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British Engineering Standards Association

BRITISH
STANDARD SPECIFICATION
AND
SECTIONS
FOR
BULL HEAD RAILWAY RAILS

(REVISED 1928)

SEPTEMBER 1928

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British Engineering Standards Association. (Incorporated 1918.)

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THE INSTITUTION OF MECHANICAL ENGINEERS.
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THE IRON AND STEEL INSTITUTE.
THE INSTITUTION OF ELECTRICAL ENGINEERS.

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National Physical Laboratory.
Railway Companies of Great Britain.
Institution of Municipal and County Engineers.
Tramways and Light Railways Association.
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National Federation of Iron and Steel Manufacturers.

This Specification was adopted by the Sectional Committee on Rails at their meeting on June 27th, 1928, and approved on behalf of the Main Committee on July 16th, 1928.

NOTE.

In order to keep abreast of progress in the Industries concerned, the British Standard Specifications are subjected to periodical review.

Suggestions for improvements, addressed to the Secretary, British Engineering Standards Association, 28, Victoria Street, London, S.W. 1, will be welcomed at all times. They will be recorded, and in due course brought to the notice of the Committees charged with the revision of the Specifications to which they refer.

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PREFACE.

The British Standard Specification for Bull Head Railway Rails Report No. 9, 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 a second revision in 1922.

Since then it has been necessary to make certain changes to bring it into line with present-day requirements, and these have at various times been published as addendum slips to the Specification. In the present revised edition these amendments have been incorporated into the text of the Specification, which, therefore, differs from the previous issue in the following respects :—

1. All reference to steel made by the Basic Bessemer and "other" Processes has been deleted.
2. The maximum limits for sulphur and phosphorus in steel made by the Acid Open Hearth Process (ordinary and higher carbon qualities) and the maximum limit for phosphorus in steel made by the Acid Bessemer Process (higher carbon quality) have been raised.
3. The obligation to mark Rails with the Association's Brand (or Mark) to indicate that they are of British Standard Section has been cancelled.

(7)

NOTE.—The Association 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

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(REVISED SEPTEMBER, 1928.)

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 III, 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 "Ordinary Carbon" and "Higher Carbon" 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 lbs. per yard (39.68 kgs. per metre) and upwards.

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(8)

Table 1. Steel made by the Open Hearth Process.

Element.	Acid.		Basic.	
	Ordinary Carbon.	Higher Carbon.	Ordinary Carbon.	Higher Carbon.
Carbon ...	Per Cent. 0.45 to 0.55	Per Cent. 0.50 to 0.60	Per Cent. 0.45 to 0.60	Per Cent. 0.55 to 0.65
Manganese ...	0.90 (max.)	0.80 (max.)	0.90 (max.)	0.80 (max.)
Silicon ...	0.15 (max.)	0.10 to 0.30	0.15 (max.)	0.10 to 0.30
Phosphorus ...	0.07 (max.)	0.06 (max.)	0.05 (max.)	0.04 (max.)
Sulphur ...	0.07 (max.)	0.06 (max.)	0.06 (max.)	0.05 (max.)

Table 2. Steel made by the Acid Bessemer Process.

Element.	Acid.	
	Ordinary Carbon.	Higher Carbon.
Carbon ...	Per Cent. 0.40 to 0.50	Per Cent. 0.45 to 0.55
Manganese ...	0.70 to 1.30	0.90 (max.)
Silicon ...	0.15 (max.)	0.10 to 0.30
Phosphorus ...	0.075 (max.)	0.07 (max.)
Sulphur ...	0.07 (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 $\frac{3}{8}$ 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.

(9)

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 I, 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 I, 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.

No. of B.S. Section and Nominal Weight 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 lb. per yard (kg. per metre).
	1st Blow.	and Blow.	Ordinary Carbon Rail.	Higher Carbon Rail.	
60 (29.76)	ft. (m.) 10 (3.05)	ft. (m.) 10 (3.05)	in. (mm.) 3.9 (99.06)	in. (mm.) 3.7 (93.98)	60 (29.76)
65 (32.24)	5 (1.52)	12 (3.66)	3.9 (99.06)	3.7 (93.98)	65 (32.24)
70 (34.72)	6 (1.83)	12 (3.66)	3.9 (99.06)	3.7 (93.98)	70 (34.72)
75 (37.20)	6 (1.83)	12 (3.66)	3.9 (99.06)	3.7 (93.98)	75 (37.20)
80 (39.68)	6 (1.83)	15 (4.57)	4.2 (106.68)	4.0 (101.60)	80 (39.68)
85R (42.16)	6 (1.83)	15 (4.57)	4.2 (106.68)	4.0 (101.60)	85R (42.16)
90R (44.64)	7 (2.13)	18 (5.49)	4.3 (109.22)	4.1 (104.14)	90R (44.64)
95R (47.13)	7 (2.13)	20 (6.10)	4.3 (109.22)	4.1 (104.14)	95R (47.13)
100 (49.61)	7 (2.13)	20 (6.10)	4.1 (104.14)	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.

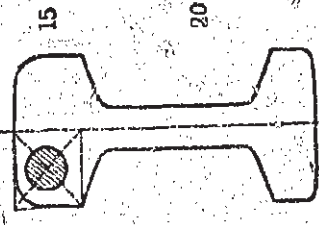
8. If the Engineer (or the Purchaser) requires the tensile breaking strength and elongation of the steel, it shall be determined by a test made in a testing machine of approved pattern from Standard Tensile Test Pieces C or D. (See Appendix II, page 21.)

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:—

Class of Steel.	Process of Manufacture.	Tensile Breaking Strength. (kg. per sq. mm.)	Minimum Elongation. Per cent.
Ordinary Carbon	Open Hearth (Acid or Basic) or Bessemer (Acid).	42 (66.14) with 15 to 50 (78.74) with 12	15 (The minimum elongations for intermediate breaking strength being in proportion.)
		Over 50 (78.74) and up to 53 (83.47)	10
Higher Carbon	Open Hearth (Acid or Basic)	46 (72.44) to 50 (78.74) and up to 55 (86.62)	12
		Bessemer (Acid)	10
		44 (69.29) to 50 (78.74) and up to 53 (83.47)	12
		Over 50 (78.74) and up to 53 (83.47)	10

Fig. 2.



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.

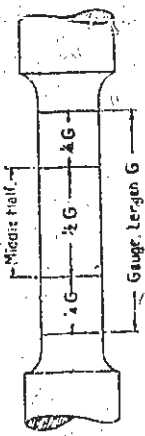


Fig. 3. Diagram explaining the term "Middle Half" of the Gauge Length.

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