



SLOVENSKI STANDARD
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Nadomešča:
SIST EN 13674-1:2011+A1:2017

Železniške naprave - Tirnica - 1. del: Vignolove tirnice z maso 46 kg/m in več

Railway applications - Rail - Part 1: Vignole railway rails 46 kg/m and above

Bahnanwendungen - Schienen - Teil 1: Vignolschienen ab 46 kg/m

Applications ferroviaires - Rails - Partie 1 : Vignole de masse supérieure ou égale à 46 kg/m

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Applications ferroviaires - Rails - Partie 1 : Rails
Vignole de masse supérieure ou égale à 46 kg/m

Bahnanwendungen - Schienen - Teil 1: Vignolschienen
ab 46 kg/m

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European foreword

This document (prEN 13674-1:2023) has been prepared by Technical Committee CEN/TC 256 "Railway Applications", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13674-1:2011+A1:2017.

prEN 13674-1:2023 includes the following significant technical changes with respect to EN 13674-1:2011+A1:2017:

- The number of rail profiles is modified: 24 instead of 23;
- Introduction of a new steel grade: R335V;
- The minimum depth of stamping is reduced from 0,5 mm to 0,4 mm;
- 60E2 can be used as well as the 60E1 for the qualifying tests;
- The predictive equation is removed from the qualifying tests to the acceptance tests;
- Suppression of 02 as an element to be controlled and measured;
- Brinell hardness test conditions have been modified;
- New value for foot toe thickness;
- The rail transition references have been removed;
- A new normative annex "Minimum requirements for the introduction of a new rail steel grade in EN 13674-1" has been introduced.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

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Introduction

This Introduction provides an explanation of the concepts and reasoning considered for this standard.

Whenever possible this part of EN 13674 is performance based, recognizes the European Quality System standard EN ISO 9001 and requires manufacturers to offer the latest proven technology to consistently satisfy the demanding quality of the required product.

This part of EN 13674 has two major divisions:

- 1) qualifying tests;
- 2) acceptance tests.

The qualifying tests take into account performance requirements. They also include typical results from relevant acceptance tests.

The acceptance tests control those characteristics of the rail steel and rail that are of relevance to the production of high quality rails including heat treated rails and the demands of the railway.

To ensure the supply of high quality rails, some restrictions on production processes are considered.

The performance based standard applies to all procurements falling inside the requirements of the European Procurement Directive (93/38/EEC of 14th June 1993), taking into account safety implications and at the same time addressing modern production technology and the requirements of high-speed railways. As a result of the Directive it was recognized that there would be few opportunities (and these would have to be for transparent safety considerations) for derogation from the standard to operate between the user and the manufacturer.

The standard includes a prerequisite for all manufacturers to prove conformity against a set of qualifying test criteria. Qualifying tests include all "normal" acceptance test results plus new "type-casting" features such as fracture toughness, fatigue cracks growth rate, fatigue test and residual stress. To provide users with the necessary confidence, acceptance limits have been based on results from rail known to have performed well in demanding track installations.

The standard includes a quality assurance and inspection clause as part of product integrity.

In order that quality management systems are consistent across all manufacturers and that users have the best assurance for the consistency of required product quality on this safety critical component of the track, this rail standard recommends that the manufacturers' quality assurance systems are at least equivalent to the requirements of EN ISO 9001. The inclusion of this requirement also reduces the need to incorporate detailed method and calibration descriptions on items such as normal chemical composition determination and the need to define more extensive testing.

1 Scope

This document specifies Vignole railway rails of 46 kg/m and greater linear mass, for conventional and high speed railway track usage.

Pearlitic steel grades are specified covering a hardness range of 200 HBW to 440 HBW and include non heat treated non alloy steels, non heat treated alloy steels, and heat treated non alloy steels and heat treated alloy steels.

There are 24 rail profiles specified in this document.

Two classes of rail straightness are specified, differing in requirements for straightness, surface flatness and crown profile. Two classes of profile tolerances are specified.

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 10163-1:2004, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 1: General requirements*

CEN/TR 10261:2018, *Iron and steel - European standards for the determination of chemical composition*

EN ISO 6506-1:2014, *Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1:2014)*

EN ISO 6892-1:2019, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1:2019)*

EN ISO 14284:2022, *Steel and iron - Sampling and preparation of samples for the determination of chemical composition (ISO 14284:2022)*

EN ISO 80000-1:2022, *Quantities and units - Part 1: General (ISO 80000-1:2022)*

ISO 1099:2017, *Metallic materials - Fatigue testing - Axial force-controlled method*

ISO 4968:2022, *Steel - Macrographic examination by sulphur print (Baumann method)*

ISO 12108:2018, *Metallic materials - Fatigue testing - Fatigue crack growth method*

ASTM E399-22, *Standard test method for linear-elastic plane-strain fracture toughness of metallic materials*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1

bloom

refers to a semi product produced from a continuous casting machine with either a square, rectangular or circular section

prEN 13674-1:2023 (E)**3.2****heat**

liquid steel melt tapped out of a converter or electric arc furnace which includes after continuous casting a given number of blooms relating to the weight of the heat and the extension of the mixing zone

Note 1 to entry: In the case of sequence casting the blooms belonging to the mixing zone should be clearly defined.

3.3**sequence**

any number of heats, of the same steel grade, which undergo continuous casting in tundishes

Note 1 to entry: Tundishes may be used in parallel.

3.4**heat treated rail**

rail that has undergone accelerated cooling from austenitizing temperature during the metallurgical transformation period

Note 1 to entry: The heat treatment can be carried out directly after rolling or following a separate reheating process to achieve the austenitization temperature.

3.5**rolling process**

process between the blooms leaving the heating furnace and exiting the finishing pass

3.6**isothermal treatment process**

process whereby blooms are held for a period of time at an elevated temperature for reducing the hydrogen content

Note 1 to entry: For maximum efficiency this is as near to (but below) the austenite to pearlite transformation temperature as is practically possible.

Note 2 to entry: This process is sometimes referred to as sub critical diffusion annealing.

3.7**qualifying test**

special test and criteria which are relevant to some aspects of the service performance of rails

Note 1 to entry: Acceptance tests also form part of the qualifying tests.

3.8**acceptance test**

test carried out as part of the process and product control system, normally on a heat, sequence or tonnage basis

3.9**rail running surface**

curved surface of the rail head. Area between both gauge corners (transition points of the head inclination and the first head radius)

3.10**units of measurement**

for the purpose of determining conformance with the specification, numeric values are rounded according to the rules stipulated in EN ISO 80000-1:2022

4 Information to be supplied by the purchaser

The purchaser shall provide the supplier with the following information at the time of tender or order:

- a) rail profile (see Annex A);
- b) steel grade (see Clause 5);
- c) profiles class, 'X' or 'Y' (see 9.2.1);
- d) straightness class 'A' or 'B' of rail as specified in 9.2.2;
- e) length(s) of rail (see Table 9);
- f) undrilled or drilled rail ends to take fish bolts, and location and dimensions of holes when required (see 9.2.3);
- g) any special treatment to be applied to bolt holes and corresponding special tolerances for bolt holes (see 9.2.3);
- h) cold stamping on the cut face (see 7.4.3);
- i) paint code requirements (see 7.4.4).

5 Steel grades iTeh STANDARD PREVIEW

The applicable steel grades are given in Table 1. The hardness ranges of the steel grades shall conform to those given in Table 1.

For the steel grades in Table 1, the steel names and steel numbers were allocated in accordance with EN 10027-1 and EN 10027-2, respectively.

For inclusion of a new rail steel grade in this document, the supplier shall comply with the requirements of Annex G "Minimum requirements for the introduction of a new rail steel grade in EN 13674-1".

Table 1 — Steel grades

Steel grade ^a		Hardness range (HBW)	Description	Branding lines
Steel name	Steel number			
R200	1.0521	200 to 240	Non-alloy Non heat treated	No branding lines
R220	1.0524	220 to 260	Non-alloy Non heat treated	-----
R260	1.0623	260 to 300	Non-alloy Non heat treated	--- -----
R260Mn	1.0624	260 to 300	Non-alloy Mn Non heat treated	----- -----
R320Cr	1.0915	320 to 360	Alloy (Cr, Si) Non heat treated	----- ----- -----
R335V	1.0639	335 - 375	Alloy (V, Si) Non heat treated	----- ----- -----
R350HT	1.0631	350 to 390 ^b	Non-alloy Heat treated	--- ----- -----
R350LHT	1.0632	350 to 390 ^b	Non-alloy Heat treated	--- ----- ----- ---
R370CrHT	1.0992	370 to 410	Alloy (Cr)) Heat treated	--- ----- ----- -----
R400HT	1.1254	400 to 440	Non-alloy Heat treated	----- ----- -----

^a See Table 5 a) and Table 5 b) for chemical composition/mechanical properties.
^b See Table 6 for hardness requirements.

6 Profile drawings/properties/mass

Rail profiles, dimensions, properties and linear masses shall be in accordance with Annex A. The tolerances of certain dimensions shall be as given in Table 7. All other quantities are informative only.

NOTE Linear masses have been calculated based on the density of steel of 7,85 kg/dm³.

7 Manufacture

7.1 Product integrity

Rails shall be produced under a comprehensive system of factory production control which shall ensure confidence in the conformity of the finished product. The system shall address this document to ensure that the finished products consistently comply with requirements to achieve the product integrity necessary to provide assurance of product safety in track.

Manufacturers shall demonstrate continuing compliance, including documented evidence, with the factory production control system required.

NOTE Manufacturers having a factory production control system which complies with EN ISO 9001 are recognized as satisfying the minimum requirements specified by this clause.

7.2 Blooms

Blooms made from basic oxygen steel or electric arc furnace steel that has been secondary ladle arc refined, vacuum degassed and continuously cast, shall be used for the manufacture of rails.

7.3 Rails

7.3.1 The manufacturer shall operate a procedure for the effective removal of scale during the manufacturing process.

7.3.2 The cross-sectional area of the rail shall not exceed one ninth that of the bloom from which the rail is rolled.

7.3.3 Rail straightening shall be by a two stage roller straightening process which straightens the rail about its XX and YY axes as defined in the rail profiles shown in Annex A. End deviations or a localised deviation on the rail may be corrected using pressing.

NOTE Other mandatory processes are described in the relevant clauses within the document.

7.4 Identification

7.4.1 Branding

Brand marks shall be rolled in relief on one side and in the middle of the web (see Annex A) of each rail at least once every 4 m. The brand marks on the rails shall be clearly legible and shall be 20 mm to 25 mm high, raised between 0,6 mm and 1,3 mm.

The branding line(s) to denote grade shall be 50 mm in length for the long branding line and 25 mm in length for the short branding line.

The brand marks shall include:

- a) identification of the mill;
- b) steel grade as shown in Table 1;
- c) last two figures of the year of manufacture;
- d) rail profile identification as shown in Annex A.

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EXAMPLES

ROLLING MILL _____ 07 60 E1

(60 E1 profile rail rolled 2007, non-alloy rail steel grade R260).

ROLLING MILL _____ 07 60 E1

(60 E1 profile rail rolled 2007, non-alloy heat treated rail steel grade R350HT).

NOTE The sequence of the branding marks is at the discretion of the manufacturer.

7.4.2 Hot stamping

In addition to the branding requirements of 7.4.1, each rail shall be identified by a numerical and/or alphabetical code system, hot stamped on the non-branded side of the rail web by machine and each rail shall be hot stamped at least once every 10 m.

The figures and letters used shall be clearly legible and shall be 16 mm high. The stamped characters shall have a flat or radius face (1 mm to 1,5 mm wide) with bevels on each side. The letters and numbers shall be on a 10° angle from vertical and shall have rounded corners. The stamping shall be between 0,4 mm and 1,5 mm in depth along the middle of the web as defined for the branding in annex A. The design shall be as shown in Figure 1.

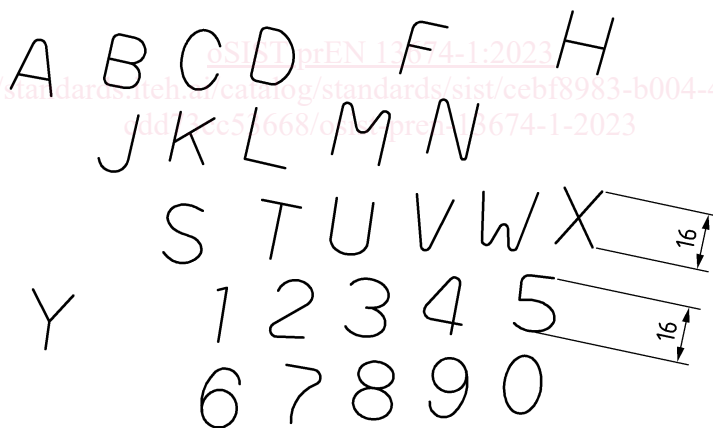


Figure 1 — Design of letters and numbers on a 10° angle for rail stamps

The identification system employed shall be such as to enable the hot stamped marking to be collated with the:

- number of the heat from which the rail has been rolled;
- number of the strand and position of bloom within the strand;
- position of the rail in the bloom (A, B ... Y).

In the event of identification marks having been removed, omitted or requiring alteration, re-identification of such marks shall be made by rotary burr or other method agreed by the customer.

NOTE 1 A rail can display different indications of position of the rail in the bloom (A,B...Y) along its length.

NOTE 2 Subsequent cutting could result in more than one rail length having the same identity.

7.4.3 Cold stamping

Cold stamping may only be used on the cut face of the rail within the central portion of the head. Cold stamping at another position shall be agreed by the purchaser.

7.4.4 Other identification

The purchaser shall specify their requirements for any colour coding or special marking instructions and their position on the rail at the time of enquiry or order.

8 Qualifying tests

8.1 Procedure

8.1.1 The manufacturer shall describe any bloom slow cooling or isothermal treatment process used to demonstrate compliance with the requirements of 9.1.3.2.

8.1.2 All qualifying tests as specified in 8.2 to 8.8 shall be undertaken at least once every five years and as a result of any significant production process change for all grades.

The manufacturer shall only carry out testing on the 60E1/60E2 profile or the heaviest section produced.

All rail grades and profiles supplied shall conform to the qualifying criteria in accordance with 8.2 to 8.8.

The results for the grades to be supplied shall be provided at the time of tendering.

In the event of a manufacturer not having produced the rail grade prior to the tender enquiry he shall have the option of carrying out such tests on the first available sequence. When the qualifying criteria have been complied with, compliance with the standard is demonstrated and consequently the manufacturer is qualified.

8.1.3 The samples in accordance with 8.1.4 and 8.1.5 shall be removed from finished roller straightened rails. These samples shall not be subject to any further mechanical or thermal treatment (other than the treatment of ageing of the tensile test pieces as described in 9.1.9.2).

8.1.4 Test pieces for fracture toughness, fatigue crack growth rate and fatigue tests (see 8.2, 8.3 and 8.4 respectively) shall be taken from at least 3 sample rails taken at a minimum of 3 m from the cut ends of the rail. Sample rails shall be from different heats.

8.1.5 For residual stress tests (see 8.5), there shall be 6 sample rails and the test pieces shall be taken at least 3 m from each rail end. Sample rails shall be from at least 3 different heats.

8.1.6 All tests should be carried out by a laboratory that operates an approved and audited quality assurance system conforming to requirements at least equivalent to EN ISO 9001.

8.1.7 The purchaser shall have access to all test records, calibrations and calculations that contribute to the final results.

8.1.8 All test results shall be reported to the purchaser.

8.2 Fracture toughness (K_{IC})

8.2.1 Test pieces and test methods

Tests shall be performed in accordance with Annex B.

8.2.2 Qualifying criteria

The value of K_{IC} shall comply with Table 2.