



Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate¹

This standard is issued under the fixed designation B 209; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification² covers aluminum and aluminum-alloy flat sheet, coiled sheet, and plate in the alloys (Note 1) and tempers shown in Tables 2 and 3, and in the following finishes:

1.1.1 Plate in all alloys and sheet in heat-treatable alloys: mill finish.

1.1.2 Sheet in nonheat-treatable alloys: mill finish, one-side bright mill finish, standard one-side bright finish, and standard two-sides bright finish.

NOTE 1—Throughout this specification, use of the term *alloy* in the general sense includes aluminum as well as aluminum alloy.

NOTE 2—See Specification B 632/B 632M for tread plate.

NOTE 3—See Specification B 928/B 928M for 5xxx-H116 and 5xxx-H321 aluminum alloys containing 3 % or more nominal magnesium and intended for marine service and similar environments. Other alloy-temper products listed in this specification, which do not require the additional corrosion testing/capability called out in ASTM B 928/ B928M, may be suitable for marine and similar environment applications.

1.2 Alloy and temper designations are in accordance with ANSI H35.1/H35.1(M). The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9, for example, A91100 for aluminum 1100 in accordance with Practice E 527.

1.3 A complete metric companion to Specification B 209 has been developed—Specification B 209M; therefore, no metric equivalents are presented in this specification.

1.4 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see Annex A2.

2. Referenced Documents

2.1 The following documents form a part of this specification to the extent referenced herein:

2.2 ASTM Standards:³

B 548 Test Method for Ultrasonic Inspection of Aluminum-Alloy Plate for Pressure Vessels

B 557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products

B 594 Practice for Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications

B 632/B 632M Specification for Aluminum-Alloy Rolled Tread Plate

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products

B 666/B 666M Practice for Identification Marking of Aluminum and Magnesium Products

B 881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

B 918 Practice for Heat Treatment of Wrought Aluminum Alloys

B 928/B 928M Specification for High Magnesium Aluminum-Alloy Sheet and Plate for Marine Service and Similar Environments

B 947 Practice for Hot Rolling Mill Solution Heat Treatment for Aluminum Alloy Plate

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

E 290 Test Methods for Bend Testing of Material for Ductility

E 527 Practice for Numbering Metals and Alloys (UNS)

E 607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere

E 716 Practices for Sampling Aluminum and Aluminum

¹ This specification is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.03 on Aluminum Alloy Wrought Products.

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² For ASME Boiler and Pressure Vessel Code applications see related Specification SB-209 in Section II of that Code.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard.

Alloys for Spectrochemical Analysis

E 1004 Practice for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method

E 1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Atomic Emission Spectrometry

G 34 Test Method for Exfoliation Corrosion Susceptibility in 2xxx and 7xxx Series Aluminum Alloys (EXCO Test)⁴

G 47 Test Method for Determining Susceptibility to Stress-Corrosion Cracking of 2xxx and 7xxx Aluminum Alloy Products

2.3 *ANSI Standards*:⁵

H35.1/H35.1(M) Alloy and Temper Designation Systems for Aluminum

H35.2 Dimensional Tolerances for Aluminum Mill Products

2.4 *AMS Specification*:⁶

AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials

3. Terminology

3.1 *Definitions*—Refer to Terminology **B 881** for definitions of product terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *capable of*—The term *capable of*, as used in this specification, means that the test need not be performed by the producer of the material. However, should testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

4. Ordering Information

4.1 Orders for material to this specification shall include the following information:

4.1.1 This specification designation (which includes the number, the year, and the revision letter, if applicable),

4.1.2 Quantity in pieces or pounds,

4.1.3 Alloy (7.1),

4.1.4 Temper (9.1),

4.1.5 Finish for sheet in nonheat-treatable alloys (Section 1),

4.1.6 For sheet, whether flat or coiled,

4.1.7 Dimensions (thickness, width, and length or coil size),

4.1.8 Tensile property limits and dimensional tolerances for sizes not covered in **Table 2** or **Table 3** of this specification and in **ANSI H35.2**, respectively.

4.2 Additionally, orders for material meeting the requirements of this specification shall include the following information when required by the purchaser:

4.2.1 Whether a supply of one of the pairs of tempers where shown in **Table 2**, (H14 or H24) or (H34 or H24), is specifically excluded (**Table 2**, Footnote *D*),

4.2.2 Whether heat treatment in accordance with Practice **B 918** is required (8.2),

4.2.3 Whether bend tests are required (12.1),

4.2.4 Whether testing for stress-corrosion cracking resistance of alloy 2124-T851 is required (13.1),

4.2.5 Whether ultrasonic inspection for aerospace or pressure vessels applications is required (Section 17),

4.2.6 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (18.1),

4.2.7 Whether certification is required (Section 22),

4.2.8 Whether marking for identification is required (20.1), and

4.2.9 Whether Practices **B 660** applies and, if so, the levels of preservation, packaging, and packing required (21.3).

