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Railway infrastructure — Rail fastening systems —

Part 8:
Determination of stiffness

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Foreword

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This document was prepared by Technical Committee *[or Project Committee]* ISO/TC *[or ISO/PC]* ###, *[name of committee]*, Subcommittee SC ##, *[name of subcommittee]*.

This second/third/... edition cancels and replaces the first/second/... edition (ISO #####:####), which has been technically revised.

The main changes compared to the previous edition are as follows:

— xxx xxxxxxx xxx xxxx

A list of all parts in the ISO ##### 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 brings together test methods for measuring the stiffness of pads and fastening assemblies under static and low frequency dynamic loading.

No method for testing at acoustic frequencies is included. The procedure in EN 15461, which involves testing a length of track incorporating the fastening assemblies under test is recommended.

Railway infrastructure — Rail fastening systems —

Part 8:
Determination of stiffness

1 Scope

This International Standard specifies laboratory test procedures to determine the static and low frequency dynamic stiffness of rail pads, baseplate pads and complete rail fastening assemblies.

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 infrastructure — Rail fastening systems — Part 1: Vocabulary*

ISO 22074-4, *Railway applications — Infrastructure - Rail fastening systems — Part 4: Effect of repeated loading*

ISO 6344-1:1998, *Coated abrasives — Grain size analysis — Part 1: Grain size distribution test*

ISO 7500-1:2004, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system (ISO 7500-1:2004)*

ISO 9513:2002, *Metallic materials — Calibration of extensometers used in uniaxial testing (ISO 9513:1999)*

3 Terms and definitions

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

3.1
static stiffness
force required to cause a unit displacement of a pad or a rail fastening assembly with the load applied slowly enough to avoid all significant loading rate effects.

3.2
low frequency dynamic stiffness
force required to cause a unit displacement of a pad or a rail fastening assembly with a cyclic load applied at a frequency and force amplitude representative of the loading in conventional railway track associated with passing wheels or bogies.

4 Symbols and abbreviated terms

		Relevant sub-clause
F_{SPmax}	reference force applied to pad in measurement of static stiffness of pad, in kN;	6.1.3
F_{SP1}	lower limit of force for determining the static secant stiffness of a pad, in kN; (approximately equal to the clamping force expected in a fastening system).	6.1.3
F_{SP2}	upper limit of force for determining the static secant stiffness of a pad, in kN	6.1.3
k_{SP}	static stiffness of pad, in MN/m;	6.1.3
d_{SP}	mean vertical displacement of pad, in mm;	6.1.3
F_{LFPmax}	reference force for measurement of dynamic low frequency stiffness of pad, in kN;	6.2.3.2
F_{LFP1}	lower limit of force for determining the dynamic low frequency stiffness of pad, in kN; (approximately equal to the clamping force expected in a fastening system).	6.2.4
F_{LFP2}	upper limit of force for determining the dynamic low frequency stiffness of pad, in kN	6.2.4
d_{LFP}	displacement of pad in measurement of low frequency dynamic stiffness of pad, in mm;	6.2.4
f_{LFP}	frequency of measurement of low frequency measurement dynamic stiffness of pad, in Hz;	6.2.4
k_{LFPf}	low frequency dynamic stiffness of pad at a specific frequency, in MN/m;	6.2.4
$k_{LFPmean}$	mean of measurements of low frequency dynamic stiffness of pad measured at 5 Hz, 10 Hz and 20 Hz, in MN/m;	6.2.4
F_{SAmax}	reference force for measurement of static stiffness of assembly, in kN;	7.1.4
k_{SA}	static stiffness of assembly, in MN/m;	7.1.4
d_{SA}	mean displacement of rail in measurement of static stiffness of assembly, in mm;	7.1.4
F_{SA1}	lower limit of force for determining the static secant stiffness of assembly, in kN;	7.1.4
F_{SA2}	upper limit of force for determining the static secant stiffness of assembly = 0,8 $F_{LFAmax,}$ in kN;	7.1.4
k_{LFA}	low frequency dynamic stiffness of assembly, in MN/m;	7.2.4
F_{LFA1}	lower limit of force for determining the dynamic low frequency stiffness of assembly, in kN;	7.2.4
F_{LFA2}	upper limit of force for determining the dynamic low frequency stiffness of assembly, in kN;	7.2.4
F_{LFAmax}	reference force for measurement of dynamic low frequency stiffness of assembly, in kN;	7.2.4
d_{LFA1}	displacement of assembly in measurement of dynamic low frequency stiffness of assembly for force F_{LFA1}, in mm;	7.2.4

5 Verification of calibration

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

The calibration of displacement measuring instruments shall be in accordance with ISO 9513.

