
**Železniške naprave – Zgornji ustroj – Zahteve za izdelavo pritrtilnih sistemov
– 6. del: Posebni pritrtilni sistemi za dušenje vibracij**

Railway applications - Track - Performance requirements for fastening systems -
Part 6: Special fastening systems for attenuation of vibration

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**Railway applications - Track - Performance requirements for
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attenuation of vibration**

Applications ferroviaires - Voie - Prescriptions de
performance pour les systèmes de fixation - Partie 6:
Systèmes de fixation spéciaux pour atténuation des
vibrations

Bahnanwendungen - Oberbau - Leistungsanforderungen für
Schienenbefestigungssysteme - Teil 6: Spezielle
Befestigungssysteme zur Minderung von Schwingungen

This European Prestandard (ENV) was approved by CEN on 28 December 2000 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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Foreword

This document (ENV 13481-6) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

The text of ENV 13481-6:2002 has been approved by CEN as a European Prestandard

This European Prestandard is one of a series of standards EN 13481 as listed below.

- *Railway applications - Track - Performance requirements for fastening systems - Part 1 : Definitions*
- *Railway applications - Track - Performance requirements for fastening systems - Part 2 : Fastening systems for concrete sleepers*
- *Railway applications - Track - Performance requirements for fastening systems - Part 3 : Fastening systems for wood sleepers*
- *Railway applications - Track - Performance requirements for fastening systems - Part 4 : Fastening systems for steel sleepers*
- *Railway applications - Track - Performance requirements for fastening systems - Part 5 : Fastening systems for slab track*
- *Railway applications - Track - Performance requirements for fastening systems - Part 6 : Special fastening systems for attenuation of vibration*
- *Railway applications - Track - Performance requirements for fastening systems - Part 7 : Special fastening systems for switches and crossings and check rails*

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ENV 13481-6:2002 (E)**Introduction**

This European Prestandard was originally drafted as a European Standard but it was decided that the state of the art would not permit publication as a full Standard. It is intended to review this Prestandard two or three years after publication when there should be sufficient experience and data available to permit a full Standard to be prepared.

A requirement for longitudinal rail restraint is included to control rail creep and pull apart in the event of a broken rail. The relationship between longitudinal rail restraint and the overall design of the track slab requires consideration.

A class of high attenuation of dynamic loading is included for use when it is necessary to protect the track from vehicle induced impacts.

The laboratory test for the effect of repeated loading is the means of assessing potential long term performance of the fastening in track

For systems in which the rail is continuously supported, test procedures are modified to take account of the change from discrete support.

The attenuation of vibration achieved by fastening systems depends on the foundation impedance and transient load conditions which may vary in situ. For the purposes of this European Prestandard it is assumed that the stationary vertical vibration is adequate to characterize the performance of fastening systems in respect of attenuation of vibration. Two test procedures, direct and indirect, are included as it is known that the apparatus for both procedures is in use. It is intended to include only one test procedure when this Prestandard is replaced by a full Standard.

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Some fastening systems utilise concrete elements, such as booted sleepers, to contribute to their overall vibration attenuation. The procedure for measuring attenuation of vibration is not applicable to such fastening systems.

1 Scope

This European Prestandard specifies requirements for the performance of fastening systems for attaching rails to sleepers or longitudinal bearers or in non-ballasted track to the uppermost surface of concrete or asphalt slabs. It applies to track with a minimum curve radius greater than 40 m and subject to a maximum design axle load of 260 kN. It does not apply to embedded rails.

The requirements apply to direct fastening systems and systems which incorporate a baseplate. They are not applicable to systems which incorporate concrete elements or other high mass elements nor to special fastening systems used at bolted rail joints.

This European Prestandard is for type approval only.

