

SVENSK STANDARD

SS-EN 14811:2019



Fastställt/Approved: 2019-03-26
Utgåva/Edition: 2
Språk/Language: engelska/English
ICS: 14.540;45.060.01;45.080;93.100

Järnvägar – Spår – Räler för speciella användningsområden – Gaturäl och tillhörande konstruktionsprofiler

Railway applications – Track – Special purpose rail – Grooved rails and associated construction profiles

This preview is downloaded from www.sis.se. Buy the entire standard via <https://www.sis.se/std-80010646>

Standarder får världen att fungera

SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.

Delta och påverka

Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

Ta del av det färdiga arbetet

Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standardpaket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

Utveckla din kompetens och lyckas bättre i ditt arbete

Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på www.sis.se eller ta kontakt med oss på tel 08-555 523 00.



Standards make the world go round

SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.

Take part and have influence

As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

Get to know the finished work

We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

Increase understanding and improve perception

With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

If you want to know more about SIS, or how standards can streamline your organisation, please visit www.sis.se or contact us on phone +46 (0)8-555 523 00



Europastandarden EN 14811:2019 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 14811:2019.

Denna standard ersätter SS-EN 14811:2006+A1:2009, utgåva 1.

The European Standard EN 14811:2019 has the status of a Swedish Standard. This document contains the official version of EN 14811:2019.

This standard supersedes the SS-EN 14811:2006+A1:2009, edition 1.

© Copyright/Upphovsrätten till denna produkt tillhör SIS, Swedish Standards Institute, Stockholm, Sverige. Användningen av denna produkt regleras av slutanvändarlicensen som återfinns i denna produkt, se standardens sista sidor.

© Copyright SIS, Swedish Standards Institute, Stockholm, Sweden. All rights reserved. The use of this product is governed by the end-user licence for this product. You will find the licence in the end of this document.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS, who can also provide general information about Swedish and foreign standards.

Denna standard är framtagen av kommittén för Järnvägar, SIS/TK 254.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD

EN 14811

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2019

ICS 93.100

Supersedes EN 14811:2006+A1:2009

English Version

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

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

Bahnanwendungen - Oberbau - Speziialschienen -
Rillenschienen und zugehörige Konstruktionsprofile

This European Standard was approved by CEN on 14 December 2018.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

SS-EN 14811:2019 (E)

Contents	Page
European foreword.....	4
Introduction	6
1 Scope.....	8
2 Normative references.....	8
3 Terms and definitions	8
4 Information to be supplied by the purchaser.....	9
5 Steel grades	9
6 Dimensions, static properties, linear mass and tolerances.....	10
7 Manufacture	10
7.1 Product integrity.....	10
7.1.1 Factory production control	10
7.1.2 Best practice manufacture.....	10
7.2 Blooms.....	11
7.3 Grooved rails and associated construction rail profiles.....	11
7.4 Marking.....	11
7.4.1 Rolling marks	11
7.4.2 Hot stamping.....	12
7.4.3 Other identification.....	12
7.4.4 Exceptions.....	12
8 Acceptance tests	13
8.1 Laboratory tests.....	13
8.1.1 General.....	13
8.1.2 Chemical composition	13
8.1.3 Hydrogen.....	15
8.1.4 Hardness test.....	15
8.1.5 Tensile test	16
8.1.6 Retests.....	16
8.2 Dimensional and straightness tolerances.....	16
8.2.1 Profile.....	16
8.2.2 Straightness and twist.....	19
8.2.3 Cutting and drilling.....	19
8.2.4 Gauges	20
8.3 Surface imperfections.....	20
8.3.1 General.....	20
8.3.2 Protrusions.....	20
8.3.3 Depressions in the web and foot.....	21
8.3.4 Depressions in the running surface	21
8.4 Surface microstructural damage.....	21
8.5 Proving and dressing of surface imperfections.....	21
8.6 Determination of the linear mass	22
Annex A (normative) Grooved rail profiles and associated construction rail profiles.....	26
Annex B (normative) Gauges	79

Annex C (informative) Holes in grooved rails	98
Annex D (informative) Electric conductivity of the rails	100
Bibliography	101

SS-EN 14811:2019 (E)

European foreword

This document (EN 14811:2019) 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 September 2019, and conflicting national standards shall be withdrawn at the latest by September 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 14811:2006+A1:2009.

This revision introduces new profiles, and technical changes on drawings and technical data.

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, but excluding 46 kg/m.*

Other standards for rails and corresponding welding processes, already published or under preparation, are:

- 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 15594, *Railway applications — Track — Restoration of rails by electric arc welding;*
- EN 16273, *Railway applications — Track — Forged rail transitions;*
- EN 16725, *Railway applications — Track — Restoration and repair of manganese crossings;*
- EN 16771, *Railway applications — Infrastructure — Aluminothermic welding of grooved rails.*

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.

SS-EN 14811:2019 (E)

Introduction

This Introduction provides an explanation of the concept and reasoning for preparing this document. 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 document. 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 this standard be reconsidered.

Whenever possible, this document 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 this document reflect trends in commuter railway usage and heat-treated rails as well as associated construction rail profiles. This document 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 (Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014). 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 document 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 document. For example, the classification of the steel grades of grooved rails and associated construction rail profiles and also other aspects of the document 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 document is the integration of a clause on quality management and testing in order to ensure 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 document recommends that the manufacturer operates a quality management system at least equivalent to the requirements of a quality management standard such as 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.

SS-EN 14811:2019 (E)

1 Scope

This document 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.

Five 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 document specifies 26 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 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 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 after continuous casting includes a given number of blooms relating to the weight of the heat and the extent of the mixing zone

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

3.2

sequence

number of heats of the same steel grade which undergo continuous casting in a new or repaired tundish

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

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 1 to entry: Grooved rail profiles can also be used as construction elements in switches and crossings.

3.6

grooved head

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

Note 1 to entry: 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);
- f) for the profiles 54G1 and 55R1 tolerance group (see Table A.1).

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.

SS-EN 14811:2019 (E)

Table 1 — Steel grades

Steel 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	
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 3 and 4 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 6 and 7. All other quantities are informative only.

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

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 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.

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

Manufacturers having a factory production control system such as 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

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.

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

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

7.3 Grooved rails and associated construction rail profiles

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.

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.

If the linear mass of the profile is less than 110 kg/m, the original cross-section area 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 area 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 area shall be at least 2,5 times greater than that of the rail profile to be rolled. In this case, the suitability for heat treatment may be limited.

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.

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.

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

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.

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 raised marks between 0,6 mm and 1,3 mm and in characters that are clearly legible between 15 mm and 20 mm high:

- 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).

SS-EN 14811:2019 (E)

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, 73C1, 75C1	78
55R1, 57R1, 67R1	63
62R1, 62R2	78
53G1, 54G1, 54G2, 54G3, 54G4, 55G1, 55G2, 55G3	55
46G1	52
68G1	71
60R3, 63R1	81
105C1	65

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 Subsequent cutting 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 3 and 4.

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 3 and 4.

Table 3 — Chemical composition and mechanical properties

Steel designation	Chemical composition for	% by mass					% by mass in 10 ⁻⁴ % (ppm)	Tensile strength <i>R_m</i> MPa min.	Elongation after fracture <i>A</i> % 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			
R290GHT	Liquid	0,50 to 0,65	0,15 to 0,58	1,00 to 1,25	0,025	0,025	2,5	960 ^b	10	290 to 330 ^b
	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.

^b For the profiles 73C1 and 105C1, the minimum requirement for the tensile strength of is 940 MPa, and the hardness limits are 280–320 BHN.

Table 4 — 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 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. 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.

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;
- 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 5 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.

- For grades R200, R220G1 and R260, the hardness shall be tested at the running surface only.
- For heat-treated steel grades R290GHT and 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.