

Alloy and Temper Designation Systems for Aluminum and Aluminum Alloys

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SYSTEMS FOR DESIGNATING aluminum and aluminum alloys that incorporate the product form (wrought, casting, or foundry ingot), and its respective temper (with the exception of foundry ingots, which have no temper classification) are covered by American National Standards Institute (ANSI) standard H35.1. The Aluminum Association is the registrar under ANSI H35.1 with respect to the designation and composition of aluminum alloys and tempers registered in the United States.

Wrought Aluminum and Aluminum Alloy Designation System

A four-digit numerical designation system is used to identify wrought aluminum and aluminum alloys. As shown below, the first digit of the four-digit designation indicates the group:

Aluminum, $\geq 99.00\%$	1xx
Aluminum alloys grouped by major alloying element(s):	
Copper	2xx
Manganese	3xx
Silicon	4xx
Magnesium	5xx
Magnesium and silicon	6xx
Zinc	7xx
Other elements	8xx
Unused series	9xx

For the 2xx through 7xx series, the alloy group is determined by the alloying element present in the greatest mean percentage. An exception is the 6xx series alloys in which the proportions of magnesium and silicon available to form magnesium silicide (Mg_2Si) are predominant. Another exception is made in those cases in which the alloy qualifies as a modification of a previously registered alloy. If the great-

est mean percentage is the same for more than one element, the choice of group is in order of group sequence: copper, manganese, silicon, magnesium, magnesium silicide, zinc, or others.

Aluminum. In the 1xx group, the series 10xx is used to designate unalloyed compositions that have natural impurity limits. The last two of the four digits in the designation indicate the minimum aluminum percentage. These digits are the same as the two digits to the right of the decimal point in the minimum aluminum percentage when expressed to the nearest 0.01%. Designations having second digits other than zero (integers 1 through 9, assigned consecutively as needed) indicate special control of one or more individual impurities.

Aluminum Alloys. In the 2xxx through 8xxx alloy groups, the second digit in the designation indicates alloy modification. If the second digit is zero, it indicates the original alloy; integers 1 through 9, assigned consecutively, indicate modifications of the original alloy. Explicit rules have been established for determining whether a proposed composition is merely a modification of a previously registered alloy or if it is an entirely new alloy. The last two of the four digits in the 2xxx through 8xxx groups have no special significance, but serve only to identify the different aluminum alloys in the group.

Cast Aluminum and Aluminum Alloy Designation System

A system of four-digit numerical designations incorporating a decimal point is used to identify aluminum and aluminum alloys in the form of castings and foundry ingot. The first digit indicates the alloy group:

Aluminum, $\geq 99.00\%$	1xx.x
Aluminum alloys grouped by major alloying element(s):	
Copper	2xx.x
Silicon, with added copper and/or magnesium	3xx.x
Silicon	4xx.x
Magnesium	5xx.x
Zinc	7xx.x
Tin	8xx.x
Other elements	9xx.x
Unused series	6xx.x

For 2xx.x through 8xx.x alloys, the alloy group is determined by the alloying element present in the greatest mean percentage, except in cases in which the composition being registered qualifies as a modification of a previously registered alloy. If the greatest mean percentage is common to more than one alloying element, the alloy group is determined by the element that comes first in the sequence.

The second two digits identify the specific aluminum alloy or, for the aluminum (1xx.x) series, indicate purity. The last digit, which is separated from the others by a decimal point, indicates the product form, whether casting or ingot. A modification of an original alloy, or of the impurity limits for unalloyed aluminum, is indicated by a serial letter preceding the numerical designation. The serial letters are assigned in alphabetical sequence starting with A but omitting I, O, Q, and X, the X being reserved for experimental alloys. Explicit rules have been established for determining whether a proposed composition is a modification of an existing alloy or if it is a new alloy.

