

Please be aware that this PDF has been created from the original hardcopy document, which might not be in good condition and so the PDF might reflect this.

No. 215-1925.

no Amos

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

HARD-DRAWN ALUMINIUM AND STEEL-CORED ALUMINIUM CONDUCTORS

FOR OVERHEAD POWER TRANSMISSION PURPOSES.

LONDON:

PUBLISHED FOR THE ASSOCIATION BY GOSBY LOCKWOOD & SON,
STATIONERS' HALL COURT, LUDGATE HILL, LONDON, E.C.4;
AND TO BE PURCHASED FROM ANY BOOKSELLER, OR DIRECT FROM THE OFFICES OF THE
BRITISH ENGINEERING STANDARDS ASSOCIATION,
28, VICTORIA STREET, LONDON, S.W. 1.

October, 1925.

COPYRIGHT.

ALL RIGHTS RESERVED, INCLUDING RIGHTS OF TRANSLATION

PRICE 1/- Net. Post Free 1/2.

No. 215—1925.

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

HARD-DRAWN ALUMINIUM AND STEEL-CORED ALUMINIUM CONDUCTORS

FOR OVERHEAD POWER TRANSMISSION PURPOSES.

LONDON:

PUBLISHED FOR THE ASSOCIATION BY CROSBY LOCKWOOD & SON,
7, STATIONERS' HALL COURT, LUDGATE HILL, LONDON, E.C.4;
AND TO BE PURCHASED FROM ANY BOOKSELLER, OR DIRECT FROM THE OFFICES OF THE
BRITISH ENGINEERING STANDARDS ASSOCIATION,
29, VICTORIA STREET, LONDON, S.W. 1.

October, 1925.

COPYRIGHT.

ALL RIGHTS RESERVED, INCLUDING RIGHTS OF TRANSLATION.

PRICE 1/- Net. Post Free 1/2.

The following Authorities have officially co-operated in the preparation of this Specification:—

Admiralty.
General Post Office.
Home Office.
India Office.
War Office.
Electricity Commissioners.
National Physical Laboratory.
Crown Agents for the Colonies.
London County Council.
Institution of Electrical Engineers.
Association of Consulting Engineers.
British Electrical and Allied Industries Research Association.
British Electrical and Allied Manufacturers' Association.
British Pottery Manufacturers' Association.
Cable Makers' Association.
Electric Lamp Manufacturers' Association.
High-Conductivity Association.
Incorporated Association of Electric Power Companies.
Incorporated Municipal Electrical Association.
Municipal Tramways Association.
National Electrical Contractors' Association.
Provincial Electric Supply Committee of the United Kingdom.
Tramways and Light Railways Association.

This Specification was adopted by the Sectional Electrical Committee in June, 1925, and approved on behalf of the Main Committee on September 23rd, 1925.*

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.

* The Sectional Electrical Committee is the British National Committee of the International Electrotechnical Commission.

CONTENTS.

STANDARDS FOR HARD-DRAWN ALUMINIUM.

1. Resistance at 60° F.	2
2. Density at 60° F.	3
3. Constant-Mass Temperature Coefficient at 60° F.	3
4. Coefficient of Linear Expansion	4
DEFINITIONS.	
5. (a) Solid Conductor	4
(b) Stranded Aluminium Conductor	4
(c) Steel-cored Aluminium Conductor	4
(d) Lay	4
(e) Tolerance	4
(f) Piece	4
(g) Test Sample	4
SPECIFICATION.	
6. Material	4
7. Standard Resistances, Weights and Sizes of Solid Conductors	5
8. Standard Resistances, Weights and Sizes of Stranded Aluminium and Steel-cored Aluminium Conductors	5
9. Tolerances on Diameter, Weight and Resistance of Wires	6
10. Mechanical Properties	7
11. Freedom from Defects	7
12. Joints in Aluminium Wires	7
13. Stranding	8
14. Test Samples	8
15. Mechanical Tests:—	8
(a) General	8
(b) Tensile Test	8
(c) Elongation Test	9
(d) Galvanising Test	9
17. Resistance Test	10

TABLES.

Table 1. Solid Aluminium Conductors used in the make-up of Standard Stranded Aluminium and Steel-cored Aluminium Conductors	13
Table 2. Solid Steel Wires used in the make-up of Standard Steel-Cored Aluminium Conductors	14
Table 3. Standard Stranded Aluminium Conductors	15
Table 4. Standard Steel-cored Aluminium Conductors	16

APPENDIX.

British Standards of Resistance of Aluminium for Electrical Conductors	17
--	----

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 articles herein referred to, but does not purport to comprise all the necessary provisions of a Contract.

BRITISH
STANDARD SPECIFICATION
FOR
HARD-DRAWN ALUMINIUM AND STEEL-CORED ALUMINIUM
CONDUCTORS
FOR OVERHEAD POWER TRANSMISSION PURPOSES.

NOTE.—The Steel-cored Aluminium Conductors referred to in this Specification are restricted to conductors with a core of galvanised steel.

STANDARDS FOR HARD-DRAWN ALUMINIUM.

Resistance at 60° F.

1. The resistivity of aluminium depends upon its purity and its physical condition. For the purpose of this Specification, the resistivity of hard-drawn aluminium wire is assumed to vary with its tensile strength in accordance with the following formula:—

$$R = 2.7320 + (2.8289 \times 10^{-6}) T_p$$

$$\text{or } R = 2.7320 + (6.3367 \times 10^{-3}) T_t$$

where T_p is the tensile strength in lb. per square inch,

T_t is the tensile strength in tons per square inch, and

R is the resistivity in microhms per cm. cube at 60° F. (15.6° C.).