5. Responsibility for Quality Assurance

5.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser in the order or at the time of contract signing. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

5.2 *Lot Definition*—An inspection lot shall be defined as follows:

5.2.1 For heat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and thickness traceable to a heat-treat lot or lots, and subjected to inspection at one time.

5.2.2 For nonheat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and thickness subjected to inspection at one time.

6. General Quality

6.1 Unless otherwise specified, the material shall be supplied in the mill finish and shall be uniform as defined by the requirements of this specification and shall be commercially sound. Any requirement not covered is subject to negotiation between producer and purchaser.

6.2 Each sheet and plate shall be examined to determine conformance to this specification with respect to general quality and identification marking. On approval of the purchaser, however, the producer may use a system of statistical quality control for such examinations.

7. Chemical Composition

7.1 *Limits*—The sheet and plate shall conform to the chemical composition limits specified in **Table 1**. Conformance shall be determined by the producer by analyzing samples taken at the time the ingots are cast, or samples taken from the finished or semifinished product. If the producer has determined the chemical composition of the material during the course of manufacture, additional sampling and analysis of the finished product shall not be required.

NOTE 4—It is standard practice in the United States aluminum industry

⁴ The applicable edition in the use of this specification is G 34–72—formerly available in the gray pages of the *Annual Book of ASTM Standards*, Vol 02.02.

⁵ Available in the Related Materials section (gray pages) of the *Annual Book of ASTM Standards*, Vol 02.02.

⁶ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

TABLE 1 Chemical Composition Limits^{A,B,C}

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Other Elements ^D		Aluminum
									Each	Total ^E	
1060	0.25	0.35	0.05	0.03	0.03	...	0.05	0.03	0.03 ^F	...	99.60 min ^G
1100	0.95 Si + Fe		0.05–0.20	0.05	0.10	...	0.05	0.15	99.00 min ^G
1230 ^H	0.70 Si + Fe		0.10	0.05	0.05	...	0.10	0.03	0.03 ^F	...	99.30 min ^G
2014	0.50–1.2	0.7	3.9–5.0	0.40–1.2	0.20–0.8	0.10	0.25	0.15	0.05	0.15	remainder
Alclad 2014	2014 clad with 6003										
2024	0.50	0.50	3.8–4.9	0.30–0.9	1.2–1.8	0.10	0.25	0.15	0.05	0.15	remainder
Alclad 2024	2024 clad with 1230										
2124	0.20	0.30	3.8–4.9	0.30–0.9	1.2–1.8	0.10	0.25	0.15	0.05	0.15	remainder
2219	0.20	0.30	5.8–6.8	0.20–0.40	0.02	...	0.10	0.02–0.10	0.05 ^I	0.15 ^I	remainder
Alclad 2219	2219 clad with 7072										
3003	0.6	0.7	0.05–0.20	1.0–1.5	0.10	...	0.05	0.15	remainder
Alclad 3003	3003 clad with 7072										
3004	0.30	0.7	0.25	1.0–1.5	0.8–1.3	...	0.25	...	0.05	0.15	remainder
Alclad 3004	3004 clad with 7072										
3005	0.6	0.7	0.30	1.0–1.5	0.20–0.6	0.10	0.25	0.10	0.05	0.15	remainder
3105	0.6	0.7	0.30	0.30–0.8	0.20–0.8	0.20	0.40	0.10	0.05	0.15	remainder
5005	0.30	0.7	0.20	0.20	0.50–1.1	0.10	0.25	...	0.05	0.15	remainder
5010	0.40	0.7	0.25	0.10–0.30	0.20–0.6	0.15	0.30	0.10	0.05	0.15	remainder
5050	0.40	0.7	0.20	0.10	1.1–1.8	0.10	0.25	...	0.05	0.15	remainder
5052	0.25	0.40	0.10	0.10	2.2–2.8	0.15–0.35	0.10	...	0.05	0.15	remainder
5059	0.45	0.50	0.25	0.6–1.2	5.0–6.0	0.25	0.40–0.9	0.20	0.05 ^J	0.15	remainder
5083	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	remainder
5086	0.40	0.50	0.10	0.20–0.7	3.5–4.5	0.05–0.25	0.25	0.15	0.05	0.15	remainder
5154	0.25	0.40	0.10	0.10	3.1–3.9	0.15–0.35	0.20	0.20	0.05	0.15	remainder
5252	0.08	0.10	0.10	0.10	2.2–2.8	...	0.05	...	0.03 ^F	0.10 ^F	remainder
5254	0.45 Si + Fe		0.05	0.01	3.1–3.9	0.15–0.35	0.20	0.05	0.05	0.15	remainder
5454	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	remainder
5456	0.25	0.40	0.10	0.50–1.0	4.7–5.5	0.05–0.20	0.25	0.20	0.05	0.15	remainder
5457	0.08	0.10	0.20	0.15–0.45	0.8–1.2	...	0.05	...	0.03 ^F	0.10 ^F	remainder
5652	0.40 Si + Fe		0.04	0.01	2.2–2.8	0.15–0.35	0.10	...	0.05	0.15	remainder
5657	0.08	0.10	0.10	0.03	0.6–1.0	...	0.05	...	0.02 ^K	0.05 ^K	remainder
5754	0.40	0.40	0.10	0.50 ^L	2.6–3.6	0.30 ^L	0.20	0.15	0.05	0.15	remainder
6003 ^H	0.35–1.0	0.6	0.10	0.8	0.8–1.5	0.35	0.20	0.10	0.05	0.15	remainder
6013	0.6–1.0	0.50	0.6–1.1	0.20–0.8	0.8–1.2	0.10	0.25	0.10	0.05	0.15	remainder
6061	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.35	0.25	0.15	0.05	0.15	remainder
Alclad 6061	6061 clad with 7072										
7008 ^H	0.10	0.10	0.05	0.05	0.7–1.4	0.12–0.25	4.5–5.5	0.05	0.05	0.10	remainder
7072 ^H	0.7 Si + Fe		0.10	0.10	0.10	...	0.8–1.3	...	0.05	0.15	remainder
7075	0.40	0.50	1.2–2.0	0.30	2.1–2.9	0.18–0.28	5.1–6.1	0.20	0.05	0.15	remainder
Alclad 7075	7075 clad with 7072										
7008 Alclad 7075	7075 clad with 7008										
7178	0.40	0.50	1.6–2.4	0.30	2.4–3.1	0.18–0.28	6.3–7.3	0.20	0.05	0.15	remainder
Alclad 7178	7178 clad with 7072										

