Draft for Public Comment

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Title: Draft BS EN 13674-2 Railway applications - Track - Rail

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

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Introduction

This draft standard is based on European discussions in which the UK has taken an active part. Your comments on this draft are welcome and will assist in the preparation of the consequent British Standard. Comment is particularly welcome on national, legislative or similar deviations that may be necessary.

Even if this draft standard is not approved by the UK, if it receives the necessary support in Europe, the UK will be obliged to publish the official English Language text unchanged as a British Standard and to withdraw any conflicting standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with reasons) or positive vote on this draft.

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- The guidance given below is intended to ensure that all comments receive efficient and appropriate attention by the responsible BSI committee. **Annotated drafts are not acceptable and will be rejected.**

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Date: xx/xx/20xx	Document: **ISO/DIS xxxx**

1	2	(3)	4	5	(6)	(7)
MB	**Clause No./ Subclause No./Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/Note**	**Type of com-ment**	**Commend (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations on each comment submitted**
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

EXAMPLE ONLY

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 13674-2

April 2016

ICS 93.100

Will supersede EN 13674-2:2006+A1:2010

English Version

Railway applications - Track - Rail - Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above

Applications ferroviaires - Voie - Rails - Partie 2 : Rails pour appareils de voie utilisés avec des rails Vignole de masse supérieure ou égale à 46 kg/m

Bahnanwendungen - Oberbau - Schienen - Teil 2: Schienen für Weichen und Kreuzungen, die in Verbindung mit Vignolschienen ab 46 kg/m verwendet werden

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CEN 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. prEN 13674-2:2016 E

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European foreword

This document (prEN 13674-2:2016) 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 13674-2:2006+A1:2010.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/CE.

For relationship with EU Directive 2008/57/CE, see informative Annex ZA, which is an integral part of this document.

This part of EN 13674 is the second 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 – Track – Flash butt welding of rails – Part 1: New R220, R260, R260Mn and R350HT 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 at 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 and associated construction*

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

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

Introduction

This introduction provides an explanation of the concepts and reasoning used in the drafting of this European Standard. 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 European Standard. 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. The standard includes rail profiles for switch and crossing rails used in conjunction with Vignole rails having a linear mass 46 kg/m and above.

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

This European Standard supersedes other 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 European Standard to operate between the user and the manufacturer.

This European Standard 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 European Standard 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, the standard 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 the standard, which is a complete break from tradition, is the inclusion of 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, the rail standard requires that the manufacturer’s 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.

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 part of EN 13674 specifies switch and crossing rails that carry railway wheels. These are used in conjunction with Vignole railway rails.

This part of this standard is not applicable for the check rails that do not carry railway wheels.

Nine pearlitic steel grades are specified covering a hardness range of 200 HBW to 410 HBW and include non-heat treated non-alloy steels, non-heat treated alloy steels, heat treated non-alloy steels, heat treated low alloy steels and heat treated alloy steels.

There are 33 rail profiles specified in this standard, but they may not all be available in all steel grades.

Rails specified in EN 13674-1 may also be used as switch and crossing rails and if so used they have to comply with the requirements of EN 13674-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 1: General requirements*

EN 10276-1, *Chemical analysis of ferrous materials - Determination of oxygen in steel and iron - Part 1: Sampling and preparation of steel samples for oxygen determination*

EN 13674-1, *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)*

ISO 4968, *Steel — Macrographic examination by sulfur print (Baumann method)*

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

3 Terms and definitions

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

3.1
heat
one 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
any number of heats, of the same steel grade, which undergo continuous casting in tundishes. 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
re-heated rail
all 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. 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) length (or lengths) of rail (see 9.2.3 and Table 8);

d) paint code requirements (see 7.4.4);

e) undrilled or drilled rail ends to take fish plate bolts, and the location and dimensions of holes when required (see 9.2.3 and Table 8);

f) any special treatments to be applied and corresponding tolerances for bolt holes (see 9.2.3);

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

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 standard are compared to those in EN 10027-1 and EN 10027-2 in Annex B.

Table 1 — Steel grades

Grade [a]	Hardness range (HBW)	Description	Branding lines
R200	200 – 240	Non-alloy (C-Mn)	No branding lines
R220	220 – 260	Non-alloy (C-Mn)	——
R260	260 – 300	Non-alloy (C-Mn)	— ——
R260Mn	260 – 300	Non-alloy (C-Mn)	—— ——
R260Cr	260 – 300	Alloy (0,5 % Cr)	— —— ——
R320Cr	320 – 360	Alloy (1 % Cr)	—— —— ——
R350HT	350 – 390[b]	Non-alloy (C-Mn) heat treated	— —— ——
R350LHT	350 – 390[b]	Non-alloy (C-Mn) heat treated	— —— —— —
R370CrHT	370 to 410[b]	Alloy (C-Mn) heat treated	— —— —— ——

a See Table 3 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 shall be in accordance with Annex A. The tolerances of certain dimensions shall be 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 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.

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

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

7.1.2 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 seventh that of the bloom from which the rail is rolled, except for full web rails (Figures A.27 to A.33), where this value shall not exceed one fifth.

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 localized deviation on the rail may be corrected using pressing.

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

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. For asymmetric rails, except 50E6A2, the brand shall be on the gauge side of the rail profile. For 50E6A2 rail the brand shall be on the non-gauge side.

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.

EXAMPLES

ROLLING MILL 99 60 E1A5

(60 E1A5 profile rail rolled 1999, non-alloy rail steel grade R260)

ROLLING MILL 99 60 E1T2

(60 E1T2 profile rail rolled 1999, non-alloy heat-treated rail steel grade R350HT).

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, except 50E6A2, and each rail shall be hot stamped at least once every 5 m. If for asymmetric rails hot stamping every 5 m is not practical, the identification of the rail shall be secured by hot stamping or rotary burr near one end of the rail.

NOTE 1 A rail can display different indications of position of the rail in the blooms (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;

c) 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.

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 has to qualify under section 8 of EN 13674-1 and shall then be qualified for all profiles of 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 may not be achieved using the rail grades specified in this part of the standard.

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 Table 3. Additional information and other acceptance tests not covered by Table 3 shall comply with the requirements of 9.1.2 to 9.1.8 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 Table 3 and Table 4.

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.

Table 2 — Testing frequency

Test (on)	Relevant sub-clause	Steel grades	
		R200, R220, R260, R260Mn, R260Cr, R320Cr	**R350HT, R350LHT, R370CrHT**
Chemical composition	9.1.2	One per heat	One per heat
Hydrogen	9.1.2.2	One per heat (2 tests from first heat in sequence)	One per heat (2 from first heat in sequence)
Total oxygen	9.1.2.3	One per sequence [a]	One per sequence [a]
Microstructure	9.1.3	Not required for grades R200, R220 and R260 One per 1 000 tonnes or part thereof for grades R260Mn, R260Cr and R320Cr [a,b]	One per 100 tons [a,c]
Decarburisation	9.1.4	One per 1 000 tonnes or part thereof [a,b]	One per 500 tonnes of re-heated and mill heat treated [a,c]
Oxide cleanness	9.1.5	One per sequence [a,b]	One per sequence [a,b or c]
Sulfur print	9.1.6	One per 500 tonnes or part thereof [a,b]	One per 500 tonnes or part thereof [a,b or c]
Hardness	9.1.7	One per heat [a,b]	One per 100 tons [a,c]
Tensile	9.1.8	One calculation per heat/one test per 2000 tonnes [a,b]	One per 1 000 tonnes (test) [a,c]

a Samples shall be taken at random but only rails from blooms outside the mixing zone between heats when continuously cast in sequence.

b Samples shall be cut after rolling.

c Samples shall be cut from heat treated rails.

Table 3 — Chemical composition/mechanical properties

Steel grade		% by mass									10⁻⁴ % (ppm) Max.		Tensile strength R_m Min.	Elongation after fracture A Min.	Hardness of the running surface, Centre line[c],
Steel name	sample	C	Si	Mn	P max.	S max	Cr	Al max.	V max.	N max.	O[a]	H[b]	MPa	%	HBW
R200	Liquid	0,40/0,60	0,15/0,58	0,70/1,20	0,035	0,035	0,15 max	0,004	0,030	0,009	20	3,0			
	Solid	0,38/0,62	0,13/0,60	0,65/1,25	0,040	0,040	0,15 max	0,004	0,030	0,010	20	3,0	680	14	200/240
R220	Liquid	0,50/0,60	0,20/0,60	1,00/1,25	0,025	0,025	0,15 max	0,004	0,030	0,009	20	3,0			
	Solid	0,50/0,60	0,20/0,60	1,00/1,25	0,025	0,025	0,15 max	0,004	0,030	0,010	20	3,0	770	12	220/260
R260	Liquid	0,62/0,80	0,15/0,58	0,70/1,20	0,025	0,025	0,15 max	0,004	0,030	0,009	20	2,5			
	Solid	0,60/0,82	0,13/0,60	0,65/1,25	0,030	0,030	0,15 max	0,004	0,030	0,010	20	2,5	880	10	260/300
R260Mn	Liquid	0,55/0,75	0,15/0,60	1,30/1,70	0,025	0,025	0,15 max	0,004	0,030	0,009	20	2,5			

	Solid	0,53/0,77	0,13/0,62	1,25/1,75	0,030	0,030	0,15 max	0,004	0,030	0,010	20	2,5	880	10	260/300
R260Cr	Liquid	0,40/0,60	0,20/0,45	1,20/1,60	0,025	0,025	0,40/0,60	0,004	0,060	0,009	20	2,5			
	Solid	0,40/0,60	0,20/0,45	1,20/1,60	0,030	0,030	0,40/0,60	0,004	0,060	0,010	20	2,5	880	10	260/300
R320Cr	Liquid	0,60/0,80	0,50/1,10	0,80/1,20	0,020	0,025	0,80/1,20	0,004	0,18	0,009	20	2,5			
	Solid	0,58/0,82	0,48/1,12	0,75/1,25	0,025	0,030	0,75/1,25	0,004	0,20	0,010	20	2,5	1080	9	320/360
R350HT	Liquid	0,72/0,80	0,15/0,58	0,70/1,20	0,020	0,025	0,15 max	0,004	0,030	0,009	20	2,5			
	Solid	0,70/0,82	0,13/0,60	0,65/1,25	0,025	0,030	0,15 max	0,004	0,030	0,010	20	2,5	1175	9	350/390
R350LHT	Liquid	0,72/0,80	0,15/0,58	0,70/1,20	0,020	0,025	0,30 max	0,004	0,030	0,009	20	2,5			
	Solid	0,70/0,82	0,13/0,60	0,65/1,25	0,025	0,030	0,30 max	0,004	0,030	0,010	20	2,5	1175	9	350/390
R370CrHT	Liquid	0,70/0,82	0,40/1,00	0,70/1,10	0,020	0,020	0,40/0,60	0,004	0,030	0,009	20	1,5			
	Solid	0,68/0,84	0,38/1,02	0,65/1,15	0,025	0,025	0,35/0,65	0,004	0,030	0,010	20	1,5	1.280	9	370 to 410

[a] See 9.1.2.3

[b] See 9.1.2.2

[c] See Figure 8

Table 4 — Maximum residual elements, % by mass

	Mo	Ni	Cu	Sn	Sb	Ti	Nb	Cu and 10 Sn	Sum of the elements
R200, R220, R260, R260Mn	0,02	0,10	0,15	0,030	0,020	0,025	0,01	0,35	Cr + Mo + Ni + Cu + V : 0,35
R260Cr, R320Cr	0,02	0,10	0,15	0,030	0,020	0,025	0,01	0,35	Ni + Cu : 0,16
R350HT	0,02	0,10	0,15	0,030	0,020	0,025	0,04	0,35	Cr + Mo + Ni + Cu + V : 0,25
R350LHT; R370CrHT	0,02	0,10	0,15	0,030	0,020	0,025	0,04	0,35	Mo + Ni + Cu + V : 0,20

9.1.2.3 Determination of total oxygen content

9.1.2.3.1 General

Total oxygen content shall be determined in the liquid steel, following solidification of the sample, or from the solid rail head, in the positions shown in Figure 2, and at the frequency shown in Table 2.

The results obtained shall comply with the values given in Table 3.

9.1.2.3.2 Preparation of the sample

The thickness of the transverse rail slice shall be 4 mm.

Samples shall be prepared in accordance with EN 10276-1.

9.1.2.3.3 Measurement

The measurement of total oxygen shall be made using an automatic machine.

9.1.3 Microstructure

9.1.3.1 General

Microstructures shall be determined at a magnification of x 500.

The microstructure shall be verified for R260Mn, R260Cr, R320Cr and heat treated rails at the frequency given in Table 2.

The testing position in the rail head shall be as shown in Figure 3.

9.1.3.2 Grades R200, R220

The microstructure shall be a mixture of pearlite and grain boundary ferrite. There shall be no martensite, bainite or grain boundary cementite.

9.1.3.3 Grade R260, R260Mn, R260Cr

The microstructure shall be pearlitic but grain boundary ferrite may occur in these grades. The maximum grain boundary ferrite permitted is shown in Figure 4. There shall be no martensite, bainite or grain boundary cementite.

9.1.3.4 Grade R320Cr

The microstructure shall be fully pearlitic with no martensite, bainite or grain boundary cementite.

9.1.3.5 Grades R350HT, R350LHT, R370CrHT

The microstructure shall be pearlitic with no martensite, bainite or grain boundary cementite. The maximum grain boundary ferrite permitted is shown in Figure 4.

9.1.4 Decarburisation

The decarburisation shall be checked at the frequency shown in Table 2. The decarburisation depth shall be assessed by means of a hardness test. After a minimum of preparation of the rail surface (polishing) a hardness test according to the method indicated in 9.1.7 will be performed in three points. None of the results of hardness obtained shall be lower than the minimum value specified of the grade, reduced by 7 HBW (example: 253 HBW for grade R260).

If there are any doubts regarding the conformity with the requirements on decarburisation, alternatively to the hardness test, at the discretion of the manufacturer or on request of the purchaser, metallographic investigations shall be carried out.

Photomicrographs showing the depth of decarburisation allowed are shown in Figure 5. Figure 6 defines the rail head surface for decarburisation checks.

No closed ferrite network shall be observed below 0,5 mm depth measured anywhere on the rail head surface.

9.1.5 Oxide cleanness

Samples shall be prepared and assessed in accordance with EN 13674-1. Samples shall be taken from one of the last blooms of the last heat of the sequence but from each sample 2 specimens shall be tested. The total index K3 shall be less than 10.

The testing position in the rail head is shown in Figure 7.

9.1.6 Sulfur prints

Sulfur prints of transverse rail sections shall be prepared in accordance with ISO 4968 at the frequency shown in Table 2.

All samples, including those intended for repeat test, shall be taken from outside the mixing zones of the heat. When part or all of an adjacent heat has been withdrawn due to non-conformance, tests shall be made in the mixing zones to determine the first conforming blooms.

The sulfur prints shall correspond to the requirements specified in EN 13674-1, Annex D.

NOTE Figure D.13 of EN 13674–1 does not apply to the profiles of EN 13674–2.

9.1.7 Hardness

Brinell hardness tests shall be carried out in accordance with EN ISO 6506-1 at the frequency shown in Table 2. The test conditions shall be as follows:

— tungsten carbide ball;

— ball diameter 2,5 mm;

— load 1,839 kN;

— period of application 15 s.

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

The hardness values measured shall meet the requirements given in Table 5 for the relevant grade.

In the case of heat treated rails, the following shall apply:

$$HBW_2 > HBW_3 + 0{,}3(HBW_1 - HBW_3)$$

where HBW_1, HBW_2 and HBW_3 are the mean hardness values at position 1, 2 or 3 respectively. Also the difference between any of the three positions shall be no more than 30 HBW. The testing positions are shown in Figure 8.

The hardness on the centre line of the head crown shall not vary by more than 30 HBW on any individual rail.

For the steel grades R200, R220, R260, R260Cr, R260Mn and R320Cr the hardness shall only be tested for position RS. For heat treated rails hardness shall be tested at the positions 1 to 4 as shown in Figure 8.

0,5 mm shall be removed from the running surface before a hardness impression is made.

Table 5 — Hardness testing positions and requirements

Position	Rail steel grade						
	R200	R220	R260, R260Mn, R260Cr	R320Cr	R350HT	R350LHT	R370CrHT
	Hardness (HBW)						
RS [a]	200–240	220–260	260–300	320–360	350–390 [b]	350–390 [b]	370–410[c]
1	[d]	[d]	[d]	[d]	340 min	340 min	360 min
2					331 min	331 min	350 min
3					321 min	321 min	340 min
4					340 min	340 min	360 min

[a] RS = Point on the centre line running surface.

[b] If the hardness exceeds 390 HBW, the rail is acceptable provided the microstructure is confirmed to be pearlitic, and the hardness does not exceed 405 HBW.

[c] If the hardness exceeds 410 HBW, the rail is acceptable provided the microstructure is confirmed to be pearlitic, and the hardness does not exceed 425 HBW.

d Not relevant.

9.1.8 Tensile tests

9.1.8.1 General

The tensile test shall be carried out with the test frequency specified in Table 2. Test samples from the rail shall be taken as given in Figure 3. Results obtained shall comply with the values given in Table 3.

9.1.8.2 Method of test

The manufacturer shall determine the tensile properties in accordance with EN ISO 6892-1 using a proportional circular test piece of 10 mm diameter.

Before testing, the tensile test pieces should be maintained at a temperature of 200 °C for up to 6 h. In the case of dispute, the tensile test pieces shall be maintained at a temperature of 200 °C for 6 h before testing.

a) Predictive equations relating chemical composition to tensile strength and elongation shall be calculated using multiple regression analysis for all non-heat treated rails produced. The following procedure shall be carried out:

   — development of a predictive equation;

   — confirmation of the predictive equation;

   — periodic updating of the predictive equation;

   — corrective action.

b) Manufacturers shall calculate, using multiple regression analysis for all naturally hard steel grades produced, predictive equations relating chemical composition to tensile strength and elongation. Each manufacturer shall derive its own predictive equations.

   The predictive equations shall be produced from a minimum number of 100 heats.

The equations shall be created by carrying out one valid tensile test per heat. Tensile tests shall be carried out in accordance with 9.1.8.

The predictive equations shall produce results which are within a scatter band governed by the following limits:

— tensile strength: 12,5 MPa (1 standard deviation);

— elongation: 1,0 % (1 standard deviation).

c) The results of the predictive equations shall be compared with experimentally determined tensile strength and elongation results as described in 9.1.8. This comparison will be achieved by carrying out one valid tensile test every 2 000 tonnes or at least every tenth heat.

d) The experimental results shall be within ± 25 MPa tensile strength and ± 2 % elongation of those obtained from the predictive equations.

e) The results of the experimental tensile strength and elongation tests obtained from 9.1.8.2, c) shall be used to update the predictive equations. These results shall be accumulated and the equations updated annually. The updated equations shall be based on a minimum of the last 100 results.

f) If results from the predictive equations or the experimental results are outside the limits set in 9.1.8.2, b) and 9.1.8.2, c) then actions 1), 2) and 3) and when necessary action 4) shall be taken:

1) manufacturer shall carry out an investigation;

2) problem will be resolved by the manufacturer taking appropriate corrective action;

3) manufacturer shall report the findings of a) and b) to the purchaser;

4) if the problem cannot be resolved to the satisfaction of the purchaser, the manufacturer or potential manufacturer shall have failed the approval requirements as specified in 9.1.8.2, a). If the physical tests themselves are within the requirements of Table 3 the product is satisfactory.

9.1.9 Retest procedures

If any test fails to meet the requirements of 9.1.2 to 9.1.8 (but excluding hydrogen) then two tests shall be performed on samples from rails in close proximity to the original. Should either retest fail then rails shall be progressively tested until acceptable material is found. The failed material shall be rejected or in the case of heat treated material re-treated and tested. For hydrogen and oxygen testing refer to the 9.1.2.2 and 9.1.2.3 respectively.

9.2 Dimension tolerances

9.2.1 Profile

The nominal dimensions of the rail profile (see Annex A) and the actual dimensions anywhere on any rail shall not differ by more than the tolerances given in Table 6.

Table 6 — Profile tolerances

* Reference points (see EN 13674–1, Figure E.1)			Tolerances mm	Gauge figure number (see EN 13674–1, Annex E)
Height of rail	< 165 mm ≥ 165 mm	*H	±0,7 ±0,8	E.3
Crown profile		*C	±0,6	E.4
Width of rail head		*WH	±0,5	E.5
Width of rail head for full web rails (profile Figures A.27 to A.33)		*WH	±0,7	E.5
Rail asymmetry [a]		*As	±1,2	E.6, E.7
Height of fishing	< 165 mm ≥ 165 mm	*HF	±0,5 ±0,6	E.8 [c]
Web thickness		*WT	±0,7	E.9
Width of rail foot		*WF	±1,0	E.10
Foot toe thickness [b]		*TF	+ 0,75 - 0,5	E.11
Foot base concavity			0,3 max	

[a] Asymmetry shall only refer to symmetrical rails.

[b] Foot toe thickness requirements are not applicable for full web rails and asymmetric rails.

[c] Not applicable for full web rails (see Figures A.27 to A.33); in the case of all other rails, pairs of gauges with agreed dimensions shall be used to consider the different dimensions on both rail sides.

9.2.2 Straightness, surface flatness and twist

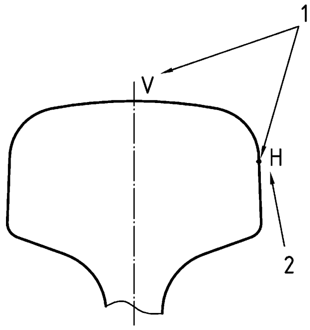
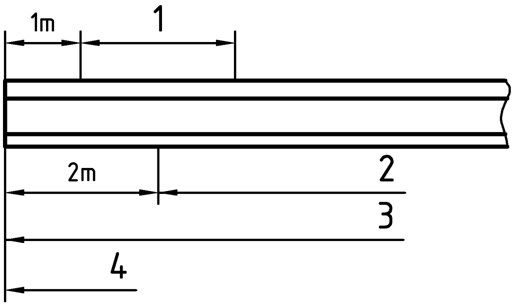
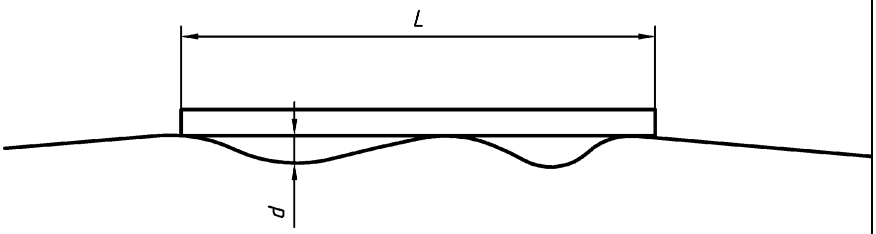
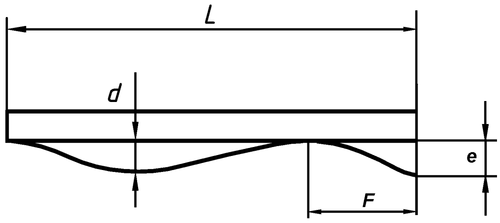
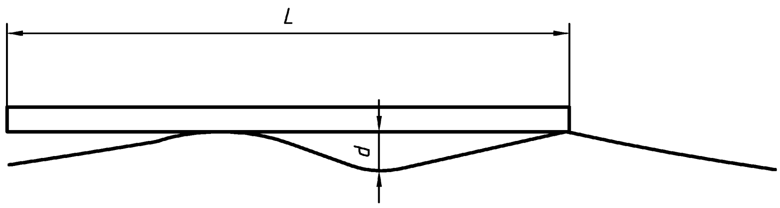
Flatness testing of the body shall be performed automatically.

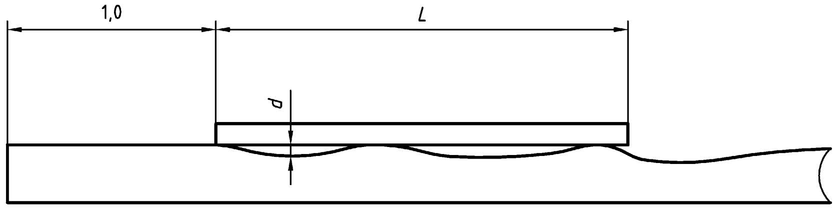
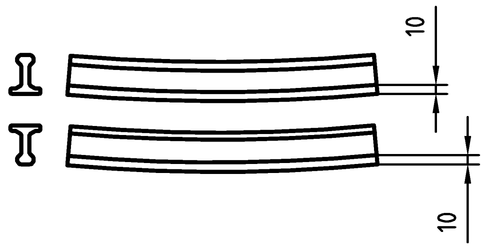
Tolerances for straightness, surface flatness and twist shall meet the requirements given in Table 7. Rejected rails may be subject to only one roller re-straightening.

In cases of dispute on the results of the automatic technique, rail flatness shall be verified using a straight edge as shown in Table 7.

When measuring side sweep the rail shall be stood vertically on a suitable support that allows the rail to be unrestrained. If a measurement technique other than that given above is used, only the above shall be used in the case of dispute.

Table 7 — Straightness, surface flatness and twist tolerances

 **Key** 1 V and H. Location of flatness measurements 2 The position of H is nominally 5–10 mm below the gauge corner on the side of the head				 **Key** 1 Overlap 2 Body 3 Whole rail 4 End “E”
		d	L	
BODY [a]	Vertical flatness V	≤ 0,4 mm and ≤ 0,3 mm	3 m [c] 1 m [c]	b 
	Horizontal flatness H	≤ 0,6 mm	1,5 m [c]	
ENDS [a]	End “E”	1,5 m		b  if e > 0 F ≥ 0,6m
	Vertical straightness	≤ 0,5 mm and e ≤ 0,2 mm	1,5 m	
	Horizontal straightness	≤ 0,7 mm	1,5 m	b 
OVERLAP [a]	Length of overlap	1,5 m		b
	Vertical flatness V	≤ 0,4 mm	1,5 m [c]	

<table>
<tr><td></td><td>Horizontal flatness H</td><td>≤ 0,6 mm</td><td>1,5 m [c]</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3">d</td><td>L</td><td></td></tr>
<tr><td rowspan="3">WHOLE RAIL</td><td colspan="3">Upsweep and down sweep</td><td>10 mm[d]</td><td rowspan="3"></td></tr>
<tr><td colspan="3">Side sweep</td><td>Curve radius R > 1 500 m</td></tr>
<tr><td colspan="3">Twist</td><td>See Figures 9 and 10</td></tr>
<tr><td colspan="6">[a] Automatic measurement equipment shall measure as much of the rail as possible but, at least the body. If the whole rail satisfies the body specifications, then measurement of end and overlap is not mandatory.
[b] Automatic measurement techniques are complex and are therefore difficult to define but the finished rail flatness shall be capable of being verified by straight edge as shown in the above drawings.
[c] 95 % of delivered rails shall be within limits specified, with 5 % of rails allowed outside the tolerances by 0,1 mm.
[d] The ends of the rails shall not be up more than 10 mm when the rail is on its foot or on its head when standing on an inspection bed.</td></tr>
</table>

9.2.3 Cutting and drilling

The size and location of drilled holes, the squareness of rail ends and rail lengths shall be within the tolerances given in Table 8.

Drilled holes and rail ends shall be deburred. For holes that are to be subject to special treatments the tolerances shall be specified [see indent Clause 4, f)].

If the purchaser agrees, asymmetric rails can be delivered hot cut to length in view of their further treatment before use. The rail length tolerance shall be $^{+100}_{\ \ 0}$ mm.

9.3 Gauges

The gauges are as shown in EN 13674-1, Annex E.

Other measurement techniques may be used; in the case of dispute, those in EN 13674-1, Annex E shall be used.

9.4 Inspection for internal quality and surface quality

9.4.1 Internal quality

All rails shall be ultrasonically tested by an automated process ensuring that the rail length and specified cross-sectional area are inspected, leaving only a very small area untested. Untested ends shall be tested by an appropriate procedure or cropped off.

The minimum cross-sectional area examined by the ultrasonic technique shall be:

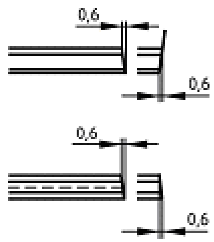
— at least 70 % of the head;

— at least 60 % of the web;

— area of the foot specified in Figure 14.

By convention these areas are based on projecting the nominal crystal size of the probe. On request of the purchaser, the manufacturer shall demonstrate that all the specified areas (see above) are covered with the used procedure. The head shall be tested from both sides and from the running surface.

Table 8 — Drilling and cutting tolerances

Number	Drilling requirement	Tolerance
1	Drilling Diameter ≤ 30 mm > 30 mm	 ±0,5 mm ±0,7 mm
	Centring and positioning of the holes vertically and horizontally	The horizontal position of the holes is checked using a gauge as shown in Figure 12 of EN 13674–1, Annex E which has a stop designed to come into contact with the end of the rail and pins designed to enter the holes. The diameter of the pins for horizontal and vertical clearances is smaller than the diameter of the holes by: - 1,0 mm for holes less than or equal to 30 mm in diameter. - 1,4 mm for holes greater than 30 mm in diameter. The distances between" the centre lines of the pins and the stop are equal to the nominal distances from the centre line of the holes to the end of the rail. The gauge pins" shall be able to enter the holes at the same time while the stop is touching the end of the rail. The vertical centring of the holes can be checked using a gauge as shown in Figure 13 of EN 13674–1, Annex E. The side of the hole, left or right, is determined by proceeding from the side with the relief markings.
2	Squareness of ends	0,6 mm in any direction 

3	Length [b] - both ends drilled ≤ 12 m > 12 m ≤ 24 m > 24 m ≤ 40 m -other (undrilled or one end drilled)	 ±2 mm ±3 mm ±4 mm ±1 mm/per metre of rail (max. ± 30 mm on any rail) For special purpose undrilled rails the length tolerance is ± 6 mm up to 24 m and ± 10 mm for > 24 m rail.

[a] The given rail lengths apply for +15 °C. Measurements made at other temperatures are to be corrected to take into account expansion or contraction of the rail.

[b] These tolerances apply only for rails with fishplate holes, not for rails with handling holes

The sensitivity levels of the automatic equipment used shall be a minimum 4 dB greater than the level required to detect the reference reflectors described in 9.4.1. After calibration with the reference reflectors, the signal-to-noise ratio of the automated equipment shall be at least 10 dB. A rail giving an echo referring to a possible defect shall be separated by means of an automatic trigger/alarm level combined with a marking and/or sorting system. For possible retesting, the test sensitivity shall be increased to 6 dB instead of 4 dB.

Rails giving signals over the threshold in the rail using the increased sensitivity shall be rejected or cut back to remove the defective portion.

The system shall incorporate continuous monitoring of interface and, if present, backwall echo signals.

There shall be a calibration rail for each profile ultrasonically tested and the positions of the reference reflectors are given for the rail head, web and foot of the 60E1 profile in Figures 11, 12 and 13 respectively. Calibration rails for other profiles with reference reflectors similar to those in accordance with Figures 11 to 13 for 60E1 shall be available, and on request detailed drawings shall be presented to the purchaser.

Other methods of calibration may be used but these methods shall be equivalent to that described above.

9.4.2 Surface quality

9.4.2.1 Requirements

9.4.2.1.1 Hot marks, protrusions and seams

Protrusions on the running surface or the underside of the foot and any protrusions affecting the fit of the fishplate at less than 1 m from the extremity of the delivered rail shall be dressed to shape.

The depth of hot marks and seams, as defined in EN 10163-1, shall not exceed:

— 0,35 mm for the running surface;

— 0,5 mm for the rest of the rail.

In the case of longitudinal guide marks, there shall be a maximum of two, to the depth limits specified, at any point along the length of the rail but no more than one of these shall be on the rail running surface. Recurring guide marks along the same axis are accepted as a single guide mark.

The maximum width of guide marks shall be 4 mm. The width to depth ratio of allowable guide marks shall be a minimum 3:1.

In the case of hot formed marks originating from the vicinity of the mill rolls, those which are recurrent along the same axis, at a distance equal to the roll circumference, shall be accepted as a single mark. They can be removed by dressing except those marks on the rail crown where a maximum of 3 per 40 m is allowed.

9.4.2.1.2 Cold marks

Cold marks are longitudinal or transverse cold formed scratches.

The discontinuity depth shall be not larger than:

— 0,3 mm for the rail running surface and underside of foot;

— 0,5 mm for the rest of rail.

NOTE It is difficult, or impossible to detect in track fatigue cracks initiating and propagating from the underside of the foot; therefore all practicable efforts are to be made to avoid cold transverse marks in this area.

9.4.2.1.3 Surface microstructural damage

Any sign of surface microstructural damage resulting in martensite or white phase is not permitted.

9.4.2.2 Inspection on surface imperfections - General inspection

All rails shall be visually or automatically inspected on all faces for surface imperfections. In addition, the underside of the rail foot shall be inspected automatically in accordance with 9.4.2.2. All rails shall comply with the acceptance criteria defined in 9.4.2.1. Dressing of imperfections shall be in accordance with 9.4.2.3, b).

