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BRITISH STANDARD 9:1935

RAILWAY RAILS
HEAD

BRITISH STANDARD 9:1935

BRITISH STANDARD
SPECIFICATION AND SECTIONS FOR

BULL HEAD
RAILWAY RAILS

B.S. 9 : 1935

31 AUG 1938

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BRITISH STANDARDS INSTITUTION

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Bull Head Railway Rails

War Emergency Revision

Page 7. Clause 2. *Quality and Chemical Composition of the Steel.*

The maximum percentage of sulphur and of phosphorus for steel made by the acid or basic open hearth process, or by the acid Bessemer process, shall be 0.07 per cent.

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PD 5131

Amendment No. 3, published 28 January, 1964

to B.S. 9 : 1935

Bull head railway rails

Revision

Clause 2. In the second line, delete 'or the acid Bessemer processes' and substitute 'acid Bessemer or approved oxygen steelmaking process'.

Add at the end of the first paragraph: 'For rails produced by an approved oxygen process, the chemical composition shall be agreed between the manufacturer and the purchaser.'

Clause 8. Add at the end of the third paragraph: 'The properties to be obtained from steel manufactured by an approved oxygen process shall be agreed between the manufacturer and the purchaser.'

Clause 11. Delete the four paragraphs relating to 'Falling Weight Tests' and substitute the following:

'Falling Weight Tests. If the cast is 50 tons or under and the original test fails, two additional tests may be made, each from the top end of other A* rails made from the same cast, and if either or both fail, all the A rails from the cast represented shall be rejected.'

If the cast is over 50 tons and one of the original tests fails, another test may be made from the top end of another A rail made from the same cast from which the test piece which failed was taken, and if this test fails, all the A rails from the cast represented shall be rejected.

If the cast is over 50 tons and both the original tests fail, four additional tests may be made, each from the top end of other A rails from the same cast from which the test pieces which failed were taken, and if any one of these four tests fails, all the A rails from the cast represented shall be rejected.

Upon the rejection of the A rails of the cast, two further falling weight test pieces shall be selected by the inspector, from the bottom end of the A rails, and only if both withstand the test shall the cast (minus the A rails) be accepted as having passed this test.'

Insert the following footnote:

* The A rail being the rail located nearest to the top of the ingot.'

PD 3090

Amendment No. 2, published 24 June, 1958

to B.S. 9 : 1935

Bull head railway rails

REVISION

Clause 2. Delete the text and tables of this clause and substitute:

The steel for the rails shall be of the best quality made by the open hearth, electric, or the acid Bessemer processes, as may be specified, or required by the engineer or the purchaser, and shall show on analysis that in chemical composition it conforms to the limits given for such processes in the following table:

CHEMICAL COMPOSITION

Element	Process					
	Open hearth		Electric		Acid Bessemer	
	per cent		per cent		per cent	
	min.	max.	min.	max.	min.	max.
Carbon	0.50	0.60	0.45	0.55	0.40	0.50
Silicon	0.08	0.20	0.08	0.20	0.08	0.20
Manganese	0.95	1.25	0.95	1.25	0.95	1.25
Sulphur	—	0.060	—	0.060	—	0.060
Phosphorus	—	0.060	—	0.060	—	0.060

Clause 8. Delete Paragraph 3 and table and substitute:

The test shall show that the steel has the properties shown in the following table:

TENSILE PROPERTIES

Process of manufacture	Minimum tensile strength		Minimum elongation per cent
	tons/sq. in.	kg/sq. mm	
Open hearth	46	72	11
Electric	46	72	11
Acid Bessemer	44	69	11

CO-OPERATING ORGANISATIONS

The Public Works Industry Committee under whose supervision this Specification was prepared consists of representatives from the following Government Departments and Scientific and Industrial Organisations :

- Admiralty
 - *Crown Agents for the Colonies
 - *High Commissioner for India
 - H.M. Office of Works
 - Ministry of Health
 - Ministry of Transport
 - *War Office
 - Association of Consulting Engineers
 - Asphalt Roads Association
 - Bridge and Constructional Ironwork Association
 - *British Iron and Steel Federation
 - British Road Tar Association
 - British Waterworks Association
 - County Surveyors' Society
 - Cement Makers' Federation
 - Federation of Civil Engineering Contractors
 - *Institution of Civil Engineers
 - Institution of Gas Engineers
 - *Institution of Municipal and County Engineers
 - Institution of Structural Engineers
 - Institution of Water Engineers
 - Iron and Steel Institute
 - *Municipal Tramways and Transport Association
 - National Federation of Clay Industries
 - National Federation of Roadstone Quarry Owners
 - Public Works Contractors' Association
 - *Railway Companies of Great Britain
 - *Tramways, Light Railways, and Transport Association
- The Government Departments and Scientific and Industrial Organisations marked with an asterisk in the above list, together with the following, were directly represented on the Committees entrusted with the preparation of this Specification :
- Union of South Africa
 - Iron and Steel Trades Employers' Association
 - London Passenger Transport Board

THIS BRITISH STANDARD, having been approved by the Public Works Industry Committee and endorsed by the Chairman of the Engineering Divisional Council, was published by the authority of the General Council on 4th March, 1935.

