

Tempers For Aluminum and Aluminum Alloy Products



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FOREWORD

Listed in this booklet, in U.S. Customary Units only, are the tempers for aluminum and aluminum alloy products registered with The Aluminum Association but not contained in The Association's *Aluminum Standards and Data*.

The strength properties are expressed in thousand pounds per square inch (ksi). Refer to APPENDIX A, "Guidelines For Transitioning Metric (SI) Units Into U.S. Customary Units", for specific conversion procedures and to the Tan Sheets (Tempers for Aluminum and Aluminum Alloy Products Metric Edition) for registered tempers with limits shown in metric (SI) units.

Some of the registered tempers may be the subject of U.S. patents or patent applications, and their listing herein is not to be construed in any way as the granting of a license under such patent rights.

Tempers for wrought products are given on pages 1–42 and for castings on page 43. Inactive alloys and tempers are listed on pages 46–54.

An explanation for The Aluminum Association's "Temper Designation System" is given in the *Aluminum Standards and Data* and in the American National Standard ANSI H35.1/ H35.1(M).

All new tempers registered since the previous issue as well as revisions to the prior registrations are marked and defined. In addition, the registration column also includes a revision date to denote the latest revision to the registered information.

TEMPER REGISTRATION

When any aluminum or aluminum alloy material is produced in a temper not previously applied to that material, the temper, along with the alloy designation and product form to which it applies, may be registered with The Aluminum Association.

PROCEDURE FOR INDIVIDUAL REGISTRATION OF TEMPER

1. Any person, firm or corporation may apply to The Aluminum Association to register a new temper.
2. Selection of the temper designation usually is left to the discretion of the Technical Committee on Product Standards, but consideration will be given to the applicant's choice when circumstances so warrant.
3. The temper is registered when, in the opinion of the Technical Committee on Product Standards, it is judged to be technically correct and complete with respect to the following:
 - 3.a. The temper designation conforms to ANSI H35.1 "Alloy and Temper Designation Systems for Aluminum" (reprinted in The Aluminum Association manual Aluminum Standards and Data).
 - 3.b. The material is offered for sale in the proposed temper and is available for use by more than one user.
 - 3.c. The mechanical property limits applicable to the temper are included. (Limits are shown as tentative unless established in accordance with the data base criteria outlined under "Mechanical Properties" in Section 6, "Standards Section" of Aluminum Standards and Data).
 - 3.c.1. The following procedure describes a method to register 6xxx and some 7xxx in -T3, -T4, -T6, -T7, -T8 and -T9 Tempers, when the temper being registered is normally produced using extrusion press solution heat treatment, rolling mill solution heat treatment or forging press solution heat treatment.
 - 3.c.1.1. Collect 100 samples minimum from at least 5 different cast lots and 10 different heat treat lots of extrusion press solution heat treated, rolling mill solution heat treated or forging press solution heat treated material. No more than 10 tests from a given heat treat lot shall be included in the data analysis. Stretch, cold work, straighten or otherwise finish the material as described in Aluminum Standards and Data Section 1, Alloy and Temper Designation System for Aluminum (ANSI H35.1), Paragraph 4.2.2, for the temper being registered. Then either naturally age (T3 and T4) or artificially age (T6, T7, T8, and T9) the material before sampling and tensile testing per ASTM B 557. Statistically analyze the data for Ultimate Tensile Strength, Yield Strength, and Elongation, and report the minimum values for each at which at least 99 percent of the material is expected to conform at a confidence level of 0.95.
 - 3.c.1.1.1. The 100 tests shall include samples which span the thickness range(s) to be registered, including samples from the thinnest section or diameter, the thickest section or diameter and, if appropriate, intermediate sections or diameters. There shall be a minimum of 30 tests for each thickness range to be registered.
 - 3.c.1.2. Collect 30 samples minimum from at least 3 different cast lots of material extruded, rolled or forged and solution heat treated in a production or commercial furnace. Stretch, cold work, straighten or otherwise finish the material as described in Aluminum Standards and Data Section 1, Alloy and Temper Designation System for Aluminum (ANSI H35.1), Paragraph 4.2.2, for the temper being registered. Then either naturally age (T3 and T4) or artificially age (T6, T7, T8, and T9) the material before sampling and tensile testing per ASTM B 557. Statistically analyze the data for Ultimate Tensile Strength, Yield Strength, and Elongation, and report the minimum values for each at which at least 99 percent of the material is expected to conform at a confidence level of 0.95.

TEMPER REGISTRATION (continued)

3.c.1.2.1. The 30 tests may include samples from one or multiple gauge thickness.

3.c.1.3. The registering entity shall report all calculated minimum values to the Technical Committee on Product Standards, along with the minimum limits the registering entity wishes to register.

3.c.1.4. The Technical Committee on Product Standards will then review the temper based on the proposed minimum limits of the registering entity, provided the minimum limits are not larger than the minimum values calculated in steps 3.c.1.1 and 3.c.1.2 of this procedure.

3.c.1.5. Tempers registered using this procedure shall carry the following note in the Remarks column: "The registered properties for this material are calculated in accordance with the procedure described under 3.c.1."

3.c.2. Tentative Limit Registration

3.c.2.1. Tentative limits are temporary in nature and are established to allow the producer to manufacture and sell the product while continuing to collect data. Tentative temper designations shall be reviewed every 2 years for possible resolution of the tentative status.

3.c.2.2. The mechanical property limits defined as tentative are established at levels at which at least 99% of the data conform at a confidence level of 95%. The limited number of observations required for a tentative registration may not represent the property distribution that is expected due to random variation within the manufacturing practice and may not have a normal distribution.

3.c.2.3. For heat treatable alloys, tentative limits are based on the results of a minimum of 30 tests from at least 3 cast lots and at least 3 heat treat lots of material. For non heat treatable alloys, tentative limits are based on the results of a minimum of 30 tests from at least 3 cast lots of material that have separately passed through subsequent processing operations as at least 3 fabricated inspection lots.

3.c.2.4. For heat treatable and non heat treatable alloys, the 30 tests shall include observations from all gauge ranges. Multiple ranges can be proposed when there are at least 10 tests from each gauge range or by using regression analysis of the 30 tests.

3.c.2.5. Tentative limits for 6xxx and some 7xxx in -T3, -T4, -T6, -T7, -T8 and -T9 Tempers, when the temper being registered is normally produced using extrusion press solution heat treatment, rolling mill solution heat treatment or forging press solution heat treatment (see 3.c.1), are based on the results of a minimum of 30 tests from at least 3 cast lots and at least 3 heat treat lots of material processed as described in 3.c.1.1 and a minimum of 30 tests from at least 3 cast lots and at least 3 heat treat lots of material processed as described in 3.c.1.2.

