



SLOVENSKI STANDARD
SIST EN 14811:2007
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Železniške aplikacije - Proga - Specialne namene železnice - Grobovane in povezane gradnje

Railway applications - Track - Special purpose rail - Grooved and associated construction

Bahnanwendungen - Oberbau - Speziialschienen - Rillenschienen und zugehörige Konstruktionsprofile

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Applications ferroviaires - Voie (Spécialisées) - Rails à gorge et profils de construction associés

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ICS:

45.080 Varnost in zdravje Rails and railway components

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ICS 45.080

English Version

Railway applications - Track - Special purpose rail - Grooved
and associated construction

Applications ferroviaires - Voie - Rails spéciaux - Rails à
gorge et profils de construction associés

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This European Standard was approved by CEN on 2 June 2006.

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Foreword

This document EN 14811:2006 has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2006, and conflicting national standards shall be withdrawn at the latest by December 2006

Other standards on rails include:

EN 13674 *Railway applications — Track — Rail* that comprises 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 46 kg/m.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

This introduction provides an explanation of the concept and reasoning for preparing this standard. Its description ensures that, during any future revisions, restrictions will be removed if technical progress has been made or will be kept if this is not the case in order that safety is maintained if new manufacturers, products and technologies appear.

The most commonly used delivery conditions in Europe for the supply of grooved rails and associated construction rail profiles have been reviewed during the preparation of this standard. Modern rail production technology and the requirements of commuter railways within the European Union have demanded that the technical requirements for the products specified in EN 14811 be reconsidered.

Whenever possible, this EN 14811 is performance-based. It recognizes the European quality management standard EN ISO 9001 and requires manufacturers to offer the latest proven technology consistently to satisfy the demanding quality of the required product.

The steels are classified according to hardness and not to tensile strength.

The acceptance tests were developed in order to monitor the properties of the grooved rail steels and grooved rails and associated construction rail profiles that are of importance for the production of grooved rails and associated construction rail profiles and which comply with the demands of commuter railways.

The steel grades covered by EN 14811 reflect trends in commuter railway usage and heat-treated rails as well as associated construction rail profiles. This standard contains profiles for grooved rails and associated construction rail profiles for grooved rail facilities having a linear mass of 42 kg/m and above.

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

This standard is applicable to all procurements covered by the European Procurement Directive (93/38/EEC of 14 June 1993). Additionally, CEN has requested a performance-based standard taking into account safety requirements and the application of the most recent technologies. With respect to the Directive, it is acknowledged that there are (and with respect to safety requirements also shall be) options to deviate from the standard upon agreement between purchaser and manufacturer.

This standard reflects the change in philosophy compared with the traditional content of delivery conditions for grooved rails and associated construction rail profiles. The most frequently used delivery conditions in Europe for the supply of grooved rails and construction rail profiles have been reviewed. All the aspects that are important for the purchasers and manufacturers have been analysed to ensure that the overall contents are particularly appropriate and relevant for the European Standard. For example, the classification of the steel grades of grooved rails and associated construction rail profiles and also other aspects of the European Standard has been based on hardness, not on tensile testing. Whilst the two are directly related, hardness testing is very quick and inexpensive to carry out and provides more relevant guidance to the user, particularly where properties vary in different parts of the profile.

One new aspect of the European Standard is the integration of a clause on quality management and testing in order to assure the product integrity.

In order to ensure that the quality management systems are consistent for all manufacturers and that all purchasers can be sure about the consistency of the product quality of these safety-related components, this standard recommends that the manufacturer operates a quality management system at least equivalent to the requirements of EN ISO 9001. This makes it possible to dispense with detailed requirements on tests and comprehensive testing.

Ideally, manufacturing methods should not be referred to in product standards. However, some rail properties are either not exactly known or cannot be determined with an adequately high statistical reliability. In these cases, as the final possibility, reference is made to manufacturing methods that correspond to best practice. Methods and requirements are specified that offer the maximum probability that the necessary product is obtained in the track. Future technological solutions can increase the list of these requirements but will preferably reduce them.

Examples of where today's technology is taken as the basis, but developments are progressing, are:

- determination of hydrogen content;
- minimum area reduction for rolling of grooved rails and associated construction rail profiles;
- roller straightening effects on contact scrub.

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1 Scope

This European Standard specifies requirements for grooved rails and associated construction rail profiles for grooved rail facilities with a linear mass of 42 kg/m and upwards for use in tram transport systems.

