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No. 9-1922. REVISED SPECIFICATION.

British Engineering Standards Association.

(Incorporated 1918.)

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE

BY

THE INSTITUTION OF CIVIL ENGINEERS.
THE INSTITUTION OF MECHANICAL ENGINEERS.
THE INSTITUTION OF NAVAL ARCHITECTS.
THE IRON AND STEEL INSTITUTE.
THE INSTITUTION OF ELECTRICAL ENGINEERS.

WITHDRAWN

BRITISH STANDARD SPECIFICATION AND SECTIONS FOR BULL HEAD RAILWAY RAILS.

(REVISED JUNE, 1922.)

LONDON:
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This Report was adopted by the Sectional Committee on Rails at their Meeting on March 22nd, 1922, and approved on behalf of the Main Committee on May 30th, 1922.

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, 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.

No. 9—1922.

British Engineering Standards Association.

(*Incorporated 1918.*)

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BRITISH ENGINEERING STANDARDS ASSOCIATION.

The following is the List of Members of the Sectional Committee on Rails, and of the Sub-Committee on Railway Rails which was entrusted with the present revision of the British Standard Specification.

SECTIONAL COMMITTEE ON RAILS.

March, 1922.

Chairman, Mr. A. ROSS.

India Office, Mr. G. Deuchars.

Crown Agents for the Colonies, Mr. Ashton M. Heath.

Institution of Municipal and County Engineers, Mr. Charles F. Wike; Mr. E. J. Elford.

Tramways and Light Railways Association, Mr. R. J. Howley, C.B.E.

Municipal Tramways Association, Mr. J. B. Hamilton, C.B.E.

Railway Engineers' Association, Mr. W. W. Grierson, C.B.E.; Mr. E. C. Trench, C.B.E.

Sir J. A. F. Aspinall; Mr. F. W. Harbord, C.B.E.; Brig.-Gen. Sir Brodie Henderson, K.C.M.G., C.B. (*Livesey, Son & Henderson*); Mr. T. R. Johnson; Mr. D. A. Matheson (*Caledonian Railway*); Mr. A. Peech (*Steel, Peech & Tozer, Ltd.*); Mr. D. Richards (*Walter Scott, Ltd.*); Mr. George Ritchie (*Bolckow, Vaughan & Co. Ltd.*); Mr. Benjamin Talbot (*Cargo Fleet Iron Co. Ltd.*); Mr. W. B. Worthington.

SUB-COMMITTEE ON RAILWAY RAILS.

March, 1922.

Chairman, Mr. W. B. WORTHINGTON.

Mr. A. Ross (*ex-officio*).

India Office, Mr. G. Deuchars.

Crown Agents for the Colonies, Mr. Ashton M. Heath.

Railway Engineers' Association, Mr. W. W. Grierson, C.B.E.; Mr. E. C. Trench, C.B.E.

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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 lbs. to 100 lbs. per yard inclusive, was first published in 1904, and the first revision issued in 1909.

The present revised edition embodies the alterations which experience has shown to be desirable to meet present day requirements, and the following are some of the more important modifications which have been made.

SPECIFICATION.

1. Two classes of rails are now included, namely, ordinary carbon and higher carbon rails, and separate chemical analyses are specified for the Bessemer and Open Hearth processes.

2. The position in the head of the rail from which the drillings and the test pieces for the chemical analyses and tensile tests are to be taken is now defined.

3. In the falling weight test the height of the drop for B.S. Section No. 90 has been reduced to 18 feet, the use of crop ends is allowed and the measurement of permanent set after the first blow has been omitted. The test is required to be carried out upon the British Standard Falling Weight Testing Machine, the Specification for which is inserted as an appendix.

4. The range of tensile breaking strengths for ordinary carbon rails, namely, from 40 to 48 tons per square inch, which appeared in the previous issue, has been increased to 42 to 53 tons per square inch, and a range of tensile strengths for higher carbon rails inserted.

5. The testing procedure before rejection has been set out in detail.

6. Provision is made for ascertaining the weight of the rails during rolling.

7. The Brand, or Mark, of the Association is now only intended to indicate that the rail is of British Standard section.

8. An Arbitration clause has been included.

SECTIONS.