This formula has been employed in determining the resistance of the standard sizes of aluminium solid and stranded conductors at 60° F. (15.6° C.) as given in Tables 1, 3 and 4.

NOTE.—The resistance of the conductors at 20° C. (68° F.) has been included in the Tables for convenience of reference.

Density at 60° F.

2. At a temperature of 60° F. (15.6° C.) the density of hard-drawn aluminium shall be taken as 2.705 grammes per cubic centimetre, and the weight of one cubic foot of hard-drawn aluminium as 168.8676 lb.

Constant-Mass Temperature Coefficient at 60° F.

3. At a temperature of 60° F. (15.6° C.) the "constant-mass" temperature coefficient of resistance of hard-drawn

(4)

aluminium, measured between two potential points rigidly fixed to the wire, has been taken as $0.0022624 = 1/442$ per degree F. $(0.0040723 = \frac{1}{245.56}$ per degree C.).

Coefficient of Linear Expansion.

4. The coefficient of linear expansion of hard-drawn aluminium between 32°F. (0°C.) and 86°F. (30°C.) shall be taken as 12.6×10^{-6} per degree F. (22.68×10^{-6} per degree C.).

DEFINITIONS.*

5. The following definitions have been adopted for the 10 purposes of this Specification :-

(a) *Solid Conductor*.—The term "Solid conductor" denotes a conductor composed of one circular wire.

(b) *Stranded Aluminium Conductor*.—The term "Stranded Aluminium Conductor" denotes a conductor consisting of three 15 or more aluminium wires in which, if the number exceeds four, the wires are built up in layers, each layer having a definite lay.

Whenever the term "Stranded Conductor" is used in this Specification, a stranded circular conductor is implied, this being a stranded conductor which, if consisting of more than four 20 wires, is built up in concentric layers, the number of wires in each layer usually increasing in arithmetical progression.

(c) *Steel-cored Aluminium Conductor*.—The term "Steel-cored Aluminium Conductor" denotes a stranded conductor of similar construction to that defined under (b) above, with 25 the exception that the inner wire or wires are of galvanised steel, the outer concentric layer or layers being of aluminium.

(d) *Lay*.—The term "lay" denotes the ratio of the axial length of a complete turn of the helix formed by any individual wire in a stranded conductor, to the mean diameter of the helix. 30

(e) *Tolerance*.—The term "tolerance" denotes the difference in magnitude allowed from the magnitude prescribed in order to allow for unavoidable variations of material and workmanship.

(f) *Piece*.—The term "piece" denotes a single length of conductor.

(g) *Test Sample*.—The term "test sample" denotes a sample 35 taken for test in accordance with the Specification.

SPECIFICATION.

Material.

6. The conductor shall be of aluminium or steel-cored 40 aluminium having the mechanical and electrical properties hereinafter specified.

* For a full list of definitions of terms used in connection with Conductors and Cables see Section V. of B.E.S.A. Publication No. 205, British Standard Glossary of Terms used in Electrical Engineering. 45

(5)

Standard Resistances, Weights and Sizes of Solid Conductors.

7. After drawing, the aluminium and steel wires shall have the physical properties and diameters given in Tables 1 and 2 respectively.

The diameter of the galvanised steel wire employed for 5 steel-cored aluminium conductors is to be measured over the zinc coating, and the figures for the ultimate stress are those obtained by dividing the breaking load of the galvanised wire by the total area of the section as calculated from the overall diameter. The weight of the galvanised steel wire is based upon 10 an average specific gravity of 7.84 grammes per cubic centimetre at 60°F. (15.6°C.).

Standard Resistances, Weights and Sizes of Stranded Aluminium and Steel-Cored Aluminium Conductors.

8. The sizes, weights and resistances of stranded aluminium 15 and steel-cored aluminium conductors shall be in accordance with the values given in Tables 3 and 4 respectively.

Note.—Tables 3 and 4 have been drawn up on the following basis :—

(a) When straightened out, each wire in the stranded conductor, except the central wire, is taken to be 2 per cent longer than the stranded conductor. Hence the resistance of any length of stranded conductor will be the resistance of the same length of any one wire multiplied by a constant as set out in Table A.

In the case of Steel-cored Aluminium Conductors, the conductivity of the steel core is neglected and the resistance of the conductor is calculated with reference to the resistance of the aluminium wires only. 25

(b) The weight of each wire in any length of stranded conductor, except the central wire, will be 2 per cent greater than that of an equal length of straight wire, and the total weight of a stranded aluminium conductor is therefore obtained by multiplying the weight of any one 30 wire by an appropriate constant as set out in Table A.

In the case of a steel-cored aluminium conductor, the weights of the steel core and aluminium wires are calculated separately by a similar process and the two weights added together.

(c) *Calculated Area*.—This term denotes the area of a solid aluminium 35 rod which would have the same resistance as the stranded conductor, assuming the same specific conductivity. This area therefore takes into account the assumed increase of resistance of 2 per cent of each wire, except the centre wire, and can be determined by multiplying the area of any one wire by a constant, as set out in Table A, which is the reciprocal 40 of the constant for calculating resistance.

(d) *Standard Nominal Copper Area*.—This term denotes in round figures the area of a solid hard-drawn copper rod of resistance approximately equal to that of the stranded aluminium or steel-cored aluminium conductor. For comparison purposes the resistance of standard copper 45 conductors as given in the British Standard Specification for Hard-Drawn Copper, Solid and Stranded Circular Conductors (B.E.S.A. Publication No. 125-1924) is included in Tables 3 and 4.