



Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)¹

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

1. Scope*

1.1 This specification covers aluminum and aluminum alloy flat sheet, coiled sheet, and plate in the alloys (**Note 1**) and tempers shown in Tables 2 and 4, 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/H35.1(M). The equivalent Unified Numbering System (UNS) 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 Specification B209, 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 This specification is the SI companion to Specification B209.

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.*

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. Referenced Documents

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

2.2 *ASTM Standards*:²

B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

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

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 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

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

E290 Test Methods for Bend Testing of Material for Ductility

² 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

- [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 \(Withdrawn 2011\)³](#)
- [E716 Practices for Sampling and Sample Preparation of 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 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 ISO Standards:⁴

- [ISO209-1 Wrought Aluminum and Aluminum Alloys—Chemical Composition and Forms of Product](#)
- [ISO2107 Aluminum, Magnesium and their Alloys—Temper Designation](#)
- [ISO6361-2 Wrought Aluminum and Aluminum Alloys, Sheets, Strips, and Plates](#)

2.4 ANSI Standards:⁵

- [H35.1/H35.1\(M\) Alloy and Temper Designation Systems for Aluminum](#)
- [H35.2M Dimensional Tolerances for Aluminum Mill Products](#)

2.5 AMS Specification:⁶

- [AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials](#)

2.6 Other Standards:⁷

- [CEN EN 14242 Aluminum and aluminum alloys. Chemical analysis. Inductively coupled plasma optical emission spectral analysis](#)

3. Terminology

3.1 *Definitions*—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.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from Aluminum Association, Inc., 1525 Wilson Blvd., Suite 600, Arlington, VA 22209, <http://www.aluminum.org>.

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

⁷ Available from European Committee for Standardization (CEN), 36 Rue de Stassart, B-1050, Brussels, Belgium, <http://www.cen.eu/esearch>.

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 kilograms.
- 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).

4.2 Additionally, orders for material to 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 [B918](#) 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 (Section [18](#)).
- 4.2.8 Whether certification is required (Section [22](#)).
- 4.2.9 Whether there are exceptions to identification marking as provided in Practice [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 [Tables 2 and 3](#), whether tensile testing should be in a direction other than the direction specified in Test Method [B557M](#) (Section [9.4](#)).

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 assure 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

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 alloy										
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 alloy										
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 alloy										
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 alloy										
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 alloy										
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 alloy										
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 alloy										

^A Limits are in mass 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 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 non-conforming. 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. 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.

^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>.

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, shall be uniform as defined by the requirements of this specification, and shall be commercially sound. Any requirement not so covered is subject to negotiation between producer and purchaser.

TABLE 2 Mechanical Property Limits for Nonheat-Treatable Alloys^{A,B}

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
1060	O	0.15	0.32	55	95	15	...	15	...	...
1060	O	0.32	0.63	55	95	15	...	18	...	...
1060	O	0.63	1.20	55	95	15	...	23	...	...
1060	O	1.20	6.30	55	95	15	...	25	...	...
1060	O	6.30	80.00	55	95	15	...	25	22	...
1060	H12 ^D or H22 ^D	0.40	0.63	75	110	60	...	6	...	...
1060	H12 ^D or H22 ^D	0.63	1.20	75	110	60	...	7	...	...
1060	H12 ^D or H22 ^D	1.20	6.30	75	110	60	...	12	...	...
1060	H12 ^D or H22 ^D	6.30	50.00	75	110	60	...	12	10	...
1060	H14 ^D or H24 ^D	0.20	0.32	85	120	70	...	1	...	...
1060	H14 ^D or H24 ^D	0.32	0.63	85	120	70	...	2	...	...
1060	H14 ^D or H24 ^D	0.63	1.20	85	120	70	...	6	...	...
1060	H14 ^D or H24 ^D	1.20	6.30	85	120	70	...	10	...	...
1060	H14 ^D or H24 ^D	6.30	25.00	85	120	70	...	10	9	...
1060	H16 ^D or H26 ^D	0.15	0.32	95	130	75	...	1	...	...
1060	H16 ^D or H26 ^D	0.32	0.63	95	130	75	...	2	...	...
1060	H16 ^D or H26 ^D	0.63	1.20	95	130	75	...	4	...	...
1060	H16 ^D or H26 ^D	1.20	4.00	95	130	75	...	5	...	...
1060	H18 ^D or H28 ^D	0.15	0.32	110	...	85	...	1	...	...
1060	H18 ^D or H28 ^D	0.32	0.63	110	...	85	...	2	...	...
1060	H18 ^D or H28 ^D	0.63	1.20	110	...	85	...	3	...	...
1060	H18 ^D or H28 ^D	1.20	3.20	110	...	85	...	4	...	...
1060	H112	6.30	12.50	75	...	...	...	10	...	...
1060	H112	12.50	40.00	70	...	...	...	...	18	...
1060	H112	40.00	80.00	60	...	...	...	...	22	...
1060	F ^E	6.30	80.00	...	...	...	...	...	...	...
1100	O	0.15	0.32	75	105	25	...	15	...	0
1100	O	0.32	0.63	75	105	25	...	17	...	0
1100	O	0.63	1.20	75	105	25	...	22	...	0
1100	O	1.20	6.30	75	105	25	...	30	...	0
1100	O	6.30	80.00	75	105	25	...	28	25	0
1100	H12 ^D or H22 ^D	0.40	0.63	95	130	75	...	3	...	0
1100	H12 ^D or H22 ^D	0.63	1.20	95	130	75	...	5	...	0
1100	H12 ^D or H22 ^D	1.20	6.30	95	130	75	...	8	...	0
1100	H12 ^D or H22 ^D	6.30	12.50	95	130	75	...	10	9	0
1100	H12 ^D or H22 ^D	12.50	50.00	95	130	75	...	10	9	...
1100	H14 ^D or H24 ^D	0.20	0.32	110	145	95	...	1	...	0
1100	H14 ^D or H24 ^D	0.32	0.63	110	145	95	...	2	...	0
1100	H14 ^D or H24 ^D	0.63	1.20	110	145	95	...	3	...	0
1100	H14 ^D or H24 ^D	1.20	6.30	110	145	95	...	5	...	0
1100	H14 ^D or H24 ^D	6.30	25.00	110	145	95	...	7	6	0
1100	H16 ^D or H26 ^D	0.15	0.32	130	165	115	...	1	...	4
1100	H16 ^D or H26 ^D	0.32	0.63	130	165	115	...	2	...	4
1100	H16 ^D or H26 ^D	0.63	1.20	130	165	115	...	3	...	4
1100	H16 ^D or H26 ^D	1.20	4.00	130	165	115	...	4	...	4
1100	H18 ^D or H28 ^D	0.15	0.32	150	...	...	...	1	...	...
1100	H18 ^D or H28 ^D	0.32	0.63	150	...	...	...	1	...	...
1100	H18 ^D or H28 ^D	0.63	1.20	150	...	...	...	2	...	...
1100	H18 ^D or H28 ^D	1.20	3.20	150	...	...	...	4	...	...
1100	H112	6.30	12.50	90	...	50	...	9	...	...
1100	H112	12.50	40.00	85	...	40	...	...	12	...
1100	H112	40.00	80.00	80	...	30	...	...	18	...
1100	F ^E	6.30	80.00	...	...	...	...	...	...	...
3003	O	0.15	0.20	95	130	35	...	14	...	0
3003	O	0.20	0.32	95	130	35	...	18	...	0
3003	O	0.32	0.63	95	130	35	...	20	...	0
3003	O	0.63	1.20	95	130	35	...	23	...	0
3003	O	1.20	6.30	95	130	35	...	25	...	0
3003	O	6.30	80.00	95	130	35	...	23	21	...
3003	H12 ^D or H22 ^D	0.40	0.63	120	160	85	...	3	...	0
3003	H12 ^D or H22 ^D	0.63	1.20	120	160	85	...	4	...	0
3003	H12 ^D or H22 ^D	1.20	6.30	120	160	85	...	6	...	0
3003	H12 ^D or H22 ^D	6.30	50.00	120	160	85	...	9	8	...
3003	H14 ^D or H24 ^D	0.20	0.32	140	180	115	...	1	...	0
3003	H14 ^D or H24 ^D	0.32	0.63	140	180	115	...	2	...	0
3003	H14 ^D or H24 ^D	0.63	1.20	140	180	115	...	3	...	0
3003	H14 ^D or H24 ^D	1.20	3.20	140	180	115	...	5	...	0
3003	H14 ^D or H24 ^D	3.20	6.30	140	180	115	...	5	...	2

TABLE 2 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
3003	H14 ^D or H24 ^D	6.30	25.00	140	180	115	...	8	7	...
3003	H16 ^D or H26 ^D	0.15	0.32	165	205	145	...	1	...	4
3003	H16 ^D or H26 ^D	0.32	0.63	165	205	145	...	2	...	4
3003	H16 ^D or H26 ^D	0.63	1.20	165	205	145	...	3	...	4
3003	H16 ^D or H26 ^D	1.20	4.00	165	205	145	...	4	...	6
3003	H18 ^D or H28 ^D	0.15	0.32	185	...	165	...	1	...	...
3003	H18 ^D or H28 ^D	0.32	0.63	185	...	165	...	1	...	...
3003	H18 ^D or H28 ^D	0.63	1.20	185	...	165	...	2	...	...
3003	H18 ^D or H28 ^D	1.20	3.20	185	...	165	...	4	...	...
3003	H112	6.30	12.50	115	...	70	...	8	...	...
3003	H112	12.50	40.00	105	...	40	...	...	10	...
3003	H112	40.00	80.00	100	...	40	...	...	16	...
3003	F ^F	6.30	80.00	...	...	...	...	...	...	...
Alclad 3003	O	0.15	0.32	90	125	30	...	14	...	...
Alclad 3003	O	0.32	0.63	90	125	30	...	20	...	...
Alclad 3003	O	0.63	1.20	90	125	30	...	22	...	...
Alclad 3003	O	1.20	6.30	90	125	30	...	25	...	...
Alclad 3003	O	6.30	12.50	90	125	30	...	23	...	...
Alclad 3003	O	12.50	80.00	95 ^F	130 ^F	35 ^F	...	...	21	...
Alclad 3003	H12 ^D or H22 ^D	0.40	0.63	115	155	80	...	4	...	...
Alclad 3003	H12 ^D or H22 ^D	0.63	1.20	115	155	80	...	5	...	...
Alclad 3003	H12 ^D or H22 ^D	1.20	6.30	115	155	80	...	6	...	...
Alclad 3003	H12 ^D or H22 ^D	6.30	12.50	115	155	80	...	9	...	...
Alclad 3003	H12 ^D or H22 ^D	12.50	50.00	120 ^F	160 ^F	85 ^F	...	...	8	...
Alclad 3003	H14 ^D or H24 ^D	0.20	0.32	135	175	110	...	1	...	...
Alclad 3003	H14 ^D or H24 ^D	0.32	0.63	135	175	110	...	2	...	...
Alclad 3003	H14 ^D or H24 ^D	0.63	1.20	135	175	110	...	3	...	...
Alclad 3003	H14 ^D or H24 ^D	1.20	6.30	135	175	110	...	5	...	...
Alclad 3003	H14 ^D or H24 ^D	6.30	12.50	135	175	110	...	8	...	...
Alclad 3003	H14 ^D or H24 ^D	12.50	25.00	140 ^F	180 ^F	115 ^F	...	...	7	...
Alclad 3003	H16 ^D or H26 ^D	0.15	0.32	160	200	140	...	1	...	...
Alclad 3003	H16 ^D or H26 ^D	0.32	0.63	160	200	140	...	2	...	...
Alclad 3003	H16 ^D or H26 ^D	0.63	1.20	160	200	140	...	3	...	...
Alclad 3003	H16 ^D or H26 ^D	1.20	4.00	160	200	140	...	4	...	...
Alclad 3003	H18	0.15	0.32	180	...	...	...	1	...	...
Alclad 3003	H18	0.32	0.63	180	...	...	...	1	...	...
Alclad 3003	H18	0.63	1.20	180	...	...	...	2	...	...
Alclad 3003	H18	1.20	3.20	180	...	...	...	4	...	...
Alclad 3003	H112	6.30	12.50	110	...	65	...	8	...	...
Alclad 3003	H112	12.50	40.00	105 ^F	...	40 ^F	...	...	10	...
Alclad 3003	H112	40.00	80.00	100 ^F	...	40 ^F	...	...	16	...
Alclad 3003	F ^E	6.30	80.00	...	...	...	...	...	...	...
3004	O	0.15	0.32	150	200	60	...	9	...	0
3004	O	0.32	0.63	150	200	60	...	12	...	0
3004	O	0.63	1.20	150	200	60	...	15	...	0
3004	O	1.20	6.30	150	200	60	...	18	...	0
3004	O	6.30	80.00	150	200	60	...	16	14	...
3004	H32 ^D or H22 ^D	0.40	0.63	190	240	145	...	1	...	0
3004	H32 ^D or H22 ^D	0.63	1.20	190	240	145	...	3	...	1
3004	H32 ^D or H22 ^D	1.20	3.20	190	240	145	...	5	...	2
3004	H32 ^D or H22 ^D	3.20	6.30	190	240	145	...	5	...	...
3004	H32 ^D or H22 ^D	6.30	50.00	190	240	145	...	6	5	...
3004	H34 ^D or H24 ^D	0.20	0.32	220	265	170	...	1	...	2
3004	H34 ^D or H24 ^D	0.32	0.63	220	265	170	...	2	...	2
3004	H34 ^D or H24 ^D	0.63	1.20	220	265	170	...	3	...	3
3004	H34 ^D or H24 ^D	1.20	3.20	220	265	170	...	4	...	4
3004	H34 ^D or H24 ^D	3.20	6.30	220	265	170	...	4	...	...
3004	H34 ^D or H24 ^D	6.30	25.00	220	265	170	...	5	4	...
3004	H36 ^D or H26 ^D	0.15	0.32	240	285	190	...	1	...	6
3004	H36 ^D or H26 ^D	0.32	0.63	240	285	190	...	2	...	6
3004	H36 ^D or H26 ^D	0.63	1.20	240	285	190	...	3	...	6
3004	H36 ^D or H26 ^D	1.20	4.00	240	285	190	...	4	...	8
3004	H38 ^D or H28 ^D	0.15	0.32	260	...	215	...	...	...	...
3004	H38 ^D or H28 ^D	0.32	0.63	260	...	215	...	1	...	...
3004	H38 ^D or H28 ^D	0.63	1.20	260	...	215	...	2	...	...
3004	H38 ^D or H28 ^D	1.20	3.20	260	...	215	...	4	...	...
3004	H112	6.30	12.50	160	...	60	...	7	...	...