3.c.2.5.1. The 30 tests from the material processed as described in 3.c.1.1 shall include samples which span the thickness range(s) to be registered, including samples from the thinnest section or diameter, the thickest section or diameter and, if appropriate, intermediate sections or diameters. There shall be a minimum of 10 tests for each thickness range to be registered.

3.c.2.5.2. The 30 tests from material processed as described in 3.c.1.2 may be from one or multiple gauge thickness.

TEMPER REGISTRATION (continued)

3.d. The following additional information is included when characteristics, in addition to mechanical properties, are specified for the temper:

3.d.1. Test methods by which conformance with the requirements for specified characteristics can be evaluated, OR

3.d.2. Details of the practice to be followed in producing the temper.

3.e. When not already registered, the minimum tensile strength limit applicable to the O temper shall accompany the request for registration of H tempers.

3.e.1. If the annealed product is not offered for sale and the O temper limits that accompany an H temper registration are based on material annealed in standard production furnaces, the description provided in the Remarks column of the registration shall state "O temper not offered for sale but used as basis for H temper registration."

3.e.2. If the annealed product is not offered for sale, the O temper limits can be measured on laboratory annealed materials. These limits shall be designated as O2 and the description provided in the Remarks column of the registration shall state "O temper not offered for sale. O2 temper used as basis for H temper registration."

3.e.3. When the O temper or O2 temper limits are based on the requirements of a tentative registration, the O or O2 limits will be shown as tentative. However, O or O2 temper tentative limits, which are noted as not being offered for sale, shall not be subject to the two year review.

3.f. The indication of a variation in treatment of a basic T temper is limited to one additional digit (excluding zero) unless all available digits have been used, and except as provided for in the Appendix to ANSI H35.1.

3.g. A description of the process variation or the product characteristics of the registration shall be provided when an additional digit, beyond those defined, is requested.

± 4. When an expansion of the gauge range for an existing temper is registered, the following additional procedures apply:

4.a. For registrations that are not tentative, registration of an expansion to the existing gauge range for the registered temper shall be treated as an independent registration in accordance with the procedures provided in section 3.

4.b. When a tentative registration is being finalized by removing the tentative status, the gauge range can be expanded by adding to the data from the existing tentatively registered gauge range provided that the following 3 conditions apply:

4.b.1. The data from the existing tentative registration is available for analysis, and

4.b.2. The data for the gauge range to be added to the registration complies with 3.c.2.3. and 3.c.2.4. and 3.c.2.5, and

4.b.3. The combined data set is sufficient to meet the criteria outlined under "Mechanical Properties" in Section 6, "Standards Section" of Aluminum Standards and Data and analysis of the combine data set supports the limits published for the gauge range of existing tentative registration.

4.c. Alternatively, the gauge range of a registered tentative temper can be expanded by treating the expanded gauge range as an independent tentative registration in accordance with the procedures provided in section 3.c.2.

TEMPER REGISTRATION (concluded)

PROCEDURES FOR ALUMINUM ASSOCIATION TECHNICAL DIVISION (AATD) REGISTRATION OF TEMPERS

A temper for an aluminum alloy material may be registered as an AATD temper when, through formal ballot of the Technical Committee on Product Standards, all the following requirements are met:

1. The material is offered for sale in the proposed temper and gauges(s) by more than one producer.
2. The material meets all the requirements listed in the *Procedure for Individual Registration of Tempers* section of this document.
3. The temper is not registered with a tentative status.

REQUIREMENTS FOR PROPOSED CHANGES TO REGISTERED TEMPERS

Proposed changes to a registered designation's mechanical properties and/or characteristics:

1. Require approval by formal ballot of the Technical Committee on Product Standards for registered tempers having "minimum" and/or "maximum" mechanical property limits.
2. Require a 30-day review by the Technical Committee on Product Standards for registered tempers having "tentative" mechanical property limits. The registrant has the final authority to change the temper limits, provided the change complies with item 3 under Individual Registration of Tempers. Changes proposed by others than the registrant are acceptable only with the approval of the registrant.

REQUIREMENTS FOR DELETION OF TEMPERS FROM THE REGISTRATION LIST

1. When any alloy is removed from the active alloy registration list, all tempers applicable to that alloy are automatically removed from the active temper registration list.
2. Approval of the Technical Committee on Product Standards through formal ballot is required to effect deletion of any registered temper from the active registration list, except as provided by the preceding sentence.

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Classification of the listed properties is as specified in the column headed "Basis"

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
1100-O2	Alumax	04/04/78	Fin Stock	0.005-0.012	Min Max	11.0 16.0	5.0 -	15 -	Minimum amount of cold work controlled. Temper controlled within especially close limits. Extra hard temper closely controlled.
1100-H151	Alcoa	-	Tube	-	Min	17.0	-	-	
1100-H181	Alcoa	-	Sheet	0.013-0.019	Min	21.0	20.0	1	
1100-H185	AATD	-	Impact	0.028 & over	Min ⁶	22.0	20.0	-	
1100-H19	Alcoa	02/23/56	Wire	0.006-0.063	Min	24.0	-	-	
1100-H191	Alcoa	-	Sheet	0.013-0.019	Min	23.0	22.0	1	
1200-O	AATD	07/01/68	Sheet & Plate	0.006-3.000	Min Max	10.0 15.0	- -	* -	*15% for 0.006-0.019 *20% for 0.020-0.031 *25% for 0.032-0.050 *30% for 0.051-0.249 *28% for 0.250-3.000
1200-H112	AATD	07/01/68	Sheet, Plate & Extrusion	-	Min	10.0	-	25	*3% for 0.017-0.019 *4% for 0.020-0.031 *6% for 0.032-0.050 *8% for 0.051-0.113 *9% for 0.114-0.499 *12% for 0.500-2.000 *1% for 0.009-0.012 *2% for 0.013-0.019 *3% for 0.020-0.031 *4% for 0.032-0.050 *5% for 0.051-0.113 *6% for 0.114-0.499 *10% for 0.500-1.000 *1% for 0.006-0.019 *2% for 0.020-0.031 *3% for 0.032-0.050 *4% for 0.051-0.162 *1% for 0.006-0.019 *2% for 0.020-0.031 *3% for 0.032-0.050 *4% for 0.051-0.128
1200-H12	AATD	07/01/68	Sheet & Plate	0.017-2.000	Min Max	13.0 18.0	- -	* -	
1200-H14	AATD	07/01/68	Sheet & Plate	0.009-1.000	Min Max	15.0 20.0	- -	* -	
1200-H16	AATD	07/01/68	Sheet	0.006-0.162	Min Max	18.0 23.0	- -	* -	
1200-H18	AATD	07/01/68	Sheet	0.006-0.128	Min	20.0	-	*	
1235-O	Alcoa	05/12/80	Drawn Tube (Straight)	0.014-0.500	Min Max	10.0 15.0	3.0 -	35 -	
1235-O	Alcoa	05/12/80	Drawn Tube (Coiled)	0.014-0.065	Min Max	11.0 16.0	3.5 -	35 -	
1235-H18	Alcoa	05/12/80	Drawn Tube	0.014-0.500	Min	18.0	16.0	3	
1235-H111	Alcoa	05/12/80	Drawn Tube	0.014-0.500	Min	11.0	7.5	30	

Footnotes appear beginning on page 46.

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
1145-H12	AATD	11/06/67	Sheet	-	Min Max	11.0 16.0	- -	- -	Fin Stock.
1145-H16	AATD	11/06/67	Sheet	-	Min Max	16.0 21.0	- -	- -	Fin Stock.
1145-H18	AATD	11/06/67	Sheet	-	Min	18.0	-	-	Fin Stock.
1345-H24	Reynolds	05/17/63	Wire	0.030-0.250	Min	14.0	-	-	
1345-H26	Reynolds	05/17/63	Wire	0.030-0.250	Min	16.0	-	-	
1350-H113	AATD	05/28/71	Wire	Up thru #1	Min Max	12.0 20.0	- -	- -	Conforms to ICEA requirements for solid conductors.
				1/0 & over	Min Max	9.0 20.0	- -	- -	
1350-H141	Alcoa	06/20/69	Wire	Up thru 0.374	Min	15.0	-	-	Applicable to insulated conductors and currently specified as "1/2 to 3/4 hard".
1350-H142	Alcoa	09/09/69	Wire	Up thru 0.374	Min Max	15.0 22.0	- -	- -	
1350-H161	Alcoa	09/09/69	Wire	Up thru 0.374	Min	17.0	-	-	Applicable to insulated conductors and currently specified as "3/4 to full hard".
2008-T4	Alcoa	10/20/87 Revised 03/09/95	Sheet	0.025-0.075	Min	32.0	15.0	22	
2010-T4	Reynolds	06/16/94 Revised 10/29/98	Sheet	0.025-0.070	Min	32.0	16.0	22	The material shall exhibit (1) No lines or ridges in the rolling direction after buffing or polishing a blank, typically 2 by 9 inches, oriented with the long axis in the long transverse direction and stretching 5%, or (2) Random distribution of grain orientations with no continuous bands of cube oriented grains as determined by microtexture analysis of the rolling surface of the sheet using orientation image microscopy (OIM).
2010-T41	Reynolds	12/19/95 Revised 10/29/98	Sheet	0.025-0.070	Min	32.0	16.0	22	
2011-T6 & -T651	Kaiser	11/01/93	Rod	0.375-6.500	Min ⁶	54.0	40.0	10	Cold finished rod.
+ 2111-T8	Kaiser	01/18/18	Rod & Bar	0.500-3.500	*Min ⁶	52.0	38.0	10	*Tentative Cold finished Rod & Bar used primarily in, but not limited to, machining applications.
+ 2013-T4511	Sumitomo	08/01/12	Drawn Tube	0.120-0.400	*Min ⁶	40.0	21.0	20	*Tentative
2013-T6511	Sumitomo	09/19/03	Extrusion	Up thru 0.200	Min ⁶	58.0	53.0	8	<u>Exfoliation Corrosion Resistance</u> See footnote 15.b.
+ 2013-T6511	Sumitomo	12/15/11	Drawn Tube	0.120-0.400	*Min ⁶	60.0	56.0	7	*Tentative

Classification of the listed properties is as specified in the column headed "Basis"

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
2014-T41	Alcoa	-	Die Forging	-	Min	52.0	27.0	12	Quenched from solution temperature to provide minimum internal stress. Because the T41 temper has lowered resistance to corrosion, it should be used only for forgings which are to be artificially aged to the T61 temper before use.
2014-T61	Alcoa	-	Die Forging	Up thru 2.000	Min ³	57.0	45.0	6	To provide low level of internal stress. Artificially aged from T41.
2014-T611	Alcoa	04/15/68	Die Forging	Up thru 2.000	Min ³	62.0	53.0	6	To provide low level of internal stress with mechanical properties between those of the T6 and T61 tempers.
2014-T64	Alcoa	-	Extrusion	-	Min	59.0	52.0	7	For stock with lower residual stresses.
2017-H15 & -H25	Alcoa	09/12/89	Wire & Rod	Up thru 1.000	Min Max	35.0 45.0	- -	- -	For rivet and cold heading wire.
2219-T31	Alcoa	06/30/60	Drawn Tube	Up thru 0.500	Min	45.0	26.0	12	Solution heat treated and cold worked a specific controlled amount.
2219-T7	Alcoa	01/10/80	Forged Piston	Up thru 3.000	Min ³ Min ⁸	55.0 53.0	32.0 30.0	8 4	Intended to give minimum growth and maximum stability. BHN 93 minimum.
2219-T851	Alcoa	05/28/86	Die Forging	Up thru 2.000	Min ⁶ Min ⁹	62.0 60.0	50.0 46.0	6 3	
2519-T87	Alcoa	03/14/86	Armor Plate	0.500-1.500 1.501-2.000 2.001-3.000 3.001-4.000	Min ⁶ Min ⁹ Min ⁶ Min ⁹	66.0 68.0 66.0 68.0 67.0 68.0 68.0 68.0	59.0 58.0 59.0 58.0 60.0 59.0 61.0 59.0	10 7 9 7 8 6 7 5	Solution heat treated, cold worked approximately 8% and artificially aged.
2024-T3	Alcoa	05/22/85	Foil	0.0016-0.0025	Min	48.0	36.0	2	Limits same as MIL-A-81596.
2024-T351	Kaiser	05/15/02	Rod	6.501-8.000	Min	62.0	45.0	9	Cold finished
2024-T432	Alcan/ Airbus	11/12/04	Extrusion	0.063-0.375	Min ⁶	68.0	48.0	14	Peripheral coarse grain control. Absence of re-crystallization.
2024-T81	Alcoa	08/23/83	Drawn Tube	0.010-0.024 0.025-0.049 0.050-0.500	Min Min Min	66.0 66.0 66.0	58.0 58.0 58.0	- * *	<u>*Full Section</u> - 5% 6% <u>*Cut Out</u> - 4% 5%
2024-T81	Alcoa	05/22/85	Foil	0.0016-0.0025	Min	60.0	55.0	1	Limits same as MIL-A-81596.
2024-T84	Alcoa	-	Tube	-	Min	70.0	65.0	3	Amount of cold work between solution heat treatment and artificial aging is controlled at about 4%.
2124-O	Reynolds	09/12/83	Sheet	0.050-0.187	Max	32.0	14.0	12 (Min)	
2124-T62	Reynolds	09/12/83	Sheet	0.050-0.187	Min	62.0	48.0	5	

Footnotes appear beginning on page 46.

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
2124-T8151	Alcoa	10/06/86	Plate	1.001-1.499	Min ⁶ Min ⁹	68.0 68.0	62.0 62.0	8 7	<u>Fracture Toughness</u> ¹⁴ – Min K _{IC} For thicknesses 1.500-2.000 inches L-T direction 26 ksi $\sqrt{\text{in.}}$ T-L direction 23 ksi $\sqrt{\text{in.}}$ S-L direction 19 ksi $\sqrt{\text{in.}}$ For thicknesses 2.001-4.000 inches L-T direction 26 ksi $\sqrt{\text{in.}}$ T-L direction 22 ksi $\sqrt{\text{in.}}$ S-L direction 20 ksi $\sqrt{\text{in.}}$ For thicknesses 4.001-6.000 inches L-T direction 25 ksi $\sqrt{\text{in.}}$ T-L direction 21 ksi $\sqrt{\text{in.}}$ S-L direction 21 ksi $\sqrt{\text{in.}}$
				1.500-2.000	Min ⁶ Min ⁹ Min ¹⁰	68.0 68.0 65.0	62.0 62.0 57.0	8 7 2	
				2.001-3.000	Min ⁶ Min ⁹ Min ¹⁰	67.0 67.0 64.0	60.0 60.0 57.0	8 7 2	
				3.001-4.000	Min ⁶ Min ⁹ Min ¹⁰	67.0 67.0 64.0	59.0 59.0 57.0	7 6 2	
				4.001-5.000	Min ⁶ Min ⁹ Min ¹⁰	66.0 66.0 63.0	58.0 58.0 55.0	6 6 2	
				5.001-6.000	Min ⁶ Min ⁹ Min ¹⁰	65.0 65.0 62.0	57.0 56.0 54.0	6 5 2	
2224-T3510 & -T3511	Boeing	12/21/78	Extrusion	0.250-0.749	Min ⁶	65.0	48.0	12	Requires special extrusion practice; standard 2024 heat treatment.
				0.750-1.500	Min ⁶	69.0	50.0	10	
2324-T39	Boeing	12/21/78 Revised 03/25/98	Plate	0.750-1.300	Min ⁶ Min ⁹	68.0 71.0	62.0 58.0	10 8	Standard 2024 solution treatment and quench followed by 11% nominal cold roll and 1% minimum stretcher stress relief.
				1.301-1.500	Min ⁶ Min ⁹	67.0 71.0	61.0 57.0	10 8	
Alclad 2524-T3	Alcoa	02/27/97	Sheet & Plate	0.032-0.062	Min ⁹	59.0	39.0	15	
				0.063-0.128	Min ⁹	61.0	40.0	15	
				0.129-0.249	Min ⁹	62.0	40.0	15	
				0.250-0.310	Min ⁹	62.0	40.0	15	
++ 2624-T351	Alcoa	06/22/11 Revised 10/22/13	Plate	0.500-1.000	Min ⁶ Min ⁹	63.0 65.0	48.0 44.0	16 15	<u>Fracture Toughness</u> ¹⁴ – Min. K _{IC} or K _Q For thicknesses 0.750-1.500 inches L-T direction 42 ksi $\sqrt{\text{in.}}$ T-L direction 41 ksi $\sqrt{\text{in.}}$
				1.001-1.500	Min ⁶ Min ⁹	62.0 64.0	47.0 44.0	16 15	
+ 2624-T39	Alcoa	01/28/11	Plate	0.750-1.500	Min ⁶ Min ⁹	68.0 71.0	62.0 58.0	11 9	Cold rolled ~10% and stretched ~1% after solution heat treating. <u>Fracture Toughness</u> ¹⁴ – K _{IC} or K _Q For thicknesses 0.750-1.500 inches L-T direction 39 ksi $\sqrt{\text{in.}}$ T-L direction 33 ksi $\sqrt{\text{in.}}$

Classification of the listed properties is as specified in the column headed "Basis"

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
+ 2824-T3511	Universal Alloy	06/25/14	Extrusion	0.250-0.499	*Min ⁶ *Min ⁹	71.0 68.0	54.0 48.0	12 -	*Tentative Cross-sectional area less than or equal to 25 in. ²
				0.500-0.749	*Min ⁶ *Min ⁹	73.0 68.0	55.0 47.0	11 8	
				0.750-0.999	*Min ⁶ *Min ⁹	73.0 67.0	55.0 47.0	11 8	
				1.000-1.499	*Min ⁶ *Min ⁹	74.0 66.0	56.0 47.0	11 8	
				1.500-1.999	*Min ⁶ *Min ⁹	74.0 65.0	56.0 46.0	11 8	
				2.000-2.500	*Min ⁶ *Min ⁹	74.0 64.0	56.0 46.0	10 8	
2026-T3511	Alcoa	06/22/00	Extruded Rod, Bar, & Profiles	Up thru 0.249	Min ⁶	66.0	48.0	11	
				0.250-0.499	Min ⁶	70.0	52.0	12	
				0.500-1.499	Min ⁶ Min ⁹	72.0 66.0	53.0 46.0	11 8	
				1.500-2.249	Min ⁶ Min ⁹	73.0 64.0	54.0 44.0	11 8	
2027-T351	Alcan	12/08/04	Plate	0.500-1.500	Min ⁶ Min ⁹	68.0 67.0	52.0 46.0	14 14	
				1.501-2.250	Min ⁶ Min ⁹ Min ¹⁰	66.0 65.0 60.0	50.0 45.0 41.0	14 14 4	
2027-T3511	Alcan	11/29/04	Extruded Profiles	0.750-1.500	Min ⁶	75.0	57.0	14	Fracture Toughness ¹⁴ - min K _{IC} For thicknesses 0.750-1.500 in. L-T direction 40 ksi $\sqrt{\text{in.}}$ T-L direction 38 ksi $\sqrt{\text{in.}}$
+ Alclad 2029-T8	Alcoa	05/12/15	Sheet & Plate	0.063-0.164	*Min ⁶ *Min ⁹	61.0 61.0	55.0 54.0	8 9	*Tentative
				0.165-0.249	*Min ⁶ *Min ⁹	61.0 61.0	55.0 54.0	10 10	
				0.250-0.499	*Min ⁶ *Min ⁹	61.0 61.0	56.0 54.0	11 10	
				0.500-0.600	*Min ⁶ *Min ⁹	63.0 64.0	58.0 56.0	13 11	
2038-T4	Reynolds	10/10/82	Sheet	0.025-0.070	Min	40.0	20.0	20	Automotive sheet
2038-T6	Reynolds	10/10/82	Sheet	0.025-0.070	Min	50.0	44.0	8	Automotive sheet

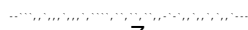
Footnotes appear beginning on page 46.

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
+ 2139-T84	Alcan Global ATI	03/23/11	Plate	1.000-1.500	*Min ⁶	65.0	62.0	11	* Tentative Material is cold worked in the range of 3-6% after solution heat treatment <u>Stress Corrosion Resistance</u> For thicknesses 1.000 – 5.000 inches. C-rings and tensile specimens machined and tested in accordance with ASTM G47 shall show no evidence of stress corrosion failure when tested in the short transverse direction at 40 ksi and exposed for 30 days. <u>Fracture Toughness</u> ¹⁴ *Min K _{IC} For thicknesses 1.000-3.750 inches L-T direction 35 ksi √in T-L direction 32 ksi √in S-L direction 27 ksi √in (from 2.000 inch) For thicknesses 3.751 – 5.000 inches L-T direction 32 ksi √in T-L direction 30 ksi √in S-L direction 27 ksi √in
					*Min ⁹	67.0	61.0	8	
					*Min ¹⁰	63.0	55.0	5	
				1.501-3.750	*Min ⁶	66.0	62.0	9	
					*Min ⁹	68.0	61.0	7	
					*Min ¹⁰	62.0	55.0	4	
				3.751-5.000	*Min ⁶	65.0	59.0	8	
					*Min ⁹	67.0	59.0	6	
					*Min ¹⁰	61.0	53.0	4	
++ 2050-T34	Constellium	01/25/16 Revised 08/04/17	Plate	0.500-1.999	*Min ⁹	52.0	36.0	17	* Tentative
				2.000-6.500	*Min ⁹	52.0	34.0	17	Solution heat treated and cold worked 3-4.5%
+ 2050-T82	Constellium	08/10/17	Plate	0.500-1.500	*Min ⁶	72.0	68.0	7	*Tentative Solution heat treated and cold worked 3-4.5% and artificially aged Properties are from material that was aged in a laboratory or test furnace for response to heat treatment <u>Stress Corrosion Resistance</u> For thickness 0.750 – 6.500 inches C-rings and Tensile specimens machined and tested in accordance with ASTM G47 shall show no evidence of stress corrosion failure when tested in the short transverse direction at 45 ksi and exposed for 30 days
					*Min ⁹	73.0	67.0	5	
				1.501-2.000	*Min ⁶	72.0	67.0	7	
					*Min ⁹	73.0	65.0	5	
					*Min ¹⁰	71.0	61.0	2	
				2.001-3.000	*Min ⁶	72.0	67.0	7	
					*Min ⁹	72.0	65.0	5	
					*Min ¹⁰	71.0	61.0	2	
				3.001-4.000	*Min ⁶	71.0	67.0	6	
					*Min ⁹	72.0	65.0	4	
					*Min ¹⁰	70.0	60.0	1.5	
				4.001-5.000	*Min ⁶	71.0	66.0	6	
					*Min ⁹	71.0	64.0	3	
					*Min ¹⁰	69.0	59.0	1.5	
+ 2050-T84	Constellium	01/20/14	Extruded Bar	1.750-5.900	*Min ⁶	71.0	66.0	5	*Tentative Solution heat treated, cold worked approximately 4% and artificially aged. <u>Stress Corrosion Resistance</u> For thicknesses 1.750-5.900 inches Tensile specimens machined and tested in accordance with ASTM G47 shall show no evidence of stress corrosion failure when tested in the short transverse direction at 58 ksi and exposed for 30 days.
					*Min ⁹	71.0	64.0	4	

Classification of the listed properties is as specified in the column headed "Basis"

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
++ 2050-T84	Alcan Revised Constellium	03/23/07 Revised 03/09/12	Plate	0.500-1.500	Min ⁶ Min ⁹	73.0 74.0	69.0 67.0	9 7	<u>Stress Corrosion Resistance</u> For thickness 0.750 – 6.500 inches
				1.501-2.000	Min ⁶ Min ⁹ Min ¹⁰	72.0 73.0 71.0	67.0 65.0 61.0	9 7 2	Direct C-rings and Tensile specimens machined and tested in accordance with ASTM G47 shall show no evidence of stress corrosion failure when tested in the short transverse direction at 45 ksi and exposed for 30 days.
				2.001-3.000	Min ⁶ Min ⁹ Min ¹⁰	72.0 72.0 71.0	67.0 65.0 61.0	8 6 2	<u>Fracture Toughness</u> ¹⁴ – Min K _{IC}
				3.001-4.000	Min ⁶ Min ⁹ Min ¹⁰	71.0 72.0 70.0	67.0 65.0 60.0	7 4 1.5	For thicknesses 0.500 – 1.500 inches L-T direction 33 ksi√in. T-L direction 29 ksi√in. S-L direction 25 ksi√in.
				4.001-5.000	Min ⁶ Min ⁹ Min ¹⁰	71.0 71.0 69.0	66.0 64.0 59.0	6 3 1.5	For thicknesses 1.501 – 2.000 inches L-T direction 31 ksi√in. T-L direction 27 ksi√in. S-L direction 23 ksi√in.
				5.001-6.500	Min ⁶ Min ⁹ Min ¹⁰	71.0 71.0 69.0	66.0 64.0 59.0	5 3 1.5	For thicknesses 2.001 – 3.000 inches L-T direction 28 ksi√in. T-L direction 25 ksi√in. S-L direction 23 ksi√in.
									For thicknesses 3.001 – 4.000 inches L-T direction 26 ksi√in. T-L direction 23 ksi√in. S-L direction 21 ksi√in.
									For thicknesses 4.001 – 5.000 inches L-T direction 25 ksi√in. T-L direction 21 ksi√in. S-L direction 21 ksi√in.
									For thicknesses 5.001 – 6.000 inches L-T direction 22 ksi√in. T-L direction 20 ksi√in. S-L direction 18 ksi√in.
									For thicknesses 6.001 – 6.500 inches L-T direction 22 ksi√in. T-L direction 19 ksi√in. S-L direction 16 ksi√in.

Footnotes appear beginning on page 46.



Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
+ 2050-T852	Aubert & Duval	01/21/14 Revised 10/02/15	Die Forging	0.250-1.500	Min ⁶ Min ⁹	75.0 76.0	69.0 70.0	9 8	<u>Fracture Toughness</u> ¹⁴ – K _{IC} or K _Q For thicknesses 0.250-1.500 in L-T direction 32 ksi√in T-L direction 29 ksi√in For thicknesses 1.501-2.000 in L-T direction 32 ksi√in T-L direction 29 ksi√in For thicknesses 2.001-3.000 in L-T direction 29 ksi√in T-L direction 26 ksi√in S-L direction 20 ksi√in For thicknesses 3.001-4.000 in L-T direction 26 ksi√in T-L direction 23 ksi√in S-L direction 20 ksi√in For thicknesses 4.001-5.000 in L-T direction 25 ksi√in T-L direction 21 ksi√in S-L direction 19 ksi√in For thicknesses 5.001-6.000 in L-T direction 23 ksi√in T-L direction 20 ksi√in S-L direction 17 ksi√in For thicknesses 6.001-7.000 in L-T direction 22 ksi√in T-L direction 18 ksi√in S-L direction 16 ksi√in For thicknesses 7.001-8.000 in L-T direction 21 ksi√in T-L direction 18 ksi√in S-L direction 16 ksi√in For thicknesses 8.001-9.000 in L-T direction 20 ksi√in T-L direction 18 ksi√in S-L direction 16 ksi√in For thicknesses 9.001-10.000 in L-T direction 20 ksi√in T-L direction 18 ksi√in S-L direction 16 ksi√in
				1.501-2.000	Min ⁶ Min ⁹ Min ¹⁰	75.0 76.0 75.0	69.0 70.0 64.0	9 8 4	
				2.001-3.000	Min ⁶ Min ⁹ Min ¹⁰	74.0 74.0 73.0	68.0 68.0 64.0	8 6 3	
				3.001-4.000	Min ⁶ Min ⁹ Min ¹⁰	74.0 73.0 73.0	68.0 67.0 63.0	7 6 3	
				4.001-5.000	Min ⁶ Min ⁹ Min ¹⁰	74.0 73.0 72.0	67.0 66.0 62.0	6 6 2	
				5.001-6.000	Min ⁶ Min ⁹ Min ¹⁰	73.0 72.0 71.0	67.0 65.0 61.0	6 6 2	
				6.001-7.000	Min ⁶ Min ⁹ Min ¹⁰	73.0 71.0 71.0	66.0 64.0 61.0	5 5 2	
				7.001-8.000	Min ⁶ Min ⁹ Min ¹⁰	72.0 71.0 70.0	66.0 63.0 60.0	5 5 2	
				8.001-9.000	Min ⁶ Min ⁹ Min ¹⁰	72.0 70.0 70.0	65.0 63.0 60.0	5 5 2	
				9.001-10.000	Min ⁶ Min ⁹ Min ¹⁰	71.0 69.0 69.0	64.0 62.0 59.0	4 4 1.5	
+ 2055-T84	Alcoa	01/14/14	Extrusion	0.040-0.125	*Min ⁶	82.0	78.0	5	*Tentative Solution heat treated, cold worked in the range 2-5% and artificially aged. Cross Sectional Area less than or equal to 18.5 in. ² and Circle Size less than or equal to 14.5 in. <u>Fracture Toughness</u> ¹⁴ – Min K _{IC} or K _Q For thicknesses 0.750-1.500 inches L-T direction 22 ksi√in. T-L direction 19 ksi√in.
				0.126-0.249	*Min ⁶ *Min ⁹	83.0 84.0	79.0 78.0	6 5	
				0.250-0.499	*Min ⁶ *Min ⁹	85.0 84.0	80.0 78.0	7 5	
				0.500-0.749	*Min ⁶ *Min ⁹	87.0 84.0	82.0 78.0	8 5	
				0.750-1.249	*Min ⁶ *Min ⁹	88.0 84.0	84.0 78.0	8 5	
				1.250-1.500	*Min ⁶ *Min ⁹	90.0 84.0	86.0 78.0	8 5	
Alclad 2056-T3	Pechiney	12/10/03	Sheet	0.063-0.126	Min ⁹	62.0	41.0	15	
				0.127-0.236	Min ⁹	62.0	40.0	16	

Classification of the listed properties is as specified in the column headed "Basis"

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
+ 2060-T86	Alcoa	06/03/13	Plate	0.750-1.500	*Min ⁶ *Min ⁹	73.0 73.0	68.0 63.0	9 6	*Tentative Solution heat treated, cold worked approximately 6% and artificially aged. <u>Fracture Toughness</u> ¹⁴ – Min K _{IC} or K _Q L-T direction 38 ksi√in. T-L direction 33 ksi√in.
+ 2065-T84	Constellium	04/16/14	Extrusion	0.040-0.49 0.250-0.499	*Min ⁶ *Min ⁹	87.0 87.0	83.0 84.0	6 6	*Tentative Solution heat treated, cold worked approximately 3-4% and artificially aged.
2090-T3	Alcoa	02/28/89 Revised 03/23/99	Sheet	0.032-0.249	Min	46.0	31.0	6	
2090-T83	Alcoa	03/15/88 Revised 03/09/98	Sheet	0.032-0.125	Min ⁶ Min ⁹	77.0 73.0	70.0 66.0	3 5	
				0.126-0.249	Min ⁶ Min ⁹	75.0 73.0	70.0 66.0	4 5	
++ 2090-T86	Alcoa	08/11/88 Revised 07/30/90 Reactivated 07/18/12	Extrusion	Up thru 0.124	Min ⁶	78.0	71.0	4	
				0.125-0.249	Min ⁶	78.0	71.0	5	
				0.250-0.499	Min ⁶ Min ⁹	80.0 76.0	73.0 68.0	5 -	
2195-T34	Rio Tinto Alcan	06/07/10	Plate	0.500-2.250	Min ⁹	52.0	36.0	14	Solution heat treated and cold worked in the range 3-5%. <u>Stress Corrosion Resistance</u> For thicknesses 0.750 - 2.250 inches. C-rings or Tensile specimens machined and tested in accordance with ASTM G47 shall show no evidence of stress corrosion failure when tested in the short transverse direction at 45 ksi and exposed for 30 days. <u>Compressive Yield Strength</u> For thicknesses 0.500 - 2.250 inches in LT direction, Min 76.0 ksi.
+ 2195-T8	Constellium	03/09/12 Revised 01/20/15	Sheet & Plate	0.125-0.499	Min ⁶ Min ⁹	82.0 80.0	78.0 76.0	6 6	
2195-T82	Rio Tinto Alcan	10/11/09	Plate	0.500-1.499	Min ⁶ Min ⁹	80.0 82.0	75.0 76.0	6 5	
				1.500-2.250	Min ⁶ Min ⁹ Min ¹⁰	77.0 80.0 81.0	73.0 72.0 69.0	6 5 2	
+ 2195-T841	Constellium Global ATI	06/24/11	Plate	0.500-2.250	*Min ⁹	71.0	63.0	9	*Tentative Developed to meet armor plate requirements of Mil-STD-32341. Material is solution heat treated, cold worked in the range 3-5%, and under- aged.

Footnotes appear beginning on page 46.

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
+ 2395-T84	Universal Alloy	02/10/16	Extrusion	0.040-0.125	*Min ⁶ *Min ⁹	84.0 85.0	78.0 78.0	6 5	* Tentative Cross-sectional area less than or equal to 23 in ² and circle size less than or equal to 16 in. Solution heat treated and cold worked in the range 2-5% and artificially aged.
				0.126-0.249	*Min ⁶ *Min ⁹	85.0 85.0	78.0 78.0	6 5	
				0.250-0.499	*Min ⁶ *Min ⁹	85.0 85.0	79.0 78.0	6 5	
				0.500-1.500	*Min ⁶ *Min ⁹	90.0 85.0	83.0 78.0	7 5	
++ 2196-T8511	Alcan Constellium Global ATI	10/04/07 Revised 03/29/12 Revised 10/27/16	Extrusion	0.040-0.062	*Min ⁶	75.0	69.0	6	* Tentative
				0.063-0.125	*Min ⁶	76.0	69.0	6	
				0.129-0.249	*Min ⁶	76.0	71.0	7	
				0.250-1.000	*Min ⁶	78.0	71.0	5	
2297-T87	McCook Metals	06/21/00 Revised 06/03/04	Plate	1.500-2.000	Min ⁶ Min ⁹ Min ¹⁰	64.0 66.0 65.0	58.0 60.0 57.0	10 8 2	<u>Stress Corrosion Resistance</u> 30 days at 30 ksi when tested in the ST direction per ASTM G47. <u>Exfoliation Corrosion Resistance</u> See footnote 15.b. <u>Fracture Toughness</u> ¹⁴ – Min K _{IC} For thicknesses 1.500-3.000 inches L-T direction 32 ksi $\sqrt{\text{in.}}$ T-L direction 27 ksi $\sqrt{\text{in.}}$ S-L direction 20 ksi $\sqrt{\text{in.}}$ For thicknesses 3.001-4.000 inches L-T direction 31 ksi $\sqrt{\text{in.}}$ T-L direction 27 ksi $\sqrt{\text{in.}}$ S-L direction 20 ksi $\sqrt{\text{in.}}$ For thicknesses 4.001-5.000 inches L-T direction 30 ksi $\sqrt{\text{in.}}$ T-L direction 26 ksi $\sqrt{\text{in.}}$ S-L direction 18 ksi $\sqrt{\text{in.}}$ For thicknesses 5.001-6.000 inches L-T direction 29 ksi $\sqrt{\text{in.}}$ T-L direction 25 ksi $\sqrt{\text{in.}}$ S-L direction 18 ksi $\sqrt{\text{in.}}$
				2.001-2.500	Min ⁶ Min ⁹ Min ¹⁰	63.0 64.0 64.0	57.0 58.0 56.0	9 7 2	
				2.501-3.000	Min ⁶ Min ⁹ Min ¹⁰	62.0 64.0 62.0	57.0 58.0 55.0	9 7 2	
				3.001-4.000	Min ⁶ Min ⁹ Min ¹⁰	62.0 62.0 59.0	57.0 57.0 54.0	5 4 1.5	
				4.001-5.000	Min ⁶ Min ⁹ Min ¹⁰	61.0 61.0 58.0	56.0 56.0 52.0	5 4 1.5	
				5.001-6.000	Min ⁶ Min ⁹ Min ¹⁰	60.0 60.0 57.0	55.0 55.0 52.0	5 4 1.5	

Classification of the listed properties is as specified in the column headed "Basis"

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
2397-T87	Alcoa	02/12/03 Revised 08/17/05	Plate	3.001-4.000	*Min ⁶	62.0	57.0	5	*Tentative <u>Stress Corrosion Resistance</u> See footnote 4.b. <u>Exfoliation Corrosion Resistance</u> See footnote 15.b. <u>Fracture Toughness</u> ¹⁴ – Min K _{IC} For thicknesses 3.001-4.000 L-T direction 31 ksi $\sqrt{\text{in.}}$ T-L direction 27 ksi $\sqrt{\text{in.}}$ S-L direction 20 ksi $\sqrt{\text{in.}}$ For thicknesses 4.001-5.000 L-T direction 32 ksi $\sqrt{\text{in.}}$ T-L direction 26 ksi $\sqrt{\text{in.}}$ S-L direction 18 ksi $\sqrt{\text{in.}}$ For thicknesses 5.001-6.000 L-T direction 29 ksi $\sqrt{\text{in.}}$ T-L direction 25 ksi $\sqrt{\text{in.}}$ S-L direction 18 ksi $\sqrt{\text{in.}}$ Note: Fracture toughness test parameters are defined in AMS 4328.
					*Min ⁹	62.0	57.0	4	
					*Min ¹⁰	60.0	54.0	1.5	
				4.001-5.000	Min ⁶	62.0	56.0	6	
					Min ⁹	62.0	56.0	4	
					Min ¹⁰	60.0	55.0	1.5	
				5.001-6.000	Min ⁶	60.0	55.0	5	
					Min ⁹	60.0	55.0	4	
					Min ¹⁰	57.0	52.0	1.5	
2098-O	Pechiney	06/20/03	Plate	0.250-0.300	Max	35.0	25.0	11	<u>Stress Corrosion Resistance</u> Direct tensile specimens machined and tested in accordance with ASTM G47 shall show no evidence of Stress Corrosion failure when tested in the long transverse direction at 35.0 ksi and exposed for 30 days. <u>Fracture Toughness</u> ¹³ – Min K _C For thicknesses 0.250-0.300 inch L-T direction 101 ksi $\sqrt{\text{in.}}$ T-L direction 75 ksi $\sqrt{\text{in.}}$
2098-T8	Rio Tinto Alcan	03/21/08	Sheet	0.125-0.249	Min ⁶	77.0	71.0	6	
					Min ⁹	74.0	69.0	6	
2098-T82	Pechiney	06/20/03	Plate	0.250-0.300	Min ⁶	73.0	68.0	7	
					Min ⁹	73.0	68.0	6	
2198-T8	Alcan	03/21/07 Revised 10/21/08	Sheet	0.063-0.124	Min ⁶	68.0	62.0	8	
					Min ⁹	67.0	59.0	9	
				0.125-0.249	Min ⁶	71.0	64.0	8	
					Min ⁹	69.0	62.0	9	

Footnotes appear beginning on page 46.

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
+ 2099-T81	Alcoa	08/01/11	Extrusion	0.375-1.300	Min ⁶ Min ⁹	73.0 63.0	59.0 51.0	7 7	Stretched approximately 1-3 % and underaged. <u>Stress Corrosion Resistance</u> Material shall be capable of passing the stress corrosion cracking test described in ASTM G47 when tested in the LT direction at a stress of 38.4 ksi for 30 days. <u>Exfoliation Corrosion Resistance</u> Specimens shall not exhibit exfoliation corrosion at a T/2 plane greater than that illustrated by Photo 2 (EB) from Figure 2 of ASTM G34 when specimens are exposed for 2 weeks according to the procedures in ASTM G85 Annex A2, using the dry-bottom MASTMAASIS Test Method. <u>Fracture Toughness</u> ¹⁴ – Min K _{IC} or K _Q For thicknesses 0.500-1.300 inch L-T direction 45 ksi √in
					Min ⁶	75.0	67.0	6	<u>Stress Corrosion Resistance</u> For ST specimens taken from section thicknesses 0.750 inch and greater, see footnote 4.b.
					Min ⁶ Min ⁹	78.0 79.0	69.0 71.0	7 7	<u>Exfoliation Corrosion Resistance</u> See footnote 15.b. Note: For Al-Li alloys, specimens are exposed for 2 weeks according to the procedures in ASTM G 85 Annex A2, using the dry-bottom MASTMAASIS Test Method. The solution used for exposure by ASTM G 34, the EXCO Test, has been determined to be inappropriate for Al-Li alloys. For further information on this review ASTM G 112 paragraph 6.3.1 which describes limitations on this test method for Al-Li alloys.
2099-T83	Alcoa	01/07/05 Revised 08/16/10	Extrusion	0.050-0.249 0.250-0.499 0.500-0.999 1.000-3.000	Min ⁶ Min ⁶ Min ⁶ Min ⁶	75.0 78.0 73.0 80.0	67.0 69.0 65.0 72.0	6 7 7 7	<u>Stress Corrosion Resistance</u> For ST specimens taken from section thicknesses 0.750 inch and greater, see footnote 4.b. <u>Exfoliation Corrosion Resistance</u> See footnote 15.b. Note: For Al-Li alloys, specimens are exposed for 2 weeks according to the procedures in ASTM G 85 Annex A2, using the dry-bottom MASTMAASIS Test Method. The solution used for exposure by ASTM G 34, the EXCO Test, has been determined to be inappropriate for Al-Li alloys. For further information on this review ASTM G 112 paragraph 6.3.1 which describes limitations on this test method for Al-Li alloys.
2099-T86	Alcoa	07/31/09	Plate	0.500-2.000	Min ⁶ Min ⁹	71.0 72.0	63.0 62.0	6 5	Solution heat treated, cold worked approximately 6% and artificially aged. <u>Stress Corrosion Resistance</u> For ST specimens, see footnote 4.f. For LT specimens, see footnote 4.g. <u>Exfoliation Corrosion Resistance</u> Specimens shall not exhibit exfoliation corrosion at a T/10 plane greater than that illustrated by Photo 2 (EB) from Figure 2 of ASTM G34 when specimens are exposed for 2 weeks according to the procedures in ASTM G85 Annex A2, using the dry-bottom MASTMAASIS Test Method. <u>Fracture Toughness</u> ¹⁴ – Min K _{IC} or K _Q For thicknesses 1.000-2.000 inches L-T direction 30 ksi √in. T-L direction 25 ksi √in.
2199-T8	Alcoa	06/01/07	Sheet & Plate	0.125-0.325 0.326-0.550	Min ⁶ Min ⁹ Min ⁶ Min ⁹	61.0 62.0 61.0 63.0	52.0 50.0 52.0 51.0	9 6 10 7	

Classification of the listed properties is as specified in the column headed "Basis"

Alloy Temper	Registered		Product	Thickness in.	Tensile Strength, ksi			Elongation Percent in 2 in. or 4 D	Remarks ²
	By	Date			Basis ¹	Ult.	Yield		
+ 2199-T86	Alcoa	06/16/11	Plate	0.750-1.250	Min ⁶ Min ⁹	64.0 66.0	58.0 58.0	9 8	* Tentative Solution heat treated, cold worked approximately 6% and artificially aged. <u>Exfoliation Corrosion Resistance</u> Specimens shall not exhibit exfoliation corrosion at a T/10 plane greater than that illustrated by Photo 2 (EA) from Figure 2 of ASTM G34 when specimens are exposed for 2 weeks according to the procedures in ASTM B85 Annex A2, using the dry-bottom MASTMAASIS Test Method. <u>Fracture Toughness</u> ¹⁴ – Min. K _{IC} or K _Q For thicknesses 0.750-1.250 inches L-T direction 48 Ksi √in T-L direction 43 Ksi √in
3002-O	Alcoa	05/17/74	Sheet	0.025-0.063	Min Max	11.0 16.0	3.0 -	* -	*20% for 0.025-0.031 *23% for 0.032-0.050 *25% for 0.051-0.063
3102-O	AATD	03/19/80	Drawn Seamless Tube (Coiled & Straight)	0.018-0.049 0.050-0.065	Min Max Min Max	12.0 17.0 12.0 17.0	4.0 - 4.0 -	* - * -	*Full Section *Cut Out 30% 20% - - 35% 25% - -
3102-H112	Bohn	04/07/76	Extruded Coiled Tube	0.028-0.050	Min Max	11.0 18.0	4.0 -	25 -	
3003-H121	Howmet	02/13/79	Sheet	0.028-0.036	Min Max	17.0 23.0	12.0 -	16 -	
3003-H183	Alcoa	12/21/53	Tube	-	Min	27.0	-	-	
3003-H191	Alcoa	12/01/64	Sheet	-	Min Max	30.0 35.0	- -	- -	
+ 3003-H22	Alcoa	04/12/11	Sheet	0.045-0.063 0.064-0.249	Min ⁶ Min ⁶	17.0 17.0	12.0 12.0	5 7	Used for tread plate applications.
3003-H231	Reynolds	01/03/91	Sheet	0.063-0.113 0.114-0.161 0.162-0.188	Min Min Min	19.0 19.0 19.0	15.0 15.0 15.0	5 6 7	Used for tread plate applications.
3003-H271	Alcoa	08/08/56	Sheet	-	Min	25.0	-	7	
3003-H281	Alcoa	12/01/83	Drawn Tube	0.025-0.049 0.050-0.249	Min Min	27.0 27.0	24.0 24.0	* *	*Full Section *Cut Out 5% 4% 6% 5%

Footnotes appear beginning on page 46.