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Railway infrastructure — Rail fastening systems —

Part 7:
Test method for clamping force and uplift stiffness

Infrastructure ferroviaire — Systèmes de fixation du rail —

Partie 7: Méthode d'essai pour la détermination de l'effort d'application au patin du rail et la rigidité au soulèvement

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Foreword

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This document was prepared by Technical Committee ISO/TC 269, *Railway applications*, Subcommittee SC 01, *Infrastructure*.

A list of all parts in the ISO 22074 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This standard specifies the procedure to be used to measure the clamping force applied by a rail fastening system in laboratory conditions. It also describes a method for determining uplift stiffness- a parameter required as an input for calculations of Track-Bridge Interaction.

Railway infrastructure — Rail fastening systems —

Part 7:
Test method for clamping force and uplift stiffness

1 Scope

This International Standard specifies the laboratory test procedure for determining the clamping force exerted by the fastening system on the foot of the rail by measuring the force to separate the rail foot from its immediate support. When required, the procedure is also used to determine the uplift stiffness of the fastening system. It is applicable to systems with and without baseplates on all types of sleepers, bearers or elements of ballastless track. The test does not determine the security of the fastening components fixed into the sleeper or other fastening system support.

This test procedure applies to a complete fastening assembly. It is not applicable to fastening systems for embedded rail or other fastening systems which do not act on the foot of the rail.

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.

ISO 22074-1, *Railway applications – Infrastructure – Rail fastening systems - Part 1: Definitions*

ISO 22074-8, *Railway applications — Infrastructure — Rail fastening systems — Part 8: Determination of stiffness*

ISO 7500-1:2015, *Metallic materials – Verification of static uniaxial testing machines – Part 1: Tension/compression testing machines – Verification and calibration of the force-measuring system*

3 Terms and definitions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22074-1 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.2 Symbols

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

d for direct fastening systems – vertical displacement of the rail relative to the sleeper, in mm; for indirect fastening systems – vertical displacement of the rail relative to the baseplate, in mm;

m_s mass of sleeper or part sleeper and fastening components fixed to it, used in the test, in kg;

m_f mass of loading frame supported by the sleeper, in kg;

P vertical load applied to the rail, in kN;

P_c initial estimate of clamping force

P_0 vertical load at zero rail displacement which just counteracts the clamping force, in kN.

4 Principle

The clamping force for a complete rail fastening assembly is determined by measuring the force necessary to separate the rail from the surface on which it is supported.

5 Apparatus

5.1 Rail

A short length of rail, of the section for which the fastening assembly under test is designed.

5.2 Loading device

A device to apply a vertical load to the rail at a controlled rate of approximately 10 kN/min.

5.3 Measuring and recording instruments

Instruments which measure the vertical displacement of the rail support (baseplate or sleeper) relative to the rail with an accuracy of ± 0,1 mm and instruments conforming to EN ISO 7500-1:2015, Class 1 which measure the applied force. The recording instruments shall be capable of plotting load-displacement diagrams.

5.4 Calibration

The calibration of actuators and measuring instruments shall be verified periodically with equipment having certified traceability to European or International Standards using the International System of Units (SI).

5.5 Steel shims

Steel shims 25 mm × 25 mm × 0,25 mm, maximum thickness 0,30 mm.

6 Test specimens

6.1 Sleeper, bearer or concrete block

A portion of a sleeper, bearer or a concrete block whose centroid is approximately at the centre line of the rail seat or baseplate support area. This is described as a sleeper in the test procedure.

6.2 Fastening components

All fastening components, as used in track, including baseplates where incorporated.

7 Test procedure (Reference Method)

7.1 Preparation for test

Fix the rail to the sleeper, with the baseplate if part of the assembly, using the fastening components assembled as in track. If the test is to be conducted on an indirect fastening system, the clamps may be fixed over the baseplate provided that movement of the rail relative to the baseplate is not constrained.

If a rail pad is used which is shaped to provide positive location in the assembly, the edges of the pad can be cut off to simplify removal of the pad as described in 7.2. The portion of the pad under the rail should not be cut.

NOTE For fastening assemblies for switches and crossings which incorporate long baseplates additional fixings can be made into the supporting bearer or slab to minimize bending of the baseplate during this test.

Clamp the portion of sleeper to the base of the test fixture. Set up the test arrangement as shown in Figure 1 to permit a load P to be applied to the rail normal to the rail seat. Locate one displacement transducer at each of the four corners of the rail seat to measure d. Zero the displacement transducers.

7.2 Loading and measurement for assemblies incorporating a rail pad

Apply an increasing tensile load P to the rail, ensuring that the rail base is kept parallel to the rail seat without tilting, until the pad can just be moved. Remove the pad and decrease the load until the average of the displacement transducers is zero. At this point the $P = P_c$. Record the load P_c and then reduce the load to approximately 0,9 P_c. Whilst recording d (the average of the four transducers) increase the load P at a rate of (10 ± 1) kN/min until the load is 1,1 P_c. From the load-displacement diagram (Figure 2) read off the value of P_0 at $d = 0$ which is taken as the clamping force. On the same test specimen, and without changing or adjusting any components, repeat the loading and unloading sequence twice more and calculate the mean clamping force.

7.3 Loading and measurement for assemblies not incorporating a rail pad

Apply an increasing tensile load P to the rail until there is a clear space under the rail which is just sufficient to allow insertion of four steel shims under the rail, one at each corner of the rail seat. Reduce the load P to zero and then reapply an increasing load until a value is reached at which it is just possible to move all the shims by hand. This load is P_0 which is taken as the clamping force. Repeat the procedure twice more and calculate the clamping force as the average of the three values of P_0 obtained.

7.4 Determination of uplift stiffness

When required, the uplift stiffness of the spring clip components of the rail fastening system may be determined as the secant stiffness between the load limits of 0,9 P_c and 1,1 P_c as indicated in Figure 2.

In fastening systems which include a physical limit to the amount of uplift displacement which may be applied, the force and displacement required to reach that limit shall be recorded. (Figure 3)

NOTE Where there is significant elasticity in other elements of the fastening system, e.g. between a baseplate and the supporting element or under a rail seat block, the method of para 7.4 is not applicable.

7.5 Testing with two baseplated fastening assemblies

When this test procedure is used in conjunction with the procedure for repeated load testing of asymmetric baseplated fastening systems, according to ISO 22074-4, two fastening systems may be tested together. In this case, the following procedure shall be followed:

