
British Standard Specification for
Wrought aluminium and aluminium alloys
for general engineering purposes:
plate, sheet and strip

Aluminium et alliages d'aluminium corroyés pour mécanique générale : tôles fortes, moyennes, minces et feuillards — Spécifications

Bleche und Bänder aus Aluminium und Aluminiumknetlegierungen für den allgemeinen Maschinenbau

Foreword

This British Standard has been prepared under the direction of the Non-ferrous Metals Standards Committee. It is the fifth revision of this standard and replaces the 1972 edition, which is withdrawn.

Other standards in this series of specifications for wrought aluminium and aluminium alloys for general engineering purposes are as follows.

- BS 1471 Drawn tube
- BS 1472 Forging stock and forgings
- BS 1473 Rivet, bolt and screw stock
- BS 1474 Bars, extruded round tubes and sections
- BS 1475 Wire

New designation systems for both composition and tempers have been introduced in this revision.

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 (AA) of the USA, which issues the 'Registration record of international alloy designations and chemical composition limits for wrought aluminum and wrought aluminum alloys'.

It has been decided to use this system in British Standards to designate the nominal chemical composition of the alloys specified. This has necessitated, in some cases, minor compositional changes from the previous alloys used. The details of the AA system are given in appendix B, and a cross-reference table for the new and old British Standard alloy designations and the nearest equivalent ISO (International Organization for Standardization) alloy designations is included in appendix C.

It has also been decided to adopt the ISO 'alternative' temper designation system, given in ISO 2107, which is now widely recognized internationally. Details of this temper designation system are given in appendix D. Cross-references between the new and old British Standard temper designations are given in appendix C.

The opportunity was taken in this revision to consider the alloys and tempers currently used commercially in significant quantities. As a consequence three alloys previously in BS 4300 (alloys 3105, 5005 and 5454) and a new alloy 2024, clad and unclad, have been included.

The dimensional tolerances given in this standard have been completely revised. The requirements for flatness are given in more detail, following the format of ISO 6361/4. Details of the rounding of numbers rule are given in appendix E.

The appendices contained in the 1972 edition concerning forms of material available; the annealing and heat treatment of wrought aluminium and its alloys; and standard sizes of material have been omitted. Detailed information concerning the annealing and heat treatment of aluminium alloys can be obtained from the Aluminium Federation publication 'Properties of aluminium and its alloys'*.

As a result of the trend in the aluminium processing industries towards the use of larger coil masses, the batch size for the mechanical testing of non-heat-treatable alloys has been increased to 10 000 kg in this revision.

In previous editions of this standard, clauses were included entitled 'Inspection' and 'Facilities for testing'. As the clauses were contractual in nature and not relevant to a product standard, they have been omitted from this revision.

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

* Available from the Aluminium Federation, Broadway House, Calthorpe Road, Five Ways, Birmingham.

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Specification

1 Scope

This British Standard specifies requirements for chemical composition, mechanical properties, dimensional tolerances, the selection of test samples and test methods for plate, sheet and strip made from three grades of aluminium (unalloyed) and ten aluminium alloys in various tempers and conditions.

NOTE 1. Information which purchasers are recommended to provide in any enquiry or order is given in appendix A. Details of the international alloy designations and chemical composition limits for wrought aluminium alloys are given in appendix B. Appendix C contains a cross-reference table for British Standard and ISO alloy and temper designations. Information on the temper designation system used in this standard is given in appendix D, while in appendix E, a rule for the rounding of numbers is set out.

NOTE 2. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

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

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

2.2 plate. A product of rectangular section over 6 mm thick, supplied flat and with less control of surface finish than applies to sheet.

2.3 purchaser. The party, whether user, retailer, wholesaler or corporate body or his/its agent(s), as appropriate, responsible for ordering the material standardized.

2.4 sheet. A product of rectangular section over 0.2 mm thick but not exceeding 6 mm thick, supplied flat.

2.5 strip. A product of rectangular section supplied in coil, over 0.2 mm thick but not exceeding 6.0 mm thick.

3 General requirements

Plates, sheets and strips shall comply with clauses 4 to 8. When tests are carried out to verify that a batch of plate, sheet or strip complies with the requirements for mechanical properties (see clause 6), the selection of test samples and the test methods used shall be in accordance with clauses 9 and 10.

4 Chemical composition

The chemical composition of aluminium and aluminium alloy plate, sheet and strip shall be as given in table 1, 2 or 3 for the appropriate material.

In the case of clad material designated clad 2014A and clad 2024 the cladding shall be of aluminium complying with the chemical composition of material designation 1050A.

NOTE. Alloys 3105, 5005 and 5454 in table 2 were previously included in BS 4300.

5 Tempers

The material shall be supplied in one of the following tempers as specified by the purchaser and selected from table 1, 2 or 3 (see item (d) of appendix A).

F As fabricated.

O Annealed.

H12	} Strain-hardened.
H14	
H16	
H18	

NOTE 1. The H1 designations are in increasing order of tensile strength.

H22	} Strain-hardened and partially annealed.
H24	
H28	

NOTE 2. The H2 designations are in increasing order of tensile strength.

T3 Solution heat-treated, cold worked and naturally aged.

T4 Solution heat-treated and naturally aged.

NOTE 3. The properties of some alloys in this temper are unstable.

T6 Solution heat-treated and artificially aged.

NOTE 4. Full details of the temper designation system, including definitions of the tempers are given in appendix D.

6 Mechanical properties

The mechanical properties (i.e. 0.2 % proof stress, tensile strength and elongation, as appropriate) of the plate, sheet and strip shall be as given in tables 1, 2 and 3.

Where a tensile strength range is specified in tables 1, 2 and 3, the requirements of the standard shall be regarded as being met if the upper limit of the range is exceeded by a maximum of 10 N/mm², provided that the minimum value specified for the elongation after fracture is achieved.

NOTE. The tensile strength requirements given in tables 1, 2 and 3 are either single minimum or maximum values, or ranges, depending upon the technical requirements and application of the individual materials.

7 Tolerances on dimensions

NOTE 1. The tolerances on thickness, width, length, squareness, lateral curvature and flatness for plate, sheet or strip outside the size ranges given in tables 4 to 10 should be agreed between the supplier and the purchaser.

The tolerances on the thickness and width of plate, sheet and strip, and on the length of sheet and plate shall be as given in tables 4, 5, 6 and 7 for the appropriate tolerance category (see note 2), size and class (see note 3).

For category B alloys, the 'normal' tolerances given in table 4 for the thickness of cold rolled (i.e. class 1) plate, sheet and strip shall apply, unless the purchaser has expressed an option for 'close' toleranced material in the enquiry and order (see item (g) of appendix A). In the latter case, the tolerances shall be the same as those given for normal tolerances for category A.

NOTE 2. For the purposes of this standard, each of the materials designated in tables 1, 2 and 3 has been placed in one of two tolerance categories, designated A and B, used in specifying the thickness tolerances in table 4 and the flatness tolerances in table 10, as follows.

Category A consists of the following materials:

1080A
1050A
1200
3103
3105
5005
5251

Category B consists of the following materials:

5083
5154A
5454
2014A
clad 2014A
2024
clad 2024
6082

NOTE 3. In tables 4, 5, 6, 8 and 10, material for which the final manufacturing process is cold rolling is designated 'class 1' and material for which the final manufacturing process is hot rolling is designated 'class 2'.

The tolerances on the squareness of plate and sheet, i.e. the maximum values of the difference in length of the diagonals, shall be as given in table 8 for the appropriate size and class.

The tolerances on the lateral curvature of plate and sheet, i.e. the maximum deviations d allowable from a straight line (see figure 1), shall be as given in table 9 for the appropriate size. The maximum lateral curvature for a coil of strip, when laid out flat, shall be such that any part of its edge is no further from a 3000 mm chord than 6 mm for class 1 and 12 mm for class 2.

The tolerances on the flatness (transverse arch and longitudinal arch) of sheet and plate, i.e. the maximum deviation d for width W or length L (see figures 2 and 3), when measured on a flatness inspection table, shall be as

given in table 10 for the appropriate size and class.

In addition, local deviation (d in figures 4 and 5) from flatness of sheets and plates (i.e. buckle or edge wave) shall not exceed 1 % of the length of the buckle or edge wave (see figures 4 and 5).

8 Freedom from defects

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

9 Selection of test samples

9.1 Plate, sheet and strip of unalloyed aluminium or non-heat-treatable aluminium alloys

Material of the same thickness, produced in the same way and of the same nominal composition shall be grouped into batches of not more than 10 000 kg. If an individual plate or coil exceeds 10 000 kg in mass, that plate or coil shall be deemed to represent one batch.

One test sample shall be taken from each batch. Before the test samples are cut off, they shall be suitably marked to identify them with the batch represented. The test samples shall be taken from the finished material and shall not be annealed or mechanically worked (except for machining the test piece) before they are tested.

NOTE. The test samples may be cut from the margins of the material before cutting it to size.

9.2 Plate, sheet and strip of heat-treatable aluminium alloys

One test sample shall be cut from a plate, sheet or strip selected from each heat treatment batch. Before the test samples are cut, they shall be marked to identify them with the heat treatment batch they represent.