TABLE 2 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
3004	H112	12.50	40.00	160	...	60	...	...	6	...
3004	H112	40.00	80.00	160	...	60	...	...	6	...
3004	F ^E	6.30	80.00	...	...	...	...	...	...	...
Alclad 3004	O	0.15	0.32	145	195	55	...	9	...	...
Alclad 3004	O	0.32	0.63	145	195	55	...	12	...	...
Alclad 3004	O	0.63	1.20	145	195	55	...	15	...	...
Alclad 3004	O	1.20	6.30	145	195	55	...	18	...	...
Alclad 3004	O	6.30	12.50	145	195	55	...	16	...	...
Alclad 3004	O	12.50	80.00	150 ^F	200 ^F	60 ^F	...	...	14	...
Alclad 3004	H32 ^D or H22 ^D	0.40	0.63	185	235	140	...	1	...	...
Alclad 3004	H32 ^D or H22 ^D	0.63	1.20	185	235	140	...	3	...	...
Alclad 3004	H32 ^D or H22 ^D	1.20	6.30	185	235	140	...	5	...	...
Alclad 3004	H32 ^D or H22 ^D	6.30	12.50	185	235	140	...	6	...	...
Alclad 3004	H32 ^D or H22 ^D	12.50	50.00	190 ^F	240 ^F	145 ^F	...	...	5	...
Alclad 3004	H34 ^D or H24 ^D	0.20	0.32	215	260	165	...	1	...	...
Alclad 3004	H34 ^D or H24 ^D	0.32	0.63	215	260	165	...	2	...	...
Alclad 3004	H34 ^D or H24 ^D	0.63	1.20	215	260	165	...	3	...	...
Alclad 3004	H34 ^D or H24 ^D	1.20	6.30	215	260	165	...	4	...	...
Alclad 3004	H34 ^D or H24 ^D	6.30	12.50	215	260	165	...	5	...	...
Alclad 3004	H34 ^D or H24 ^D	12.50	25.00	220 ^F	265 ^F	170 ^F	...	...	4	...
Alclad 3004	H36 ^D or H26 ^D	0.15	0.32	235	280	185	...	1	...	...
Alclad 3004	H36 ^D or H26 ^D	0.32	0.63	235	280	185	...	2	...	...
Alclad 3004	H36 ^D or H26 ^D	0.63	1.20	235	280	185	...	3	...	...
Alclad 3004	H36 ^D or H26 ^D	1.20	4.00	235	280	185	...	4	...	...
Alclad 3004	H38	0.15	0.32	255	...	...	...	...	...	...
Alclad 3004	H38	0.32	0.63	255	...	...	...	1	...	...
Alclad 3004	H38	0.63	1.20	255	...	...	...	2	...	...
Alclad 3004	H38	1.20	3.20	255	...	...	...	4	...	...
Alclad 3004	H112	6.30	12.50	155	...	55	...	7	...	...
Alclad 3004	H112	12.50	40.00	160 ^F	...	60 ^F	...	...	6	...
Alclad 3004	H112	40.00	80.00	160 ^F	...	60 ^F	...	...	6	...
Alclad 3004	F ^E	6.30	80.00	...	...	...	...	...	...	...
3005	O	0.15	0.32	115	165	45	...	10	...	...
3005	O	0.32	0.63	115	165	45	...	14	...	...
3005	O	0.63	1.20	115	165	45	...	17	...	...
3005	O	1.20	6.30	115	165	45	...	20	...	...
3005	H12	0.40	0.63	140	190	115	...	1	...	...
3005	H12	0.63	1.20	140	190	115	...	2	...	...
3005	H12	1.20	6.30	140	190	115	...	3	...	...
3005	H14	0.20	0.32	165	215	145	...	1	...	...
3005	H14	0.32	0.63	165	215	145	...	1	...	...
3005	H14	0.63	1.20	165	215	145	...	2	...	...
3005	H14	1.20	6.30	165	215	145	...	3	...	...
3005	H16	0.15	0.32	190	240	170	...	1	...	...
3005	H16	0.32	0.63	190	240	170	...	1	...	...
3005	H16	0.63	1.20	190	240	170	...	2	...	...
3005	H16	1.20	4.00	190	240	170	...	2	...	...
3005	H18	0.15	0.32	220	...	200	...	1	...	...
3005	H18	0.32	0.63	220	...	200	...	1	...	...
3005	H18	0.63	1.20	220	...	200	...	2	...	...
3005	H18	1.20	3.20	220	...	200	...	2	...	...
3005	H19	0.15	0.32	235	...	...	...	...	...	...
3005	H19	0.32	0.63	235	...	...	...	1	...	...
3005	H19	0.63	1.20	235	...	...	...	1	...	...
3005	H19	1.20	1.60	235	...	...	...	1	...	...
3005	H25	0.15	0.32	180	235	150	...	1	...	...
3005	H25	0.32	0.63	180	235	150	...	2	...	...
3005	H25	0.63	1.20	180	235	150	...	3	...	...
3005	H25	1.20	2.00	180	235	150	...	4	...	...
3005	H27	0.15	0.32	205	260	175	...	1	...	...
3005	H27	0.32	0.63	205	260	175	...	2	...	...
3005	H27	0.63	1.20	205	260	175	...	3	...	...
3005	H27	1.20	2.00	205	260	175	...	4	...	...
3005	H28	0.15	0.32	215	...	185	...	1	...	...
3005	H28	0.32	0.63	215	...	185	...	2	...	...
3005	H28	0.63	1.20	215	...	185	...	3	...	...
3005	H28	1.20	2.00	215	...	185	...	4	...	...

TABLE 2 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
3105	O	0.32	0.63	95	145	35	....	16	...	...
3105	O	0.63	1.20	95	145	35	...	19	...	...
3105	O	1.20	2.00	95	145	35	...	20	...	...
3105	H12	0.40	0.63	130	180	105	...	1	...	...
3105	H12	0.63	1.20	130	180	105	...	2	...	...
3105	H12	1.20	2.00	130	180	105	...	3	...	...
3105	H14	0.32	0.63	150	200	125	...	1	....	...
3105	H14	0.63	1.20	150	200	125	...	2	...	...
3105	H14	1.20	2.00	150	200	125	...	2	...	...
3105	H16	0.32	0.63	170	220	145	...	1	...	...
3105	H16	0.63	1.20	170	220	145	...	1	...	...
3105	H16	1.20	2.00	170	220	145	...	2	...	...
3105	H18	0.32	0.63	190	...	165	...	1	...	...
3105	H18	0.63	1.20	190	...	165	...	1	...	...
3105	H18	1.20	2.00	190	...	165	...	2	...	...
3105	H22	0.32	0.50	130	...	105	...	3	...	...
3105	H22	0.50	0.80	130	...	105	...	4	...	...
3105	H22	0.80	1.20	130	...	105	...	5	...	...
3105	H22	1.20	2.00	130	...	105	...	6	...	...
3105	H24	0.32	0.50	150	...	125	...	2	...	...
3105	H24	0.50	0.80	150	...	125	...	3	...	...
3105	H24	0.80	1.20	150	...	125	...	4	...	...
3105	H24	1.20	2.00	150	...	125	...	6	...	...
3105	H25	0.32	0.63	160	...	130	...	2	...	...
3105	H25	0.63	1.20	160	...	130	...	4	...	...
3105	H25	1.20	2.00	160	...	130	...	6	...	...
3105	H26	0.32	0.80	170	...	145	...	3	...	...
3105	H26	0.80	1.20	170	...	145	...	4	...	...
3105	H26	1.20	2.00	170	...	145	...	5	...	...
3105	H28	0.32	0.80	190	...	165	...	2	...	...
3105	H28	0.80	1.20	190	...	165	...	3	...	...
3105	H28	1.20	2.00	190	...	165	...	4	...	...
5005	O	0.15	0.32	105	145	35	...	12	...	...
5005	O	0.32	0.63	105	145	35	...	16	...	...
5005	O	0.63	1.20	105	145	35	...	19	...	...
5005	O	1.20	6.30	105	145	35	...	21	...	...
5005	O	6.30	80.00	105	145	35	...	22	20	...
5005	H12	0.40	0.63	125	165	95	...	2	...	...
5005	H12	0.63	1.20	125	165	95	...	4	...	...
5005	H12	1.20	6.30	125	165	95	...	6	...	...
5005	H12	6.30	50.00	125	165	95	...	9	8	...
5005	H14	0.20	0.32	145	185	115	...	1	...	...
5005	H14	0.32	0.63	145	185	115	...	1	...	...
5005	H14	0.63	1.20	145	185	115	...	2	...	...
5005	H14	1.20	6.30	145	185	115	...	3	...	...
5005	H14	6.30	25.00	145	185	115	...	8	7	...
5005	H16	0.15	0.32	165	205	135	...	1	...	...
5005	H16	0.32	0.63	165	205	135	...	1	...	...
5005	H16	0.63	1.20	165	205	135	...	2	...	...
5005	H16	1.20	4.00	165	205	135	...	3	...	...
5005	H18	0.15	0.32	185	...	...	...	1	...	...
5005	H18	0.32	0.63	185	...	...	...	1	...	...
5005	H18	0.63	1.20	185	...	...	...	2	...	...
5005	H18	1.20	3.20	185	...	...	...	3	...	...
5005	H32 ^D or H22 ^D	0.40	0.63	120	160	85	...	3	...	...
5005	H32 ^D or H22 ^D	0.63	1.20	120	160	85	...	4	...	...
5005	H32 ^D or H22 ^D	1.20	6.30	120	160	85	...	7	...	...
5005	H32 ^D or H22 ^D	6.30	50.00	120	160	85	...	10	9	...
5005	H34 ^D or H24 ^D	0.20	0.32	140	180	105	...	2	...	...
5005	H34 ^D or H24 ^D	0.32	0.63	140	180	105	...	3	...	...
5005	H34 ^D or H24 ^D	0.63	1.20	140	180	105	...	4	...	...
5005	H34 ^D or H24 ^D	1.20	6.30	140	180	105	...	5	...	...
5005	H34 ^D or H24 ^D	6.30	25.00	140	180	105	...	8	7	...
5005	H36 ^D or H26 ^D	0.15	0.32	160	200	125	...	1	...	...
5005	H36 ^D or H26 ^D	0.32	0.63	160	200	125	...	2	...	...
5005	H36 ^D or H26 ^D	0.63	1.20	160	200	125	...	3	...	...
5005	H36 ^D or H26 ^D	1.20	4.00	160	200	125	...	4	...	...

