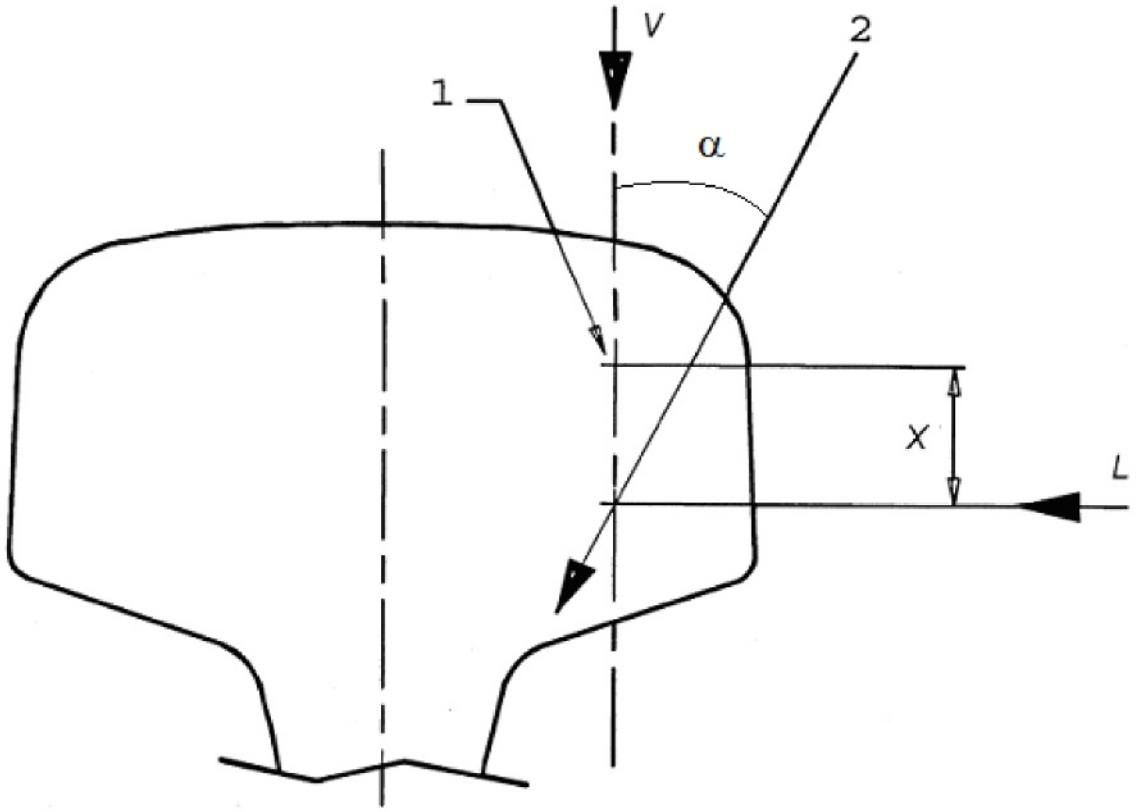
This test procedure applies to a complete fastening assembly and rail segments.

A.2 Symbols

For the purposes of this standard, the following symbols apply:

α	angle between the load line and a line normal to the running surface of the rails, in degrees
F	maximum axial longitudinal load on the rail without non-elastic displacement occurring, in kN
L	lateral component of force transmitted by the wheel to the rail head as shown in Figure A.1, in kN
P_{L}	component of load parallel to the running surface of the rails in kN
P_{V}	component of load normal to the running surface of the rails, in kN
V	vertical component of force transmitted by the wheel to the rail head as shown in Figure A.1, in kN
X	position of the line of application of P_{L} below the centre of curvature of the gauge corner of the rail head as shown in Figure A.1, in mm

NOTE $\frac{L}{V} = \frac{P_{\mathrm{L}}}{P_{\mathrm{V}}} = \tan\alpha$



Key

1 centre of gauge corner radius

2 line of load application

Figure A.1 – Position of load application

A.3 Principle

A constant amplitude, cyclic force is applied by a single actuator at a predetermined load line and position on the rail head. The load, position and line of application to be used are those of Table 1.

