SLOVENSKI STANDARD
SIST EN 13146-4:2020

01-julij-2020

Nadomešča:
SIST EN 13146-4:2012+A1:2015

Železniške naprave - Zgornji ustroj proge - Preskušanje pritrdilnih sistemov - 4. del: Učinek ponavljajoče se obremenitve

Railway applications - Track - Test methods for fastening systems - Part 4: Effect of repeated loading

Bahnanwendungen - Oberbau - Prüfverfahren für Schienenbefestigungssysteme - Teil 4: Dauerschwingversuch

Applications ferroviaires - Voie - Méthodes d'essai pour les systèmes de fixation - Partie 4 : Effets produits par des charges répétitives

Ta slovenski standard je istoveten z: **EN 13146-4:2020**

ICS:

93.100	Gradnja železnic	Construction of railways

SIST EN 13146-4:2020 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13146-4

April 2020

ICS 93.100

Supersedes EN 13146-4:2012+A1:2014

English Version

Railway applications - Track - Test methods for fastening systems - Part 4: Effect of repeated loading

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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 13146-4:2020) 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of an identical text or by endorsement, at the latest by October 2020, and conflicting national standards shall be withdrawn at the latest by October 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13146-4:2012+A1:2014.

In this revision of EN 13146-4:2012+A1:2014, the procedure has been modified to clarify the detail of some of the test procedures.

This document is one of the series EN 13146, *Railway applications — Track — Test methods for fastening systems*, which consists of the following parts:

— *Part 1: Determination of longitudinal rail restraint*;

— *Part 2: Determination of torsional resistance*;

— *Part 3: Determination of attenuation of impact loads*;

— *Part 4: Effect of repeated loading*;

— *Part 5: Determination of electrical resistance*;

— *Part 6: Effect of severe environmental conditions*;

— *Part 7: Determination of clamping force and uplift stiffness*;

— *Part 8: In-service testing*;

— *Part 9: Determination of stiffness*;

— *Part 10: Proof load test for pull-out resistance*.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document 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 fastening systems.

The procedure is applicable to surface mounted rail on sleepers, bearers and slab track, and embedded rail.

This test procedure applies to a complete fastening assembly.

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 13146-1, *Railway applications — Track — Test methods for fastening systems — Part 1: Determination of longitudinal rail restraint*

EN 13146-7, *Railway applications — Track — Test methods for fastening systems — Part 7: Determination of clamping force and uplift stiffness*

EN 13146-9:2020, *Railway applications — Track — Test methods for fastening systems — Part 9: Determination of stiffness*

EN 13481-1:2012, *Railway applications — Track — Performance requirements for fastening systems — Part 1: Definitions*

EN ISO 7500-1:2018, *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 7500-1:2018)*

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

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13481-1:2012 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp/ui

3.2 Symbols and abbreviations

For the purposes of this document, 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;

F_{SAmax} force applied to assembly in measurement of static stiffness of assembly, in kN;

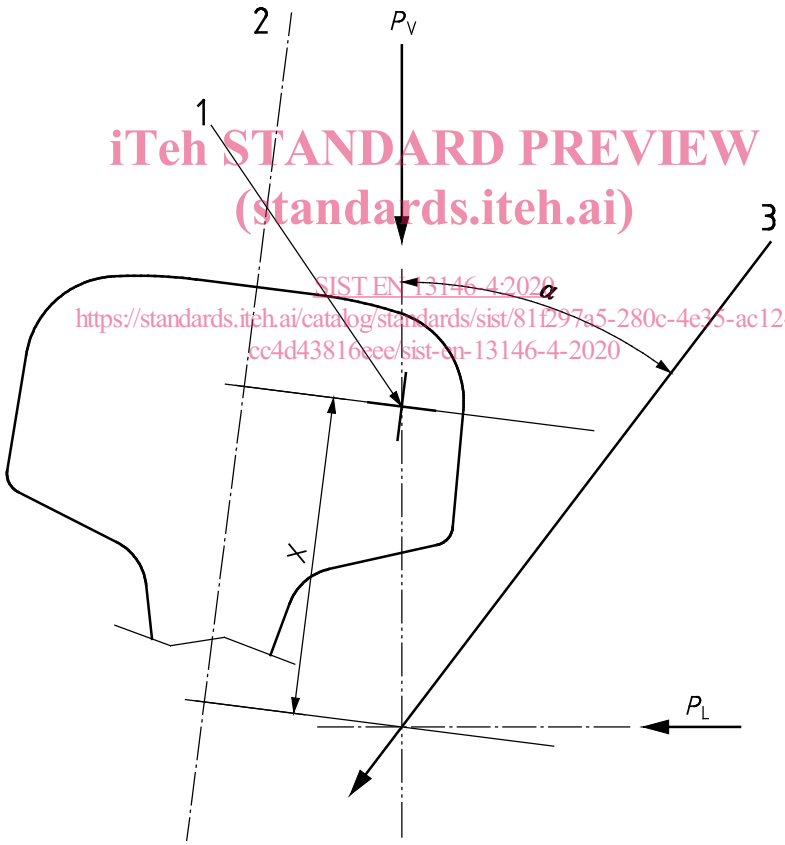
P_L component of force parallel to the running surface of the rails, in kN;

P_V component of force normal to the running surface of the rails, 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 1, in mm.

NOTE 1 $\frac{P_L}{P_V} = \tan \alpha$

NOTE 2 Running surface is defined in EN 13481-1:2012.



Key

1 Centre of gauge corner radius

2 Centre line of rail profile

3 Line of load application

Figure 1 — Position of load application

4 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 determined from the vertical stiffness of the fastening assembly, axle loads and curve conditions of the track for which the fastening assembly is being tested.

Performance is determined by the change in clamping force, longitudinal rail restraint, vertical stiffness and rail position, and visual inspection of the components during test.

5 Apparatus

5.1 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 neither have 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 1, refers to the design rail section for the fastening assembly.

For embedded rail, the rail is part of the test specimen and its length is specified in 6.1.

5.2 Actuator

Actuator capable of applying a force of up to 150 kN in a cyclic manner at a frequency of (4 ± 1) Hz.

NOTE For simultaneous loading of two and four rail seats the required capacity will be correspondingly greater.

5.3 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.

5.4 Displacement-measuring instruments

5.4.1 Calibration procedure

If contacting displacement-measuring instruments are used they shall conform to EN ISO 9513:2012, Table 2, Class 2.

If non-contacting displacement-measuring instruments are used they shall be calibrated to ensure that they are capable of measuring the displacement of the rail, relative to the supporting sleeper or other element as required in 5.4.2.

5.4.2 Calibration requirement

The instrument shall be capable of measuring displacements as follows:

— for assemblies with an expected low-frequency dynamic stiffness ≤ 100 MN/m, displacement-measurement within ± 0,02 mm;

— for assemblies with an expected low-frequency dynamic stiffness > 100 MN/m, displacement-measurement within ± 0,01 mm.

5.4.3 Fixtures for mounting displacement-measuring instruments

For measurement of displacements during repeated loading, mounting fixtures shall be provided which minimize additional measurement errors under the conditions within which the test is running.

When displacements are to be measured while the test is running, steps should be taken to ensure that any fixtures used to support the displacement-measuring instruments are short and stiff. This is to ensure that the dynamic response of the fixture does not affect significantly the accuracy or repeatability of the measurements.

5.5 Force-measuring instruments

Instruments conforming to EN ISO 7500-1:2018, Class 1 and over the required range of force.

5.6 Verification of calibration

The calibration of actuators shall be verified periodically in accordance with EN ISO 7500-1:2018 using equipment having traceability to European or International Standards using the International System of Units (SI).

6 Test specimens

6.1 Sleeper or other rail support

A sleeper, half sleeper, concrete block or other rail support with cast-in fastening components or holes, and rail seats, as made without modification for this test. It is recommended that two sleepers or half sleepers are used if the cast-in fastening components or holes are non-symmetrical about the longitudinal centre line of the sleeper.

For surface mounted rail on slab track, the fastening system (or two fastening systems if required: see 7.2.2) shall be mounted centrally on the top of a reinforced concrete block. The length and width of the block shall be large enough to support the area of the fastening system or systems as they would be supported in use in track, and to extend at least 100 mm around any component which is embedded into the block. The depth of the block shall be the depth of the slab or (200 ± 10) mm, whichever is the smaller.

For surface mounted fastening systems on slab track, with continuous support of the rail, the test shall be performed using a length of pad equal in length to the design spacing of the fastening along the rail. The piece of rail used for the test shall be at least as long as the piece of pad and the size of the concrete block shall be sufficient to provide support to the full length of the piece of pad.

For embedded rail the channel containing the rail shall be contained in a concrete block similar to that for surface mounted rail on sleepers, bearers and slab track.

For mechanically fastened embedded rail, the length of rail shall be the typical spacing of fastenings.

For adhesively fastened embedded rail, the length of the rail shall be 0,5 m to 0,85 m.

6.2 Fastening

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

7 Procedure for one rail

7.1 General

The following procedure is for the test when a rail is fixed to one end of the sleeper or half sleeper. When two rails are used the procedure in Clause 8 shall be used.

The sequence of tests shall be 7.3, 7.4, 7.5, 7.6, 7.5, 7.4, 7.3 performed on test specimens assembled in accordance with 7.2.1 or 7.2.2. At no time during the test sequence shall any part of the fastening assembly be adjusted, retightened or modified.

7.2 Preparation for test

7.2.1 In line fastening

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

7.2.2 Offset fastening

If the fastenings are non-symmetrical, the test set up can become unstable during test. In such cases fix a short length of rail to one rail seat on each of two adjacent sleepers or half sleepers as shown in Figure 2. On slab track with non-symmetrical fastenings a section of slab with two rail seats should be used.

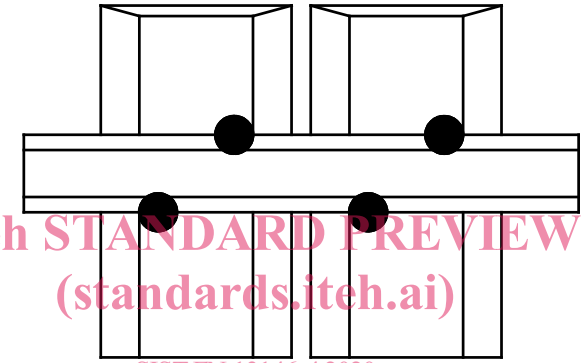


Figure 2 — Arrangement of test sleepers for offset fastenings

When testing two fastening assemblies together, the effect of bending of the rail should be minimized. This can be done by (a) placing the two fastening systems as close together as possible and/or (b) using a “spreader beam” to distribute the load equally between the two fastening assemblies.

7.3 Clamping force

Determine the clamping force of the assembly using the procedure in EN 13146-7.

If the test is being carried out on two rail seats with indirect fastenings (e.g. as described in 7.2.2), the vertical force is applied directly over the centre line of each of the rail seats in turn, whilst the anchors of the baseplate at the other rail seat are partially unfastened. The clamping force is determined as the mean of the measured values for the two rail seats.