TABLE 2 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
5005	H38	0.15	0.32	180	...	...	...	1	...	...
5005	H38	0.32	0.63	180	...	...	...	2	...	...
5005	H38	0.63	1.20	180	...	...	...	3	...	...
5005	H38	1.20	3.20	180	...	...	...	4	...	...
5005	H112	6.30	12.50	115	...	...	...	8	...	...
5005	H112	12.50	40.00	105	...	...	...	...	10	...
5005	H112	40.00	80.00	100	...	...	...	...	16	...
5005	F ^E	6.30	80.00	...	...	...	...	...	...	...
5010	O	0.25	1.80	105	145	35	...	3	...	...
5010	H22	0.25	1.80	115	160	95	...	2	...	...
5010	H24	0.25	1.80	140	180	115	...	1	...	...
5010	H26	0.25	1.80	160	200	145	...	1	...	...
5010	H28	0.25	1.80	180	...	...	...	...	...	...
5050	O	0.15	0.32	125	165	40	...	15	...	0
5050	O	0.32	0.63	125	165	40	...	17	...	0
5050	O	0.63	1.20	125	165	40	...	19	...	0
5050	O	1.20	6.30	125	165	40	...	20	...	0
5050	O	6.30	80.00	125	165	40	...	20	18	2
5050	H32 ^D or H22 ^D	0.40	0.63	150	195	110	...	4	...	1
5050	H32 ^D or H22 ^D	0.63	1.20	150	195	110	...	5	...	1
5050	H32 ^D or H22 ^D	1.20	6.30	150	195	110	...	6	...	2
5050	H34 ^D or H24 ^D	0.20	0.32	170	215	140	...	3	...	1
5050	H34 ^D or H24 ^D	0.32	0.63	170	215	140	...	3	...	1
5050	H34 ^D or H24 ^D	0.63	1.20	170	215	140	...	4	...	1
5050	H34 ^D or H24 ^D	1.20	6.30	170	215	140	...	5	...	3
5050	H36 ^D or H26 ^D	0.15	0.32	185	230	150	...	2	...	3
5050	H36 ^D or H26 ^D	0.32	0.63	185	230	150	...	2	...	3
5050	H36 ^D or H26 ^D	0.63	1.20	185	230	150	...	3	...	3
5050	H36 ^D or H26 ^D	1.20	4.00	185	230	150	...	4	...	4
5050	H38	0.15	0.32	200	...	...	...	1	...	...
5050	H38	0.32	0.63	200	...	...	...	2	...	...
5050	H38	0.63	1.20	200	...	...	...	3	...	...
5050	H38	1.20	3.20	200	...	...	...	4	...	...
5050	H112	6.30	12.50	140	...	55	...	12	...	...
5050	H112	12.50	40.00	140	...	55	...	...	10	...
5050	H112	40.00	80.00	140	...	55	...	...	10	...
5050	F ^E	6.30	80.00	...	...	...	...	...	...	...
5052	O	0.15	0.32	170	215	65	...	13	...	0
5052	O	0.32	0.63	170	215	65	...	15	...	0
5052	O	0.63	1.20	170	215	65	...	17	...	0
5052	O	1.20	6.30	170	215	65	...	19	...	0
5052	O	6.30	80.00	170	215	65	...	18	16	...
5052	H141	2.00	5.00	245	...	165	...	6	...	...
5052	H141	5.00	8.00	235	...	165	...	8	...	...
5052	H32 ^D or H22 ^D	0.40	0.63	215	265	160	...	4	...	0
5052	H32 ^D or H22 ^D	0.63	1.20	215	265	160	...	5	...	1
5052	H32 ^D or H22 ^D	1.20	3.20	215	265	160	...	7	...	2
5052	H32 ^D or H22 ^D	3.20	6.30	215	265	160	...	7	...	3
5052	H32 ^D or H22 ^D	6.30	50.00	215	265	160	...	11	10	...
5052	H34 ^D or H24 ^D	0.20	0.32	235	285	180	...	3	...	1
5052	H34 ^D or H24 ^D	0.32	0.63	235	285	180	...	3	...	1
5052	H34 ^D or H24 ^D	0.63	1.20	235	285	180	...	4	...	2
5052	H34 ^D or H24 ^D	1.20	3.20	235	285	180	...	6	...	3
5052	H34 ^D or H24 ^D	3.20	6.30	235	285	180	...	6	...	4
5052	H34 ^D or H24 ^D	6.30	25.00	235	285	180	...	10	9	...
5052	H36 ^D or H26 ^D	0.15	0.32	255	305	200	...	2	...	4
5052	H36 ^D or H26 ^D	0.32	0.63	255	305	200	...	3	...	4
5052	H36 ^D or H26 ^D	0.63	1.20	255	305	200	...	4	...	5
5052	H36 ^D or H26 ^D	1.20	4.00	255	305	200	...	4	...	5
5052	H38 ^D or H28 ^D	0.15	0.32	270	...	220	...	2	...	...
5052	H38 ^D or H28 ^D	0.32	0.63	270	...	220	...	3	...	...
5052	H38 ^D or H28 ^D	0.63	1.20	270	...	220	...	4	...	...
5052	H38 ^D or H28 ^D	1.20	3.20	270	...	220	...	4	...	...
5052	H112	6.30	12.50	190	...	110	...	7	...	...
5052	H112	12.50	40.00	170	...	65	...	...	10	...

TABLE 2 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
5052	H112	40.00	80.00	170	...	65	...	...	14	...
5052	H322	0.50	1.20	215	240	145	...	5	...	...
5052	H322	1.20	2.90	215	240	145	...	7	...	...
5052	H322	2.90	3.20	215	240	145	...	9	...	...
5052	F ^E	6.30	80.00	...	...	...	...	...	...	...
5059	O	1.99	6.30	330	...	160	...	24	...	...
5059	O	6.30	12.50	330	...	160	...	24	...	...
5059	O	12.50	20.00	330	...	160	...	...	24	...
5059	O	20.00	40.00	330	...	160	...	...	20	...
5059	O	40.00	180.00	300	...	145	...	...	17	...
5059	H111	1.99	6.30	330	...	160	...	24	...	...
5059	H111	6.30	12.50	330	...	160	...	24	...	...
5059	H111	12.50	20.00	330	...	160	...	...	24	...
5059	H111	20.00	40.00	330	...	160	...	...	20	...
5059	H111	40.00	180.00	300	...	145	...	...	17	...
5059	F ^E	6.30	200.00	...	...	...	...	...	...	...
5083	O	1.20	40.00	275	350	125	200	16	14	...
5083	O	40.00	80.00	270	345	115	200	...	14	...
5083	O	80.00	100.00	260	...	110	...	...	14	...
5083	O	100.00	120.00	260	...	110	...	...	12	...
5083	O	120.00	180.00	255	...	105	...	...	12	...
5083	O	180.00	200.00	250	...	95	...	...	10	...
5083	H112	6.30	12.50	275	...	125	...	12	...	...
5083	H112	12.50	40.00	275	...	125	...	...	10	...
5083	H112	40.00	80.00	270	...	115	...	...	10	...
5083	H32	3.20	5.00	305	385	215	...	10	...	...
5083	H32	5.00	12.50	305	385	215	...	12	...	...
5083	H32	12.50	40.00	305	385	215	...	...	10	...
5083	H32	40.00	80.00	285	385	200	...	...	10	...
5083	F ^E	6.30	200.00	...	...	...	...	...	...	...
5086	O	0.50	0.63	240	305	95	...	15	...	...
5086	O	0.63	1.20	240	305	95	...	16	...	...
5086	O	1.20	6.30	240	305	95	...	18	...	...
5086	O	6.30	50.00	240	305	95	...	16	14	...
5086	H32 ^D or H22 ^D	0.50	0.63	275	325	195	...	6	...	...
5086	H32 ^D or H22 ^D	0.63	1.20	275	325	195	...	6	...	...
5086	H32 ^D or H22 ^D	1.20	6.30	275	325	195	...	8	...	...
5086	H32 ^D or H22 ^D	6.30	50.00	275	325	195	...	12	10	...
5086	H34 ^D or H24 ^D	0.20	0.32	300	350	235	...	4	...	...
5086	H34 ^D or H24 ^D	0.32	0.63	300	350	235	...	4	...	...
5086	H34 ^D or H24 ^D	0.63	1.20	300	350	235	...	5	...	...
5086	H34 ^D or H24 ^D	1.20	6.30	300	350	235	...	6	...	...
5086	H34 ^D or H24 ^D	6.30	25.00	300	350	235	...	10	9	...
5086	H36 ^D or H26 ^D	0.15	0.32	325	375	260	...	3	...	...
5086	H36 ^D or H26 ^D	0.32	0.63	325	375	260	...	3	...	...
5086	H36 ^D or H26 ^D	0.63	1.20	325	375	260	...	4	...	...
5086	H36 ^D or H26 ^D	1.20	4.00	325	375	260	...	6	...	...
5086	H38 ^D or H28 ^D	0.15	0.63	345	...	285	...	3	...	...
5086	H112	4.00	12.50	250	...	125	...	8	...	...
5086	H112	12.50	40.00	240	...	105	...	...	9	...
5086	H112	40.00	80.00	235	...	95	...	...	12	...
5086	F ^E	6.30	80.00	...	...	...	...	...	...	...
5154	O	0.50	0.63	205	285	75	...	12	...	...
5154	O	0.63	1.20	205	285	75	...	13	...	...
5154	O	1.20	6.30	205	285	75	...	16	...	...
5154	O	6.30	80.00	205	285	75	...	18	16	...
5154	H32 ^D or H22 ^D	0.50	0.63	250	300	180	...	5	...	...
5154	H32 ^D or H22 ^D	0.63	1.20	250	300	180	...	6	...	...
5154	H32 ^D or H22 ^D	1.20	6.30	250	300	180	...	8	...	...
5154	H32 ^D or H22 ^D	6.30	50.00	250	300	180	...	12	10	...
5154	H34 ^D or H24 ^D	0.20	0.32	270	320	200	...	4	...	...
5154	H34 ^D or H24 ^D	0.32	0.63	270	320	200	...	4	...	...
5154	H34 ^D or H24 ^D	0.63	1.20	270	320	200	...	5	...	...

TABLE 2 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
5154	H34 ^D or H24 ^D	1.20	6.30	270	320	200	...	6	...	...
5154	H34 ^D or H24 ^D	6.30	25.00	270	320	200	...	10	9	...
5154	H36 ^D or H26 ^D	0.15	0.32	290	340	220	...	3	...	...
5154	H36 ^D or H26 ^D	0.32	0.63	290	340	220	...	3	...	...
5154	H36 ^D or H26 ^D	0.63	1.20	290	340	220	...	4	...	...
5154	H36 ^D or H26 ^D	1.20	4.00	290	340	220	...	4	...	...
5154	H38 ^D or H28 ^D	0.15	0.32	310	...	240	...	3	...	...
5154	H38 ^D or H28 ^D	0.32	0.63	310	...	240	...	3	...	...
5154	H38 ^D or H28 ^D	0.63	1.20	310	...	240	...	3	...	...
5154	H38 ^D or H28 ^D	1.20	3.20	310	...	240	...	4	...	...
5154	H112	6.30	12.50	220	...	125	...	8	...	...
5154	H112	12.50	40.00	210	...	90	...	...	9	...
5154	H112	40.00	80.00	205	...	75	...	...	13	...
5154	F ^E	6.30	80.00	...	...	...	...	...	...	...
5252	H24	0.63	2.50	205	260	...	...	10	...	...
5252	H25	0.63	2.50	215	270	...	...	9	...	...
5252	H28	0.63	2.50	260	...	...	...	3	...	...
5254	O	0.50	0.63	205	285	75	...	12	...	...
5254	O	0.63	1.20	205	285	75	...	13	...	...
5254	O	1.20	6.30	205	285	75	...	16	...	...
5254	O	6.30	80.00	205	285	75	...	18	16	...
5254	H32 ^D or H22 ^D	0.50	0.63	250	300	180	...	5	...	...
5254	H32 ^D or H22 ^D	0.63	1.20	250	300	180	...	6	...	...
5254	H32 ^D or H22 ^D	1.20	6.30	250	300	180	...	8	...	...
5254	H32 ^D or H22 ^D	6.30	50.00	250	300	180	...	12	10	...
5254	H34 ^D or H24 ^D	0.20	0.32	270	320	200	...	4	...	...
5254	H34 ^D or H24 ^D	0.32	0.63	270	320	200	...	4	...	...
5254	H34 ^D or H24 ^D	0.63	1.20	270	320	200	...	5	...	...
5254	H34 ^D or H24 ^D	1.20	6.30	270	320	200	...	6	...	...
5254	H34 ^D or H24 ^D	6.30	25.00	270	320	200	...	10	9	...
5254	H36 ^D or H26 ^D	0.15	0.32	290	340	220	...	3	...	...
5254	H36 ^D or H26 ^D	0.32	0.63	290	340	220	...	3	...	...
5254	H36 ^D or H26 ^D	0.63	1.20	290	340	220	...	4	...	...
5254	H36 ^D or H26 ^D	1.20	4.00	290	340	220	...	4	...	...
5254	H38 ^D or H28 ^D	0.15	0.32	310	...	240	...	3	...	...
5254	H38 ^D or H28 ^D	0.32	0.63	310	...	240	...	3	...	...
5254	H38 ^D or H28 ^D	0.63	1.20	310	...	240	...	3	...	...
5254	H38 ^D or H28 ^D	1.20	3.20	310	...	240	...	4	...	...
5254	H112	6.30	12.50	220	...	125	...	8	...	...
5254	H112	12.50	40.00	210	...	90	...	...	9	...
5254	H112	40.00	80.00	205	...	75	...	...	13	...
5254	F ^E	6.30	80.00	...	...	...	...	...	...	...
5454	O	0.50	0.63	215	285	85	...	12	...	...
5454	O	0.63	1.20	215	285	85	...	13	...	...
5454	O	1.20	6.30	215	285	85	...	16	...	...
5454	O	6.30	80.00	215	285	85	...	18	16	...
5454	H32 ^D or H22 ^D	0.50	0.63	250	305	180	...	5	...	...
5454	H32 ^D or H22 ^D	0.63	1.20	250	305	180	...	6	...	...
5454	H32 ^D or H22 ^D	1.20	6.30	250	305	180	...	8	...	...
5454	H32 ^D or H22 ^D	6.30	50.00	250	305	180	...	12	10	...
5454	H34 ^D or H24 ^D	0.50	0.63	270	325	200	...	4	...	...
5454	H34 ^D or H24 ^D	0.63	1.20	270	325	200	...	5	...	...
5454	H34 ^D or H24 ^D	1.20	6.30	270	325	200	...	6	...	...
5454	H34 ^D or H24 ^D	6.30	25.00	270	325	200	...	10	9	...
5454	H112	6.30	12.50	220	...	125	...	8	...	...
5454	H112	12.50	40.00	215	...	85	...	...	9	...
5454	H112	40.00	80.00	215	...	85	...	...	13	...
5454	F ^E	6.30	80.00	...	...	...	...	...	...	...
5754	O	0.75	1.40	200	270	80	...	17	...	...
5754	O	1.40	2.20	200	270	80	...	18	...	...
5754	O	2.20	3.50	200	270	80	...	19	...	...