Aluminum Castings and Ingot. For the 1xx.x group, the second two of the four digits in the designation indicate the minimum aluminum percentage. These digits are the same as the two digits to the right of the decimal point in the minimum aluminum

Table 1 Alloying element and impurity specifications for ingots that will be remelted into sand, permanent mold, and die castings

Alloying element	Composition, wt%			Ingot
	Sand and permanent mold	Casting	Die	
Iron	≤0.15	...	...	Casting -0.03
	>0.15-0.25	...	...	Casting -0.05
	>0.25-0.6	...	...	Casting -0.10
	>0.6-1.0	...	...	Casting -0.2
	>1.0	...	...	Casting -0.3
	...	≤1.3	...	Casting -0.3
Magnesium	...	>1.3	...	≤1.1
	...	...	<0.50	Casting +0.05(a)
	...	...	≥0.50	Casting +0.1(a)
Zinc	...	>0.25 to 0.60	...	Casting -0.10
	...	>0.60	...	Casting -0.1

(a) Applicable only when the specified range for castings is >0.15% Mg. Source: Ref 1

percentage when expressed to the nearest 0.01%. The last digit indicates the product form: 1xx.0 indicates castings, and 1xx.1 indicates ingot.

Aluminum Alloy Castings and Ingot. For the 2xx.x through 9xx.x alloy groups, the second two of the four digits in the designation have no special significance but serve only to identify the different alloys in the group. The last digit, which is to the right of the decimal point, indicates the product form: xxx.0 indicates castings, and xxx.1 indicates ingot having limits for alloying elements the same as those for the alloy in the form of castings, except for those listed in Table 1.

Designations for Experimental Alloys

Experimental alloys also are designated in accordance with the systems for wrought and cast alloys, but they are indicated by the prefix X. The prefix is dropped when the alloy is no longer experimental. During development and before they are designated as experimental, new alloys may be identified by serial numbers assigned by their originators. Use of the serial number is discontinued when the ANSI H35.1 designation is assigned.

Cross-Referencing of Aluminum and Aluminum Alloy Products

Tables 2 and 3 cross-reference aluminum wrought and ingot/cast products according to composition, per Aluminum Association, Unified Numbering System (UNS), and International Organization for Standardization (ISO) standards.

Unified Numbering System. UNS numbers correlate many nationally used numbering systems currently administered by societies, trade associations, and individual users and producers of metals and alloys.

Aluminum Association International Alloy Designations. For wrought aluminum and aluminum alloys only, compositions may be registered with the Aluminum Association by a number of foreign organizations. These

organizations are signatories of a Declaration of Accord on the Recommendation for an International Designation System for Wrought Aluminum and Wrought Aluminum Alloys. In addition to the United States, the countries represented by signatories are Argentina, Australia, Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, South Africa, and the United Kingdom. The European Aluminum Association is also a signatory.

Under ANSI standard H35.1, wrought aluminum or aluminum alloys will be registered in decreasing priority as national variations, as modifications, or as a new four-digit number. A national variation that has composition limits very close but not identical to those registered by another country is identified by a serial letter following the numerical designation.

Castings and Foundry Alloys. There is no similar international accord for these aluminum or aluminum alloy products.

Foreign Alloy Designations. Historically, all major industrialized countries developed their own standard designations for aluminum and aluminum alloys. These are now being grouped under systems of the American National Standards Institute, the International Organization for Standardization, and the European Committee for Standardization.

The International Organization for Standardization has developed its own alphanumeric designation system for wrought aluminum and its alloys, based on the systems that have been used by certain European countries. The main addition element is distinguished by specifying the required content (middle of range) rounded off to the nearest 0.5:

5052=Al Mg2.5

5251=Al Mg2

If required, the secondary addition elements are distinguished by specifying the required content rounded off to the nearest 0.1, for two elements at most:

6181=Al Si1Mg0.8

The chemical symbols for addition elements should be limited to four:

7050=Al Zn6CuMgZr

If an alloy cannot otherwise be distinguished, a suffix in brackets is used:

6063=Al Mg0.7Si

6463=Al Mg0.7Si(B)

and international alloy registration

6063A=Al Mg0.7Si(A)

Note that suffixes (A), (B), and so on, should not be confused with suffixes of the Aluminum Association.

The proposed ISO chemical composition standard for aluminum and its alloys references Aluminum Association equivalents as well as its own identification system. A listing of these is given in Table 4.

European Committee for Standardization. This committee (Comité Européen de Normalisation, CEN) of European Common Market members has developed a composition standard based on the ISO standard, but is proposing new designations not included in that standard. Some of these new designations are already registered as German (Deutsche Industrial-Normen, DIN) standards. The proposed standard also references Aluminum Association equivalents.

