

Specification for

**Wrought aluminium
and aluminium alloys
for general engineering
purposes
(supplementary
series) —**

**7020 Bar, extruded round tube and
sections**

UDC 669.71 – 13 + 669.715 – 462 – 42

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*	Institution of Structural Engineers *
Association of Bronze and Brass Founders	Lead Development Association
British Electrical and Allied Manufacturers' Association	Light Metal Founders' Association
British Lead Manufacturers' Association	London Metal Exchange
British Non-ferrous Metals Federation	Magnesium Industry Council
British Non-ferrous Metals Federation High Conductivity Copper Group	Ministry of Defence, Army Department
British Non-ferrous Metals Research Association*	Ministry of Defence, Navy Department *
Copper Development Association	National Brassfoundry Association
Department of Trade and Industry (Marine Division)	Non-ferrous metal stockists *
Electric Cable Makers' Confederation	Post Office
Institute of British Foundrymen	Royal Institute of British Architects *
Institution of Mining and Metallurgy	Society of Motor Manufacturers and Traders Ltd.*
Institution of Production Engineers	Tin Research Institute
	Zinc Development Association
	Individual manufacturers

The 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:

ALARS (Association of Light Alloy Refiners and Smelters)	Lloyd's Register of Shipping
British Aluminium Hollowware Manufacturers' Association	London Transport Executive
Department of Trade and Industry	National Association of Drop Forgers and Stampers
Institute of Sheet Metal Engineering	National Federation of Vehicle Trades
	Small Rivet Association

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 September 1973

© BSI 04-2000

First published March 1969
First revision September 1973

The following BSI references relate to the work on this standard:
Committee reference NFE/19
Draft for comment 71/40417

ISBN 0 580 07692 X

Amendments issued since publication

Amd. No.	Date of issue	Comments
3392	June 1980	Indicated by a sideline in the margin

Contents

	Page
Co-operating organizations	Inside front cover
Foreword	ii
1 General	1
1.1 Scope	1
1.2 Definitions	1
2 General requirements	1
2.1 General	1
2.2 Freedom from defects	1
2.3 Chemical composition	1
2.4 Condition	1
2.5 Sizes and tolerances	2
2.6 Selection of test samples	2
2.7 Mechanical tests	2
2.8 Retests	2
2.9 Certificate of compliance	2
2.10 Inspection	2
2.11 Independent test	3
2.12 Facilities for testing	3
2.13 The rounding of numbers rule	3
3 Specific requirements	3
3.1 Chemical composition	3
3.2 Mechanical properties	4
3.3 Tolerances	4
3.4 Normal radii for corners	14
Appendix A Standard sizes of material	15
Appendix B Details of the international alloy designations and chemical composition limits for wrought aluminium alloys system	19
Figure 1 — Tolerances on open ends of channels and I-beams	9
Table 1 — Heat-treatable materials; grouping into batches	2
Table 3 — Tensile test	4
Table 4 — Tolerances on diameter and length of round bar intended for use on automatic lathes	4
Table 5 — Tolerances on width across flats of hexagonal bar for nuts and bolts	5
Table 6 — Tolerances on length	5
Table 7 — Tolerances on width and diameter of bars and regular sections	6
Table 8 — Tolerances on thickness of bars and regular sections	7
Table 9 — Tolerances on open ends of channels and I-beams	8
Table 10 — Angular tolerances for extruded sections	9
Table 11 — Tolerances on wall thickness of extruded round tube	10
Table 12 — Tolerances on outside diameter of extruded round tube or on inside diameter of Class A and Class B extruded round tubing	11
Table 13 — Tolerances on width or width across flats of hollow sections	11
Table 14 — Tolerances on thickness of hollow sections	12
Table 15 — Tolerances on straightness for extruded bar, regular sections and extruded round tube	13
Table 16 — Tolerances on twist for extruded solid and hollow sections	14
Table 17 — Normal radii for corners	14
Publications referred to	20

Foreword

This British Standards specification for bar, extruded round tube and sections is one of a series of supplementary specifications for wrought aluminium and aluminium alloys, the preparation of which has been authorized by the Non-ferrous Metals Industry Standards Committee. In reflection of the decision of the Government that British industry should effect a complete change to the metric system by 1975, this specification is expressed in metric terms using SI units.

