SLOVENSKI STANDARD
SIST EN 13674-4:2019

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Železniške naprave - Zgornji ustroj proge - Tirnice - 4. del: Vignolove tirnice z maso v razponu od 27 kg/m do 46 kg/m

Railway applications - Track - Rail - Part 4: Vignole railway rails from 27 kg/m to, but excluding 46 kg/m

Bahnanwendungen - Oberbau - Schienen - Teil 4: Vignolschienen mit einer längenbezogenen Masse zwischen 27 kg/m und unter 46 kg/m

Applications ferroviaires - Voie - Rails - Partie 4: Rails Vignole de masse comprise entre 27 kg/m et 46 kg/m, 46 kg/m non compris

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45.080	Tračnice in železniški deli	Rails and railway components

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Railway applications - Track - Rail - Part 4: Vignole railway rails from 27 kg/m to, but excluding 46 kg/m

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 13674-4:2019) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2019, and conflicting national standards shall be withdrawn at the latest by October 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13674-4:2006+A1:2009.

This part of EN 13674 is the fourth one of the series EN 13674, *Railway applications — Track — Rail*, which consists of the following parts:

— *Part 1: Vignole railway rails 46 kg/m and above*;

— *Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above*;

— *Part 3: Check rails*;

— *Part 4: Vignole railway rails from 27 kg/m to but excluding 46 kg/m*.

Other published standards include the following:

— EN 14587-1, *Railway applications – Infrastructure – Flash butt welding of new rails – Part 1: R220, R260, R260Mn, R320Cr, R350HT, R350LHT, R370CrHT and R400HT grade rails in a fixed plant*;

— EN 14587-2, *Railway applications – Track - Flash butt welding of rails – Part 2: New R220, R260, R260Mn and R350HT grade rails by mobile welding machines at sites other than a fixed plant*;

— EN 14587-3, *Railway applications – Track - Flash butt welding of rails – Part 3: Welding in association with crossing construction*;

— EN 14730-1, *Railway applications – Track - Aluminothermic welding of rails – Part 1: Approval of welding processes*;

— EN 14730-2, *Railway applications – Track - Aluminothermic welding of rails – Part 2: Qualification of aluminothermic welders, approval of contractors and acceptance of welds*;

— EN 14811, *Railway applications – Track - Special purpose rail - Grooved rails and associated construction profiles*;

— EN 15594, *Railway applications – Track - Restoration of rails by electric arc welding*;

— EN 16273, *Railway applications – Track - Forged rail transitions*.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta,

Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This Introduction provides an explanation of the concepts and reasoning used in the drafting of this document. Its inclusion also ensures that during future revisions, restrictions are removed where technology progresses and held where it does not, thus ensuring continued safety as new manufacturers, products and technologies are introduced.

The most commonly used standards of the world for the supply of railway rails have been reviewed during the preparation of this document. However, modern rail production technology within the European Union has demanded a completely new look at the philosophy and content of this part of EN 13674.

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.

Rail grading is based on hardness rather than tensile strength.

The acceptance tests have been designed to control those characteristics of the rail steel and rail that are of relevance to the production of high quality rails and the demands of the railway.

The steel grades covered by this part of EN 13674 reflect trends in railway usage and heat-treated rails are included. This document includes rail profiles for Vignole rails having a linear mass from 27 kg/m to, but excluding 46 kg/m.

To ensure the supply of high quality rails, some restrictions on production processes have been imposed.

This document supersedes national standards covered by the Scope. In addition CEN required, where possible, a performance based standard, taking into account safety implications and at the same time addressing modern production technology. It was recognized that there would be few opportunities (and these would have to be for transparent safety considerations) for derogation from this document to operate between the user and the manufacturer.

This document reflects this change in philosophy from the traditional content of rail standards. A review was undertaken of the most commonly used rail standards of the world. All relevant aspects important to both user and manufacturer were considered with the aim of ensuring that all of the content had specific usefulness and relevance. For example rail grading and much of this document has been based on hardness rather than tensile strength. While the two are directly related, hardness is very quick and cheap to carry out and provides more relevant guidance to the user particularly where properties vary in different parts of the profile.

