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SPECIFICATION FOR

WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS

SHEET AND STRIP

BRITISH STANDARDS INSTITUTION

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SPECIFICATION FOR

WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS

For General Engineering Purposes

SHEET AND STRIP

B.S. 1470 : 1963

Price 17/6 net

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THIS BRITISH STANDARD, having been approved by the Non-ferrous Metals Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 3rd September, 1963.

First published December, 1948.
First revision December, 1955.
Second revision September, 1963.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

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 4000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook.

This standard makes reference to the following British Standards:

B.S. 18. Tensile testing of metals.
B.S. 1499. Sampling non-ferrous metals.
B.S. 1728. Methods for the analysis of aluminium and aluminium alloys.
B.S. 1957. Presentation of numerical values (fineness of expression ; rounding of numbers).

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard:
Committee reference NFE/19. Draft for comment AC(NFE)257

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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:

*Admiralty
*Aluminium Federation
Association of Bronze and Brass Founders
Association of Consulting Engineers, Incorporated
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 Research Association
Cable Makers' Association
Copper Development Association
Crown Agents for Oversea Governments and Administrations
High Commission of India
High Conductivity Copper Association
Institute of British Foundrymen
*Institute of Metals
*Institution of Mechanical Engineers (Automobile Division)
Institution of Mining and Metallurgy
*Institution of Structural Engineers
Lead Development Association
Light Metal Founders' Association
London Metal Exchange
Magnesium Industry Council
*Ministry of Aviation
Ministry of Transport
National Brassfoundry Association
*Non-ferrous metal stockists
Post Office
*Royal Institute of British Architects
Society of British Aircraft Constructors
*Society of Motor Manufacturers and Traders Ltd.
Tin Research Institute
War Office
Zinc Development Association
Individual manufacturers

The Government departments 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:

ALARS (Association of Light Alloy Refiners and Smelters)
British Aluminium Holloware Manufacturers' Association
Institute of Sheet Metal Engineering
Institute of Welding
Lloyd's Register of Shipping
London Transport Board
National Association of Drop Forgers and Stampers
National Federation of Vehicle Trades
National Physical Laboratory (D.S.I.R.)
Rolled Thread Screw Association
Small Rivet Association

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BRITISH STANDARD SPECIFICATION FOR

WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS

FOR GENERAL ENGINEERING PURPOSES

Sheet and Strip

FOREWORD

This British Standard for sheet and strip was first issued in 1948 and forms part of a comprehensive series of British Standards for aluminium and aluminium alloys in various wrought forms for general engineering purposes. The whole series was reviewed in 1955 and the requirements for wire previously covered by B.S. 1474 and 1475 were incorporated in the one standard B.S. 1475. The number 1474 was then allocated to a new standard for extruded round tube and hollow sections. This numbering system has been retained in this second revision of the series of which the other British Standards are:

B.S. 1471. Drawn tube.
B.S. 1472. Forging stock and forgings.
B.S. 1473. Rivet, bolt and screw stock for forging.
B.S. 1474. Extruded round tube and hollow sections.
B.S. 1475. Wire.
B.S. 1476. Bars and sections.
B.S. 1477. Plate.

The same system of nomenclature has been adopted for all standards in the series and particular care should be taken to ensure that the correct symbol is quoted.

In this revision of the series the ranges for magnesium in alloys N4 and N5 have been amended, N5/6 has been omitted and a new alloy N8 has been introduced. For all these alloys the iron limits have been reduced so that these and the new ranges for magnesium are more in line with those agreed for inclusion in ISO Recommendation R 209. For certain other alloys amendments have been made to the limits for essential elements and impurities. As in the earlier editions, major alloying elements are printed in heavy type throughout Section Two and limits in all cases have been set bearing in mind the rounding rule of B.S. 1957, 'Presentation of numerical values (fineness of expression; rounding of numbers)'.

In this revised standard for sheet and strip material N7 has been omitted and the mechanical properties for certain of the alloys have been amended. In

particular, proof stress values for alloys N5 and N6 in the annealed condition which are 'for information only' now appear only in a footnote. For H14 the 'T' condition has been replaced by the 'W' condition. The Appendix setting out recommended standard sizes of sheets has been omitted.

SYSTEM OF NOMENCLATURE

In this series of British Standards the following symbols have been adopted throughout:

a. Form of material.

S	Sheet and strip (B.S. 1470).
C	Clad sheet and strip (B.S. 1470).
T	Drawn tube (B.S. 1471).
F	Forging stock and forgings (B.S. 1472).
R	Rivet stock (B.S. 1473).
B	Bolt and screw stock (B.S. 1473).
V	Extruded round tube and hollow sections (B.S. 1474).
G	Wire (B.S. 1475).
E	Bars and sections (B.S. 1476).
P	Plate (B.S. 1477).
PC	Clad plate (B.S. 1477).

b. Heat treatment. In the case of the aluminium alloys, the following prefix symbols have been adopted throughout:

N	Non-heat-treatable alloys, i.e. those which are not strengthened by heat treatment.
H	Heat-treatable alloys, i.e. those which are strengthened by heat treatment.

Thus the letters NG indicate non-heat-treatable alloys in the form of wire. The letters HS refer to heat-treatable alloys in the form of sheet and strip.

c. Condition. Suffix letters have been used to indicate the temper or condition of heat treatment in which the materials are available. These symbols are as follows for aluminium and the non-heat-treatable alloys:

O	Material in the annealed condition.
M	Material in the 'as manufactured' conditions, i.e. as rolled, as extruded, straightened and/or drawn to size, or as forged.
OD	Material in the annealed and controlled drawn condition (at present applicable only to rivet stock).
¼H, ½H, ¾H, H	Material subjected to the application of cold work after annealing or to a combination of cold work and partial annealing/stabilizing in order to secure the specified mechanical properties. The designations are in ascending order of tensile strength.

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For the heat-treatable alloys, the suffix letters have the following significance:

O Material in the annealed condition.

M Material in the 'as manufactured' conditions, i.e. as rolled, as extruded, straightened and/or drawn to size, or as forged, without subsequent heat treatment of any kind.

OD Material in the annealed and controlled drawn condition (at present applicable only to rivet, bolt and screw stock).

W Material in the solution-treated and naturally aged condition.

WP Material in the fully heat-treated condition, i.e. solution-treated and subsequently precipitation-treated.

WD Material in the solution-treated and drawn condition (at present applicable only to wire).

WDP Material drawn after solution treatment and subsequently precipitation-treated (at present applicable only to wire).

P Material in the air-quenched and precipitation-treated condition.

d. Numerical classification. The different grades of pure aluminium and the aluminium alloys are listed under numbers and the same number has been used to indicate any given grade of pure aluminium or aluminium alloy in whatever wrought form it may be obtainable.

99·99 grade aluminium has been given the classification 1, whilst the three other grades of aluminium have been identified by the suffix letters A, B and C.

e. Examples. The following are examples of the nomenclature specified above:

S1C-H Aluminium of grade 1C in the form of sheet or strip, in the hard condition.

NS5-¼H Non-heat-treatable aluminium alloy No. 5 in the form of sheet or strip, in the quarter-hard temper.

HS30-W Heat-treatable aluminium alloy No. 30 in the form of sheet or strip, which has been solution-treated and naturally aged.

WROUGHT ALUMINIUM ALLOYS FOR GENERAL ENGINEERING PURPOSES
SUMMARY OF CHEMICAL COMPOSITIONS

Material	Aluminium	Copper		Magnesium		Silicon		Iron		Manganese		Nickel		Zinc	Lead	Tin	Titanium and/or other grain refining elements		Chromium	Antimony
		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	max.	max.	max.	min.	max.	max.	max.
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
*1	99·99	§see below		—	—	§see below		§see below		—	—	—	—	—	—	—	—	—	—	—
*1A	‡99·8	—	0·02	—	—	—	0·15	—	0·15	—	0·03	—	—	—	0·06	—	—	—	—	—
*1B	‡99·5	—	0·05	—	—	—	0·3	—	0·4	—	0·05	—	—	—	0·10	—	—	—	—	—
*1C	‡99·0	—	0·10	—	—	—	0·5	—	0·7	—	0·1	—	—	—	†0·10	—	—	—	—	—
N2	remainder	—	0·10	—	†0·25	10·0	13·0	—	0·6	—	0·5	—	†0·2	†0·2	0·05	0·05	—	—	—	—
N21	remainder	—	0·10	—	†0·25	4·5	6·0	—	0·6	—	0·5	—	†0·2	†0·2	0·05	0·05	—	—	—	—
*N3	remainder	—	0·1	—	—	—	0·6	—	0·7	1·0	1·5	—	—	†0·2	—	—	0·20	—	—	—
*N4	remainder	—	0·10	1·7	2·8	—	0·6	—	0·5	—	0·5	—	—	†0·2	—	—	0·15	—	0·25	—
*N5	remainder	—	0·10	2·8	4·0	—	0·6	—	0·5	—	0·6	—	—	†0·2	—	—	0·15	—	0·25	—
*N6	remainder	—	0·10	4·5	5·5	—	0·6	—	0·5	—	1·0	—	—	†0·2	—	—	0·15	—	0·25	—
N7	remainder	—	0·10	6·5	7·5	—	0·6	—	0·5	—	0·5	—	—	†0·2	—	—	0·15	—	0·25	—
N8	remainder	—	0·10	4·0	4·9	—	0·40	—	0·40	0·5	1·0	—	—	†0·2	—	—	0·15	—	0·25	—
H9	remainder	—	0·10	0·4	0·9	0·3	0·7	—	0·5	—	0·30	—	—	†0·1	—	—	0·2	—	0·10	—
H19	remainder	—	0·10	0·4	1·5	0·60	1·3	—	0·6	—	0·2	—	—	†0·1	—	—	0·2	—	0·10	—
*H20	remainder	0·15	0·40	0·8	1·2	0·4	0·8	—	0·7	‖0·2	0·8	—	—	†0·2	—	—	0·2	‖0·15	0·35	—
*H30	remainder	—	0·10	0·4	1·4	0·60	1·3	—	0·5	0·40	1·0	—	—	†0·1	—	—	0·2	—	0·3	—
H11	remainder	1·0	2·0	0·5	1·2	0·8	1·3	—	0·7	—	1·0	—	†0·2	†0·2	0·05	0·05	0·3	—	—	0·05
H12	remainder	1·8	2·8	0·6	1·2	0·5	1·3	0·6	1·2	—	0·5	0·6	1·4	†0·2	0·05	0·05	0·3	—	—	0·05
*H14	remainder	3·5	4·7	0·4	1·2	0·2	0·7	—	0·7	0·4	1·0	—	†0·2	†0·2	0·05	0·05	¶0·3	—	¶0·3	0·05
*H15	remainder	3·8	4·8	0·2	0·8	0·5	0·90	—	0·7	0·3	1·2	—	†0·2	†0·2	0·05	0·05	¶0·3	—	¶0·3	0·05
H18	remainder	1·8	2·7	1·2	1·6	—	1·3	0·6	1·2	—	†0·2	0·6	1·4	†0·2	0·05	0·05	0·3	—	—	0·05

* These materials are covered by this standard for sheet and strip.
† The supplier shall undertake that the material does not contain the named impurities in excess of the amounts shown.
‡ The sum of the named elements shall not exceed 0·20 for 1A, 0·5 for 1B and 1·0 for 1C.
§ The combined copper, silicon and iron content shall not exceed 0·01 per cent.
‖ Either manganese within the limits stated or chromium within the limits stated shall be included.
¶ Titanium and/or other grain refining elements and/or chromium may be present at the option of the supplier provided the total content does not exceed 0·3 per cent.

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NOTE. Where metric equivalents are stated the figures in British units are to be regarded as the standard. The metric conversions are approximate. More accurate conversions should be based on B.S. 350, 'Conversion factors and tables'.

SPECIFICATION

SCOPE

1. This British Standard specifies requirements for sheet and strip made from four grades of aluminium, and from eight aluminium alloys in various conditions.

SECTION ONE : GENERAL CLAUSES

DEFINITIONS

2. 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 batch.* 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.

Sheet.* A cold-rolled product of rectangular section, over 0·006 inch thick up to and including 0·252 inch thick, supplied flat with sheared or slit edges. It may be prepared as strip and subsequently flattened and cut to length.

Strip.* A cold-rolled product of rectangular section, supplied in coil with slit edges, over 0·006 inch thick but not exceeding 0·192 inch thick.