First published October, 1904.

First revision July, 1909.

Second revision June, 1922.

Third revision September, 1928.

Fourth revision March, 1935.

This British Standard was reset in new type in June, 1944. The text is identical with that of previous copies of the 1935 edition.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the Committees charged with the revision of the Standards to which they refer.

A complete list of British Standards, numbering over one thousand, indexed and cross-indexed for reference, together with a list of new standards in preparation will be found in the Institution's Year-book.

This British Standard requires reference to the following :

B.S. 47. Steel Fishplates for Bull Head and Flat Bottom Railway Rails.

British Standards are revised, when necessary, either by the issue of amendment slips or revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or edition.

Users wishing to be kept informed of any alteration to this standard should notify Publications Sales Department of the Institution, giving the number and title of the standard.

FOREWORD

The British Standard Specification for Bull Head Railway Rails, with the accompanying Standard Sections of rails from 60 lb. to 100 lb. per yard inclusive, was first published in 1904. The first revision was issued in 1909, and in 1922 a further revision was published in which modifications were made to the original rail sections Nos. 85, 90 and 95, the revised sections being designated Nos. 85R, 90R and 95R. Other revisions covering alterations to the requirements appeared in 1922 and 1928.

The revisions embodied in the present edition consist in :

- a. the introduction of a medium manganese quality of rail with the appropriate analysis and mechanical tests,
- b. the omission of the ordinary carbon quality of rail,
- c. certain modifications to the chemical composition of basic open hearth and acid Bessemer higher carbon rails, and
- d. an increase in the permissible quantity of short lengths which may be supplied when standard 60 ft. lengths of rail are ordered.

NOTE. The Institution desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the material herein referred to, but does not purport to include all the necessary provisions of a contract.

BRITISH STANDARD SPECIFICATION AND SECTIONS FOR

BULL HEAD RAILWAY RAILS

The figures in British measures are to be regarded as the Standard. Approximate metric equivalents are given for the convenience of users in countries in which the metric system has been generally adopted.

BULL HEAD RAILWAY RAIL SECTIONS

1. The section of the bull head railway rails (hereinafter referred to as the 'rails') shall be in accordance with one or other of the drawings of rails shown on Plates 2 to 10 (see Appendix C, pages 27 to 43), as may be specified or required.

QUALITY AND CHEMICAL COMPOSITION OF THE STEEL

2. The steel for the rails shall be of the best quality made by the open hearth or acid Bessemer process, as may be specified or required by the engineer† (or the purchaser), and shall show on analysis that in chemical composition it conforms to the limits given for such processes respectively in Tables 1 and 2.

The steel shall conform to the limits of chemical composition appearing in Tables 1 and 2, under the headings of 'Higher Carbon' and 'Medium Manganese', respectively, as may be specified or required by the engineer (or the purchaser).*

† The word 'engineer' throughout this Specification shall mean the engineer or firm of engineers supervising or acting as engineer or engineers for the purchaser or in connection with the works for which the rails are required.

* It is recommended that the higher limit of carbon given in each of the tables be worked to, as far as possible, for rails of 80 lb. per yard (39.68 kg. per metre) and upwards.

TABLE 1. STEEL MADE BY THE OPEN HEARTH PROCESS

Element	Acid		Basic	
	Higher carbon	Medium manganese	Higher carbon	Medium manganese
Carbon	per cent 0.50 to 0.60	per cent 0.45 to 0.55	per cent 0.55 to 0.65	per cent 0.50 to 0.60
Manganese	0.90 (max.)	0.90 to 1.20	0.90 (max.)	0.90 to 1.20
Silicon	0.10 to 0.30	0.10 to 0.30	0.10 to 0.30	0.10 to 0.30
Phosphorus	0.06 (max.)	0.06 (max.)	0.05 (max.)	0.05 (max.)
Sulphur	0.06 (max.)	0.06 (max.)	0.05 (max.)	0.05 (max.)

TABLE 2. STEEL MADE BY THE ACID BESSEMER PROCESS

Element	Higher carbon	Medium manganese
Carbon	per cent 0.45 to 0.55	per cent 0.40 to 0.50
Manganese	0.90 (max.)	0.90 to 1.20
Silicon	0.10 to 0.30	0.10 to 0.30
Phosphorus	0.06 (max.)	0.06 (max.)
Sulphur	0.06 (max.)	0.06 (max.)

DETERMINATIONS FOR CARBON AND PHOSPHORUS BEFORE ROLLING

3. The manufacturer shall, at his own expense, make carbon and phosphorus determinations of each cast, which shall conform to the limits in Clause 2. Such determinations shall, if required, be furnished to the engineer or the inspector* (or the purchaser). If the carbon and phosphorus determinations of a cast do not conform to the limits in Clause 2 the cast may be rejected, subject to the provisions of Clause 11.

COMPLETE CHEMICAL ANALYSIS AFTER ROLLING

4. A complete chemical analysis shall be made from drillings taken either from a hole drilled in a rail selected by the engineer or the inspector (or the purchaser) and from the position shown in Figure 1, or from the tensile test piece or pieces selected by the engineer or the inspector (or the purchaser), and shall show that the chemical composition conforms to the limits in Clause 2 hereof. The diameter of the drill shall be $\frac{3}{4}$ inch (19.05 mm.) for B.S. Sections Nos. 60 to 80, and 1 inch (25.40 mm.) for B.S. Sections Nos. 85R to 100.

If required by the engineer or the inspector (or the purchaser) the carbon content shall be taken by combustion, and determination shall be given of arsenic and copper.

* The word 'inspector' throughout this Specification shall mean any person expressly authorised in writing by the engineer (or the purchaser) to perform the duties herein referred to or any of them.

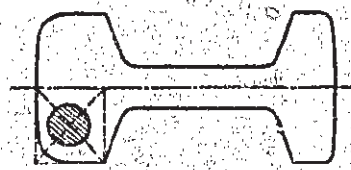


Fig. 1

NUMBER OF CHEMICAL ANALYSES AFTER ROLLING

5. The manufacturer shall, at his own expense, make and furnish to the engineer or the inspector (or the purchaser), one complete chemical analysis after each rolling from every 100 tons or part of 100 tons (224 000 lb. = 101 605 kg.) of rails rolled. If the analysis of any of the 100 tons of rails or part thereof should fail to conform to the provisions of Clause 2, the 100 tons of rails or part thereof represented by the analysis which so failed may be rejected subject to the provisions of Clause 11.

FALLING WEIGHT TEST

6. A falling weight test shall be made in the following manner: A piece of rail 5 feet (1.52 m.) long, taken from one of the rails selected by the engineer or the inspector (or the purchaser), shall be placed in a horizontal position with the head uppermost upon the two steel bearers of the British Standard Falling Weight Testing Machine (Appendix A, page 19), the bearers being 3 feet 6 inches (1.07 m.) apart at their centres, and having their upper surfaces curved to a radius of 3 inches (76.20 mm.).

The piece of rail shall be cut at the hot saws, and may be selected from that part of the rail adjacent to the top end crop, or, with the consent of the manufacturer, from the top end crop itself.

The test shall comprise two blows delivered midway between the bearers from a falling iron weight as described in Appendix A, page 19. The height of the drop for the various sections of rails shall be as tabulated below. The blows shall be sustained without fracture, and the permanent set measured on the specified distance between the centres of the bearers resulting from the two blows must not exceed the limits given below.

Falling weight of 20 cwt. (2 240 lb. = 1 016 kg.)
Centres of bearers, 3 feet 6 inches (1.07 m.) apart

No. of B.S. section and nominal weight in lb. per yard (kg. per metre)	Height of drop		Maximum permanent set resulting from the two blows	No. of B.S. section and nominal weight in lb. per yard (kg. per metre)
	1st blow	2nd blow		
	ft. (m.)	ft. (m.)	in. (mm.)	
60 (29.76)	5 (1.52)	10 (3.05)	3.7 (93.98)	60 (29.76)
65 (32.24)	5 (1.52)	12 (3.66)	3.7 (93.98)	65 (32.24)
70 (34.72)	6 (1.83)	12 (3.66)	3.7 (93.98)	70 (34.72)
75 (37.20)	6 (1.83)	12 (3.66)	3.7 (93.98)	75 (37.20)
80 (39.68)	6 (1.83)	15 (4.57)	4.0 (101.60)	80 (39.68)
85R (42.16)	6 (1.83)	15 (4.57)	4.0 (101.60)	85R (42.16)
90R (44.64)	7 (2.13)	18 (5.49)	4.1 (104.14)	90R (44.64)
95R (47.13)	7 (2.13)	20 (6.10)	4.1 (104.14)	95R (47.13)
100 (49.61)	7 (2.13)	20 (6.10)	3.9 (99.06)	100 (49.61)

NUMBER OF FALLING WEIGHT TESTS

7. The manufacturer shall, at his own expense, make one falling weight test from each cast when the cast is 50 tons (112 000 lb. = 50 802 kg.) or under, and an additional falling weight test in respect of every 50 tons or part thereof when the cast exceeds 50 tons, the test pieces being selected from rails rolled from different ingots.