The depth of the head of the 85, 90 and 95 lbs. rails has been increased, by $\frac{1}{16}$ inch, $\frac{5}{64}$ inch and $\frac{1}{32}$ inch respectively, with the object of securing a longer life, a corresponding amount being taken off the foot in each case in order to preserve the same weight and depth of the rail. The revised sections have been designated 85 R, 90 R and 95 R.

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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.*

Note.—*It is to be understood that the British Engineering Standards Association in no case guarantees that the goods bearing its mark are made to the Standard sections issued by the Association. The mark is to be regarded as no more than primâ facie evidence adduced by the Manufacturer that the goods are made in accordance with the Standard sections issued by the British Engineering Standards Association.*

BRITISH STANDARD SPECIFICATION AND SECTIONS FOR BULL HEAD RAILWAY RAILS

(REVISED JUNE, 1927.)

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, Bessemer or other 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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Table 1. Steel made by the Open Hearth Process.

Element.	Acid.		Basic.	
	Ordinary Carbon.	Higher Carbon.	Ordinary Carbon.	Higher Carbon.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Carbon	0·45 to 0·55	0·50 to 0·60	0·45 to 0·60	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 ...	0·06 (max.)	0·05 (max.)	0·05 (max.)	0·04 (max.)
Sulphur	0·06 (max.)	0·05 (max.)	0·06 (max.)	0·05 (max.)

Table 2. Steel made by the Bessemer Process.

Element.	Acid.		Basic.
	Ordinary Carbon.	Higher Carbon.	Ordinary Carbon.
	Per Cent.	Per Cent.	Per Cent.
Carbon	0·40 to 0·50	0·45 to 0·55	0·40 to 0·50
Manganese ...	0·70 to 1·00	0·90 (max.)	0·70 to 1·00
Silicon	0·15 (max.)	0·10 to 0·30	0·15 (max.)
Phosphorus ...	0·075 (max.)	0·06 (max.)	0·07 (max.)
Sulphur... ...	0·07 (max.)	0·06 (max.)	0·07 (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 ¾ 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.

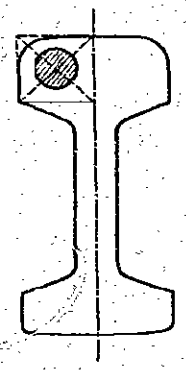

Fig. 1.

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.

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 (101,604·70 kgs.) of Rails rolled. If the analysis of any of the 100 tons (101,604·70 kgs.) of Rails or part thereof should fail to conform to the provisions of Clause 2, the 100 tons (101,604·70 kgs.) 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.

Falling Weight of 20 cwts. (1,016·05 kgs.)
Centres of bearers, 3 feet 6 inches (1·07 m.) apart.

No. of B.S. Section and Nominal Weight in lbs. per yard (kgs. per metre).	Height of Drop.		Maximum Permanent Set resulting from the two blows.		No. of B.S. Section and Nominal Weight in lbs. per yard (kgs. per metre).
	1st Blow.	2nd Blow.	Ordinary Carbon Rail.	Higher Carbon Rail.	
	ft. (m.)	ft. (m.)	in. (mm.)	in. (mm.)	
60 (29·76)	5 (1·52)	10 (3·05)	3·9 (99·06)	3·7 (93·98)	60 (29·76)
65 (32·24)	5 (1·52)	12 (3·63)	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)

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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 (50,802·35 kgs.) or under, and an additional falling weight test in respect of every 50 tons (50,802·35 kgs.) or part thereof when the cast exceeds 50 tons (50,802·35 kgs.), 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 (101,604·70 kgs.) or part of 100 tons (101,604·70 kgs.) 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.

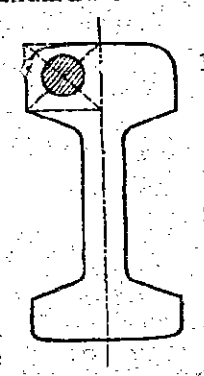

Fig. 2.