FREEDOM FROM DEFECTS

3. The sheet or strip shall be sound and free from harmful defects.

TOLERANCES

4. *a. Tolerances on thickness, width and length.* The tolerances on thickness, width and length of sheet or strip shall be in accordance with the following tables. Unless otherwise specified by the purchaser, the general tolerances shall apply:

Table 1. Tolerances (general) on thickness of sheet.
Table 2. Tolerances (fine) on thickness of sheet.
Table 3. Tolerances (general and fine) on thickness of strip.
Table 4. Shearing tolerances (general and fine) for sheet.
Table 5. Shearing tolerances (general) for strip.
Table 6. Shearing tolerances (fine) for strip.

For sheet or strip ordered in metric sizes Tables 1M, 2M, 3M, 4M, 5M and 6M apply.

* Extracted from B.S.3660 'Glossary of terms used in the wrought aluminium industry'.

b. Lateral curvature. No part of the edge of any sheet shall be distant from a 10 ft (3 m) chord by more than ¼ in (6·5 mm). In the case of lengths shorter than 10 ft (3 m) the distance shall be proportionate. Strip in coil shall be so free from lateral curvature that when laid out flat no part of its edge shall be distant from a 10 ft (3 m) chord by more than ½ in (12·75 mm). In the case of lengths shorter than 10 ft (3 m) the distance shall be proportionate.

SELECTION OF TEST SAMPLES

5. *a. Sheet and strip of pure aluminium or non-heat-treatable aluminium alloys.* The sheet or strip to the same individual specifications and of the same width and thickness produced in the same way at one time shall be grouped into batches.

The supplier shall sample each batch at such a rate that he can, on the results of the mechanical tests on the samples, certify that the material conforms to this standard.

Before the test samples are cut off, they shall be marked to identify them with the batch they represent.

The test samples shall be taken from the sheet (as supplied in the flattened condition) or strip as supplied and shall not be annealed or mechanically worked (except for machining the test piece) before being tested.

When sheet is ordered to specified dimensions, the test samples shall be cut from the transverse margins of the sheets before shearing to size.

b. Sheet and strip of heat-treatable aluminium alloys. One test sample shall be cut from a sheet or strip selected from each heat-treatment batch. Before any of the test samples are cut off, they shall be marked to identify them with the heat-treatment batch they represent.

For material supplied in the M or O condition, the test samples shall be tested in the O, W or WP condition, as specified by the purchaser. The test samples, after heat treatment, shall not be mechanically worked (except for straightening and machining the test piece) before being tested.

Material in the M condition can be expected to have the mechanical properties of the W and WP conditions on appropriate heat treatment but material in the O condition when heat-treated may be expected to have properties of the order of 1 ton/sq in less than the specified properties for the W or WP condition as appropriate.

For material supplied in the W condition, the test samples shall be tested in the condition as supplied, unless the purchaser has specified that he requires the test samples to be tested in the WP condition. The test samples shall not be mechanically worked (except for machining the test piece) before being tested.

For material supplied in the WP 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 machining the test piece) before being tested.

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When sheet is ordered to specified dimensions, the test samples shall be cut from the transverse margins of the sheets before shearing to size and attached to the sheets from which they were cut before final heat treatment is carried out.

MECHANICAL TESTS
(including preparation of test pieces)

6. The following tests shall be made on test pieces prepared from test samples selected as specified in Sub-clauses 5*a* and *b*:

a. Tensile test. The tensile test shall be made in accordance with B.S. 18, 'Tensile testing of metals'. The tensile test piece shall be of the dimensions of the British Standard rectangular section test-piece (see Appendix A), having a gauge length of 2 in (50·8 mm).

The test pieces shall be cut transverse to the direction of rolling for sheet and strip 12 in (304·8 mm) wide and over and parallel to the direction of rolling for sheet and strip under 12 in (304·8 mm) wide.

When the width of the material to be tested is insufficient to permit of the preparation of the standard tensile test piece, a piece of the full width of the material may be used.

b. 0·1 per cent proof stress. The 0·1 per cent proof stress is defined as the stress (load divided by the original area of cross-section of a test piece) which is just sufficient to produce, under load, a non-proportional elongation equal to 0·1 per cent of the original gauge length.