The rail shall be automatically inspected on the underside of the foot along its entire length.

The equipment used shall be able to detect test imperfections with sizes as shown in Table 9. The imperfections shall have a tolerance of ± 0,1 mm.

Table 9 — Dimensions of test imperfections

Depth mm	Length mm	Width mm
1,0	20	0,5
1,5	10	0,5

An edge loss for the automatic technique is permitted for the extreme 5 mm of the flat portion of the foot width at each side.

9.4.2.3 Dressing of surface imperfections

a) Imperfections exceeding the limits specified in 9.4.2.1.1 to 9.4.2.1.3 shall be dressed out. Any protrusions affecting the fit of the fishplate (see 9.4.2.1.1) shall be dressed to shape.

   If the imperfection depth cannot be measured it shall be investigated by depth proving, and subsequently dressed to the criteria below, using a rotary burr, lamellar flap tool or grinding belt, providing the rail microstructure is not affected by the operation and the work is contour blended.

   The depth of dressing shall be not larger than:

   — 0,35 mm for the rail running surface;

   — 0,5 mm for the rest of rail.

   No more than three defects within a length of 10 m of rail and, over the whole length, a maximum of one defect per 10 m rail length shall be dressed. After dressing profile tolerances shall be in accordance with Table 6 and flatness tolerances shall be in accordance with Table 7.

b) Any sign of surface microstructural damage resulting in martensite or white phase shall be dressed or the rail rejected. The dressed area shall be proved by suitable hardness testing. The hardness shall not be more than 50 BW greater than the surrounding material.

9.4.3 Checking of automated testing equipment

The calibration rail shall be used to test the equipment at production speed at the beginning and once every 8 h of testing a particular profile.

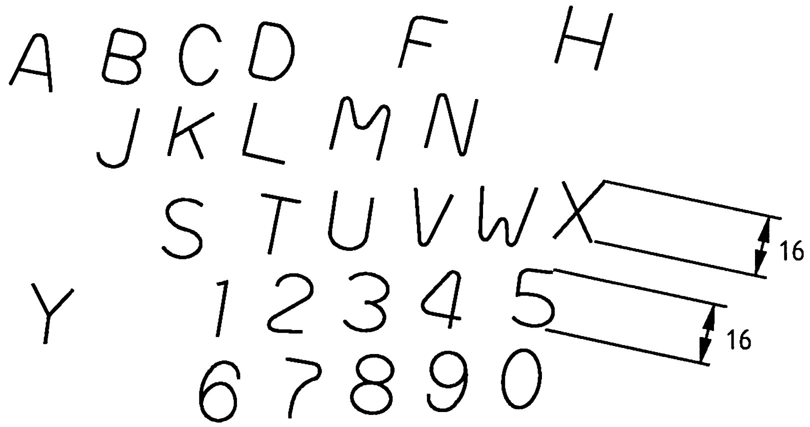


Figure 1 — Design of letters and numbers on a 10° angle for rail stamps

Dimensions in millimetres

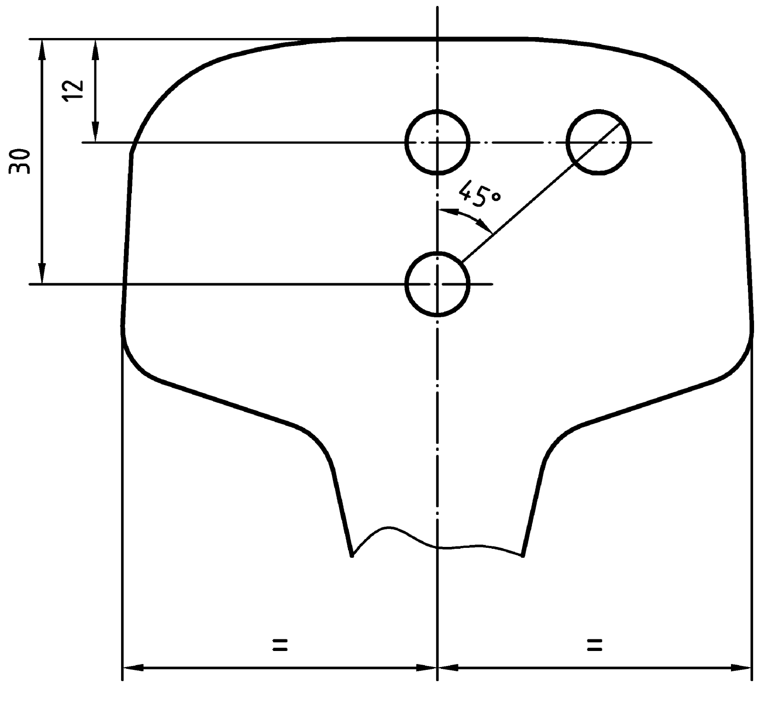
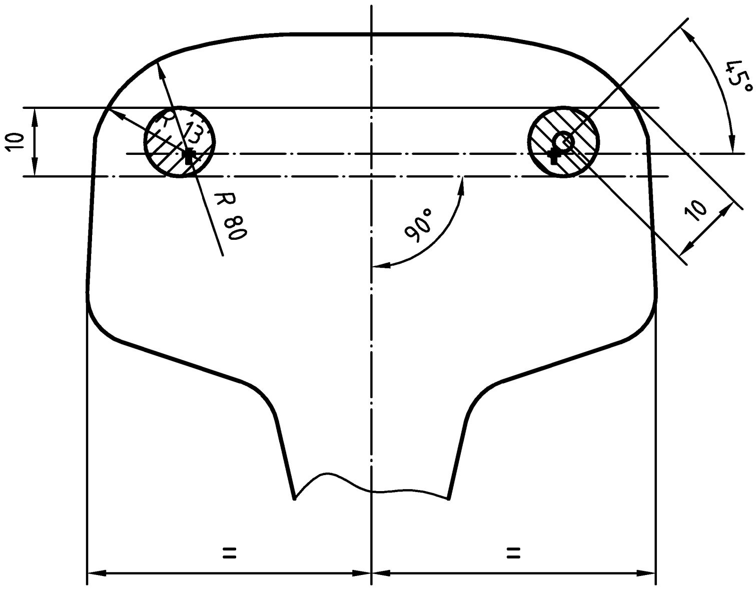


Figure 2 — Sampling positions in rail for total oxygen determination

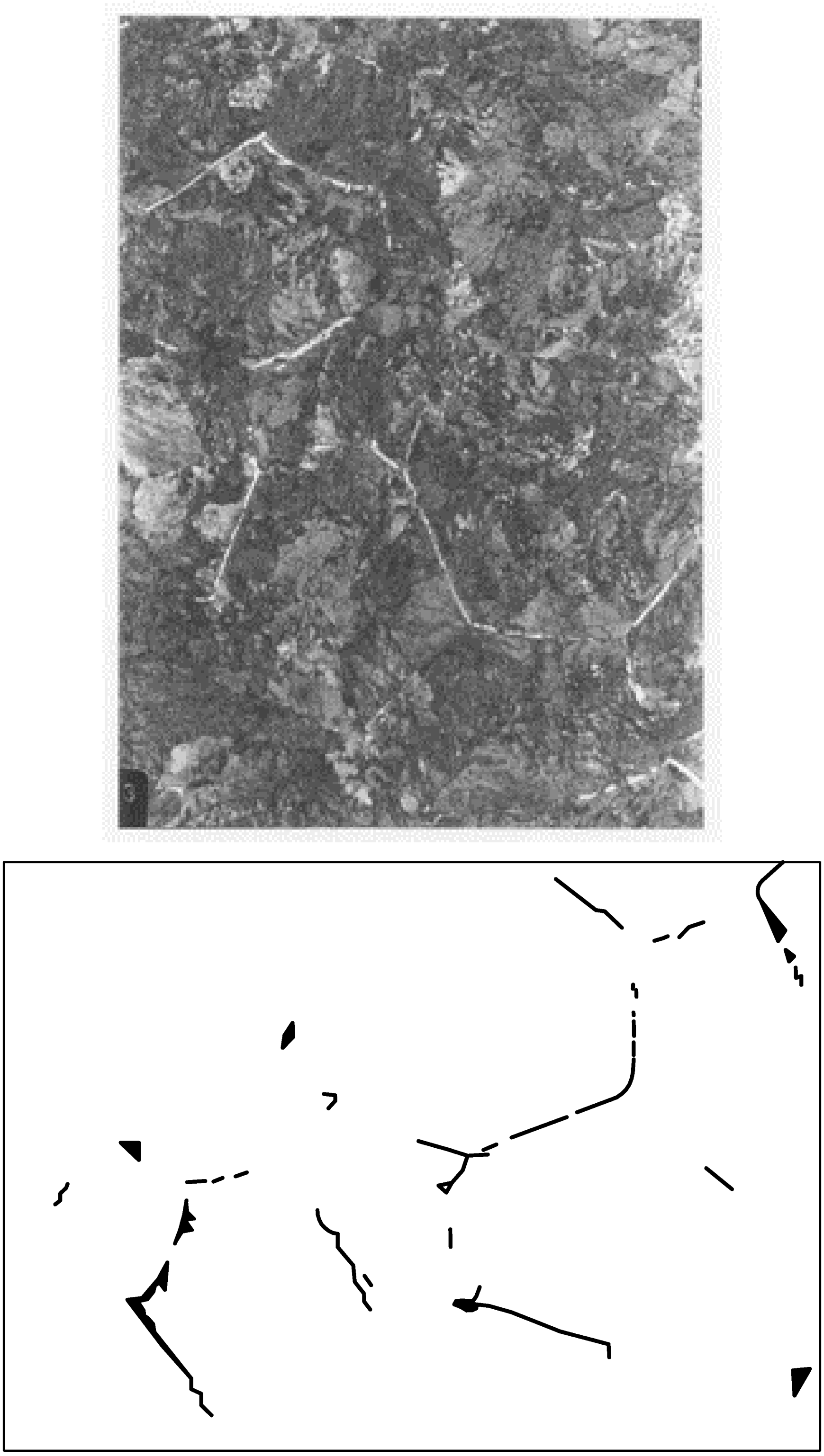
Dimensions in millimetres



Key

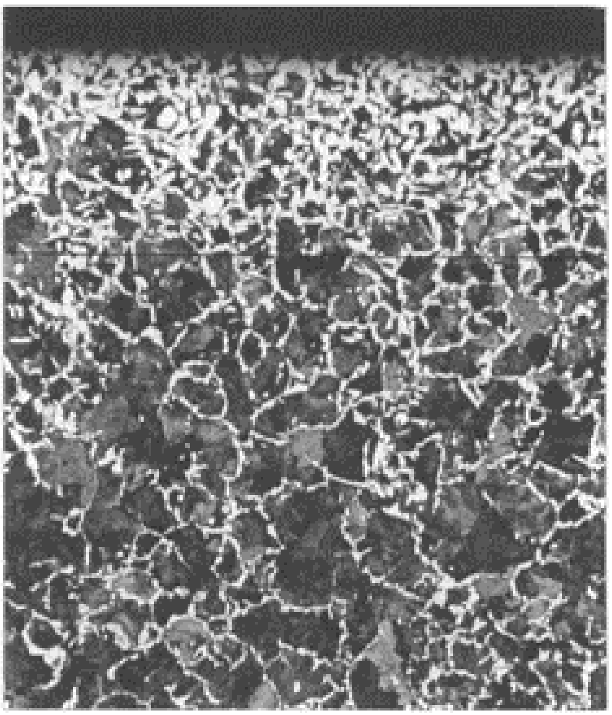
✝	Intersecting point of the R 13 and R 80 (60E1 profile)
○	Location at the centre of the tensile test piece
▨	Area to be checked for microstructure

Figure 3 — Location of tensile test piece and microstructure checks



Photomicrograph × 500

Figure 4 — Photomicrograph and diagram showing maximum allowable ferrite at the grain boundaries for grades other than R200 and R220



← Surface of rail

← Limit of continuous ferrite network. This example shows decarburisation to a depth of 0,28 mm

Grades R200 and R220

← Surface of rail

← Limit of continuous ferrite network. This example shows decarburisation to a depth of 0,28 mm

All grades other than R200 and R220

Figure 5 — Photomicrographs (× 100) showing the depth of decarburization allowed on the rail wear surface

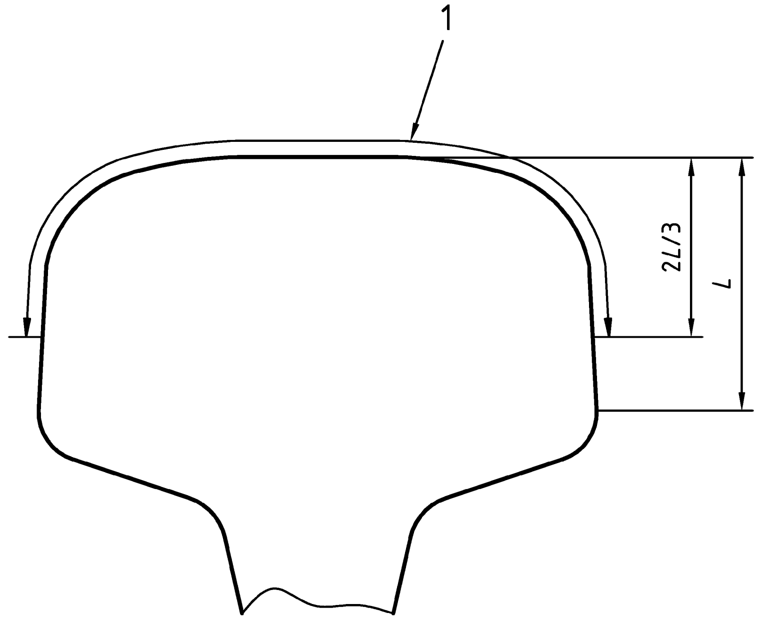
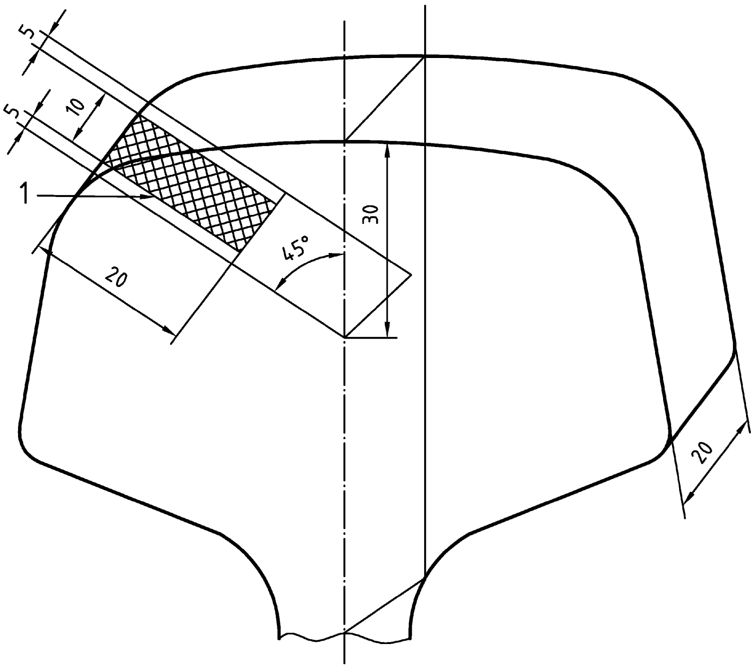


Figure 6 — Range of extent of rail head surface for decarburisation checks

Key

1 decarburisation limits apply to this part of rail head

Dimensions in millimetres

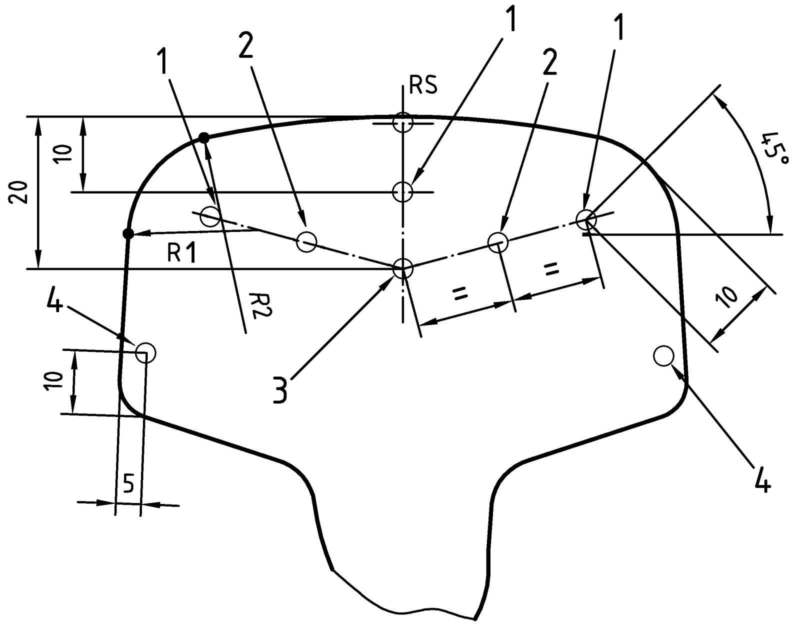


Key

1 Face to be examined

Figure 7 — Oxide cleanness sampling position in rail head

Dimensions in millimetres



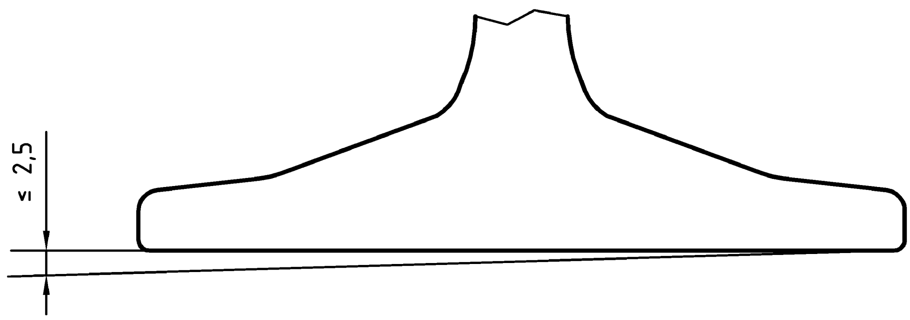
Key

1,2,3 and 4 Location of hardness testing (see Table 5)

● exact intersecting points of the radii

Figure 8 — Hardness testing positions

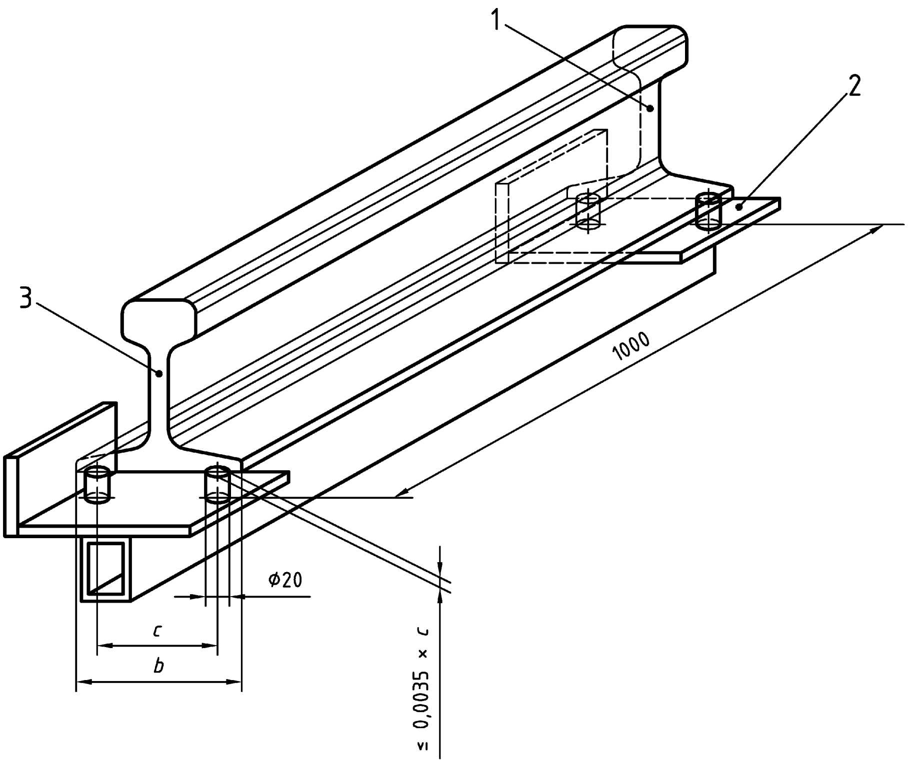
Dimension in millimetres



NOTE If the rail shows evidence of twist being laid head up on an inspection bed, it will be checked by inserting feeler gauges between the base of the rail and the rail skid nearest the rail end. If the gap exceeds 2,5 mm the rail is rejected.

Figure 9 — Whole rail twist

Dimensions in millimetres



Key

1 Cross section 1 m away from the rail end

2 Gauge

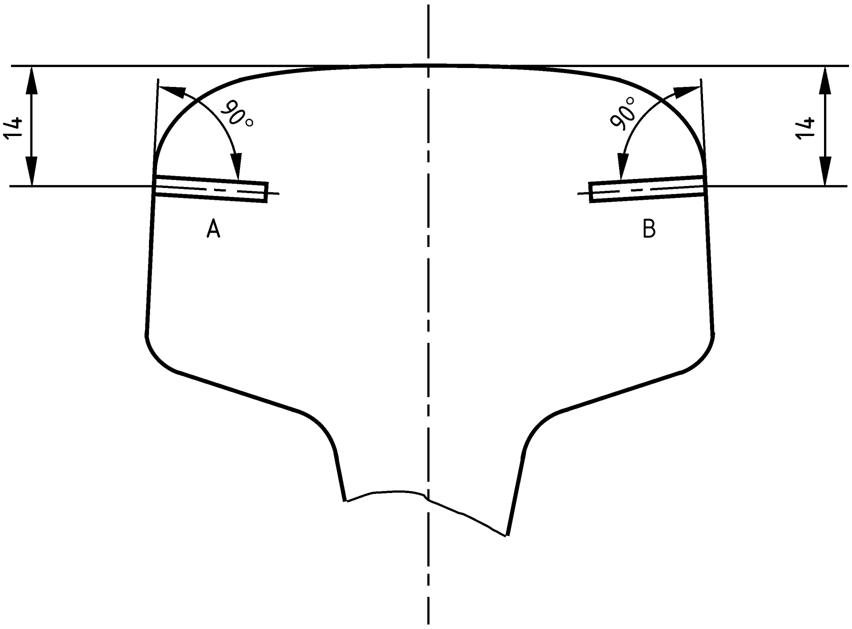
3 Cross section at the rail end

NOTE 1 If the rotational twist in the end metre of the rail exceeds 0,2° as measured by the gauge illustrated above the rail is rejected.

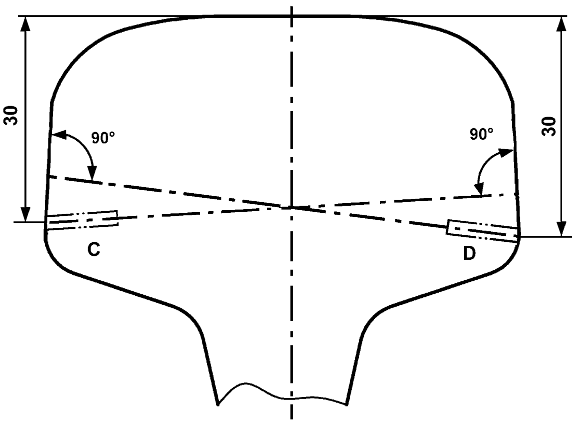
NOTE 2 The relative twist between the cross-sections at the rail ends, and the cross-sections 1 m away from each end, does not exceed 0,0035 × *c*. The following measurements is made with a specific gauge (1 m long), on each rail end, using as measuring references, points on the under surface of the foot following the measuring procedures below.

Foot width b (mm)	**Distance between contacts** (*) c (mm)
b < 130	90
130 ≤ b < 150	110
b ≥ 150	130
(*) Diameter of contact surfaces: 20 mm	

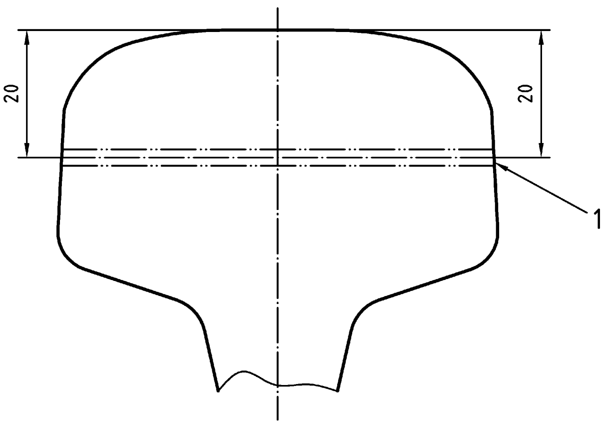
Figure 10 — Rail end twist



NOTE Both flat bottomed holes are 2 mm diameter and 15 mm deep.



NOTE Both flat bottomed holes are 2 mm diameter and 15 mm deep.

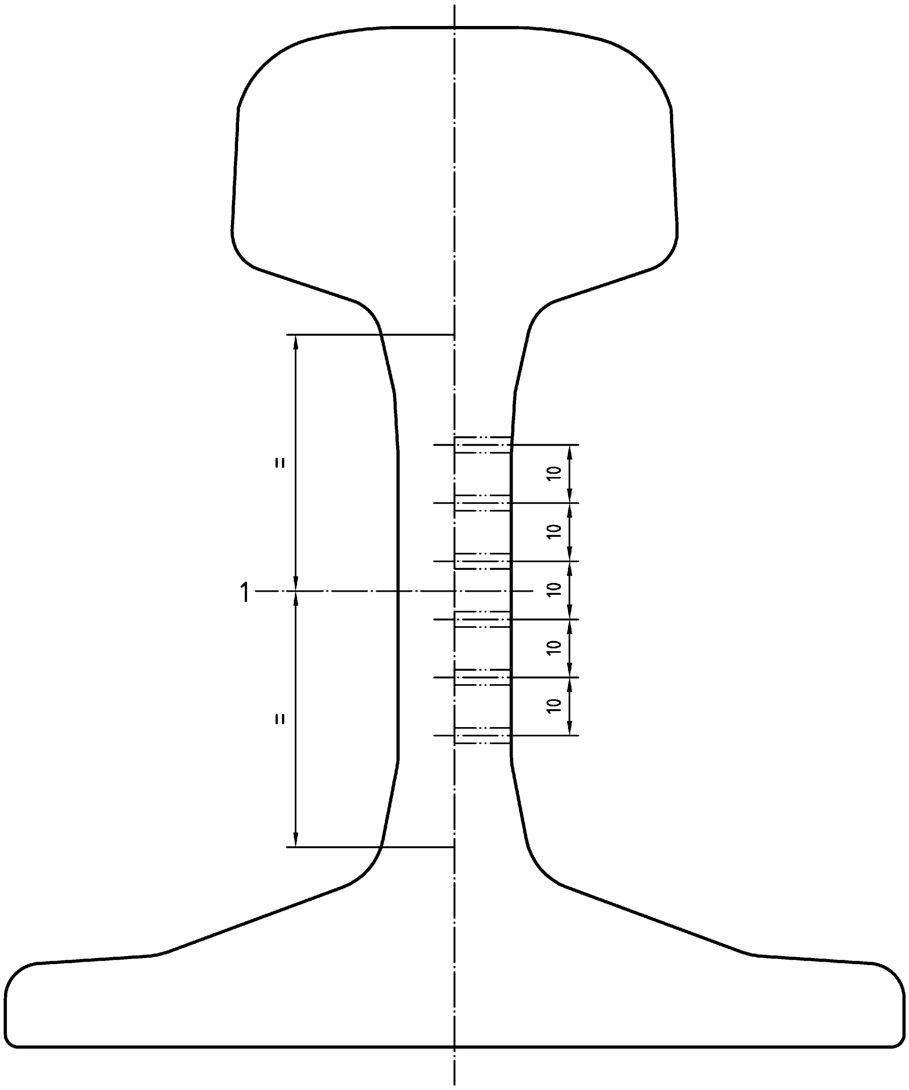


Key

1 2 mm diameter through hole

Figure 11 — Location of reference reflectors in rail head of 60E1 profile

All dimensions in millimetres measured from the centre line



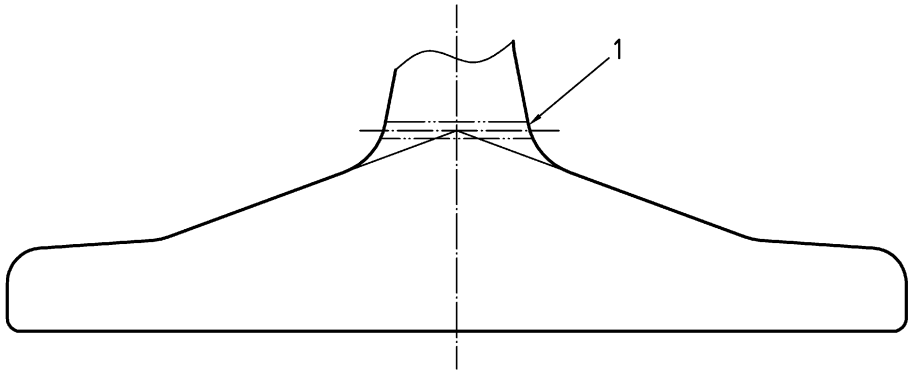
Key

1 Centreline of web

NOTE 1 Flat bottomed holes are 2 mm diameter drilled to centre line of web.

NOTE 2 Flat bottomed holes are allowed to be ± 1° from horizontal.

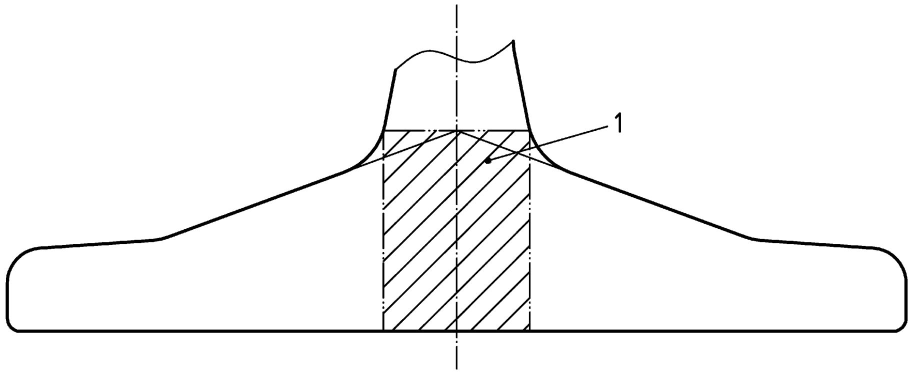
Figure 12 — Location of reference reflectors in rail web of 60E1 profile



Key

1 2 mm diameter through hole

Figure 13 — Location of reference reflector in rail foot of 60E1 profile



Key

1 Area to be tested

Figure 14 — Area to be tested in rail foot of 60E1 profile

Annex A
(normative)

Rail profiles

The rail profiles listed in Table A.1 are new designated and accurately dimensioned profiles developed from the previous less accurately dimensioned profiles listed.

Rail transition points are shown in Table A.2.