6 Test procedures for pads

6.1 Static test procedure for pads

6.1.1 Principle

A force is applied normal to the test pad and the displacement is measured.

6.1.2 Apparatus

6.1.2.1 Controlled temperature test area

The area of the laboratory where the test is conducted, maintained at (25 ± 5) °C.

Where pads are to be used at other ambient temperatures additional tests shall be performed in a temperature controlled chamber, if required by the purchaser, at one or more of the following temperatures:

(–30 ± 3) °C, (–20 ± 3) °C, (–10 ± 3) °C, (0 ± 3) °C and (50 ± 3) °C.

Additional test temperatures may be agreed between the manufacturer and the purchaser.

6.1.2.2 Metal plate

A rigid metal plate larger than the load distribution plate.

6.1.2.3 Load distribution plates

A rectangular upper load distribution plate made from metal 10 mm minimum thickness, with smooth, rounded edges. The dimensions of the plate depend on the type of pad being tested as follows:

— For rail pads – the same width as the foot of the rail used for the repeated loading test (ISO 22074-4) and a length of 210 mm. Alternatively, a short length of rail, at least 210 mm long, may be used instead of the upper load distribution plate and upper metal plate.

— For baseplate pads – the same width and length as the maximum rectangular area within the part of the baseplate transmitting the load to the pad in the fastening assembly.

When the pad is supported in use over a limited area a lower load distribution plate, of the same dimensions as the part of the pad which would be actively supported in the fastening assembly, is also required.

NOTE 1 For tests on continuous pads used in slab track a length of pad of 150 mm is used.

NOTE 2 If the metal plate described in 6.1.2.2 is size required for the load distribution plate, the load distribution plate may be omitted.

6.1.2.4 Abrasive cloth

Sheets of abrasive cloth with grit size P120 to P400 (ISO 6344) in unworn condition. Each sheet being not less than the full area of the pad to be tested.

6.1.2.5 Actuator

Actuator capable of applying a force of (F_{SPmax} + 10 %) kN through a spherical seating.

NOTE Typically the maximum force is 120 kN.

6.1.2.6 Displacement measuring instruments

6.1.2.6.1 Calibration procedure

If contacting displacement measuring instruments are used they shall comply with ISO 9513:2012.

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 6.1.3.

6.1.2.6.2 Calibration requirement

The instrument shall be capable of measuring displacements as follows:

- For pads with a declared stiffness ≤ 100 MN/m, displacement measurement within ± 0,02 mm
- For pads with a declared stiffness > 100 MN/m, displacement measurement within ± 0,01 mm

6.1.2.7 Force measuring instruments

Instruments complying with ISO 7500-1:2004, Class 1 over the required range of force.

6.1.2.8 Recording equipment

Equipment to make a digital recording and print out of the displacement and applied force.

6.1.3 Procedure

All components and equipment used shall be kept in a temperature of (25 ± 5) °C or other test temperature (see 6.1.2.1) for at least 16 h prior to starting the test. Place the test set-up on a flat, rigid, horizontal base, which will support the whole area of the pad, in the following sequence: base, lower load distribution plate (if necessary), abrasive cloth (abrasive side up), pad, abrasive cloth (abrasive side down), upper load distribution plate, metal plate as shown in Figure 1.

Ensure the load distribution plates are located on the active area of the pad. Locate at least three independent instruments to measure the displacement of the metal plate at equal intervals around the perimeter of the plate.

Apply a force, F_{SPmax}, with a rate of application (120 ± 10) kN/min as specified in the performance requirements for the type of track for which the pad is intended.

NOTE Performance requirements are set out in other standards including the EN13481 series.

Then reduce the force to the minimum value (F_{SP1}) and repeat this cycle of loading and unloading twice more. Increase the applied force from F_{SP1} to F_{SP2}, where F_{SP2} = 0.8 $F_{SPmax,}$ recording the displacement while increasing the force in this final cycle. (See Figure X)