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Committee Report

BRITISH STANDARD 24: PART 6: 1942

Sup. by 1951 issue

STEEL PLATES

SECTIONS

BAR AND RIVETS

RAILWAY

ROLLING STOCK

MATERIAL

BRITISH STANDARDS INSTITUTION

C.F. (ME) 9368

January, 1942

BRITISH STANDARDS INSTITUTION

BRITISH STANDARD SPECIFICATION FOR

STEEL PLATES FOR FIREBOXES OF

LOCOMOTIVE BOILERS

B.S. 24 : Part 6, Spec. 16 : 1942

WAR EMERGENCY REVISION

Owing to the present comparative scarcity of raw materials sufficiently low in sulphur and phosphorus for the production of steel to comply with the limits laid down in the above Specification the following amendment is hereby made :

Clause 1. Quality of Material. The maximum percentage of sulphur and of phosphorus for plates for fireboxes to be 0.04 in place of 0.03.

[B.S. 24 : Part 6 : 1942, P. 5]

BRITISH STANDARD SPECIFICATIONS

STEEL PLATES, SECTIONS BARS AND RIVETS

FOR LOCOMOTIVE BOILERS

LOCOMOTIVES

CARRIAGES AND WAGONS

RAILWAY ROLLING STOCK MATERIAL

B.S. 24 : PART 6 : 1942

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BRITISH STANDARDS INSTITUTION

Incorporated by Royal Charter

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Telegrams : Standards, Sowest, London. Telephone : Abbey 3333

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CO-OPERATING ORGANISATIONS

The Mechanical Industry Committee under whose supervision this British Standard was prepared consists of representatives from the following Government Departments and Scientific and Industrial Organisations :

- Admiralty
- *Crown Agents for the Colonies
- Department of Scientific and Industrial Research
- *High Commissioner for India
- Ministry of Works and Buildings
- Home Office
- *Ministry of Transport
- *War Office
- Agricultural and Road Machinery Manufacturers' Association
- Association of Consulting Engineers (Incorporated)
- British Chemical Plant Manufacturers' Association
- British Electrical and Allied Manufacturers' Association
- British Engineers' Association
- *British Iron and Steel Federation
- British Marine Oil-Engine Manufacturers' Association
- Engineering Insurance Companies
- Institute of Marine Engineers
- Institute of Petroleum
- Institution of Automobile Engineers
- Institution of Civil Engineers
- Institution of Gas Engineers
- Institution of Heating and Ventilating Engineers
- Institution of Mechanical Engineers
- Institution of Production Engineers
- *Locomotive Manufacturers' Association
- Machine Tool Trades Association
- *Railway Companies of Great Britain

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 Committee entrusted with the preparation of these Specifications :

- Dominion of New Zealand
- High Commissioner for the Union of South Africa
- National Physical Laboratory
- Institution of Locomotive Engineers
- Iron and Steel Trades Employers' Association
- Laminated Railway Spring Manufacturers' Association
- Steel Castings Manufacturers' Association
- Association of Drop Forgers and Stampers
- British Non-Ferrous Metals Research Association
- Railway Carriage and Wagon and Financiers' Parliamentary Association
- Railway Coil Spring Association

THESE SPECIFICATIONS having been approved by the Mechanical Industry Committee and endorsed by the Chairman of the Engineering Divisional Council were published under the authority of the General Council as British Standards on 26th January, 1942.

- First published, August, 1906
- First revision, June, 1907
- Second revision, December, 1911
- Third revision, March, 1921
- Fourth revision, September, 1929
- Fifth revision, January, 1942

The Institution desires to call attention to the fact that these Specifications are intended to include the technical provisions necessary for the supply of the material herein referred to, but do not purport to include all the necessary provisions of a contract.

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.

In order to keep abreast of progress in the industries concerned, the 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, indexed and cross-indexed for reference, will be found in the Institution's Handbook.

Other parts of Report No. 24 are as follows :

- Part 1. Locomotive, Carriage and Wagon Axles.
- Part 2. Locomotive, Carriage and Wagon Tyres.
- Part 3. Springs and Spring Steel.
- Part 4. Steel Forgings, Blooms and Castings.
- Part 5. Copper Plates, Rods and Tubes, and Brass Tubes.