Temper Designation System for Aluminum and Aluminum Alloys

The temper designation system used in the United States for aluminum and aluminum alloys is used for all product forms (both wrought and cast), with the exception of ingot. The system is based on the sequences of mechanical or thermal treatments, or both, used to produce the various tempers. The temper designation follows the alloy designation and is separated from it by a hyphen. Basic temper designations consist of individual capital letters. Major subdivisions of basic tempers, where required, are indicated by one or more digits following the letter. These digits designate specific sequences of treatments that produce specific combinations of characteristics in the product. Variations in treatment conditions within major subdivisions are identified by additional digits. The conditions during heat treatment (such as time, temperature, and quenching rate) used to produce a given temper in one alloy may differ from those employed to produce the same temper in another alloy.

Basic Temper Designations

Designations for the common tempers, and descriptions of the sequences of operations used to produce these tempers, are given in the following paragraphs.

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Table 2 Composition of wrought unalloyed aluminum and wrought aluminum alloys

Grade designation				Composition, wt%														
Aluminum Association	UNS No.	ISO No. R209	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ga	V	Specified other elements		Unspecified other elements		Al, minimum	
													Ti	Each	Total	Each		Total
1035	---	---	0.35	0.6	0.10	0.05	0.05	---	---	0.10	---	0.05	---	---	0.03	0.03	---	99.35
1040	A91040	---	0.30	0.50	0.10	0.05	0.05	---	---	0.10	---	0.05	---	---	0.03	0.03	---	99.40
1045	A91045	---	0.30	0.45	0.10	0.05	0.05	---	---	0.05	---	0.05	---	---	0.03	0.03	---	99.45
1050	A91050	AI 99.5	0.25	0.40	0.05	0.05	0.05	---	---	0.05	---	0.05	---	---	0.03	0.03	---	99.50
1060	A91060	AI 99.6	0.25	0.35	0.05	0.03	0.03	---	---	0.05	---	0.05	---	---	0.03	0.03	---	99.60
1065	A91065	---	0.25	0.30	0.05	0.03	0.03	---	---	0.05	---	0.05	---	---	0.03	0.03	---	99.65
1070	A91070	AI 99.7	0.20	0.25	0.04	0.03	0.03	---	---	0.04	---	0.05	---	---	0.03	0.03	---	99.70
1080	A91080	AI 99.8	0.15	0.15	0.03	0.02	0.02	---	---	0.03	0.03	0.05	---	---	0.03	0.02	---	99.80
1085	A91085	---	0.10	0.12	0.03	0.02	0.02	---	---	0.03	0.03	0.05	---	---	0.02	0.01	---	99.85
1090	A91090	---	0.07	0.07	0.02	0.01	0.01	---	---	0.03	0.03	0.05	---	---	0.01	0.01	---	99.90
1098	---	---	0.010	0.006	0.003	---	---	---	---	0.015	---	---	---	---	0.003	0.003	---	99.98