NOTE Grooved rails are also used for harbour and industrial tracks.

Six pearlitic steel grades are specified in a hardness range between 200 HBW and 390 HBW. The rails are either non-heat-treated or heat-treated and are made from non-alloyed (C-Mn) steel in both cases.

This standard specifies 18 specific grooved rail profiles and 7 specific construction rail profiles. The grooved rail profiles can also be used as construction elements in switches and crossings.

Two grooved rail classes are specified differing in requirements for profile tolerances.

2 Normative references

The following referenced documents are indispensable for the application 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 10002-1, *Metallic materials — Tensile testing — Part 1: Method of testing at ambient temperature*

EN 10027-1, *Designation systems for steel — Part 1: Steel names*

EN 10027-2, *Designation systems for steel — Part 2: Steel numbers*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:2005)*

3 Terms and definitions

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

3.1
heat
liquid steel melt tapped out of a converter or electric arc furnace which after continuous casting includes a given number of blooms relating to the weight of the heat and the extent of the mixing zone. In the case of sequence casting, the blooms belonging to the mixing zone are to be clearly defined

3.2
sequence
number of heats of the same steel grade which undergo continuous casting in a new or repaired tundish. Tundishes may 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
head-hardened grooved rail
grooved rail where the rail head and/or the grooved head has been heat-treated

3.5**construction rail profile**

rail used in switches and crossings which carries the wheel

NOTE Grooved rail profiles can also be used as construction elements in switches and crossings.

3.6**grooved head**

that part of the profile that provides the space for the wheel flange. It is also used as the supporting element for the pavement

NOTE The term "grooved head" has been introduced instead of "guiding head", "guiding rail" and other similar terms.

3.7**rolling bead**

protuberance that is formed at the roll gap during rolling

4 Information to be supplied by the purchaser

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

- a) the rail profile (see annex A);
- b) the steel grade (see clause 5);
- c) the individual length or individual lengths of the rails. Unless otherwise agreed, short lengths shall be supplied in pairs and they shall not be less than half the individual length of the rails; also, the total mass of the short lengths shall not exceed 10 % of the total mass of the order;
- d) the location and dimensions of holes (see Annex C);
- e) paint code requirements (see 7.4.3).

5 Steel grades

The applicable steel grades are given in Table 1. The hardness ranges shall meet the requirements in Table 1.

For the steel grades in Table 1, the steel names in accordance with EN 10027-1 and the steel numbers in accordance with EN 10027-2 shall be used.

Other requirements that can be agreed between the manufacturer and the purchaser are given in Annex D.

Table 1 — Steel grades

Stahl grade ^a		Hardness range in HBW	Description	Type of rolling mark
Steel name	Material number			
R200	1.0521	200 to 240	Non-alloyed (C-Mn)-steel	No rolling marks
R220G1	1.0604	220 to 260	Non-alloyed (C-Mn)-steel	_____
R260	1.0623	260 to 300	Non-alloyed (C-Mn)-steel	_____ _____
R260GHT	1.0636	260 to 300	Non-alloyed (C-Mn)-steel, head-hardened	_____ _____ _____
R290GHT	1.0637	290 to 330	Non-alloyed (C-Mn)-steel, head-hardened	_____ _____ _____
R340GHT	1.0638	340 to 390	Non-alloyed (C-Mn)-steel, head-hardened	_____ _____ _____

^a See Tables 3a and 3b for the chemical composition and the mechanical properties..

6 Dimensions, static properties, linear mass and tolerances

The requirements for the profile drawings, their dimensions, static properties and linear mass are given in Annex A. The tolerances of certain dimensions shall be as given in Tables 5a and 5b. All other quantities are informative only.

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

7.1 Product integrity

7.1.1 Factory production control

All grooved rails and associated construction rail profiles shall be produced under a comprehensive system of production control in order to ensure confidence in the conformity of the finished product. The system shall address this European Standard to ensure that the finished products consistently comply with requirements to achieve the product integrity necessary to provide assurance of product safety in track.

The manufacturer shall demonstrate by documented evidence continuing compliance with the factory production control system required.

Manufacturers having a factory production control system which complies with EN ISO 9001 shall be 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

7.2.1 Basic oxygen steel or electric arc furnace steel shall be used for the manufacture of grooved rails and associated construction rail profiles. In the case of electric arc steel, a secondary ladle arc refining facility shall be used.