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. Tons per sq. in. (kgs. per mm².)	Minimum Elongation. Per cent.
Ordinary Carbon	Open Hearth or Bessemer	Acid or Basic	42 (66·14) with	15 (The minimum elongations for intermediate breaking strengths being in proportion.)
			to 50 (78·74) with	12
			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)	12
			Over 50 (78·74) and up to 55 (86·62)	10
	Bessemer	Acid	44 (69·29) to 50 (78·74)	12
			Over 50 (78·74) and up to 53 (83·47)	10

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.

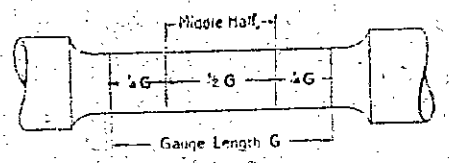

Fig. 3. Diagram explaining the term "Middle Half" of the Gauge Length.

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 (101,604·70 kgs.), of Rails rolled. If the test of any of the 100 tons (101,604·70 kgs.) of Rails or part thereof should fail the whole of the 100 tons (101,604·70 kgs.) 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 of 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

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respects as the chemical analyses and mechanical tests hereinbefore required to be made in the first instance.

Chemical Analyses.—The following are the additional chemical analyses which may be made when the first analysis has failed :—

Cast.	Number of Tests.	Events.	Conditions.
First cast—viz. : the cast from which the drillings were taken for the analysis which failed.	2	If both pass	The cast and all remaining casts are to be considered as complying with Clause 2.
		If one fails or both fail	The cast may be rejected and another analysis may be made from a second cast.
Second cast.	1	If this passes	The cast and all other casts except the first are to be considered as complying with Clause 2.
		If this fails	Two more analyses may be made from the same cast.
	2	If both pass	The cast and all other casts except the first are to be considered as complying with Clause 2.
		If one fails or both fail	The cast may be rejected.

In the event of there being more than two casts and both the first and second casts fail to pass the tests, the Manufacturer may make chemical analyses of the remaining casts in the same manner as before described, and any cast which passes will be considered as complying with Clause 2, and any which fails may be rejected.

Provided always that should the Manufacturer not forthwith make the above-mentioned additional chemical analyses, or should he otherwise fail to comply with the conditions upon which additional chemical analyses may be made by him, the whole of the casts comprised in the 100 tons (101,604·70 kgs.) or part thereof rolled may be rejected.

Falling Weight Tests.—If the cast is 50 tons (50,802·35 kgs.) or under and the original test fails, two additional tests may be made each from another Rail made from the same cast from which the test piece was taken which failed, and if either or both fail all the Rails from the cast represented may be rejected.

If the cast is over 50 tons (50,802·35 kgs.) and one of the original tests fails, another test may be made from another Rail made from the same cast from which the test piece was taken which failed, and if this test fails the cast represented may be rejected.

If the cast is over 50 tons (50,802·35 kgs.) and both the original tests fail, four additional tests may be made each from another Rail from the same cast from which the test piece was taken which failed, and if any one or more of these four tests fails or fail the cast represented may be rejected.

Provided always that should the Manufacturer not forthwith make the above-mentioned additional falling weight tests, or should he otherwise fail to comply with the conditions upon which such additional falling weight tests may be made by him, the cast represented may be rejected.

Tensile Tests.—The following are the additional tensile tests which may be made when the first tensile test has failed.

Cast.	Number of Tests.	Events.	Conditions.
First cast—viz. : the cast from which the original test piece was taken which failed.	2	If both pass	The cast and all remaining casts are to be considered as complying with Clause 8.
		If one fails or both fail	The cast may be rejected and another test may be made from a second cast.
Second cast.	1	If this passes	The cast and all other casts except the first are to be considered as complying with Clause 8.
		If this fails	Two more tests may be made from the same cast.
	2	If both pass	The cast and all other casts except the first are to be considered as complying with Clause 8.
		If one fails or both fail	The cast may be rejected.

In the event of there being more than two casts and both the first and second casts fail to pass the tests, the Manufacturer may make tests of the remaining casts in the same manner as before described and any cast which passes will be considered as complying with Clause 8, and any which fails may be rejected.

Provided always that should the Manufacturer not forthwith make the above-mentioned additional tensile tests, or should he otherwise fail to comply with the conditions upon which additional tensile tests may be made by him, the whole of the casts comprised in the 100 tons (101,604·70 kgs.) or part thereof rolled may be rejected.

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