Table A.1 — List of profiles and previous rail profiles

Figure N.o	Profile	Previous profile
Asymmetric rails		
A.1	54E1A1	A69, UIC54B, Zu UIC54B
A.2	49E1A1	Zu 2–49 (DB)
A.3	49E1A2	Zu 2–49 (ÖBB)
A.4	49E1A3	I49
A.5	60E1A1	A73, UIC60B, Zu 1–60
A.6	60E1A2	A60U
A.7	60E1A3	Zu 1–65A
A.8	54E1A2	Zu 1–54
A.9	54E2A1	Zu-SBB IV
A.10	46E1A1	Zu-SBB I
A.11	50E6A1	U59
A.12	50E6A2	U60
A.13	54E1A3	54D20
A.14	54E1A4	54D40
A.15	60E1A4	60D
A.16	60E1A5	60D40
A.17	60E1A6	I60
A.18	60E2A1	60E2–40
A.19	60E2A2	Zu60E2–40
Symmetric thick web rails (T)		
A.20	46E2T1	A56
A.21	50E1T1	A50
A.22	60E1T1	A61, UIC60C
A.23	50E2T1	A63, EB63T
A.24	54E1T1	A65, UIC54A
A.25	54E1T2	A59, C59

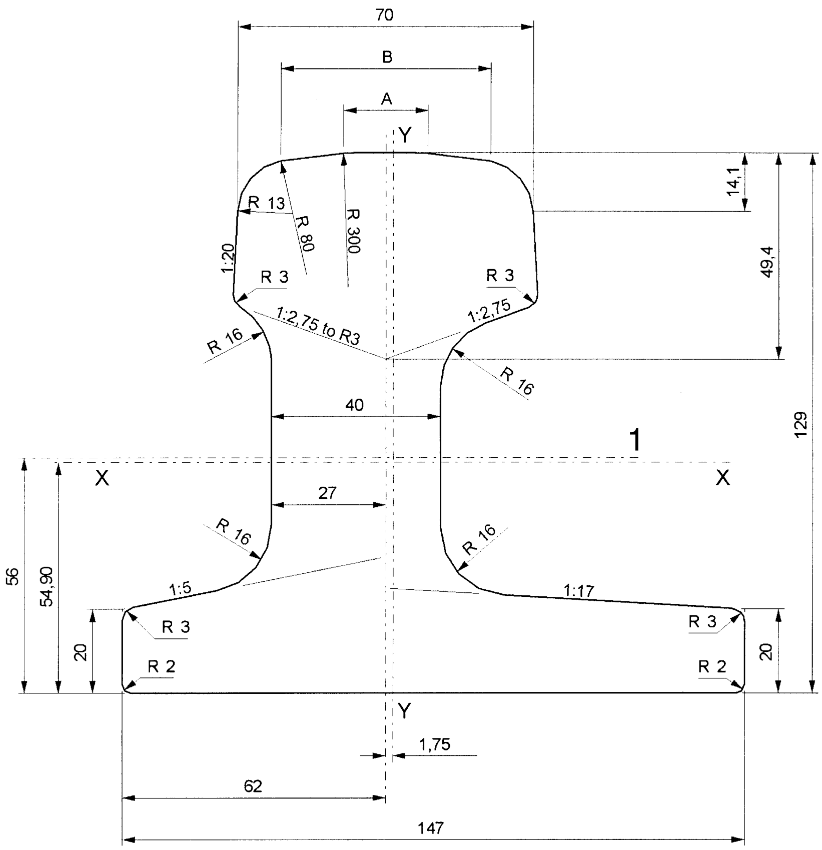
A.26	60E1T2	A74, UIC60A
Symmetric full web rails		
A.27	49E1F1	VO 1–49
A.28	49E1F2	KL49
A.29	54E1F1	VO 1-UIC54
A.30	54E3F1	VO 1–54
A.31	60E1F1	VO 1–60
A.32	60E1F2	KL60
A.33	60E2F1	VO60E2–40

Table A.2 — List of rail transition points

Figure N.o	Profile	Previous profile
Asymmetric rails		
A.34	54E1A1 (see Figure A.1)	A69, UIC54B, Zu UIC54B
A.35	49E1A1 (see Figure A.2)	Zu 2–49 (DB)
A.36	49E1A2 (see Figure A.3)	Zu 2–49 (ÖBB)
A.37	49E1A3 (see Figure A.4)	I49
A.38	60E1A1 (see Figure A.5)	A73, UIC60B, Zu 1–60
A.39	60E1A2 (see Figure A.6)	A60U
A.40	60E1A3 (see Figure A.7)	Zu 1–65A
A.41	54E1A2 (see Figure A.8)	Zu 1–54
A.42	54E2A1 (see Figure A.9)	Zu-SBB IV
A.43	46E1A1 (see Figure A.10)	Zu-SBB I
A.44	50E6A1 (see Figure A.11)	U59
A.45	50E6A2 (see Figure A.12)	U60
A.46	54E1A3 (see Figure A.13)	54D20
A.47	54E1A4 (see Figure A.14)	54D40
A.48	60E1A4 (see Figure A.15)	60D
A.49	60E1A5 (see Figure A.16)	60D40
A.50	60E1A6 (see Figure A.17)	I60
Symmetric thick web rails		
A.51	46E2T1 (see Figure A.20)	A56
A.52	50E1T1 (see Figure A.21)	A50
A.53	60E1T1 (see Figure A.22)	A61, UIC60C
A.54	50E2T1 (see Figure A.23)	A63, EB63T
A.55	54E1T1 (see Figure A.24)	A65, UIC54A
A.56	54E1T2 (see Figure A.25)	A59, C59
A.57	60E1T2 (see Figure A.26)	A74, UIC60A

Symmetric full web rails		
A.58	49E1F1 (see Figure A.27)	VO 1–49
A.59	49E1F2 (see Figure A.28)	KL49
A.60	54E1F1 (see Figure A.29)	VO 1-UIC54
A.61	54E3F1 (see Figure A.30)	VO 1–54
A.62	60E1F1 (see Figure A.31)	VO 1–60
A.63	60E1F2 (see Figure A.32)	KL60
A.64	60E2F1 (see Figure A.33)	VO60E2–40
[a] For profiles 60E2A1 (see Figure A.18), 60E2A2 (see Figure A.19) and 60E2A3 (see Figure A.20) no figures for transition points are available.		

Dimensions in millimetres



Key

1	Centre line of branding

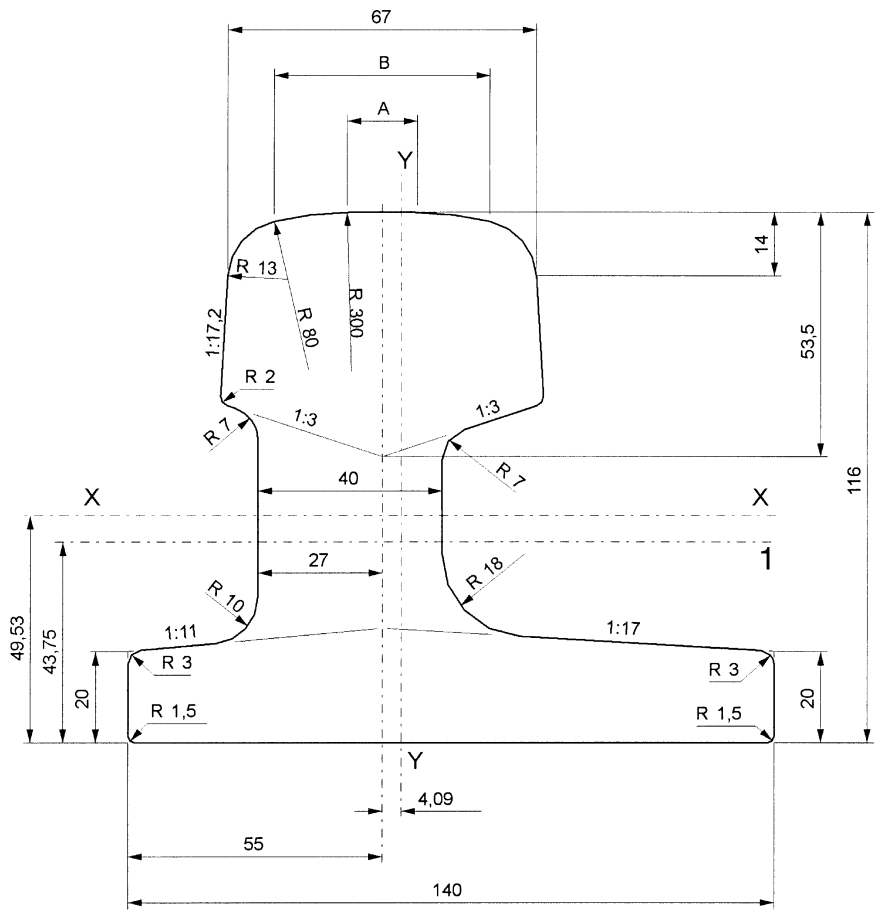
Cross-sectional area	:	87,83	cm^2
Mass per metre	:	68,95	kg/m
Moment of inertia x-x-axis	:	1 544,0	cm^4
Section modulus-Head	:	208,4	cm^3
Section modulus-Base	:	281,3	cm^3
Moment of inertia y-y-axis	:	767,6	cm^4
Section modulus y-y-axis left	:	120,4	cm^3
Section modulus y-y-axis right	:	92,2	cm^3

Indicative dimensions: A = 20,025 mm

B = 49,727 mm

Figure A.1 — Rail profile 54E1A1

Dimensions in millimetres



Key

1 centre line of branding

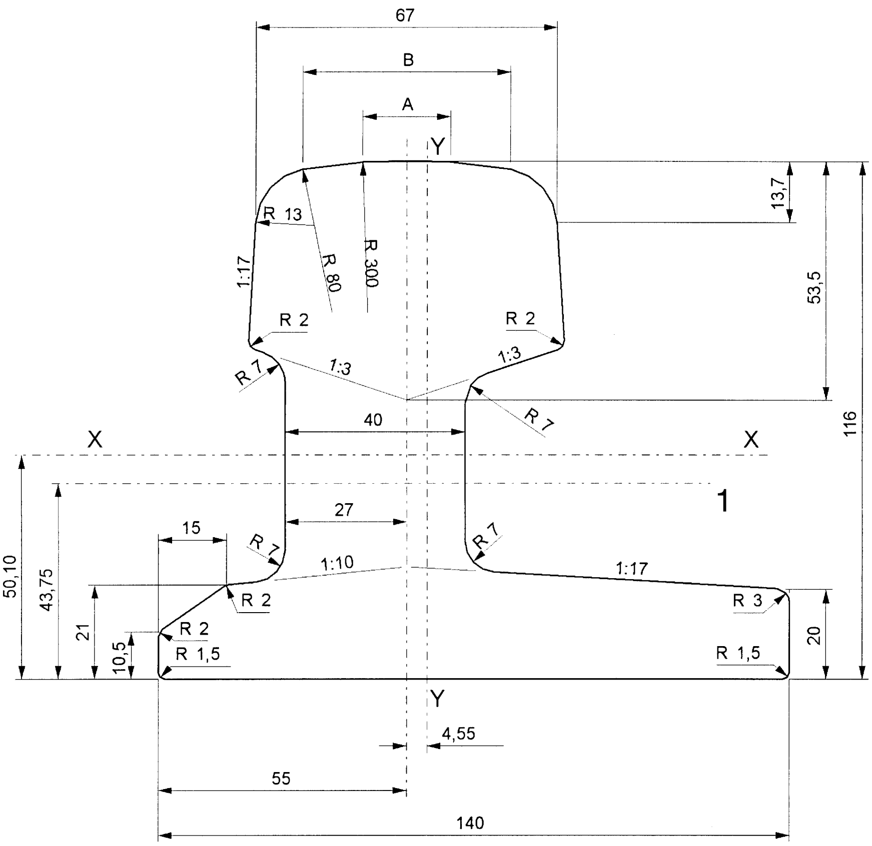
Cross-sectional area	:	80,43	cm^2
Mass per metre	:	63,14	kg/m
Moment of inertia x-x-axis	:	1 098,4	cm^4
Section modulus-Head	:	165,3	cm^3
Section modulus-Base	:	221,7	cm^3
Moment of inertia y-y-axis	:	681,9	cm^4
Section modulus y-y-axis left	:	115,4	cm^3
Section modulus y-y-axis right	:	84,3	cm^3

Indicative dimensions: A = 15,267 mm

B = 46,835 mm

Figure A.2 — Rail profile 49E1A1

Dimensions in millimetres



Key

1 centre line of branding

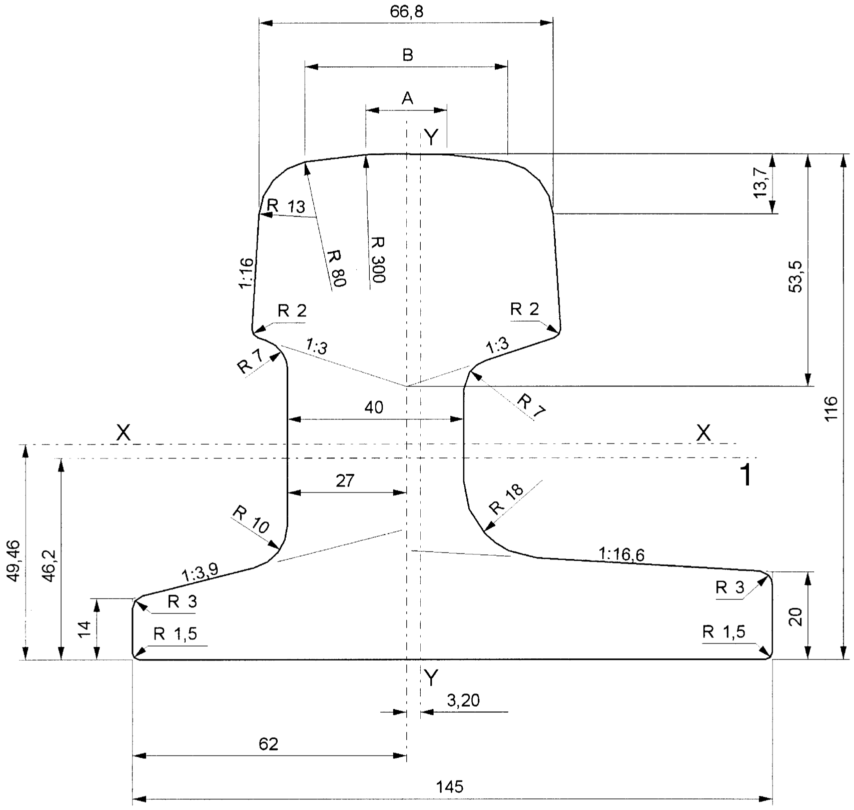
Cross-sectional area	:	79,18	cm^2
Mass per metre	:	62,15	kg/m
Moment of inertia x-x-axis	:	1 091,5	cm^4
Section modulus-Head	:	165,6	cm^3
Section modulus-Base	:	217,9	cm^3
Moment of inertia y-y-axis	:	658,9	cm^4
Section modulus y-y-axis left	:	110,7	cm^3
Section modulus y-y-axis right	:	81,9	cm^3

Indicative dimensions A = 19,514 mm

B = 46,232 mm

Figure A.3 — Rail profile 49E1A2

Dimensions in millimetres



Key

1 centre line of branding

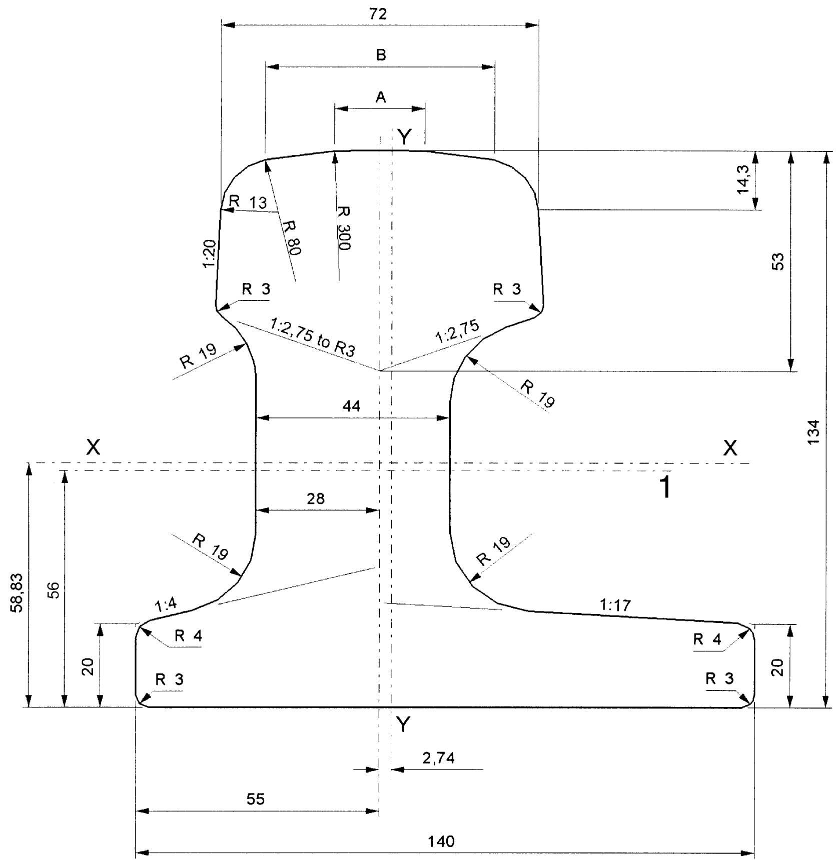
Cross-sectional area	:	80,49	cm^2
Mass per metre	:	63,18	kg/m
Moment of inertia x-x-axis	:	1 107,3	cm^4
Section modulus-Head	:	166,4	cm^3
Section modulus-Base	:	223,9	cm^3
Moment of inertia y-y-axis	:	680,8	cm^4
Section modulus y-y-axis left	:	104,4	cm^3
Section modulus y-y-axis right	:	85,3	cm^3

Indicative dimensions: A = 18,457 mm

B = 46,151 mm

Figure A.4 — Rail profile 49E1A3

Dimensions in millimetres



Key

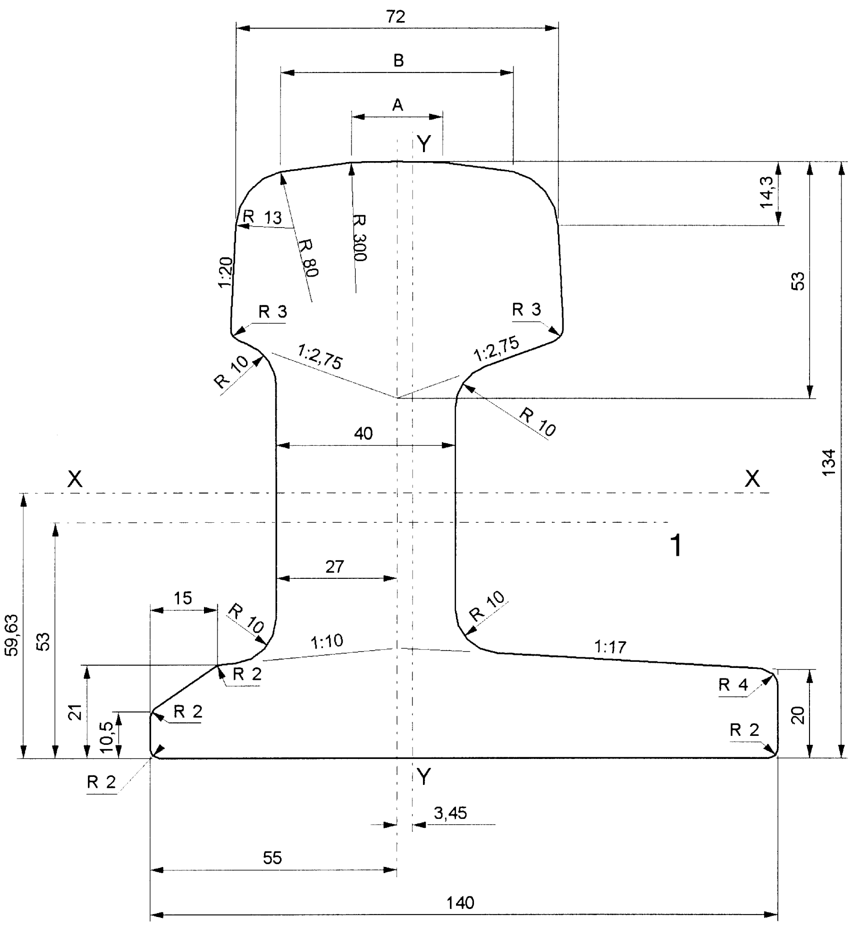
1	centre line of branding

Cross-sectional area	:	92,95	cm^2
Mass per metre	:	72,97	kg/m
Moment of inertia x-x-axis	:	1 726,9	cm^4
Section modulus-Head	:	229,7	cm^3
Section modulus-Base	:	293,5	cm^3
Moment of inertia y-y-axis	:	741,2	cm^4
Section modulus y-y-axis left	:	128,4	cm^3
Section modulus y-y-axis right	:	90,1	cm^3

Indicative dimensions: A = 20,456 mm
B = 52,053 mm

Figure A.5 — Rail profile 60E1A1

Dimensions in millimetres



Key

1	centre line of branding

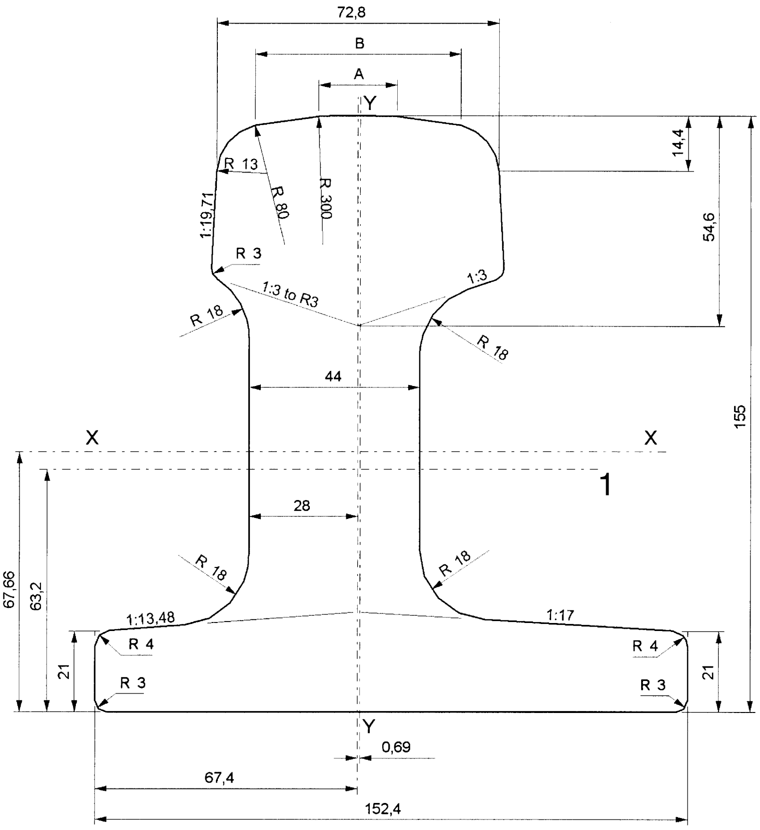
Cross-sectional area	:	87,95	cm^2
Mass per metre	:	69,04	kg/m
Moment of inertia x-x-axis	:	1 738,7	cm^4
Section modulus - Head	:	233,8	cm^3
Section modulus - Base	:	291,6	cm^3
Moment of inertia y-y-axis	:	645,1	cm^4
Section modulus y-y-axis left	:	110,4	cm^3
Section modulus y-y-axis right	:	79,1	cm^3

Indicative dimensions: A = 20,456 mm

B = 52,053 mm

Figure A.6 — Rail profile 60E1A2

Dimensions in millimetres



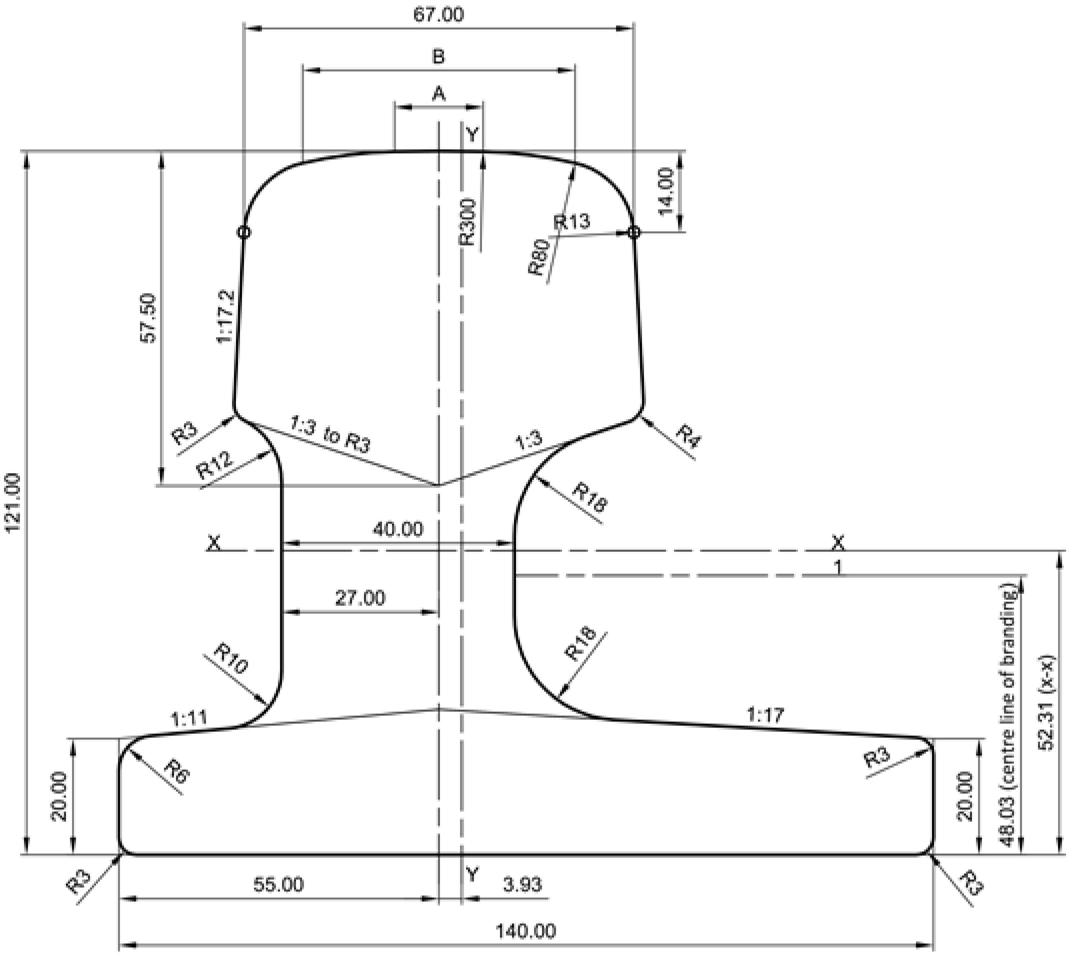
Key

1	centre line of branding		
Cross-sectional area	:	106,54	cm^2
Mass per metre	:	83,64	kg/m
Moment of inertia x-x-axis	:	2 722,8	cm^4
Section modulus-Head	:	311,7	cm^3
Section modulus-Base	:	402,4	cm^3
Moment of inertia y-y-axis	:	897,3	cm^4
Section modulus y-y-axis left	:	131,8	cm^3
Section modulus y-y-axis right	:	106,4	cm^3

Indicative dimensions: A = 20,290 mm
B = 53,033 mm

Figure A.7 — Rail profile 60E1A3

Dimensions in millimetres



Key

1	centre line of branding

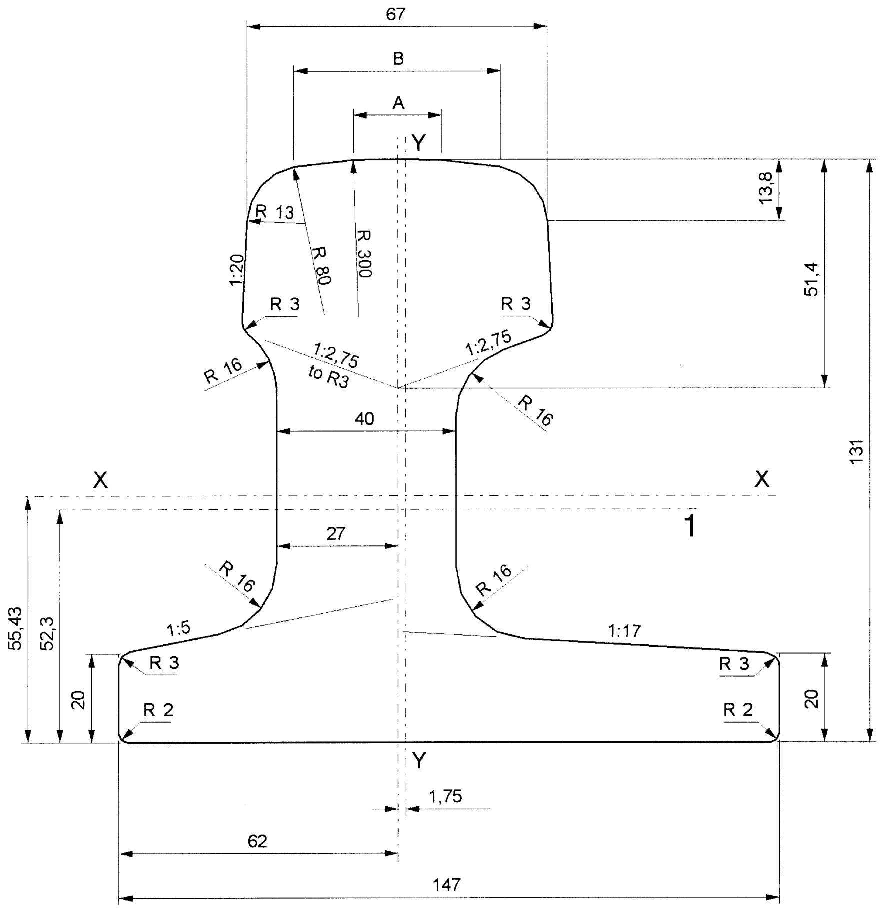
Cross-sectional area	:	83,85	cm^2
Mass per metre	:	65,82	kg/m
Moment of inertia x-x-axis	:	1 244,3	cm^4
Section modulus-Head	:	181,1	cm^3
Section modulus-Base	:	237,9	cm^3
Moment of inertia y-y-axis	:	692,3	cm^4
Section modulus y-y-axis left	:	117,5	cm^3
Section modulus y-y-axis right	:	85,4	cm^3

Indicative dimensions: A = 16,703 mm

B = 46,617 mm

Figure A.8 — Rail profile 54E1A2

Dimensions in millimetres



Key

1	Centre line of branding

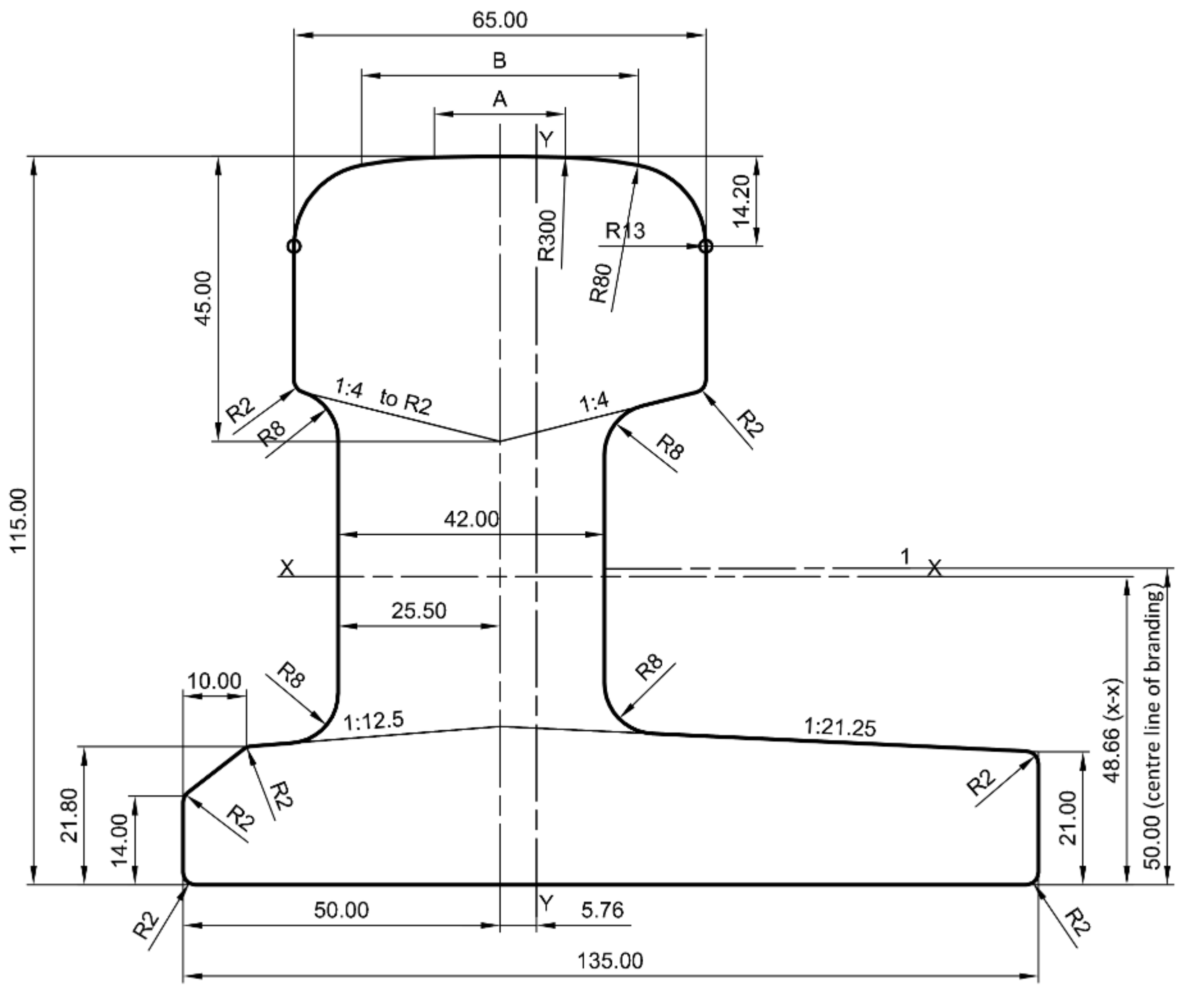
Cross-sectional area	:	88,22	cm^2
Mass per metre	:	69,25	kg/m
Moment of inertia x-x-axis	:	1 587,3	cm^4
Section modulus-Head	:	210,0	cm^3
Section modulus-Base	:	286,4	cm^3
Moment of inertia y-y-axis	:	761,7	cm^4
Section modulus y-y-axis left	:	119,5	cm^3
Section modulus y-y-axis right	:	91,5	cm^3

Indicative dimensions: A = 19,721 mm

B = 46,188 mm

Figure A.9 — Rail profile 54E2A1

Dimensions in millimetres

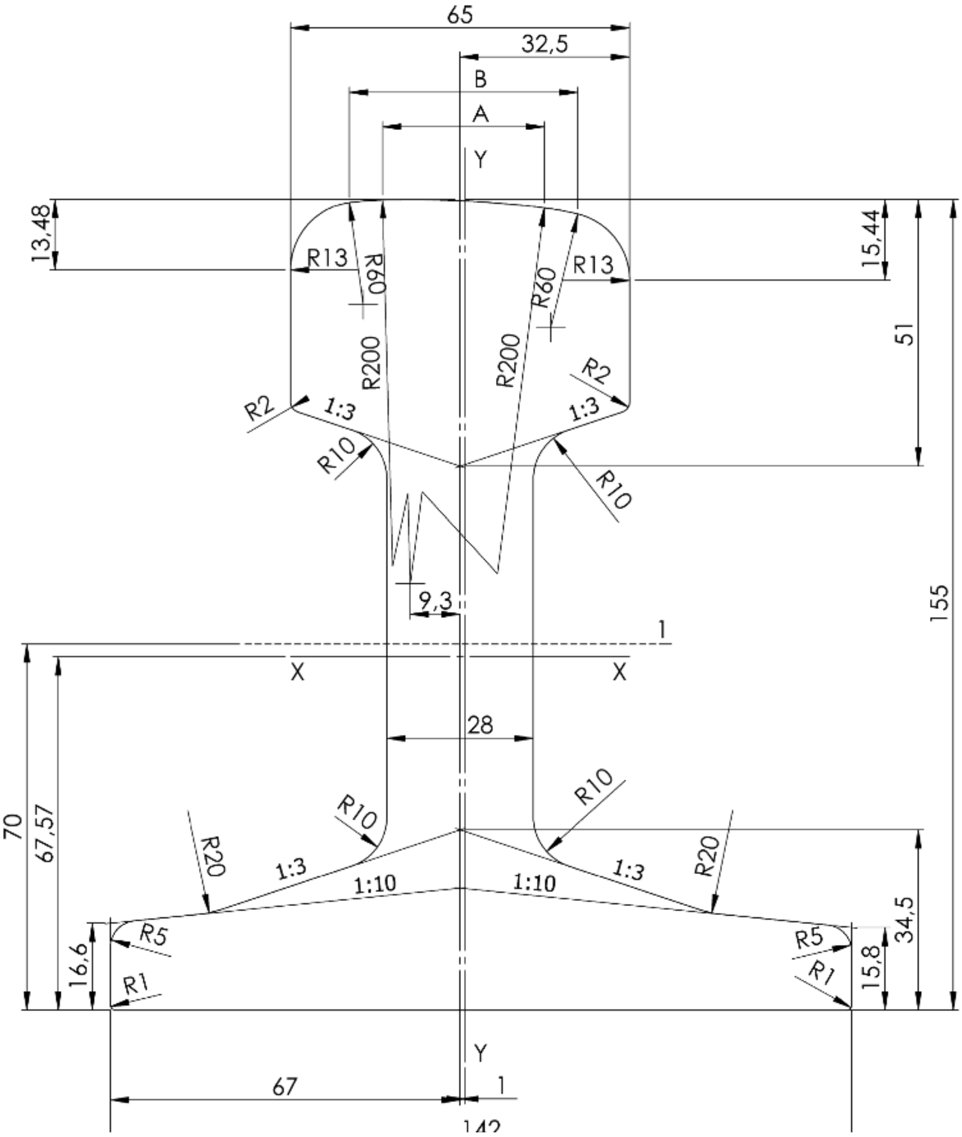


Key

1	centre line of branding		
Cross-sectional area	:	76,87	cm^2
Mass per metre	:	60,34	kg/m
Moment of inertia x-x-axis	:	1029,7	cm^4
Section modulus-Head	:	155,1	cm^3
Section modulus-Base	:	211,7	cm^3
Moment of inertia y-y-axis	:	625,1	cm^4
Section modulus y-y-axis left	:	112,1	cm^3
Section modulus y-y-axis right	:	78,9	cm^3
Indicative dimensions:	A = 18,881 mm		
	B = 43,881 mm		

Figure A.10 — Rail profile 46E1A1

Dimensions in millimetres

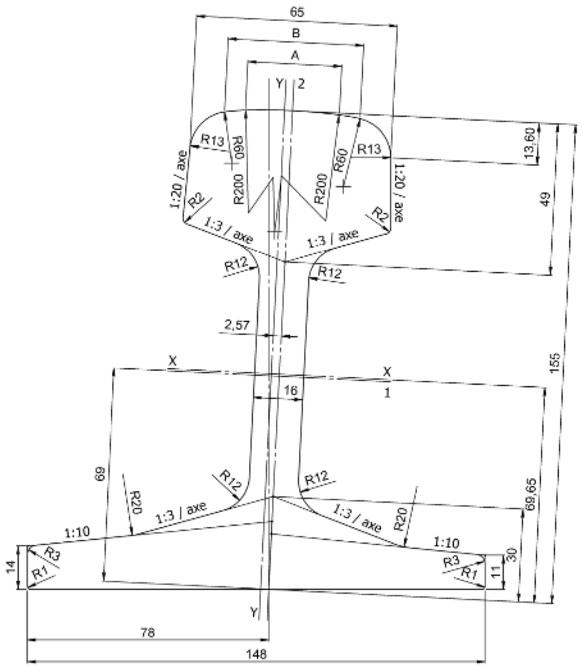


Key

1	centre line of branding		
Cross-sectional area	:	82,78	cm^2
Mass per metre	:	64,98	kg/m
Moment of inertia x-x-axis	:	2 327,2	cm^4
Section modulus-Head	:	266,2	cm^3
Section modulus-Base	:	344,4	cm^3
Moment of inertia y-y-axis	:	550,8	cm^4
Section modulus y-y-axis left	:	81,0	cm^3
Section modulus y-y-axis right	:	74,4	cm^3
Indicative dimensions	A = 30,999 mm		
	B = 43,785 mm		

Figure A.11 — Rail profile 50E6A1

Dimensions in millimetres



Key

1	centre line of branding
2	1:20 to web and head axis
3	web and head axis 1:20 to vertical
4	1:10 to horizontal

Section Properties on axis 1:20 from vertical

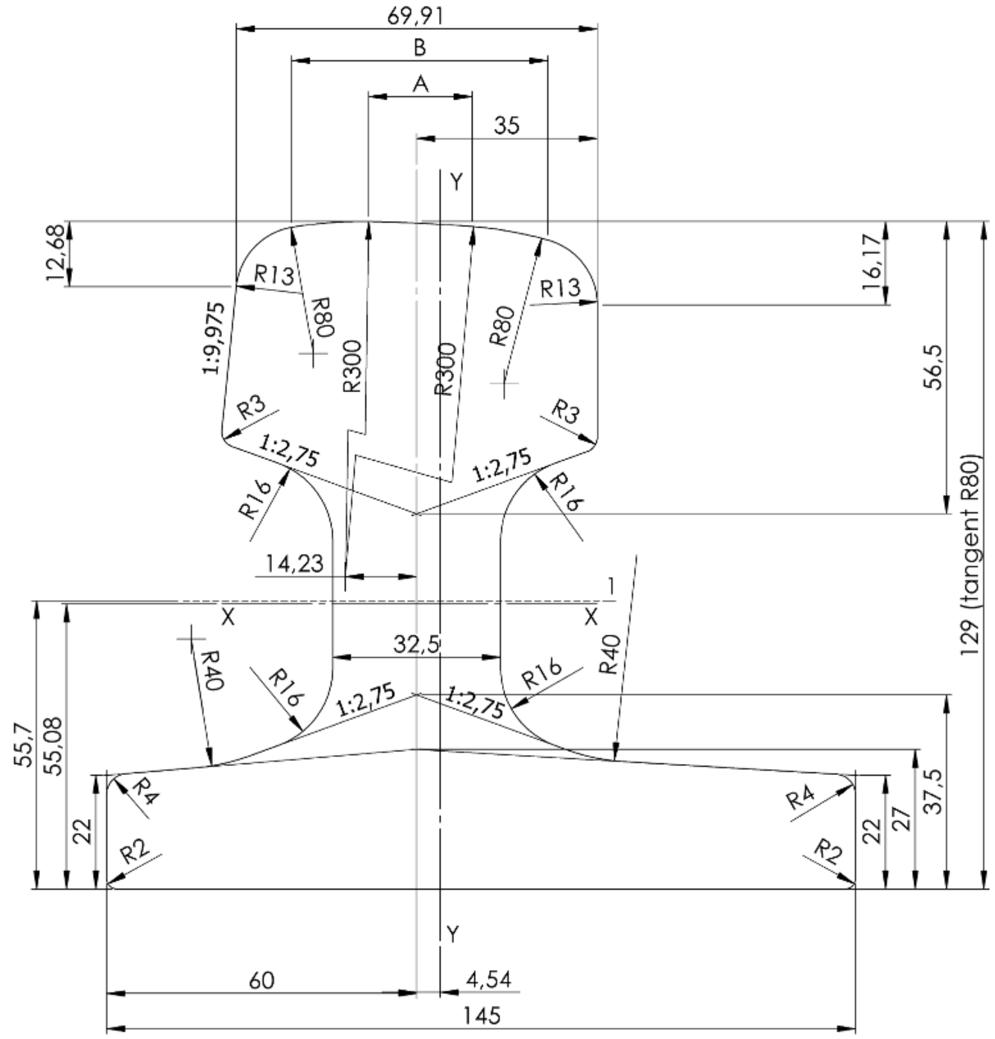
Cross-sectional area	:	69,06	cm^2
Mass per metre	:	54,21	kg/m
Moment of inertia x-x-axis	:	2 213,0	cm^4
Section modulus-Head	:	259,3	cm^3
Section modulus-Base	:	301,1	cm^3
Moment of inertia y-y-axis	:	497,4	cm^4
Section modulus y-y-axis left	:	65,5	cm^3
Section modulus y-y-axis right	:	68,7	cm^3

Indicative dimensions: A = 30,437 mm

B = 43,936 mm

Figure A.12 — Rail profile 50E6A2

Dimensions in millimetres



Key

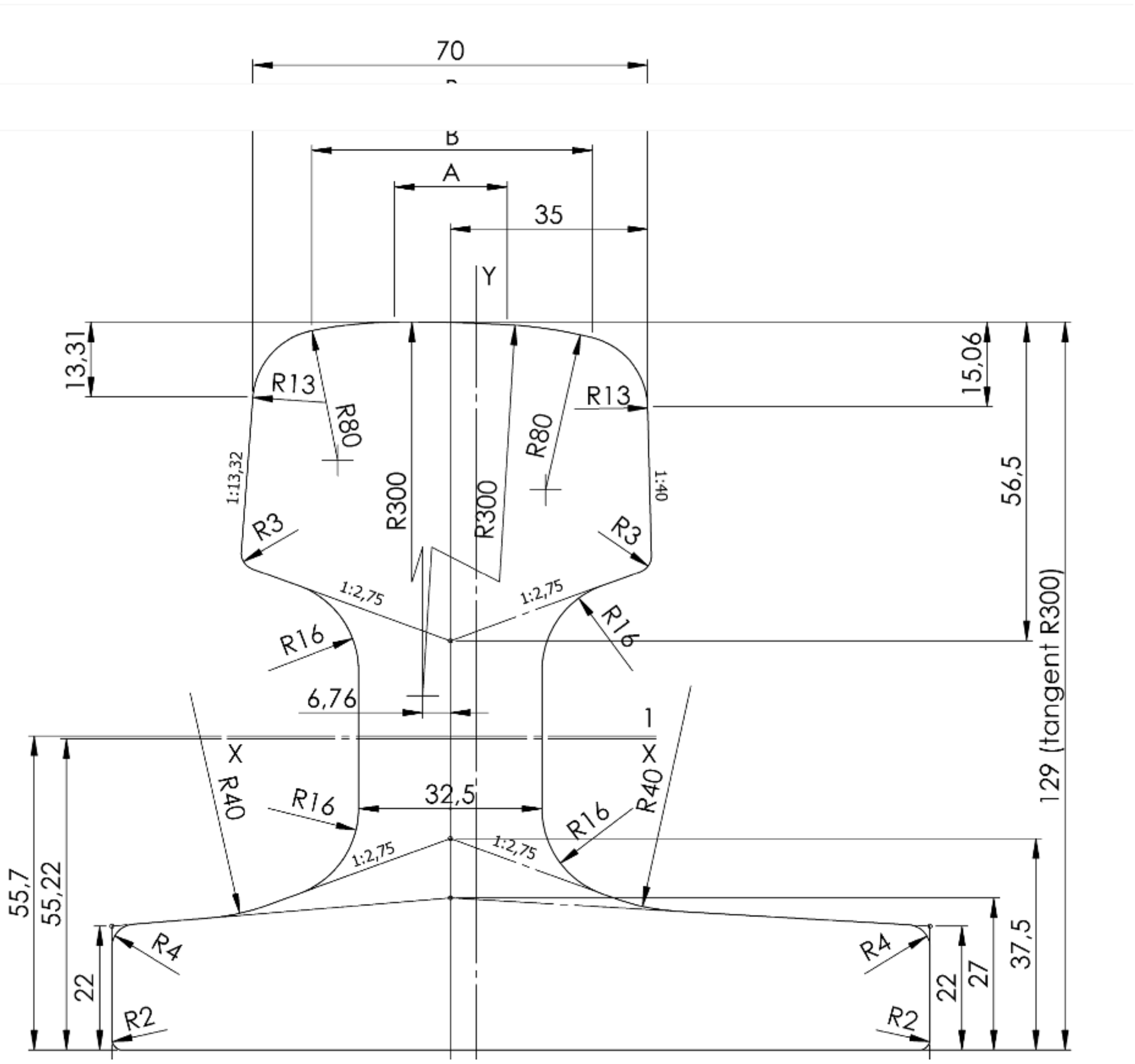
1 centre line of branding

Cross-sectional area	:	87,41	cm^2
Mass per metre	:	68,62	kg/m
Moment of inertia x-x-axis	:	1 552,5	cm^4
Section modulus-Head	:	210	cm^3
Section modulus-Base	:	281,9	cm^3
Moment of inertia y-y-axis	:	772,5	cm^4
Section modulus y-y-axis left	:	119,7	cm^3
Section modulus y-y-axis right	:	96	cm^3

Indicative dimensions A = 20,000 mm
B = 49,661 mm

Figure A.13 — Rail profile 54E1A3

Dimensions in millimetres



Key

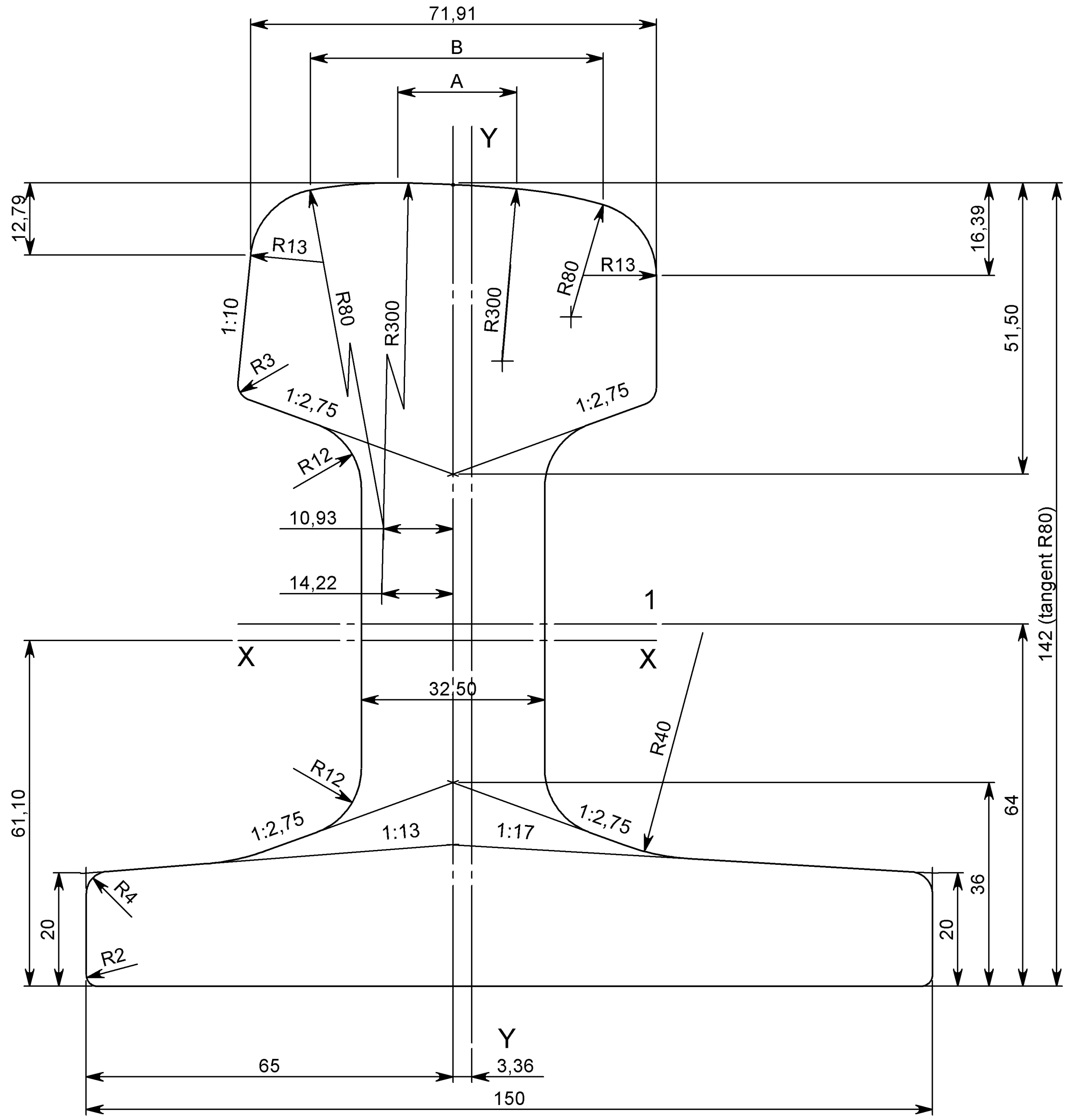
1	centre line of branding

Cross-sectional area	:	87,58	cm^2
Mass per metre	:	68,75	kg/m
Moment of inertia x-x-axis	:	1 560,9	cm^4
Section modulus-Head	:	211,6	cm^3
Section modulus-Base	:	282,7	cm^3
Moment of inertia y-y-axis	:	771,9	cm^4
Section modulus y-y-axis left	:	119,3	cm^3
Section modulus y-y-axis right	:	96,1	cm^3

Indicative dimensions A = 19,973 mm
B = 49,731mm

Figure A.14 — Rail profile 54E1A4

Dimensions in millimetres

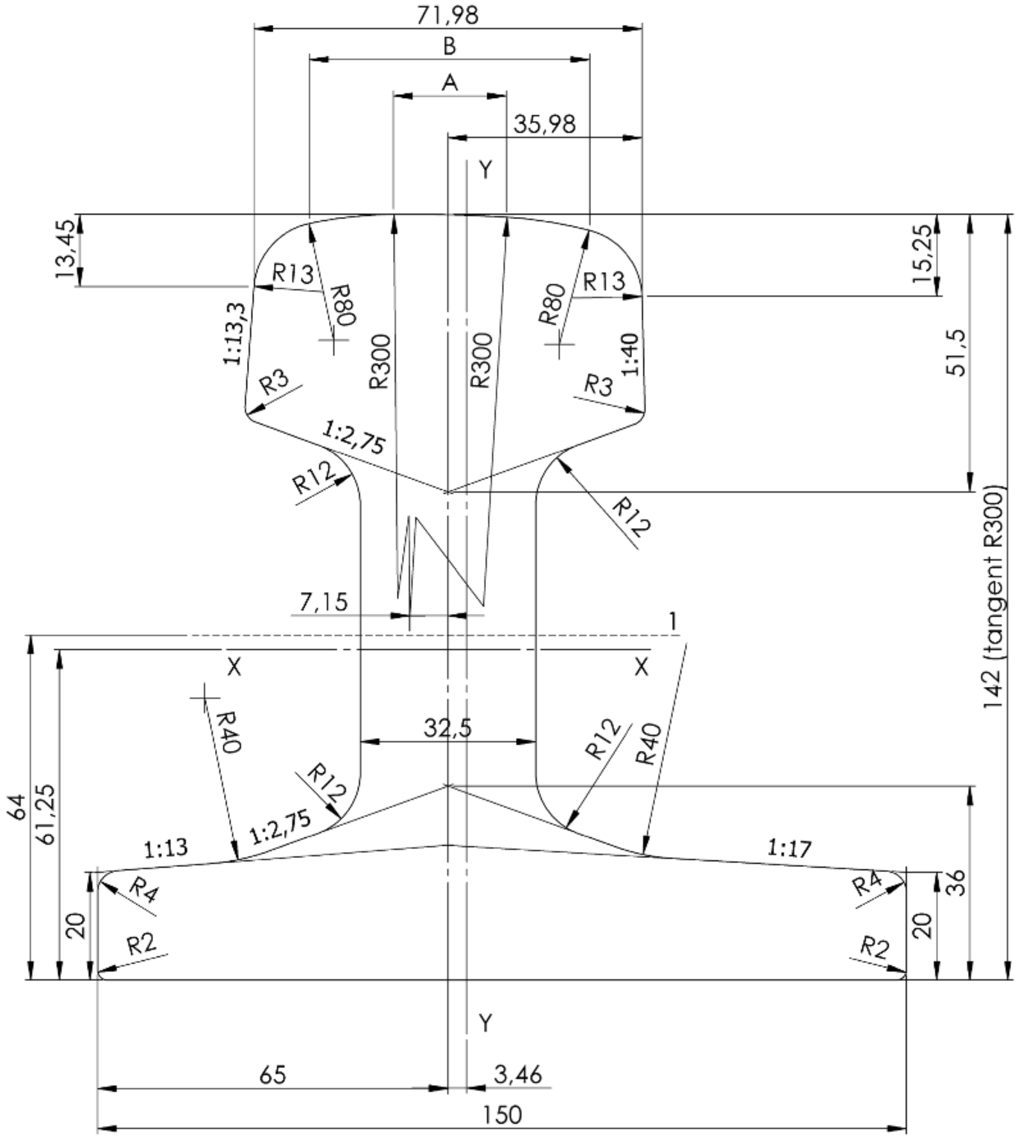


Key

1	centre line of branding		
Cross-sectional area	:	88,95	cm^2
Mass per metre	:	69,83	kg/m
Moment of inertia x-x-axis	:	2 025,8	cm^4
Section modulus - Head	:	250,4	cm^3
Section modulus - Base	:	331,5	cm^3
Moment of inertia y-y-axis	:	764,4	cm^4
Section modulus y-y-axis left	:	111,8	cm^3
Section modulus y-y-axis right	:	93,6	cm^3
Indicative dimensions	A = 21,042 mm		
	B = 51,901 mm		

Figure A.15 — Rail profile 60E1A4

Dimensions in millimetres



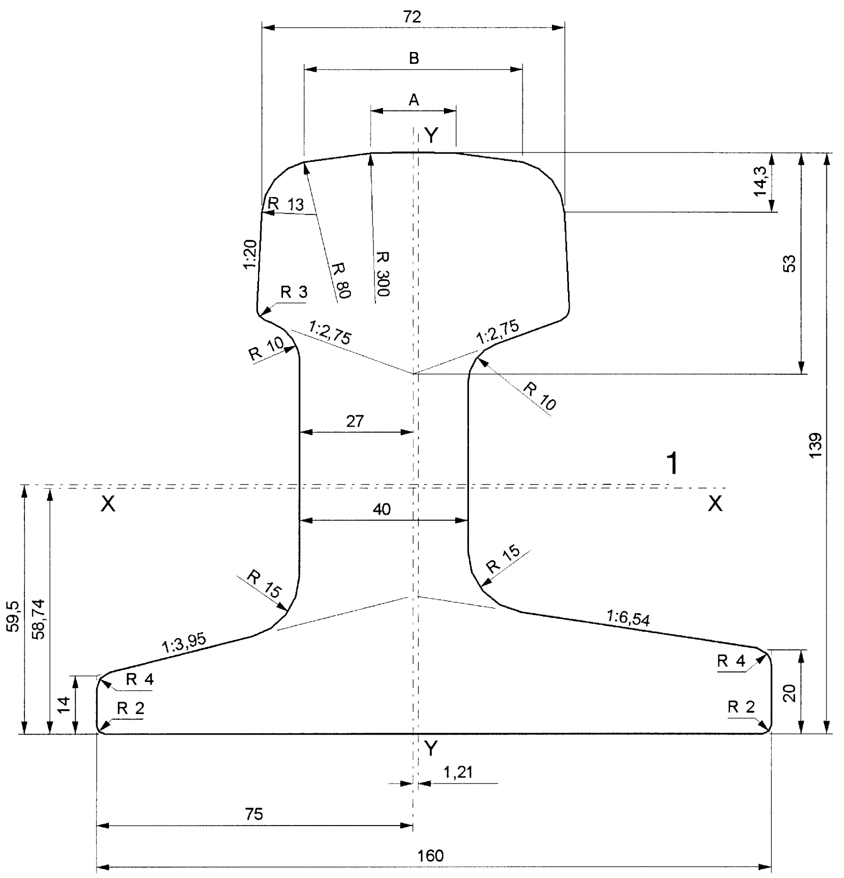
Key

1	centre line of branding		
Cross-sectional area	:	89,11	cm^2
Mass per metre	:	69,95	kg/m
Moment of inertia x-x-axis	:	2 035,8	cm^4
Section modulus-Head	:	252,1	cm^3
Section modulus-Base	:	332,4	cm^3
Moment of inertia y-y-axis	:	764,3	cm^4
Section modulus y-y-axis left	:	111,6	cm^3
Section modulus y-y-axis right	:	93,7	cm^3

Indicative dimensions: A = 20,985 mm
B = 51,978 mm

Figure A.16 — Rail profile 60E1A5

Dimensions in millimetres



Key

1	centre line of branding

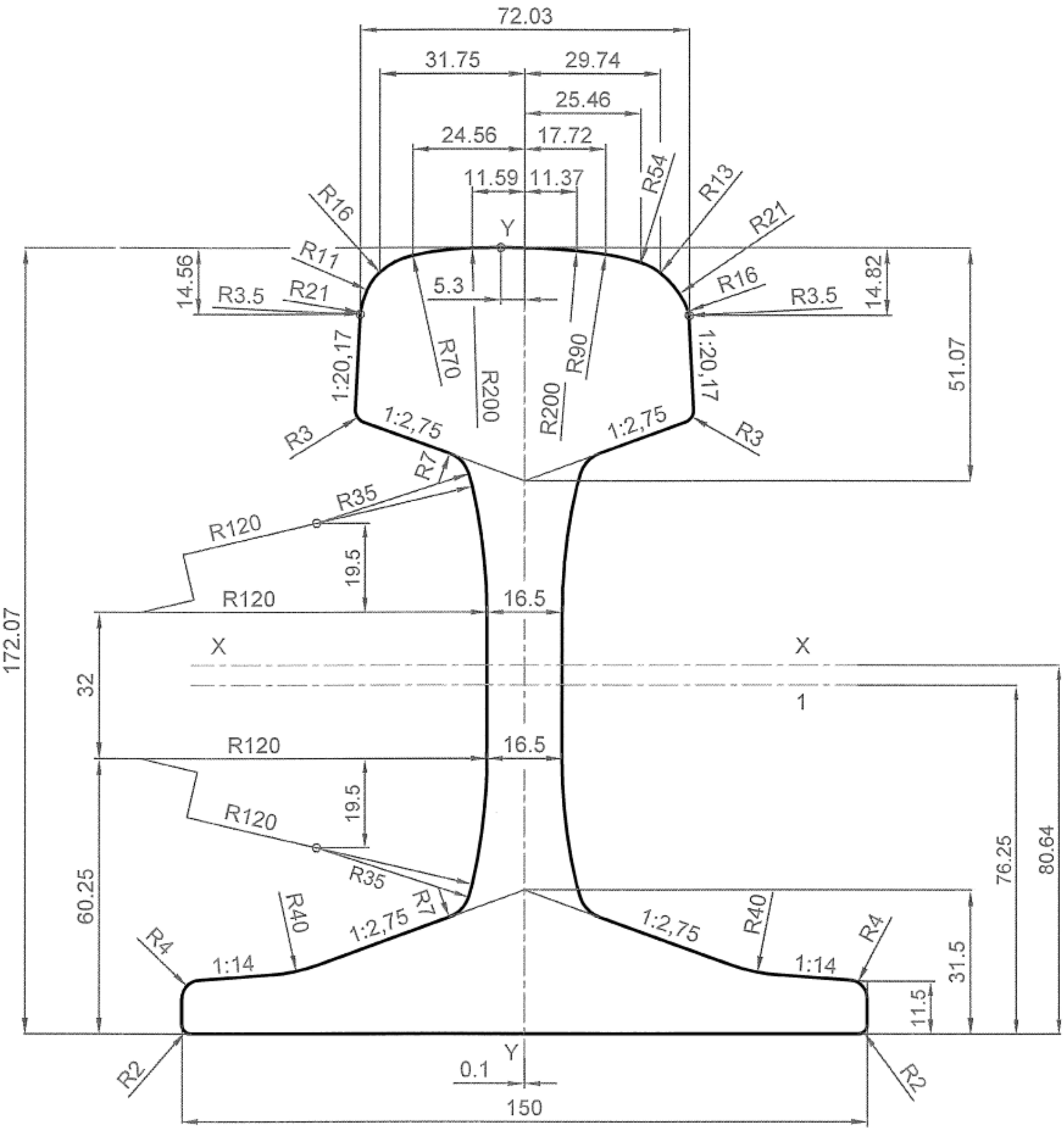
Cross-sectional area	:	97,08	cm^2
Mass per metre	:	76,21	kg/m
Moment of inertia x-x-axis	:	2 009,9	cm^4
Section modulus-Head	:	250,4	cm^3
Section modulus-Base	:	342,2	cm^3
Moment of inertia y-y-axis	:	910,9	cm^4
Section modulus y-y-axis left	:	119,5	cm^3
Section modulus y-y-axis right	:	108,7	cm^3

Indicative dimensions: A = 20,456 mm

B = 52,053 mm

Figure A.17 — Rail profile 60E1A6

Dimensions in millimetres

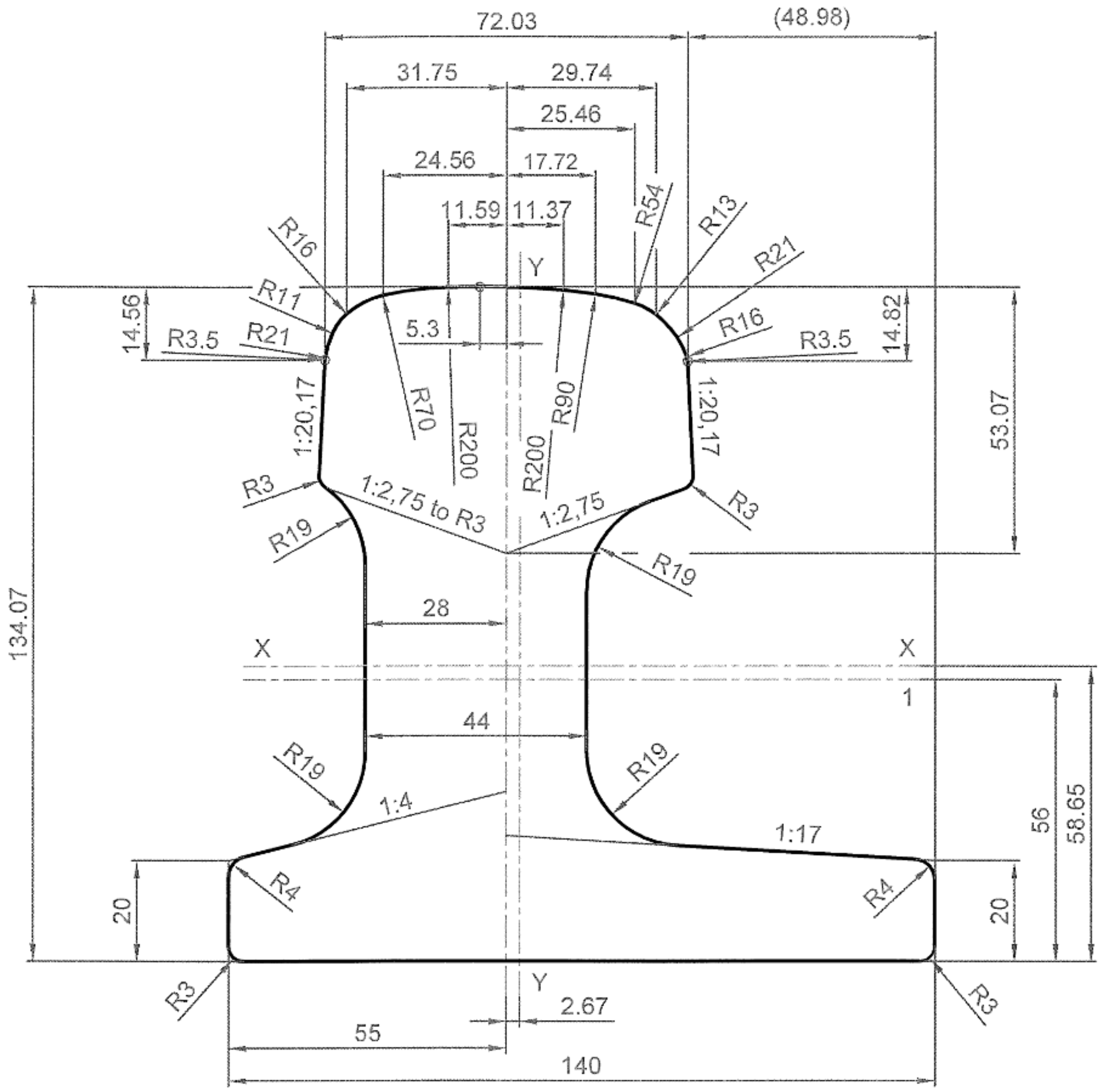


Key

Cross-sectional area	:	76,48	cm^2
Mass per metre	:	60,04	kg/m
Moment of inertia x-x-axis	:	3 021,0	cm^4
Section modulus-Head	:	330,4	cm^3
Section modulus-Base	:	374,6	cm^3
Moment of inertia y-y-axis	:	511,1	cm^4
Section modulus y-y-axis left	:	67,2	cm^3
Section modulus y-y-axis right	:	69,2	cm^3

Figure A.18 — 60E2A1

Dimensions in millimetres

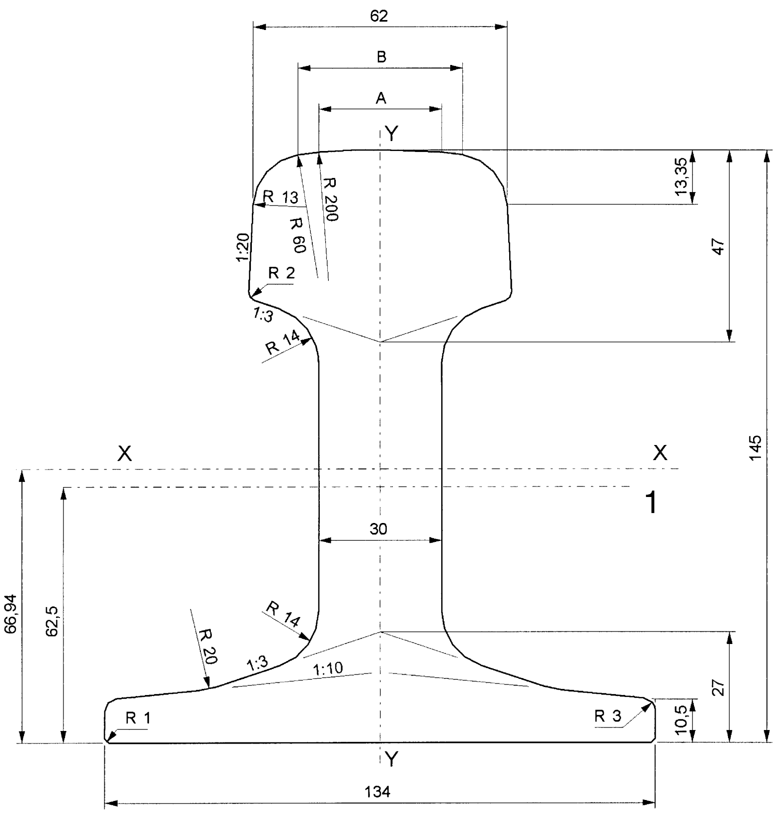


Key

Cross-sectional area	:	92,71	cm^2
Mass per metre	:	72,78	kg/m
Moment of inertia x-x-axis	:	1 715,1	cm^4
Section modulus-Head	:	227,6	cm^3
Section modulus-Base	:	292,4	cm^3
Moment of inertia y-y-axis	:	739,6	cm^4
Section modulus y-y-axis left	:	89,8	cm^3
Section modulus y-y-axis right	:	128,3	cm^3

Figure A.19 — 60E2A2

Dimensions in millimetres



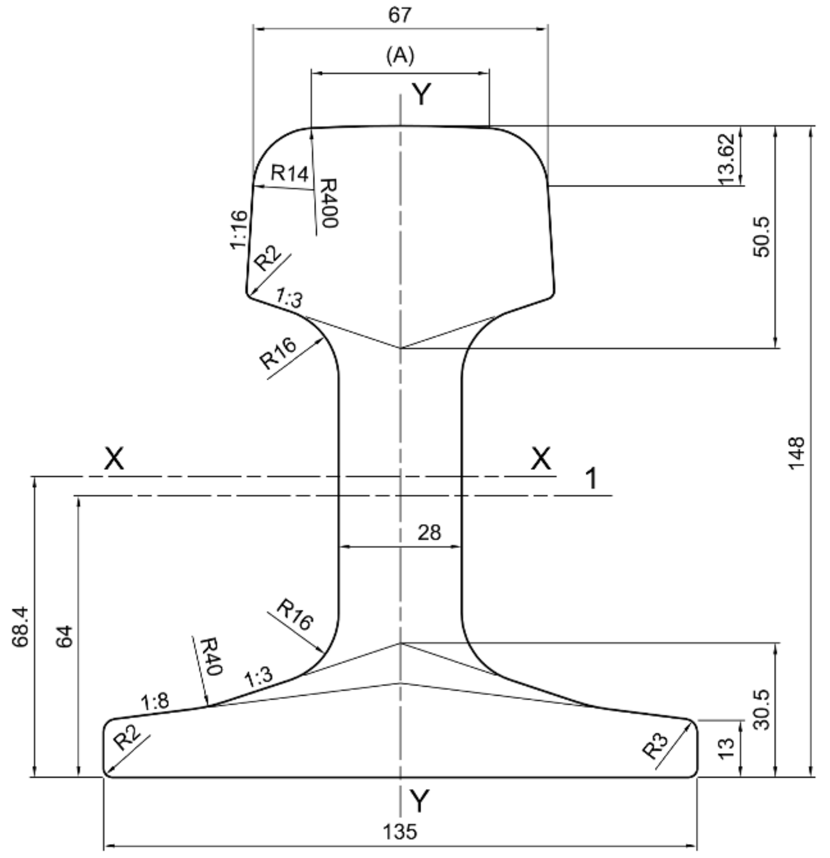
Key

1	centre line of branding		
Cross-sectional area	:	71,32	cm^2
Mass per metre	:	55,98	kg/m
Moment of inertia x-x-axis	:	1 716,7	cm^4
Section modulus-Head	:	219,9	cm^3
Section modulus-Base	:	256,5	cm^3
Moment of inertia y-y-axis	:	347,6	cm^4
Section modulus y-y-axis	:	51,9	cm^3

Indicative dimensions: A = 30,000 mm
B = 40,190 mm

Figure A.20 — Rail profile 46E2T1

Dimensions in millimetres



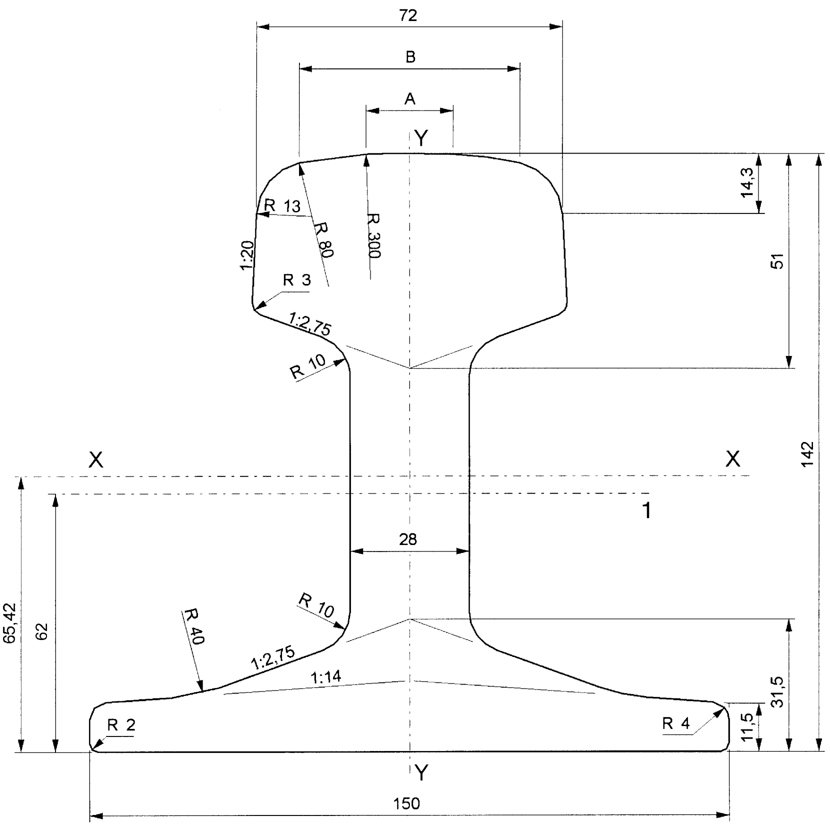
Key

1	centre line of branding		
Cross-sectional area	:	77,66	cm^2
Mass per metre	:	60,96	kg/m
Moment of inertia x-x-axis	:	1 997,3	cm^4
Section modulus-Head	:	250,9	cm^3
Section modulus-Base	:	292,0	cm^3
Moment of inertia y-y-axis	:	437,8	cm^4
Section modulus y-y-axis	:	64,9	cm^3

Indicative dimensions: A = 40,471 mm

Figure A.21 — Rail profile 50E1T1

Dimensions in millimetres



Key

1	centre line of branding

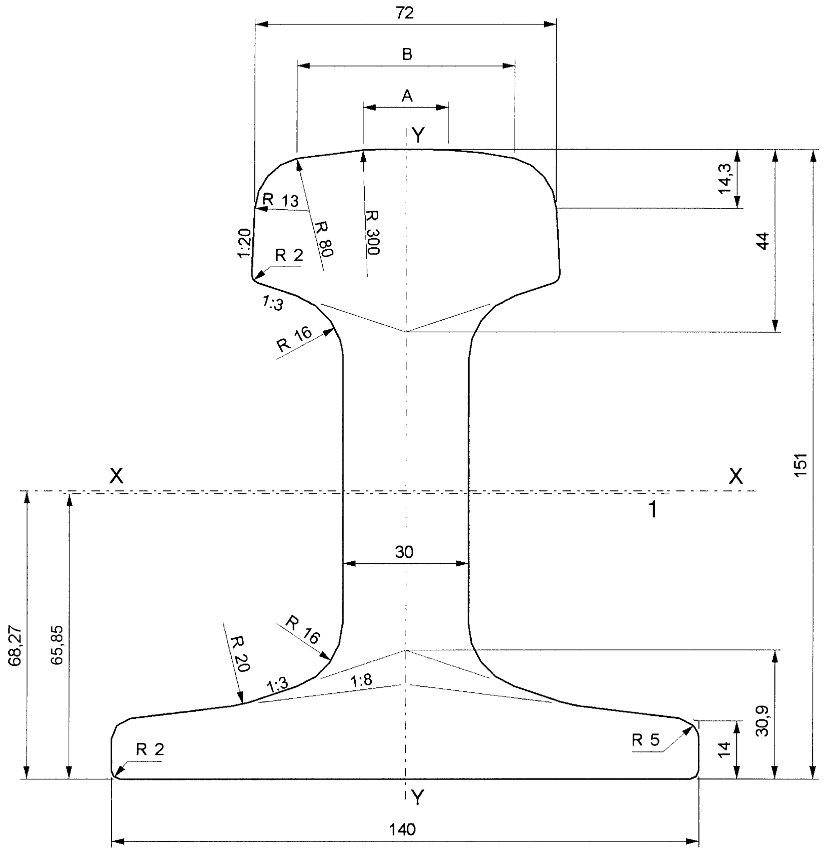
Cross-sectional area	:	77,84	cm^2
Mass per metre	:	61,11	kg/m
Moment of inertia x-x-axis	:	1 866,5	cm^4
Section modulus-Head	:	243,7	cm^3
Section modulus-Base	:	285,3	cm^3
Moment of inertia y-y-axis	:	519,9	cm^4
Section modulus y-y-axis	:	69,3	cm^3

Indicative dimensions: A = 20,456 mm

B = 52,053 mm

Figure A.22 — Rail profile 60E1T1

Dimensions in millimetres



Key

1	centre line of branding

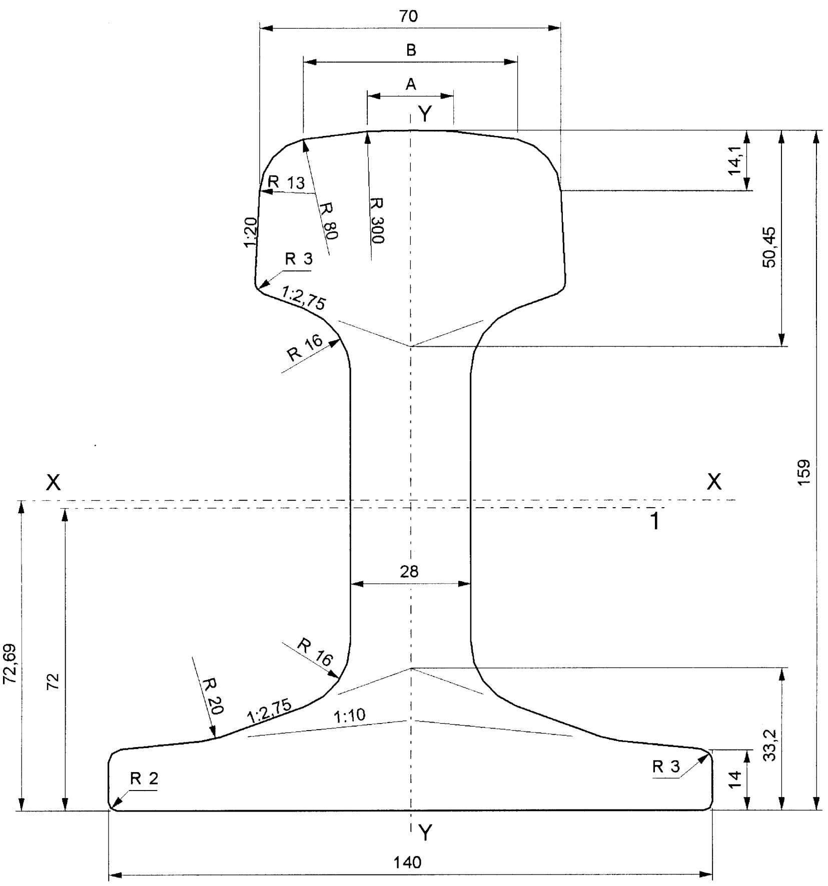
Cross-sectional area	:	80,22	cm^2
Mass per metre	:	62,97	kg/m
Moment of inertia x-x-axis	:	2 166,0	cm^4
Section modulus-Head	:	261,8	cm^3
Section modulus-Base	:	317,3	cm^3
Moment of inertia y-y-axis	:	493,2	cm^4
Section modulus y-y-axis	:	70,5	cm^3

Indicative dimensions: A = 20,456 mm

B = 52,053 mm

Figure A.23 — Rail profile 50E2T1

Dimensions in millimetres



Key

1 centre line of branding

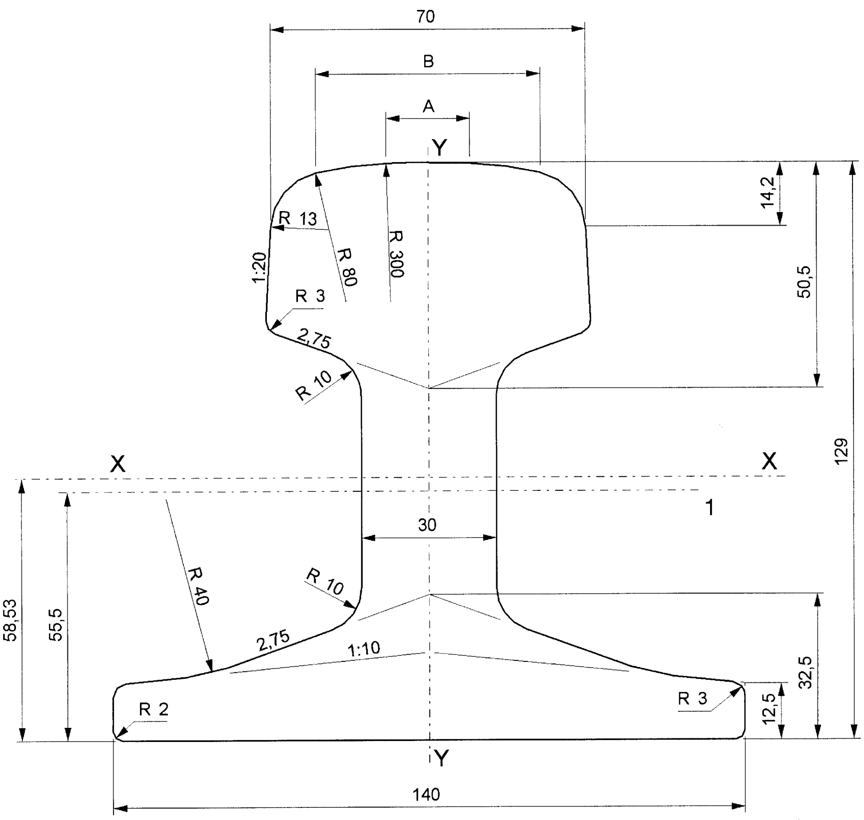
Cross-sectional area	:	83,32	cm²
Mass per metre	:	65,40	kg/m
Moment of inertia x-x-axis	:	2 513,8	cm⁴
Section modulus-Head	:	291,3	cm³
Section modulus-Base	:	345,8	cm³
Moment of inertia y-y-axis	:	504,1	cm⁴
Section modulus y-y-axis	:	72,0	cm³

Indicative dimensions: A = 20,025 mm

B = 49,727 mm

Figure A.24 — Rail profile 54E1T1

Dimensions in millimetres

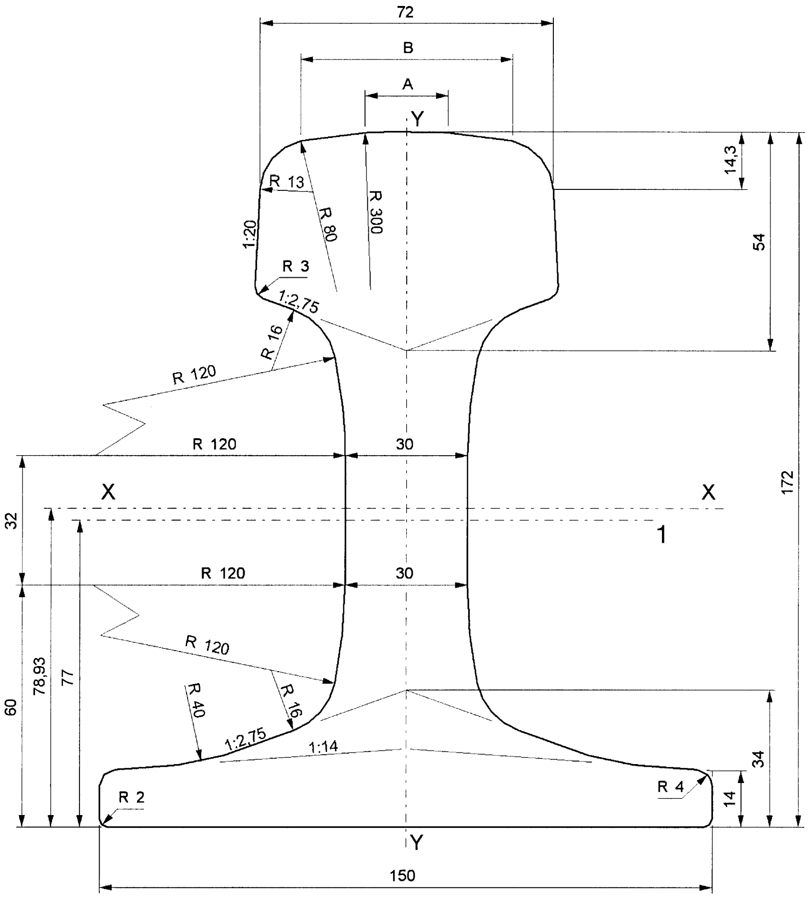


Key

1	centre line of branding		
Cross-sectional area	:	74,35	cm^2
Mass per metre	:	58,36	kg/m
Moment of inertia x-x-axis	:	1 410,4	cm^4
Section modulus-Head	:	200,1	cm^3
Section modulus-Base	:	241,0	cm^3
Moment of inertia y-y-axis	:	471,5	cm^4
Section modulus y-y-axis	:	67,4	cm^3
Indicative dimensions:	A = 18,640 mm		
	B = 49,923 mm		

Figure A.25 — Rail profile 54E1T2

Dimensions in millimetres



Key

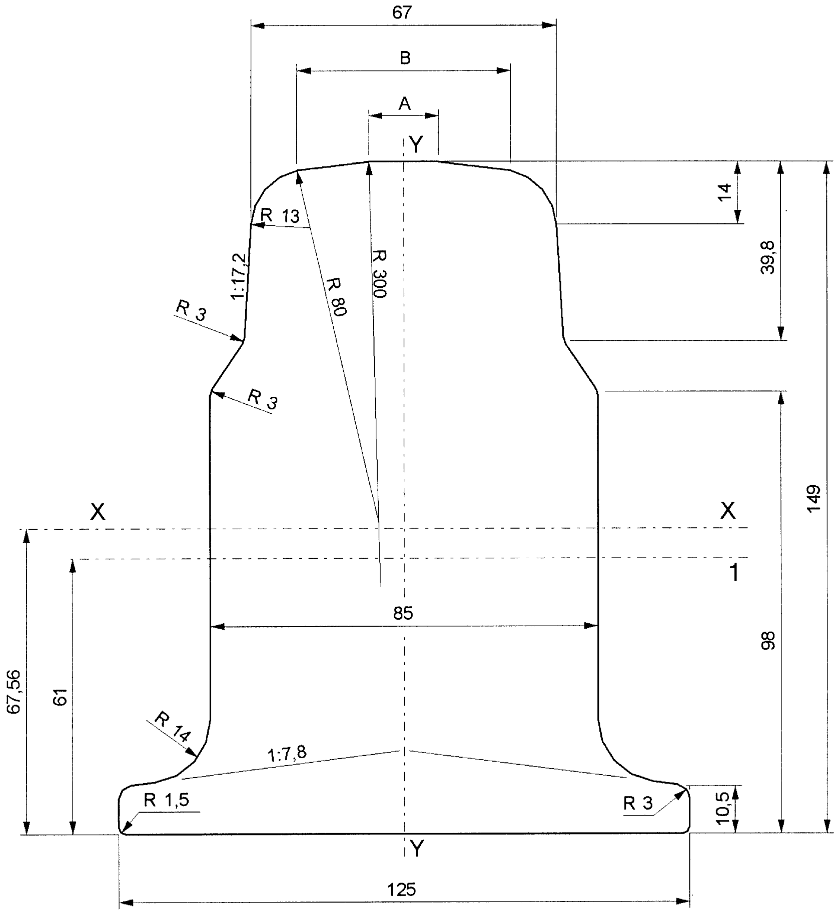
1	centre line of branding		
Cross-sectional area	:	94,57	cm^2
Mass per metre	:	74,24	kg/m
Moment of inertia x-x-axis	:	3 301,4	cm^4
Section modulus-Head	:	354,7	cm^3
Section modulus-Base	:	418,3	cm^3
Moment of inertia y-y-axis	:	615,3	cm^4
Section modulus y-y-axis	:	82,0	cm^3

Indicative dimensions: A = 20,456 mm

B = 52,053 mm

Figure A.26 — Rail profile 60E1T2

Dimensions in millimetres



Key

1	centre line of branding

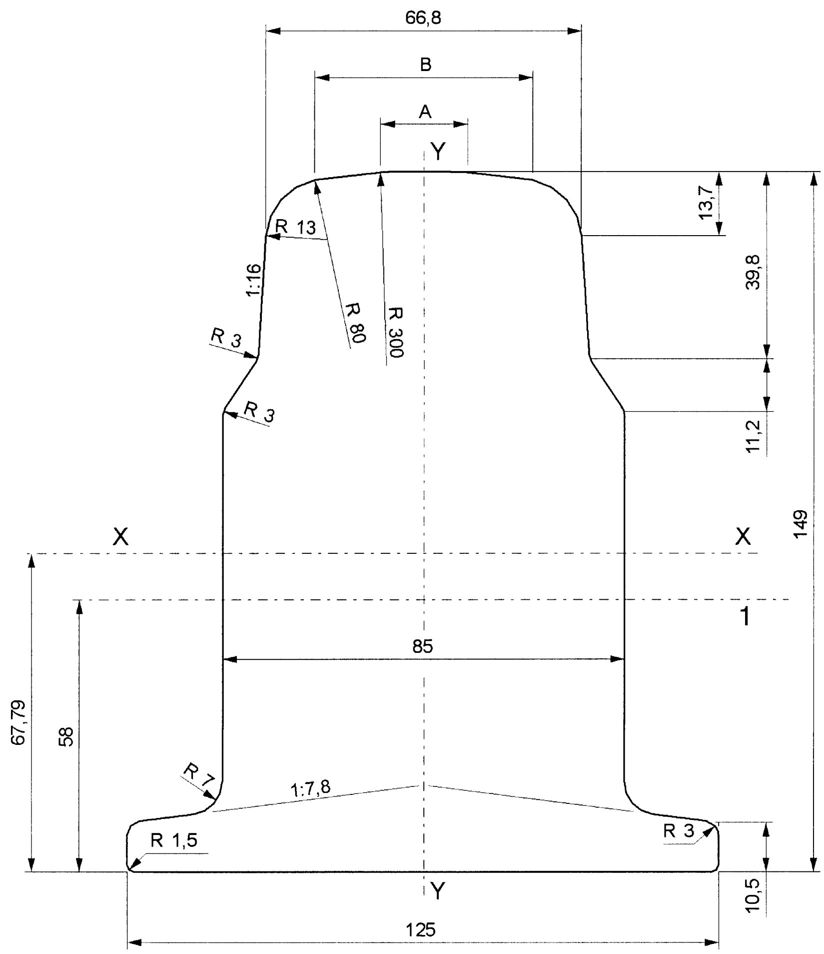
Cross-sectional area	:	123,00	cm^2
Mass per metre	:	96,55	kg/m
Moment of inertia x-x-axis	:	2 234,0	cm^4
Section modulus-Head	:	274,3	cm^3
Section modulus-Base	:	330,6	cm^3
Moment of inertia y-y-axis	:	779,9	cm^4
Section modulus y-y-axis	:	124,8	cm^3

Indicative dimensions: A = 15,267 mm

B = 46,835 mm

Figure A.27 — Rail profile 49E1F1

Dimensions in millimetres



Key

1 centre line of branding

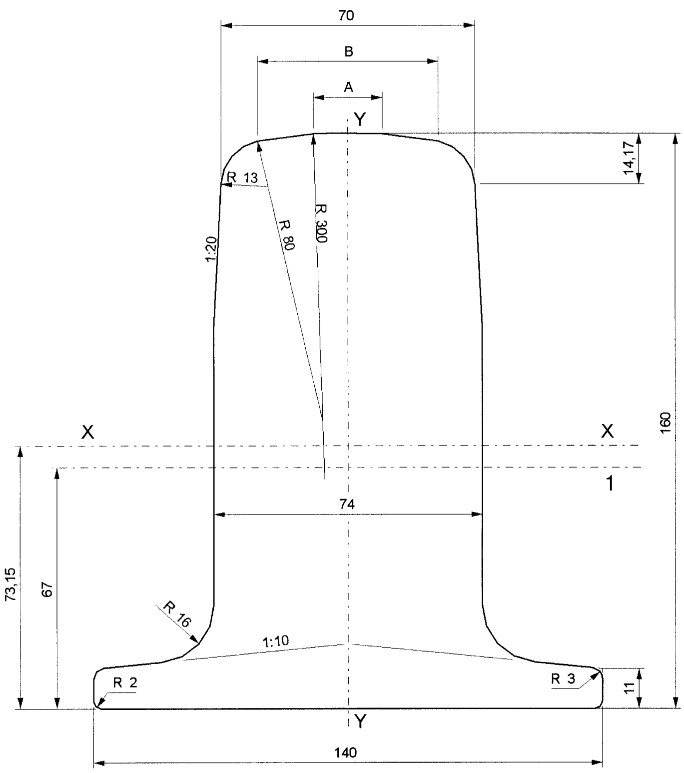
Cross-sectional area	:	122,58	cm^2
Mass per metre	:	96,23	kg/m
Moment of inertia x-x-axis	:	2 224,7	cm^4
Section modulus-Head	:	273,9	cm^3
Section modulus-Base	:	328,2	cm^3
Moment of inertia y-y-axis	:	770,4	cm^4
Section modulus y-y-axis	:	123,3	cm^3

Indicative dimensions: A = 18,457 mm

B = 46,151 mm

Figure A.28 — 49E1F2

Dimensions in millimetres



Key

1 centre line of branding

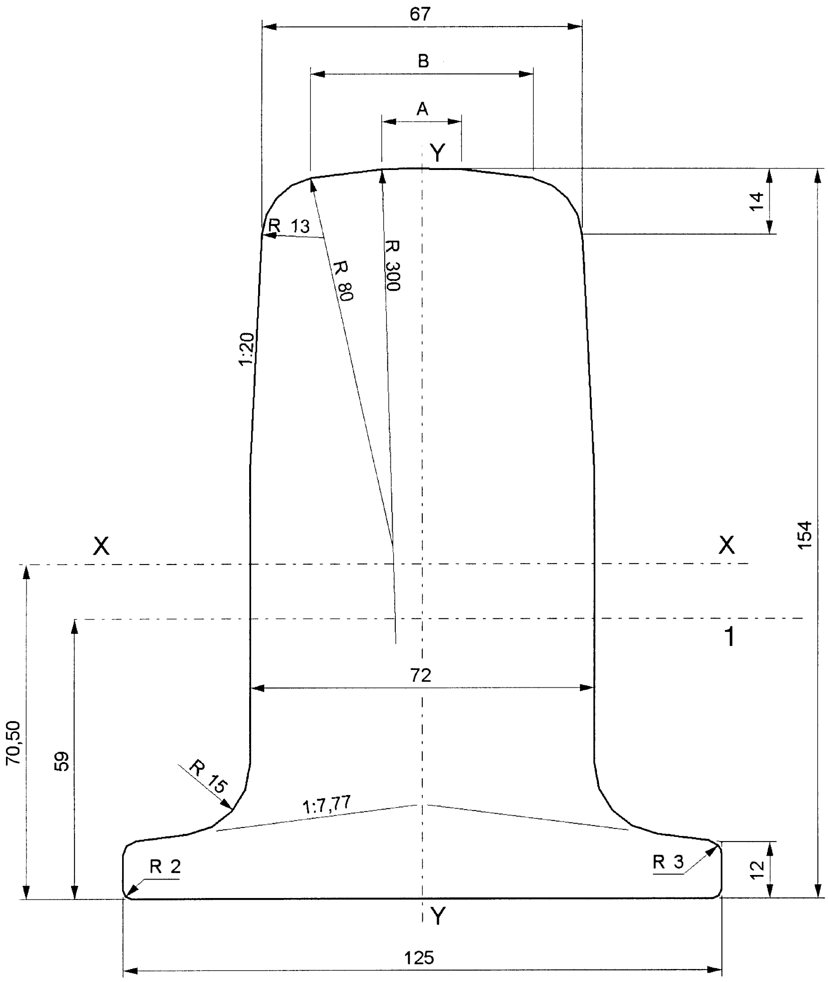
Cross-sectional area	:	124,83	cm^2
Mass per metre	:	98,00	kg/m
Moment of inertia x-x-axis	:	2 818,5	cm^4
Section modulus-Head	:	324,5	cm^3
Section modulus-Base	:	385,3	cm^3
Moment of inertia y-y-axis	:	762,4	cm^4
Section modulus y-y-axis	:	108,9	cm^3

Indicative dimensions: A = 19,045 mm

B = 49,866 mm

Figure A.29 — Rail profile 54E1F1

Dimensions in millimetres



Key

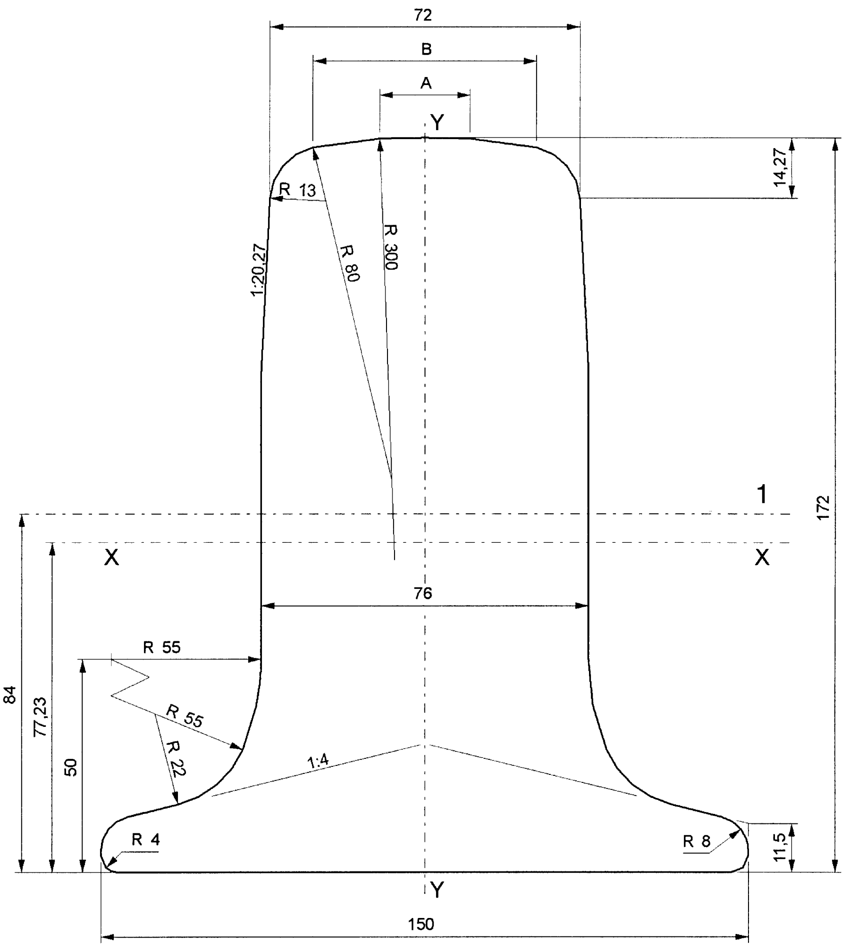
1	centre line of branding

Cross-sectional area	:	115,56	cm^2
Mass per metre	:	90,72	kg/m
Moment of inertia x-x-axis	:	2 389,0	cm^4
Section modulus-Head	:	286,1	cm^3
Section modulus-Base	:	338,9	cm^3
Moment of inertia y-y-axis	:	630,3	cm^4
Section modulus y-y-axis	:	100,8	cm^3

Indicative dimensions: A = 16,703 mm
B = 46,617 mm

Figure A.30 — Rail profile 54E3F1

Dimensions in millimetres



Key

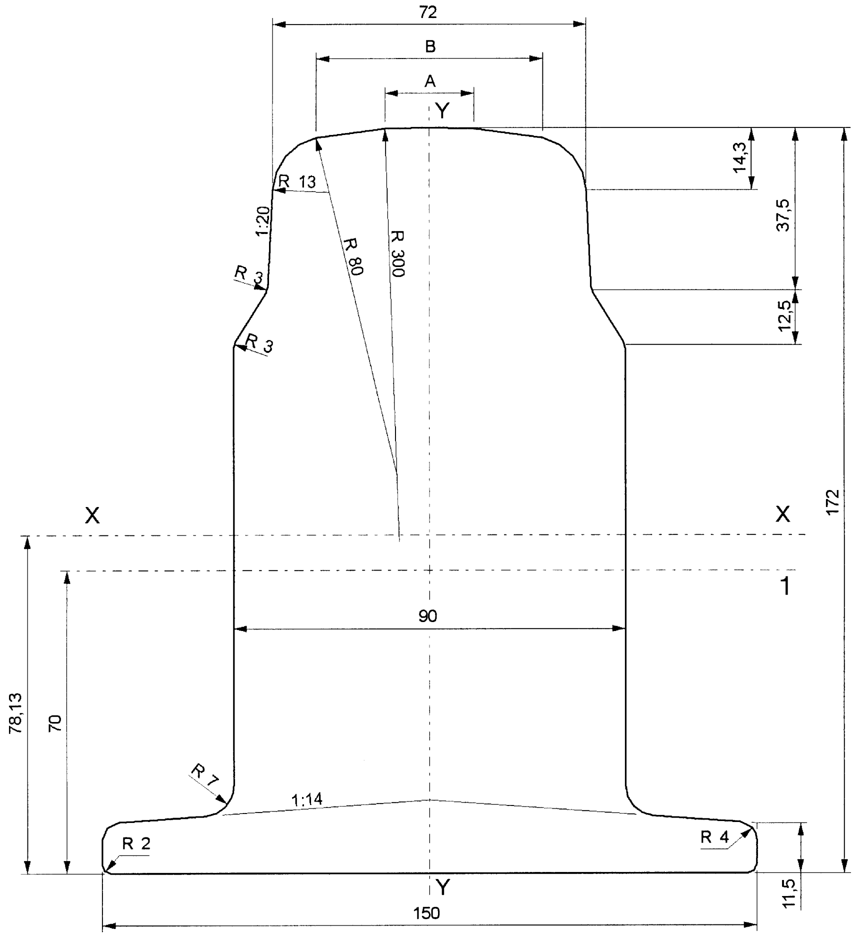
1	centre line of branding		
Cross-sectional area	:	141,71	cm^2
Mass per metre	:	111,24	kg/m
Moment of inertia x-x-axis	:	3 737,3	cm^4
Section modulus-Head	:	394,3	cm^3
Section modulus-Base	:	483,9	cm^3
Moment of inertia y-y-axis	:	992,3	cm^4
Section modulus y-y-axis	:	132,3	cm^3

Indicative dimensions: A = 20,976 mm

B = 51,978 mm

Figure A.31 — Rail profile 60E1F1

Dimensions in millimetres



Key

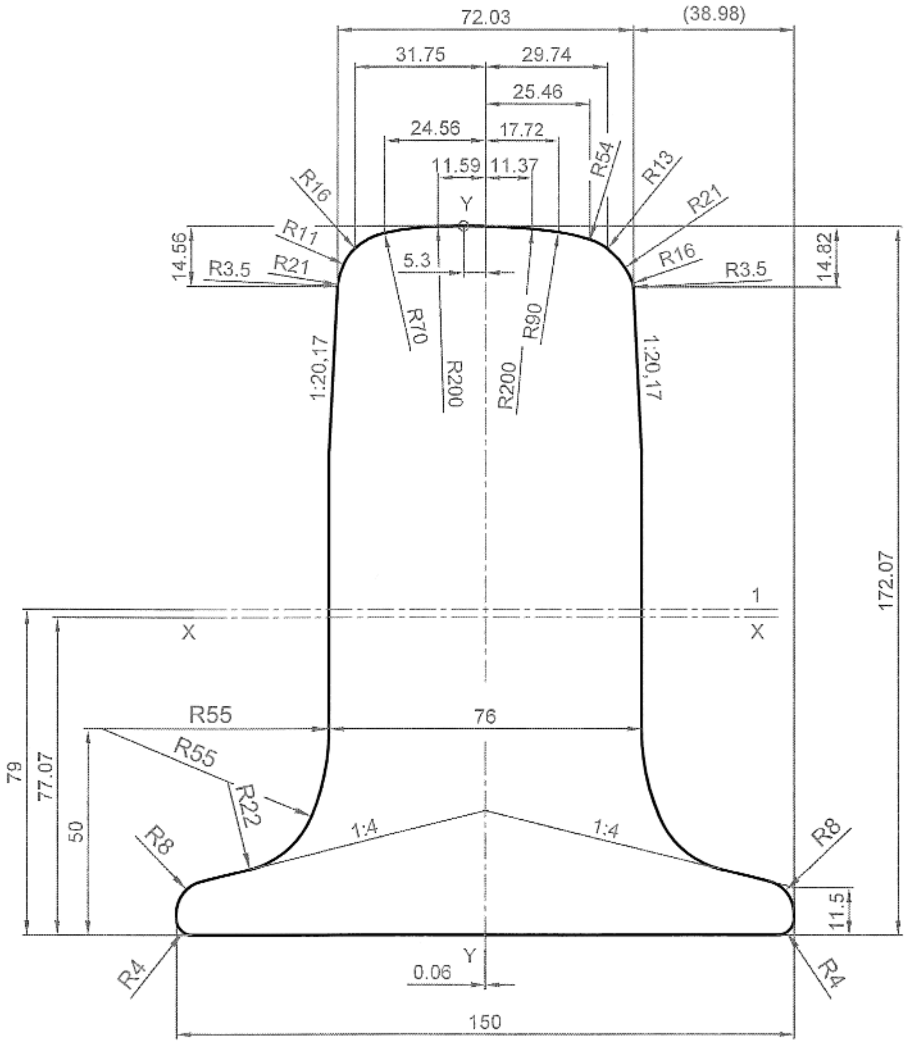
1	centre line of branding

Cross-sectional area	:	153,56	cm^2
Mass per metre	:	120,55	kg/m
Moment of inertia x-x-axis	:	3 783,5	cm^4
Section modulus-Head	:	403,1	cm^3
Section modulus-Base	:	484,3	cm^3
Moment of inertia y-y-axis	:	1 179,6	cm^4
Section modulus y-y-axis	:	157,3	cm^3

Indicative dimensions: A = 20,456 mm
B = 52,053 mm

Figure A.32 — Rail profile 60E1F2

Dimensions in millimetres



Key

1	centre line of branding		
Cross-sectional area	:	141,45	cm^2
Mass per metre	:	111,24	kg/m
Moment of inertia x-x-axis	:	3 717,13	cm^4
Section modulus - Head	:	391,6	cm^3
Section modulus - Base	:	482,3	cm^3
Moment of inertia y-y-axis	:	990,17	cm^4
Section modulus y-y-axis left	:	132,2	cm^3
Section modulus y-y-axis right	:	121,9	cm^3

Figure A.33 — Rail profile 60E2F1

Dimensions in millimetres

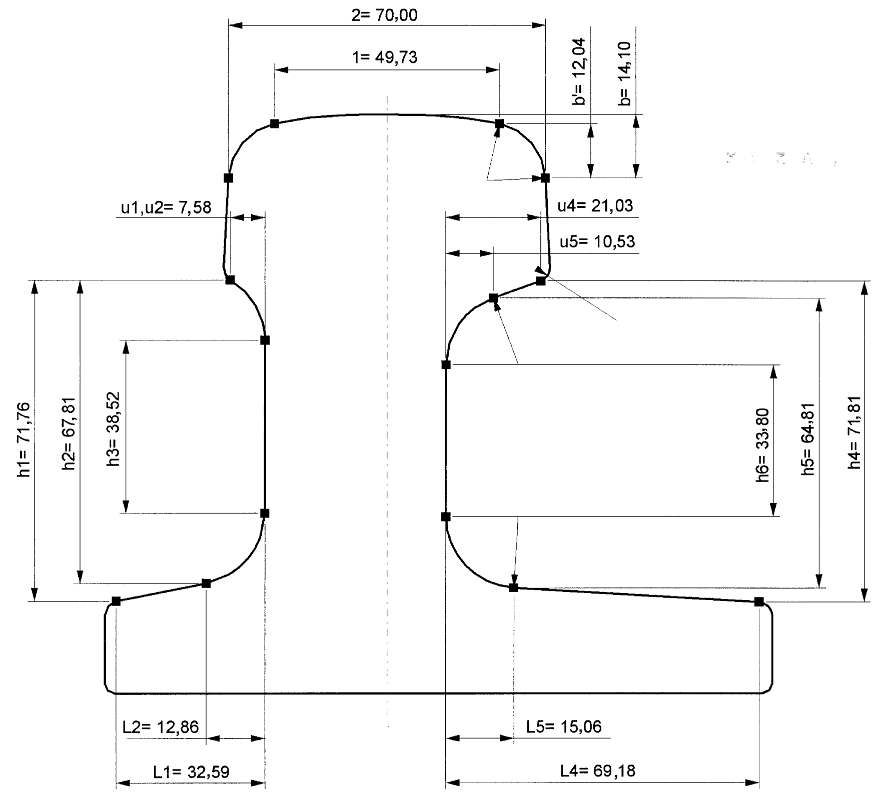


Figure A.34 — 54E1A1 Rail Transition Points

Dimensions in millimetres

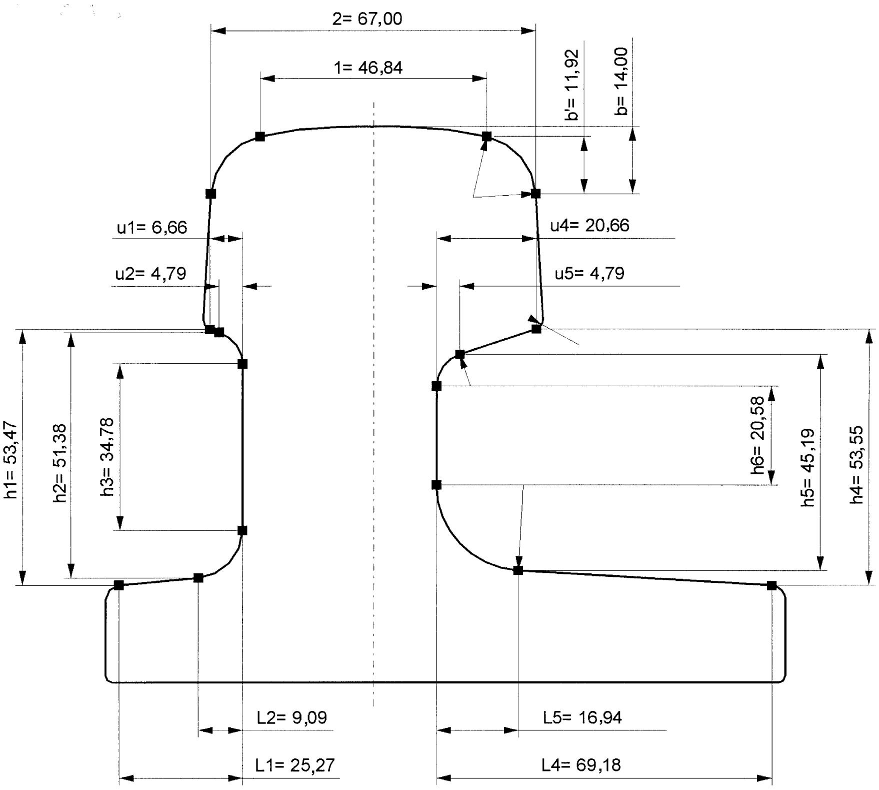


Figure A.35 — 49E1A1 Rail Transition Points

Dimensions in millimetres

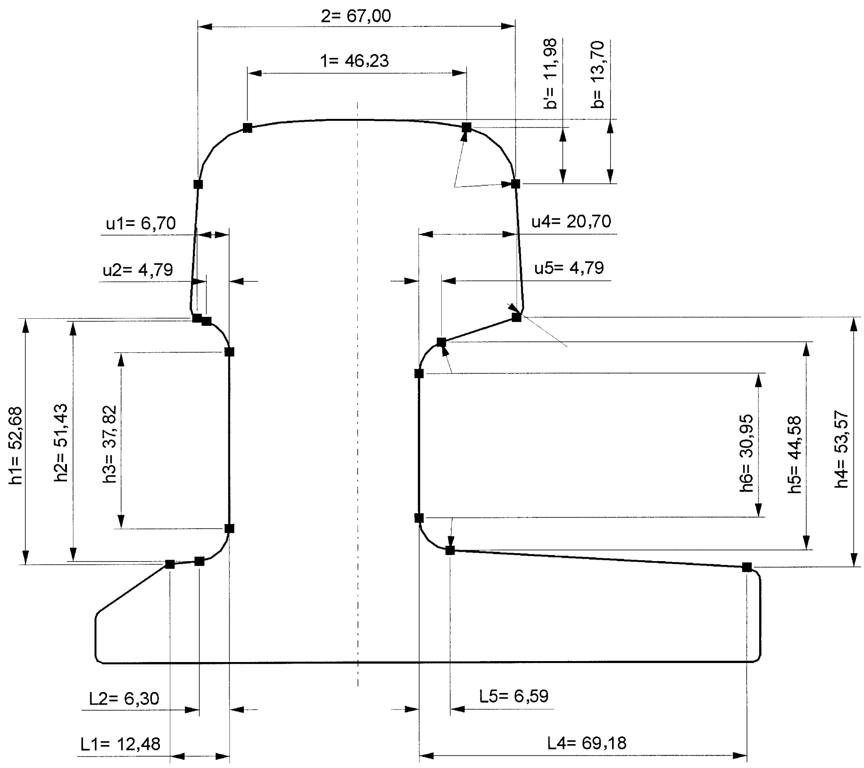


Figure A.36 — 49E1A2 Rail Transition Points

Dimensions in millimetres

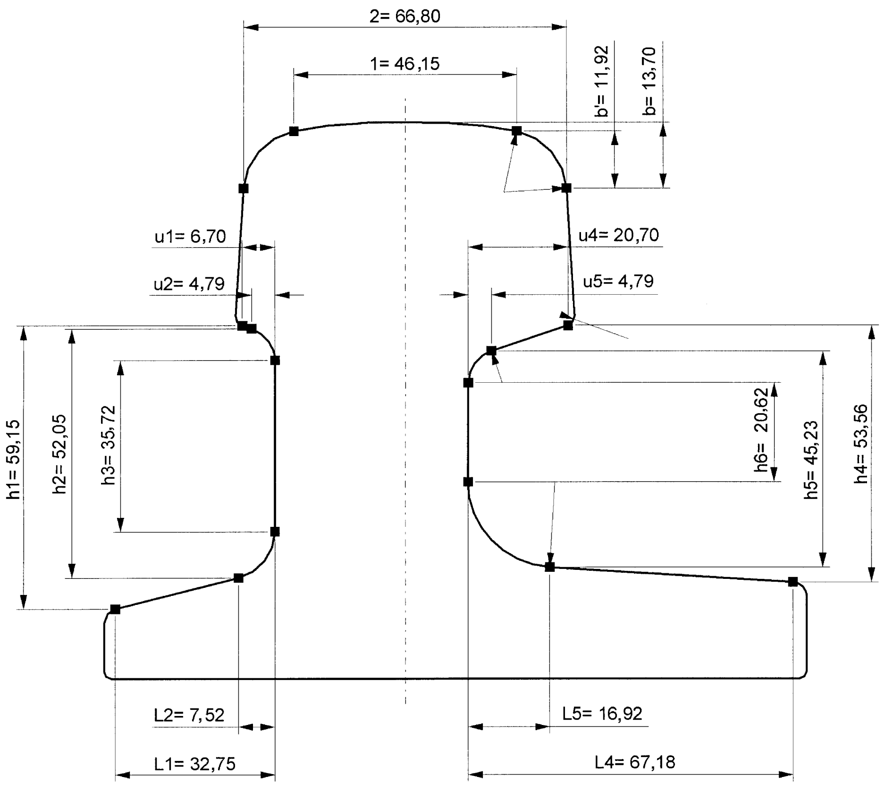


Figure A.37 — 49E1A3 Rail Transition Points

Dimensions in millimetres

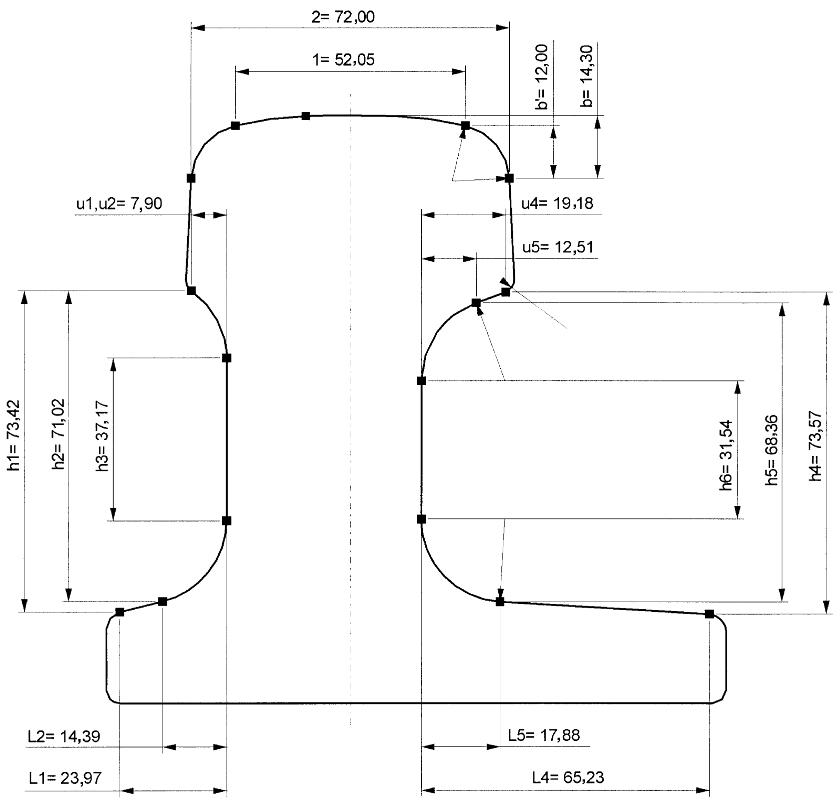


Figure A.38 — 60E1A1 Rail Transition Points

Dimensions in millimetres

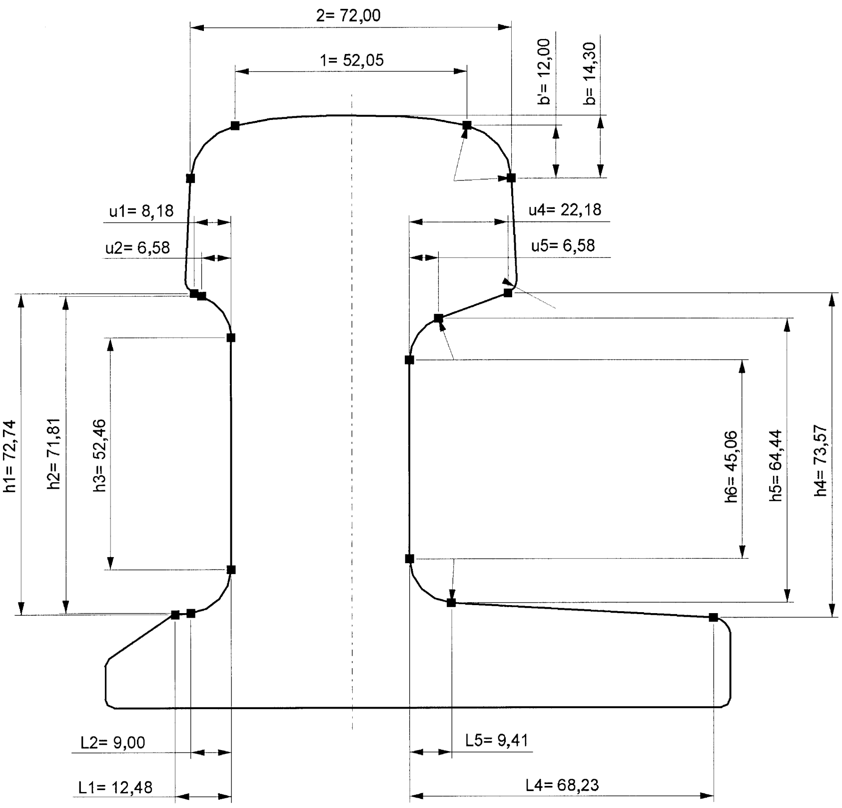


Figure A.39 — 60E1A2 Rail Transition Points

Dimensions in millimetres

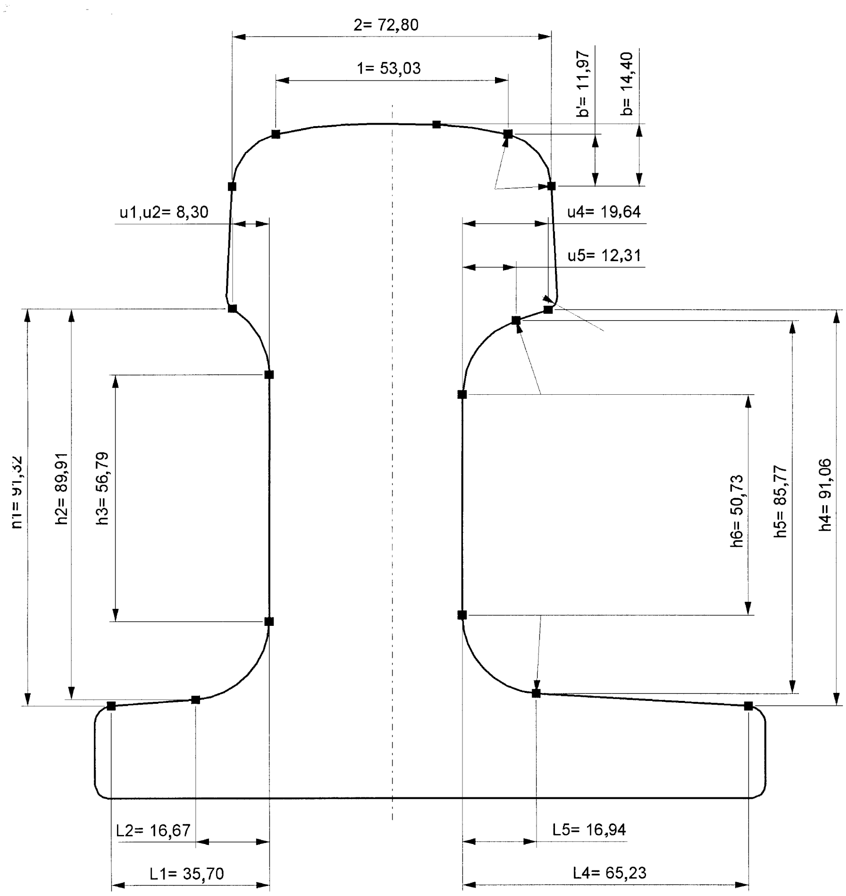


Figure A.40 — 60E1A3 Rail Transition Points

Dimensions in millimetres

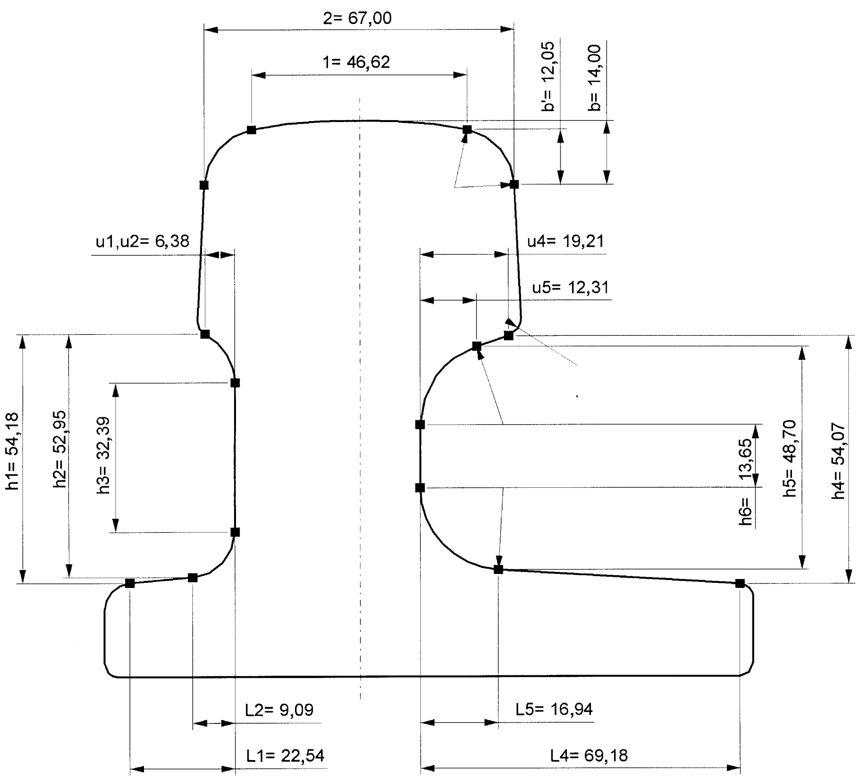


Figure A.41 — 54E1A2 Rail Transition Points

Dimensions in millimetres

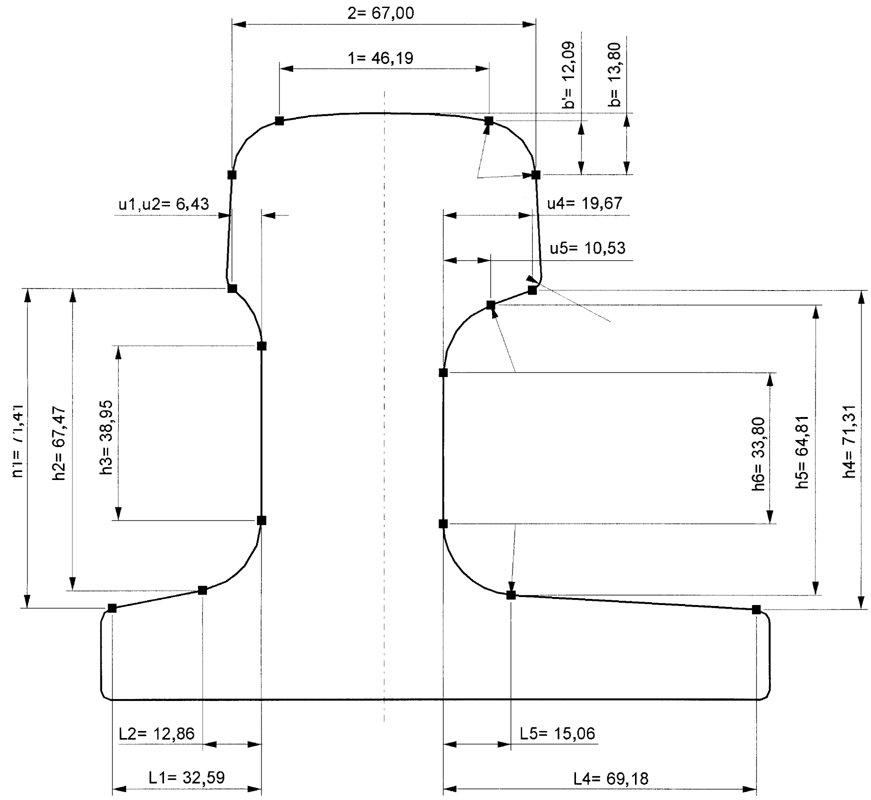


Figure A.42 — 54E2A1 Rail Transition Points

Dimensions in millimetres

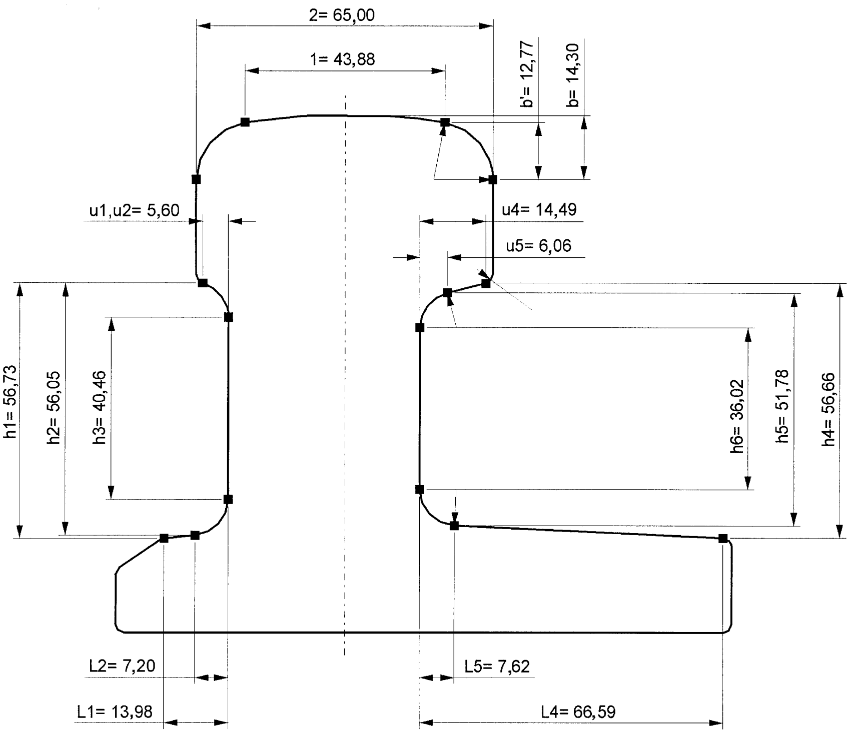


Figure A.43 — 46E1A1 Rail Transition Points

Dimensions in millimetres

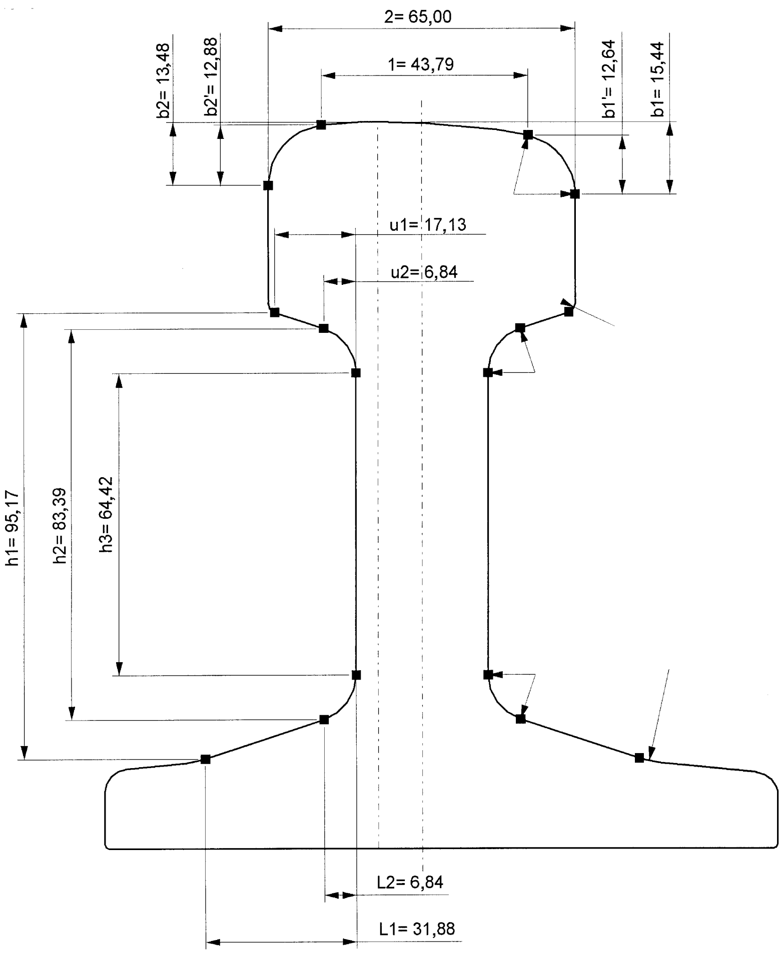


Figure A.44 — 50E6A1 Rail Transition Points

Dimensions in millimetres

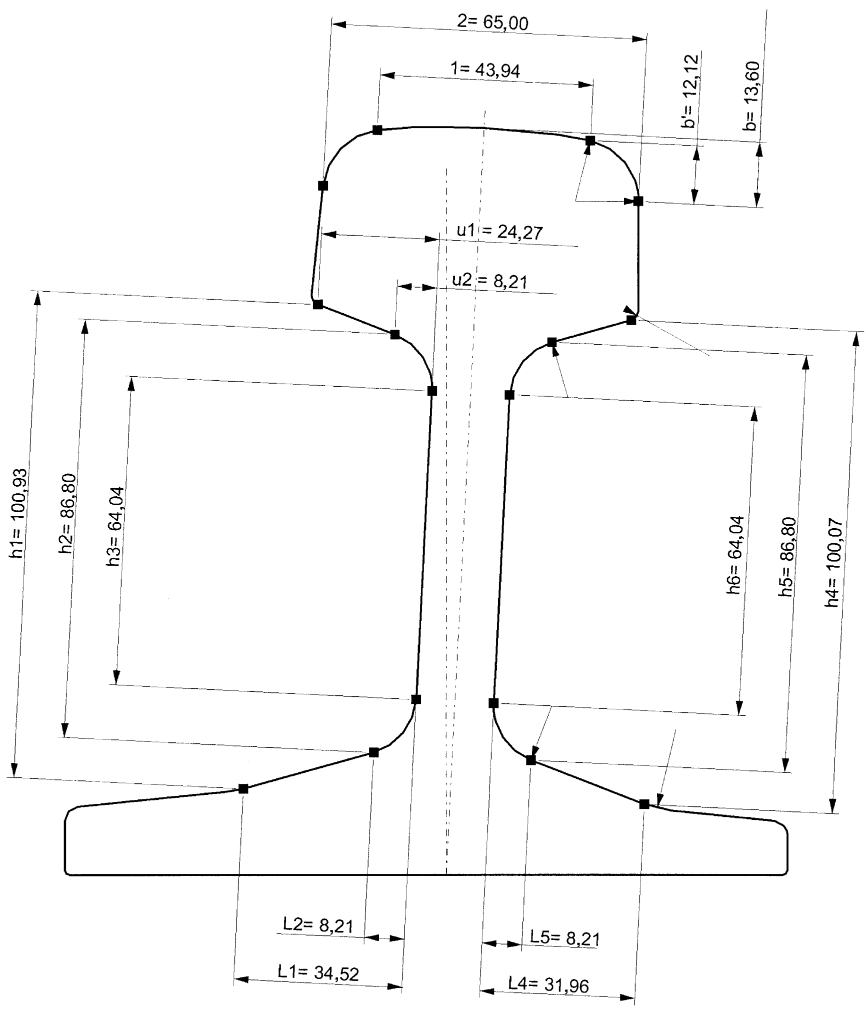


Figure A.45 — 50E6A2 Rail Transition Points

Dimensions in millimetres

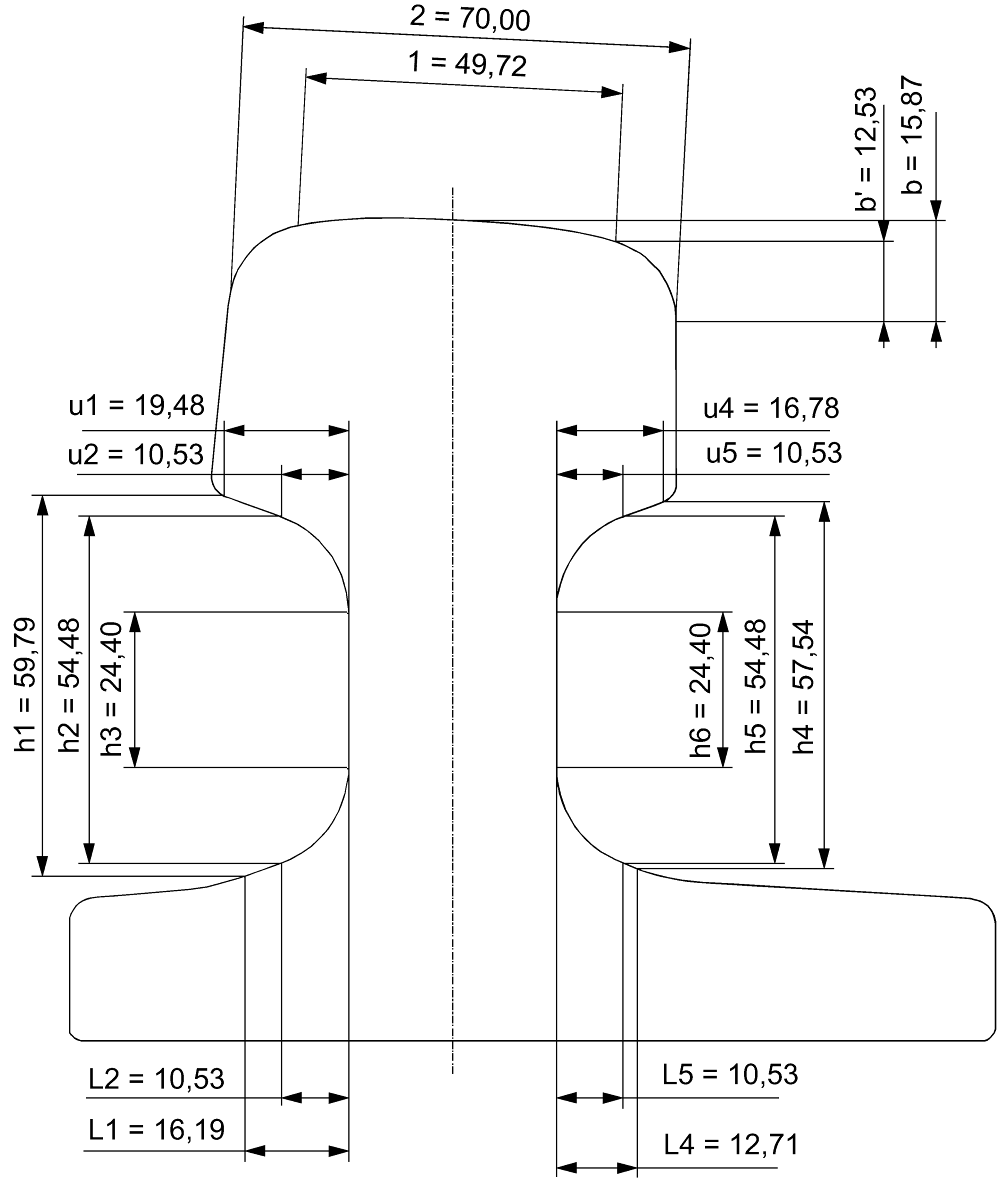


Figure A.46 — 54E1A3 Rail Transition Points

Dimensions in millimetres

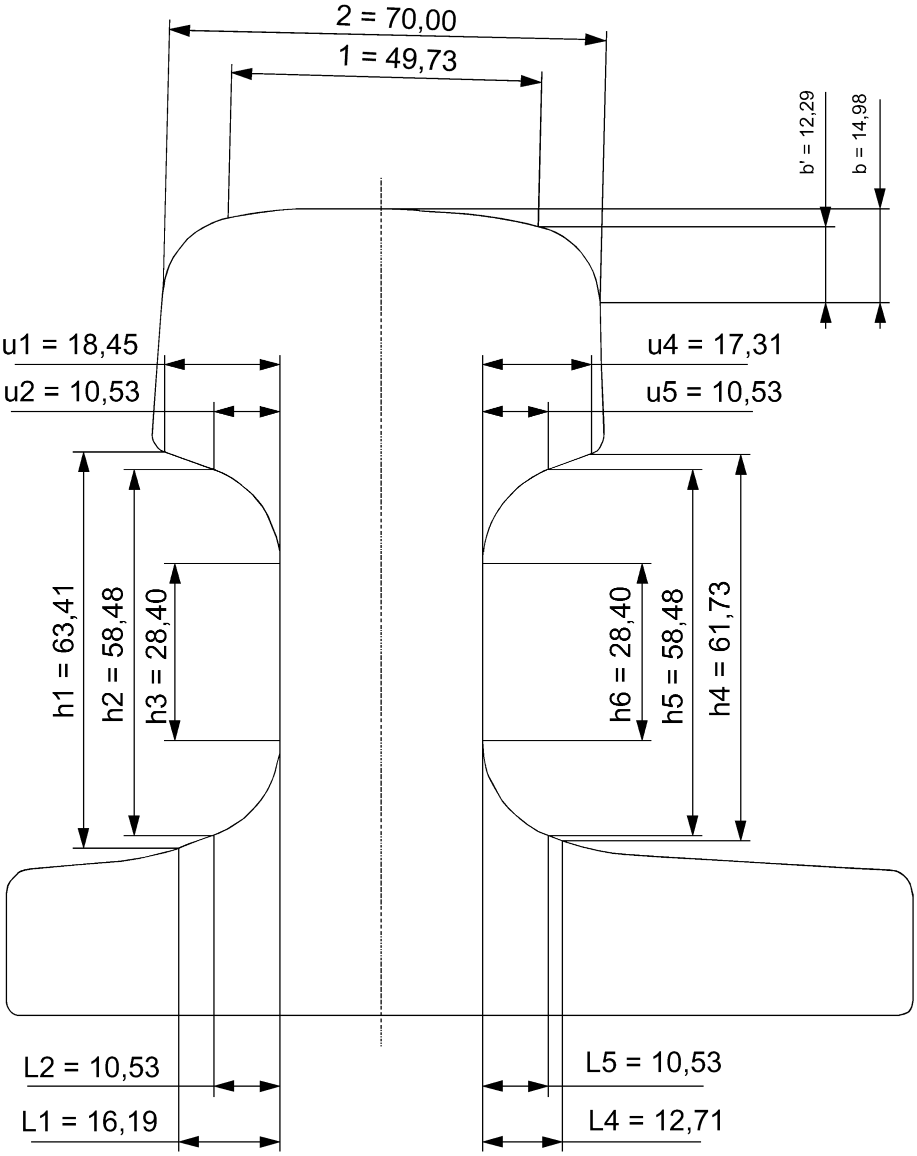


Figure A.47 — 54E1A4 Rail Transition Points

Dimensions in millimetres

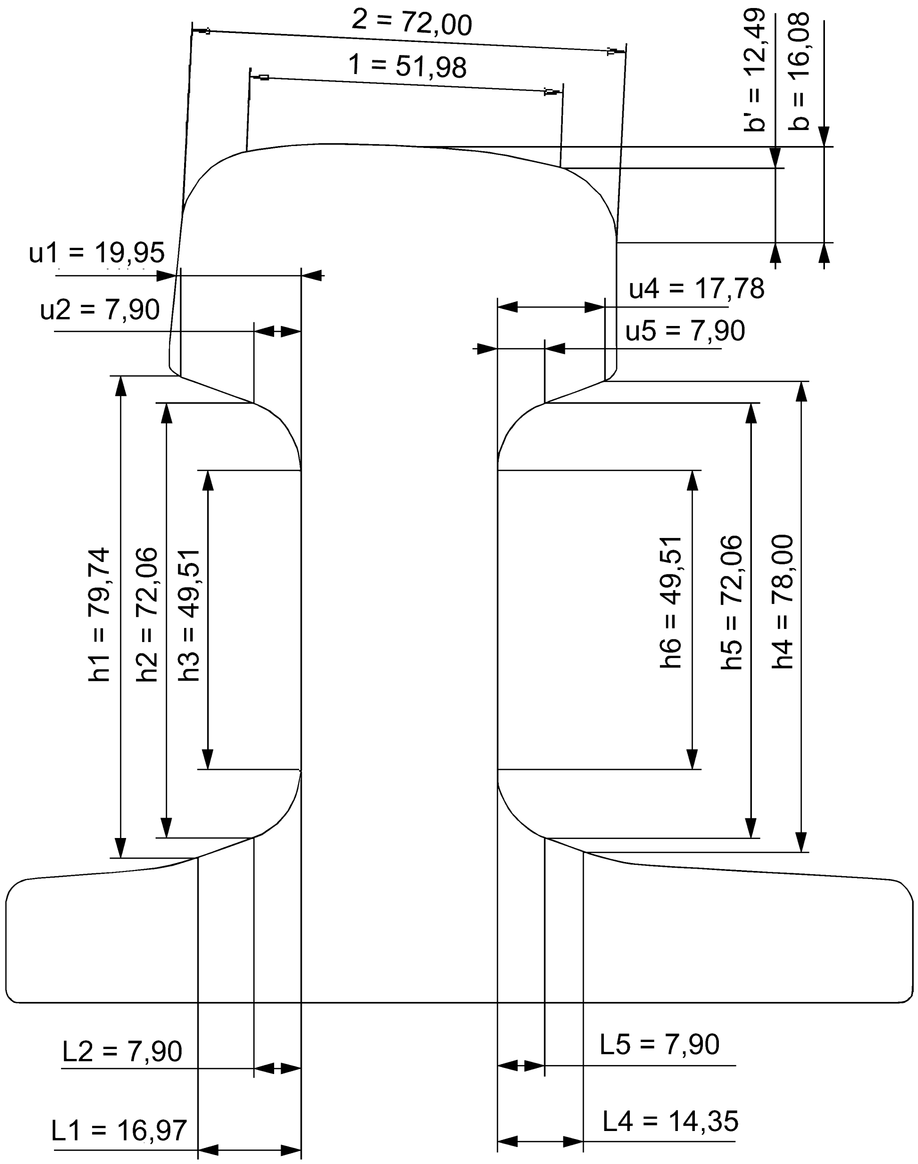


Figure A.48 — 60E1A4 Rail Transition Points

Dimensions in millimetres

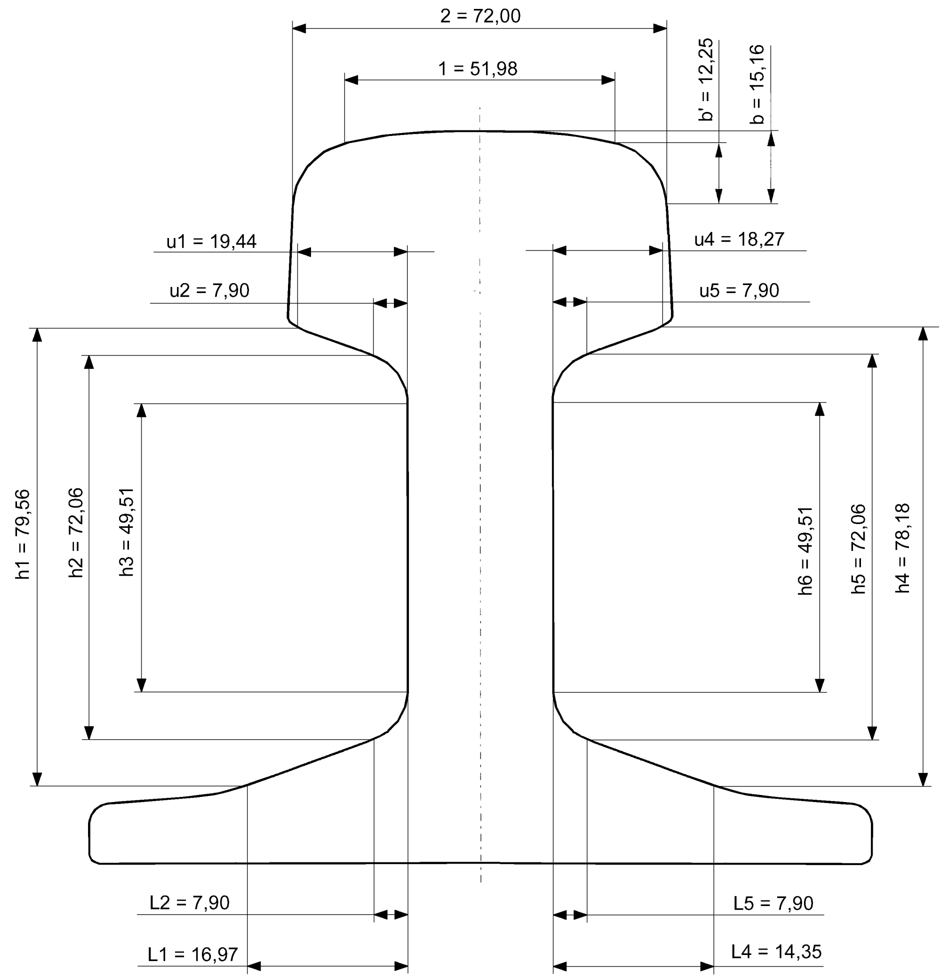


Figure A.49 — 60E1A5 Rail Transition Points

Dimensions in millimetres

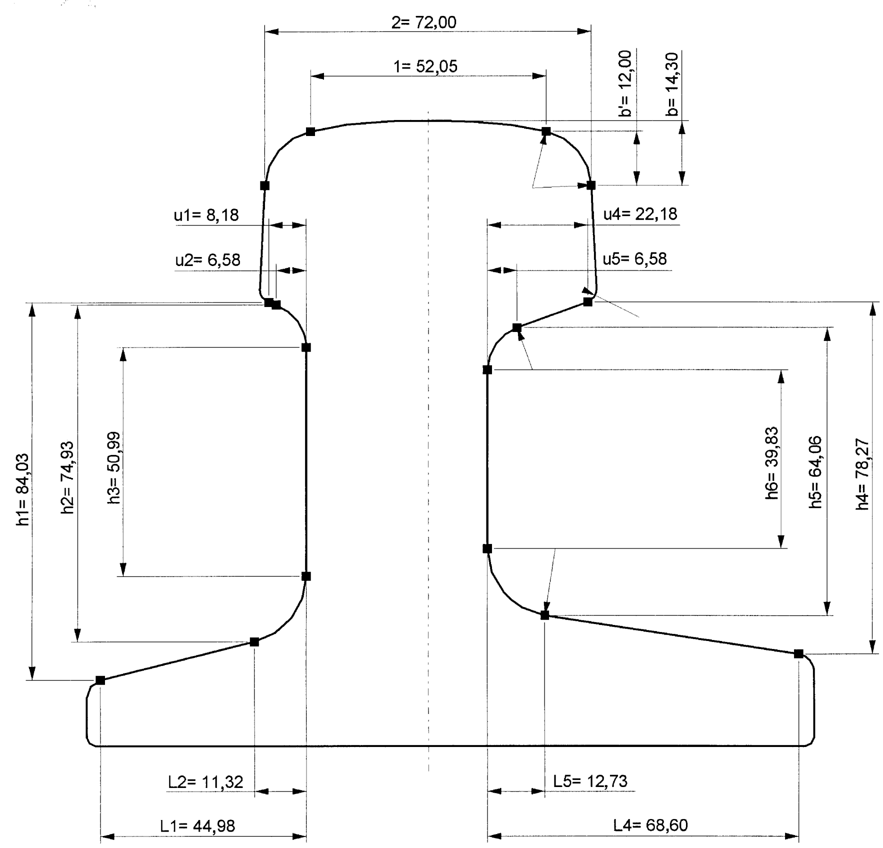


Figure A.50 — 60E1A6 Rail Transition Points

Dimensions in millimetres

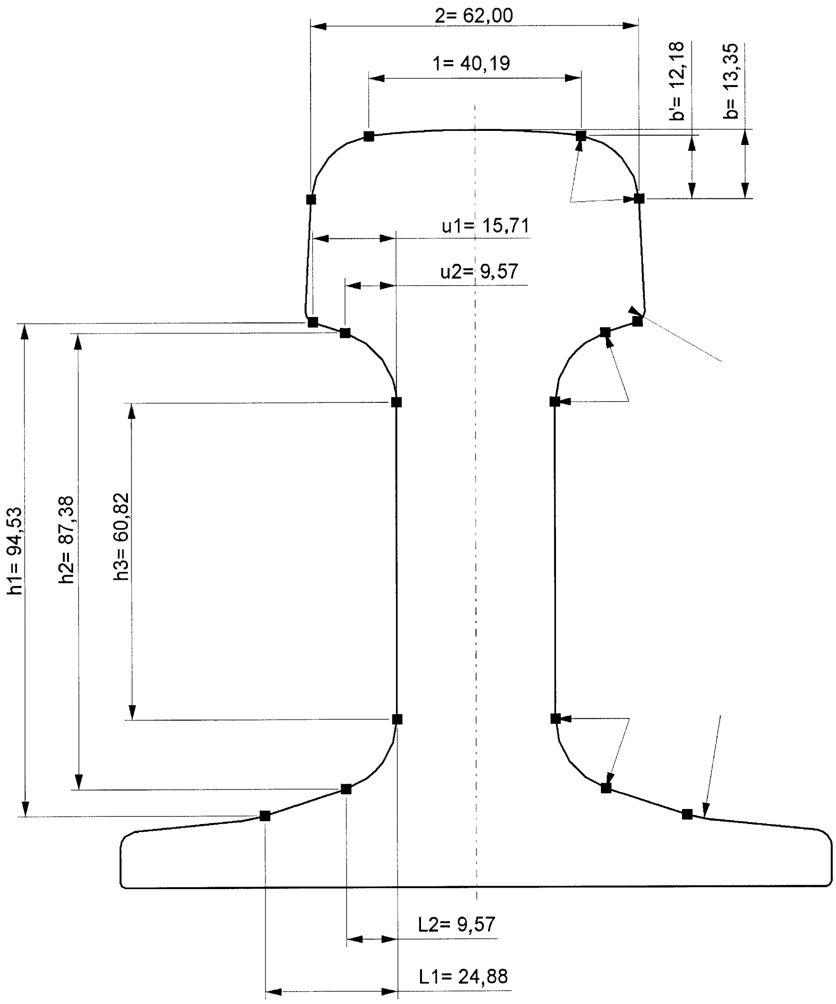


Figure A.51 — 46E2T1 Rail Transition Points

Dimensions in millimetres

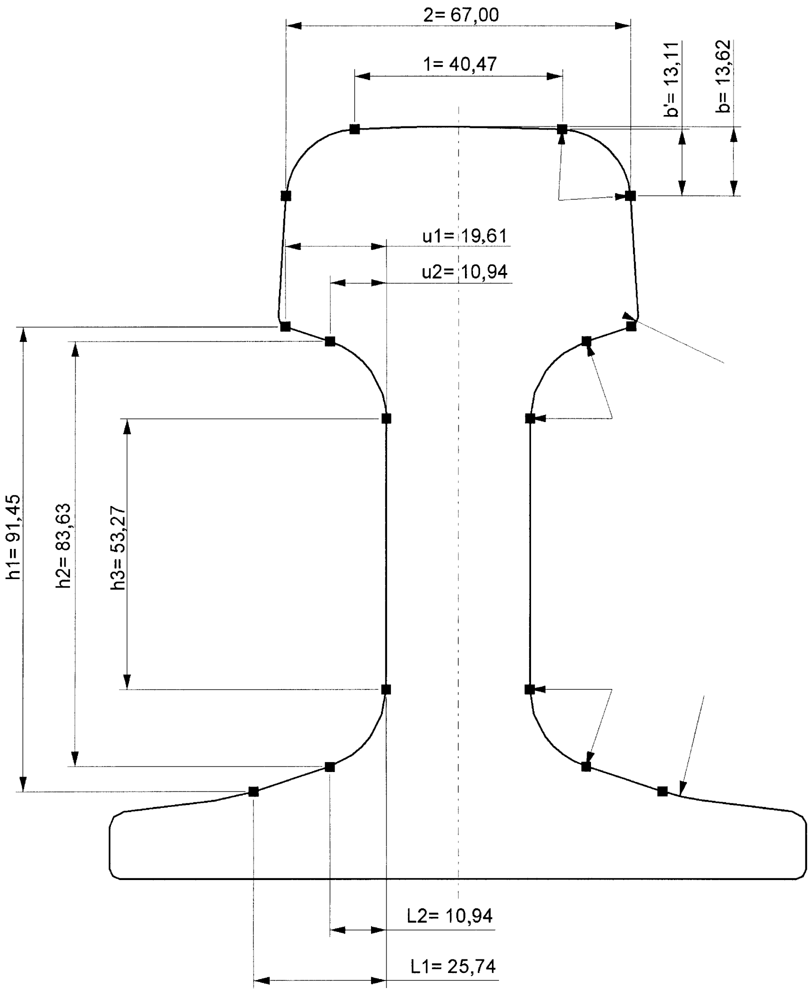


Figure A.52 — 50E1T1 Rail Transition Points

Dimensions in millimetres

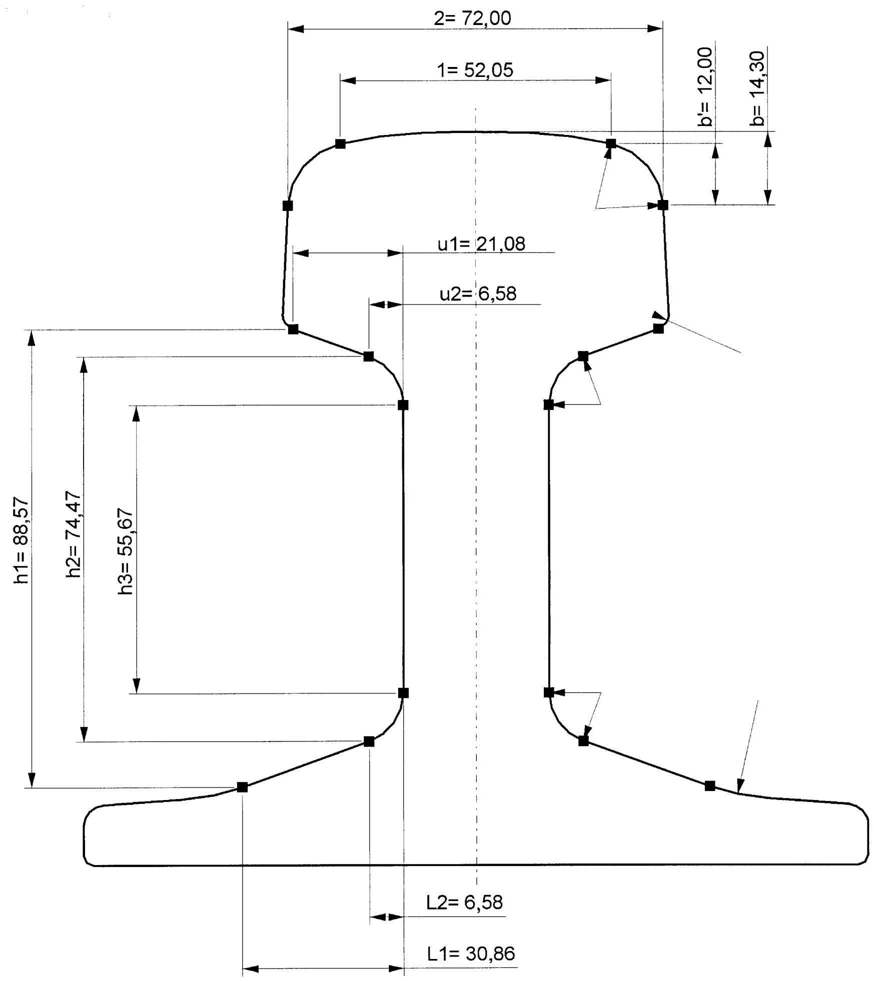


Figure A.53 — 60E1T1 Rail Transition Points

Dimensions in millimetres

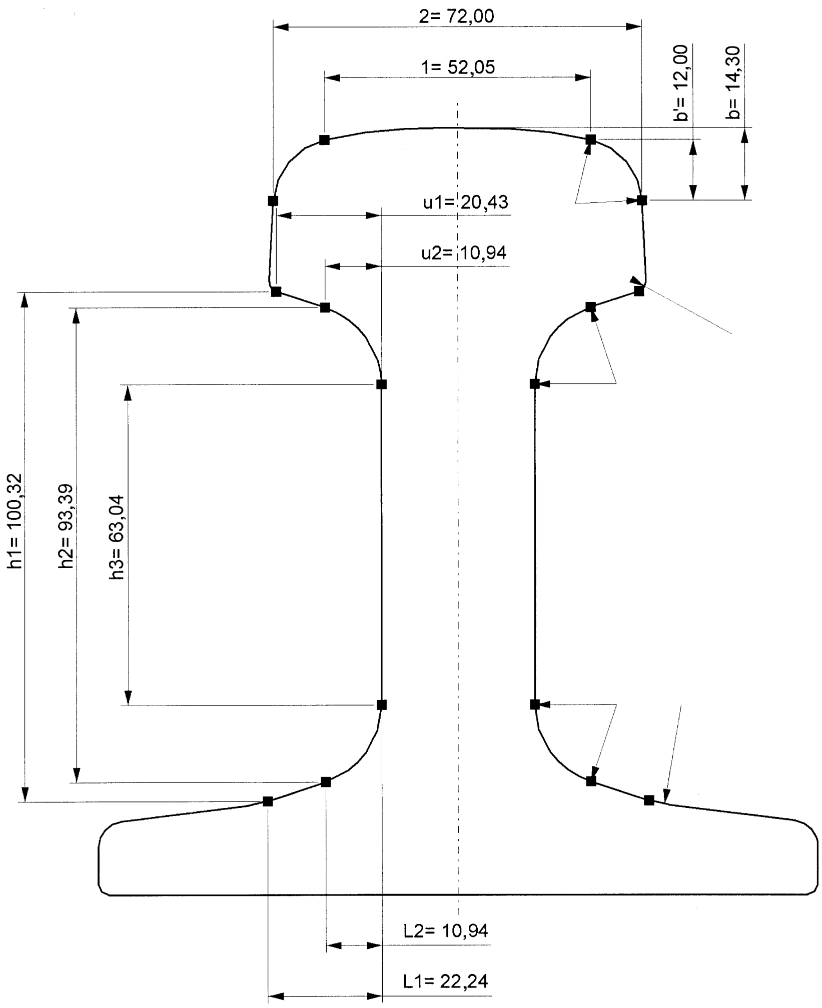


Figure A.54 — 50E2T1 Rail Transition Points

Dimensions in millimetres

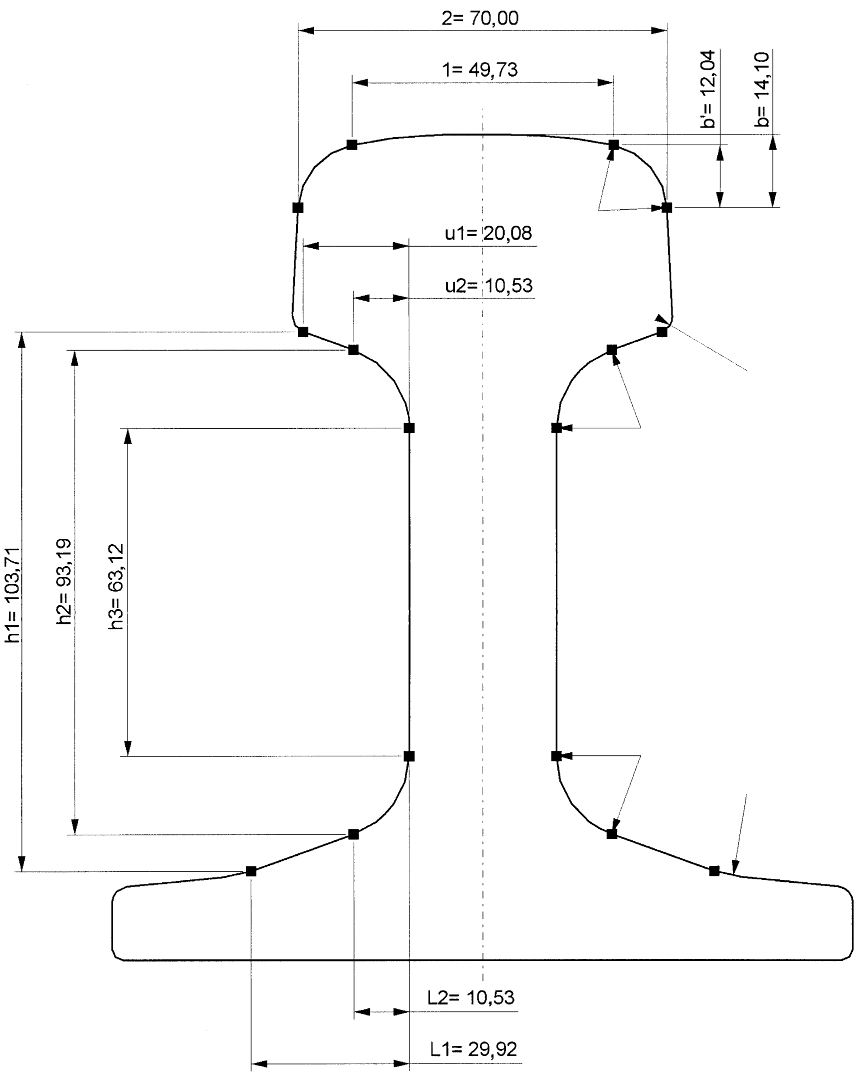


Figure A.55 — 54E1T1 Rail Transition Points

Dimensions in millimetres

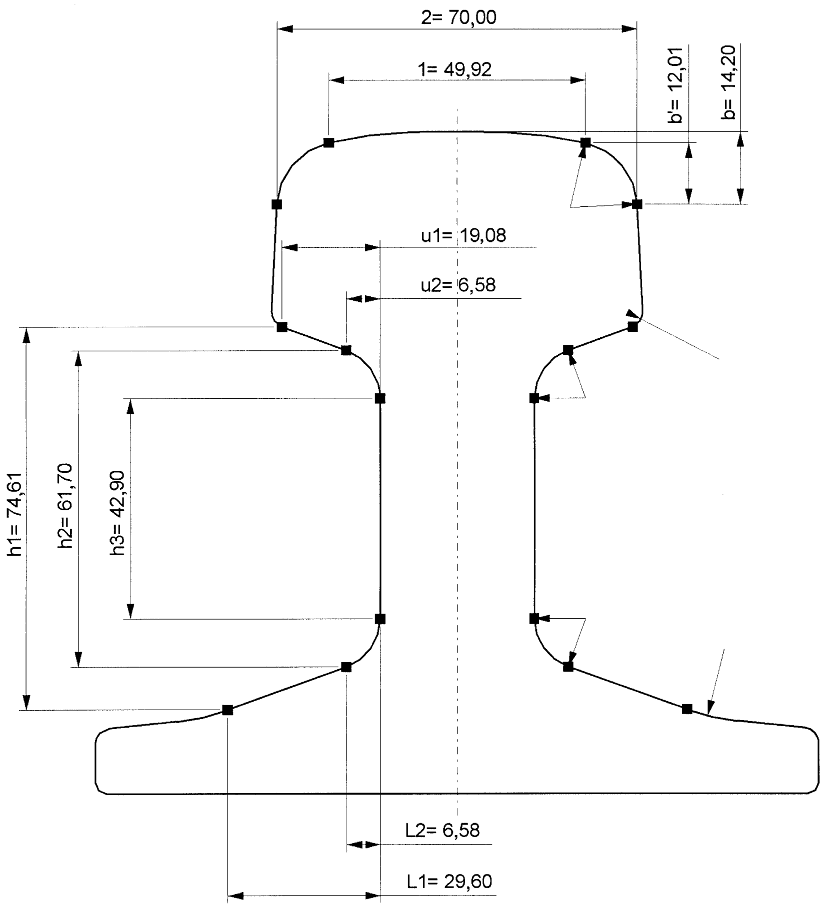


Figure A.56 — 54E1T2 Rail Transition Points

Dimensions in millimetres

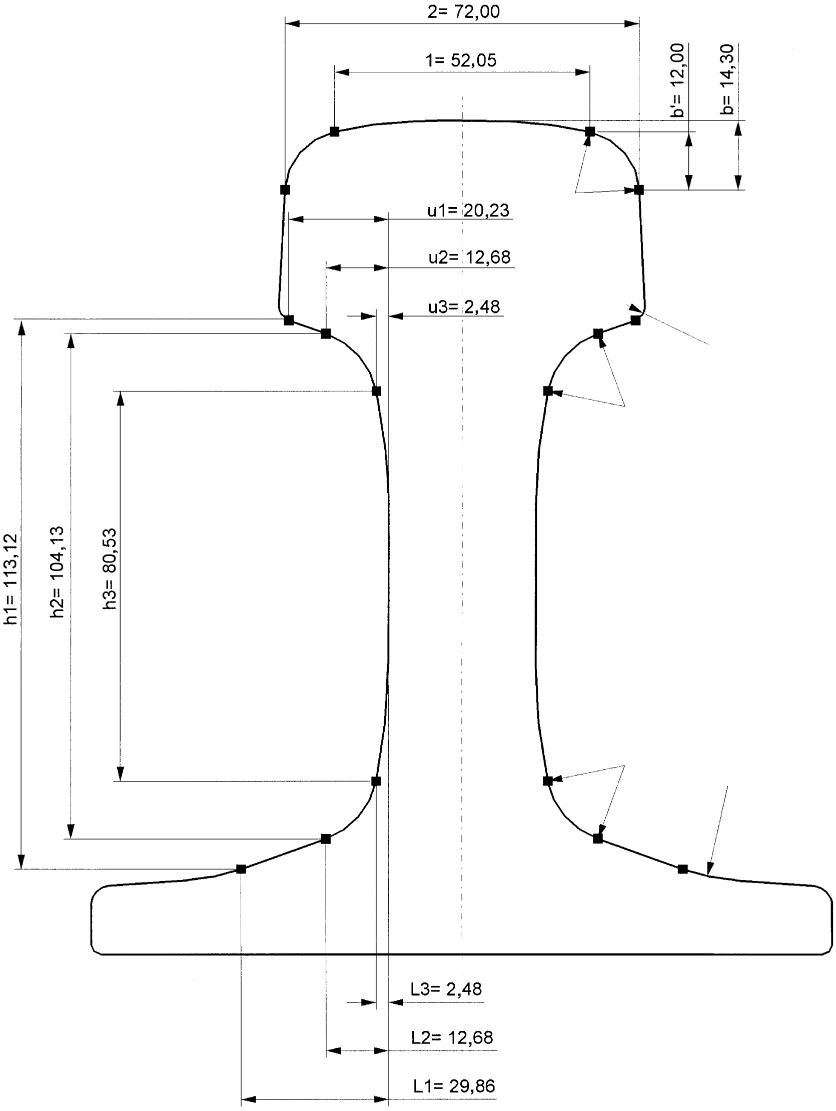


Figure A.57 — 60E1T2 Rail Transition Points

Dimensions in millimetres

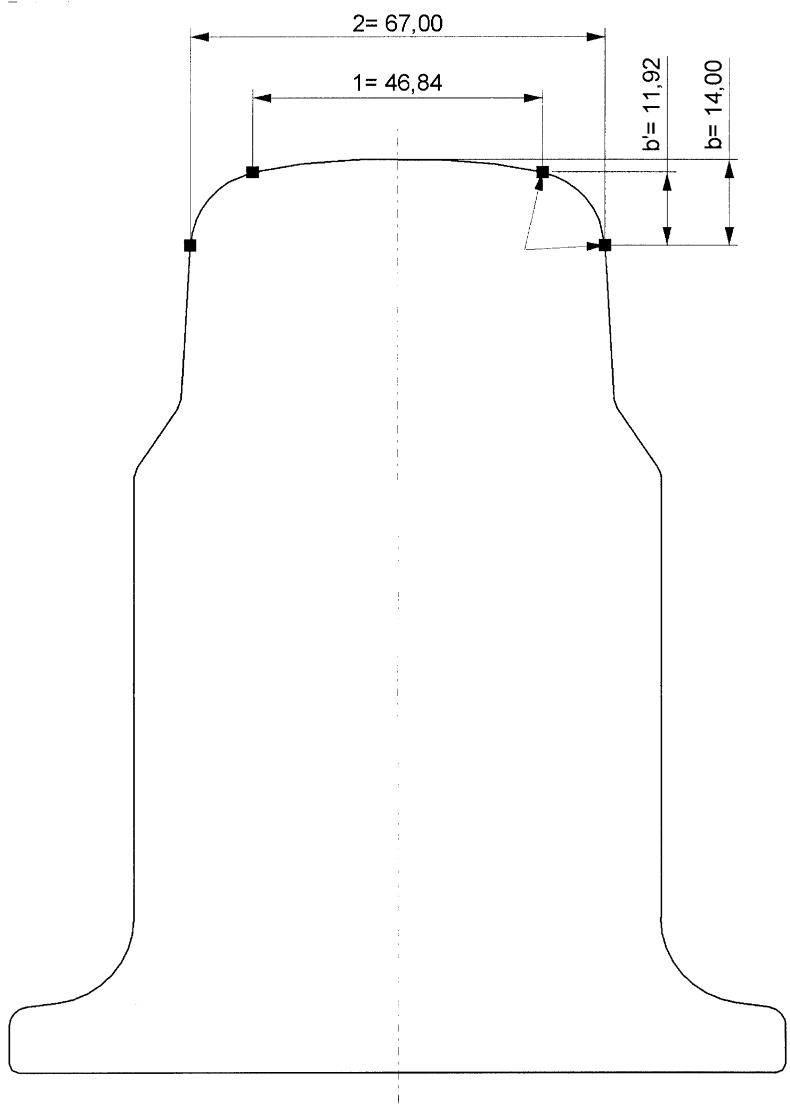


Figure A.58 — 49E1F1 Rail Transition Points

Dimensions in millimetres

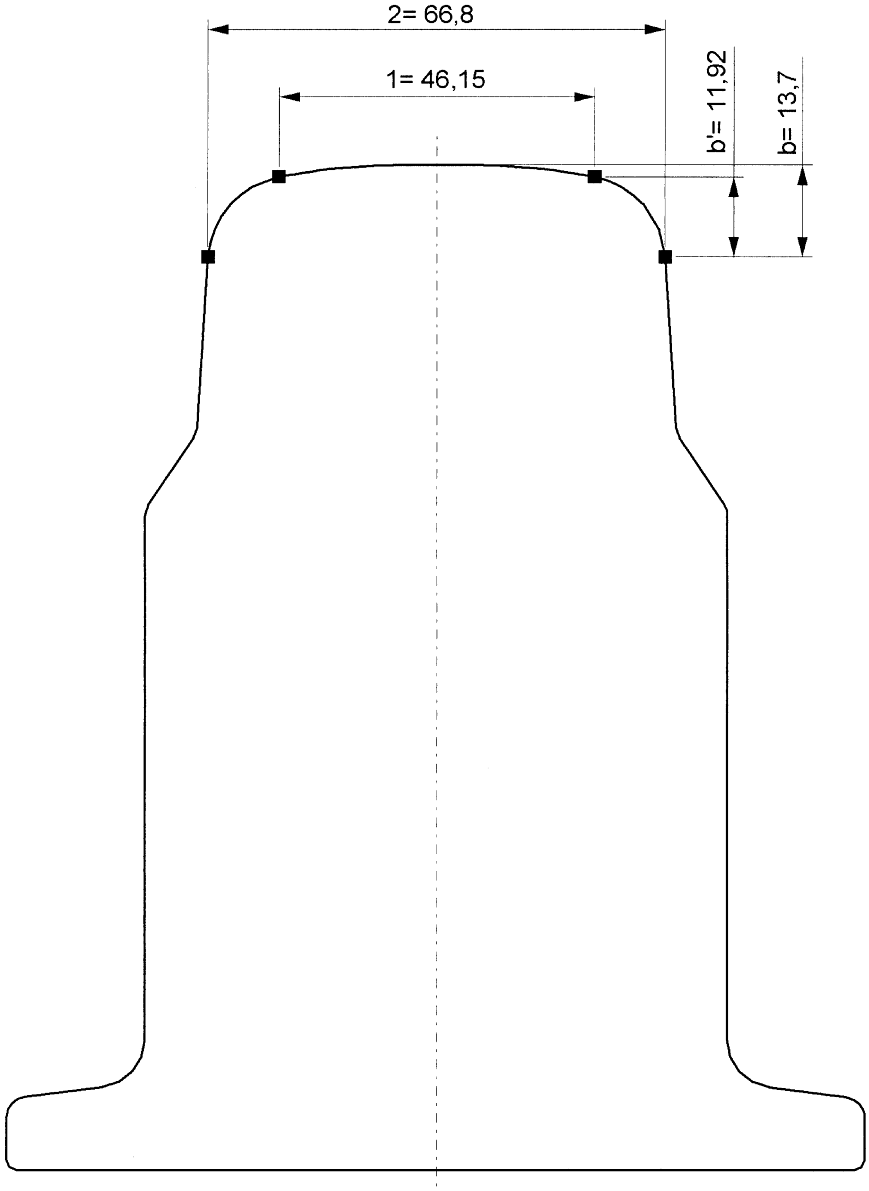


Figure A.59 — 49E1F2 Rail Transition Points

Dimensions in millimetres

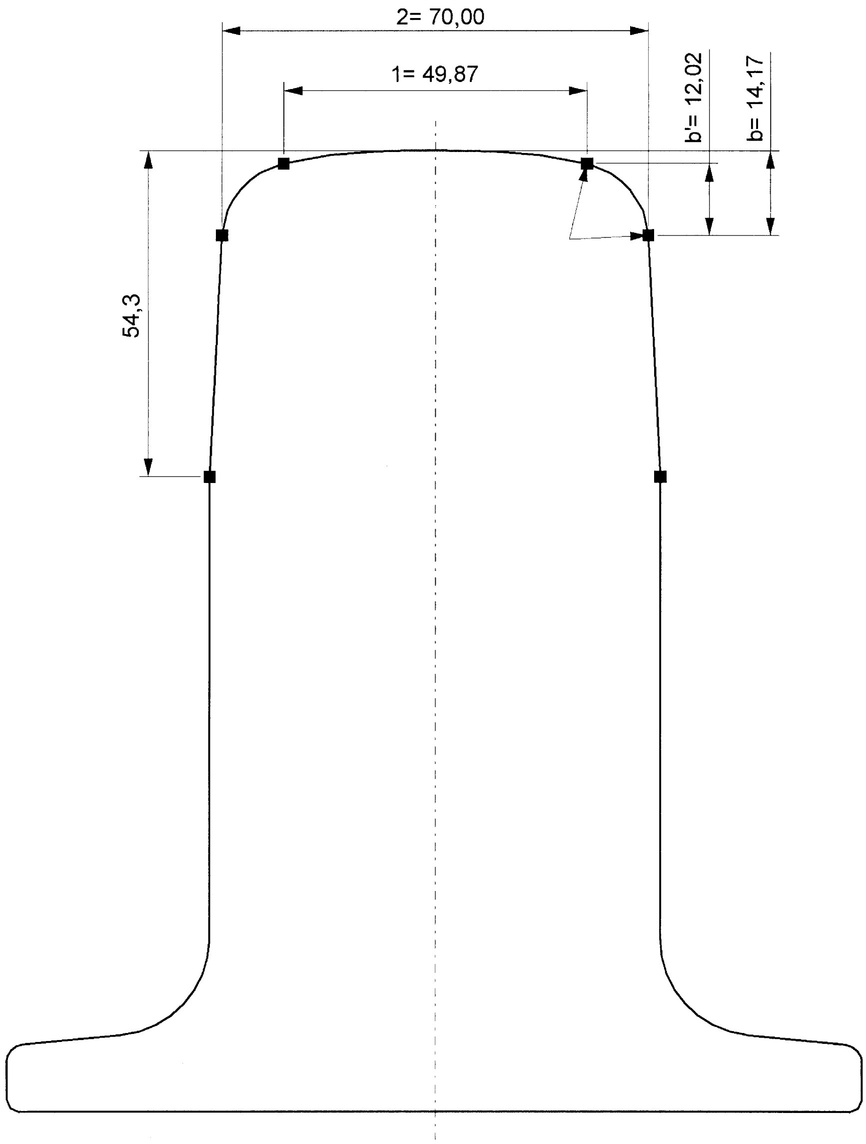


Figure A.60 — 54E1F1 Rail Transition Points

Dimensions in millimetres

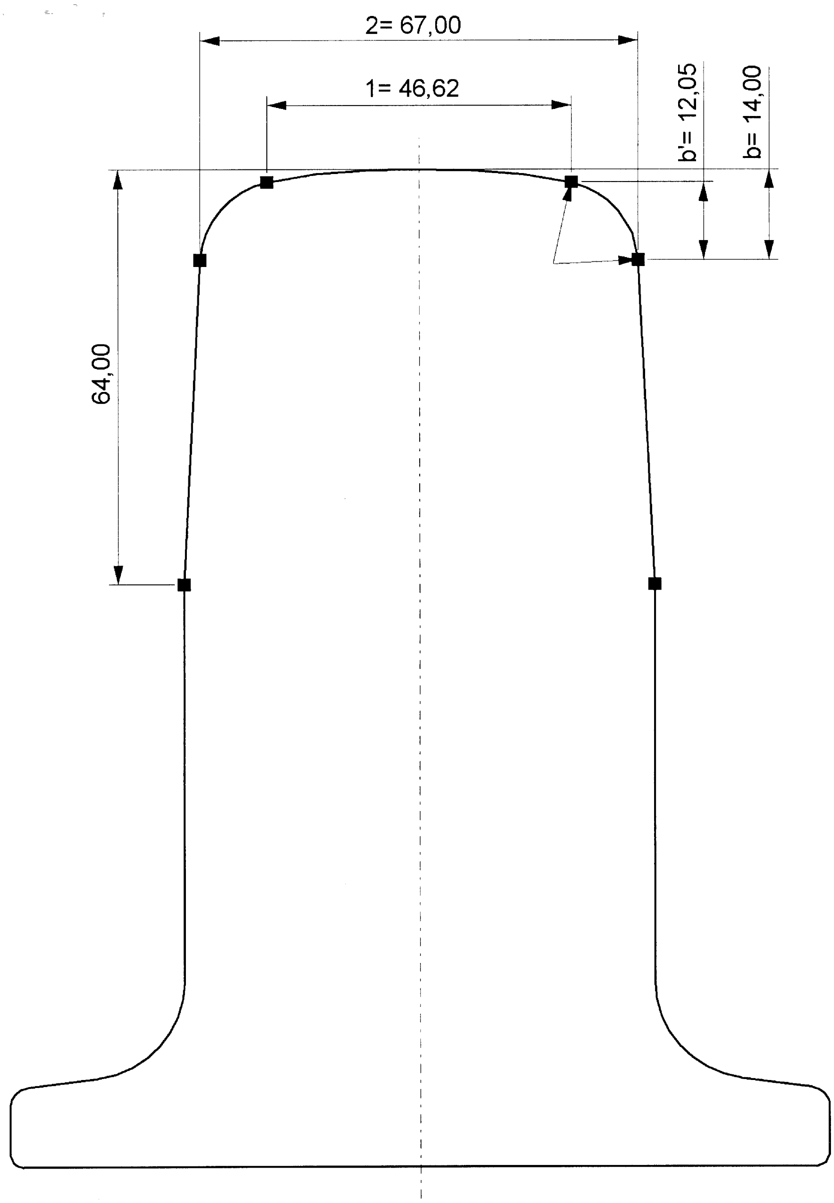


Figure A.61 — 54E3F1 Rail Transition Points

Dimensions in millimetres

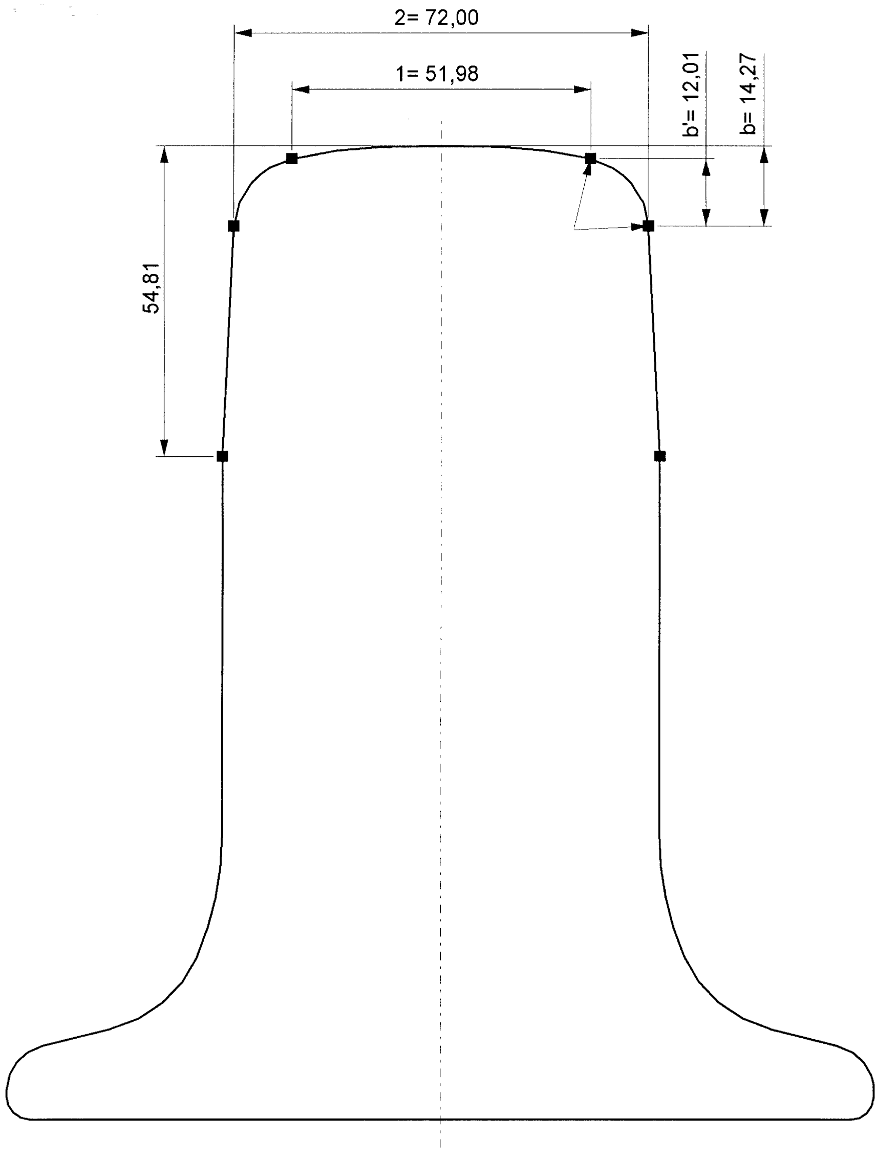


Figure A.62 — 60E1F1 Rail Transition Points

Dimensions in millimetres

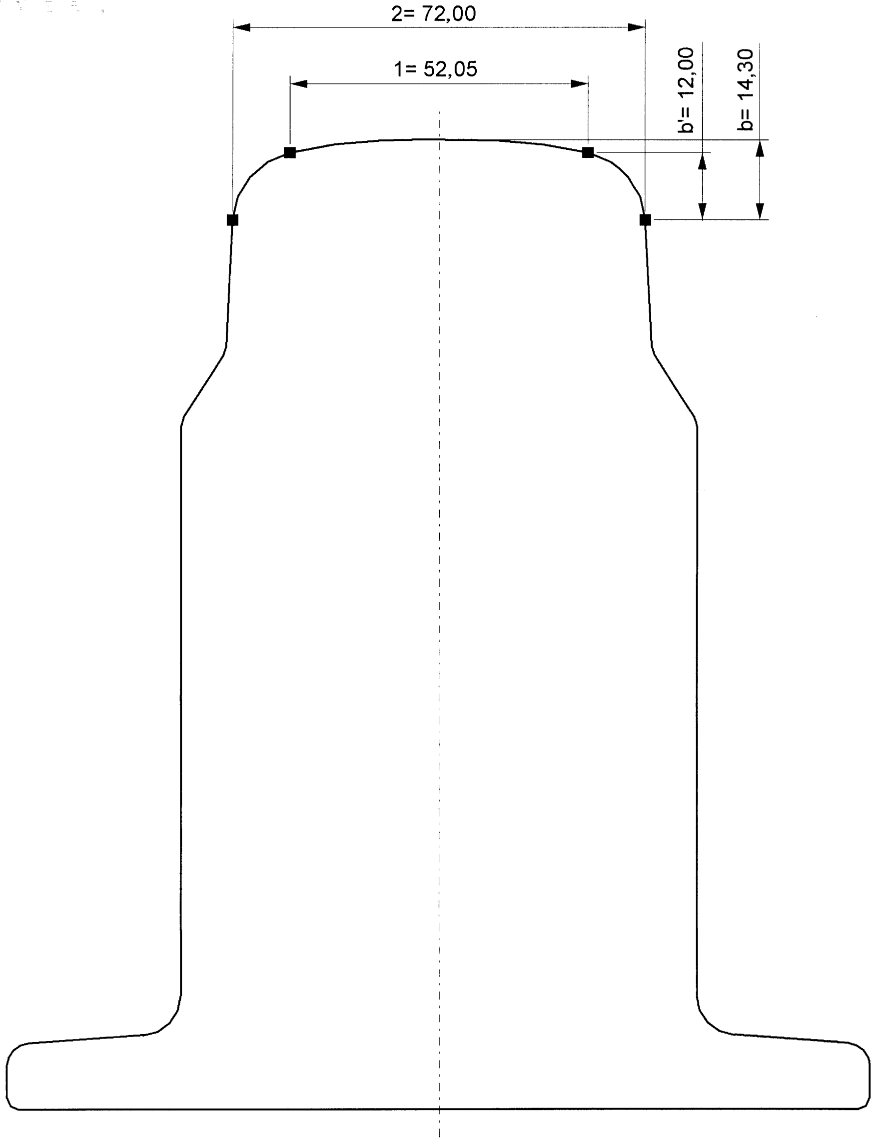


Figure A.63 — 60E1F2 Rail Transition Points

Dimensions in millimetres

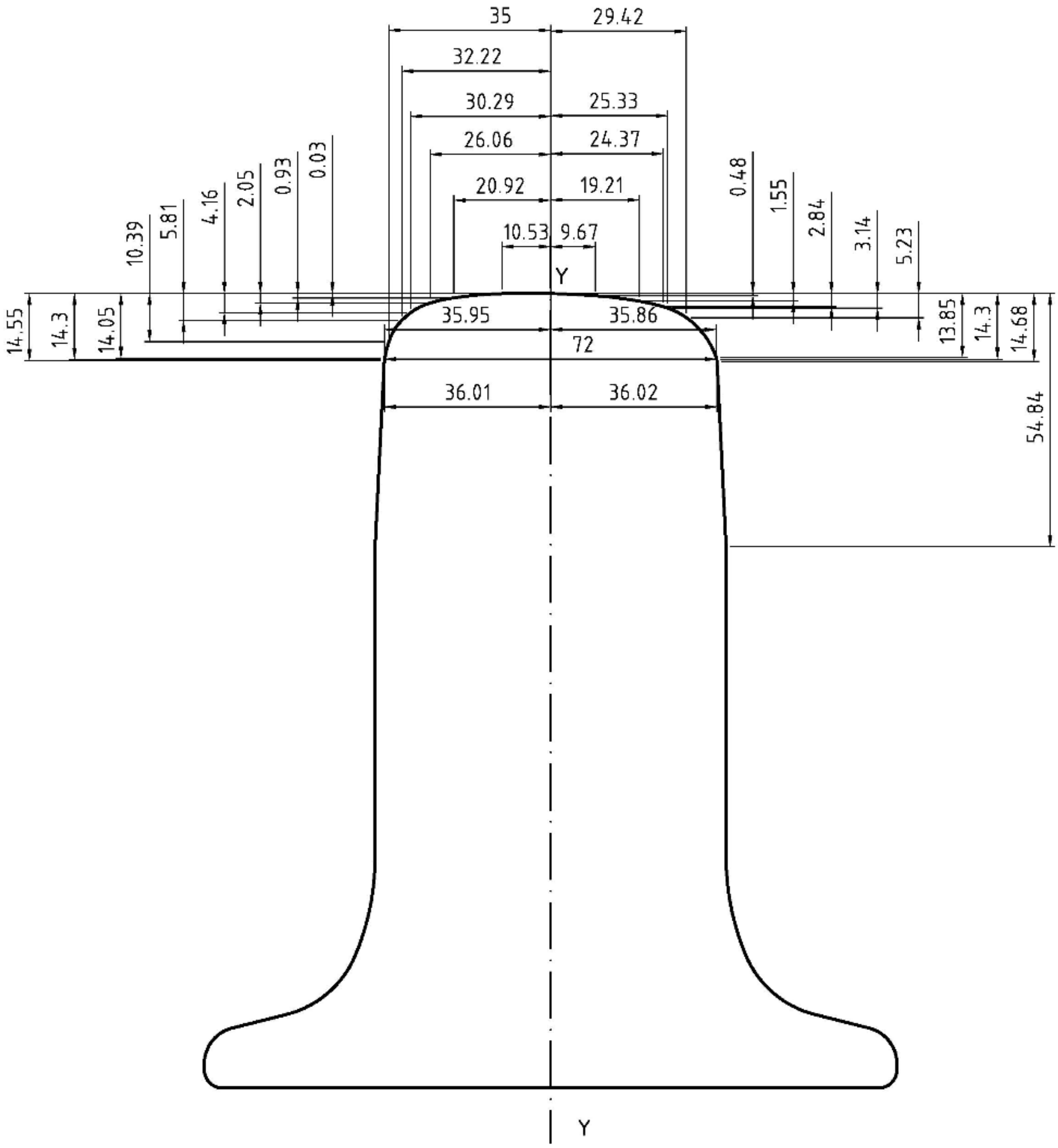


Figure A.64 — 60E2F1 Rail Transition

Annex B
(normative)

Comparison of steel designations referred to in this standard compared to those in EN 10027-1 and EN 10027-2

Steel grade in this standard	**Steel name according to** EN 10027–1	**Steel number according to** EN 10027–2
R200	R200	1.0521
R220	R220	1.0524
R260	R260	1.0623
R260Mn	R260Mn	1.0624
R260Cr	R260Cr	1.0911
R320Cr	R320Cr	1.0915
R350HT	R350G1HT	1.0631
R350LHT	R350G2HT	1.0632
R370CrHT		1.0992

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (Recast)

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2008/57/EC[1)].

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 for HS Infrastructure confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

1) This Directive 2008/57/EC adopted on 17th June 2008 is a recast of the previous Directives 96/48/EC 'Interoperability of the trans-European high-speed rail system' and 2001/16/EC 'Interoperability of the trans-European conventional rail system' and revisions thereof by 2004/50/EC 'Corrigendum to Directive 2004/50/EC of the European Parliament and of the Council of 29 April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system' and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system'.

Table ZA — Correspondence between this European standard, the HS TSI INF, published in OJEU dated 19 March 2008, and Directive 2008/57/EC

Clause(s)/ sub-clause(s) of this European Standard	Chapter/ § of the TSI	Essential Requirements of Directive 2008/57/EC	Comments
Clause 5 Steel grades Clause 6 Dimensions, static properties, linear mass and tolerances Clause 8 Qualification of the manufacturer Clause 9 Acceptance tests Annex A Rail profiles	3.3. Essential Requirements- Meeting the essential requirements by the specifications of the Infrastructure domain 3.3.1 Safety (two first paragraphs) 3.4 Elements of the Infrastructure domain corresponding to essential requirements 5.3.1 Interoperability constituents – Constituents performances and specifications - The rail 5.3.1.1 b) Railhead profile – switches and crossings 5.3.1.2 Design linear mass 5.3.1.3 b). Steel grade – switches and crossings Annex A – Table A.1 Interoperability constituents of the infrastructure domain – Assessment of interoperability constituents for the EC declaration of conformity 5.3.1.1 – Rail head profile 5.3.1.2 – Design linear mass 5.3.1.3 – Steel grade Annex F – Rail profile 60E2	Annex III – Essential Requirements – 1 General Requirements 1.1 Safety Clauses 1.1.1 – 1.1.2 and 1.1.3 Clause 1.5 - Technical compatibility	Clauses of the standard made mandatory by being quoted in the TSI: - 5.3.1.1 Selection of railhead profile from the range of Annex A of the standard or shall be profile 60E2 defined in Annex F of the TSI - 5.3.1.2 Design linear mass of the rail, specified in Annex A of the standard shall be more than 53 kg/m - 5.3.1.3 The steel grade of the rail shall comply with Clause 5 of the standard

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 10027-1, *Designation systems for steels - Part 1: Steel names*

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

[3] EN ISO 9001, *Quality management systems - Requirements (ISO 9001:2015)*