7.2.2 Steels for head-hardened grooved rails shall be vacuum-degassed.

7.2.3 Only continuously-cast materials shall be used for manufacturing of blooms.

7.3 Grooved rails and associated construction rail profiles

7.3.1 The rail manufacturing process used is at the discretion of the manufacturer. If the purchaser so requests, however, he shall indicate the method and main characteristics. The manufacturer shall not change these without informing the purchaser beforehand.

7.3.2 The scale shall be removed by means of highly-pressurized water between the removal of the blooms from the heating furnace and the last pass in order to minimize surface damage and roughness.

7.3.3 If the linear mass of the profile is less than 110 kg/m, the original cross-section of the continuously-cast bloom shall be at least 8 times greater than that of the rail profile to be rolled. An exception applies for the profile 105C1 where the original cross-section of the continuously-cast bloom shall be at least 7,5 times greater than that of the rail profile to be rolled.

For heavier profiles (construction rails), the original cross-section shall be at least 2,5 times greater than that of the rail profile to be rolled.

NOTE In this case, suitability for a heat treatment may be limited.

7.3.4 The straightening of the rails shall be done in a two-step roller-straightening process that straightens the rails about the axes $x-x$ and $y-y$, described in Annex A. Straightening presses may be used for end straightening or for correcting locally limited deviations from straightness. The rolled marking shall be protected from the effect of the straightening rolls.

7.3.5 Dividing into finished lengths shall be carried out by cold-sawing. Other cutting methods may be applied, provided that the microstructure remains unchanged. Any burr shall be removed without resulting in any noticeable bevelling of the profile.

7.3.6 Fishplate holes in the web of the rail shall be made round with smooth walls and be deburred.

7.3.7 Tie bar holes shall be round or oval. Round holes shall be stamped or drilled, oval holes stamped or milled. The edges of tie bar holes shall not have any dangerous burrs.

7.3.8 Fundamentally, no rolling beads shall be present at the rail head, grooved head or outer edges of the foot. Exceptions may be agreed between the purchaser and the manufacturer, but the inside edge of the grooved head shall not be sharp.

7.4 Marking

7.4.1 Rolling marks

The following rolling marks shall be rolled on the outside of the web (running head side) in relief at least 0,8 mm high and in characters that are clearly legible of between 15 mm and 20 mm:

- the identification of the mill;
- the last two figures of the year of manufacture;

- the grooved rail or construction rail profile identification (see Tables A.1 and A.2);
- the symbol for the steel grade (see Table 1).

Short lines shall be approximately half the length of the long lines.

The position of the rolling mark is specified in Table 2.

Other symbols or marks may be added if agreed between purchaser and manufacturer.

Table 2 — Position of the rolling mark

Grooved rails and associated construction rail profiles	Distance H in Figure 1 in mm
52R1, 56R1, 61C1	68
51R1, 53R1	53
59R1, 59R2, 60R1, 60R2, 75C1, 76C1	78
57R1, 67R1	63
62R1, 62R2	78
55G1, 55G2	55
46G1	52
68G1	71
60R3, 63R1	81
105C1	65

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7.4.2 Hot stamping

Each rail shall be identified by a stamped mark consisting of a numerical and/or alphabetical code. The code shall allow the following information to be identified:

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

The identification mark of the rail shall be stamped at least once by the manufacturer on one of the two sides of the web of the hot-rolled rail.

The figures and letters shall be clearly legible and 16 mm high. The stamped characters shall have a flat or radius (1 mm to 1,5 mm radius) face with bevels at the side. The marks shall be on a 10° angle from the vertical and shall have rounded corners. The stamping shall be not greater than 1,0 mm deep along the centre of the web. The design of the characters shall be as shown in Figure 2.

If the rail does not have any stamped mark, it shall be identified by means of a code made by rotary burr.

NOTE The following division of the rails can result in more than one rail having the same identity.

7.4.3 Other identification

At the request of the purchaser, the rails can be marked with paint. The colour and position of these paint marks shall be specified by the purchaser.

7.4.4 Exceptions

The requirements of 7.4.1 and 7.4.2 do not apply to construction rail profiles 310C1, 338C1 or 42C1.

8 Acceptance tests

8.1 Laboratory tests

8.1.1 General

One laboratory test per heat shall be carried out. Results for each laboratory test shall comply with the limiting values given in Tables 3a and 3b.

8.1.2 Chemical composition

The liquid chemical composition shall be determined for each heat. If the solid chemical composition is determined, it shall be determined at the point from which the samples were taken for the tensile test. The requirements for the chemical limits for liquid and solid are given in Tables 3a and 3b.