If the test should fail the cast from which the rail was taken may be rejected, subject to the provisions of Clause 11.

TENSILE TEST AND TEST PIECES

8. If the engineer (or the purchaser) requires the tensile breaking strength and elongation of the steel, it shall be determined by a test made in a testing machine of approved pattern from Standard Tensile Test Pieces C or D. (See Appendix B, page 21.)

Such test shall be made on the Standard test piece cut from a piece of steel selected by the engineer or the inspector (or the purchaser) from any rail in each 100 tons (224 000 lb. = 101 605 kg.) or part of 100 tons of rails rolled, or from a short length cut at the hot saws during rolling from the bar of which such rail or rails formed part. The test piece shall be taken from the position shown in Figure 2.

The test must show the tensile-breaking strength and minimum elongation of the steel given in the following table :



Fig. 2

Class of steel	Process of manufacture	Tensile breaking strength, Tons per sq. in.	Minimum elongation	
			Per cent	Between limits of breaking strength in tons per sq. in.
Higher Carbon	Open Hearth (Acid or Basic)	46 to 55	12	46 to 50
	Bessemer (Acid)	44 to 53	10	Over 50 and up to 55
Medium Manganese	Open Hearth (Acid or Basic)	46 and over	12	44 to 50
	Bessemer (Acid)	44 and over	10	Over 50 and up to 53
			12	46 to 50
			10	Over 50
			12	44 to 50
			10	Over 50

METRIC EQUIVALENTS IN ABOVE TABLE

Tons per sq. in.	kg. per mm. ²	Tons per sq. in.	kg. per mm. ²
44	69.29	53	83.47
46	72.44	55	86.62
50	78.74		

Should a tensile test piece break outside the middle half of its gauge length (see Figure 3) it may be discarded, and such break shall not be considered as a failure of the test, and a fresh test, or fresh tests, may be made by the manufacturer with a test piece or test pieces taken from a rail from the same cast from which the discarded test piece was taken.

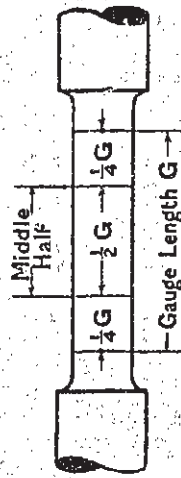


Fig. 3. Diagram explaining the term 'middle half' of the gauge length.

NUMBER OF TENSILE TESTS

9. The manufacturer shall, at his own expense, make one tensile test (if required by the engineer or the purchaser) from every 100 tons or part of 100 tons (224 000 lb. = 101 605 kg.) of rails rolled. If the test of any of the 100 tons of rails or part thereof should fail the whole of the 100 tons or part thereof represented by the test may be rejected, subject to the provisions of Clause 11.

TESTS AT MANUFACTURER'S WORKS

10. The manufacturer shall carry out the foregoing mechanical tests at his works in the presence of the engineer or the inspector (or the purchaser) and shall, at his own expense, supply the engineer or the inspector (or the purchaser) with properly authenticated certificates of the carbon and phosphorus determinations in Clause 3 (if required) and of the chemical analyses in Clauses 4 and 5.

ADDITIONAL CHEMICAL ANALYSES AND MECHANICAL TESTS BEFORE REJECTION

11. Should any of the chemical analyses or mechanical tests not comply with the requirements of this Specification and should the manufacturer in either or any of such events give notice in writing forthwith to the engineer or the inspector (or the purchaser) that he desires to make additional chemical analyses and/or mechanical tests, he shall be at liberty forthwith, at his own expense, to make additional chemical analyses and/or mechanical tests and shall, if he gives such notice, make such additional chemical analyses and/or mechanical tests as are hereinafter in this clause mentioned. The drillings, test pieces and/or pieces of rails for such additional chemical analyses and mechanical tests shall be taken or cut in the same manner as before and be selected by the engineer or the inspector (or the purchaser).

These additional chemical analyses and mechanical tests shall be carried out by the manufacturer in the same manner in all respects as