METRIC
Designation: B 209M – 03~~3~~4

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

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

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

1. Scope*

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

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

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

1.2 Alloy and temper designations are in accordance with ANSI H35.1M. 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 E 527.

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

NOTE 2—See Specification B 632/B 632M for Tread Plate.

NOTE 3—See Specification B 928/B 928M for marine sheet and plate. Due to the additional corrosion testing required, it is not intended that Specification B 209M be used for marine sheet and plate.

1.3 This specification is the metric counterpart of Specification B 209.

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

2. Referenced Documents

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

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

Current edition approved ~~Apr. 10, 2003.~~ March 1, 2004. Published ~~October 2003.~~ March 2004. Originally approved in 1978. Last previous edition approved in 200~~2~~3 as B 209M – 0~~2a~~3.

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

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

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Other Elements[D]		Aluminum
									Each	Total[E]	
1060	0.25	0.35	0.05	0.03	0.03	...	0.05	0.03	0.03[F]	...	99.60 min[G]
1100	0.95 Si + Fe		0.05–0.20	0.05	...	...	0.10	...	0.05	0.15	99.00 min[G]
1230[H]	0.70 Si + Fe		0.10	0.05	0.05	...	0.10	0.03	0.03[F]	...	99.30 min[G]
2014	0.50–1.2	0.7	3.9–5.0	0.40–1.2	0.20–0.8	0.10	0.25	0.15	0.05	0.15	remainder
Alclad 2014	2014 clad with 6003 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
~~5754~~	~~0.40~~	~~0.40~~	~~0.10~~	~~0.50[J]~~	~~2.6-3.6~~	~~0.30[J]~~	~~0.20~~	~~0.15~~	~~0.05~~	~~0.15~~	~~remainder~~
5456	0.25	0.40	0.10	0.50–1.0	4.7–5.5	0.05–0.20	0.25	0.20	0.05	0.15	remainder
5457	0.08	0.10	0.20	0.15–0.45	0.8–1.2	...	0.05	...	0.03[F]	0.10[F]	remainder
5652	0.40 Si + Fe		0.04	0.01	2.2–2.8	0.15–0.35	0.10	...	0.05	0.15	remainder
5657	0.08	0.10	0.10	0.03	0.6–1.0	...	0.05	...	0.02[K]	0.05[K]	remainder
5754	0.40	0.40	0.10	0.50[L]	2.6-3.6	0.30[L]	0.20	0.15	0.05	0.15	remainder
6003[H]	0.35–1.0	0.6	0.10	0.8	0.8–1.5	0.35	0.20	0.10	0.05	0.15	remainder
6013	0.6–1.0	0.50	0.6–1.1	0.20–0.8	0.8–1.2	0.10	0.25	0.10	0.05	0.15	remainder
6061	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.35	0.25	0.15	0.05	0.15	remainder
Alclad 6061	6061 clad with 7072 alloy										
7008[H]	0.10	0.10	0.05	0.05	0.7–1.4	0.12–0.25	4.5–5.5	0.05	0.05	0.10	remainder
7072[H]	0.7 Si + Fe		0.10	0.10	0.10	...	0.8–1.3	...	0.05	0.15	remainder
7075	0.40	0.50	1.2–2.0	0.30	2.1–2.9	0.18–0.28	5.1–6.1	0.20	0.05	0.15	remainder
Alclad 7075	7075 clad with 7072 alloy										
7008 Alclad 7075	7075 clad with 7008 alloy										
7178	0.40	0.50	1.6–2.4	0.30	2.4–3.1	0.18–0.28	6.3–7.3	0.20	0.05	0.15	remainder
Alclad 7178	7178 clad with 7072 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 righthand place of figures used in expressing the specified limit, in accordance with the rounding-off method of Practice E 29.

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

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

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

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

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

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

[J] ~~–0.10-5–0.6 Mn + C~~25 Zr.

[K] ~~Gallium 0.03 max, vanadium 0.05 max. The total for other elements does not include vanadium and gallium.~~

[L] Gallium 0.03 max, vanadium 0.05 max. The total for other elements does not include vanadium and gallium.

2.2 *ASTM Standards:* [2]

B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

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

B 557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products [Metric]

[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*, ~~Vol 02.02.~~ volume information, refer to the standard's Document Summary page on the ASTM website.

B 594 Practice for Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications
B 632/B 632M Specification for Aluminum-Alloy Rolled Tread Plate
B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products
B 666/B 666M Practice for Identification Marking of Aluminum and Magnesium Products
B 881 Terminology Relating to Aluminum- and Magnesium-Alloy Products
B 918 Practice for Heat Treatment of Wrought Aluminum Alloys
B 928/B 928M High Magnesium Aluminum-Alloy Sheet and Plate for Marine Service
E 3 Practice for Preparation of Metallographic Specimens
E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys
E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition
E 290 Test Method for Bend Test for Ductility
E 407 Practice for Microetching Metals and Alloys
E 527 Practice for Numbering Metals and Alloys (UNS)
E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere
E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis
E 1004 Practice for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method
E 1251 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge
G 34 Test Method for Exfoliation Corrosion Susceptibility in 2xxx and 7xxx Series Aluminum Alloys (EXCO Test)
G 47 Test Method for Determining Susceptibility to Stress-Corrosion Cracking of 2xxx and 7xxx Aluminum Alloy Products
~~G 66 Test Method for Visual Assessment of Exfoliation Corrosion Susceptibility of 5xxx Series Aluminum Alloys (ASSET Test)[8]~~

2.3 *ISO Standards:*[3]
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:*[4]
H35.1M Alloy and Temper Designation Systems for Aluminum
H35.2M Dimensional Tolerances for Aluminum Mill Products
2.5 *AMS Specification:*[5]
AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials

3. Terminology

3.1 *Definitions:*
3.2 Refer to Terminology B 881 for definitions of product terms used in this specification.
3.3 *Definitions of Terms Specific to This Standard:*
3.3.1 *capable of*—The term *capable of* as used in this specification means that the test need not be performed by the producer of the material. However, should testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

4. Ordering Information

4.1 Orders for material to this specification shall include the following information:
4.1.1 This specification designation (which includes the number, the year, and the revision letter, if applicable),
4.1.2 Quantity in pieces or 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:

~~*Annual Book of ASTM*~~

[3] Available from American National Standards~~, Vol 03.01.~~ Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.
[4] Available in the Related Materials section (gray pages) of the *Annual Book of ASTM Standards*, Vol ~~14.02.~~ 02.02.
~~*Annual Book*~~
[5] Available from Society of ~~ASTM Standards, Vol 03.05.~~ Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

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

4.2.2 Whether bend tests are required (12.1),

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

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

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

4.2.6 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (Section 18),

4.2.7 Whether certification is required (Section 22),

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

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

5. Responsibility for Quality Assurance

5.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser in the order or at the time of contract signing. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to 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 form, alloy, temper, and thickness traceable to a heat-treat lot or lots, and subjected to inspection at one time.

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

6. General Quality

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

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

7. Chemical Composition

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

NOTE ~~3~~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 *Number of Samples*—The number of samples taken for determination of chemical composition shall be as follows:

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

7.2.2 When samples are taken from the finished or semifinished product, a sample shall be taken to represent each 2000 kg, or fraction thereof, of material in the lot, except that not more than one sample shall be required per piece.

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

7.3.1 Samples for chemical analysis shall be taken by drilling, sawing, milling, turning, or clipping a representative piece or pieces to obtain a prepared sample of not less than 75 g. Sampling shall be in accordance with Practice E 55.

7.3.2 Sampling for spectrochemical analysis shall be in accordance with Practices E 716. Samples for other methods of analysis shall be suitable for the form of material being analyzed and the type of analytical method used.

NOTE ~~4~~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.

7.4 *Methods of Analysis*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Methods E 34)~~,~~ or spectrochemical (Test Methods E 607 and E 1251)~~,~~ methods. Other methods may be used only when no published ASTM test method is available. In case of dispute, the methods of analysis shall be agreed upon between the producer and purchaser.

8. Heat Treatment

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

8.2 When specified, heat treatment of applicable tempers in Table 3 shall be in accordance with Practice B 918.

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 Methods B 557M.

9.4 *Test Methods*—The tension test shall be made in accordance with Test Methods B 557M.

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 4 days, but samples of material may be tested prior to 4 days aging, and if the material fails to conform to the requirements of T42 temper material, the tests may be repeated after completion of 4 days aging without prejudice.

10.2 Also, material in the O or F temper of alloys 2219, Alclad 2219, 7075, Alclad 7075, Alclad one-side 7075, 7008 Alclad 7075, 7178, and Alclad 7178 shall, upon proper solution heat treatment and precipitation heat treatment, develop the properties specified in Table 3 for T62 temper material.

10.3 Mill-produced material in the O or F temper of 7008 Alclad 7075 shall, upon proper solution heat treatment and stabilizing, be capable of attaining the properties specified in Table 3 for the T76 temper.

10.4 *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 10.1-10.3 and 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 one side 2024, 1½ % Alclad one 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 4 days, but samples of material may be tested prior to 4 days aging, and if the material fails to conform to the requirements of T42 temper material, the tests may be repeated after completion of 4 days aging without prejudice.

11.2 Mill-produced material in the O or F temper of alloys 2219, Alclad 2219, 7075, Alclad 7075, Alclad one-side 7075, 7008 Alclad 7075, 7178, and Alclad 7178 (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 O or F temper of 7008 Alclad 7075 (without the subsequent imposition of cold work or forming operations) shall, upon proper solution heat treatment and stabilizing, be capable of attaining the properties specified in Table 3 for the T76 temper.

11.4 Mill-produced material in the following alloys and tempers shall, after proper resolution heat treatment and natural aging for 4 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 one side 2024 and 1½ % Alclad on side 2024~~	~~T3, T351, T81, T851~~
1½ % Alclad 2024, Alclad one side 2024 and 1½ % Alclad one side 2024	T3, T351, T81, T851

NOTE ~~5~~6—Beginning with the 1974 revision of Specification B 209, 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.

11.5 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, 7008 Alclad 7075, 7178, and Alclad 7178	T6, T651, T76, T7651
~~Alclad one- side 7075~~	~~T6, T651~~
Alclad one side 7075	T6, T651

11.6 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 one side 2024 and 1½ % Alclad one side 2024-T3, T351, T361, T42~~	~~T81, T851, T861, T62 or T72, respec- tively~~
2024, Alclad 2024, 1½ % Alclad 2024, Alclad one side 2024 and 1½ % Alclad one side 2024-T3, T351, T361, T42	T81, T851, T861, T62, or T72, respec- tively
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 deg~~ 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 E 290 except as stated otherwise in 12.2.

13. Stress-Corrosion Resistance

13.1 When specified on the purchase order or contract, alloy 2124-T851 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 alloys Alclad 7075, 7008 Alclad 7075, 7178, and Alclad 7178 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 ~~so~~ 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:

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 T73-type tempers, stress levels shall be 75 % of the specified minimum yield strength and for T76-type it shall be 170 MPa.

13.3.2 The stress-corrosion test shall be made in accordance with Test Method G 47.

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 ~~5083, 5086, and 5456 in the H116 temper shall be capable of exhibiting no evidence of exfoliation corrosion when subjected to the test described in Method G 66.~~

~~NOTE 6—Alloys 5083, 5086, and 5456 should not be used for continuous service at temperatures exceeding 150°F because of susceptibility to stress corrosion cracking. In addition, stress corrosion susceptibility is increased by cold forming.~~

~~14.1.1 For lot-acceptance purposes, the acceptability of each lot of material in the alloys and temper listed in 14.1 shall be determined by the producer by metallographic examination of one sample per lot selected from midsection at one end of a random sheet or plate. The microstructure of the sample from each production lot shall be compared to that of a producer-established reference photomicrograph of acceptable material in the same thickness range which is characterized by being predominantly free of a continuous grain boundary network of aluminum-magnesium (Mg_2Al_3) precipitate. A reference photomicrograph taken at 500× shall be established for each of the thickness ranges shown in Table 2 in which materials are produced and shall be taken from a sample within that thickness range. A longitudinal section perpendicular to the rolled surface shall be prepared for metallographic examination (see Practice E 3, symbol E in Fig. 1) and shall be microetched for metallographic examination using 40 % phosphoric acid etch for 3 min at 35°C or using etchant No. 6 in accordance with Test Methods E 407, Table 2, for 2 min. The metallographic examination shall be conducted at 500× magnification. If the microstructure shows evidence of aluminum-magnesium precipitate in excess of the producer-established reference photomicrograph of acceptable material, the lot is either rejected or tested for exfoliation-corrosion resistance in accordance with 14.1. The sample for corrosion test should be selected in the same manner specified for metallographic tests and shall be taken from the same sheet or plate used for metallographic test. Specimens prepared from the sample shall be full section thickness except that for material 2.5 mm or more in thickness, 10 % of the thickness shall be removed, by machining, from one as-rolled surface. Both the machined surface and the remaining as-rolled surface shall be evaluated after exposure to the test solution. Production practices shall not be changed after establishment of the reference micrograph except as provided in 14.1.3.~~

~~14.1.2 The producer shall maintain at the producing facility all records relating to the establishment of reference photomicrographs and production practices.~~

~~14.1.3 Significant changes in production practices that alter the microstructures of the alloy shall require qualification of the practice in accordance with 14.1.1.~~

~~14.2 Alloys~~ 7075, Alclad 7075, 7008, Alclad 7075, 7178, and Alclad 7178, 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 G 34, when subjected to the test in 14.3.

14.~~2~~1.1 For lot-acceptance purposes, resistance to exfoliation corrosion for each lot of material in the alloys and tempers listed in 14.~~2~~1 shall be established by testing the previously selected tension-test samples to the criteria shown in Table 4.

14.~~2~~1.2 For surveillance purposes, each month the producer shall perform at least one test for exfoliation-corrosion resistance for each alloy 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.~~3~~2 The test for exfoliation corrosion resistance shall be made in accordance with Test Method G 34 and the following:

14.~~3~~2.1 The specimens shall be a minimum of 50 mm 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 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 mm through 115.00 mm in thickness and up to a maximum mass of 1000 kg in alloys 2014, 2024, 2124, 2219, 7075, and 7178, both bare and alclad where applicable, shall be tested in accordance with Practice B 594 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, 5652, 6061, and Alclad 6061 shall be tested in accordance with Method B 548. In such cases the material will be subject to rejection if the following limits are exceeded unless it is 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 his 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 in which defects are discovered 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 When specified on the purchase order or contract, all sheet and plate shall be marked in accordance with Practice B 666/B 666M.

20.2 In addition, alloys in the 2xxx and 7xxx series in the T6, T651, T73, T7351, T76, T7651, or T851 tempers shall be marked with the lot number in at least one location on each piece.

20.3 The requirements specified in 20.1 and 20.2 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 B 660. 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

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

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
					Aluminum 1060				
0	0.15	0.32	55	95	15	...	15	...	...
	0.32	0.63	55	95	15	...	18	...	...
	0.63	1.20	55	95	15	...	23	...	...
	1.20	6.30	55	95	15	...	25	...	...
	6.30	80.00	55	95	15	...	25	22	...
H12[D]	0.40	0.63	75	110	60	...	6	...	...
or	0.63	1.20	75	110	60	...	7	...	...
H22[D]	1.20	6.30	75	110	60	...	12	...	...
	6.30	50.00	75	110	60	...	12	10	...
H14[D]	0.20	0.32	85	120	70	...	1	...	...
or	0.32	0.63	85	120	70	...	2	...	...
H24[D]	0.63	1.20	85	120	70	...	6	...	...
	1.20	6.30	85	120	70	...	10	...	...
	6.30	25.00	85	120	70	...	10	9	...
H16[D]	0.15	0.32	95	130	75	...	1	...	...
or	0.32	0.63	95	130	75	...	2	...	...
H26[D]	0.63	1.20	95	130	75	...	4	...	...
	1.20	4.00	95	130	75	...	5	...	...
H18[D]	0.15	0.32	110	...	85	...	1	...	...
or	0.32	0.63	110	...	85	...	2	...	...
H28[D]	0.63	1.20	110	...	85	...	3	...	...
	1.20	3.20	110	...	85	...	4	...	...
H112	6.30	12.50	75	...	...	...	10	...	...
	12.50	40.00	70	...	...	...	...	18	...
	40.00	80.00	60	...	...	...	...	22	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Aluminum 1100				
O	0.15	0.32	75	105	25	...	15	...	0
	0.32	0.63	75	105	25	...	17	...	0
	0.63	1.20	75	105	25	...	22	...	0
	1.20	6.30	75	105	25	...	30	...	0
	6.30	80.00	75	105	25	...	28	25	0
H12[D]	0.40	0.63	95	130	75	...	3	...	0
or	0.63	1.20	95	130	75	...	5	...	0
H22[D]	1.20	6.30	95	130	75	...	8	...	0
	6.30	12.50	95	130	75	...	10	9	0
	12.50	50.00	95	130	75	...	10	9	...
H14[D]	0.20	0.32	110	145	95	...	1	...	0
or	0.32	0.63	110	145	95	...	2	...	0
H2[D]	0.63	1.20	110	145	95	...	3	...	0
	1.20	6.30	110	145	95	...	5	...	0
	6.30	12.50	110	145	95	...	7	6	0
	12.50	25.00	110	145	95	...	7	6	...

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
H16[D]	0.15	0.32	130	165	115	...	1	...	4
or	0.32	0.63	130	165	115	...	2	...	4
H26[D]	0.63	1.20	130	165	115	...	3	...	4
	1.20	4.00	130	165	115	...	4	...	4
H18[D]	0.15	0.32	150	...	...	...	1	...	...
or	0.32	0.63	150	...	...	...	1	...	...
H28[D]	0.63	1.20	150	...	...	...	2	...	...
	1.20	3.20	150	...	...	...	4	...	...
H112	6.30	12.50	90	...	50	...	9	...	...
	12.50	40.00	85	...	40	...	...	12	...
	40.00	80.00	80	...	30	...	...	18	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 3003				
O	0.15	0.32	95	130	35	...	14	...	0
	0.32	0.63	95	130	35	...	20	...	0
	0.63	1.20	95	130	35	...	22	...	0
	1.20	6.30	95	130	35	...	25	...	0
	6.30	80.00	95	130	35	...	23	21	...
H12[D]	0.40	0.63	120	160	85	...	3	...	0
or	0.63	1.20	120	160	85	...	4	...	0
H22[D]	1.20	6.30	120	160	85	...	6	...	0
	6.30	50.00	120	160	85	...	9	8	...
H14[D]	0.20	0.32	140	180	115	...	1	...	0
or	0.32	0.63	140	180	115	...	2	...	0
H24[D]	0.63	1.20	140	180	115	...	3	...	0
	1.20	3.20	140	180	115	...	5	...	0
	3.20	6.30	140	180	115	...	5	...	2
	6.30	25.00	140	180	115	...	8	7	...
H16[D]	0.15	0.32	165	205	145	...	1	...	4
or	0.32	0.63	165	205	145	...	2	...	4
H26[D]	0.63	1.20	165	205	145	...	3	...	4
	1.20	4.00	165	205	145	...	4	...	6
H18[D]	0.15	0.32	185	...	165	...	1	...	...
or	0.32	0.63	185	...	165	...	1	...	...
H28[D]	0.63	1.20	185	...	165	...	2	...	...
	1.20	3.20	185	...	165	...	4	...	...
H112	6.30	12.50	115	...	70	...	8	...	...
	12.50	40.00	105	...	40	...	...	10	...
	40.00	80.00	100	...	40	...	...	16	...
F[F]	6.30	80.00	...	...	...	...	...	...	...
					Alclad Alloy 3003				
O	0.15	0.32	90	125	30	...	14	...	...
	0.32	0.63	90	125	30	...	20	...	...
	0.63	1.20	90	125	30	...	22	...	...
	1.20	6.30	90	125	30	...	25	...	...
	6.30	12.50	90	125	30	...	23	...	...
	12.50	80.00	95[F]	130[F]	35[F]	...	...	21	...
H12[D]	0.40	0.63	115	155	80	...	4	...	...
or	0.63	1.20	115	155	80	...	5	...	...
H22[D]	1.20	6.30	115	155	80	...	6	...	...
	6.30	12.50	115	155	80	...	9	...	...
	12.50	50.00	120[F]	160[F]	85[F]	...	...	8	...
H14[D]	0.20	0.32	135	175	110	...	1	...	...
or	0.32	0.63	135	175	110	...	2	...	...
H24[D]	0.63	1.20	135	175	110	...	3	...	...
	1.20	6.30	135	175	110	...	5	...	...
	6.30	12.50	135	175	110	...	8	...	...
	12.50	25.00	140[F]	180[F]	115[F]	...	...	7	...

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
H16[D]	0.15	0.32	160	200	140	...	1	...	...
or	0.32	0.63	160	200	140	...	2	...	...
H26[D]	0.63	1.20	160	200	140	...	3	...	...
	1.20	4.00	160	200	140	...	4	...	...
H18	0.15	0.32	180	...	...	...	1	...	...
	0.32	0.63	180	...	...	...	1	...	...
	0.63	1.20	180	...	...	...	2	...	...
	1.20	3.20	180	...	...	...	4	...	...
H112	6.30	12.50	110	...	65	...	8	...	...
	12.50	40.00	105[F]	...	40[F]	...	...	10	...
	40.00	80.00	100[F]	...	40[F]	...	...	16	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 3004				
O	0.15	0.32	150	200	60	...	9	...	0
	0.32	0.63	150	200	60	...	12	...	0
	0.63	1.20	150	200	60	...	15	...	0
	1.20	6.30	150	200	60	...	18	...	0
	6.30	80.00	150	200	60	...	16	14	...
H32[D]	0.40	0.63	190	240	145	...	1	...	0
or	0.63	1.20	190	240	145	...	3	...	1
H22[D]	1.20	3.20	190	240	145	...	5	...	2
	3.20	6.30	190	240	145	...	5	...	...
	6.30	50.00	190	240	145	...	6	5	...
H34[D]	0.20	0.32	220	265	170	...	1	...	2
or	0.32	0.63	220	265	170	...	2	...	2
H24[D]	0.63	1.20	220	265	170	...	3	...	3
	1.20	3.20	220	265	170	...	4	...	4
	3.20	6.30	220	265	170	...	4	...	...
	6.30	25.00	220	265	170	...	5	4	...
H36[D]	0.15	0.32	240	285	190	...	1	...	6
or	0.32	0.63	240	285	190	...	2	...	6
H26[D]	0.63	1.20	240	285	190	...	3	...	6
	1.20	4.00	240	285	190	...	4	...	8
H38[D]	0.15	0.32	260	...	215	...	...	...	...
or	0.32	0.63	260	...	215	...	1	...	...
H28[D]	0.63	1.20	260	...	215	...	2	...	...
	1.20	3.20	260	...	215	...	4	...	...
H112	6.30	12.50	160	...	60	...	7	...	...
	12.50	40.00	160	...	60	...	...	6	...
	40.00	80.00	160	...	60	...	...	6	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alclad Alloy 3004				
O	0.15	0.32	145	195	55	...	9	...	...
	0.32	0.63	145	195	55	...	12	...	...
	0.63	1.20	145	195	55	...	15	...	...
	1.20	6.30	145	195	55	...	18	...	...
	6.30	12.50	145	195	55	...	16	...	...
	12.50	80.00	150[F]	200[F]	60[F]	...	...	14	...
H32[D]	0.40	0.63	185	235	140	...	1	...	...
or	0.63	1.20	185	235	140	...	3	...	...
H22[D]	1.20	6.30	185	235	140	...	5	...	...
	6.30	12.50	185	235	140	...	6	...	...
	12.50	50.00	190[F]	240[F]	145[F]	...	...	5	...
H34[D]	0.20	0.32	215	260	165	...	1	...	...
or	0.32	0.63	215	260	165	...	2	...	...
H24[D]	0.63	1.20	215	260	165	...	3	...	...
	1.20	6.30	215	260	165	...	4	...	...

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
	6.30	12.50	215	260	165	...	5	...	...
	12.50	25.00	220[F]	265[F]	170[F]	...	...	4	...
H36[D]	0.15	0.32	235	280	185	...	1	...	...
or	0.32	0.63	235	280	185	...	2	...	...
H26[D]	0.63	1.20	235	280	185	...	3	...	...
	1.20	4.00	235	280	185	...	4	...	...
H38	0.15	0.32	255	...	...	...	...	...	...
	0.32	0.63	255	...	...	...	1	...	...
	0.63	1.20	255	...	...	...	2	...	...
	1.20	3.20	255	...	...	...	4	...	...
H112	6.30	12.50	155	....	55	...	7	...	...
	12.50	40.00	160[F]	...	60[F]	...	...	6	...
	40.00	80.00	160[F]	...	60[F]	...	...	6	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 3005				
O	0.15	0.32	115	165	45	...	10	...	...
	0.32	0.63	115	165	45	...	14	...	...
	0.63	1.20	115	165	45	...	17	...	...
	1.20	6.30	115	165	45	...	20	...	...
H12	0.40	0.63	140	190	115	...	1	...	...
	0.63	1.20	140	190	115	...	2	...	
	1.20	6.30	140	190	115	...	3	...	
H14	0.20	0.32	165	215	145	...	1	...	...
	0.32	0.63	165	215	145	...	1	...	...
	0.63	1.20	165	215	145	...	2	...	...
	1.20	6.30	165	215	145	...	3	...	...
H16	0.15	0.32	190	240	170	...	1	...	...
	0.32	0.63	190	240	170	...	1	...	...
	0.63	1.20	190	240	170	...	2	...	...
	1.20	4.00	190	240	170	...	2	...	...
H18	0.15	0.32	220	...	200	...	1	...	...
	0.32	0.63	220	...	200	...	1	...	...
	0.63	1.20	220	...	200	...	2	...	...
	1.20	3.20	220	...	200	...	2	...	...
H19	0.15	0.32	235	...	...	...	...	...	...
	0.32	0.63	235	...	...	...	1	...	...
	0.63	1.20	235	...	...	...	1	...	...
	1.20	1.60	235	...	...	...	1	...	...
H25	0.15	0.32	180	235	150	...	1	...	...
	0.32	0.63	180	235	150	...	2	...	...
	0.63	1.20	180	235	150	...	3	...	...
	1.20	2.00	180	235	150	...	4	...	...
H27	0.15	0.32	205	260	175	...	1	...	...
	0.32	0.63	205	260	175	...	2	...	...
	0.63	1.20	205	260	175	...	3	...	...
	1.20	2.00	205	260	175	...	4	...	...
H28	0.15	0.32	215	...	185	...	1	...	...
	0.32	0.63	215	...	185	...	2	...	...
	0.63	1.20	215	...	185	...	3	...	...
	1.20	2.00	215	...	185	...	4	...	...
H29	0.63	1.20	230	...	195	...	1	...	...
	1.20	2.00	230	...	195	...	2	...	...
					Alloy 3105				
O	0.32	0.63	95	145	35	.....	16	...	...
	0.63	1.20	95	145	35	...	19	...	...
	1.20	2.00	95	145	35	...	20	...	...

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
H12	0.40	0.63	130	180	105	...	1	...	...
	0.63	1.20	130	180	105	...	2	...	...
	1.20	2.00	130	180	105	...	3	...	...
H14	0.32	0.63	150	200	125	...	1	....	...
	0.63	1.20	150	200	125	...	2	...	...
	1.20	2.00	150	200	125	...	2	...	...
H16	0.32	0.63	170	220	145	...	1	...	...
	0.63	1.20	170	220	145	...	1	...	...
	1.20	2.00	170	220	145	...	2	...	...
H18	0.32	0.63	190	...	165	...	1	...	...
	0.63	1.20	190	...	165	...	1	...	...
	1.20	2.00	190	...	165	...	2	...	...
H22	0.32	0.50	130	...	105	...	3	...	...
	0.50	0.80	130	...	105	...	4	...	...
	0.80	1.20	130	...	105	...	5	...	...
	1.20	2.00	130	...	105	...	6	...	...
H24	0.32	0.50	150	...	125	...	2	...	...
	0.50	0.80	150	...	125	...	3	...	...
	0.80	1.20	150	...	125	...	4	...	...
	1.20	2.00	150	...	125	...	6	...	...
H25	0.32	0.63	160	...	130	...	2	...	...
	0.63	1.20	160	...	130	...	4	...	...
	1.20	2.00	1.60	...	130	...	6	...	...
H26	0.32	0.80	170	...	145	...	3	...	...
	0.80	1.20	170	...	145	...	4	...	...
	1.20	2.00	170	...	145	...	5	...	...
H28	0.32	0.80	190	...	165	...	2	...	...
	0.80	1.20	190	...	165	...	3	...	...
	1.20	2.00	190	...	165	...	4	...	...
					Alloy 5005				
O	0.15	0.32	105	145	35	...	12	...	...
	0.32	0.63	105	145	35	...	16	...	...
	0.63	1.20	105	145	35	...	19	...	...
	1.20	6.30	105	145	35	...	21	...	...
	6.30	80.00	105	145	35	...	22	20	...
H12	0.40	0.63	125	165	95	...	2	...	...
	0.63	1.20	125	165	95	...	4	...	...
	1.20	6.30	125	165	95	...	6	...	...
	6.30	50.00	125	165	95	...	9	8	...
H14	0.20	0.32	145	185	115	...	1	...	...
	0.32	0.63	145	185	115	...	1	...	...
	0.63	1.20	145	185	115	...	2	...	...
	1.20	6.30	145	185	115	...	3	...	...
	6.30	25.00	145	185	115	...	8	7	...
H16	0.15	0.32	165	205	135	...	1	...	...
	0.32	0.63	165	205	135	...	1	...	...
	0.63	1.20	165	205	135	...	2	...	...
	1.20	4.00	165	205	135	...	3	...	...
H18	0.15	0.32	185	...	...	...	1	...	...
	0.32	0.63	185	...	...	...	1	...	...
	0.63	1.20	185	...	...	...	2	...	...
	1.20	3.20	185	...	...	...	3	...	...
H32[D]	0.40	0.63	120	160	85	...	3	...	...
or	0.63	1.20	120	160	85	...	4	...	...
H22[D]	1.20	6.30	120	160	85	...	7	...	...

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
	6.30	50.00	120	160	85	...	10	9	...
H34[D]	0.20	0.32	140	180	105	...	2	...	...
or	0.32	0.63	140	180	105	...	3	...	...
H24[D]	0.63	1.20	140	180	105	...	4	...	...
	1.20	6.30	140	180	105	...	5	...	...
	6.30	25.00	140	180	105	...	8	7	...
H36[D]	0.15	0.32	160	200	125	...	1	...	...
or	0.32	0.63	160	200	125	...	2	...	...
H26[D]	0.63	1.20	160	200	125	...	3	...	...
	1.20	4.00	160	200	125	...	4	...	...
H38	0.15	0.32	180	...	...	...	1	...	...
	0.32	0.63	180	...	...	...	2	...	...
	0.63	1.20	180	...	...	...	3	...	...
	1.20	3.20	180	...	...	...	4	...	...
H112	6.30	12.50	115	...	...	...	8	...	...
	12.50	40.00	105	...	...	...	...	10	...
	40.00	80.00	100	...	...	...	...	16	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 5010				
O	0.25	18.00	105	145	35	...	3	...	...
H22	0.25	18.00	120	160	95	...	2	...	...
H24	0.25	18.00	140	180	120	...	1	...	...
H26	0.25	18.00	160	200	145	...	1	...	...
H28	0.25	18.00	180	...	...	...	...	...	...
					Alloy 5050				
O	0.15	0.32	125	165	40	...	15	...	0
	0.32	0.63	125	165	40	...	17	...	0
	0.63	1.20	125	165	40	...	19	...	0
	1.20	6.30	125	165	40	...	20	...	0
	6.30	80.00	125	165	40	...	20	18	2
H32[D]	0.40	0.63	150	195	110	...	4	...	1
or	0.63	1.20	150	195	110	...	5	...	1
H22[D]	1.20	6.30	150	195	110	...	6	...	2
H34[D]	0.20	0.32	170	215	140	...	3	...	1
or	0.32	0.63	170	215	140	...	3	...	1
H24[D]	0.63	1.20	170	215	140	...	4	...	1
	1.20	6.30	170	215	140	...	5	...	3
H36[D]	0.15	0.32	185	230	150	...	2	...	3
or	0.32	0.63	185	230	150	...	2	...	3
H26[D]	0.63	1.20	185	230	150	...	3	...	3
	1.20	4.00	185	230	150	...	4	...	4
H38	0.15	0.32	200	...	...	...	1	...	...
	0.32	0.63	200	...	...	...	2	...	...
	0.63	1.20	200	...	...	...	3	...	...
	1.20	3.20	200	...	...	...	4	...	...
H112	6.30	12.50	140	...	55	...	12	...	...
	12.50	40.00	140	...	55	...	...	10	...
	40.00	80.00	140	...	55	...	...	10	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 5052				
O	0.15	0.32	170	215	65	...	13	...	0
	0.32	0.63	170	215	65	...	15	...	0
	0.63	1.20	170	215	65	...	17	...	0

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
	1.20	6.30	170	215	65	...	19	...	0
	6.30	80.00	170	215	65	...	18	16	...
H32[D]	0.40	0.63	215	265	160	...	4	...	0
or	0.63	1.20	215	265	160	...	5	...	1
H22[D]	1.20	3.20	215	265	160	...	7	...	2
	3.20	6.30	215	265	160	...	7	...	3
	6.30	50.00	215	265	160	...	11	10	...
H34[D]	0.20	0.32	235	285	180	...	3	...	1
or	0.32	0.63	235	285	180	...	3	...	1
H24[D]	0.63	1.20	235	285	180	...	4	...	2
	1.20	3.20	235	285	180	...	6	...	3
	3.20	6.30	235	285	180	...	6	...	4
	6.30	25.00	235	285	180	...	10	9	...
H36[D]	0.15	0.32	255	305	200	...	2	...	4
or	0.32	0.63	255	305	200	...	3	...	4
H26[D]	0.63	1.20	255	305	200	...	4	...	5
	1.20	4.00	255	305	200	...	4	...	5
H38[D]	0.15	0.32	270	...	220	...	2	...	...
or	0.32	0.63	270	...	220	...	3	...	...
H28[D]	0.63	1.20	270	...	220	...	4	...	...
	1.20	3.20	270	...	220	...	4	...	...
	~~6.30~~	~~12.50~~	~~190~~	~~...~~	~~110~~	~~...~~	~~7~~	~~...~~	~~...~~
H112	6.30	12.50	190	...	110	...	7	...	...
	12.50	40.00	170	...	65	...	...	10	...
	40.00	80.00	170	...	65	...	...	14	...
H322	0.50	1.20	215	240	145	...	5	...	...
	1.20	2.90	215	240	145	...	7	...	...
	2.90	3.20	215	240	145	...	9	...	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 5059				
O	1.99	6.30	330	...	160	...	24	...	...
	6.30	12.50	330	...	160	...	24	...	...
	12.50	20.00	330	...	160	...	...	24	...
	20.00	40.00	330	...	160	...	...	20	...
	40.00	180.00	330	...	145	...	...	17	...
H111	1.99	6.30	330	...	160	...	24	...	...
	6.30	12.50	330	...	160	...	24	...	...
	12.50	20.00	330	...	160	...	...	24	...
	20.00	40.00	330	...	160	...	...	20	...
	40.00	180.00	300	...	145	...	...	17	...
F[E]	6.30	200.00	...	...	...	...	...	...	...
					Alloy 5083				
O	1.25	6.30	275	350	125	200	16	...	...
	6.30	80.00	270	345	115	200	16	14	...
	80.00	120.00	260	...	110	...	...	12	...
	120.00	160.00	255	...	105	...	...	12	...
	160.00	200.00	250	...	100	...	...	10	...
H112	6.30	12.50	275	...	125	...	12	...	...
	12.50	40.00	275	...	125	...	...	10	...
	40.00	80.00	270	...	115	...	...	10	...
H32	3.20	5.00	305	385	215	295	10	...	...
~~H321~~	~~4.00~~	~~12.50~~	~~305~~	~~385~~	~~215~~	~~295~~	~~12~~	~~...~~	~~...~~
	5.00	12.50	305	385	215	295	12	...	...
	12.50	40.00	305	385	215	295	...	10	...
	40.00	80.00	285	385	200	295	...	10	...
~~H116[G]~~	~~1.60~~	~~12.50~~	~~305~~	~~...~~	~~215~~	~~...~~	~~10~~	~~...~~	~~...~~
	~~12.50~~	~~30.00~~	~~305~~	~~...~~	~~215~~	~~...~~	~~...~~	~~10~~	~~...~~

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
	~~30.00~~	~~40.00~~	~~305~~	...	~~215~~	...	...	~~10~~	...
	~~40.00~~	~~80.00~~	~~285~~	...	~~200~~	...		~~10~~	...
F[E]	6.30	200.00	...	...	...	...	...	...	...
					Alloy 5086				
O	0.50	0.63	240	305	95	...	15	...	...
	0.63	1.20	240	305	95	...	16	...	...
	1.20	6.30	240	305	95	...	18	...	...
	6.30	50.00	240	305	95	...	16	14	...
H32[D]	0.50	0.63	275	325	195	...	6	...	...
or	0.63	1.20	275	325	195	...	6	...	...
H22[D]	1.20	6.30	275	325	195	...	8	...	...
	6.30	50.00	275	325	195	...	12	10	...
H34[D]	0.20	0.32	300	350	235	...	4	...	...
or	0.32	0.63	300	350	235	...	4	...	...
H24[D]	0.63	1.20	300	350	235	...	5	...	...
	1.20	6.30	300	350	235	...	6	...	...
	6.30	25.00	300	350	235	...	10	9	...
H36[D]	0.15	0.32	325	375	260	...	3	...	...
or	0.32	0.63	325	375	260	...	3	...	...
H26[D]	0.63	1.20	325	375	260	...	4	...	...
	1.20	4.00	325	375	260	...	6	...	...
H38[D] or H28[D]	0.15	0.63	345	...	285	...	3	...	...
H112	4.00	12.50	250	...	125	...	8	...	...
	12.50	40.00	240	...	105	...	...	9	...
	40.00	80.00	235	...	95	...	...	12	...
~~H116[G]~~	~~1.60~~	~~6.30~~	~~275~~	...	~~195~~	...	~~8~~	...	...
									...
	~~6.30~~	~~12.50~~	~~275~~	...	~~195~~	...	~~10~~	...	...
	~~12.50~~	~~30.00~~	~~275~~	...	~~195~~	...	...	~~9~~	...
	~~30.00~~	~~50.00~~	~~275~~	...	~~195~~	...	...	~~9~~	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 5154				
O	0.50	0.63	205	285	75	...	12	...	...
	0.63	1.20	205	285	75	...	13	...	...
	1.20	6.30	205	285	75	...	16	...	...
	6.30	80.00	205	285	75	...	18	16	...
H32[D]	0.50	0.63	250	300	180	...	5	...	...
or	0.63	1.20	250	300	180	...	6	...	...
H22[D]	1.20	6.30	250	300	180	...	8	...	...
	6.30	50.00	250	300	180	...	12	10	...
H34[D]	0.20	0.32	270	320	200	...	4	...	...
or	0.32	0.63	270	320	200	...	4	...	...
H24[D]	0.63	1.20	270	320	200	...	5	...	...
	1.20	6.30	270	320	200	...	6	...	...
	6.30	25.00	270	320	200	...	10	9	...
H36[D]	0.15	0.32	290	340	220	...	3	...	...
or	0.32	0.63	290	340	220	...	3	...	...
H26[D]	0.63	1.20	290	340	220	...	4	...	...
	1.20	4.00	290	340	220	...	4	...	...
H38[D]	0.15	0.32	310	...	240	...	3	...	...
or	0.32	0.63	310	...	240	...	3	...	...
H28[D]	0.63	1.20	310	...	240	...	3	...	...
	1.20	3.20	310	...	240	...	4	...	...
H112	6.30	12.50	220	...	125	...	8	...	...
	12.50	40.00	210	...	90	...	...	9	...
	40.00	80.00	205	...	75	...	...	13	...

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter ($5.65\sqrt{A}$)	
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 5252				
H24	0.63	2.50	205	260	...	...	10	...	...
H25	0.63	2.50	215	270	...	...	9	...	...
H28	0.63	2.50	260	...	...	...	3	...	...
					Alloy 5254				
O	0.50	0.63	205	285	75	...	12	...	...
	0.63	1.20	205	285	75	...	13	...	...
	1.20	6.30	205	285	75	...	16	...	...
	6.30	80.00	205	285	75	...	18	16	...
H32[D]	0.50	0.63	250	300	180	...	5	...	...
or	0.63	1.20	250	300	180	...	6	...	...
H22[D]	1.20	6.30	250	300	180	...	8	...	...
	6.30	50.00	250	300	180	...	12	10	...
H34[D]	0.20	0.32	270	320	200	...	4	...	...
or	0.32	0.63	270	320	200	...	4	...	...
H24[D]	0.63	1.20	270	320	200	...	5	...	...
	1.20	6.30	270	320	200	...	6	...	...
	6.30	25.00	270	320	200	...	10	9	...
H36[D]	0.15	0.32	290	340	220	...	3	...	...
or	0.32	0.63	290	340	220	...	3	...	...
H26[D]	0.63	1.20	290	340	220	...	4	...	...
	1.20	4.00	290	340	220	...	4	...	...
H38[D]	0.15	0.32	310	...	240	...	3	...	...
or	0.32	0.63	310	...	240	...	3	...	...
H28[D]	0.63	1.20	310	...	240	...	3	...	...
	1.20	3.20	310	...	240	...	4	...	...
H112	6.30	12.50	220	...	125	...	8	...	...
	12.50	40.00	210	...	90	...	...	9	...
	40.00	80.00	205	...	75	...	...	13	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 5454				
O	0.50	0.63	215	285	85	...	12	...	...
	0.63	1.20	215	285	85	...	13	...	...
	1.20	6.30	215	285	85	...	16	...	...
	6.30	80.00	215	285	85	...	18	16	...
H32[D]	0.50	0.63	250	305	180	...	5	...	...
or	0.63	1.20	250	305	180	...	6	...	...
H22[D]	1.20	6.30	250	305	180	...	8	...	...
	6.30	50.00	250	305	180	...	12	10	...
H34[D]	0.50	0.63	270	325	200	...	4	...	...
or	0.63	1.20	270	325	200	...	5	...	...
H24[D]	1.20	6.30	270	325	200	...	6	...	...
	6.30	25.00	270	325	200	...	10	9	...
H112	6.30	12.50	220	...	125	...	8	...	...
	12.50	40.00	215	...	85	...	...	9	...
	40.00	80.00	215	...	85	...	...	13	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
					Alloy 5754				
O	0.75	1.40	200	270	80	...	17	...	...
	1.40	2.20	200	270	80	...	18	...	...
	2.20	3.50	200	270	80	...	19	...	...
					Alloy 5456				

TABLE 2 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]		Bend Diameter Factor, *N*
	over	through	min	max	min	max	in 50 mm	in 5× Diameter (5.65 $\sqrt{A}$)	
O	1.25	6.30	290	365	130	205	16	...	...
O	1.20	6.30	290	365	130	205	16	...	...
	6.30	80.00	285	360	125	205	16	14	...
	80.00	120.00	275	...	120	...	...	12	...
	120.00	160.00	270	...	115	...	...	12	...
	160.00	200.00	265	...	105	...	...	10	...
H112	6.30	12.50	290	...	130	...	12	...	...
	12.50	40.00	290	...	130	...	...	10	...
	40.00	80.00	285	...	125	...	...	10	...
~~H116[G]~~	~~1.60~~	~~12.50~~	~~315~~	~~...~~	~~230~~	~~...~~	~~10~~	~~...~~	~~...~~
H32	~~1.60~~	~~12.50~~	~~315~~	~~...~~	~~230~~	~~...~~	~~10~~	~~...~~	~~...~~
	~~12.50~~	~~30.00~~	~~315~~	~~...~~	~~230~~	~~...~~	~~...~~	~~10~~	~~...~~
	~~30.00~~	~~40.00~~	~~305~~	~~...~~	~~215~~	~~...~~	~~...~~	~~10~~	~~...~~
	~~40.00~~	~~80.00~~	~~285~~	~~...~~	~~200~~	~~...~~	~~...~~	~~10~~	~~...~~
	~~80.00~~	~~110.00~~	~~275~~	~~...~~	~~170~~	~~...~~	~~...~~	~~10~~	~~...~~
~~H321~~	4.00	12.50	315	405	230	315	12	...	....
	12.50	40.00	305	385	215	305	...	10	...
	40.00	80.00	285	370	200	295	...	10	...
F[E]	6.30	200.00	...	...	...	...	...	...	...
Alloy 5457									
O	0.63	2.50	110	150	...	...	20	...	...
Alloy 5652									
O	1.20	6.30	170	215	65	...	19	...	0
	6.30	80.00	170	215	65	...	18	16	...
H32[D]	1.20	3.20	215	265	160	...	7	...	2
or	3.20	6.30	215	265	160	...	7	...	3
H22[D]	6.30	50.00	215	265	160	...	11	10	...
H34[D]	1.20	3.20	235	285	180	...	6	...	3
or	3.20	6.30	235	285	180	...	6	...	4
H24[D]	6.30	25.00	235	285	180	...	10	9	...
H112	6.30	12.50	190	...	110	...	7	...	...
	12.50	40.00	170	...	65	...	...	10	...
	40.00	80.00	170	...	65	...	...	14	...
F[E]	6.30	80.00	...	...	...	...	...	...	...
Alloy 5657									
~~H241[H]~~	~~0.63~~	~~2.50~~	~~125~~	~~180~~	~~...~~	~~...~~	~~13~~	~~...~~	~~...~~
H241[G]	0.63	2.50	125	180	...	...	13	...	...
H25	0.63	2.50	140	195	...	...	8	...	...
H26	0.63	2.50	150	205	...	...	7	...	...
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 E 29.

[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 (5.65 $\sqrt{A}$) for thicknesses over 12.50 mm where *A* is the cross-sectional area of the specimen.

[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] ~~The H116 temper designation now also applies to products previously designated H117.~~

[H] ~~This~~ This material is subject to some recrystallization and an attendant loss of brightness.

TABLE 3 Tensile Property Limits for Heat-Treatable Alloys[A,B]

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 (5.65 $\sqrt{A}$)
				Alloy 2014				
O	0.50	12.50	...	220	...	110	16	...
	12.50	25.00	...	220	...	...	...	9
T3	0.50	1.00	405	...	240	...	14	...
	1.00	6.30	405	...	250	...	14	...
T4[D]	0.50	6.30	405	...	240	...	14	...
T451[E]	6.30	12.50	400	...	250	...	14	...
	12.50	25.00	400	...	250	...	...	12
	25.00	50.00	400	...	250	...	...	10
	50.00	80.00	395	...	250	...	...	7
T42[F]	0.50	12.50	400	...	235	...	14	...
	12.50	25.00	400	...	235	...	...	12
T6, T62[F]	0.50	1.00	440	...	395	...	6	...
	1.00	6.30	455	...	400	...	7	...
T6[F], T651[E]	6.30	12.50	460	...	405	...	7	...
	12.50	25.00	460	...	405	...	...	5
	25.00	50.00	460	...	405	...	...	3
	50.00	60.00	450	...	400	...	...	1
	60.00	80.00	435	...	395	...	...	1
	80.00	100.00	405	...	380	...	...	...
F[G]	6.30	25.00	...	...	...	...	...	...
				Alclad Alloy 2014				
O	0.50	0.63	...	205	...	95	16	...
	0.63	1.00	...	205	...	95	16	...
	1.00	2.50	...	205	...	95	16	...
	2.50	12.50	...	205	...	95	16	...
	12.50	25.00	...	220[H]	...	...	...	9
T3	0.50	0.63	370	...	230	...	14	...
	0.63	1.00	380	...	235	...	14	...
	1.00	2.50	395	...	240	...	15	...
	2.50	6.30	395	...	240	...	15	...
T4[E]	0.50	0.63	370	...	215	...	14	...
	0.63	1.00	380	...	220	...	14	...
	1.00	2.50	395	...	235	...	15	...
	2.50	6.30	395	...	235	...	15	...
T451[E]	6.30	12.50	395	...	250	...	15	...
	12.50	25.00	400[H]	...	250[H]	...	...	12
	25.00	50.00	400[H]	...	250[H]	...	...	10
	50.00	80.00	395[H]	...	250[H]	...	...	7
T42[F]	0.50	0.63	370	...	215	...	14	...
	0.63	1.00	380	...	220	...	14	...
	1.00	2.50	395	...	235	...	15	...
	2.50	12.50	395	...	235	...	15	...
	12.50	25.00	400[H]	...	235[H]	...	...	12
T6, T62[F]	0.50	0.63	425	...	370	...	7	...
	0.63	1.00	435	...	380	...	7	...
	1.00	2.50	440	...	395	...	8	...
	2.50	6.30	440	...	395	...	8	...
T62[F], T651[E]	6.30	12.50	440	...	395	...	8	...
	12.50	25.00	460[H]	...	405[H]	...	...	5
	25.00	50.00	460[H]	...	40[H]	...	...	3
	50.00	60.00	450[H]	...	400[H]	...	...	1
	60.00	80.00	435[H]	...	395[H]	...	...	1
	80.00	100.00	405[H]	...	380[H]	...	...	...
F[G]	6.30	25.00	...	...	...	...	...	...

TABLE 3 *Continued*

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 (5.65 $\sqrt{A}$)
				Alloy 2024				
O	0.24	12.50	...	220	...	95	12	...
	12.50	45.00	...	220	...	...	...	10
T3	0.19	0.25	435	...	290	...	10	...
	0.25	0.50	435	...	290	...	12	...
	0.50	3.20	435	...	290	...	15	...
	3.20	6.30	435	...	290	...	15	...
T351[E]	6.30	12.50	440	...	290	...	12	...
	12.50	25.00	435	...	290	...	...	7
	25.00	40.00	425	...	290	...	...	6
	40.00	50.00	425	...	290	...	...	5
	50.00	80.00	415	...	290	...	...	3
	80.00	100.00	395	...	285	...	...	3
T361	0.50	1.60	460	...	345	...	8	...
	1.60	6.30	470	...	350	...	9	...
	6.30	12.50	455	...	340	...	9	...
	12.50	12.70	455	...	340	...	...	9
T4[D]	0.24	0.50	425	...	275	...	12	...
	0.50	6.30	425	...	275	...	15	...
T42[F]	0.24	0.50	425	...	260	...	12	...
	0.50	6.30	425	...	260	...	15	...
	6.30	12.50	425	...	260	...	12	...
	12.50	25.00	420	...	260	...	...	7
	25.00	40.00	415	...	260	...	...	6
	40.00	50.00	415	...	260	...	...	5
	50.00	80.00	400	...	260	...	...	3
T62[F]	0.24	12.50	440	...	345	...	5	...
	12.50	80.00	435	...	345	...	...	4
T72[F,I]	0.24	6.30	415	...	315	...	5	...
T81	0.24	6.30	460	...	400	...	5	...
T851[E]	6.30	12.50	460	...	400	....	5	...
	12.50	25.00	455	...	400	...	...	4
	25.00	40.00	455	...	395	...	...	4
T861	0.50	1.60	480	...	425	...	3	...
	1.60	6.30	490	...	455	...	4	...
	6.30	12.50	480	...	440	...	4	...
	12.50	12.70	480	...	440	...	...	3
F[G]	6.30	80.00	...	...	...	...	...	...
				Alclad Alloy 2024				
O	0.19	0.25	...	205	...	95	10	...
	0.25	1.60	...	205	...	95	12	...
	1.60	12.50	...	220	...	95	12	...
	12.50	45.00	...	220[H]	...	...	...	10
T3	0.19	0.25	400	...	270	...	10	...
	0.25	0.50	405	...	270	...	12	...
	0.50	1.60	405	...	270	...	15	...
	1.60	3.20	420	...	275	...	15	...
	3.20	6.30	420	...	275	...	15	...
T351[E]	6.30	12.50	425	...	275	...	12	...
	12.50	25.00	435[H]	...	290[H]	...	...	7
	25.00	40.00	425[H]	...	290[H]	...	...	6
	40.00	50.00	425[H]	...	290[H]	...	...	5
	50.00	80.00	415[H]	...	290[H]	...	...	3
	80.00	100.00	395[H]	...	285[H]	...	...	3
T361	0.50	1.60	420	...	325	...	8	...
	1.60	6.30	440	...	330	...	9	...

TABLE 3 *Continued*

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 ($5.65\sqrt{A}$)
	6.30	12.50	440	...	330	...	9	...
	12.50	12.70	455[H]	...	340[H]	...	...	9
T4[D]	0.24	0.50	400	...	245	...	12	...
	0.50	1.60	400	...	245	...	15	...
	1.60	3.20	420	...	260	...	15	...
T42[F]	0.19	0.25	380	...	235	...	10	...
	0.25	0.50	395	...	235	...	12	...
	0.50	1.60	395	...	235	...	15	...
	1.60	6.30	415	...	250	...	15	...
	6.30	12.50	415	...	250	...	12	...
	12.50	25.00	420[H]	...	260[H]	...	...	7
	25.00	40.00	415[H]	...	260[H]	...	...	6
	40.00	50.00	415[H]	...	260[H]	...	...	5
	50.00	80.00	400[H]	...	260[H]	...	...	3
T62[F]	0.24	1.60	415	...	325	...	5	...
	1.60	12.50	425	...	335	...	5	...
T72[F,I]	0.24	1.60	385	...	295	...	5	...
	1.60	6.30	400	...	310	...	5	...
T81	0.24	1.60	425	...	370	...	5	...
	1.60	6.30	445	...	385	...	5	...
T851[E]	6.30	12.50	445	...	385	...	5	...
	12.50	25.00	455[H]	...	400[H]	...	...	4
T861	0.50	1.60	440	...	400	...	3	...
	1.60	6.30	475	...	440	...	4	...
	6.30	12.50	470	...	425	...	4	...
	12.50	12.70	480[H]	...	440[H]	...	...	3
F[G]	6.30	80.00	...	...	...	...	...	...
			1½ % Alclad Alloy 2024					
O	4.00	12.50	...	220	...	95	12	...
	12.50	45.00	...	220[H]	...	...	...	10
T3	4.00	6.30	430	...	285	...	15	...
T351[E]	6.30	12.50	435	...	285	...	12	...
	12.50	25.00	435[H]	...	290[H]	...	...	7
	25.00	40.00	425[H]	...	290[H]	...	...	6
	40.00	50.00	425[H]	...	290[H]	...	...	5
	50.00	80.00	415[H]	...	290[H]	...	...	3
	80.00	100.00	395[H]	...	285[H]	...	...	3
T361	4.00	6.30	450	...	340	...	9	...
	6.30	12.50	450	...	330	...	9	...
	12.50	12.70	455[H]	...	340[H]	...	...	9
T42[F]	4.00	6.30	420	...	255	...	15	...
	6.30	12.50	420	...	255	...	12	...
	12.50	25.00	420[H]	...	260[H]	...	...	7
	25.00	40.00	415[H]	...	260[H]	...	...	6
	40.00	50.00	415[H]	...	260[H]	...	...	5
	50.00	80.00	400[H]	...	260[H]	...	...	3
T62[F]	4.00	12.50	425	...	340	...	5	...
T72[F,I]	4.00	6.30	405	...	310	...	5	...
T81	4.00	6.30	455	...	395	...	5	...
T851[E]	6.30	12.50	455	...	395	...	5	...
	12.50	25.00	455[H]	...	400[H]	...	...	4
T861	4.00	6.30	480	...	450	...	4	...
	6.30	12.50	475	...	435	...	4	...

TABLE 3 *Continued*

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 ($5.65\sqrt{A}$)
	12.50	12.70	480[H]	...	440[H]	...	...	3
F[G]	6.30	80.00	...	...	...	...	...	...
			Alclad One Side Alloy 2024					
O	0.19	0.25	...	215	...	95	10	...
	0.25	1.60	...	215	...	95	12	...
	1.60	12.50	...	220	...	95	12	...
T3	0.24	0.50	420	...	275	...	12	...
	0.50	1.60	420	...	275	...	15	...
	1.60	3.20	425	...	285	...	15	...
	3.20	6.30	430	...	285	...	15	...
T351[E]	6.30	12.50	435	...	285	...	12	...
T361	0.50	1.00	440	...	330	...	8	...
	1.60	6.30	455	...	340	...	9	...
	6.30	12.50	450	...	330	...	9	...
T42[F]	0.24	0.50	405	...	240	...	12	...
	0.50	1.60	405	...	250	...	15	...
	1.60	6.30	420	...	255	...	15	...
	6.30	12.50	420	...	255	...	12	...
T62[F]	0.24	1.60	425	...	330	...	5	....
	1.60	12.50	435	...	340	...	5	...
T72[F,I]	0.24	1.60	400	...	305	...	5	...
	1.60	6.30	405	...	310	...	5	...
T81	0.24	1.60	440	...	385	...	5	...
	1.60	6.30	455	...	395	...	5	...
T851[E]	6.30	12.50	455	...	395	...	5	...
T861	0.50	1.60	460	...	415	...	3	...
	1.60	6.30	485	...	450	...	4	...
	6.30	12.50	475	...	435	...	4	...
F[G]	6.30	12.50	...	...	...	...	...	...

TABLE 3 *Continued*

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 (5.65 $\sqrt{A}$)
			1½ % Alclad One Side Alloy 2024					
O	4.00	12.50	...	220	...	95	12	...
T3	4.00	6.30	430	...	285	...	15	...
T351[E]	6.30	12.50	435	...	285	...	12	...
T361	4.00	6.30	455	...	340	...	9	...
	6.30	12.50	450		330		9	...
T42[F]	4.00	6.30	420	...	255	...	15	...
	6.30	12.50	420	...	255	...	12	...
T62[F]	4.00	12.50	435	...	340	...	5	...
T72[F,I]	4.00	6.30	405	...	310	...	5	...
T81	4.00	6.30	455	...	395	...	5	...
T851[E]	6.30	12.50	455	...	395	...	5	...
T861	4.00	6.30	480	...	450	...	4	...
	6.30	12.50	475	...	435	...	4	...
F[G]	6.30	12.50	...	...	...	...	...	...

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 5× Diameter (5.65 $\sqrt{A}$)
			Alloy 2124						
~~T851[E]~~	~~25.00~~	~~50.00~~	~~Longitudinal~~	~~455~~	...	~~395~~	...	...	~~5~~
T851[E]	25.00	50.00	longitudinal	455	...	395	...	...	5
			~~Long Transverse~~	~~455~~	...	~~395~~	...	...	~~4~~
			long transverse	455	...	395	...	...	4
			~~Short Transverse~~	~~440[J]~~	...	~~380[J]~~	...	...	~~1~~
			short transverse	440[J]	...	380[J]	...	...	1
	~~50.00~~	~~80.00~~	~~Longitudinal~~	~~450~~	...	~~395~~	...	...	~~5~~
	50.00	80.00	longitudinal	450	...	395	...	...	5
			~~Long Transverse~~	~~450~~	...	~~395~~	...	...	~~4~~
			long transverse	450	...	395	...	...	4
			~~Short Transverse~~	~~435~~	...	~~380~~	...	...	~~1~~
			short transverse	435	...	380	...	...	1
	~~80.00~~	~~100.00~~	~~Longitudinal~~	~~450~~	...	~~385~~	...	...	~~4~~
	80.00	100.00	longitudinal	450	...	385	...	...	4
			~~Long Transverse~~	~~450~~	...	~~385~~	...	...	~~3~~
			long transverse	450	...	385	...	...	3
			~~Short Transverse~~	~~425~~	...	~~370~~	...	...	~~1~~
			short transverse	425	...	370	...	...	1
	~~100.00~~	~~130.00~~	~~Longitudinal~~	~~440~~	...	~~380~~	...	...	~~4~~
	100.00	130.00	longitudinal	440	...	380	...	...	4
			~~Long Transverse~~	~~440~~	...	~~380~~	...	...	~~3~~
			long transverse	440	...	380	...	...	3
			~~Short Transverse~~	~~420~~	...	~~365~~	...	...	~~1~~
			short transverse	420	...	365	...	...	1
	~~130.00~~	~~150.00~~	~~Longitudinal~~	~~435~~	...	~~370~~	...	...	~~4~~
	130.00	150.00	longitudinal	435	...	370	...	...	4
			~~Long Transverse~~	~~435~~	...	~~370~~	...	...	~~3~~
			long transverse	435	...	370	...	...	3
			~~Short Transverse~~	~~400~~	...	~~350~~	...	...	~~1~~
			short transverse	400	...	350	...	...	1

TABLE 3 *Continued*

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 (5.65 $\sqrt{A}$)
				Alloy 2219				
O	0.50	12.50	...	220	...	110	12	...
	12.50	50.00	...	220	...	110	...	10
T31[K] (flat sheet)	0.50	1.00	315	...	200	...	8	...
	1.00	6.30	315	...	195	...	10	...
T351[E,H] plate (formerly T31 plate)	6.30	12.50	315	...	195	...	10	...
	12.50	50.00	315	...	195	...	...	9
	50.00	80.00	305	...	195	...	...	9
	80.00	100.00	290	...	185	...	...	8
	100.00	130.00	275	...	180	...	...	8
	130.00	150.00	270	...	170	...	...	7
T37[K]	0.50	1.00	340	...	260	...	6	...
	1.00	12.50	340	...	255	...	6	...
	12.50	60.00	340	...	255	...	...	5
	60.00	80.00	325	...	250	...	...	5
	80.00	100.00	310	...	240	...	...	4
	100.00	120.00	295	...	235	...	...	3
T62[F]	0.50	1.00	370	...	250	...	6	...
	1.00	6.30	370	...	250	...	7	...
	6.30	12.50	370	...	250	...	8	...
	12.50	25.00	370	...	250	...	...	7
	25.00	50.00	370	...	250	...	...	6
T81 sheet	0.50	1.00	425	...	315	...	6	...
	1.00	6.30	425	...	315	...	7	...
T851[E] (formerly T81 plate)	6.30	12.50	425	...	315	...	8	...
	12.50	25.00	425	...	315	...	...	7
	25.00	50.00	425	...	315	...	...	6
	50.00	80.00	425	...	310	...	...	5
	80.00	100.00	415	...	305	...	...	4
	100.00	130.00	405	...	295	...	...	4
	130.00	150.00	395	...	290	...	...	3
T87	0.50	1.00	440	...	360	...	5	...
	1.00	6.30	440	...	360	...	6	...
	6.30	12.50	440	...	350	...	7	...
	12.50	25.00	440	...	350	...	...	6
	25.00	80.00	440	...	350	...	...	5
	80.00	100.00	425	...	345	...	...	3
	100.00	120.00	420	...	340	...	...	2
F[G]	6.30	50.00	...	...	...	...	...	...
				Alclad Alloy 2219				
O	0.50	1.00	...	220	...	110	12	...
	1.00	2.50	...	220	...	110	12	...
	2.50	12.50	...	220	...	110	12	...
	12.50	50.00	...	220[H]	...	110[H]	...	10
T31[K] (flat sheet)	1.00	2.50	290	...	170	...	10	...
	2.50	6.30	305	...	180	...	10	...
T351[EK] plate (formerly T31 plate)[K]	6.30	12.50	305	...	180	...	10	...
T37[K]	1.00	2.50	310	...	235	...	6	...
	2.50	12.50	325	...	240	...	6	...
T62[F]	0.50	1.00	305	...	200	...	6	...
	1.00	2.50	340	...	220	...	7	...
	2.50	6.30	350	...	235	...	7	...
	6.30	12.50	350	...	235	...	8	...
	12.50	25.00	370[H]	...	250[H]	...	...	7
	25.00	50.00	370[H]	...	250[H]	...	...	6

TABLE 3 *Continued*

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 (5.65 $\sqrt{A}$)
T81 (flat sheet)	0.50	1.00	340	...	255	...	6	...
	1.00	2.50	380	...	285	...	7	...
	2.50	6.30	400	...	295	...	7	...
T851[E] plate (formerly T81 plate)	6.30	12.50	400	...	290	...	8	...
T87	1.00	2.50	395	...	315	...	6	...
	2.50	6.30	415	...	330	...	6	...
	6.30	12.50	415	...	330	...	7	...
F[G]	6.30	50.00	...	...	...	...	...	...
				Alloy 6013				
T4	0.50	6.30	275	...	145	...	20	...
T6	0.50	6.30	360	...	315	...	8	...
T651[E]	6.30	40.00	365	...	305	...	...	4
	40.00	80.00	370	...	325	...	...	4
	80.00	160.00	380	...	325	...	...	3
				Alloy 6061				
~~θ~~	~~0.15~~	~~0.20~~	~~...~~	~~150~~	~~...~~	~~85~~	~~10~~	~~...~~
O	0.15	0.20	...	150	...	85	10	...
	0.20	0.25	...	150	...	85	12	...
	0.25	0.50	...	150	...	85	14	...
	0.50	3.20	...	150	...	85	16	...
	3.20	12.50	...	150	...	85	18	...
	12.50	25.00	...	150	...	...	...	16
	25.00	80.00	...	150	...	...	...	14
T4	0.15	0.20	205	...	110	...	10	...
	0.20	0.25	205	...	110	...	12	...
	0.25	0.50	205	...	110	...	14	...
	0.50	6.30	205	...	110	...	16	...
T451[E]	6.30	12.50	205	...	110	...	18	...
	12.50	25.00	205	...	110	...	...	16
	25.00	80.00	205	...	110	...	...	14
T42[F]	0.15	0.20	205	...	95	...	10	...
	0.20	0.25	205	...	95	...	12	...
	0.25	0.50	205	...	95	...	14	...
	0.50	6.30	205	...	95	...	16	...
	6.30	12.50	205	...	95	...	18	...
	12.50	25.00	205	...	95	...	...	16
	25.00	80.00	205	...	95	...	...	14
T6, T62[F]	0.15	0.20	290	...	240	...	4	...
	0.20	0.25	290	...	240	...	6	...
	0.25	0.50	290	...	240	...	8	...
	0.50	6.30	290	...	240	...	10	...
T62[F], T651[E]	6.30	12.50	290	...	240	...	10	...
	12.50	25.00	290	...	240	...	...	8
	25.00	50.00	290	...	240	...	...	7
	50.00	100.00	290	...	240	...	...	5
	100.00	150.00[L]	275	...	240	...	...	5
F[G]	6.30	80.00	...	...	...	...	...	...
				Alclad Alloy 6061				
~~θ~~	~~0.24~~	~~0.50~~	~~...~~	~~140~~	~~...~~	~~85~~	~~16~~	~~...~~
O	0.24	0.50	...	140	...	85	16	...
	0.50	3.20	...	140	...	85	16	...
	3.20	12.50	...	140	...	85	18	...
	12.50	25.00	...	150[H]	...	...	...	16
	25.00	80.00	...	150[H]	...	...	...	14

TABLE 3 *Continued*

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 (5.65 $\sqrt{A}$)
T4	0.24	0.50	185	...	95	...	14	...
	0.50	6.30	185	...	95	...	16	...
T451[E]	6.30	12.50	185	...	95	...	18	...
				...		...	...	
				...		...	...	
	12.50	25.00	205	...	110[H]	...	...	16
	25.00	80.00	205	...	110[H]	...	...	14
T42[F]	0.24	0.50	185	...	85	...	14	...
	0.50	6.30	185	...	85	...	16	...
	6.30	12.50	185	...	85	...	18	...
	12.50	25.00	205[H]	...	95[H]	...	...	16
	25.00	80.00	205[H]	...	95[H]	...	...	14
T6, T62[F]	0.24	0.50	260	...	220	...	8	...
	0.50	6.30	260	...	220	...	10	...
T62[F], T651[E]	6.30	12.50	260	...	220	...	10	...
	12.50	25.00	290[H]	...	240[H]	...	...	8
	25.00	50.00	290[H]	...	240[H]	...	...	7
	50.00	100.00	290[H]	...	240[H]	...	...	5
	100.00	120.00	275[H]	...	240[H]	...	...	5
F[G]	6.30	80.00	...	...	...	...	...	...
				Alloy 7075				
O	0.39	12.50	...	275	...	145	10	...
	12.50	50.00	...	275	...	...	...	9
T6, T62[F]	0.19	0.32	510	...	435	...	5	...
	0.32	1.00	525	...	460	...	7	...
	1.00	3.20	540	...	470	...	8	...
	3.20	6.30	540	...	475	...	8	...
T62[F], T651[E]	6.30	12.50	540	...	460	...	9	...
	12.50	25.00	540	...	470	...	...	6
	25.00	50.00	530	...	460	...	...	5
	50.00	60.00	525	...	440	...	...	4
	60.00	80.00	495	...	420	...	...	4
	80.00	90.00	490	...	400	...	...	4
	90.00	100.00	460	...	370	...	...	2
T73 sheet	1.00	6.30	460	...	385	...	8	...
T7351[E] plate	6.30	12.50	475	...	390	...	7	...
	12.50	25.00	475	...	390	...	...	6
	25.00	50.00	475	...	390	...	...	5
	50.00	60.00	455	...	360	...	...	5
	60.00	80.00	440	...	340	...	...	5
T76 sheet	3.10	6.30	500	...	425	...	8	...
T7651[E] plate	6.30	12.50	495	...	420	...	8	...
	12.50	25.00	490	...	415	...	...	5
F[G]	6.30	100.00	...	...	...	...	...	...
				Alclad Alloy 7075				
O	0.19	0.40	...	250	...	140	9	...
	0.40	1.60	...	250	...	140	10	...
	1.60	4.00	...	260	...	140	10	...
	4.00	12.50	...	270	...	145	10	...
	12.50	25.00	...	275[H]	...	...	...	9
T6, T62[F]	0.19	0.32	470	...	400	...	5	...
	0.32	1.00	485	...	415	...	7	...
	1.00	1.60	495	...	425	...	8	...
	1.60	3.20	505	...	435	...	8	...
	3.20	4.00	505	...	435	...	8	...

TABLE 3 *Continued*

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 (5.65 $\sqrt{A}$)
	4.00	6.30	515	...	440	...	8	...
T62[F], T651[E]	6.30	12.50	515	...	445[H]	...	9	...
	12.50	25.00	540[H]	...	470[H]	...	...	6
	25.00	50.00	530[H]	...	460[H]	...	...	5
	50.00	60.00	525[H]	...	440[H]	...	...	4
	60.00	80.00	495[H]	...	420[H]	...	...	4
	80.00	90.00	490[H]	...	400[H]	...	...	4
	90.00	100.00	460[H]	...	370[H]	...	...	2
T76 sheet	3.10	4.00	470	...	390	...	8	...
	4.00	6.30	485	...	405	...	8	...
T7651[E] plate	6.30	12.50	475	...	400	...	8	...
	12.50	25.00	490[H]	...	415[H]	...	...	5
F[G]	6.30	100.00	...	...	...	...	...	...
Alclad One Side Alloy 7075								
O	0.39	1.60	...	260	...	145	10	...
	1.60	4.00	...	270	...	145	10	...
	4.00	12.50	...	270	...	145	10	...
	12.50	25.00	...	275[H]	...	...	...	9
T6, T62[F]	0.31	1.00	505	...	435	...	7	...
	1.00	1.60	510	...	440	...	8	...
	1.60	3.20	515	...	445	...	8	...
	3.20	4.00	515	...	445	...	8	...
	4.00	6.30	525	...	455	...	8	...
T62[F], T651[E]	6.30	12.50	525	....	455	...	9	...
	12.50	25.00	540[H]	...	470[H]	...	...	6
	25.00	50.00	530[H]	...	460[H]	...	...	5
F[G]	6.30	50.00	...	...	...	...	...	...
7008 Alclad Alloy 7075								
O	0.39	1.60	...	275	...	145	10	...
	1.60	4.00	...	275	...	145	10	...
	4.00	12.50	...	275	...	145	10	...
	12.50	50.00	...	275[H]	...	...	...	9
T6, T62[F]	0.39	1.00	505	...	435	...	7	...
	1.00	1.60	515	...	445	...	8	...
	1.60	3.20	515	...	445	...	8	...
	3.20	4.00	515	...	445	...	8	...
	4.00	6.30	525	...	455	...	8	...
T62[F], T651[E]	6.30	12.50	525		455		9	...
	12.50	25.00	540[H]	...	470[H]	...	...	6
	25.00	50.00	530[H]	...	460[H]	...	...	5
	50.00	60.00	525[H]	...	440[H]	...	...	4
	60.00	80.00	495[H]	...	420[H]	...	...	4
	80.00	90.00	490[H]	...	400[H]	...	...	4
	90.00	100.00	460[H]	...	370[H]	...	...	2
T76 sheet	1.00	1.60	485	...	405	...	8	...
	1.60	4.00	490	...	415	...	8	...
	4.00	6.30	495	...	420	...	8	...
T7651[H] plate	6.30	12.50	490	...	415	...	8	...
	12.50	25.00	490[H]	...	415[H]	...	...	5
F[G]	6.30	100.00	...	...	...	...	...	...
Alloy 7178								
~~O~~	~~0.39~~	~~12.50~~	~~...~~	~~275~~	~~...~~	~~145...~~	~~10...~~	~~...~~
O	0.39	12.50	...	275	...	145	10	...
	12.50	12.70	...	275	...	...	...	9
T6, T62[F]	0.39	1.20	570	...	495	...	7	...

TABLE 3 *Continued*

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 (5.65 $\sqrt{A}$)
	1.20	6.30	580	...	505	...	8	...
T62[F], T651[E]	6.30	12.50	580	...	505	...	8	...
	12.50	25.00	580	...	505	...	...	5
	25.00	40.00	580	...	505	...	...	3
	40.00	50.00	550	...	480	...	...	2
T76	1.00	6.30	515	...	440	...	8	...
T7651[E]	6.30	12.50	510	...	435	...	8	...
	12.50	25.00	500	...	425	...	...	5
F[G]	6.30	50.00	...	...	...	...	...	...
				Alclad Alloy 7178				
O	0.39	1.60	...	250	...	140	10	...
	1.60	4.00	...	265	...	140	10	...
	4.00	12.50	...	275	...	145	10	...
	12.50	12.70	...	275[H]	...	...	...	9
T6, T62[F]	0.39	1.20	525	...	455	...	7	...
	1.20	1.60	540	...	470	...	8	...
	1.60	4.00	550	...	480	...	8	...
	4.00	6.30	565	...	490	...	8	...
T62[F], T651[E]	6.30	12.50	565	...	490	...	8	...
	12.50	25.00	580[H]	...	505[H]	...	...	5
	25.00	40.00	580[H]	...	505[H]	...	...	3
	40.00	50.00	550[H]	...	480[H]	...	...	2
T76	1.00	1.60	490	...	415	...	8	...
	1.60	4.00	490	...	415	...	8	...
	4.00	6.30	500	...	420	...	8	...
T7651[E]	6.30	12.50	495	...	415	...	8	...
	12.50	25.00	500[H]	...	425[H]	...	...	5
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 E 29.

[B] The basis for establishment of mechanical property limits is shown in Annex AI.

[C] Elongations in 50 mm apply for thicknesses up through 12.50 mm and in 5× diameter (5.65 $\sqrt{A}$) for thicknesses over 12.50 mm where *A* is the cross-sectional area of the specimen.

[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.

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,	38.0 or greater	per specified requirements	acceptable
Alclad 7075-T76 and T7651 and	36.0 through 37.9	per specified requirements	unacceptable[B]
7008 Alclad 7075-T76 and -T7651	less than 36.0	any level	unacceptable[B]
7178-T76 and T7651	38.0 or greater	per specified requirements	acceptable
Alclad 7178-T76 and T7651	35.0 through 37.9	per specified requirements	unacceptable[B]
	less than 35.0	any level	unacceptable[B]

[A] The electrical conductivity shall be determined in accordance with Test Method E 1004 in the following locations:

Alloy-Temper	Thickness, mm	Location
7075-T73 and T7351	all	surface of tension sample
7075-T76 and T7651	up through 2.50	surface of tension sample
7178-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.

[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).

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]	
	Core	Cladding	Over	Through			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	
Alclad 2024	2024	1230	...	1.60	both	5	4	
			1.60	...	both	2.5	2	
1½ % Alclad 2024	2024	1230	4.00	...	both	1.5	1.2	3[C]
Alclad one-side 2024	2024	1230	...	1.60	one	5	4	
			1.60	...	one	2.5	2	
1½ % Alclad one-side 2024	2024	1230	4.00	...	one	1.5	1.2	3[C]
Alclad 2219	2219	7072	...	1.00	both	10	8	
			1.00	2.50	both	5	4	
			2.50	...	both	2.5	2	
Alclad 3003	3003	7072	all		both	5	4	6[D]
Alclad 3004	3004	7072	all		both	5	4	6[D]
Alclad 6061	6061	7072	all		both	5	4	6[D]
Alclad 7075	7075	7072	...	1.60	both	4	3.2	
7008 Alclad 7075	7075	7008	1.60	4.00	both	2.5	2	
			4.00	...	both	1.5	1.2	3[C]
Alclad one-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[C]
Alclad 7178	7178	7072	...	1.60	both	4	3.2	
			1.60	4.00	both	2.5	2	
			4.00	...	both	1.5	1.2	3[C]

[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] 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.

[D] Applicable for thicknesses over 12.50 mm.

TABLE 6 Ultrasonic Discontinuity Limits for Plate

Alloy	Thickness, mm		Maximum mass Per Piece, kg[A]	Discontinuity Class[B]
	over	through		
2014[C]				
2024[C]	12.50	38.00	1000	B
2124				
2219[C]				
7075[C]	38.00	80.00	1000	A
7178[C]	80.00	115.00	1000	B

[A] 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.
[B] The discontinuity class limits are defined in Section 11 of Practice B 594.
[C] Also applies for alclad plate.
[D] 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.

ANNEXES

(Mandatory Information)

A1. BASIS FOR INCLUSION OF PROPERTY LIMITS

A1.1 Limits are established at a level at which a statistical evaluation of the data indicates that 99 % of the population obtained from all standard material meets the limit with 95 % confidence. For the products described, mechanical property limits for the respective size ranges are based on the analyses of at least 100 data from standard production material with no more than ten data from a given lot. All tests are performed in accordance with the appropriate ASTM test methods. ~~For informational purposes, refer to "Statistical Aspects of~~[6] Mechanical ~~Property Assurance" in the Related Material section of the *Annual Book of ASTM Standards*, Vol 02.02. Mechanical~~ property limits in this metric issue were derived from the inch-pound system limits that were developed under the ~~above principles.~~ principles in Footnote 12. As test data on metric dimensioned specimens are accumulated, some refinement of limits, particularly for elongations measured in 5D, can be anticipated.

[6] For informational purposes, refer to "Statistical Aspects of Mechanical Property Assurance" in the Related Material section of the *Annual Book of ASTM Standards*, Vol ~~01.01.~~ 02.02.

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(M). The Aluminum Association[7] 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(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.

~~*Annual Book of ASTM Standards*, Vol 03.03.~~

[7] The Aluminum Association, 900 19th St., NW, Washington, DC 20006.

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, etc.~~
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 (Note A2.1); Titanium; 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 zinc and titanium, or are specified in footnotes.

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

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 and Table X1.2 are included in ISO 209-1, Part 1, Chemical Composition, and ISO 2107. 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 B 209M

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)	7178	Al Zn7MgCu

TABLE X1.2 ISO Equivalents of Tempers in B 209M

Tempers			
ANSI	ISO	ANSI	ISO
F	F	T3	TD
O	O	T4	TB
H12, H22, H32	H1B, H2B, H3B	T6	TF
H14, H24, H34	H1D, H2D, H3D	T7	TM
H16, H26, H36	H1F, H2F, H3F	T8	TH
H18, H28, H38	H1H, H2H, H3H		
H19, H29	H1J,H2J		
H112	M		

SUMMARY OF CHANGES

Committee B07 has identified the location of selected changes to this standard since the last issue (B 209M – 02a3) that may impact the use of this standard. (Approved Apr. 10, 2003.) its use.

(1) Updated Referenced Documents by removing Footnote 10 and Test Method G 34 fromAdded Note 3, referring the list of footnotes. reader to Specification B 928/B 928M and renumbered Notes 4 and 5.
(2) Referred reader to Terminology B 881 for definitions, Updated Reference Documents section by adding Specification B 928/B 928M and deleted sections 3.1.1 through 3.1.13. removing Test Method G 66.
(3) In Removed old sections 14.1, 14.1.1, 14.1.2, and 14.3, replaced reference 14.1.3 and renumbered the rest of Section 14 to Practice G 34 – 72 with reference to Practice G 34. remove Exfoliation-Corrosion testing requirements for 5083, 5086, and 5456.
(4) Changed "2000 Removed Note 6 that discussed the corrosion of 5083, 5086, and 7000" to read "2xxx and 7xxx" in section 20.2. 5456.
(5) In Table 2, added tensile properties for 3105-H22, -H24, -H26, Added 5059 composition limits and -H28. Footnote L to Table 1;
(6) In Section 16, updated ANSI H35.2M table numbers Added properties for 5052-H322, 5059-O, and 5059-H111 to relate to the revised ANSI H35.2M document.

Committee B07 has identified the location of selected changes to this standard since the last issue (B 209M – 02$^{\epsilon 1}$) that may impact the use of this standard. (Approved Dec. 10, 2002.)

Table 2.
(1)(7) Up Removed 5083-H321 and replaced it with 5083-H32, re-Rmovefd 5083-H116, removed 5086-H116, removed 5456-H321 and replace it with 5456-H32, and D remocuved 5456-H116 from Table 2.
(8) Added designation H112, which was missing, and revised thickness range for 5456-O to 1.20–6.30 from 1.25–6.30 to agree with AS&D Metric in Table 2.
(9) In Table 2, removed Footnote G and renumbered footnotes.