The test samples shall be tested in the 'as supplied' temper, i.e. 0, T3, T4 or T6, and shall not be mechanically worked (except for straightening and machining the test piece) before being tested.

NOTE 1. The test samples may be cut from the margins of the material concerned before cutting it to size.

NOTE 2. If the purchaser intends to convert the material to a final temper which is different from the 'as supplied' temper, then additional testing may be requested by the purchaser in order to satisfy himself that the material is capable of meeting the specified properties of the final temper. For instance, additional testing could be requested on a batch of material supplied in the T3 temper to demonstrate that it will meet the T6 temper properties when artificially aged by the purchaser. It is only necessary for the supplier to confirm that selected samples, heat treated using supplier laboratory conditions, meet the properties specified for the final temper required by the purchaser [see item (i) of Appendix A].

NOTE 3. Material supplied in the 0 temper, when subsequently heat treated, may be expected to have tensile properties approximately 15 N/mm² less than the specified properties for the T3, T4 or T6 tempers, as appropriate.

10 Test methods

10.1 General

The tensile test and the test for 0.2 % proof stress described in **10.2** and **10.3** shall be carried out on test pieces prepared from the test samples selected in accordance with clause 9.

10.2 Tensile test

The tensile test shall be carried out as described in BS 18. The test piece shall be so taken from the test sample that its longitudinal axis is at right angles to the direction of final rolling for material 300 mm wide and over, and parallel to the direction of final rolling for material less than 300 mm wide. In all cases the longitudinal axis of the test piece shall be located at a distance from the surface of the material equal to half the thickness.

The test piece shall be machined from the test sample to the dimensions given in BS 18 for either:

- (a) one of the non-proportional rectangular test pieces; or
- (b) for samples from plate thicker than 12.5 mm and at the option of the supplier, one of the proportional round test pieces

specified in BS 18. If option (a) is chosen, then the elongation shall be determined using a 50 mm gauge length.

10.3 Test for 0.2 % proof stress

The 0.2 % proof stress shall be determined as described in BS 18 on the test piece used in **10.2**.

11 Retests

Should any one of the test pieces, tested as described in clause 10, fail to pass the mechanical tests, then two further test samples from the same batch shall be selected for testing, one of which shall be from the plate, sheet or strip from which the original failed test sample was taken, unless that plate, sheet or strip has been withdrawn by the supplier.

NOTE. For heat treatable alloys, the supplier is permitted to heat treat the material again 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 the requirements of 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 the requirements of this standard.

12 Certificate of conformity

The supplier shall certify, if requested, that the material complies with this British Standard.

Figures in parentheses refer to the notes at the end of this table.

Material designation	Tolerance category	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Nickel	Zinc	Gallium	Titanium	Others ⁽²⁾		Aluminium min.	Temper ⁽⁴⁾	Thickness		Tensile strength		Elongation on 50 mm					Elongation on 5.65 √S ₀ over 12.5 mm thick (min.)
												Each	Total			>	≤	Min.	Max.	Materials thicker than					
																				0.5 mm min.	0.8 mm min.	1.3 mm min.	2.6 mm min.	3.0 mm min.	
1080A	A	0.15	0.15	0.03	0.02	0.02	—	—	0.06	0.03	0.02	0.02	—	99.80 ⁽³⁾	F 0 H14 H18	mm	mm	N/mm ²	N/mm ²	%	%	%	%	%	%
																3.0	25.0	—	—	—	—	—	—	—	—
																0.2	6.0	—	90	29	29	29	35	35	—
																0.2	12.5	90	125	5	6	7	8	8	—
																0.2	3.0	125	—	3	4	4	5	—	—
1050A	A	0.25	0.40	0.05	0.05	0.05	—	—	0.07	—	0.05	0.03	—	99.50 ⁽³⁾	F 0 H12 H14 H18	3.0	25.0	—	—	—	—	—	—	—	—
																0.2	6.0	55	95	22	25	30	32	32	—
																0.2	6.0	80	115	4	6	8	9	9	—
																0.2	12.5	100	135	4	5	6	6	8	—
																0.2	3.0	135	—	3	3	4	4	—	—
1200	A	1.0 Si + Fe	0.05	0.05	—	—	—	0.10	—	0.05	0.05	0.15	99.00 ⁽³⁾	F 0 H12 H14 H16 H18	3.0	25.0	—	—	—	—	—	—	—	—	
															0.2	6.0	70	105	20	25	30	30	30	—	
															0.2	6.0	90	125	4	6	8	9	9	—	
															0.2	12.5	105	140	3	4	5	5	6	—	
															0.2	6.0	125	160	2	3	4	4	4	—	
															0.2	3.0	140	—	2	3	4	4	—	—	

NOTE 1. Composition in percent (m/m) maximum unless shown as a range or a minimum.