TABLE 2 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, % ^C		Bend Diameter Factor, <i>N</i>
		over	through	min	max	min	max	in 50 mm	in 5x Diameter	
5456	O	1.20	6.30	290	365	130	205	16	...	...
5456	O	6.30	80.00	285	360	125	205	16	14	...
5456	O	80.00	120.00	275	...	120	...	...	12	...
5456	O	120.00	160.00	270	...	115	...	...	12	...
5456	O	160.00	200.00	265	...	105	...	...	10	...
5456	H112	6.30	12.50	290	...	130	...	12	...	...
5456	H112	12.50	40.00	290	...	130	...	...	10	...
5456	H112	40.00	80.00	285	...	125	...	...	10	...
5456	H32	4.00	12.50	315	405	230	...	12	...	...
5456	H32	12.50	40.00	305	385	215	...	...	10	...
5456	H32	40.00	80.00	285	370	200	...	...	10	...
5456	F ^E	6.30	200.00	...	...	...	...	...	...	...
5457	O	0.63	2.50	110	150	...	...	20	...	...
5657	H241 ^G	0.63	2.50	125	180	...	...	13	...	...
5657	H25	0.63	2.50	140	195	...	...	8	...	...
5657	H26	0.63	2.50	150	205	...	...	7	...	...
5657	H28	0.63	2.50	170	...	...	...	5	...	...

^A To determine conformance to this specification, each value for tensile strength and for yield strength shall be rounded to the nearest 1 MPa and each value for elongation to the nearest 0.5 %, both in accordance with the Rounding Method of Practice E29.

^B The basis for establishment of mechanical property limits is shown in Annex A1.

^C Elongations in 50 mm apply for thicknesses up through 12.50 mm and in 5x diameter for thicknesses over 12.50 mm.

^D Materials in either of these tempers, (H32 or H22), (H34 or H24), (H36 or H26), (H38 or H28), (H12 or H22), (H14 or H24), (H16 or H26), (H18 or H28), may be supplied at the option of the supplier, unless one is specifically excluded by the contract or purchase order. When ordered as H2X tempers, the maximum tensile strength and minimum yield strength do not apply. When H2X tempers are supplied instead of ordered H1X or H3X tempers, the supplied H2X temper material shall meet the respective H1X or H3X temper tensile property limits.

^E Tests of F temper plate for tensile properties are not required.

^F The tension test specimen from plate over 12.50 mm in thickness is machined from the core and does not include the cladding alloy.

^G This material is subject to some recrystallization and an attendant loss of brightness.

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 poured in accordance with Practices E716 and analyzed in accordance with Test Methods E607, E1251, or E34, or with EN 14242. If the producer has determined the chemical composition during pouring of the ingots, they shall not be required to sample and analyze the finished product.

NOTE 4—It is standard practice in the United States aluminum industry 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 If it becomes necessary to analyze sheet and plate for conformance to chemical composition limits, the methods of sampling and methods of analysis shall be as provided in the following:

7.2.1 *Methods of Sampling*—Samples for chemical analysis shall be taken in accordance with Practice B985.

7.2.2 *Methods of Analysis*—Analysis shall be performed in accordance with Test Methods E34, E607, or E1251, or with EN 14242.

NOTE 5—It is difficult to obtain a reliable analysis of each of the components of clad materials using material in its finished state. A reasonably accurate determination of the core composition can be made if the cladding is substantially removed prior to analysis. The cladding composition is more difficult to determine because of the relatively thin layer and because of diffusion of core elements to the cladding. The correctness of cladding alloy used can usually be verified by a combination of metallographic examination and spectrochemical analysis of the surface at several widely separated points.

8. Heat Treatment

8.1 Unless specified in 8.2 or as noted in 8.3, producer or supplier heat treatment for the applicable tempers in Table 3 shall be in accordance with AMS 2772.

8.2 When specified (4.2.2), heat treatment of applicable tempers in Table 3 shall be in accordance with Practice B918.

8.3 When specified (4.2.3), alloy 6061 plate may be produced using hot rolling mill solution heat treatment in accordance with Practice B947, when aged in accordance with Practice B918 for the production of T651 tempers, as applicable.

TABLE 3 Tensile Property Limits for Heat-Treatable Alloys^{A,B}

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5x Diameter
2014	O	0.50	12.50	...	220	...	110	16	...
2014	O	12.50	25.00	...	220	...	...	...	9
2014	T3	0.50	1.00	405	...	240	...	14	...
2014	T3	1.00	6.30	405	...	250	...	14	...
2014	T4 ^D	0.50	6.30	405	...	240	...	14	...
2014	T451 ^E	6.30	12.50	400	...	250	...	14	...
2014	T451 ^E	12.50	25.00	400	...	250	...	...	12
2014	T451 ^E	25.00	50.00	400	...	250	...	...	10
2014	T451 ^E	50.00	80.00	395	...	250	...	...	7
2014	T42 ^F	0.50	12.50	400	...	235	...	14	...
2014	T42 ^F	12.50	25.00	400	...	235	...	...	12
2014	T6, T62 ^F	0.50	1.00	440	...	395	...	6	...
2014	T6, T62 ^F	1.00	6.30	455	...	400	...	7	...
2014	T6 ^F , T651 ^E	6.30	12.50	460	...	405	...	7	...
2014	T6 ^F , T651 ^E	12.50	25.00	460	...	405	...	...	5
2014	T6 ^F , T651 ^E	25.00	50.00	460	...	405	...	...	3
2014	T6 ^F , T651 ^E	50.00	60.00	450	...	400	...	...	1
2014	T6 ^F , T651 ^E	60.00	80.00	435	...	395	...	...	1
2014	T6 ^F , T651 ^E	80.00	100.00	405	...	380	...	...	...
2014	F ^G	6.30	25.00	...	...	...	...	...	...
Alclad 2014	O	0.50	0.63	...	205	...	95	16	...
Alclad 2014	O	0.63	1.00	...	205	...	95	16	...
Alclad 2014	O	1.00	2.50	...	205	...	95	16	...
Alclad 2014	O	2.50	12.50	...	205	...	95	16	...
Alclad 2014	O	12.50	25.00	...	220 ^H	...	...	...	9
Alclad 2014	T3	0.50	0.63	370	...	230	...	14	...
Alclad 2014	T3	0.63	1.00	380	...	235	...	14	...
Alclad 2014	T3	1.00	2.50	395	...	240	...	15	...
Alclad 2014	T3	2.50	6.30	395	...	240	...	15	...
Alclad 2014	T4 ^E	0.50	0.63	370	...	215	...	14	...
Alclad 2014	T4 ^E	0.63	1.00	380	...	220	...	14	...
Alclad 2014	T4 ^E	1.00	2.50	395	...	235	...	15	...
Alclad 2014	T4 ^E	2.50	6.30	395	...	235	...	15	...
Alclad 2014	T451 ^E	6.30	12.50	395	...	250	...	15	...
Alclad 2014	T451 ^E	12.50	25.00	400 ^H	...	250 ^H	...	...	12
Alclad 2014	T451 ^E	25.00	50.00	400 ^H	...	250 ^H	...	...	10
Alclad 2014	T451 ^E	50.00	80.00	395 ^H	...	250 ^H	...	...	7
Alclad 2014	T42 ^F	0.50	0.63	370	...	215	...	14	...
Alclad 2014	T42 ^F	0.63	1.00	380	...	220	...	14	...
Alclad 2014	T42 ^F	1.00	2.50	395	...	235	...	15	...
Alclad 2014	T42 ^F	2.50	12.50	395	...	235	...	15	...
Alclad 2014	T42 ^F	12.50	25.00	400 ^H	...	235 ^H	...	...	12
Alclad 2014	T6, T62 ^F	0.50	0.63	425	...	370	...	7	...
Alclad 2014	T6, T62 ^F	0.63	1.00	435	...	380	...	7	...
Alclad 2014	T6, T62 ^F	1.00	2.50	440	...	395	...	8	...
Alclad 2014	T6, T62 ^F	2.50	6.30	440	...	395	...	8	...
Alclad 2014	T62 ^F , T651 ^E	6.30	12.50	440	...	395	...	8	...
Alclad 2014	T62 ^F , T651 ^E	12.50	25.00	460 ^H	...	405 ^H	...	...	5
Alclad 2014	T62 ^F , T651 ^E	25.00	50.00	460 ^H	...	405 ^H	...	...	3
Alclad 2014	T62 ^F , T651 ^E	50.00	60.00	450 ^H	...	400 ^H	...	...	1
Alclad 2014	T62 ^F , T651 ^E	60.00	80.00	435 ^H	...	395 ^H	...	...	1
Alclad 2014	T62 ^F , T651 ^E	80.00	100.00	405 ^H	...	380 ^H	...	...	...
Alclad 2014	F ^G	6.30	25.00	...	...	...	...	...	...
2024	O	0.24	12.50	...	220	...	95	12	...
2024	O	12.50	45.00	...	220	...	...	...	10
2024	T3	0.19	0.25	435	...	290	...	10	...
2024	T3	0.25	0.50	435	...	290	...	12	...
2024	T3	0.50	3.20	435	...	290	...	15	...
2024	T3	3.20	6.30	435	...	290	...	15	...
2024	T351 ^E	6.30	12.50	440	...	290	...	12	...
2024	T351 ^E	12.50	25.00	435	...	290	...	...	7
2024	T351 ^E	25.00	40.00	425	...	290	...	...	6
2024	T351 ^E	40.00	50.00	425	...	290	...	...	5
2024	T351 ^E	50.00	80.00	415	...	290	...	...	3
2024	T351 ^E	80.00	100.00	395	...	285	...	...	3
2024	T361	0.50	1.60	460	...	345	...	8	...
2024	T361	1.60	6.30	470	...	350	...	9	...
2024	T361	6.30	12.50	455	...	340	...	9	...

TABLE 3 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5x Diameter
2024	T361	12.50	12.70	455	...	340	...	...	9
2024	T4 ^D	0.24	0.50	425	...	275	...	12	...
2024	T4 ^D	0.50	6.30	425	...	275	...	15	...
2024	T42 ^F	0.24	0.50	425	...	260	...	12	...
2024	T42 ^F	0.50	6.30	425	...	260	...	15	...
2024	T42 ^F	6.30	12.50	425	...	260	...	12	...
2024	T42 ^F	12.50	25.00	420	...	260	...	...	7
2024	T42 ^F	25.00	40.00	415	...	260	...	...	6
2024	T42 ^F	40.00	50.00	415	...	260	...	...	5
2024	T42 ^F	50.00	80.00	400	...	260	...	...	3
2024	T62 ^F	0.24	12.50	440	...	345	...	5	...
2024	T62 ^F	12.50	80.00	435	...	345	...	...	4
2024	T72 ^{F,I}	0.24	6.30	415	...	315	...	5	...
2024	T81	0.24	6.30	460	...	400	...	5	...
2024	T851 ^E	6.30	12.50	460	...	400	...	5	...
2024	T851 ^E	12.50	25.00	455	...	400	...	...	4
2024	T851 ^E	25.00	40.00	455	...	395	...	...	4
2024	T861	0.50	1.60	480	...	425	...	3	...
2024	T861	1.60	6.30	490	...	455	...	4	...
2024	T861	6.30	12.50	480	...	440	...	4	...
2024	T861	12.50	12.70	480	...	440	...	...	3
2024	F ^G	6.30	80.00	...	...	...	...	...	...
Alclad 2024	O	0.19	0.25	...	205	...	95	10	...
Alclad 2024	O	0.25	1.60	...	205	...	95	12	...
Alclad 2024	O	1.60	12.50	...	220	...	95	12	...
Alclad 2024	O	12.50	45.00	...	220 ^H	...	...	...	10
Alclad 2024	T3	0.19	0.25	400	...	270	...	10	...
Alclad 2024	T3	0.25	0.50	405	...	270	...	12	...
Alclad 2024	T3	0.50	1.60	405	...	270	...	15	...
Alclad 2024	T3	1.60	3.20	420	...	275	...	15	...
Alclad 2024	T3	3.20	6.30	420	...	275	...	15	...
Alclad 2024	T351 ^E	6.30	12.50	425	...	275	...	12	...
Alclad 2024	T351 ^E	12.50	25.00	435 ^H	...	290 ^H	...	...	7
Alclad 2024	T351 ^E	25.00	40.00	425 ^H	...	290 ^H	...	...	6
Alclad 2024	T351 ^E	40.00	50.00	425 ^H	...	290 ^H	...	...	5
Alclad 2024	T351 ^E	50.00	80.00	415 ^H	...	290 ^H	...	...	3
Alclad 2024	T351 ^E	80.00	100.00	395 ^H	...	285 ^H	...	...	3
Alclad 2024	T361	0.50	1.60	420	...	325	...	8	...
Alclad 2024	T361	1.60	6.30	440	...	330	...	9	...
Alclad 2024	T361	6.30	12.50	440	...	330	...	9	...
Alclad 2024	T361	12.50	12.70	455 ^H	...	340 ^H	...	...	9
Alclad 2024	T4 ^D	0.24	0.50	400	...	245	...	12	...
Alclad 2024	T4 ^D	0.50	1.60	400	...	245	...	15	...
Alclad 2024	T4 ^D	1.60	3.20	420	...	260	...	15	...
Alclad 2024	T42 ^F	0.19	0.25	380	...	235	...	10	...
Alclad 2024	T42 ^F	0.25	0.50	395	...	235	...	12	...
Alclad 2024	T42 ^F	0.50	1.60	395	...	235	...	15	...
Alclad 2024	T42 ^F	1.60	6.30	415	...	250	...	15	...
Alclad 2024	T42 ^F	6.30	12.50	415	...	250	...	12	...
Alclad 2024	T42 ^F	12.50	25.00	420 ^H	...	260 ^H	...	...	7
Alclad 2024	T42 ^F	25.00	40.00	415 ^H	...	260 ^H	...	...	6
Alclad 2024	T42 ^F	40.00	50.00	415 ^H	...	260 ^H	...	...	5
Alclad 2024	T42 ^F	50.00	80.00	400 ^H	...	260 ^H	...	...	3
Alclad 2024	T62 ^F	0.24	1.60	415	...	325	...	5	...
Alclad 2024	T62 ^F	1.60	12.50	425	...	335	...	5	...
Alclad 2024	T72 ^{F,I}	0.24	1.60	385	...	295	...	5	...
Alclad 2024	T72 ^{F,I}	1.60	6.30	400	...	310	...	5	...
Alclad 2024	T81	0.24	1.60	425	...	370	...	5	...
Alclad 2024	T81	1.60	6.30	445	...	385	...	5	...
Alclad 2024	T851 ^E	6.30	12.50	445	...	385	...	5	...
Alclad 2024	T851 ^E	12.50	25.00	455 ^H	...	400 ^H	...	...	4
Alclad 2024	T861	0.50	1.60	440	...	400	...	3	...
Alclad 2024	T861	1.60	6.30	475	...	440	...	4	...
Alclad 2024	T861	6.30	12.50	470	...	425	...	4	...
Alclad 2024	T861	12.50	12.70	480 ^H	...	440 ^H	...	...	3
Alclad 2024	F ^G	6.30	80.00	...	...	...	...	...	...
1½ % Alclad 2024	O	4.00	12.50	...	220	...	95	12	...

TABLE 3 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5× Diameter
1½ % Alclad 2024	O	12.50	45.00	...	220 ^H	...	...	...	10
1½ % Alclad 2024	T3	4.00	6.30	430	...	285	...	15	...
1½ % Alclad 2024	T351 ^E	6.30	12.50	435	...	285	...	12	...
1½ % Alclad 2024	T351 ^E	12.50	25.00	435 ^H	...	290 ^H	...	...	7
1½ % Alclad 2024	T351 ^E	25.00	40.00	425 ^H	...	290 ^H	...	...	6
1½ % Alclad 2024	T351 ^E	40.00	50.00	425 ^H	...	290 ^H	...	...	5
1½ % Alclad 2024	T351 ^E	50.00	80.00	415 ^H	...	290 ^H	...	...	3
1½ % Alclad 2024	T351 ^E	80.00	100.00	395 ^H	...	285 ^H	...	...	3
1½ % Alclad 2024	T361	4.00	6.30	450	...	340	...	9	...
1½ % Alclad 2024	T361	6.30	12.50	450	...	330	...	9	...
1½ % Alclad 2024	T361	12.50	12.70	455 ^H	...	340 ^H	...	...	9
1½ % Alclad 2024	T42 ^F	4.00	6.30	420	...	255	...	15	...
1½ % Alclad 2024	T42 ^F	6.30	12.50	420	...	255	...	12	...
1½ % Alclad 2024	T42 ^F	12.50	25.00	420 ^H	...	260 ^H	...	...	7
1½ % Alclad 2024	T42 ^F	25.00	40.00	415 ^H	...	260 ^H	...	...	6
1½ % Alclad 2024	T42 ^F	40.00	50.00	415 ^H	...	260 ^H	...	...	5
1½ % Alclad 2024	T42 ^F	50.00	80.00	400 ^H	...	260 ^H	...	...	3
1½ % Alclad 2024	T62 ^F	4.00	12.50	425	...	340	...	5	...
1½ % Alclad 2024	T72 ^{F,I}	4.00	6.30	405	...	310	...	5	...
1½ % Alclad 2024	T81	4.00	6.30	455	...	395	...	5	...
1½ % Alclad 2024	T851 ^E	6.30	12.50	455	...	395	...	5	...
1½ % Alclad 2024	T851 ^E	12.50	25.00	455 ^H	...	400 ^H	...	...	4
1½ % Alclad 2024	T861	4.00	6.30	480	...	450	...	4	...
1½ % Alclad 2024	T861	6.30	12.50	475	...	435	...	4	...
1½ % Alclad 2024	T861	12.50	12.70	480 ^H	...	440 ^H	...	...	3
1½ % Alclad 2024	F ^G	6.30	80.00	...	...	...	...	...	...
Alclad 1-Side 2024	O	0.19	0.25	...	215	...	95	10	...
Alclad 1-Side 2024	O	0.25	1.60	...	215	...	95	12	...
Alclad 1-Side 2024	O	1.60	12.50	...	220	...	95	12	...
Alclad 1-Side 2024	T3	0.24	0.50	420	...	275	...	12	...
Alclad 1-Side 2024	T3	0.50	1.60	420	...	275	...	15	...
Alclad 1-Side 2024	T3	1.60	3.20	425	...	285	...	15	...
Alclad 1-Side 2024	T3	3.20	6.30	430	...	285	...	15	...
Alclad 1-Side 2024	T351 ^E	6.30	12.50	435	...	285	...	12	...
Alclad 1-Side 2024	T361	0.50	1.00	440	...	330	...	8	...

TABLE 3 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5x Diameter
Alclad 1-Side 2024	T361	1.60	6.30	455	...	340	...	9	...
Alclad 1-Side 2024	T361	6.30	12.50	450	...	330	...	9	...
Alclad 1-Side 2024	T42 ^F	0.24	0.50	405	...	240	...	12	...
Alclad 1-Side 2024	T42 ^F	0.50	1.60	405	...	250	...	15	...
Alclad 1-Side 2024	T42 ^F	1.60	6.30	420	...	255	...	15	...
Alclad 1-Side 2024	T42 ^F	6.30	12.50	420	...	255	...	12	...
Alclad 1-Side 2024	T62 ^F	0.24	1.60	425	...	330	...	5	...
Alclad 1-Side 2024	T62 ^F	1.60	12.50	435	...	340	...	5	...
Alclad 1-Side 2024	T72 ^{F,I}	0.24	1.60	400	...	305	...	5	...
Alclad 1-Side 2024	T72 ^{F,I}	1.60	6.30	405	...	310	...	5	...
Alclad 1-Side 2024	T81	0.24	1.60	440	...	385	...	5	...
Alclad 1-Side 2024	T81	1.60	6.30	455	...	395	...	5	...
Alclad 1-Side 2024	T851 ^E	6.30	12.50	455	...	395	...	5	...
Alclad 1-Side 2024	T861	0.50	1.60	460	...	415	...	3	...
Alclad 1-Side 2024	T861	1.60	6.30	485	...	450	...	4	...
Alclad 1-Side 2024	T861	6.30	12.50	475	...	435	...	4	...
Alclad 1-Side 2024	F ^G	6.30	12.50	...	...	...	...	...	...
1½ % Alclad 1-Side 2024	O	4.00	12.50	...	220	...	95	12	...
1½ % Alclad 1-Side 2024	T3	4.00	6.30	430	...	285	...	15	...
1½ % Alclad 1-Side 2024	T351 ^E	6.30	12.50	435	...	285	...	12	...
1½ % Alclad 1-Side 2024	T361	4.00	6.30	455	...	340	...	9	...
1½ % Alclad 1-Side 2024	T361	6.30	12.50	450	...	330	...	9	...
1½ % Alclad 1-Side 2024	T42 ^F	4.00	6.30	420	...	255	...	15	...
1½ % Alclad 1-Side 2024	T42 ^F	6.30	12.50	420	...	255	...	12	...
1½ % Alclad 1-Side 2024	T62 ^F	4.00	12.50	435	...	340	...	5	...
1½ % Alclad 1-Side 2024	T72 ^{F,I}	4.00	6.30	405	...	310	...	5	...
1½ % Alclad 1-Side 2024	T81	4.00	6.30	455	...	395	...	5	...
1½ % Alclad 1-Side 2024	T851 ^E	6.30	12.50	455	...	395	...	5	...
1½ % Alclad 1-Side 2024	T861	4.00	6.30	480	...	450	...	4	...
1½ % Alclad 1-Side 2024	T861	6.30	12.50	475	...	435	...	4	...
1½ % Alclad 1-Side 2024	F ^G	6.30	12.50	...	...	...	...	...	...

Alloy	Temper	Specified Thickness, mm		Axis of Test Specimen	Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through		min	max	min	max	in 50 mm	in 5x Diameter
2124	T851 ^E	25.00	50.00	longitudinal	455	...	395	...	...	5
2124	T851 ^E			long transverse	455	...	395	...	...	4
2124	T851 ^E			short transverse	440 ^J	...	380 ^J	...	...	1

TABLE 3 *Continued*

Alloy	Temper	Specified Thickness, mm		Axis of Test Specimen	Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through		min	max	min	max	in 50 mm	in 5x Diameter
2124	T851 ^E	50.00	80.00	longitudinal	450	...	395	...	...	5
2124	T851 ^E			long transverse	450	...	395	...	...	3
2124	T851 ^E			short transverse	435	...	380	...	...	1
2124	T851 ^E	80.00	100.00	longitudinal	450	...	385	...	...	4
2124	T851 ^E			long transverse	450	...	385	...	...	3
2124	T851 ^E			short transverse	425	...	370	...	...	1
2124	T851 ^E	100.00	130.00	longitudinal	440	...	380	...	...	4
2124	T851 ^E			long transverse	440	...	380	...	...	3
2124	T851 ^E			short transverse	420	...	365	...	...	1
2124	T851 ^E	130.00	150.00	longitudinal	435	...	370	...	...	4
2124	T851 ^E			long transverse	435	...	370	...	...	3
2124	T851 ^E			short transverse	400	...	350	...	...	1

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5x Diameter
2219	O	0.50	12.50	...	220	...	110	12	...
2219	O	12.50	50.00	...	220	...	110	...	10
2219	T31 ^K (flat sheet)	0.50	1.00	315	...	200	...	8	...
2219	T31 ^K (flat sheet)	1.00	6.30	315	...	195	...	10	...
2219	T351 ^{E,H} plate (formerly T31 plate)	6.30	12.50	315	...	195	...	10	...
2219	T351 ^{E,H} plate (formerly T31 plate)	12.50	50.00	315	...	195	...	...	9
2219	T351 ^{E,H} plate (formerly T31 plate)	50.00	80.00	305	...	195	...	...	9
2219	T351 ^{E,H} plate (formerly T31 plate)	80.00	100.00	290	...	185	...	...	8
2219	T351 ^{E,H} plate (formerly T31 plate)	100.00	130.00	275	...	180	...	...	8
2219	T351 ^{E,H} plate (formerly T31 plate)	130.00	150.00	270	...	170	...	...	7
2219	T37 ^K	0.50	1.00	340	...	260	...	6	...
2219	T37 ^K	1.00	12.50	340	...	255	...	6	...
2219	T37 ^K	12.50	60.00	340	...	255	...	...	5
2219	T37 ^K	60.00	80.00	325	...	250	...	...	5
2219	T37 ^K	80.00	100.00	310	...	240	...	...	4
2219	T37 ^K	100.00	120.00	295	...	235	...	...	3
2219	T62 ^F	0.50	1.00	370	...	250	...	6	...
2219	T62 ^F	1.00	6.30	370	...	250	...	7	...
2219	T62 ^F	6.30	12.50	370	...	250	...	8	...
2219	T62 ^F	12.50	25.00	370	...	250	...	...	7
2219	T62 ^F	25.00	50.00	370	...	250	...	...	6
2219	T81 sheet	0.50	1.00	425	...	315	...	6	...
2219	T81 sheet	1.00	6.30	425	...	315	...	7	...
2219	T851 ^E (formerly T81 plate)	6.30	12.50	425	...	315	...	8	...
2219	T851 ^E (formerly T81 plate)	12.50	25.00	425	...	315	...	...	7
2219	T851 ^E (formerly T81 plate)	25.00	50.00	425	...	315	...	...	6
2219	T851 ^E (formerly T81 plate)	50.00	80.00	425	...	310	...	...	5
2219	T851 ^E (formerly T81 plate)	80.00	100.00	415	...	305	...	...	4
2219	T851 ^E (formerly T81 plate)	100.00	130.00	405	...	295	...	...	4
2219	T851 ^E (formerly T81 plate)	130.00	150.00	395	...	290	...	...	3
2219	T87	0.50	1.00	440	...	360	...	5	...
2219	T87	1.00	6.30	440	...	360	...	6	...
2219	T87	6.30	12.50	440	...	350	...	7	...
2219	T87	12.50	25.00	440	...	350	...	...	6
2219	T87	25.00	80.00	440	...	350	...	...	5
2219	T87	80.00	100.00	425	...	345	...	...	3
2219	T87	100.00	120.00	420	...	340	...	...	2
2219	F ^G	6.30	50.00	...	...	...	...	...	...
Alclad 2219	O	0.50	1.00	...	220	...	110	12	...
Alclad 2219	O	1.00	2.50	...	220	...	110	12	...
Alclad 2219	O	2.50	12.50	...	220	...	110	12	...
Alclad 2219	O	12.50	50.00	...	220 ^H	...	110 ^H	...	10

TABLE 3 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5× Diameter
Alclad 2219	T31 ^K (flat sheet)	1.00	2.50	290	...	170	...	10	...
Alclad 2219	T31 ^K (flat sheet)	2.50	6.30	305	...	180	...	10	...
Alclad 2219	T351 ^{E,K} plate (formerly T31 plate)	6.30	12.50	305	...	180	...	10	...
Alclad 2219	T37 ^K	1.00	2.50	310	...	235	...	6	...
Alclad 2219	T37 ^K	2.50	12.50	325	...	240	...	6	...
Alclad 2219	T62 ^F	0.50	1.00	305	...	200	...	6	...
Alclad 2219	T62 ^F	1.00	2.50	340	...	220	...	7	...
Alclad 2219	T62 ^F	2.50	6.30	350	...	235	...	7	...
Alclad 2219	T62 ^F	6.30	12.50	350	...	235	...	8	...
Alclad 2219	T62 ^F	12.50	25.00	370 ^H	...	250 ^H	...	...	7
Alclad 2219	T62 ^F	25.00	50.00	370 ^H	...	250 ^H	...	...	6
Alclad 2219	T81 (flat sheet)	0.50	1.00	340	...	255	...	6	...
Alclad 2219	T81 (flat sheet)	1.00	2.50	380	...	285	...	7	...
Alclad 2219	T81 (flat sheet)	2.50	6.30	400	...	295	...	7	...
Alclad 2219	T851 ^E plate (formerly T81 plate)	6.30	12.50	400	...	290	...	8	...
Alclad 2219	T87	1.00	2.50	395	...	315	...	6	...
Alclad 2219	T87	2.50	6.30	415	...	330	...	6	...
Alclad 2219	T87	6.30	12.50	415	...	330	...	7	...
Alclad 2219	F ^G	6.30	50.00	...	...	...	...	...	...
6013	T4	0.50	6.30	275	...	145	...	20	...
6013	T6	0.50	6.30	360	...	315	...	8	...
6013	T651 ^E	6.30	40.00	365	...	305	...	...	4
6013	T651 ^E	40.00	80.00	370	...	325	...	...	4
6013	T651 ^E	80.00	160.00	380	...	325	...	...	3
6061	O	0.15	0.20	...	150	...	85	10	...
6061	O	0.20	0.25	...	150	...	85	12	...
6061	O	0.25	0.50	...	150	...	85	14	...
6061	O	0.50	3.20	...	150	...	85	16	...
6061	O	3.20	12.50	...	150	...	85	18	...
6061	O	12.50	25.00	...	150	...	...	...	16
6061	O	25.00	80.00	...	150	...	...	...	14
6061	T4	0.15	0.20	205	...	110	...	10	...
6061	T4	0.20	0.25	205	...	110	...	12	...
6061	T4	0.25	0.50	205	...	110	...	14	...
6061	T4	0.50	6.30	205	...	110	...	16	...
6061	T451 ^E	6.30	12.50	205	...	110	...	18	...
6061	T451 ^E	12.50	25.00	205	...	110	...	...	16
6061	T451 ^E	25.00	80.00	205	...	110	...	...	14
6061	T42 ^F	0.15	0.20	205	...	95	...	10	...
6061	T42 ^F	0.20	0.25	205	...	95	...	12	...
6061	T42 ^F	0.25	0.50	205	...	95	...	14	...
6061	T42 ^F	0.50	6.30	205	...	95	...	16	...
6061	T42 ^F	6.30	12.50	205	...	95	...	18	...
6061	T42 ^F	12.50	25.00	205	...	95	...	...	16
6061	T42 ^F	25.00	80.00	205	...	95	...	...	14
6061	T6, T62 ^F	0.15	0.20	290	...	240	...	4	...
6061	T6, T62 ^F	0.20	0.25	290	...	240	...	6	...
6061	T6, T62 ^F	0.25	0.50	290	...	240	...	8	...
6061	T6, T62 ^F	0.50	6.30	290	...	240	...	10	...
6061	T62 ^F , T651 ^E	6.30	12.50	290	...	240	...	10	...
6061	T62 ^F , T651 ^E	12.50	25.00	290	...	240	...	...	8
6061	T62 ^F , T651 ^E	25.00	50.00	290	...	240	...	...	7
6061	T62 ^F , T651 ^E	50.00	100.00	290	...	240	...	...	5
6061	T62 ^F , T651 ^E	100.00	150.00 ^L	275	...	240	...	...	5
6061	F ^G	6.30	80.00	...	...	...	...	...	...
Alclad 6061	O	0.24	0.50	...	140	...	85	14	...
Alclad 6061	O	0.50	3.20	...	140	...	85	16	...
Alclad 6061	O	3.20	12.50	...	140	...	85	18	...
Alclad 6061	O	12.50	25.00	...	150 ^H	...	...	...	16
Alclad 6061	O	25.00	80.00	...	150 ^H	...	...	...	14
Alclad 6061	T4	0.24	0.50	185	...	95	...	14	...
Alclad 6061	T4	0.50	6.30	185	...	95	...	16	...
Alclad 6061	T451 ^E	6.30	12.50	185	...	95	...	18	...
Alclad 6061	T451 ^E	12.50	25.00	205 ^H	...	110 ^H	...	...	16

TABLE 3 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5× Diameter
Alclad 6061	T451 ^E	25.00	80.00	205 ^H	...	110 ^H	...	...	14
Alclad 6061	T42 ^F	0.24	0.50	185	...	85	...	14	...
Alclad 6061	T42 ^F	0.50	6.30	185	...	85	...	16	...
Alclad 6061	T42 ^F	6.30	12.50	185	...	85	...	18	...
Alclad 6061	T42 ^F	12.50	25.00	205 ^H	...	95 ^H	...	...	16
Alclad 6061	T42 ^F	25.00	80.00	205 ^H	...	95 ^H	...	...	14
Alclad 6061	T6, T62 ^F	0.24	0.50	260	...	220	...	8	...
Alclad 6061	T6, T62 ^F	0.50	6.30	260	...	220	...	10	...
Alclad 6061	T62 ^F , T651 ^E	6.30	12.50	260	...	220	...	10	...
Alclad 6061	T62 ^F , T651 ^E	12.50	25.00	290 ^H	...	240 ^H	...	...	8
Alclad 6061	T62 ^F , T651 ^E	25.00	50.00	290 ^H	...	240 ^H	...	...	7
Alclad 6061	T62 ^F , T651 ^E	50.00	100.00	290 ^H	...	240 ^H	...	...	5
Alclad 6061	T62 ^F , T651 ^E	100.00	120.00 ^L	275 ^H	...	240 ^H	...	...	5
Alclad 6061	F ^G	6.30	80.00	...	...	...	...	...	...
7075	O	0.39	12.50	...	275	...	145	10	...
7075	O	12.50	50.00	...	275	...	...	...	9
7075	T6, T62 ^F	0.19	0.32	510	...	435	...	5	...
7075	T6, T62 ^F	0.32	1.00	525	...	460	...	8	...
7075	T6, T62 ^F	1.00	3.20	540	...	470	...	9	...
7075	T6, T62 ^F	3.20	4.70	545	...	475	...	9	...
7075	T6, T62 ^F	4.70	6.30	550	...	475	...	9	...
7075	T62 ^F , T651 ^E	6.30	12.50	540	...	460	...	9	...
7075	T62 ^F , T651 ^E	12.50	25.00	540	...	470	...	...	6
7075	T62 ^F , T651 ^E	25.00	50.00	530	...	460	...	...	5
7075	T62 ^F , T651 ^E	50.00	60.00	525	...	440	...	...	4
7075	T62 ^F , T651 ^E	60.00	80.00	495	...	420	...	...	4
7075	T62 ^F , T651 ^E	80.00	90.00	490	...	400	...	...	4
7075	T62 ^F , T651 ^E	90.00	100.00	460	...	370	...	...	2
7075	T73 sheet	1.00	6.30	460	...	385	...	8	...
7075	T7351 ^E plate	6.30	12.50	475	...	390	...	7	...
7075	T7351 ^E plate	12.50	25.00	475	...	390	...	...	6
7075	T7351 ^E plate	25.00	50.00	475	...	390	...	...	5
7075	T7351 ^E plate	50.00	60.00	455	...	360	...	...	5
7075	T7351 ^E plate	60.00	80.00	440	...	340	...	...	5
7075	T7351 ^E plate	80.00	90.00	435	...	340	...	...	5
7075	T7351 ^E plate	90.00	100.00	420	...	330	...	...	5
7075	T76 sheet	1.60	6.30	505	...	425	...	8	...
7075	T7651 ^E plate	6.30	12.50	495	...	420	...	8	...
7075	T7651 ^E plate	12.50	25.00	490	...	415	...	...	5
7075	F ^G	6.30	100.00	...	...	...	...	...	...
Alclad 7075	O	0.19	0.40	...	250	...	140	9	...
Alclad 7075	O	0.40	1.60	...	250	...	140	10	...
Alclad 7075	O	1.60	4.00	...	260	...	140	10	...
Alclad 7075	O	4.00	12.50	...	270	...	145	10	...
Alclad 7075	O	12.50	25.00	...	275 ^H	...	...	...	9
Alclad 7075	T6, T62 ^F	0.19	0.32	470	...	400	...	5	...
Alclad 7075	T6, T62 ^F	0.32	1.00	490	...	420	...	8	...
Alclad 7075	T6, T62 ^F	1.00	1.60	495	...	425	...	9	...
Alclad 7075	T6, T62 ^F	1.60	3.20	510	...	440	...	9	...
Alclad 7075	T6, T62 ^F	3.20	4.70	510	...	440	...	9	...
Alclad 7075	T6, T62 ^F	4.70	6.30	525	...	450	...	9	...
Alclad 7075	T62 ^F , T651 ^E	6.30	12.50	515	...	445 ^H	...	9	...
Alclad 7075	T62 ^F , T651 ^E	12.50	25.00	540 ^H	...	470 ^H	...	...	6
Alclad 7075	T62 ^F , T651 ^E	25.00	50.00	530 ^H	...	460 ^H	...	...	5
Alclad 7075	T62 ^F , T651 ^E	50.00	60.00	525 ^H	...	440 ^H	...	...	4
Alclad 7075	T62 ^F , T651 ^E	60.00	80.00	495 ^H	...	420 ^H	...	...	4
Alclad 7075	T62 ^F , T651 ^E	80.00	90.00	490 ^H	...	400 ^H	...	...	4
Alclad 7075	T62 ^F , T651 ^E	90.00	100.00	460 ^H	...	370 ^H	...	...	2
Alclad 7075	T76 sheet	1.00	1.60	460	...	385	...	8	...
Alclad 7075	T76 sheet	1.60	4.70	470	...	395	...	8	...
Alclad 7075	T76 sheet	4.70	6.30	485	...	405	...	8	...
Alclad 7075	T7651 ^E plate	6.30	12.50	475	...	400	...	8	...
Alclad 7075	T7651 ^E plate	12.50	25.00	490 ^H	...	415 ^H	...	...	5
Alclad 7075	F ^G	6.30	100.00	...	...	...	...	...	...

TABLE 3 *Continued*

Alloy	Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, ^C min, %	
		over	through	min	max	min	max	in 50 mm	in 5× Diameter
Alclad 1-Side 7075	O	0.39	1.60	...	260	...	145	10	...
Alclad 1-Side 7075	O	1.60	4.00	...	270	...	145	10	...
Alclad 1-Side 7075	O	4.00	12.50	...	270	...	145	10	...
Alclad 1-Side 7075	O	12.50	25.00	...	275 ^H	...	...	...	9
Alclad 1-Side 7075	T6, T62 ^F	0.19	0.32	490	...	415	...	5	...
Alclad 1-Side 7075	T6, T62 ^F	0.32	1.00	510	...	440	...	8	...
Alclad 1-Side 7075	T6, T62 ^F	1.00	1.60	515	...	450	...	9	...
Alclad 1-Side 7075	T6, T62 ^F	1.60	3.20	525	...	455	...	9	...
Alclad 1-Side 7075	T6, T62 ^F	3.20	4.70	530	...	460	...	9	...
Alclad 1-Side 7075	T6, T62 ^F	4.70	6.30	540	...	460	...	9	...
Alclad 1-Side 7075	T62 ^F , T651 ^E	6.30	12.50	525	...	455	...	9	...
Alclad 1-Side 7075	T62 ^F , T651 ^E	12.50	25.00	540 ^H	...	470 ^H	...	...	6
Alclad 1-Side 7075	T62 ^F , T651 ^E	25.00	50.00	530 ^H	...	460 ^H	...	...	5
Alclad 1-Side 7075	F ^G	6.30	50.00	...	...	...	...	...	...

^A To determine conformance to this specification, each value for tensile strength shall be rounded to the nearest 1 MPa and each value for elongation to the nearest 0.5 %, both in accordance with the Rounding Method of Practice E29.

^B The basis for establishment of mechanical property limits is shown in Annex A1.

^C Elongations in 50 mm apply for thicknesses up through 12.50 mm and in 5× diameter for thicknesses over 12.50 mm.

^D Coiled sheet.

^E For stress-relieved tempers (T351, T451, T651, T7351, T7651, and T851), characteristics and properties other than those specified may differ somewhat from the corresponding characteristics and properties of material in the basic temper.

^F Material in the T42, T62, and T72 tempers is not available from the material producer.

^G Test for tensile properties in the F temper are not required.

^H The tension test specimen from plate over 12.50 mm in thickness is machined from the core and does not include the cladding.

^I The T72 temper is applicable only to Alloys 2024 and Alclad 2024 sheet solution heat treated and artificially overaged by the user to develop increased resistance to stress-corrosion cracking.

^J Short transverse tensile properties are not applicable to material less than 40 mm in thickness.

^K Use of Alloys 2219 and Alclad 2219 in the T31, T351, and T37 tempers for finished products is not recommended.

^L The properties for this thickness apply only to the T651 temper.

9. Tensile Properties of Material as Supplied

9.1 *Limits*—The sheet and plate shall conform to the requirements for tensile properties as specified in Table 2 and Table 3 for nonheat-treatable and heat-treatable alloys, respectively.

9.2 *Number of Samples*—One sample shall be taken from each end of each parent coil, or parent plate, but no more than one sample per 1000 kg of sheet or 2000 kg of plate, or part thereof, in a lot shall be required. Other procedures for selecting samples may be employed if agreed upon between the producer and purchaser.

9.3 *Test Specimens*—Geometry of test specimens and the location in the product from which they are taken shall be as specified in Test Method B557M.

9.4 *Test Direction*—Unless otherwise specified, tensile testing shall be in the direction specified in Test Method B557M.

When a direction other than specified in Test Method B557M is tested, the tensile testing direction shall be noted on all documentation.

9.5 *Test Methods*—The tension test shall be made in accordance with Test Method B557M.

10. Producer Confirmation of Heat-Treat Response

10.1 In addition to the requirements of 9.1, material in the O or F temper of alloys 2014, Alclad 2014, 2024, Alclad 2024, 1½ % Alclad 2024, Alclad one side 2024, 1½ % Alclad one side 2024, 6061, and Alclad 6061 shall, upon proper solution heat treatment and natural aging at room temperature, develop the properties specified in Table 3 for T42 temper material. The natural aging period at room temperature shall be not less than four days, but samples of material may be tested prior to four days aging, and if the material fails to conform to the

requirements of T42 temper material, the tests may be repeated after completion of four days aging without prejudice.

10.2 Also, material in the O or F temper of alloys 2219, Alclad 2219, 7075, Alclad 7075, and Alclad one-side 7075 shall, upon proper solution heat treatment and precipitation heat treatment, develop the properties specified in **Table 3** for T62 temper material.

10.3 *Number of Specimens*—The number of specimens from each lot of O temper material and F temper material to be tested to verify conformance with **10.1 – 10.2** shall be as specified in **9.2**.

11. Heat Treatment and Reheat-Treatment Capability

11.1 Mill-produced material in the O or F temper of alloys 2014, Alclad 2014, 2024, Alclad 2024, 1½ % Alclad 2024, Alclad 1-Side 2024, 1½ % Alclad 1-Side 2024, 6061, and Alclad 6061 (without the subsequent imposition of cold work or forming operations) shall, upon proper solution heat treatment and natural aging at room temperature, develop the properties specified in **Table 3** for T42 temper material. The natural aging period at room temperature shall be not less than four days, but samples of material may be tested prior to four days aging, and if the material fails to conform to the requirements of T42 temper material, the tests may be repeated after completion of four days aging without prejudice.

11.2 Mill-produced material in the O or F temper of alloys 2219, Alclad 2219, 7075, Alclad 7075, and Alclad one-side 7075 (without the subsequent imposition of cold work or forming operations) shall, upon proper solution heat treatment and precipitation heat treatment, develop the properties specified in **Table 3** for T62 temper material.

11.3 Mill-produced material in the following alloys and tempers shall, after proper resolution heat treatment and natural aging for four days at room temperature, be capable of attaining the properties specified in **Table 3** for the T42 temper.

Alloys	Tempers
2014 and Alclad 2014	T3, T4, T451, T6, T651
2024 and Alclad 2024	T3, T4, T351, T81, T851
1½ % Alclad 2024, Alclad 1-Side 2024 and 1½ % Alclad 1-Side 2024	T3, T351, T81, T851

NOTE 6—Beginning with the 1974 revision of Specification **B209**, 6061 and Alclad 6061 T4, T451, T6, and T651 were deleted from this paragraph because experience has shown that reheat treated material may develop large recrystallized grains and may fail to develop the tensile properties shown in **Table 3**.

11.4 Mill-produced material in the following alloys and tempers shall, after proper resolution heat treatment and precipitation heat treatment, be capable of attaining the mechanical properties specified in **Table 3** for the T62 temper.

Alloys	Tempers
2219 and Alclad 2219	T31, T351, T81, T851
7075	T6, T651, T73, T7351, T76, T7651
Alclad 7075	T6, T651, T76, T7651
Alclad 1-Side 7075	T6, T651

11.5 Mill-produced material in the following alloys and tempers and T42 temper material shall, after proper precipitation heat treatment, be capable of attaining the properties specified in **Table 3** for the aged tempers listed below.

Alloy and Temper	Temper after Aging
2014 and Alclad 2014-T3, T4, T42, T451	T6, T6, T62, T651, respectively
2024, Alclad 2024, 1½ % Alclad 2024, Alclad 1-Side 2024 and 1½ % Alclad one side 2024-T3, T351, T361, T42	T81, T851, T861, T62, or T72, respectively
2219 and Alclad 2219-T31, T351, T37	T81, T851, T87, respectively
6061 and Alclad 6061-T4, T451, T42	T6, T651, T62, respectively

12. Bend Properties

12.1 *Limits*—Sheet and plate shall be capable of being bent cold through an angle of 180° around a pin having a diameter equal to *N* times the thickness of the sheet or plate without cracking, the value of *N* being as prescribed in **Table 2** for the different alloys, tempers, and thicknesses. The test need not be conducted unless specified on the purchase order.

12.2 *Test Specimens*—When bend tests are made, the specimens for sheet shall be the full thickness of the material, approximately 20 mm in width, and when practical, at least 150 mm in length. Such specimens may be taken in any direction and their edges may be rounded to a radius of approximately 2 mm. For sheet less than 20 mm in width, the specimens should be the full width of the material.

12.3 *Test Methods*—The bend tests shall be made in accordance with Test Method **E290** except as stated otherwise in **12.2**.

13. Stress-Corrosion Resistance

13.1 When specified on the purchase order or contract, alloy 2124-T851, 2219-T851, and 2219-T87 plate shall be subjected to the test specified in **13.3** and shall exhibit no evidence of stress-corrosion cracking. One sample shall be taken from each parent plate in each lot and a minimum of three adjacent replicate specimens from this sample shall be tested. The producer shall maintain records of all lot acceptance test results and make them available for examination at the producer’s facility.

13.2 Alloy 7075 in the T73-type and T76-type tempers, and Alclad 7075 in the T76-type tempers, shall be capable of exhibiting no evidence of stress-corrosion cracking when subjected to the test specified in **13.3**.

13.2.1 For lot-acceptance purposes, resistance to stress-corrosion cracking for each lot of material shall be established by testing the previously selected tension-test samples to the criteria shown in **Table 4**.

13.2.2 For surveillance purposes, each month the producer shall perform at least one test for stress-corrosion resistance in accordance with **13.3** on each applicable alloy-temper for each thickness range 20.00 mm and over listed in **Table 3**, produced that month. Each sample shall be taken from material considered acceptable in accordance with lot-acceptance criteria of **Table 4**. A minimum of three adjacent replicate specimens shall be taken from each sample and tested. The producer shall maintain records of all lots tested and make them available for examination at the producer’s facility.

13.3 The stress-corrosion cracking test shall be performed on plate 20.00 mm and over in thickness as follows:

TABLE 4 Lot Acceptance Criteria for Resistance to Stress Corrosion and Exfoliation Corrosion

Alloy and Temper	Lot Acceptance Criteria		Lot Acceptance Status
	Electrical Conductivity ^A % IACS	Level of Mechanical Properties	
7075-T73 and T7351	40.0 or greater	per specified requirements	acceptable
	38.0 through 39.9	per specified requirements and yield strength does not exceed minimum by more than 82 MPa	acceptable
	38.0 through 39.9	per specified requirements but yield strength exceeds minimum by more than 82 MPa	unacceptable ^B
	less than 38.0	any level	unacceptable ^B
7075-T76 and T7651, Alclad 7075-T76 and T7651	38.0 or greater	per specified requirements	acceptable
	36.0 through 37.9	per specified requirements	suspect ^C
	less than 36.0	any level	unacceptable ^B

^A The electrical conductivity shall be determined in accordance with Test Method E1004 in the locations specified below.

^B When material is found to be unacceptable, it shall be reprocessed (additional precipitation heat treatment or re-solution heat treatment, stress relieving and precipitation heat treatment, when applicable).

^C When material in these tempers is found to be suspect it is either tested for exfoliation corrosion resistance in accordance with Test Method G34 or it is reprocessed (additional precipitation heat treatment or resolution heat treatment and precipitation heat treatment). Favorable exfoliation corrosion test results must never be used as an acceptance criteria for stress corrosion resistance.

Alloy-Temper	Thickness, mm	Location
7075-T73 and T7351	all	surface of tension-test sample
	up through 2.50	surface of tension-test sample
7075-T76 and T7651	over 2.50	sub-surface after removal of approximately 10 % of the thickness

For alclad products, the cladding must be removed and the electrical conductivity determined on the core alloy.

13.3.1 Specimens shall be stressed in tension in the short transverse direction with respect to grain flow and held at constant strain. For alloy 2124-T851, the stress levels shall be 50 % of the specified minimum long transverse yield strength. For alloy 2219-T851 and T87, the stress levels shall be 75 % of the specified minimum long transverse yield strength. For alloy 7075 in the T73-type tempers, stress levels shall be 75 % of the specified minimum yield strength, and for 7075 and Alclad 7075 in the T76-type temper it shall be 170 MPa.

13.3.2 The stress-corrosion test shall be made in accordance with Test Method G47.

13.3.3 There shall be no visual evidence of stress-corrosion cracking in any specimen, except that the retest provisions of 19.2 shall apply.

14. Exfoliation-Corrosion Resistance

14.1 Alloys 7075 and Alclad 7075 in the T76-type tempers, shall be capable of exhibiting no evidence of exfoliation corrosion equivalent to or in excess of that illustrated by Photo B in Fig. 2 of Test Method G34, when subjected to the test in 14.2.

14.1.1 For lot-acceptance purposes, resistance to exfoliation corrosion for each lot of material in the alloys and tempers listed in 14.1 shall be established by testing the previously selected tension-test samples to the criteria shown in Table 4.

14.1.2 For surveillance purposes, each month the producer shall perform at least one test for exfoliation-corrosion resistance on each applicable alloy-temper for each thickness range listed in Table 3, produced that month. The samples for test shall be selected at random from material considered acceptable in accordance with the lot-acceptance criteria of Table 4.

The producer shall maintain records of all surveillance test results and make them available for examination.

14.2 The test for exfoliation corrosion resistance shall be made in accordance with Test Method G34 and the following:

14.2.1 The specimens shall be a minimum of 50 by 100 mm with the 100-mm dimension in a plane parallel to the direction of final rolling. They shall be full-section thickness specimens of the material except that for material 2.5 mm or more in thickness, 10 % of the thickness shall be removed by machining one surface. The cladding of alclad sheet of any thickness shall be removed by machining the test surface; the cladding on the back side (nontest surface) of the specimen for any thickness of alclad material shall also either be removed or masked off. For machined specimens, the machined surface shall be evaluated by exposure to the test solution.

15. Cladding

15.1 Preparatory to rolling alclad sheet and plate to the specified thickness, the aluminum or aluminum-alloy plates which are bonded to the alloy ingot or slab shall be of the composition shown in Table 1 and shall each have a thickness not less than that shown in Table 5 for the alloy specified.

15.2 When the thickness of the cladding is to be determined on finished material, not less than one transverse sample approximately 20 mm in length shall be taken from each edge and from the center width of the material. Samples shall be mounted to expose a transverse cross section and shall be polished for examination with a metallurgical microscope. Using 100× magnification, the maximum and minimum cladding thickness on each surface shall be measured in each of

TABLE 5 Components of Clad Products

Alloy	Component Alloys ^A		Specified Total Composite Thickness of Finished Sheet and Plate, mm		Sides Clad	Cladding Thickness per Side, percent of Composite Thickness		
						Nominal	Average ^B	
							min	max
Alclad 2014	2014	6003	...	0.63	both	10	8	...
			0.63	1.00	both	7.5	6	...
			1.00	2.50	both	5	4	...
			2.50	...	both	2.5	2	3 ^C
Alclad 2024	2024	1230	...	1.60	both	5	4	...
			1.60	...	both	2.5	2	3 ^C
1½ % Alclad 2024	2024	1230	4.00	...	both	1.5	1.2	3 ^D
Alclad 1-Side 2024	2024	1230	...	1.60	one	5	4	...
			1.60	...	one	2.5	2	3 ^C
1½ % Alclad 1-Side 2024	2024	1230	4.00	...	one	1.5	1.2	3 ^D
Alclad 2219	2219	7072	...	1.00	both	10	8	...
			1.00	2.50	both	5	4	...
			2.50	...	both	2.5	2	3 ^C
Alclad 3003	3003	7072	all	...	both	5	4	6 ^C
Alclad 3004	3004	7072	all	...	both	5	4	6 ^C
Alclad 6061	6061	7072	all	...	both	5	4	6 ^C
Alclad 7075	7075	7072	...	1.60	both	4	3.2	...
			1.60	4.00	both	2.5	2	...
			4.00	...	both	1.5	1.2	3 ^D
Alclad 1-Side 7075	7075	7072	...	1.60	one	4	3.2	...
			1.60	4.00	one	2.5	2	...
			4.00	...	one	1.5	1.2	3 ^D

^A Cladding composition is applicable only to the aluminum alloy bonded to the alloy ingot or slab preparatory to rolling to the specified composite product. The composition of the cladding may be altered subsequently by diffusion between the core and cladding due to thermal treatment.