Aluminium and aluminium alloy materials intended for general engineering use are the subject of specification in BS 1470 to BS 1475, whilst those intended for specialized use or which are of limited interest, are published in the supplementary engineering series. The latter series will be kept under frequent review, and if changed circumstances appear to warrant such, from time to time particular material specifications may be transferred from the supplementary to the general engineering series.

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 Aluminum Association Inc., who issue the "Registration Record of International Alloy Designations and Chemical Composition Limits for Wrought Aluminum 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.

The designation 7020 therefore replaces the former designation HE 17 nearest ISO equivalent Al Zn4.5 Mg). Minor compositional changes have been made.

Satisfactory performance of this alloy in service is as dependent on correct methods of manufacture and fabrication as on control of composition and tensile properties. It is essential therefore that there should be direct collaboration between the purchaser and the manufacturer concerning the intended use and likely environmental conditions.

NOTE Attention is drawn to certification facilities offered by BSI; see the inside back cover of this standard.

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 and ii, pages 1 to 20, an inside back cover 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.

1 General

1.1 Scope

This British Standard specifies aluminium alloy bar, extruded round tube and sections.

NOTE The titles of the British Standards referred to in this standard are listed on the inside back cover.

1.2 Definitions

For the purposes of this British Standard the following definitions apply:

purchaser

the party, whether user, retailer, wholesaler or corporate body or their agent(s) as appropriate, responsible for ordering the material standardized

heat-treatment batch¹⁾

a quantity of material of one alloy, of the same dimensions and produced in the same way, solution-treated in one furnace load or such material so solution-treated and subsequently precipitation-treated in one furnace load. More than one heat-treatment batch may comprise a furnace load

bar¹⁾

a round, rectangular or polygonal solid section supplied in straight lengths. The term is applied to materials of not less than 6 mm diameter or minor dimension

extruded round tube¹⁾

a circular hollow extrusion of uniform wall thickness not subjected to cold drawing

hollow section¹⁾

an extruded shape other than round, the cross section of which completely encloses a void or voids, and which is not subjected to cold drawing

regular section

a solid drawn or extruded section, not otherwise covered by the definition of a bar, which can be conveniently divided into approximate rectangles with measurable dimensions, e.g. angles, channels, toes, etc. The ratio of maximum thickness to minimum thickness of such regular sections does not exceed 4 : 1

2 General requirements

2.1 General

The bars, extruded round tube and sections shall comply with the general requirements set out in the following clauses and with the appropriate requirements specified in Section 3.

2.2 Freedom from defects

The material shall be free from defects prejudicial to its use.

2.3 Chemical composition

The chemical composition shall comply with the requirements specified in 3.1.

2.4 Condition

The material shall be supplied in one of the following conditions as specified by the purchaser and cited in 3.2.

TB *Solution heat-treated and naturally aged.* Material which receives no cold work after solution heat-treatment except as may be required to flatten or straighten it. Properties in this temper are unstable.

TF *Solution heat-treated and precipitation-treated.*

¹⁾ Extracted from BS 3660.

2.5 Sizes and tolerances

2.5.1 Standard sizes. Material shall be available in the standard sizes for round, square and hexagonal bar given in BS 4229-1. Details of standard sizes are given in Appendix A.

2.5.2 Tolerances on round bar, regular sections, extruded round tube and hollow sections. The dimensional tolerances shall comply with the requirements given in Table 4 to Table 16 and the relevant clauses in Section 3.

2.6 Selection of test samples

Material of the same dimension, produced in the same way and of the same composition, shall be grouped into batches as shown in Table 1, unless the heat-treatment batch is smaller, in which event that shall constitute the batch.

Table 1 — Heat-treatable materials; grouping into batches

Diameter or equivalent cross section of material	Batch quantity
mm	kg
Up to and including 10	1 000
Over 10	2 000

One test shall be cut from a bar or section selected from each batch. The test piece shall be machined coaxially from the test sample. Before the test samples are cut off they shall be marked to identify them with the batch they represent.

Unless otherwise agreed for material supplied in the TB condition the material shall be tested in the condition as supplied. The test samples shall not be mechanically worked (except for straightening and machining the test piece) before being tested.

For materials in the TF condition the test samples shall be tested in the condition as supplied. The test samples shall not be further heat-treated or mechanically worked (except for straightening and machining the test piece) before being tested.

2.7 Mechanical tests

The following tests shall be made on test pieces prepared from test samples selected as specified in 2.6. The values obtained shall comply with the appropriate requirements given in 3.2.

