



Designation: B209/B209M – 21a

Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate¹

This standard is issued under the fixed designation B209/B209M; 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 reapproval. 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 U.S. 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, 3, 4, and 5, 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.

1.2 Alloy and temper designations are in accordance with ANSI H35.1/H35.1M. 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 **E527**.

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 **B632/B632M** for tread plate.

NOTE 3—See Specification **B928/B928M** 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 Specification **B928/B928M**, may be suitable for marine and similar environment applications.

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

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards*:³

B548 Test Method for Ultrasonic Inspection of Aluminum-Alloy Plate for Pressure Vessels

B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products

B557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)

B594 Practice for Ultrasonic Inspection of Aluminum-Alloy Wrought Products

B632/B632M Specification for Aluminum-Alloy Rolled Tread Plate

B660 Practices for Packaging/Packing of Aluminum and Magnesium Products

B666/B666M Practice for Identification Marking of Aluminum and Magnesium Products

B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

B918/B918M Practice for Heat Treatment of Wrought Aluminum Alloys

B928/B928M Specification for High Magnesium Aluminum-Alloy Products for Marine Service and Similar Environments

B947 Practice for Hot Rolling Mill Solution Heat Treatment

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.

Current edition approved Dec. 1, 2021. Published January 2022. Originally approved in 1946. Last previous edition approved in 2021 as B209/B209M – 21. DOI: 10.1520/B0209_B0209M-21A.

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

for Aluminum Alloy Plate

B985 Practice for Sampling Aluminum Ingots, Billets, Castings and Finished or Semi-Finished Wrought Aluminum Products for Compositional Analysis

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys (Withdrawn 2017)⁴

E290 Test Methods for Bend Testing of Material for Ductility

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)⁴

E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spark Atomic Emission Spectrometry

E1004 Test Method for Determining Electrical Conductivity Using the Electromagnetic (Eddy Current) Method

E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry

G34 Test Method for Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)

G47 Test Method for Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products

2.3 *ANSI Standards:*⁵

H35.1/H35.1M American National Standard Alloy and Temper Designation Systems for Aluminum

H35.2 American National Standard Dimensional Tolerances for Aluminum Mill Products

H35.2M American National Standard Dimensional Tolerances for Aluminum Mill Products (Metric)

2.4 *ISO Standards:*⁶

ISO 209-1 Wrought aluminium and aluminium alloys – Chemical composition and forms of products – Part 1: Chemical composition

ISO 2107 Aluminium and aluminium alloys – Wrought products – Temper designations

ISO 6361-2 Wrought aluminium and aluminium alloys – Sheets, strips and plates – Part 2: Mechanical properties

2.5 *AMS Specification:*⁷

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

2.6 *CEN Standard:*⁸

CEN - EN 14242 Aluminium and aluminium alloys – Chemical analysis – Inductively coupled plasma optical

emission spectral analysis

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology **B881** 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**, **Table 3**, **Table 4**, or **Table 5** of this specification or in ANSI H35.2 [H35.2M].

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** or **Table 3**, (H14 or H24) or (H34 or H24), is specifically excluded (**Table 2** and **Table 3**, Footnote C).

4.2.2 Whether heat treatment in accordance with Practice **B918/B918M** is required (**8.2**).

4.2.3 Whether solution heat treatment using the hot rolling mill is acceptable (**8.3**).

4.2.4 Whether bend tests are required (**12.1**).

4.2.5 Whether testing for stress-corrosion cracking resistance of alloy 2124-T851, 2219-T851, or 2219-T87 is required (**13.1**).

4.2.6 Whether ultrasonic inspection for aerospace or pressure vessels applications is required (Section 17).

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

4.2.8 Whether certification is required (Section 22).

4.2.9 Whether there are exceptions to identification marking as provided in **B666/B666M** (**20.1**).

4.2.10 Whether Practices **B660** apply and, if so, the levels of preservation, packaging, and packing required (**21.3**).

4.2.11 For sheet and plate with tensile properties having more than one test direction shown in **Table 2**, **Table 3**, **Table 4**, and **Table 5**, whether tensile testing should be in a direction other than the direction specified in Test Method **B557** or **B557M** (Subsection 9.4).

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Available from Aluminum Association, 1400 Crystal Dr., Suite 430, Arlington, VA 22202, <http://www.aluminum.org>.

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

⁷ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

⁸ Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.

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

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
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					
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					

^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 righthand place of figures used in expressing the specified limit, in accordance with the Rounding Method of Practice E29.

^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. The Total for Other Elements does not include elements shown in the footnotes with specific composition limits.

^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.

^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.

^J 0.05–0.25 Zr

^K Gallium 0.03 max, vanadium 0.05 max.

^L 0.10–0.6 Mn + Cr.

^M In case there is a discrepancy in the values listed in Table 1 with those listed in the “International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys” (known as the “Teal Sheets”), the composition limits registered with the Aluminum Association and published in the “Teal Sheets” shall be considered the controlling composition. The “Teal Sheets” are available at <http://www.aluminum.org/tealsheets>.

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 their 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.