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Table 3a — Chemical composition and mechanical properties

Steel designation	Chemical composition for	% by mass					% by mass in 10 ⁴ % (ppm)	Tensile strength R_m MPa min.	Elongation after fracture ^a A % min.	Centre line running surface hardness HBW
		C	Si	Mn	P max.	S max.	H max.			
R200	Liquid	0,40 to 0,60	0,15 to 0,58	0,70 to 1,20	0,035	0,035	3,0	680	14	200 to 240
	Solid	0,38 to 0,62	0,13 to 0,60	0,65 to 1,25	0,040	0,040	3,0			
R220G1	Liquid	0,50 to 0,65	0,15 to 0,58	1,00 to 1,25	0,025	0,025	3,0	780	12	220 to 260
	Solid	0,48 to 0,67	0,13 to 0,60	0,95 to 1,30	0,030	0,030	3,0			
R260	Liquid	0,62 to 0,80	0,15 to 0,58	0,70 to 1,20	0,025	0,025	2,5	880	10	260 to 300
	Solid	0,60 to 0,82	0,13 to 0,60	0,65 to 1,25	0,030	0,030	2,5			
R260GHT	Liquid	0,40 to 0,60	0,15 to 0,58	0,70 to 1,20	0,035	0,035	2,5	880	12	260 to 300
	Solid	0,38 to 0,62	0,13 to 0,60	0,65 to 1,25	0,040	0,040	2,5			
R290GHT	Liquid	0,50 to 0,65	0,15 to 0,58	1,00 to 1,25	0,025	0,025	2,5	960	10	290 to 330
	Solid	0,48 to 0,67	0,13 to 0,60	0,95 to 1,30	0,030	0,030	2,5			
R340GHT	Liquid	0,62 to 0,80	0,15 to 0,58	0,70 to 1,20	0,025	0,025	2,5	1175	9	340 to 390
	Solid	0,60 to 0,82	0,13 to 0,60	0,65 to 1,25	0,030	0,030	2,5			

^a The limiting values for elongation after fracture do not apply for heavy construction rails 310C1 and 338C1.

Table 3b — Maximum residual elements content in % by mass

Cr	Mo	Al	Cu	Cu + 10Sn	Cr + Mo + Ni + Cu + V
0,15	0,02	0,004	0,15	0,35	0,35

8.1.3 Hydrogen

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

At least two 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. The first sample from the first heat in a sequence shall be taken from the tundish at the time when the maximum hydrogen content is reached.

If the hydrogen content is less than or equal to the values listed in Table 3a for the respective grades, the heat shall be deemed satisfactory.

Blooms of heats where the determined hydrogen content is greater than the values listed in Table 3a shall be slowly cooled or isothermally treated. The test shall be performed on the finished rail for all heats. All blooms cast prior to sampling and all other blooms cast until the next satisfactory heat shall be slowly cooled or isothermally treated.

When testing of the 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 of any strand. Hydrogen determination shall be carried out on samples taken from the centre of the rail head.

If any result fails to meet the requirements stated in Table 3a, the whole heat shall be rejected.

8.1.4 Hardness test

Brinell hardness tests shall be carried out in accordance with EN ISO 6506-1 once per heat. The following test conditions shall be met:

— tungsten carbide ball;

— ball diameter 2,5 mm; standards.iteh.ai/catalog/standards/sist/08eeb3c4-6a60-4e90-8a90-8ada0a92b32e/sist-en-14811-2007

— load of 1,839 kN;

— period of application 15 s.

Other measurement techniques, for example Rockwell or Vickers hardness testing, may be used, but in cases of dispute, Brinell hardness testing in accordance with EN ISO 6506-1 shall be used.

No hardness test is carried out for the heavy construction rails 310C1 and 338C1.

The hardness values measured shall meet the requirements given in Table 4 for the relevant grade. Material shall be ground from the running surface to a depth of 0,5 mm before the hardness impression is made. The hardness values for hardness impression at the running surface shall not vary by more than 30 HBW on any individual rail.

8.1.4.1 For grades R200G, R220G and R260G, the hardness shall be tested at the running surface only.

8.1.4.2 For heat-treated steel grades R260GHT, R290GHT und R340GHT, the tests shall be carried out on the running surface and on the cross-section. The positions of the test impressions on the cross-section are shown in Figure 3.