

No. 101—1929.

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.

BRITISH STANDARD SPECIFICATION FOR TRAMWAY TYRES.

(REVISED 1929.)

LONDON:

PUBLISHED FOR THE ASSOCIATION BY CROSBY LOCKWOOD & SON,

7, STATIONERS' HALL COURT, LUDGATE HILL, LONDON, E.C. 4;

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BRITISH ENGINEERING STANDARDS ASSOCIATION,

28, VICTORIA STREET, LONDON, S.W. 1.

February, 1929.

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Brass and Copper Tube Association.
British Carriage and Wagon Builders and
Financiers Parliamentary Association.

This Specification was adopted by the Sectional Committee on Locomotives at their meeting on November 27th, 1928, and approved on behalf of the Main Committee on 5th February, 1929.

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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FOREWORD.

Since this Specification was first published in July, 1921, there has been an increasing use of material of higher tensile strength and it was therefore decided to prepare a revised edition.

Examination of the position showed that there was a sufficient demand for a hard Tyre to justify its inclusion, and provision has therefore been made in the present issue for two distinct classes, which have been classified according to the tensile strength of the material as Grade X and Grade Y Tyres—the former being hardened by heat treatment, and the latter being in the “as rolled” condition. 5

The testing requirements of the Specification have been modified to provide for both classes of Tyres.

For the Grade Y Tyres a Dropping Test—in which all the Tyres are dropped from a height of 10 feet—has been substituted for the Falling Weight Test. 15

For Grade X Tyres the Dropping Test is an alternative to the Falling Weight Test at the Engineer's option.

A new formula, based on current practice, has been incorporated from which the deflection to be obtained in the Falling Weight Test is to be determined. 20

Clause 6, Number of Tyres to be tested, and Clause 10, Additional Tests Before Rejection have been amended consequent to the alterations that have been made.

(5)

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
FOR
TRAMWAY TYRES.

(REVISED 1929).

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.

Quality of Material.

1. The Tyres shall be manufactured from the highest quality of steel ingots of a length and weight to produce, after sufficient discard has been taken, four or more tyre blanks from each ingot. 15

This Specification provides for two alternative grades of Tyres, viz :—

Grade X :—70/80 tons per sq. inch (110/126 kg. per mm.²) tensile breaking strength, 20

Grade Y :—65/75 tons per sq. inch (102/118 kg. per mm.²) tensile breaking strength, and the Engineer (or the Purchaser) shall specify, with his enquiry, which grade he desires to purchase. 25

Freedom from Defects.

2. The Tyres shall be free from defects of any kind, and shall be made to the prescribed dimensions as shown on Plate 1, according to whether they are ordered with or without the machining allowances.

Branding.

3. The Tyres shall be distinctly stamped when hot with the Manufacturer's name or recognised brand, the cast number and the date of manufacture, and with such other brands as the Engineer (or the Purchaser) may require, and in such a manner that these marks shall be legible when the Tyres are worn out. 30

Heat Treatment.

4. Grade X Tyres shall be supplied hardened and tempered, and Grade Y Tyres shall be supplied with or without heat treatment at the option of the Manufacturer.

Grade Y Tyres shall be submitted to the dropping test, and not to the falling weight test. 40

(6)

Number of Tyres to be Tested.

5. Except as specified below, extra Tyres for testing in the manner described in Clauses 7 and 9 shall be provided by the Manufacturer at his own expense at the rate of one Tyre for each lot of 100 Tyres or portion thereof as submitted for testing, or such extra number as will allow of one Tyre being selected from each cast of steel submitted for test. When less than 50 tyres are ordered, the Manufacturer shall not be required to provide an extra Tyre for testing except at the request of, and at the expense of, the Purchaser, but shall supply a Works Certificate of the test obtained from Tyres from the same cast of steel and similarly treated.

Where the falling weight test is not taken, all the Tyres ordered under the contract shall be subjected to the dropping test as described in Clause 8.

The representatives of the Engineer (or of the Purchaser) shall select and test such of the Tyres as he may think proper to the extent indicated above. After selection of Tyres for testing, each Tyre selected shall comply with the following tests without reheating or any other manipulation whatever either of the Tyre selected for testing or any portion cut therefrom to furnish the test pieces.

Mechanical Tests.