Since many rail manufacturers would not have previously carried out proving trials, this document includes a prerequisite for all manufacturers to prove conformity against a set of qualifying test criteria at the time of tendering. The qualifying tests include all “normal” acceptance test results plus new ‘type-casting’ features such as fracture toughness, fatigue and residual stress (see EN 13674-1). 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.

One aspect of this document, which is a complete break from tradition, is the inclusion of quality assurance and inspection clause as part of product integrity.

So 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, the rail standard requires that the manufacturers' quality assurance systems are at least equivalent to the requirements of a quality management standard such as 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.

Ideally, manufacturing techniques should not be referenced in a product standard. However, some rail attributes are either not known in an exact manner or are not measurable with satisfactory statistical significance. In such cases best practice manufacturing techniques have been included as a last resort. The equipment specified is that which gives the best probability of achieving the required product for use in track. In the future new technology can add to, but preferably will reduce or delete such items.

Examples of areas where the technological state of the art renders the standard less than complete include:

— oxide/oxygen relationships;

— hydrogen test techniques;

— roller straightening effects on residual stresses;

— roller straightening effects on contact scrub;

— measurement and effect of residual stresses throughout the rail.

1 Scope

This document specifies flat bottom Vignole railway rails from 27 kg/m to, but excluding 46 kg/m.

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

There are 15 rail profiles specified in this document, but these may not be available in all steel grades.

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 10027-1, *Designation systems for steels – Part 1: Steel names*

EN 10027-2, *Designation systems for steels – Part 2: Numerical system*

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

EN 13674-1:2011+A1:2017, *Railway applications – Track – Rail – Part 1: Vignole railway rails 46 kg/m and above*

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

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

3 Terms and definitions

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

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

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

3.1
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.

3.2
sequence
number of heats, of the same steel grade, which undergo continuous casting in tundishes

Note 1 to entry: Tundishes can be used in parallel if the caster has many strands.

3.3
heat-treated rail
rail that has undergone accelerated cooling from austenitizing temperature during the metallurgical transformation period

3.4
re-heated rail
rolled rail that has undergone re-austenitization for heat treatment purposes

3.5
mill heat-treated rail
heat-treated rail that has not undergone re-austenitization after rolling

3.6
rolling process
process between the blooms leaving the heating furnace and exiting the finishing pass

3.7
isothermal treatment process
process whereby blooms are held for a period of time at an elevated temperature for diminishing the hydrogen content

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

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

3.8
qualifying tests
special tests 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.

3.9
acceptance tests
tests carried out as part of the process and product control system, normally on a heat, sequence or tonnage basis

4 Information to be supplied by the purchaser

The purchaser shall provide the supplier with the following information when inviting tenders to supply:

a) rail profiles (see Annex A);

b) steel grades (see Table 1);

c) lengths of rail including any rails for special purposes (see Table 8);

d) un-drilled or drilled rail ends to take fish plate bolts and the location and dimensions of holes when required (see 9.2.3);

e) any special treatments to be applied to bolt holes;

f) tolerances for bolt holes to which special processes are to be applied (see 9.2.3);

g) cold stamping on the cut surface, if applicable (see 7.4.3);

h) paint code requirements (see 7.4.4);

i) tolerances for the horizontal and vertical straightness of un-drilled rail ends (to be welded).

5 Steel grades

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

The steel grade designations referred to in this document are compared to the corresponding steel designations in EN 10027-1 and EN 10027-2 as shown in Annex B.

Table 1 — Steel grades

Grade [a]	Hardness range (HBW)	Description	Branding lines
R200	200 to 240	Non-alloy (C-Mn)	No branding lines
R220	220 to 260	Non-alloy (C-Mn)	____
R260	260 to 300	Non-alloy (C-Mn)	— ____
R320Cr	320 to 360	Alloy (1 % Cr)	____ ____ ____
R350HT	350 to 390 [b]	Non-alloy (C-Mn), heat-treated	— ____ ____
R350LHT	350 to 390 [b]	Non-alloy (C-Mn), heat-treated	— ____ ____ —
R370CrHT	370 to 410 [b]	Alloy (C-Mn), heat-treated	— ____ ____ ____
R400HT	400 to 440 [b]	Non-alloy (C-Mn), heat-treated	____ ____ ____

[a] See Tables 3 and 4 for chemical composition/mechanical properties.