The proof stress shall be determined as specified in B.S. 18 (see Appendix B).

c. Bend test. Unless otherwise stated, the bend test pieces shall be ½ in (12·7 mm) wide, of convenient length and cut with their longer axes transverse to the direction of rolling for the sheet or strip. The longer edges shall be carefully rounded and smoothed longitudinally, so that the cross-section of the test piece has approximately semi-circular ends.

d. Bend tests on thin material. For thin material, the use of a former may be impracticable. The test piece may then be bent by hand to a U form and the piece thus obtained shall subsequently be closed in a vice until the inner surfaces of the bend are twice the specified radius apart (or are in general contact if the test piece is to be closed flat).

NOTE. The true radius of bend is not obtained by this free bend method and the severity of the test is both increased and variable.

RETESTS

7. 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 sheet or strip from which the original test sample was taken, unless that sheet or strip has been withdrawn by the supplier.

For heat-treatable alloys 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 batch represented by the test samples shall be deemed to comply with this standard. Should the test pieces from either of these additional samples fail, the batch represented by the test samples shall be deemed not to comply with this standard.

CERTIFICATE OF COMPLIANCE

8. The supplier shall certify that the material complies with the requirements of this standard.

INSPECTION

9. 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.

INDEPENDENT TEST

10. 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 this standard, the cost of independent testing shall be borne by the supplier; if the material complies with this standard the cost shall be borne by the purchaser.

The method of sampling for analysis shall be in accordance with B.S. 1499, 'Sampling non-ferrous metals' and the methods of analysis shall be in accordance with B.S. 1728, 'Methods for the analysis of aluminium and aluminium alloys', where the appropriate method exists.

FACILITIES FOR TESTING

11. For orders of 112 lb (50·8 kg) or more of any one size of sheet or strip the supplier shall provide 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 standard. Failing facilities at his own works for making the prescribed tests the supplier shall make the necessary arrangements for making the tests elsewhere.

For orders of less than 112 lb (50·8 kg) of any one size of sheet or strip in one material, the mechanical tests shall be made only by special arrangement between supplier and purchaser.

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THE ROUNDING OF NUMBERS RULE

12. Values between the limits of composition and mechanical properties shown (NOT dimensional tolerances) are subject to the application of the 'rounding' rule in accordance with B.S. 1957*. Under this rule the determined values are 'rounded' to the last place of figures stated as limits.

The following examples illustrate the application of the rounding rule:

Specification limits		Extreme values which round to specification limitations	
min.	max.	min.	max.
—	0·050	—	0·0505
0·2	0·6	0·15	0·65
6	9	5·5	9·4
6·0	9·0	5·95	9·05
7	10	6·6	10·5
7·5	10·5	7·46	10·54

* B.S. 1957, 'Presentation of numerical values (fineness of expression; rounding of numbers)'.

SHEET (UP TO AND INCLUDING 0·252 IN THICK) AND STRIP (UP TO AND INCLUDING 0·192 IN THICK) SUMMARY OF MECHANICAL PROPERTIES

For details reference should be made to the individual specifications

Material		0·1 per cent proof stress min.	Tensile strength min.	Tensile strength max.	Elongation on 2 in min.	Bend test radius of bend
		ton/sq in	ton/sq in	ton/sq in	per cent	
S1	-O	—	—	4·0	45	close
	-½H	—	5·0	6·0	12	close
	-H	—	6·5	—	6	½*t*
S1A	-O	—	—	5·0	35	close
	-½H	—	6·0	7·5	8	½*t*
	-H	—	8·0	—	5	*t*
S1B	-O	—	—	6·0	30	close
	-½H	—	6·5	8·0	8	½*t*
	-H	—	8·5	—	5	*t*
S1C	-O	—	—	6·5	30	close
	-¼H	—	6·0	7·5	12	close
	-½H	—	7·0	8·5	7	½*t*
	-¾H	—	8·0	9·5	5	½*t*
	-H	—	9·0	—	3	*t*
NS3	-O	—	—	7·5	30	close
	-¼H	—	7·5	9·5	12	close
	-½H	—	9·0	11·0	7	½*t*
	-¾H	—	10·5	12·5	5	*t*
	-H	—	11·5	—	3	3*t*
NS4	-O	—	11·0	14·0	18	close
	-¼H	8·0	13·0	—	8	½*t*
	-½H	11·0	15·0	—	5	*t*
NS5	-O	—	14·0	—	18	close
	-¼H	10·0	16·0	—	8	*t*
	-½H	14·0	18·0	—	5	2*t*
NS6	-O	—	17·0	—	18	close
	-¼H	14·0	19·0	—	8	2*t*
HS20	-O	—	—	11·0	18	close
	-W	7·0	13·0	—	15	2*t*
	-WP	15·0	18·0	—	8	3*t*
HS30	-O	—	—	11·0	18	close
	-W	7·0	13·0	—	15	2*t*
	-WP	16·0	19·0	—	8	3*t*
HS14	-W	15·0	25·0	—	15	3*t*
HC14	-W	14·0	24·0	—	15	3*t*
HS15	-W	15·0	25·0	—	15	3*t*
HC15	-W	14·0	24·0	—	15	3*t*
	-WP	20·0	26·0	—	8	5*t*