Performance is determined by the vertical deflexion variation of the sleeper body and visual inspection of the components during test.

A.4 Apparatus

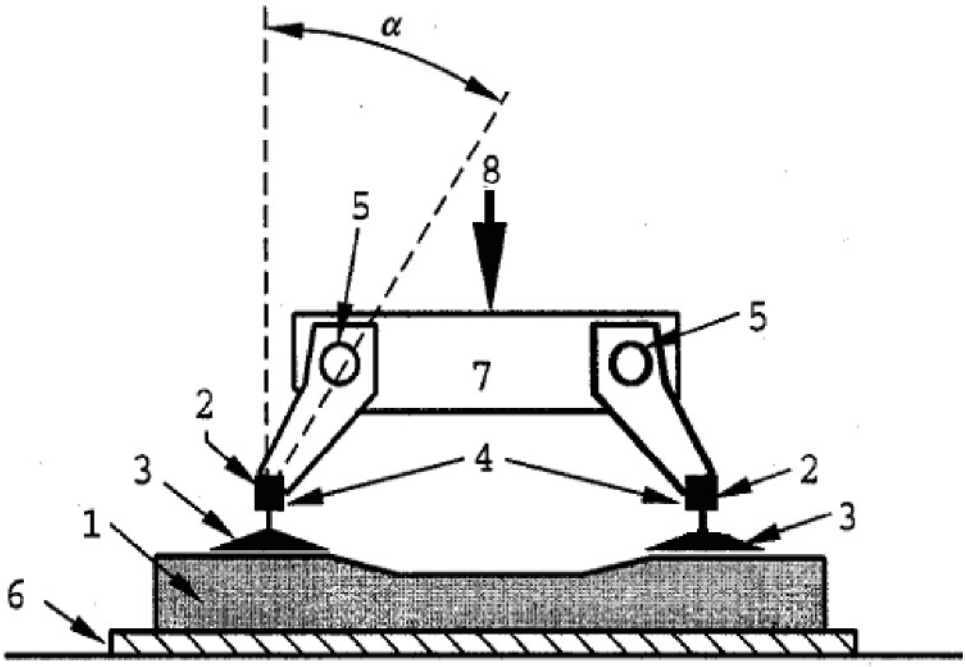
A.4.1 Rail

Short lengths of rail (approximately 0,5 m per rail seat, or longer if required), of the section for which the fastening assembly under test is designed. The rail shall be unlaminated and have no loose rust on the surface nor be polished on the foot by repeated testing.

The head of the rail may be modified to accommodate the load application head except when testing fastenings which support the web of the rail. In this case the dimension *X*, as shown in Figure A.1, refers to the design rail section for the fastening assembly.

A.4.2 Load application head

A head in contact with the rail which is capable of transmitting the applied force to a rail at the required position relative to the rail head. A typical arrangement is shown in Figure A.2.



Key

1 hollow sleeper or bearer
2 short length of rail of the required section
3 fastening assembly with appropriate pad
4 loading mechanism which allows free rotation of rail under load
5 free pivot either above or below the actuator with minimum length of strut from pivot to rail of 0,4 m
6 layer of crushable or conformable material on a rigid support (e.g. gypsum board)
7 Beam of length to suit track gauge
8 applied load $2P_V$

Figure A.2 – Test arrangement

A.4.3 Verification of calibration

The calibration of actuators shall be verified in accordance with EN ISO 7500-1 using equipment having traceability to European or International Standards using the International System of Units (SI).

A.5 Test specimens

A.5.1 Sleeper or other rail support

Hollow sleeper with cast-in fastening components or holes, and rail seats, that has been made, without modification, for this test.