6. Grade X Tyres shall be submitted to the falling weight test or to the dropping test at the option of the Engineer (or of the Purchaser) provided that the option is exercised when the order is placed.

Falling Weight Test.

7. The Tyre shall be placed in a running position with the tread resting on a block of metal not less than five tons (11,200 lb. = 5,080 kg.) in weight supported on a rigid concrete or other solid foundation, and shall withstand, without fracture, blows from a falling weight of one ton (2,240 lb. = 1,016 kg.). The weight shall be allowed to fall freely on to the tread once from heights of three feet (0.9 m.) and four feet (1.2 m.) and from five feet (1.5 m.) as often as may be necessary to cause a permanent deflection of the Tyre in inches corresponding to that given by the following formula :—

$$D = \frac{(d + 7)^2}{22 (T - 64)t^2}$$

where D = deflection required

d = internal diameter of Tyre as rolled

t = thickness of Tyre as rolled

T = tensile strength in tons per square inch.

All dimensions in inches.

(7)

The deflection aimed at shall be calculated on the assumption that the tensile strength is 70 tons per square inch (110 kg. per mm.²), and in the event of fracture before this deflection is reached, the actual tensile strength of the Tyre shall be employed in using the formula.

The Manufacturer shall be at liberty before testing to remove the internal sharp edge of the Tyres selected for the Falling Weight Test to the extent of a $\frac{1}{16}$ in. (1.59 mm.) radius.

Dropping Test.

8. The Tyres shall be taken to a height of 10 feet (3.05 m.) and allowed to fall freely in a running position, on the tread, on a solid metal foundation.

Tensile Test.

9. A standard Test piece C (see Appendix, Page 11) taken from the position shown in the sketch from each of the selected Tyres tested as above and machined cold, shall show a tensile breaking strength of 70 to 80 tons per square inch (110 to 126 kg. per mm.²) in the case of Grade X Tyres with an elongation of not less than 7 per cent. with 70 tons and 4 per cent. with 80 tons; and of 65 to 75 tons per square inch (102 to 118 kg. per mm.²) in the case of Grade Y Tyres with an elongation of 7 per cent. with 65 tons and 4 per cent. with 75 tons; the elongation for intermediate tensile strengths being in proportion.

For Grade X Tyres the Yield Point* shall occur at not less than 45 tons per sq. inch (70.9 kg. per mm.²).

Should a tensile test piece break outside the middle half of its gauge length (see diagram below) 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 the same Tyre from which the discarded test piece was taken.

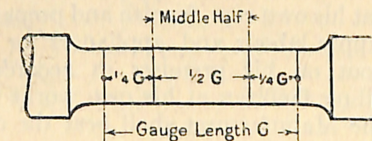


Diagram explaining the term "Middle Half" of the Gauge Length.

* The Yield Point shall, for the purpose of this Specification, be the load per square inch at which a distinctly visible increase occurs in the distance between the gauge points on the test piece, observed by using dividers after the removal of the load; 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 of the gauge finger.

(8)

Additional Tests before Rejection.

10. In the event of any tested Tyres not satisfying the requirements of Clauses 7, 8, or 9, the representative of the Engineer (or of the Purchaser) shall make further tests, as specified below, at the expense of the Manufacturer.

5

- (a) Should the Tyre fail in the tensile test, two more tensile tests shall be taken from the same Tyre. If either of these fail, the Tyres represented by the tests may be heat treated and re-submitted for testing.
- (b) Should a Tyre fail in the falling weight test, two more Tyres shall be taken from the same lot for testing and the Tyres shall be considered to have passed the test if these two Tyres fulfil the conditions of the falling weight and tensile tests. If any of the repeat tests fail, the Manufacturer may heat treat or re-heat treat the Tyres represented by the tests, and re-submit them for testing.
- (c) Should any Tyre fail under the dropping test, the Manufacturer shall be allowed to heat treat the tyres of the cast represented and re-submit them for test.
- (d) The Tyres shall be accepted if the results of the repeat tests are satisfactory.

Inspection.

11. 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.

12. The Manufacturer shall supply the material required for testing, 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.

35

(9)

APPENDIX.**FORMS**

OF

BRITISH STANDARD TENSILE TEST PIECES.

(10)

APPENDIX.

FORMS
OF

BRITISH STANDARD TENSILE TEST PIECES.

TEST PIECE A.

