Designation: B209 – 10

Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate[1]

This standard is issued under the fixed designation B209; 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 Department of Defense.

1. Scope*

1.1 This specification[2] 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 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 ASTM B928/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 E527.

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

1.4 This specification is the inch-pound companion to Specification B209M; therefore, no SI equivalents are presented in the specification.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 The following documents 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

B594 Practice for Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications

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 Practice for Heat Treatment of Wrought Aluminum Alloys

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

B947 Practice for Hot Rolling Mill Solution Heat Treatment for Aluminum Alloy Plate

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

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

E716 Practices for Sampling and Sample Preparation of

[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.**

TABLE 1 Chemical Composition Limits[A,B,C]

NOTE—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" should be considered the controlling composition. The "Teal Sheets" are available at http://www.aluminum.org/tealsheets.

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.

Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis

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

E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by 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

TABLE 2 Mechanical Property Limits for Nonheat-Treatable Alloy[A,B]

Alloy	Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in. or 4× Diameter, min, %	Bend Diameter Factor, *N*
			min	max	min	max		
1060	O	0.006–0.019	8.0	14.0	2.5	....	15	...
1060	O	0.020–0.050	8.0	14.0	2.5	...	22	...
1060	O	0.051–3.000	8.0	14.0	2.5	...	25	...
1060	H12[C] or H22[C]	0.017–0.050	11.0	16.0	9.0	...	6	...
1060	H12[C] or H22[C]	0.051–2.000	11.0	16.0	9.0	...	12	...
1060	H14[C] or H24[C]	0.009–0.019	12.0	17.0	10.0	...	1	...
1060	H14[C] or H24[C]	0.020–0.050	12.0	17.0	10.0	...	5	..
1060	H14[C] or H24[C]	0.051–1.000	12.0	17.0	10.0	...	10	...
1060	H16[C] or H26[C]	0.006–0.019	14.0	19.0	11.0	...	1	...
1060	H16[C] or H26[C]	0.020–0.050	14.0	19.0	11.0	...	4	...
1060	H16[C] or H26[C]	0.051–0.162	14.0	19.0	11.0	...	5	...
1060	H18[C] or H28[C]	0.006–0.019	16.0	...	12.0	...	1	...
1060	H18[C] or H28[C]	0.020–0.050	16.0	...	12.0	...	3	...
1060	H18[C] or H28[C]	0.051–0.128	16.0	...	12.0	...	4	...
1060	H112	0.250–0.499	11.0	...	7.0	...	10	...
1060	H112	0.500–1.000	10.0	...	5.0	...	20	...
1060	H112	1.001–3.000	9.0	...	4.0	...	25	...
1060	F	0.250–3.000	...	...	...	...	...	...
1100	O	0.006–0.019	11.0	15.5	3.5	...	15	0
1100	O	0.020–0.031	11.0	15.5	3.5	...	20	0
1100	O	0.032–0.050	11.0	15.5	3.5	...	25	0
1100	O	0.051–0.249	11.0	15.5	3.5	...	30	0
1100	O	0.250–3.000	11.0	15.5	3.5	...	28	0
1100	H12[C] or H22[C]	0.017–0.019	14.0	19.0	11.0	...	3	0
1100	H12[C] or H22[C]	0.020–0.031	14.0	19.0	11.0	...	4	0
1100	H12[C] or H22[C]	0.032–0.050	14.0	19.0	11.0	...	6	0
1100	H12[C] or H22[C]	0.051–0.113	14.0	19.0	11.0	...	8	0
1100	H12[C] or H22[C]	0.114–0.499	14.0	19.0	11.0	...	9	0
1100	H12[C] or H22[C]	0.500–2.000	14.0	19.0	11.0	...	12	0
1100	H14[C] or H24[C]	0.009–0.012	16.0	21.0	14.0	...	1	0
1100	H14[C] or H24[C]	0.013–0.019	16.0	21.0	14.0	...	2	0
1100	H14[C] or H24[C]	0.020–0.031	16.0	21.0	14.0	...	3	0
1100	H14[C] or H24[C]	0.032–0.050	16.0	21.0	14.0	...	4	0
1100	H14[C] or H24[C]	0.051–0.113	16.0	21.0	14.0	...	5	0
1100	H14[C] or H24[C]	0.114–0.499	16.0	21.0	14.0	...	6	0
1100	H14[C] or H24[C]	0.500–1.000	16.0	21.0	14.0	...	10	0
1100	H16[C] or H26[C]	0.006–0.019	19.0	24.0	17.0	...	1	4
1100	H16[C] or H26[C]	0.020–0.031	19.0	24.0	17.0	...	2	4
1100	H16[C] or H26[C]	0.032–0.050	19.0	24.0	17.0	...	3	4
1100	H16[C] or H26[C]	0.051–0.162	19.0	24.0	17.0	...	4	4
1100	H18[C] or H28[C]	0.006–0.019	22.0	...	...	...	1	...
1100	H18[C] or H28[C]	0.020–0.031	22.0	...	...	...	2	...
1100	H18[C] or H28[C]	0.032–0.050	22.0	...	...	...	3	...
1100	H18[C] or H28[C]	0.051–0.128	22.0	...	...	...	4	...
1100	H112	0.250–0.499	13.0		7.0	...	9	...
1100	H112	0.500–2.000	12.0	...	5.0	...	14	...
1100	H112	2.001–3.000	11.5	...	4.0	...	20	...
1100	F[D]	0.250–3.000	...	...	...	...	...	...
3003	O	0.006–0.007	14.0	19.0	5.0	...	14	0
3003	O	0.008–0.012	14.0	19.0	5.0	...	18	0
3003	O	0.013–0.031	14.0	19.0	5.0	...	20	0
3003	O	0.032–0.050	14.0	19.0	5.0	...	23	0
3003	O	0.051–0.249	14.0	19.0	5.0	...	25	0
3003	O	0.250–3.000	14.0	19.0	5.0	...	23	...
3003	H12[C] or H22[C]	0.017–0.019	17.0	23.0	12.0	...	3	0
3003	H12[C] or H22[C]	0.020–0.031	17.0	23.0	12.0	...	4	0
3003	H12[C] or H22[C]	0.032–0.050	17.0	23.0	12.0	...	5	0
3003	H12[C] or H22[C]	0.051–0.113	17.0	23.0	12.0	...	6	0
3003	H12[C] or H22[C]	0.114–0.161	17.0	23.0	12.0	...	7	0
3003	H12[C] or H22[C]	0.162–0.249	17.0	23.0	12.0	...	8	0
3003	H12[C] or H22[C]	0.250–0.499	17.0	23.0	12.0	...	9	...
3003	H12[C] or H22[C]	0.500–2.000	17.0	23.0	12.0	...	10	...
3003	H14[C] or H24[C]	0.009–0.012	20.0	26.0	17.0	...	1	0
3003	H14[C] or H24[C]	0.013–0.019	20.0	26.0	17.0	...	2	0
3003	H14[C] or H24[C]	0.020–0.031	20.0	26.0	17.0	...	3	0
3003	H14[C] or H24[C]	0.032–0.050	20.0	26.0	17.0	...	4	0