^B Average thickness per side as determined by averaging cladding thickness measurements when determined in accordance with the procedure specified in 15.2.

^C Applicable for thicknesses over 12.50 mm.

^D For thickness over 12.50 mm with 1.5 % of nominal cladding thickness, the average maximum thickness of cladding per side after rolling to the specified thickness of plate shall be 3 % of the thickness of the plate as determined by averaging cladding thickness measurements taken at a magnification of 100 diameters on the cross section of a transverse sample polished and etched for examination with a metallurgical microscope.

five fields approximately 2.5 mm apart for each sample. The average of the ten values (five minima plus five maxima) on each sample surface is the average cladding thickness and shall meet the minimum average and, when applicable, the maximum average specified in Table 5.

16. Dimensional Tolerances

16.1 *Thickness*—The thickness of flat sheet, coiled sheet, and plate shall not vary from that specified by more than the respective permissible variations prescribed in Tables 7.7a, 7.7b, 7.26, 7.31, and 8.2 of ANSI H35.2M. Permissible variations in thickness of plate specified in thicknesses exceeding 160 mm shall be the subject of agreement between the purchaser and the producer or the supplier at the time the order is placed.

16.2 *Length, Width, Lateral Bow, Squareness, and Flatness*—Coiled sheet shall not vary in width or in lateral bow from that specified by more than the permissible variations prescribed in Tables 7.11 and 7.12, respectively, of ANSI H35.2M. Flat sheet and plate shall not vary in width, length, lateral bow, squareness, or flatness by more than the permissible variations prescribed in the following tables of ANSI H35.2M except that where the tolerances for sizes ordered are not covered by this standard, the permissible variations shall be the subject of agreement between the purchaser and the producer or supplier at the time the order is placed:

Table No.	Title
7.8	width, sheared flat sheet and plate
7.9	width and length, sawed flat sheet and plate
7.10	length, sheared flat sheet and plate
7.13	lateral bow, flat sheet and plate
7.14	squareness, flat sheet and plate
7.17	flatness, flat sheet
7.18	flatness, sawed or sheared plate

16.3 *Sampling for Inspection*—Examination for dimensional conformance shall be made to ensure conformance to the tolerance specified.

17. Internal Quality

17.1 When specified by the purchaser at the time of placing the order, plate over 12.50 through 115.00 mm in thickness and up to a maximum mass of 1000 kg in alloys 2014, 2024, 2124, 2219, and 7075, both bare and alclad where applicable, shall be tested in accordance with Practice B594 to the discontinuity acceptance limits of Table 6.

17.2 When specified by the purchaser at the time of placing the order, plate over 12.50 mm in thickness for ASME pressure vessel applications in alloys 1060, 1100, 3003, Alclad 3003, 3004, Alclad 3004, 5052, 5083, 5086, 5154, 5254, 5454, 5456, 6061, and Alclad 6061 shall be tested in accordance with Method B548. In such cases the material will be subject to rejection if the following limits are exceeded unless it is

TABLE 6 Ultrasonic Discontinuity Limits for Plate^A

Alloy	Thickness, mm		Maximum Mass per Piece, kg ^B	Discontinuity Class ^C
	over	through		
2014 ^D 2024 ^D	12.50	38.00	1,000	B
2124 2219 ^D 7075 ^D	38.00	80.00	1,000	A
	80.00	115.00	1,000	B

^A Discontinuities in excess of those listed in this table shall be allowed if it is established that they will be removed by machining or that they are in non-critical areas.
^B The maximum mass is either the ordered mass of a plate of rectangular shape or the planned mass of a rectangular plate prior to removing metal to produce a part or plate shape to a drawing.
^C The discontinuity class limits are defined in Section 11 of Practice B594.
^D Also applies for alclad plate.

determined by the purchaser that the area of the plate containing significant discontinuities will be removed during the subsequent fabrication process or that the plate may be repaired by welding.

17.2.1 If the longest dimension of the marked area representing a discontinuity causing a complete loss of back reflection (95 % or greater) exceeds 25 mm.

17.2.2 If the length of the marked area representing a discontinuity causing an isolated ultrasonic indication without a complete loss of back reflection (95 % or greater) exceeds 25 mm.

17.2.3 If each of two marked areas representing two adjacent discontinuities causing isolated ultrasonic indications without a complete loss of back reflection (95 % or greater) is longer than 25 mm, and if they are located within 75 mm of each other.

18. Source Inspection

18.1 If the purchaser desires that their representative inspect or witness the inspection and testing of the material prior to shipment, such agreement shall be made by the purchaser and producer as part of the purchase contract.

18.2 When such inspection or witness of inspection and testing is agreed upon, the producer shall afford the purchaser's representative all reasonable facilities to satisfy him that the material meets the requirements of this specification. Inspection and tests shall be conducted so there is no unnecessary interference with the producer's operations.

19. Retest and Rejection

19.1 If any material fails to conform to all of the applicable requirements of this specification, it shall be cause for rejection of the inspection lot.

19.2 When there is evidence that a failed specimen was not representative of the inspection lot and when no other sampling plan is provided or approved by the purchaser through the contract or purchase order, at least two additional specimens shall be selected to replace each test specimen that failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection.

19.3 Material which is determined to be nonconforming subsequent to inspection may be rejected.

19.4 If material is rejected by the purchaser, the producer or supplier is responsible only for replacement of the material to the purchaser. As much as possible of the rejected material shall be returned to the producer or supplier by the purchaser.

20. Identification Marking of Product

20.1 All sheet and plate shall be marked in accordance with Practice B666/B666M, unless otherwise specified.

20.2 The requirements specified in 20.1 are minimum; marking systems that involve added information, larger characters, and greater frequencies are acceptable under this specification.

21. Packaging and Package Marking

21.1 The material shall be packaged to provide adequate protection during normal handling and transportation and each package shall contain only one size, alloy, and temper of material unless otherwise agreed. The type of packaging and gross mass of containers shall, unless otherwise agreed, be at the producer's or supplier's discretion, provided that they are such as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the delivery point.

21.2 Each shipping container shall be marked with the purchase order number, material size, specification number, alloy and temper, gross and net masses, and the producer's name or trademark.

21.3 When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B660. The applicable levels shall be as specified in the contract or order.

22. Certification

22.1 The producer or supplier shall, on request, furnish to the purchaser a certificate stating that each lot has been sampled, tested, and inspected in accordance with this specification, and has met the requirements.

23. Keywords

23.1 aluminum alloy; aluminum-alloy plate; aluminum-alloy sheet

ANNEXES
(Mandatory Information)
A1. BASIS FOR INCLUSION OF PROPERTY LIMITS

A1.1 Mechanical property limits are established in accord with Section 6, Standards Section, of the most current edition of the Aluminum Standards and Data and the latest edition of the Aluminum Association publication “Tempers for Aluminum and Aluminum Alloy Products (Yellow and Tan Sheets).”

Limits are based on a statistical evaluation of the data indicating that at least 99 % of the population obtained from all standard material meets the limit with 95 % confidence. For the products described, mechanical property limits are based on the statistical analyses of at least 100 tests from at least five cast lots of standard production material with no more than ten observations from a given heat treat or inspection lot. Mechanical properties limits for press solution heat treated products have specific additional requirements which are provided in the “Tempers for Aluminum and Aluminum Alloy Products.”

Limits denoted as “Tentative” by the Aluminum Association may be included. Requirements for tentative property registrations are defined in the latest edition of the Aluminum Association publication “Tempers for Aluminum and Aluminum Alloy Products.” Tentative property limits are established at levels at which at least 99 % of the data conform at a confidence level of 95 %. Tentative property limits, which are subject to revision, shall be based on a statistical analysis of at least 30 tests from at least three cast lots of standard production material with no more than ten observations from a given heat treat or inspection lot. Where tentative property limits are listed, they shall be shown in italics and footnoted as Tentative in the standard.

All tests are performed in accordance with the appropriate ASTM test methods.

A2. ACCEPTANCE CRITERIA FOR INCLUSION OF NEW ALUMINUM AND ALUMINUM ALLOYS IN THIS SPECIFICATION

A2.1 Prior to acceptance for inclusion in this specification, the composition of wrought or cast aluminum or aluminum alloy shall be registered in accordance with ANSI H35.1/H35.1(M). The Aluminum Association⁸ holds the Secretariat of ANSI H35 Committee and administers the criteria and procedures for registration.

A2.2 If it is documented that the Aluminum Association could not or would not register a given composition, an alternative procedure and the criteria for acceptance shall be as follows:

A2.2.1 The designation submitted for inclusion does not utilize the same designation system as described in ANSI H35.1/H35.1(M). A designation not in conflict with other designation systems or a trade name is acceptable.

A2.2.2 The aluminum or aluminum alloy has been offered for sale in commercial quantities within the prior twelve months to at least three identifiable users.

A2.2.3 The complete chemical composition limits are submitted.

A2.2.4 The composition is, in the judgment of the responsible subcommittee, significantly different from that of any other aluminum or aluminum alloy already in the specification.

A2.2.5 For codification purposes, an alloying element is any element intentionally added for any purpose other than grain refinement and for which minimum and maximum limits are specified. Unalloyed aluminum contains a minimum of 99.00 % aluminum.

A2.2.6 Standard limits for alloying elements and impurities are expressed to the following decimal places:

Less than 0.001 %	0.000X
0.001 to but less than 0.01 %	0.00X
0.01 to but less than 0.10 %	
Unalloyed aluminum made by a refining process	0.0XX
Alloys and unalloyed aluminum not made by a refining process	0.0X
0.10 through 0.55 %	0.XX
(It is customary to express limits of 0.30 through 0.55 % as 0.X0 or 0.X5.)	
Over 0.55 %	0.X, X.X, and so forth

(except that combined Si+Fe limits for 99.00 % minimum aluminum must be expressed as 0.XX or 1.XX)

A2.2.7 Standard limits for alloying elements and impurities are expressed in the following sequence: Silicon; Iron; Copper; Manganese; Magnesium; Chromium; Nickel; Zinc; Titanium (**Note A2.1**); Other Elements, Each; Other Elements, Total; Aluminum (**Note A2.2**).

NOTE A2.1—Additional specified elements having limits are inserted in alphabetical order of their chemical symbols between titanium and Other Elements, Each, or are specified in footnotes.

NOTE A2.2—Aluminum is specified as *minimum* for unalloyed aluminum and as a *remainder* for aluminum alloys.

⁸ The Aluminum Association Inc., Suite 600, Arlington, VA 22209 or www.aluminum.org.

APPENDIX
(Nonmandatory Information)
X1. ISO EQUIVALENTS OF ANSI ALLOYS AND TEMPERS

X1.1 International Organization for Standardization equivalents of the ANSI alloys and tempers given in **Table X1.1** are included in ISO 209-1, Part 1, Chemical Composition. Mechanical property limits shown in ISO 6361-2, Part 2, Mechanical Properties, are similar to B209M but not necessarily identical.

TABLE X1.1 ISO Equivalents of Alloys in B209M

Alloys			
ANSI	ISO	ANSI	ISO
1060	Al 99.6	5050	Al Mg1.5 (C)
1100	Al 99.0 Cu	5052	Al Mg2.5
2014	Al Cu4SiMg	5083	Al Mg4.5Mn0.7
2024	Al Cu4Mg1	5086	Al Mg4
2219	Al Cu6Mn	5154	Al Mg3.5
3003	Al Mn1Cu	5454	Al Mg3Mn
3004	Al Mn1Mg1	5456	Al Mg5Mn1
3005	Al Mn1Mg0.5	6061	Al Mg1SiCu
3105	Al Mn0.5Mg0.5	7075	Al Zn5.5MgCu
5005	Al Mg1 (B)		

SUMMARY OF CHANGES

Committee B07 has identified the location of selected changes to this standard since the last issue (B209M – 10) that may impact the use of this standard. (Approved Nov. 1, 2014.)

- (1) Revised **Table 1**; the reference to the Teal Sheet was made into a footnote, and “should” was changed to “shall.”
- (2) Revised **Table 2**; the properties of 5083-O were revised to agree with corrections made in ASD.
- (3) Practice **B985** was added to subsection **2.2**.
- (4) Subsection **4.2.3** was added to the Ordering Information, and subsequent items were renumbered.
- (5) Revised **7** to provide for sampling of semi-finished and finished products as defined in Practice **B985**.
- (6) Revised Section **8**.

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