2 Normative references

This European Prestandard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Prestandard only when incorporated in it by amendment or revision. For undated references the latest edition of the publications referred to applies (including amendments).

prEN 13481-1:1999, *Railway applications - Track - Performance requirements for fastening systems - Part 1 : Definitions.*

prEN 13481-2:1999, *Railway applications - Track - Performance requirements for fastening systems - Part 2 : Fastening systems for concrete sleepers.*

prEN 13481-5:1999, *Railway applications - Track - Performance requirements for fastening systems - Part 5 : Fastening systems for slab track.*

prEN 13146-1:1998, *Railway applications - Track - Test methods for fastening systems - Part 1 : Determination of longitudinal rail restraint.*

prEN 13146-3:1998, *Railway applications - Track - Test methods for fastening systems - Part 3 : Determination of attenuation of impact loads.*

prEN 13146-4:1998, *Railway applications - Track - Test methods for fastening systems - Part 4 : Effect of repeated loading.*

prEN 13146-5:1998, *Railway applications - Track - Test methods for fastening systems - Part 5 : Determination of electrical resistance.*

prEN 13146-6:1998, *Railway applications - Track - Test methods for fastening systems - Part 6 : Effect of severe environmental conditions.*

prEN 13146-7:1998, *Railway applications - Track - Test methods for fastening systems - Part 7 : Determination of clamping force.*

prEN 13146-8:1998, *Railway applications - Track - Test methods for fastening systems - Part 8 : In service testing.*

prEN 13674-1:1999, *Railway applications - Track - Rail - Part 1 : Flat bottom, symmetrical railway rails 46kg/m and above.*

EN ISO 10846-1, *Acoustics and vibration - Laboratory measurement of vibro-acoustic transfer properties of resilient elements - Part 1 : Principles and guidelines (ISO 10846-1:1997).*

EN ISO 10846-2, *Acoustics and vibration - Laboratory measurement of vibro-acoustic transfer properties of resilient elements - Part 2 : Dynamic stiffness of elastic supports for translatory motion - Direct method (ISO 10846-2:1997).*

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prEN ISO 10846-3:1997, *Acoustics and vibration - Laboratory measurement of vibro-acoustic transfer properties of resilient elements - Part 3 : Dynamic stiffness of elastic supports for translatory motion - Indirect method (ISO 10846-3:1997)*.

3 Terms and definitions

For the purposes of this Prestandard the terms and definitions given in prEN 13481-1:1999 and EN ISO 10846-1 apply together with the following.

3.1**dynamic stiffness**

deflection per unit force measured under a cyclic uniaxial force over the frequency range (3-5) Hz

3.2**static stiffness**

deflection per unit force measured under a uniaxial static force

3.3**transfer stiffness**

frequency dependent ratio of the force on the blocked output side of a vibration isolator to the displacement on the input side during simple harmonic vibration in the range (25-400) Hz

4 Symbols and abbreviated terms

L lateral component of force transmitted by the wheel to the rail head as shown in Figure 1, in kN.

NOTE $\frac{L}{V} = \frac{P_L}{P_V} = \tan \alpha$

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P_L component of load parallel to the base of the sleeper, in kN ;

P_V component of load normal to the base of the sleeper, in kN ;

V vertical component of force transmitted by the wheel to the rail head as shown in Figure 1, in kN ;

X distance of the line of application of P_L below the centre of curvature of the gauge corner of the rail head, in mm ;

α angle between the load line and a line normal to the base of the sleeper, in degrees.

5 Requirements**5.1 Longitudinal rail restraint**

The longitudinal rail restraint shall be not less than 7 kN when measured in accordance with prEN 13146-1:1998. For fastening systems 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.

When necessitated by the slab track design and subject to agreement between the purchaser and manufacturer, the minimum requirement for longitudinal rail restraint can be reduced.

5.2 Attenuation of impact loads for fastening systems for use on concrete sleepers or blocks

For fastening systems described as having medium or high attenuation of dynamic loads this shall be measured in accordance with prEN 13146-3:1998. During the test this element shall be supported on a rigid surface. The piece of rail used for the test shall be at least as long as the piece of pad.

The result shall comply with Table 1.

Table 1 — Requirements for attenuation of impact loads

| Description | Attenuation % |
|--------------------|---------------------------|
| Low attenuation | ≤ 15 % - no test required |
| Medium attenuation | > 15 ≤ 30 % |
| High attenuation | > 30 % |

5.3 Effect of repeated loading

The effect of repeated loading shall be determined in accordance with prEN 13146-4:1998 except that in the case of fastenings for slab track the fastening system shall be mounted in the centre of the top surface of a reinforced concrete block. The length of the block, normal to the rail, shall be ≥ 500 mm, the depth = 200 mm and the width ≥ 300 mm.

If, for stability, it is necessary to test two rail seats in accordance with prEN 13146-4:1998, 7.1.2, the width of the block shall be ≥ 2 x the design fastening spacing in track. For fastening systems 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.

Test loads for the track types specified in Table 2 shall be in accordance with Table 3. The value of $P_V/\cos \alpha$ shall be obtained from Table 3 for the assembly design under test. For fastening systems which incorporate a second resilient layer, additional to the rail pad, the assembly stiffness shall be used in accordance with Table 3.

Table 2 — Reference values for testing the effect of repeated loading

| Type of track | Main line | Light rail |
|--|--|-----------------|
| Rail section | 60 E 1 | 40 kg/m |
| Axle load kN | 225 | 100 |
| Curve radius m | > 400 (soft pads) > 150 ≤ 400 (med/hard pads) | > 40 (all pads) |
| Support spacing m | 0,6 | 0,8 |
| NOTE The dynamic stiffness of pads is stated for test purposes only. It should not be taken as a recommendation for the dynamic stiffness of pads to be used in track. | | |

Pads shall be classified as follows when the dynamic stiffness is measured in accordance with prEN 13481-2:1999, annex B or prEN 13481-5:1999, annex A as appropriate.

- soft : stiffness < 100 MN/m ;
- medium : stiffness ≥ 100 < 200 MN/m ;
- hard : stiffness ≥ 200 MN/m.

The following measurements shall be performed before and after repeated loading. The change in performance shall not exceed the values shown.

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- longitudinal rail restraint measured in accordance with prEN 13146-1:1998 change \leq 20 % ;
- vertical static stiffness measured in accordance with prEN 13146-4:1998 change \leq 25 % ;
- clamping force measured in accordance with prEN 13146-7:1998 change \leq 20 %.

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Table 3 — Test loads and positions

| Sleepers | | | Slab track | | | | | | |
|--|-----------|---------|------------|-----------|-------|--------|------------|-------|--------|
| Type of track | Main Line | | Light Rail | Main Line | | | Light Rail | | |
| Pad ^a or assembly ^a dynamic stiffness MN/m | < 100 | 100-200 | Any | < 50 | 50-75 | 75-100 | < 50 | 50-75 | 75-100 |
| Maximum load ^c $P_V/\cos \alpha$ kN | 70 | 75 | 55 | 60 | 65 | 75 | 50 | 55 | 65 |
| L/V | 0,50 | 0,65 | 0,80 | 0,49 | 0,49 | 0,65 | 1,0 | 1,0 | 0,80 |
| α° | 26 | 33 | 38,6 | 26 | 26 | 33 | 45 | 45 | 38,6 |
| Load position X in Figure 1 mm | 15 | 15 | 25 | 15 | 15 | 25 | 100 | 100 | 75 |

^a The pad dynamic stiffness is measured in accordance with prEN 13481-2:1999, annex B or prEN 13481-5:1999, annex A as appropriate.

^b The assembly dynamic stiffness is used for those fastening systems having a second resilient layer in addition to the rail pad. It shall be measured in accordance with prEN 13481-5:1999, annex B.

^c The test loads shall be used only for rail sections included in prEN 13674-1:1999, excluding 49 E 4.

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