^A Limits are in weight percent maximum unless shown as a range or stated otherwise.

^B Analysis shall be made for the elements for which limits are shown in this table.

^C For purposes of determining conformance to these limits, an observed value or a calculated value attained from analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the specified limit, in accordance with the Rounding Method of Practice E 29.

^D *Others* includes listed elements for which no specific limit is shown as well as unlisted metallic elements. The producer may analyze samples for trace elements not specified in the specification. However, such analysis is not required and may not cover all metallic *Others* elements. Should any analysis by the producer or the purchaser establish that an *Others* element exceeds the limit of *Each* or that the aggregate of several *Others* elements exceeds the limit of *Total*, the material shall be considered nonconforming.

^E *Other Elements*—Total shall be the sum of unspecified metallic elements, 0.010 % or more, rounded to the second decimal before determining the sum.

^F Vanadium 0.05 max. The total for other elements does not include vanadium.

^G The aluminum content shall be calculated by subtracting from 100.00 % the sum of all metallic elements present in amounts of 0.010 % or more each, rounded to the second decimal before determining the sum.

^H Composition of cladding alloy as applied during the course of manufacture. Samples from finished sheet or plate shall not be required to conform to these limits.

^I Vanadium 0.05–0.15, zirconium 0.10–0.25. The total for other elements does not include vanadium and zirconium.

^J 0.05–0.25 Zr

^K Gallium 0.03 max, vanadium 0.05 max. The total for other elements does not include vanadium or gallium.

^L 0.10–0.6 Mn + Cr.

to determine conformance to the chemical composition limits prior to further processing of ingots into wrought products. Due to the continuous nature of the process, it is not practical to keep a specific ingot analysis identified with a specific quantity of finished material.

7.2 Number of Samples—The number of samples taken for the determination of chemical composition shall be as follows:

7.2.1 When samples are taken at the time the ingots are cast, at least one sample shall be taken for each group of ingots cast simultaneously from the same source of molten metal.

7.2.2 When samples are taken from the finished or semifinished product, a sample shall be taken to represent each 4000 lb, or fraction thereof, of material in the lot, except that not more than one sample shall be required per piece.

7.3 Methods of Sampling—Samples for determination of chemical composition shall be taken in accordance with one of the following methods: