



Väylävirasto
Trafikledsverket

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INSULATED RAIL JOINT

Technical requirements



Väylävirasto
Trafikledsverket

Guideline

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Insulated rail joint – Technical requirements

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The guideline is part of the Finnish Transport Infrastructure Agency's safety management system for railway operations.

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The content of the document is not fully accessible.

FURTHER INFORMATION

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Foreword

Due to the safety devices on the track, in addition to ordinary rail joints and welding, rails are connected with electrically insulating expansion joints. Unlike ordinary rail expansions, the rail ends are insulated from each other, and the insulated rail joint shall meet not only mechanical requirements but also electrical requirements in this respect.

In these guidelines, the technical requirements in question have been updated to correspond to a European standard currently at a draft stage. The guidelines describe the requirements specified in the draft standard for the design, mechanical and electrical properties, approval and documentation of insulated rail joints.

The guidelines have been prepared by Jarno Junnikkala and Tero Savolainen from Sweco Finland Oy on behalf of the Finnish Transport Infrastructure Agency. The steering group that directed the work consisted of Marko Lehtosaari, Aki Loikala, Tuija Myllymäki and Henri Seppälä from the Finnish Transport Infrastructure Agency.

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Finnish Transport Infrastructure Agency

Technology and the environment

Contents

1	INTRODUCTION.....	5
2	TERMINOLOGY AND DEFINITIONS.....	6
3	REQUIREMENTS.....	7
3.1	GENERAL REQUIREMENTS.....	7
3.2	DESIGN REQUIREMENTS.....	7
3.3	MECHANICAL REQUIREMENTS.....	7
3.3.1	TENSILE STRENGTH TEST.....	7
3.3.2	BENDING TEST.....	8
3.4	ELECTRICAL REQUIREMENTS.....	8
3.5	FIELD TEST REQUIREMENTS.....	8
4	USE PERMIT PROCEDURE.....	9
5	ACCEPTANCE TESTS AND INSPECTIONS.....	10
6	SYMBOLS AND MARKINGS.....	11
7	DOCUMENTS.....	12
8	SOURCES.....	13

1 Introduction

An insulated rail joint (also known as insulation expansion joints) connects the ends of rails and separates track circuits from each other or from a de-energized track section. As part of the track, insulated rail joints are subject to stresses caused by rolling stock, weather conditions and other external factors. The insulated rail joint shall be proven to retain the required mechanical and electrical properties under these conditions. Uniform requirements ensure and verify the mechanical and electrical performance and homogeneity of insulated rail joints.

Draft standard prEN 16843:2019 *Railway applications - Infrastructure - Mechanical requirements for joints in running rails* Indicates the minimum requirements and their verification methods for mechanical rail joints where the rail weight used is 46 kg/m or over. These guidelines refer to the requirements of the above-mentioned draft standard for insulated rail joints.

2 Terminology and definitions

Axle load	The axle load is the static weight exerted on the track by both wheels (wheelset) of one axle of the vehicle.
Insulated rail joint	Rail expansion joint that insulates railway rails electrically.
Short rail (Lk track)	Short rail (Lk track) is a track where rail length $l < 25$ metres.
Long rail (Pk track)	Long rail (Pk track) is a track where rail length $l > 25$ metres, but $l < 50$ metres.
Track circuit	Train detection system based on live track sections delimited by insulated rail joints, where travelling rolling stock are detected by a short circuit generated by the circuits of the axles.

3 Requirements

3.1 General requirements

The insulated rail joint shall meet the requirements of draft standard prEN 16843:2019 and retain the required characteristics under all of the following conditions:

- The rail temperature range is $-35 \dots +55 \text{ }^\circ\text{C}$.
- The neutral temperature range of the rail is $+12 \dots +22 \text{ }^\circ\text{C}$.
- The maximum operating speed is 220 km/h.
- The axle load is 250 kN.
- The service life is at least 30 years or the traffic volume is 180 Mbrt.

The insulation material must be resistant to sunlight and to solutions, acids and alkali that may be generated by the environment and rail traffic, while maintaining its ability to perform as required. The insulation material shall not be hygroscopic (water-absorbing) and must not contain substances which, together with water, shall form electrolytes.

3.2 Design requirements

The insulated rail joint shall meet the general design requirements set out in draft standard prEN 16843:2019. The general design shall be described in technical documentation containing at least the items presented in the draft standard.

The insulated rail joint shall form a continuous piece of the rails to be joined with regard to the alignment of the rail ends and shall prevent displacement of the rail ends, except in the longitudinal direction of the track on short and long rails. The insulated rail joint must be compatible with the rail fastening system.

3.3 Mechanical requirements

The mechanical properties are determined using the tensile strength and bending tests described in draft standard prEN 16843:2019. In connection with mechanical tests, the preservation of electrical performance is also verified. The test arrangements and methods are described in the draft standard. Reports on the tests are prepared in accordance with the draft standard.

3.3.1 Tensile strength test

The two-stage tensile strength test verifies the ability of an insulated rail joint to withstand the longitudinal track force caused by a change in rail temperature without losing the required mechanical and electrical performance. In addition, it is optional to perform a separate stress test to measure permanent deformations as described in draft standard prEN 16843:2019.

In the first step, a force equal to the minimum tensile strength requirement is applied to the test piece. The minimum requirement is calculated in accordance with the draft standard using the difference between the neutral and minimum rail temperatures $\Delta T=57 \text{ }^\circ\text{C}$ and a safety factor of 1.5. The testing apparatus shall be capable of producing a force at least 20% higher than the minimum requirement.

The tensile strength shall not be less than:

- 1,653 kN for rail profile 60E1
- 1,504 kN for rail profile 54E1.

The second stage of the test determines the maximum tensile strength of the insulated rail joint. The force applied to the test piece shall be increased as described in the draft standard until the test piece, or any of its components, fails, or the maximum force generated by the experimental apparatus is reached.

The performance of an insulated rail joint in the tensile strength test is acceptable when all of the following conditions set out in the draft standard are met:

- In the first phase, no visual damage occurs.
- The force applied in the second phase is higher than the minimum requirement for tensile strength.
- The requirements for insulation performance are met.

3.3.2 Bending test

The repeated bending test verifies the ability of an insulated rail joint to withstand repeated vertical forces generated by the rail wheels without losing the required performance. If desired, the static bending test may be used to assess the effects of the repeated bending test in advance as described in draft standard prEN 16843:2019.

In the repeated bending test, the bending moment to be applied to the test piece is determined in accordance with the recommended values of the draft standard, taking into account the rail profile (Appendix G to the draft standard).

The bending moment must be at least

- 39.8 kN for rail profile 60E1
- 36.5 kN for rail profile 54E1.

The maximum force to be used in the test performance shall be determined on the basis of the bending torque and the design values of the test arrangements using the formula presented in the draft standard. The test apparatus must be capable of applying force to the test piece in a harmonious, sinusoidal oscillation motion at a frequency of 3 to 10 Hz.

The test shall be carried out in accordance with the draft standard and approved on the basis of visual examination and insulation measurements under the conditions set out in the draft standard.

3.4 Electrical requirements

The insulating capacity of an insulated rail joint shall be verified using the test methods described in draft standard prEN 16843:2019 under dry and wet conditions and in connection with mechanical tests. A voltage of 500 V DC shall be used and the measuring equipment shall be capable of measuring resistance of at least 50 MΩ with an accuracy of at least two significant digits. The approval values set for the insulation performance of insulated rail joints are presented in Appendix H to the draft standard.

Dry performance characteristics shall also be determined in conjunction with both of the mechanical tests. The requirements for insulation performance in these tests are set out in Annex H to the draft standard.

Reports on the tests are prepared in accordance with the draft standard.

3.5 Field test requirements

The state infrastructure manager and the supplier agree in writing on the performance requirements for field tests of rail joints, including the items presented in draft standard prEN 16843:2019. The duration of the field tests is 1–3 years, and the test report shall be prepared by the state infrastructure manager. The rail joint shall be approved on the basis of an affirmative test report.

Insulated rail joints may be approved on a case-by-case basis without field tests if the insulated rail joint has been designed, manufactured, tested in accordance with European standards and is already widely in use in other similar railway systems and conditions.

4 Use permit procedure

The purpose of the use permit procedure is to ensure the reliability, availability, maintainability and safety of insulated rail joints.

An insulated rail joint is granted an operating licence when all requirements according to Chapter 6 of draft standard prEN 16843:2019 are met:

- [3.2 Design requirements](#)
- [3.3 Mechanical requirements](#)
- [3.4 Electrical requirements](#)
- [3.5 Field test requirements](#)

After the use permit procedure, the properties or materials of the insulated rail joint must not be changed without further tests and approval of the state infrastructure manager.

5 Acceptance tests and inspections

The tests and inspections presented in Chapter 8 of draft standard prEN 16843:2019 ensure the homogeneity of licensed production pieces of insulated rail joints.

The tests and inspections shall be carried out and documented in accordance with the requirements of the draft standard and the results shall be available to the state infrastructure manager.

6 Symbols and markings

Insulated rail joints shall be identified as set out in draft standard prEN 16843:2019.

7 Documents

For rail joints, the documents required by draft standard prEN 16843 shall be provided. Units based on the SI system are used as units of measurement. The documents are written in Finnish, Swedish or English.

8 Sources

- Draft standard prEN 16843: 2019 Railway applications - Infrastructure - Mechanical requirements for joints in running rails



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