1100	A91100	AI 99.0 Cu	0.95 (Si + Fe)		0.05-0.20	0.05	---	---	---	0.10	---	---	---	(a)	---	0.05	0.15	99.00
1110	---	---	0.30	0.8	0.04	0.01	0.25	0.01	---	---	---	---	---	0.02 B, 0.03 (V + Ti)	---	0.03	---	99.10
1200	A91200	AI 99.0	1.00 (Si + Fe)		0.05	0.05	---	---	---	0.10	---	---	---	---	0.05	0.05	0.15	99.00
1120	---	---	0.10	0.40	0.05-0.35	0.01	0.20	0.01	---	0.05	0.03	---	---	0.05 B, 0.02 (V + Ti)	---	0.03	0.10	99.20
1230	A91230	AI 99.3	0.70 (Si + Fe)		0.10	0.05	0.05	---	---	0.10	---	0.05	---	---	0.03	0.03	---	99.30
1135	A91135	---	0.60 (Si + Fe)		0.05-0.20	0.04	0.05	---	---	0.10	---	0.05	---	---	0.03	0.03	---	99.35
1235	A91235	---	0.65 (Si + Fe)		0.05	0.05	0.05	---	---	0.10	---	0.05	---	---	0.06	0.03	---	99.35
1435	A91345	---	0.15	0.30-0.50	0.02	0.05	0.05	---	---	0.10	---	0.05	---	---	0.03	0.03	---	99.35
1145	A91145	---	0.55 (Si + Fe)		0.05	0.05	0.05	---	---	0.05	---	0.05	---	---	0.03	0.03	---	99.45
1345	A91345	---	0.30	0.40	0.10	0.05	0.05	---	---	0.05	---	0.05	---	---	0.03	0.03	---	99.45
1445	---	---	0.50 (Si + Fe)(b)		0.04(b)	---	---	---	---	---	---	---	---	---	---	---	0.05	99.45
1150	---	---	0.45 (Si + Fe)		0.05-0.20	0.05	0.05	---	---	0.05	---	---	---	---	0.03	0.03	---	99.50
1350	A91350	E-Al 99.5	0.10	0.40	0.05	0.01	---	0.01	---	0.05	0.03	---	---	0.05 B, 0.02 (V + Ti)	---	0.03	0.10	99.50
1260	A91260(c)	---	0.40 (Si + Fe)		0.04	0.01	0.03	---	---	0.05	---	0.05	---	(a)	0.03	0.03	---	99.60
1170	A91170	---	0.30 (Si + Fe)		0.03	0.03	0.02	0.03	---	0.04	---	0.05	---	---	0.03	0.03	---	99.70
1370	---	E-Al 99.7	0.10	0.25	0.02	0.01	0.02	0.01	---	0.04	0.03	---	---	0.02 B, 0.02 (V + Ti)	---	0.02	0.10	99.70
1175	A91175	---	0.15 (Si + Fe)		0.10	0.02	0.02	---	---	0.04	0.03	0.05	---	---	0.02	0.02	---	99.75
1275	---	---	0.08	0.12	0.05-0.10	0.02	0.02	---	---	0.03	0.03	0.03	---	---	0.02	0.01	---	99.75
1180	A91180	---	0.09	0.09	0.01	0.02	0.02	---	---	0.03	0.03	0.05	---	---	0.02	0.02	---	99.80
1185	A91185	---	0.15 (Si + Fe)		0.01	0.02	0.02	---	---	0.03	0.03	0.05	---	---	0.02	0.01	---	99.85
1285	A91285	---	0.08(d)	0.08(d)	0.02	0.01	0.01	---	---	0.03	0.03	0.05	---	---	0.02	0.01	---	99.85
1385	---	---	0.05	0.12	0.02	0.01	0.02	0.01	---	0.03	0.03	---	---	0.02 (V + Ti)(e)	---	0.01	---	99.85
1188	A91188	---	0.06	0.06	0.005	0.01	0.01	---	---	0.03	0.03	0.05	---	(a)	0.01	0.01	---	99.88
1190	---	---	0.05	0.07	0.01	0.01	0.01	0.01	---	0.02	0.02	---	---	0.01 (V + Ti)(f)	---	0.01	---	99.90
1193	A91193(c)	---	0.04	0.04	0.006	0.01	0.01	---	---	0.03	0.03	0.05	---	---	0.01	0.01	---	99.93
1199	A91199	---	0.006	0.006	0.006	0.002	0.006	---	---	0.006	0.005	0.005	---	---	0.002	0.002	---	99.99