BRITISH STANDARD SPECIFICATION FOR
STEEL PLATES
(INCLUDING FIREBOX PLATES)
SECTIONS, BARS AND RIVETS
FOR LOCOMOTIVE BOILERS

NOTE 1. This revision incorporates specification 16X. Steel Plates for Fireboxes which was issued as an addendum in June, 1940.

NOTE 2. When plates are required for flanging purposes it shall be so stated at the time of the enquiry or order.

NOTE 3. This Specification shall apply also to drawn steel wire under $\frac{1}{2}$ in. diameter for the manufacture of cold forged rivets. When so applied, the words 'bar' or 'bars' where they occur, shall be deemed to include such wire, and shall be read as 'wire' or 'wires' or 'coils of wire' as the context may require.

QUALITY OF MATERIAL

1. The plates, sections and bars shall be manufactured from steel made from selected material by the process and within the analysis limits specified below :

Description	Process of manufacture	Max. sulphur and phosphorus
Plates for fireboxes	Acid open hearth or the electric	per cent -0.03-
Other plates, sections and bars	Acid or basic open hearth or the electric	0.05

The manufacturer shall supply an analysis of each cast when required to do so.

INDEPENDENT CHEMICAL ANALYSES

2. The engineer or purchaser, before accepting the material shall have the right, should he so desire, to make chemical analyses of each cast from the scrap margin or test pieces from at least two plates, bars or sections as supplied.

3. The plates, sections and bars shall be sound, free from harmful segregation of impurities and from cracks, surface flaws and laminations. Hammer dressing, patching or welding of defects is prohibited.

FREE FROM DEFECTS

Slight scale or shell may, however, be removed by such means as chisel, file, buff or sand or shot blast provided the material is nowhere reduced below the specified thickness.

MARGINS OF MANUFACTURE

4. No plate shall be under the specified thickness at any part nor shall it exceed the calculated weight by more than the appropriate rolling weight tolerance shown in the Table below. No section or bar shall be under the specified thickness at any part nor shall it exceed the calculated weight by more than 5 per cent.

TOTAL ROLLING MARGINS FOR PLATES AS PERCENTAGES OF NOMINAL WEIGHT.

Ordered thickness in.	Width of plate					
	Under 48 in.	48 in. to under 60 in.	60 in. to under 72 in.	72 in. to under 84 in.	84 in. to under 96 in.	96 in. to under 108 in.
Under 1/8 in.	per cent	per cent	per cent	per cent	per cent	per cent
1/8 in. to under 3/16 in.	10	10	10	10	10	10
3/16 in. to under 1/4 in.	10	10	10	10	10	10
1/4 in. to under 5/16 in.	5	5	5	5	5	5
5/16 in. to under 3/8 in.	5	5	5	5	5	5
3/8 in. to under 7/16 in.	5	5	5	5	5	5
7/16 in. to under 1/2 in.	5	5	5	5	5	5
1/2 in. to under 5/8 in.	5	5	5	5	5	5
5/8 in. to under 3/4 in.	5	5	5	5	5	5
3/4 in. to under 1 in.	5	5	5	5	5	5
1 in. to under 2 in.	5	5	5	5	5	5

BRANDING

5. Each plate, section or bar shall be distinctly stamped with such brands as the engineer (or the purchaser) may require, but not near the edge.

Rivet bars and other small bars shall be bundled and securely tagged with a metal tag bearing the required markings, in the manner specified by the engineer (or the purchaser).

MECHANICAL TESTS

6. The tensile and bend test pieces shall be cut or sheared crosswise to the direction of rolling in the case of plates and lengthwise in the case of sections and bars.

No test piece shall be cut or sheared from the plate, section or bar until it shall have been stamped by the representative of the engineer (or of the purchaser) with such identifying brands as he may require.

The test pieces shall not be annealed or otherwise heat treated unless the material from which they are cut is similarly annealed or heat treated in which case the test pieces shall be similarly and simultaneously heat treated with the material before testing, except in the case of drawn steel wire when the test pieces only shall always be annealed before testing.