2.7.1 Tensile test. The tensile test shall be made in accordance with BS 18. It is recommended that non-proportional test pieces should be used for testing products thinner than 12.5 mm.

2.7.2 0.2 % proof stress. The proof stress shall be determined as specified in BS 18, Part 1.

2.8 Retests

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

The supplier shall have the right, if he so desires, to re-heat treat the material before the two further samples are selected.

Should the test pieces from both these additional samples pass the tests, the batch represented by the test samples shall be deemed to comply with the requirements of this standard. Should the test pieces from either of these additional samples fail the tests, the batch represented by the test samples shall be deemed not to comply with the requirements of this standard.

2.9 Certificate of compliance

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

2.10 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.

2.11 Independent test

Should there be a dispute about the compliance of the material with regard to the composition or the 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 requirements of this standard, the cost of independent testing shall be borne by the supplier; if the material complies with the requirements of this standard the cost shall be borne by the purchaser.

The method of sampling for analysis shall be in accordance with BS 1499, and the methods of analysis shall be in accordance with BS 1728, where the appropriate method exists.

2.12 Facilities for testing

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

2.13 The rounding of numbers rule

For purposes of determining conformance to compositional limits and mechanical properties (*not* dimensional tolerances), 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.

3 Specific requirements

Material 7020 (former BS designation HE 17 nearest ISO equivalent Al Zn4.5 Mgl).

3.1 Chemical composition limits²⁾

The chemical composition of material 7020 (former BS designation HE 17, nearest ISO equivalent Al Zn4.5 Mgl) shall be as follows:

Silicon	0.35
Iron	0.40
Copper	0.20
Manganese	0.05 – 0.50
Magnesium	1.0 – 1.4
Chromium	0.10 – 0.35
Zinc	4.0 – 5.0
Zirconium	0.08 – 0.20
Zirconium + Titanium	0.08 – 0.25
Others ^a Each	0.05
Total	0.15
Aluminium	Remainder

^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.

²⁾ Composition in per cent maximum unless shown as a range or a minimum.

3.2 Mechanical properties

The mechanical properties obtained from the test pieces selected in accordance with 2.6 and prepared and tested in accordance with 2.7 shall be as given in Table 3.

Table 3 — Tensile test

Condition	Thickness		0.2 % proof stress min.	Tensile strength min.	Elongation on $5.65\sqrt{S_0}$ min.	on 50 mm min.
	Over	Up to and including				
	mm	mm	N/mm ² (= MPa)	N/mm ² (= MPa)	%	%
TB	—	25	190	300	12	10
TF	—	25	280	340	10	8

NOTE The properties for the TB condition are those which apply after thirty days natural ageing

3.3 Tolerances

3.3.1 Tolerances on diameter and length of round bar intended for use on automatic lathes shall be as given in Table 4.

Table 4 — Tolerances on diameter and length of round bar intended for use on automatic lathes

NOTE Other round bar is toleranced from Table 7, "Tolerances on width and diameter of bars and regular sections".

Diameter of bar	Tolerances						
	On diameter	On length ^a					
		300 mm up to and including 1 000 mm	Over 1 000 mm up to and including 1 500 mm	Over 1 500 mm up to and including 5 000 mm	Over 5 000 mm up to and including 7 000 mm	Over 7 000 mm up to and including 10 000 mm	Over 10 000 mm
mm	mm + mm -	mm ±	mm ±	mm ±	mm ±	mm ±	mm ±
Over 10 up to and including 18	0.05 0.10	2.0	2.5	2.5	3.5	4.0	6.5
Over 18 up to and including 30	0.08 0.13						
Over 30 up to and including 40	0.14 0.14						
Over 40 up to and including 60	0.20 0.20						
Over 60 up to and including 80	0.30 0.30	2.0	2.5	3.5	4.0	5.5	7.5
Over 80 up to and including 100	0.40 0.40						
Over 100 up to and including 140	± 1/2 % of diameter	3.0	3.5	4.0	5.0	6.5	8.0
Over 140 up to and including	± 1/2 % of diameter	3.5	4.0	5.0	6.5	8.0	9.5

NOTE Total tolerances (i.e. the sum of the plus and minus limits) may be applied unilaterally by agreement between the supplier and the purchaser.

^a Tolerances on length are measured at normal room temperature of 16 °C. They provide for out-of-squareness of cut to the extent of 1°.