2001	---	---	0.20	0.20	5.2-6.0	0.15-0.50	0.20-0.45	0.10	0.05	0.10	---	---	---	0.05 Zr(g)	0.20	0.05	0.15	rem
2002	---	---	0.35-0.8	0.30	1.5-2.5	0.20	0.50-1.0	0.20	---	0.20	---	---	---	---	0.20	0.05	0.15	rem
2003	---	---	0.30	0.30	4.0-5.0	0.30-0.8	0.02	---	---	0.10	---	0.05-0.20	0.10-0.25 Zr(h)	0.15	0.05	0.15	rem	
2004	---	---	0.20	0.20	5.5-6.5	0.10	0.50	---	---	0.10	---	---	0.30-0.50 Zr	0.05	0.05	0.15	rem	
2005	---	---	0.8	0.7	3.5-5.0	1.0	0.20-1.0	0.10	0.20	0.50	---	---	0.20 Bi, 1.0-2.0 Pb	0.20	0.05	0.15	rem	
2006	---	---	0.8-1.3	0.7	1.0-2.0	0.6-1.0	0.50-1.4	---	0.20	0.20	---	---	---	---	0.30	0.05	0.15	rem
2007	---	---	0.8	0.8	3.3-4.6	0.50-1.0	0.40-1.8	0.10	0.20	0.8	---	---	(i)	0.20	0.10	0.30	rem	
2008	---	---	0.50-0.8	0.40	0.7-1.1	0.30	0.25-0.50	0.10	---	0.25	---	0.05	---	---	0.10	0.05	0.15	rem
2011	A92011	AlCu6Bi Pb	0.40	0.7	5.0-6.0	---	---	---	---	0.30	---	---	---	(j)	---	0.05	0.15	rem
2014	A92014	AlCu4SiMg	0.50-1.2	0.7	3.9-5.0	0.40-1.2	0.20-0.8	0.10	---	0.25	---	---	---	(k)	0.15	0.05	0.15	rem
2214	A92214	AlCu4SiMg	0.50-1.2	0.30	3.9-5.0	0.40-1.2	0.20-0.8	0.10	---	0.25	---	---	---	(k)	0.15	0.05	0.15	rem
2017	A92017	AlCu4MgSi	0.20-0.8	0.7	3.5-4.5	0.40-1.0	0.40-0.8	0.10	---	0.25	---	---	---	(k)	0.15	0.05	0.15	rem
2117	A92117	AlCu2.5Mg	0.20-0.8	0.7	3.5-4.5	0.40-1.0	0.40-1.0	0.10	---	0.25	---	---	0.25 Zr + Ti	---	0.05	0.15	rem	
---	---	---	0.8	0.7	2.2-3.0	0.20	0.20-0.50	0.10	---	0.25	---	---	---	---	---	0.05	0.15	rem
2018	A92018	---	0.9	1.0	3.5-4.5	0.20	0.45-0.9	0.10	1.7-2.3	0.25	---	---	---	---	---	0.05	0.15	rem
2218	A92218	---	0.9	1.0	3.5-4.5	0.20	1.2-1.8	0.10	1.7-2.3	0.25	---	---	---	---	---	0.05	0.15	rem
2618	A92618	---	0.10-0.25	0.9-1.3	1.9-2.7	---	1.3-1.8	---	0.9-1.2	0.10	---	---	---	---	0.04-0.10	0.05	0.15	rem
2219	A92219	AlCu6Mn	0.20	0.30	5.8-6.8	0.20-0.40	0.02	---	---	0.10	---	0.05-0.15	0.10-0.25 Zr	0.02-0.10	0.05	0.15	rem	
2319	A92319	---	0.20	0.30	5.8-6.8	0.20-0.40	0.02	---	---	0.10	---	0.05-0.15	0.10-0.25 Zr(a)	0.10-0.20	0.05	0.15	rem	
2419	A92419	---	0.15	0.18	5.8-6.8	0.20-0.40	0.02	---	---	0.10	---	0.05-0.15	0.10-0.25 Zr	0.02-0.10	0.05	0.15	rem	
2519	A92519	---	0.25(l)	0.30(l)	5.3-6.4	0.10-0.50	0.05-0.40	---	---	0.10	---	0.05-0.15	0.10-0.25 Zr	0.02-0.10	0.05	0.15	rem	
2021	A92021(c)	---	0.20	0.30	5.8-6.8	0.20-0.40	0.02	---	---	0.10	---	0.05-0.15	0.10-0.25 Zr(m)	0.02-0.10	0.05	0.15	rem	
2024	A92024	AlCu4Mg1	0.50	0.50	3.8-4.9	0.30-0.9	1.2-1.8	0.10	---	0.25	---	---	---	(k)	0.15	0.05	0.15	rem
2124	A92124	---	0.20	0.30	3.8-4.9	0.30-0.9	1.2-1.8	0.10	---	0.25	---	---	---	(k)	0.15	0.05	0.15	rem

(continued)

(a) 0.0008 Be max for welding electrode and filler wire only. (b) (Si + Fe + Cu) = 0.50 max. (c) Obsolete. (d) 0.14 (Si + Fe) max. (e) 0.02 B max. (f) 0.01 B max. (g) 0.003 Pb max. (h) 0.05 to 0.20 Cd. (i) 0.20 Bi, 0.8 to 1.5 Pb, 0.20 Sn. (j) 0.20 to 0.6 Bi, 0.20 to 0.6 Pb. (k) A (Zr + Ti) limit of 0.20% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (l) 0.40 (Si + Fe) max. (m) 0.05 to 0.20 Cd, 0.03 to 0.08 Sn. (n) 1.9 to 2.6 Li. (o) 1.7 to 2.3 Li. (p) 0.6 to 1.5 Bi, 0.05 Cd max. (q) 0.0008 Be max, 0.05 to 0.25 Zr. (r) 45 to 65% of Mg. (s) 0.40 to 0.7 Bi, 0.40 to 0.7 Pb. (t) 0.25 to 0.40 Ag. (u) 0.15 (Mn + Cr) min. (v) 0.08 to 0.20 Zr, 0.08 to 0.25 (Zr + Ti). (w) 0.20 (Ti + Zr) max. (x) 0.10 to 0.40 Co, 0.05 to 0.30 O. (y) A (Zr + Ti) limit of 0.25% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (z) 0.20 to 0.50 O. (aa) 0.001 B max, 0.003 Cd max, 0.001 Co max, 0.008 Li max. (bb) 0.10 to 0.50 Bi, 0.10 to 0.25 Sn. (cc) 1.0 (Si + Fe) max. (dd) 0.02 to 0.08 Zr. (ee) 2.2 to 2.7 Li. (ff) 2.4 to 2.8 Li. (gg) 2.1 to 2.7 Li. (hh) 2.3 to 2.9 Li

Table 2 (continued)