Any straightening of test pieces which may be required shall be done cold.

TENSILE TESTS

7. The ultimate tensile stress and elongation shall be determined from standard test pieces A, B or BI (see Appendix, pages 45 to 47). The edges of the flat test pieces shall be ground or draw-filed to remove roughness and sharpness. The plates, sections and bars shall show the ultimate tensile stress and elongation given in the Table below.

TABLE OF TENSILE TESTS

Material	Ultimate tensile stress		Minimum elongation per cent		
	Tons per sq. in.	Kg. per mm ² .	Test piece A	Test piece B	Test piece B ₁
PLATES Plates, other than Firebox plates	25-30	39.37-47.25	23	—	—
	23-28	36.22-44.10	25	—	—
SECTIONS, FLATS AND BARS (other than rivet bars): Sections and flats Round and square bars (up to and including 1 in (25.4 mm.) in dia. or thickness) Round and square bars (above 1 in. (25.4 mm.) in dia. or thickness)	28-33	44.10-51.97	20	—	—
	28-33	44.10-51.97	—	20	—
	28-33	44.10-51.97	—	—	24
RIVET BARS : Rivet bars (other than cold drawn material for rivets below ½ in. (12.7 mm.) dia.) Cold drawn material for rivets below ½ in. (12.7 mm.) dia.	25-30	39.37-47.25	—	26	30
	20-25	31.49-39.37	—	26	—
	20-25	31.49-39.37	—	—	—

Firebox plates shall have a yield stress* not less than 55 per cent of the ultimate tensile stress.

* Yield stress is defined in B.S. 18 as follows :

Yield stress is the lowest stress at which the elongation of the test piece increases without increase of load.

For practical purposes the yield stress is defined as the stress at which a visible permanent increase occurs in the distance between gauge points on the test piece observed when using dividers ; or at which when the load is increased at a moderately fast rate, there is a distinct drop of the testing machine lever or, in hydraulic machines, a hesitation in the movement of the gauge finger.

Should a tensile test piece break outside the middle half of its gauge length (see Appendix, page 47) the test may be discarded, and a fresh test made with a test piece taken from the same plate, section or bar and from a position adjacent to that from which the discarded test piece was taken.

COLD BEND TESTS

8. Test pieces shall be not less than 1½ in. (38.1 mm.) wide, but for small material the whole section may be used.

The rough edge or arris caused by cutting or shearing may be removed by filing, grinding or machining and the sharpness or roughness resulting from this may be ground or draw-filed but the test pieces shall receive no other preparation.

The test pieces shall withstand without fracture the bend test described in the following table.

The bend tests may be made either by pressure or by blows :

TABLE OF BEND TESTS

Material	Maximum internal dia. of bend	Description of bend test
Plates, other than firebox plates	Twice the thickness of test piece	Doubled over until sides are parallel.
Firebox plates	The thickness of the test piece	Doubled over until sides are parallel.
Sections and bars (excluding rivet bars)	Twice the thickness of test piece	Doubled over until sides are parallel.
Rivet bars	—	Doubled over and flattened on itself.

DUMP TEST AND REVERSE TORSION TEST FOR RIVET BARS

9. a. *Dump Test.* Short lengths equal to twice their diameter cut from the rivet bars shall, when cold, withstand without fracture being compressed to half their length.

b. *Reverse Torsion Test.* Alternatively, for material under ½ in. (12.7 mm.) diameter, the reverse torsion test described below may, at the option of the manufacturer of the material, be substituted for the dump test.

A length of the material equal to 8 in. (203 mm.) between the grips of the machine shall withstand without showing splits or frills being twisted axially four complete turns in one direction, then from this position four complete turns in the reverse direction.

NUMBER OF TESTS

10. *a. Plates.* For shell plates, butt strap plates, gusset plates and firebox plates, one tensile test strip and one strip for a bend test shall be taken from each end of every plate as rolled.

For other plates, such as end plates and flanging plates, one tensile test strip and one strip for a bend test shall be cut from one end of every plate as rolled.

b. Sections and Bars.

(i) *Tensile Test.* One tensile test shall be made for each 15 or part of 15 bars of each section or diameter from the same cast, but not less than two tensile tests shall be made unless the total number of bars from the same cast is 8 or less than 8 and the bars are of the same section or diameter when one test will suffice. For round and square bars $1\frac{3}{4}$ in. in diameter or thickness and under, the numbers 50 and 20 shall be substituted for 15 and 8 respectively for determining the number of tests required.

(ii) *Bend Test.* One cold bend test shall be made for each tensile test.

(iii) *Dump Test or Reverse Torsion Test (for Rivet Bars only).* One dump test or reverse torsion test shall be made for each tensile test.

TESTS FOR MANUFACTURED RIVETS

11. The representative of the engineer (or of the purchaser) may select from the bulk up to 2 per cent of the rivets, which shall withstand the following tests :

a. The rivet shanks shall be bent cold, and hammered until the two parts of the shank touch in the manner shown in Fig. 1, without fracture on the outside of the bend.

b. The rivet heads shall be flattened, while hot, in the manner shown in Fig. 2, without cracking at the edges. The head shall be flattened until its diameter is $2\frac{1}{2}$ times the diameter of the shank.



Fig. 1

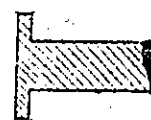


Fig. 2

ADDITIONAL TESTS BEFORE REJECTION

12. Should a test piece first selected by the representative of the engineer (or of the purchaser) not fulfil the test requirements, two further tests may be made but should either of these fail, the plates, bars or sections from which the test pieces were cut may be rejected. In all such cases further tests shall be made before any material from the same cast is accepted.

FACILITIES FOR INSPECTION

13. The manufacturer shall adopt a system of marking the ingots, billets, slabs, plates, sections and bars which will enable all finished material to be traced to the original cast; and the representative of the engineer (or of the purchaser) shall be given every facility for tracing all plates, sections and bars to their respective cast, and for witnessing the required tests.

INSPECTION

14. The representative of the engineer (or of the purchaser) shall have free access to the works of the manufacturer at all reasonable times; he shall be at liberty to inspect the manufacture at any stage, and to reject any material that does not conform to the terms of this Specification.

TESTING FACILITIES

15. The manufacturer shall supply the material required for testing free of charge and shall, at his own cost, furnish and prepare the necessary test pieces, and supply labour and appliances for such testing as may be carried out on his premises in accordance with this Specification. Failing facilities at his own works for making the prescribed tests, the manufacturer shall bear the cost of carrying out the tests elsewhere.

BRITISH STANDARD SPECIFICATION FOR
STEEL PLATES, SECTIONS, BARS
AND RIVETS
FOR LOCOMOTIVES
(WITH ANALYSIS)

(This Specification does not apply to Boilers)

NOTE 1. When material is required for cold flanging, cold pressing, welding or cold working this shall be so stated at the time of the enquiry or order.

NOTE 2. This Specification shall apply also to drawn steel wire under $\frac{1}{2}$ in. diameter for the manufacture of cold forged rivets. When so applied, the words 'bar' or 'bars,' where they occur, shall be deemed to include such wire, and shall be read as 'wire' or 'wires' or 'coils of wire' as the context may require.

QUALITY OF MATERIAL

1. The plates (other than locomotive frame plates) sections and bars shall be manufactured from steel made from selected material by the acid or basic open hearth, acid Bessemer, or the electric process. Locomotive frame plates shall be made by either the acid or basic open hearth process only.

The material shall show on analysis not more than 0.06 per cent of sulphur or of phosphorus.

The manufacturer shall supply an analysis of each cast when required to do so.

FREEDOM FROM DEFECTS

2. The plates, sections and bars shall be sound, free from harmful segregation of impurities and from cracks, surface flaws and laminations. Hammer dressing, patching, or welding of defects is prohibited. Slight scale or shell may, however, be removed by the use of such means as chisel, file, buff or sand or shot blast.

MARGINS OF MANUFACTURE

3. When the specified weight is not stated to be either a maximum or a minimum the rolling margins shall be as follows :