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MATERIAL S1
99·99 GRADE ALUMINIUM

SECTION TWO : SPECIFIC CLAUSES

GENERAL

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

CHEMICAL COMPOSITION

14. The metal shall be **aluminium** with impurities limited as follows:

Copper + silicon + iron not more than 0·01 per cent

CONDITION

15. Unless otherwise specified, the material shall be supplied in one of the following conditions, as specified by the purchaser:

Annealed (soft):	O
Half-hard:	½H
Hard:	H

in accordance with the mechanical properties laid down in this standard.

MECHANICAL PROPERTIES

16. *a. Tensile test.* The mechanical properties obtained from the test pieces selected in accordance with Clause 5 and prepared and tested in accordance with Clause 6 of Section One shall be as follows.

Condition	Tensile strength		Elongation on 2 in	Metric equivalents Tensile strength	
	min.	max.	min.	min.	max.
	ton/sq in	ton/sq in	per cent	kg/mm²	kg/mm²
O	—	4·0	45	—	6·3
½H	5·0	6·0	12	7·9	9·4
H	6·5	—	6	10·2	—

The elongation measurement shall apply only to material thicker than 0·104 in (12 S.W.G.).

b. Bend test. (For material 0·104 in (12 S.W.G.) and thinner). The bend test shall be made on a test piece, selected and prepared as specified in Clauses 5 and 6*c* of Section One which shall not crack when bent through 180° round a former having radius as follows:

Condition	Radius of bend t = thickness of material
O	close
½H	close
H	½t

Alternatively bend tests may be made as indicated in Sub-clause 6*d* of Section One.

NOTE. Bend tests are tests of ductility and not necessarily a guide to the radii to which sheet can be formed.

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MATERIAL S1A

99·8 GRADE ALUMINIUM

SECTION TWO : SPECIFIC CLAUSES

GENERAL

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

CHEMICAL COMPOSITION

14. The metal shall be aluminium with impurities limited as follows:

Copper	not more than 0·02 per cent
Silicon	not more than 0·15 per cent
Iron	not more than 0·15 per cent
Manganese	not more than 0·03 per cent
Zinc	not more than 0·06 per cent
Copper + silicon + iron + manganese + zinc	not more than 0·20 per cent

CONDITION

15. Unless otherwise specified, the material shall be supplied in one of the following conditions, as specified by the purchaser:

Annealed (soft):	O
Half-hard:	½H
Hard:	H

in accordance with the mechanical properties laid down in this standard.

MECHANICAL PROPERTIES

16. *a. Tensile test.* The mechanical properties obtained from the test pieces selected in accordance with Clause 5 and prepared and tested in accordance with Clause 6 of Section One shall be as follows:

Condition	Tensile strength		Elongation on 2 in	Metric equivalents	
				Tensile strength	
	min.	max.	min.	min.	max.
	ton/sq in	ton/sq in	per cent	kg/mm²	kg/mm²
O	—	5·0	35	—	7·9
½H	6·0	7·5	8	9·4	11·8
H	8·0	—	5	12·6	—

The elongation measurement shall apply only to material thicker than 0·104 in (12 S.W.G.).

b. Bend test. (For material 0·104 in (12 S.W.G.) and thinner). The bend test shall be made on a test piece, selected and prepared as specified in Clauses 5 and 6*c* of Section One, which shall not crack when bent through 180° round a former having radius as follows:

Condition	Radius of bend t = thickness of material
O	close
½H	½t
H	t

Alternatively bend tests may be made as indicated in Sub-clause 6*d* of Section One.

NOTE. Bend tests are tests of ductility and not necessarily a guide to the radii to which sheet can be formed.

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