BRITISH STANDARD

BS 2627:1970

Incorporating
Amendment No. 1

Specification for

Wrought aluminium —

For electrical purposes —

Wire

Co-operating organizations

The Non-ferrous Metals Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Aluminium Federation*
Association of Bronze and Brass Founders
Association of Consulting Engineers
Board of Trade
British Bronze and Brass Ingot Manufacturers' Association
British Electrical and Allied Manufacturers' Association*
British Lead Manufacturers' Association
British Non-Ferrous Metals Federation
British Non-Ferrous Metals Federation — High Conductivity Copper Group
British Non-ferrous Metals Research Association
Copper Development Association
Crown Agents for Overseas Governments and Administrations
Electric Cable Makers Confederation*
Institute of British Foundrymen
Institute of Metals
Institution of Mechanical Engineers (Automobile Division)
Institution of Mining and Metallurgy
Institution of Production Engineers
Institution of Structural Engineers
Lead Development Association
Light Metal Founders' Association
London Metal Exchange
Magnesium Industry Council
Ministry of Defence, Army Department
Ministry of Defence, Navy Department
National Brassfoundry Association
Non-ferrous Metal Stockists*
Post Office*
Royal Institute of British Architects
Society of Motor Manufacturers and Traders Ltd.
Tin Research Institute
Zinc Development Association
Individual manufacturer

The Government department and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Railways Board
Electricity Supply Industry in England and Wales
Institute of Iron and Steel Wire Manufacturers
Institute of Sheet Metal Engineering

This British Standard, having been approved by the Non-Ferrous Metals Industry Standards Committee, was published under the authority of the Executive Board on 28 January 1970

First published July, 1955
First revision October, 1961
Second revision January, 1970

The following BSI references relate to the work on this standard:
Committee reference NFE/24
Draft for comment 68/22309

ISBN 580 05555 8

Amendments issued since publication

Amd. No.	Date	Comments
3377	June 1980	Indicated by a sideline in the margin

Contents

Foreword

In order to keep abreast of progress in the industries concerned, 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, numbering over 5000, fully indexed and with a note of the contents of each, will be found in the British Standards Yearbook, price 20s. The BS Yearbook may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards:

BS 18, *Methods for the tensile testing of metals.*

BS 18-1, *Non-ferrous metals.*

BS 1499, *Sampling non-ferrous metals.*

BS 1728, *Methods for the analysis of aluminium and aluminium alloys.*

BS 3239, *Determination of resistivity of metallic electrical conductor materials.*

This British Standard was first published in 1955 under the authority of the Non-ferrous Metals Industry Standards Committee and at the request of the Aluminium Industry, in view of the increasing use of aluminium for electrical conductors of many types, and a revised edition was prepared in 1961.

In this edition all dimensions are shown in metric units which are not exact equivalents of the original inch values.

The three conditions previously covered have been replaced by six conditions the designations of which have been based on the system under consideration by ISO/TC79 — "*Light metals and their alloys*". The new designations of the six conditions bear the following relationship to the superseded designations:

New designation	*Superseded designation*
0	0
H4	No previous equivalent condition
H6	¾ H
H8	No previous equivalent condition
H68	No previous equivalent condition

The designation H68 refers to material, the tensile strength of which embraces those of H6 and H8.

H9	H

The conditions H4, H8 and H68 have been introduced to cover the requirements for wire for insulated cables in addition to the ¾ H condition formerly used for this purpose.

All stresses are quoted in terms of the hectobar (hbar)[1)].

As in the earlier edition a wrapping test is specified for the harder conditions but this is replaced by an elongation test for material in the H6 condition in larger diameters (i.e. greater than 5 mm).

In deciding on the resistivity values and associated physical properties to be quoted in this standard the committee took into account the relevant IEC Recommendations, namely IEC 111:1959, "*Recommendation for the resistivity of commercial hard-drawn aluminium electrical conductor wire*", and IEC 121:1960, "*Recommendation for commercial annealed aluminium electrical conductor wire*".

[1)] 1 hbar = 10 MN/m^2 = 10 N/mm^2.

BS 1473, "Rivet, bolt and screw stock" and BS 1475, "Wire", refer to wire used for general engineering and other purposes, and form part of a comprehensive series of standards already available for wrought aluminium and aluminium alloys for general engineering purposes (BS 1470-75). The present standard is one of a similar series of standards for wrought aluminium and aluminium alloys for electrical purposes. As a major step towards alignment of aluminium and aluminium alloy compositions on an international basis, a substantial number of countries have agreed to adopt a 4-digit classification for alloy composition designation. This system is administered by the Aluminium Association Inc., who issue the "Registration Record of International Alloy Designations and Chemical Composition Limits for Wrought Aluminium Alloys".

By amendment, it has been decided to introduce this system into the British Standards concerned with these types of material in place of the material designations formerly used. The details of the system are given in Appendix B.

The temper designations and associated mechanical property requirements remain unaltered for the present and therefore may not necessarily align precisely with those in the standards of other countries.

Material 1350 therefore replaces material G1E. Minor compositional changes have been made.

Other standards in this series are:

BS 2897, *Wrought aluminium for electrical purposes — Strip with drawn or rolled edges.*
BS 2898, *Wrought aluminium and aluminium alloys for electrical purposes — Bars, extruded round tube and sections.*
BS 3988, *Wrought aluminium for electrical purposes — Solid conductors for insulated cables.*
A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 5 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1 General requirements

1.1 Scope

This British Standard specifies requirements for aluminium round Wire for electrical conductors in six conditions and in diameters 0.4 mm up to and including 10 mm.

1.2 Definitions

For the purpose of this British Standard the following definition applies:

Wire: A round solid section of not more than 10 mm diameter produced by drawing.

1.3 Freedom from defects

The wire shall be free from defects prejudicial to its use as an electrical conductor.

1.4 Joints

There shall be no joints in the wire except those made in the base rod or wire before final drawing or, by agreement between the purchaser and the supplier, those made after final drawing by a cold welding method. Joints made in this way shall comply with the other requirements of the standard.

1.5 Tolerances on diameter

The diameter of round wire determined by means of a suitable micrometer and by taking the mean of the two measurements at right angles made at the same cross section of a sample taken from any part of a coil, reel or drum shall be as ordered within a tolerance of ± 1 %.

The difference between the maximum and minimum measurements, taken at the same cross section, shall not exceed 1 %.

1.6 Selection of test samples

Test samples for the tensile test, wrapping test and electrical resistivity tests specified in **1.7**, **1.8**, **1.9** and **1.10** shall be selected as follows:

Wire of the same diameter, produced in the same way and of the same condition, shall be grouped into batches not exceeding the weights given below, and test samples shall be cut from a coil selected from each batch. Before the test samples are cut off they shall be marked to identify them. The test samples shall be taken from the wire as supplied and shall not be annealed or mechanically worked other than straightening before testing.

Wire diameter	Weight of batch
mm	kg
0.4 up to and including 1.25	250
over 1.25	1 000

1.7 Tensile test

The test shall be made in accordance with BS 18-1[2)].

The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm per minute and not greater than 100 mm per minute.

1.8 Elongation test

The test shall be made in accordance with BS 18-1[2)]. The load shall be applied gradually and uniformly on straightened lengths of wire, having an original gauge length of 250 mm.

The elongation shall be measured on the gauge length after the fractured ends have been fitted together. The determination shall be valid, whatever the position of the fracture, if the specified value is reached. If the specified value is not reached, the determination shall be valid only if the fracture occurs between the gauge marks and not closer than 25 mm to either mark.

1.9 Wrapping test

The wire shall be wrapped round a wire of its own diameter to form a close helix of eight turns. Six turns shall then be unwrapped and again closely re-wrapped in the same direction as the first wrapping.

1.10 Electrical resistivity test

The resistivity shall be determined by direct measurement on the wire in accordance with the routine method given in BS 3239[3)].

1.11 Retests

Should any one of the test pieces first selected fail to pass the mechanical or resistivity tests, two further samples from the same batch shall be selected for testing, one of which shall be from the length from which the original test sample was taken, unless that length has been withdrawn by the supplier.

Should the test pieces from both these additional samples satisfy the requirements of the mechanical or resistivity tests, the batch represented by these samples shall be deemed to comply with the standard. Should the test pieces from either of the two additional samples fail, the batch represented shall be deemed not to comply with the standard.

[2)] BS 18, "Methods for the tensile testing of metals", Part 1, "Non-ferrous metals".
[3)] BS 3239, "Determination of resistivity of metallic electrical conductor materials".

1.12 Certificate of compliance

The supplier shall, if required, certify that the material complies with the requirements of this standard.

1.13 Inspection

If the purchaser wishes to inspect the material at the supplier's works he shall notify the supplier at the time of placing the order.

1.14 Independent test

Should there be a dispute about the compliance of the material with regard to the chemical composition or test requirements of this standard, the purchaser and the supplier shall have the right to have tests made by a mutually acceptable testing authority.

The results obtained by the independent testing authority shall be accepted as final. If the material does not comply with the standard, the cost of independent testing shall be borne by the supplier; if the material complies with the standard the cost shall be borne by the purchaser.

The method of sampling for analysis shall be in accordance with BS 1499[4)]; the methods of analysis shall be in accordance with BS 1728[5)], where the appropriate method exists, and the method for determining resistivity shall be in accordance with the reference method in BS 3239[6)].

1.15 Facilities for testing

The supplier shall make the necessary arrangements for carrying out the tests required by this standard.

Material 1350 (former BS designation G1E)

2 Specific requirements

2.1 General

The material shall comply with the general requirements of Section 1 and shall have the following chemical composition, condition and mechanical properties.

2.2 Chemical composition limits[7)8)]

The chemical composition of material 1350 shall be as follows:

Silicon		0.10
Iron		0.40
Copper		0.05
Manganese		0.01
Chromium		0.01
Zinc		0.05
Gallium		0.03
Boron		0.05
Vanadium + Titanium		0.02
Others[a]	Each	0.03
	Total	0.10
Aluminium		min. 99.50[b,]

[a] Analysis is regularly made only for the elements for which specific limits are shown. if, however, the presence of other elements is suspected to be, or in the course of routine analysis is indicated to be, in excess of the specified limits, further analysis is made to determine that these other elements are not in excess of the amount specified.

[b] The aluminium content for unalloyed aluminium not made by a refining process is the difference between 100.00 % and the sum of all other metallic elements present in amounts of 0.010 % or more each, expressed to the second decimal before determining the sum.

4) BS 1499, "Sampling non-ferrous metals".

5) BS 1728, "Methods for the analysis of aluminium and aluminium alloys".

6) Bs 3239, "Determination of resistivity of metallic electrical conductor materials".

7) Composition in per cent maximum unless shown as a range or a minimum.

8) For the purposes of determining conformance to these limits, an observed value or a calculated value obtained from analysis is rounded off to the nearest unit in the last right-hand place of figures used in expressing the specified limit, in accordance with the following.

When the figure next beyond the last figure or place to be retained is less than 5, the figure in the last place retained should be kept unchanged.

When the figure next beyond the last figure or place to be retained is greater than 5, the figure in the last place retained should be increased by 1.

When the figure next beyond the last figure or place to be retained is 5 and

a) there are no figures, or only zeros, beyond this 5, if the figure in the last place to be retained is odd, it should be increased by 1; if even, it should be kept unchanged;

b) if the 5 next beyond the figure in the last place to be retained is followed by any figures other than zero, the figure in the last place retained should be increased by 1, whether odd or even.

2.3 Condition

The materials shall be supplied in one of the conditions shown in **2.4**, as specified by the purchaser, and shall comply with the mechanical and electrical properties stipulated in **2.4**, **2.5** and **2.6**.

2.4 Mechanical properties

The mechanical properties obtained from test pieces selected as specified in **1.6** and prepared and tested as specified in **1.7**, **1.8** or **1.9** shall be as follows:

Condition	Specified diameter		Tensile strength		Elongation on 250 mm min.	Wrapping test
	Over	Up to and including	min.	max.		
	mm	mm	hbar[a]	hbar[a]	%	
0	0.4	10	—	9.0	15	not applicable
H4	0.4	5	9.5	12.5	not applicable	see **2.5**
H6	0.4	5	12.5	16.5	not applicable	see **2.5**
	5	10	12.5	16.5	3	not applicable
H8	0.4	5	16.0	20.5	not applicable	see **2.5**
H68	0.4	5	12.5	20.5	not applicable	see **2.5**
H9	1.25	1.50	19.3	—	not applicable	see **2.5**
	1.50	1.75	18.8	—	not applicable	see **2.5**
	1.75	2.00	18.4	—	not applicable	see **2.5**
	2.00	2.25	18.0	—	not applicable	see **2.5**
	2.25	2.50	17.6	—	not applicable	see **2.5**
	2.50	2.75	17.2	—	not applicable	see **2.5**
	2.75	3.00	16.9	—	not applicable	see **2.5**
	3.00	3.25	16.5	—	not applicable	see **2.5**
	3.25	3.50	16.4	—	not applicable	see **2.5**
	3.50	3.75	16.2	—	not applicable	see **2.5**
	3.75	4.25	16.0	—	not applicable	see **2.5**
	4.25	5.00	15.9	—	not applicable	see **2.5**

[a] 1 hbar = 10 MN/m^2 = 10 N/mm^2

2.5 Wrapping test

The wire shall not crack when tested in accordance with the method given in **1.9**.

2.6 Electrical resistivity

The electrical resistivity of the wire determined in accordance with **1.10**, shall not exceed the following values:

Condition	Resistivity at 20 °C
	microhm cm
0	2.803
H4	2.8264
H6	2.8264
H8	2.8264
H68	2.8264
H9	2.8264

Appendix A Standard values (for information only)

For the purposes of this British Standard the following standard values have been adopted:

a. Density at 20 °C	2.703 g/cm^3
b. Constant mass temperature coefficient of resistance at 20 °C, measured between two potential points rigidly fixed to the conductors	0.004 03/°C
c. Coefficient of linear expansion between 0 and 30 °C	23×10^{-6}/°C

Appendix B Details of the international alloy designations and chemical composition limits for wrought aluminium alloys system

B.1 Alloys groups: general. The first of the four digits in the designation indicates the alloy group as follows:

Aluminium, 99.00 % minimum and greater	1 xxx
Aluminium alloys groups by major alloying elements	
Copper	2 xxx
Manganese	3 xxx
Silicon	4 xxx
Magnesium	5 xxx
Magnesium and silicon	6 xxx
Zinc	7 xxx
Other element	8 xxx
Unused series	9 xxx

B.2 1 xxx group. In the 1 xxx group for minimum purities of 99.00 % and greater, the last two of the four digits in the designation indicate the minimum aluminium percentage. These digits are the same as the two digits to the right of the decimal point in the minimum aluminium percentage when it is expressed to the nearest 0.01 %.

The second digit in the designation indicates modifications in impurity limits or alloying elements. If the second digit in the designation is zero, it indicates unalloyed aluminium having natural impurity limits: integers 1 to 9, which are assigned consecutively as needed, indicate special control of one or more individual impurities or alloying elements.

B.3 2 xxx to 8 xxx groups. In the 2 xxx to 8 xxx groups the last two of the four digits in the designation have no special significance but serve only to identify the different aluminium alloys in the group. The second digit in the alloy designation indicates alloy modifications. If the second digit in the designation is zero, it indicates the original alloy; integers 1 to 9, which are assigned consecutively, indicate alloy modifications.

B.4 National variations. National variations of wrought aluminium and wrought aluminium alloys registered by another country are identified by a serial letter after the numerical designation. The serial letters are assigned in alphabetical sequence starting with A for the first national variation registered, but omitting I, O and Q.

BSI — British Standards Institution

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