A.5.2 Fastening

All fastening components as used in track and assembled in accordance with the manufacturer's instructions.

A.6 Test procedure

A.6.1 General

This procedure involves the use of both rail seats on one sleeper.

A.6.2 Preparation for test

The fastenings are in line. Fix a short length of rail to one rail seat using the fastening components as assembled in track.

A.6.3 Cyclic loading

The values of α and X shall be as given in Table 1 of 5.2.

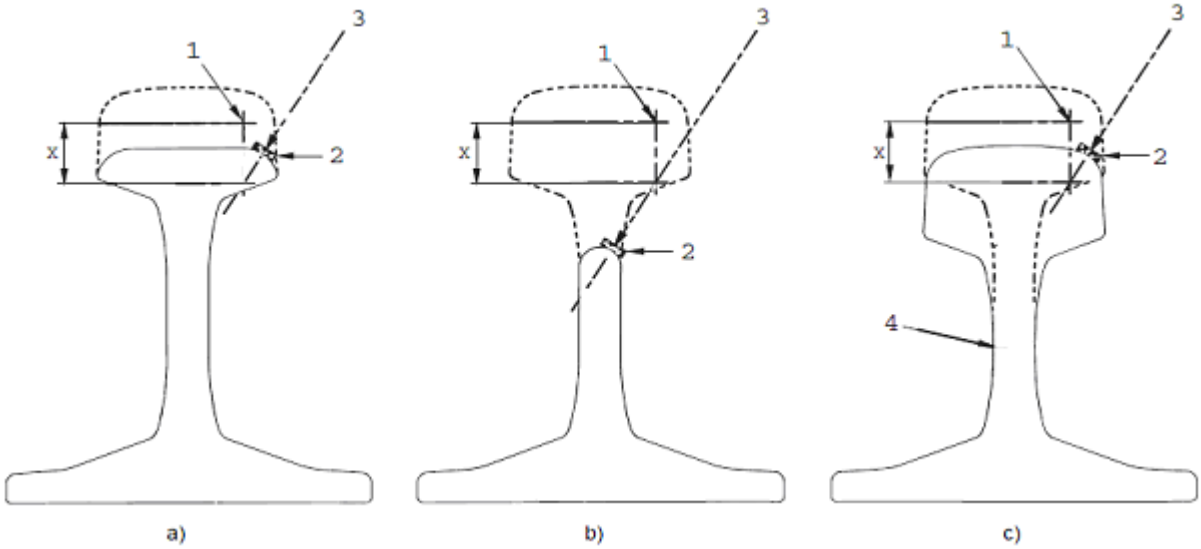
Set up the test arrangement as shown in Figure A.2.

Use the load application arrangements shown in Figure A.3 without any modification to the rail foot. The load application strut shall have a width parallel to the longitudinal axis of the rail of (100 ± 10) mm and a radius of curvature, normal to the rail head, greater than the radius of the contact surface on the rail such that the strut maintains a line contact with the rail under all load conditions.

Slowly load the test assembly to the maximum load ± 1 kN, at a rate not exceeding 100 kN/min for a single rail seat. Remove and reapply the load 10 times at the same rate as the first cycle. During the last three cycles the resultant force shall be acting to within the tolerances (α ± 0,5)° and (X ± 1) mm at maximum load.

Apply an alternating load to the test specimen from a minimum load of (5 ± 1) kN to a maximum load, for 3×10^6 cycles at a frequency of (4 ± 1) Hz. Within the first 1 000 cycles measure the dynamic displacement of the rail at the centre line of the sleeper relative to the sleeper or other support, for at least one loading cycle. Repeat the rail displacement measurements after 3×10^6 cycles. Intermediate displacement measurements may be made for information.

During this test the maximum temperature of any component shall not exceed 50 °C. Cooling by fan or a slight reduction in frequency within (4 ± 1) Hz, or a temporary stop in loading can be used to avoid overheating.



Key

1 centre of gauge corner radius

2 structure as described in A.6.3

3 line of load application according to Table 1

4 part of web removed

NOTE The original rail section is that for which the fastening assembly is designed.

Diagram (a), (b) and (c) depend on value of X and rail profile. The reduced head in (a) should not be used when $X \geq 50$ % of the depth of the rail head.

The overall depth of the reduced head shall be ≥ 15 mm.

Figure A.3 – Load application

A.6.4 Visual inspection

In order to assess the existence of damage or cracks, the fastening system, interface components and welds shall be visually inspected.

The dismantling is eventually required for this inspection. The welds control shall be completed by dye penetrant inspection.

A.6.5 Rail foot lateral displacement

After the fatigue test, the rail foot lateral displacement at the centre line of the sleeper shall be mesasured or calculated. The zero reference is taken after 1 000 cycles with 10 kN vertical load.

A.7 Test report

The test report shall include at least the following information:

a) number, title and date of issue of this standard;

b) name and address of laboratory performing the test;

c) date test performed;

d) name, designation and description of fastening assembly, including individual components, tested;

e) origin of test specimens;

f) rail section used in test;

g) test arrangement and values of $P_V/\cos \alpha$, X and α;

h) result of visual inspection after test;

i) rail foot lateral displacement.

Annex B
(normative)

Bending test for body only

B.1 Scope

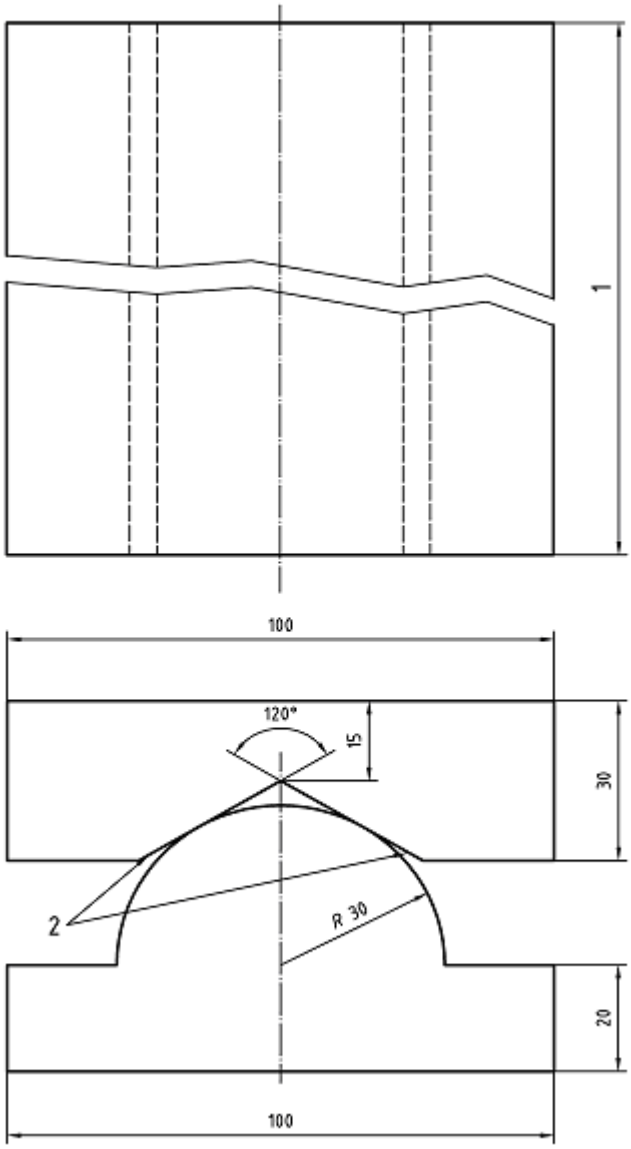
This annex specifies a laboratory test procedure for applying repeated displacement cycles representative of the loads caused by traffic on railway track. It is used for assessing the long term performance of the body only.

B.2 Apparatus

B.2.1 Load application devices

The load is applied to the body through articulated supports and tapered packing as described in Figure B.1 and Figure B.2.

Dimensions in millimetres

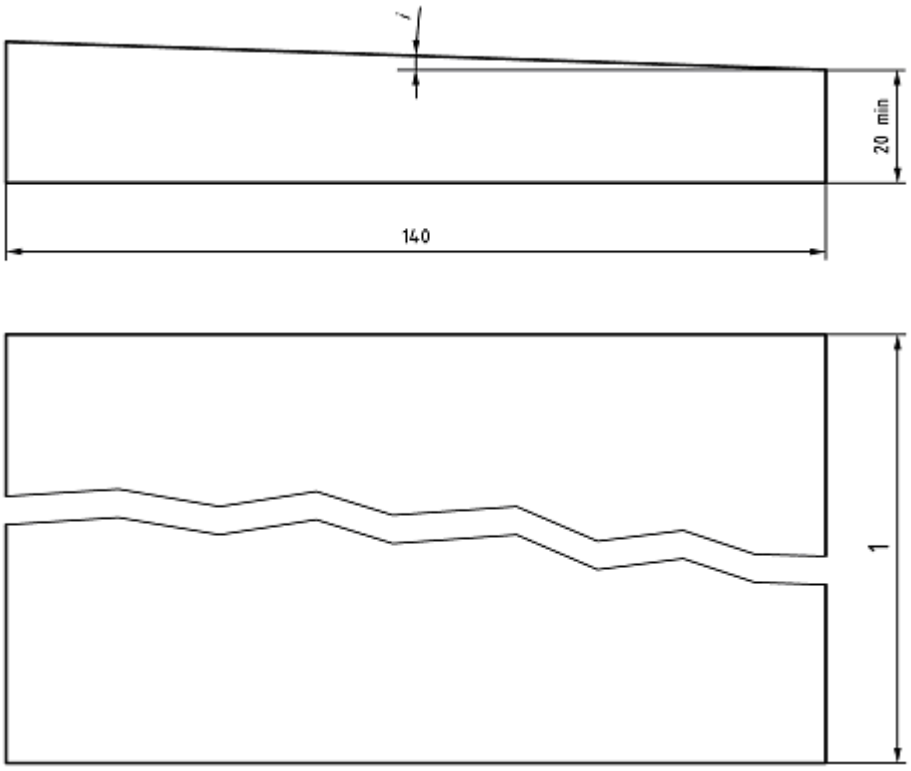


Key

Steel: minimum hardness Brinell	HBWV > 240
General tolerances	+- 0,1 mm
1	minimum length = width of the body
2	high pressure lubricant

Figure B.1 – Articulated support

Dimensions in millimetres



Key

Steel: minimum hardness Brinell	HBW > 240
General tolerances	+- 0,1 mm
i	inclination of rail seat
1	minimum length = width of the body

Figure B.2 – Tapered packing

B.3 Test specimens

B.3.1 Hollow sleeper or bearer body

A hollow sleeper or bearer body, as made, without modification for this test.

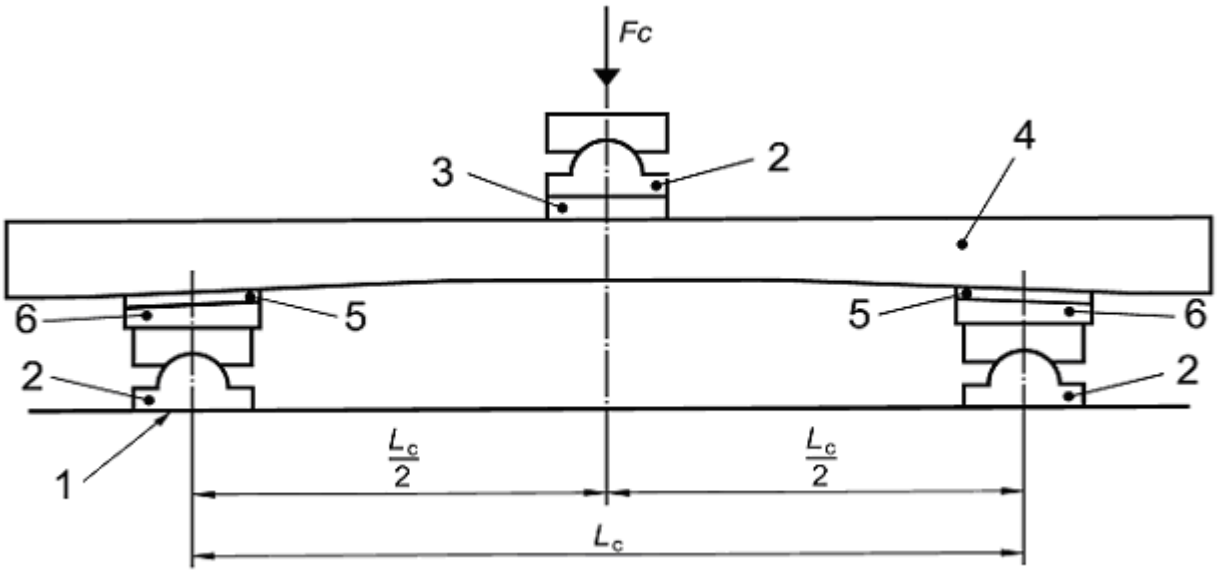
B.4 Procedure

B.4.1 General

This procedure involves the use of both rail seats on one hollow sleeper or bearer body.

B.4.2 Test arrangement

The test arrangement for the negative bending moment is shown in Figure B.3.



Key

1 rigid support

2 articulated support (see Figure B.1)

3 resilient pad as defined in B.4.3

4 body of the hollow sleeper

5 resilient pad of the fastening as defined in B.4.3

6 tapered packing (see Figure B.2)