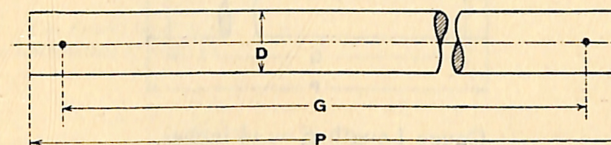
Gauge Length $G=8$ inches.Parallel Length P to be not less than 9 inches.Total length T = about 18 inches.

Thickness of Test Piece.	Maximum Width allowed.
Over $\frac{7}{8}$ in. (0.875 in.)	$W_1 = 1\frac{1}{2}$ in.
$\frac{3}{8}$ in. (0.375 in.) to $\frac{7}{8}$ in. (0.875 in.)	$W_2 = 2$ in.
Under $\frac{3}{8}$ in. (0.375 in.)	$W_3 = 2\frac{1}{2}$ in.

The widths of the test pieces for plates were selected to comply with the two following conditions. (1) As the great bulk of plates to be tested are from $\frac{3}{8}$ inch to $\frac{7}{8}$ inch thick, it was desirable for the sake of convenience that the test pieces for such plates should be of a uniform width, and, in accordance with very general practice, a width of 2 inches was selected. (2) With a test piece of a given form, the percentage of elongation was found to be less for thick plates than for thin ones; with steel of the same quality in other respects it was desirable therefore to choose widths of test piece which would be slightly in favour of the thicker plates. This is secured with the widths selected for the Standard Test Piece of form A.

(11)

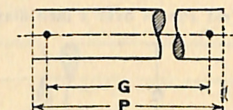
TEST PIECE B.



Gauge Length G to be not less than 8 times the diameter D .
With enlarged ends :—Parallel Length P to be not less than 9 times the reduced diameter D .

All test pieces of form B are strictly similar, and for the same material give the same percentage of elongation. They are nearly similar to a test piece of form A, 8 inches in gauge length, 2 inches wide and $\frac{3}{8}$ inch thick.

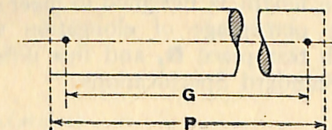
TEST PIECE C.

Gauge Length $G = 2$ inches.Parallel Length P to be not less than $2\frac{1}{4}$ inches

Dia. = 0.564 inch.

Area = $\frac{1}{4}$ sq. inch

TEST PIECE D.

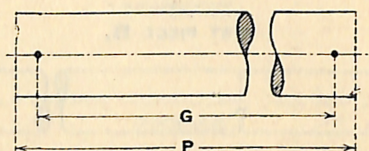
Gauge Length $G = 3$ inches.Parallel Length P to be not less than $3\frac{2}{3}$ inches.

Dia. = 0.798 inch.

Area = $\frac{1}{2}$ sq. inch.

(12)

TEST PIECE E.



Gauge Length **G** = $3\frac{1}{2}$ inches.

Parallel Length **P** to be not less than 4 inches.

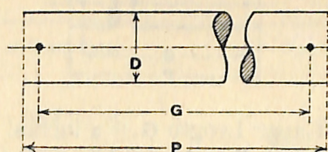
Dia. = 0.977 $\frac{5}{8}$ inch.

Area = $\frac{3}{4}$ sq. inch.

Test Pieces **C**, **D** and **E** were arranged to meet the very common practice of making test pieces for forgings, axles, tyres, etc., of either $\frac{1}{4}$ square inch or $\frac{1}{2}$ square inch in sectional area. With the gauge lengths decided upon, these three forms are very nearly similar, and, for a given material, give very approximately the same 10 percentage of elongation. Though not exactly, they are approximately similar to the Standard Test Piece **F**, and for the same material give a nearly identical, but slightly greater, percentage of elongation.

TEST PIECE F.

(For Test Pieces over 1 inch diameter.)



Gauge Length **G** to be not less than 4 times the diameter **D**.

With enlarged ends:—Parallel Length **P** to be not less than $4\frac{1}{2}$ times the reduced diameter **D**.

In some testing machines it was found inconvenient to use form **B** for bars of over 1 inch in diameter, and form **F** of half the gauge length is designed to meet such cases. For a given material the percentage of elongation with test piece **F** is greater than with test piece **B**, and this difference is provided for in the British Standard Specifications.

FORM OF ENDS.

In the case of the round test pieces **B, C, D, E** and **F**, the form of the ends is to be as required in order to suit the various methods employed for gripping the test piece. When enlarged ends are used the length of the parallel portion of the test piece must 30 in no case be less than that noted on the diagrams.

(13)

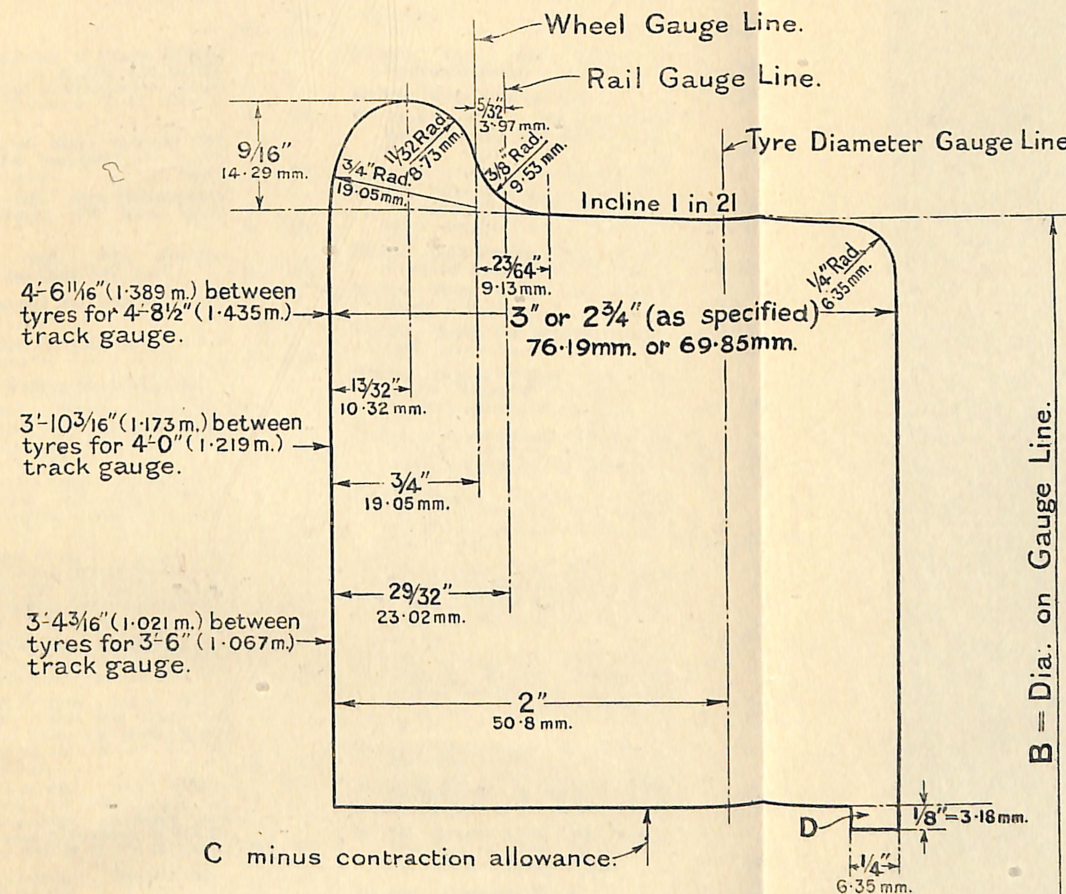
Plate 1.

BRITISH ENGINEERING STANDARDS ASSOCIATION.

BRITISH STANDARD TYRES FOR TRAMWAY DRIVING AND PONY WHEELS

(THE DIMENSIONS GIVEN ARE FINISHED SIZES).

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.



FINISHED SIZES

ROLLING ALLOWANCES FOR MACHINING.

- $\frac{3}{16}$ in. (4.76 mm.) on inside diameter.
- + $\frac{3}{16}$ in. (4.76 mm.) on outside diameter.
- + $\frac{1}{4}$ in. (1.59 mm.) on width of flange (tread side)
- + $\frac{3}{4}$ in. (6.35 mm.) on width of Snip D.

Size of Wheel.		Diameter. B		Diameter. C	
in.	mm.	in.	mm.	in.	mm.
22	558·8	22	558·8	17	431·8
32	812·8	32	812·8	27	685·8
33	838·2	33	838·2	27	685·8

British Engineering Standards Association.

SELECTED LIST OF BRITISH STANDARD SPECIFICATIONS AND REPORTS REVISED TO FEBRUARY, 1929.

Publication No.	Net.	Post free.	Publication No.	Net.	Post free.
3-1903. Influence of Gauge Length and Section of Test Bar on the Percentage of Elongation, Report on, by Professor W. C. UNWIN, F.R.S.	2/-	2/2	44-1909. Cast Iron Pipes for Hydraulic Power ...	2/-	2/2
6-1924. Rolled Steel Sections for Structural Purposes, Dimensions and Properties ... Cloth	5/-	5/3	46-1909. Keys and Keyways ...	2/-	2/2
10-Part 1-1928. Pipe Flanges (Gas and Water, for Land Use), Tables ...	2/-	2/2	46-Part 1-1924. Parallel Keys, Keyways and Key Bars, Dimensions ... (Partly superseding No. 46-1909.)	2/-	2/2
10-Part 2-1926. Pipe Flanges (Steam, for Land Use), Tables ...	2/-	2/2	51-1913. Wrought Iron for use in Railway Rolling Stock ("Best-Yorkshire" and Grades A, B and C) ...	2/-	2/2
18-1910. Tensile Test Pieces, Forms of ...		Gratis.	53-1927. Cold Drawn Weldless Steel Tubes for Locomotive Boilers ...	2/-	2/2
21-1909. Pipe Threads for Iron or Steel Pipes and Tubes, Report ...	2/-	2/2	56-1911. Yield Point and Elastic Limit, Definitions ...		Gratis.
24-Railway Rolling Stock Material—			57-1920. Heads for British Association Screws, Report ...	2/-	2/2
24-Part 1-1928. Locomotive, Carriage and Wagon Axles (containing Specifications Nos. 1, 2, 2a, 3, 3a) ...	2/-	2/2	61-1913. Copper Tubes and their Screw Threads (primarily for domestic and similar work) ...	2/-	2/2
24-Part 2-1928. Locomotive, Carriage and Wagon Tyres (containing Specifications Nos. 4, 5, 5a) ...	2/-	2/2	66-1914. Copper-Alloy Three-Piece Unions (for Low and Medium Pressure Screwed Copper Tubes) ...	2/-	2/2
24-Part 3-1921. Laminated, Volute and Helical Springs and Steel for Laminated Springs (containing Specifications Nos. 6, 6a, 6b, 6c, 7, 7a) ...	2/-	2/2	84-1918. Screw Threads, British Standard Fine and their Tolerances (Superseding parts of Reports Nos. 20 and 38) ...	2/-	2/2
24-Part 4-1921. Steel Forgings, Blooms and Castings (containing Specifications Nos. 8, 9, 10) ...	2/-	2/2	92-1919 (formerly C.L. 7270). Screw Threads, British Standard Whitworth (B.S.W.) and their Tolerances (Superseding Nos. 20 and 38), Report ...	2/-	2/2
24-Part 5-1925. Copper Plates, Rods, Tubes and Pipes and Brass Tubes (containing Specifications Nos. 11, 12, 12a, 13, 14 and 15) ...	2/-	2/2	93-1919 (formerly C.L. 7271). Screw Threads, British Association, with Tolerances for sizes Nos. 0, to 15 B.A. (Superseding No. 20), Report ...	2/-	2/2
24-Part 6-1921. Steel Plates, Angles, etc., and Rivets for Locomotives, Carriages and Wagons (containing Specifications Nos. 16, 17, 17a, 18, 18a) ...	2/-	2/2	95-1919. Corrections to Effective Diameter required to compensate Pitch and Angle Errors in Screw Threads of Whitworth Form, Tables of ...	2/-	2/2
28-1908. Withdrawn. See Nos. 190-1924 and 192-1924.			99-1922. Copper-Alloy Pipe Fittings, Screwed, for Low and Medium Pressure B.S. Copper Tubes ...	2/-	2/2
NOTE—Table II. List of Black Nuts, Lock Nuts and Bolt Heads, reprinted from No. 28-1908, is available if required.			101-1929. Tramway Tyres ...	2/-	2/2
32-1927. Steel Bars for the Production of Machined Parts for General Engineering Purposes ...	2/-	2/2	122-1920. Milling Cutters and Reamers ...	2/-	2/3
35-1907. Copper Alloy Bars for use in Automatic Machines ...	2/-	2/2	131-1920. Notched Bar Test Pieces, Forms of ...	2/-	2/2
43-1927. Boiler Tubes, Charcoal Iron Lapwelded ...	2/-	2/2	138-1922. Materials and Constructional Strength of Chemical Fire Extinguishers ...	2/-	2/2
			143-1922. Long Sweep Type Malleable Iron Pipe Fittings, for Steam, Water and Gas, Dimensions ...	2/-	2/2

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Publication No.	Net.	Post free.	Publication No.	Net.	Post free.
154-1922. Malleable and Soft Cast Iron Pipe Fittings, for Steam, Water and Gas ...	2/-	2/2	228-1925. Steel Roller Chains and Chain Wheels... ..	2/-	2/2
163-1924. Galvanised Steel Wire Strand for Signalling Purposes...	2/-	2/2	235-1927. Gear Wheels and Pinions for Electric Tramways ...	2/-	2/2
164-1924. Limits and Fits for Engineering ...	2/-	2/2	240-1926. Brinell Hardness Numbers. Tables ...	2/-	2/2
164B-1924. (Wall Chart, 21 in. x 33 in.) Tables and Diagrams of Tolerances, in inch units, taken from No. 164-1924 ...	1/-	1/3	253-1926. Withdrawn (See No. 10, Part I—1928.)		
190-1924. British Standard Whitworth (B.S.W.) Bright Hexagon Bolts, Nuts, Set-Screws, Split-Pins, Washers and Studs, Dimensions ...	2/-	2/2	276-1927. Contours for Locomotive Tyres ...	2/-	2/2
190C-1924. Do. do. (Issued as Wall Chart, 21 in. x 33 in.)	1/-	1/3	292-1927. Ball Bearings and Parallel-Roller Bearings, Dimensions ...	2/-	2/2
191-1924. British Standard Fine (B.S.F.) Bright Hexagon Bolts, Nuts, Set-Screws, Split-Pins, Washers and Studs, Dimensions...	2/-	2/2	302-1927. Round Strand Steel Wire Ropes for Cranes ...	2/-	2/2
191C-1924. Do. do. (Issued as Wall Chart, 21 in. x 33 in.)	1/-	1/3	308-1927. Engineering Drawing Office Practice, British Standard ...	2/-	2/2
192-1924. British Standard Spanners, Dimensions ...	2/-	2/2	309-1927. White Heart Malleable Iron Castings ...	2/-	2/2
193-1929. British Standard Whitworth (Small Hexagon) (B.S.W.S.) Bright Hexagon Bolts, Nuts and Set-Screws, Split-Pins, Washers and Studs ...	2/-	2/2	310-1927. Black Heart Malleable Iron Castings...	2/-	2/2
224-1925. Steel for Die Blocks for Drop Forgings, Schedule ...	2/-	2/2	321-1928. General Grey Iron Castings, Grades A and C ...	2/-	2/2
227-1928. Steel Arches for use in Mines (Straight-sided and Horse-shoe Arches) ...	2/-	2/2	325-1928. Black, Iron and Steel, Cup and Countersunk Bolt-Heads, Nuts and Washers, Dimensions ...	2/-	2/2
			327-1928. Derrick Cranes ...	2/-	2/2
			328-1928. Twist and Straight Flute Drills ...	2/-	2/2
			329-1928. Round Strand Steel Wire Ropes for Lifts and Hoists...	2/-	2/2
			336-1928. Fire Hose Couplings...	2/-	2/2
			351-1929. Friction Surface Rubber Transmission Belting ...	2/-	2/2

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**BRITISH ENGINEERING STANDARDS
ASSOCIATION.**

The Association exists for the purpose of drawing up British Standard Specifications for materials, machinery or apparatus. It does not, however, embark on such work on its own initiative, but at the specific request of an authoritative body such as a representative trade organisation, a technical society, or a Government department, and to fill a recognised want.

The Association is not a profit-making concern. Its only expenses are staff salaries, office expenses and printing. In addition to the Grants received from the Government and the amount derived from the sale of its Publications, it has to look to Industry as a whole for the funds necessary to carry on the work.