[b] See Table 5 for hardness requirements.

6 Dimensions, static properties, linear mass and tolerances

Rail profiles, dimensions, static properties and linear masses are given in Annex A. The tolerances of certain dimensions shall be as given in Table 6. All other quantities are informative only.

NOTE Linear masses have been calculated based on the density of steel of 7,85 g/cm^3.

7 Manufacture

7.1 Product integrity

7.1.1 Factory production control

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, such as EN ISO 9001, are recognized as satisfying the minimum requirements specified by this clause.

7.1.2 Best practice manufacture

The product shall be manufactured to the best practices as defined in 7.1.1.

NOTE This is to ensure that the rail attributes, described in the Introduction, which are not known in an exact manner or are not practically measurable, achieve the required high level of product integrity in track.

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

The manufacturer shall operate a procedure for the effective removal of scale during the rolling and straightening processes.

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

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 15 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.

EXAMPLE

ROLLING MILL 98 40E1

(40E1 profile rail rolled 1998, non-alloy rail steel grade R260)

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.

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.

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 0,5 mm and 1,5 mm in depth along the centre of the web. The design shall be as shown in Figure 1.

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

a) number of the heat from which the rail has been rolled;

b) number of the strand and position of bloom within the strand.

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

7.4.3 Cold stamping

Cold stamping shall only be used on the cut face of the rail within the central portion of the head, at the request of the purchaser.

7.4.4 Other identification

The steel grade may additionally be identified using paint. The purchaser shall specify the colour and position of the paint application.

8 Qualification of the manufacturer

The manufacturer shall qualify under EN 13674-1:2011+A1:2017, Clause 8 and shall then be qualified for all profiles in this part of EN 13674, provided the qualification was for the profile 60E1, 60E2 or the heaviest produced for the same grade.

NOTE The qualifying criteria specified in EN 13674-1 could not be achieved using the rail grades specified in this part of EN 13674.

9 Acceptance tests

9.1 Laboratory tests

9.1.1 General

Laboratory tests shall be performed, during production, at frequencies as stipulated in Table 2. Results for each laboratory test shall comply with the limiting values shown in Tables 3 a) and 3 b). Additional information and other acceptance tests not covered by Tables 3 a) and 3 b) shall comply with the requirements of 9.1.2 to 9.1.6 inclusive. All rails supplied shall meet the requirements of Clause 9.

9.1.2 Chemical composition

9.1.2.1 General

The liquid chemical composition shall be determined for each heat. When the solid chemical composition is checked, this shall be carried out at the position of the tensile test piece. The chemical composition shall conform to the requirements of Tables 3 a) and 3 b).

9.1.2.2 Hydrogen

The hydrogen content of the liquid steel shall be measured by determining pressure of hydrogen in the steel using an online immersion probe system.

At least two liquid samples shall be taken from the first heat of any sequence using a new tundish and one from each of the remaining heats and analysed for hydrogen content (see Table 2). The first sample from the first heat in a sequence shall be taken from the tundish at the time of the maximum hydrogen concentration.

The heats shall be assessed for hydrogen content in accordance with Table 3. If the hydrogen contents of the first samples of a first heat or the heat sample of a second or further heat do not comply with the requirements of Table 3 then the blooms made before those samples are taken shall be slowly cooled or isothermally treated. This applies also to all blooms made before the hydrogen content eventually complies with the requirements in Table 3; in these cases, all heats shall be tested in the rail form, or the manufacturer shall calculate the hydrogen content with a documented model of hydrogen diffusion taking into account the time – temperature evolution of the blooms during the isothermal treatment process. In case of dispute, the hydrogen content shall be tested in the rail form.

When testing of rails is required rail samples shall be taken at the hot saw at a frequency of one per heat at random. However on the first heat in a sequence, the rail sample shall be from the last part of a first bloom teemed on any strand. Hydrogen determination shall be carried out on samples taken from the centre of the rail head.

If any test result after corrective treatment fails to meet the requirements stated in Table 3 the heat shall be rejected.