NOTE 2. 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 case of routine analysis is indicated to be, in excess of the specified limits, further analysis should be made to determine that these other elements are not in excess of the amount specified.

NOTE 3. 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 in amounts of 0.010 % or more each, expressed to the second decimal before determining the sum.

NOTE 4. An alternative method of production, designated H2, may be used instead of the H1 routes, subject to agreement between supplier and purchaser and provided that the same specified properties are achieved.

Table 2. Chemical composition limits⁽¹⁾ and mechanical properties of aluminium alloy plate, sheet and strip (non-heat-treatable)

Figures in parentheses refer to the notes at the end of this table.

Material designation	Tolerance category	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Nickel	Zinc	Other restrictions	Titanium	Others ⁽²⁾		Aluminium	Temper ⁽³⁾	Thickness		0.2 % proof stress min.	Tensile strength		Elongation on 50 mm					Elongation on 5.65 √S ₀ over 12.5 mm thick (min.)								
												Each	Total			>	≤		Min.	Max.	Materials thicker than													
																					0.5 mm min.	0.8 mm min.	1.3 mm min.	2.6 mm min.	3.0 mm min.									
3103	A	0.50	0.7	0.10	0.9–1.5	0.30	0.10	—	0.20	0.10 Zr+Ti	—	0.05	0.15	Rem.*	F	0.2	25.0	—	—	—	20	23	24	24	25	—								
																0	6.0										90	130	5	6	7	9	9	
																H12	6.0										120	155	3	4	5	6	7	
																H14	12.5										140	175	2	3	4	4	4	
																H16	6.0										160	195	2	3	4	4	—	
																H18	3.0										175	—	2	3	4	4	—	
3105	A	0.6	0.7	0.30	0.30–0.8	0.20–0.8	0.20	—	0.40	—	0.10	0.05	0.15	Rem.	0	0.2	3.0	—	110	155	16	18	20	20	—	—								
																H12	3.0										115	130	2	3	4	5	—	
																H14	3.0										145	160	2	2	3	4	—	
																H16	3.0										170	185	1	1	2	3	—	
																H18	3.0										190	215	1	1	1	2	—	
5005	A	0.30	0.7	0.20	0.20	0.50–1.1	0.10	—	0.25	—	—	0.05	0.15	Rem.	0	0.2	3.0	—	95	145	18	20	21	22	—	—								
																H12	3.0										80	125	4	5	6	8	—	
																H14	3.0										100	145	3	3	5	6	—	
																H18	3.0										165	185	1	2	3	3	—	
5083	B	0.40	0.40	0.10	0.40–1.0	4.0–4.9	0.05–0.25	—	0.25	—	0.15	0.05	0.15	Rem.	F	3.0	25.0	—	—	—	12	14	16	16	16	14								
																0	80.0										125	275	350	5	6	8	10	8
																H22	6.0										235	310	375	4	5	6	8	6
																H24	6.0										270	345	405					
5154A	B	0.50	0.50	0.10	0.50	3.1–3.9	0.25	—	0.20	0.10–0.50 Mn+Cr	0.20	0.05	0.15	Rem.	0	0.2	6.0	85	215	275	12	14	16	18	18	—								
																H22	6.0										165	245	295	5	6	7	8	8
																H24	6.0										225	275	325	4	4	6	6	6
5251	A	0.40	0.50	0.15	0.10–0.50	1.7–2.4	0.15	—	0.15	—	0.15	0.05	0.15	Rem.	F	3.0	25.0	—	—	—	18	18	18	20	20	—								
																0	6.0										60	160	200	4	5	6	8	8
																H22	6.0										130	200	240	3	4	5	5	5
																H24	6.0										175	225	275	2	3	3	4	4
																H28	3.0										215	255	285					
5454	B	0.25	0.40	0.10	0.50–1.0	2.4–3.0	0.05–0.20	—	0.25	—	0.20	0.05	0.15	Rem.	F	3.0	25.0	—	—	—	12	14	16	18	18	—								
																0	6.0										80	215	285	4	5	7	8	—
																H22	3.0										180	250	305	3	4	5	6	—
																H24	3.0										200	270	325					

* Remainder.

NOTE 1. Composition in percent (m/m) maximum unless shown as a range or a minimum.

NOTE 2. 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 case of routine analysis is indicated to be, in excess

of the specified limits, further analysis should be made to determine that these other elements are not in excess of the amount specified.

NOTE 3. Either H1 or H2 production routes may be used, subject to agreement between supplier and purchaser and provided the specified properties are achieved.