F_c oscillating load, defined in Table 2 of 5.3

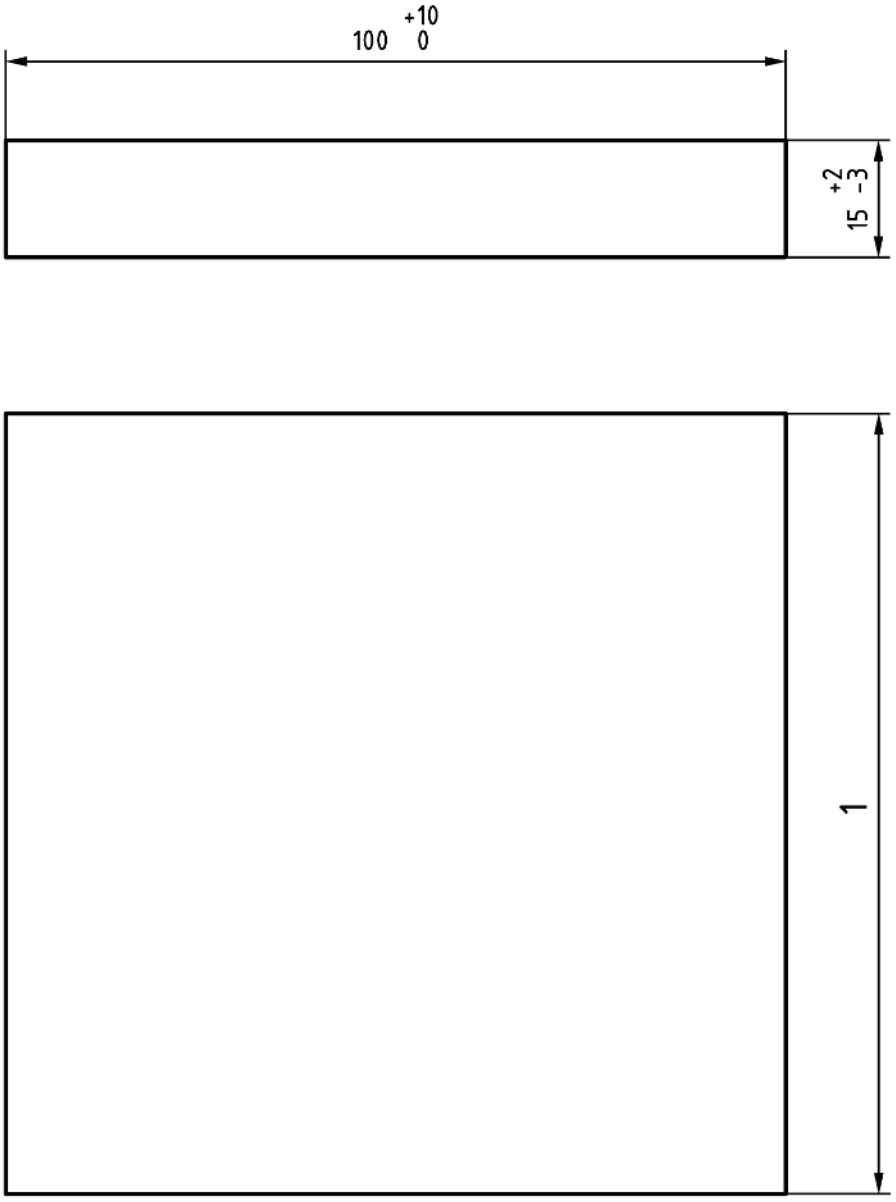
L_c design distance between centre lines of the rail seat (positions of load application), defined in Table 2 of 5.3

Figure B.3 – Test arrangement for negative bending moment

B.4.3 Resilient pad

This shall be as shown in Figure B.4.

Dimensions in millimetres



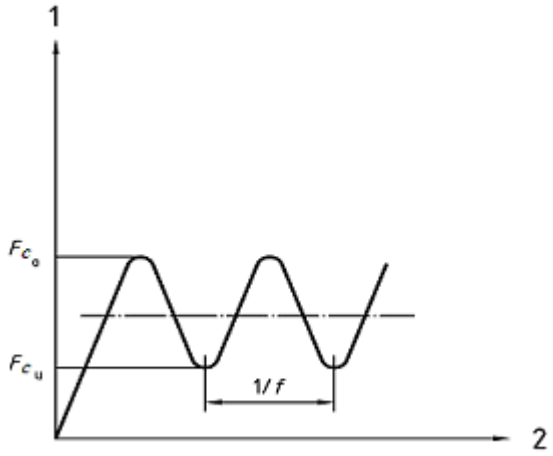
Key

Material	Elastomer
Static stiffness measured between 0,3 MPa and 2 MPa	$1 \leq c \leq 4$ N/mm^3
1	Minimum length = bottom width of the hollow sleeper or bearer at the rail seat + 20 mm

Figure B.4 — Resilient pad

B.4.4 Procedure

Apply the load given in 5.3, Table 2, and the following sequence defined in Figure B.5: (identical frequency maintained during duration of test).



Key

1 load

2 time

Figure B.5 – Dynamic load application for fatigue bending test

B.5 Test report

The test report shall include at least the following information:

a) number, title and date of issue of this standard;

b) name and address of laboratory performing the test;

c) date test performed;

d) name, designation and description of the system including tested individual components;

e) origin of test specimens;

f) rail test arrangement and values of loads;

g) result of visual inspection after test;

h) vertical deflexion variation.

Bibliography

[1] EN 13230 (all parts), *Railway applications – Track – Concrete sleepers and bearers*

[2] EN ISO 9000, *Quality management systems - Fundamentals and vocabulary (ISO 9000)*

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