Grade designation			Composition, wt%														
Aluminum Association	ISO No. R209	UNS No.	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ga	V	Specified other elements	Ti	Unspecified other elements		Al, minimum
															Each	Total	
2224	A92224	...	0.12	0.15	3.8-4.4	0.30-0.9	1.2-1.8	0.10	...	0.25	...	...	...	0.15	0.05	0.15	rem
2324	A92324	...	0.10	0.12	3.8-4.4	0.30-0.9	1.2-1.8	0.10	...	0.25	...	...	...	0.15	0.05	0.15	rem
2025	A92025	...	0.50-1.2	1.0	3.9-5.0	0.40-1.2	0.05	0.10	...	0.25	...	...	...	0.15	0.05	0.15	rem
2030	...	AlCu4PbMg	0.8	0.7	3.3-4.5	0.20-1.0	0.50-1.3	0.10	...	0.50	...	...	0.20 Bi, 0.8-1.5 Pb	0.20	0.10	0.30	rem
2031	...	...	0.50-1.3	0.6-1.2	1.8-2.8	0.50	0.6-1.2	...	0.6-1.4	0.20	...	...	...	0.20	0.05	0.15	rem
2034	...	...	0.10	0.12	4.2-4.8	0.8-1.3	1.3-1.9	0.05	...	0.20	...	...	0.08-0.15 Zr	0.15	0.05	0.15	rem
2036	A92036	...	0.50	0.50	2.2-3.0	0.10-0.40	0.30-0.6	0.10	...	0.25	...	...	...	0.15	0.05	0.15	rem
2037	A92037	...	0.50	0.50	1.4-2.2	0.10-0.40	0.30-0.8	0.10	...	0.25	...	0.05	...	0.15	0.05	0.15	rem
2038	A92038	...	0.50-1.3	0.6	0.8-1.8	0.10-0.40	0.40-1.0	0.20	...	0.50	0.05	0.05	...	0.15	0.05	0.15	rem
2048	A92048	...	0.15	0.20	2.8-3.8	0.20-0.6	1.2-1.8	...	...	0.25	...	...	...	0.10	0.05	0.15	rem
2090	A92090	...	0.10	0.12	2.4-3.0	0.05	0.25	0.05	...	0.10	...	...	0.08-0.15 Zr(n)	0.15	0.05	0.15	rem
2091	...	...	0.20	0.30	1.8-2.5	0.10	1.1-1.9	0.10	...	0.25	...	...	0.04-0.16 Zr(o)	0.10	0.05	0.15	rem
3002	A93002	...	0.08	0.10	0.15	0.05-0.25	0.05-0.20	...	...	0.05	...	0.05	...	0.03	0.03	0.10	rem
3102	A93102	...	0.40	0.7	0.10	0.05-0.40	...	...	...	0.30	...	...	...	0.10	0.05	0.15	rem
3003	A93003	AlMn1Cu	0.6	0.7	0.05-0.20	1.0-1.5	...	...	...	0.10	...	...	...	...	0.05	0.15	rem
3103	...	...	0.50	0.7	0.10	0.9-1.5	0.30	0.10	...	0.20	...	...	0.10 Zr + Ti	...	0.05	0.15	rem
3203	...	...	0.6	0.7	0.05	1.0-1.5	...	...	...	0.10	...	...	(a)	...	0.05	0.15	rem
3303	A93303	AlMn1	0.6	0.7	0.05-0.20	1.0-1.5	...	...	...	0.30	...	...	...	...	0.05	0.15	rem
3004	A93004	AlMn1Mg1	0.30	0.7	0.25	1.0-1.5	0.8-1.3	...	...	0.25	...	...	...	...	0.05	0.15	rem
3104	A93104	...	0.6	0.8	0.05-0.25	0.8-1.4	0.8-1.3	...	...	0.25	0.05	0.05	...	0.10	0.05	0.15	rem
3005	A93005	AlMn1Mg0.5	0.6	0.7	0.30	1.0-1.5	0.20-0.6	0.10	...	0.25	...	...	...	0.10	0.05	0.15	rem
3105	A93105	AlMn0.5Mg0.5	0.6	0.7	0.30	0.30-0.8	0.20-0.8	0.20	...	0.40	...	...	...	0.10	0.05	0.15	rem
3006	A93006	...	0.50	0.7	0.10-0.30	0.50-0.8	0.30-0.6	0.20	...	0.15-0.40	...	...	...	0.10	0.05	0.15	rem
3007	A93007	...	0.50	0.7	0.05-0.30	0.30-0.8	0.6	0.20	...	0.40	...	...	...	0.10	0.05	0.15	rem
3107	A93107	...	0.6	0.7	0.05-0.15	0.40-0.9	...	...	...	0.20	...	...	...	0.10	0.05	0.15	rem
3207	...	...	0.30	0.45	0.10	0.40-0.8	0.10	...	...	0.10	...	...	...	...	0.05	0.10	rem
3307	...	...	0.6	0.8	0.30	0.50-0.9	0.30	...	...	0.25	...	...	...	0.10	0.05	0.15	rem
3008	...	...	0.40	0.7	0.10	1.2-1.8	0.01	0.05	0.05	0.05	...	...	0.10-0.50 Zr	0.10	0.05	0.15	rem
3009	A93009	...	1.0-1.8	0.7	0.10	1.2-1.8	0.10	0.05	0.05	0.05	...	...	0.10 Zr	0.10	0.05	0.15	rem
3010	A93010	...	0.10	0.20	0.03	0.20-0.9	...	0.05-0.40	...	0.05	...	0.05	...	0.05	0.03	0.10	rem
3011	A93011	...	0.40	0.7	0.05-0.20	0.8-1.2	...	0.10-0.40	...	0.10	...	...	0.10-0.30 Zr	0.10	0.05	0.15	rem
3012	...	...	0.6	0.7	0.10	0.50-1.1	0.10	0.20	...	0.10	...	...	...	0.10	0.05	0.15	rem
3013	...	...	0.6	1.0	0.50	0.9-1.4	0.20-0.6	...	...	0.50-1.0	...	...	...	...	0.05	0.15	rem
3014	...	...	0.6	1.0	0.50	1.0-1.5	0.10	...	...	0.50-1.0	...	...	...	0.10	0.05	0.15	rem
3015	...	...	0.6	0.8	0.30	0.50-0.9	0.20-0.7	...	...	0.25	...	...	...	0.10	0.05	0.15	rem
3016	...	...	0.6	0.8	0.30	0.50-0.9	0.50-0.8	...	...	0.25	...	...	...	0.10	0.05	0.15	rem
4004	A94004	...	9.0-10.5	0.8	0.25	0.10	1.0-2.0	...	...	0.20	...	...	...	...	0.05	0.15	rem
4104	A94104	...	9.0-10.5	0.8	0.25	0.10	1.0-2.0	...	...	0.20	...	...	0.02-0.20 Bi	...	0.05	0.15	rem
4006	...	...	0.8-1.2	0.50-0.8	0.05	0.03	0.01	0.20	...	0.05	...	...	...	...	0.05	0.15	rem
4007	...	...	1.0-1.7	0.40-1.0	0.20	0.8-1.5	0.20	0.05-0.25	0.15-0.7	0.10	...	...	0.05 Co	0.10	0.05	0.15	rem
4008	A94008	...	6.5-7.5	0.09	0.05	0.05	0.30-0.45	...	...	0.05	...	...	(a)	0.04-0.15	0.05	0.15	rem
4009	...	...	4.5-5.5	0.20	1.0-1.5	0.10	0.45-0.6	...	...	0.10	...	...	(a)	0.20	0.05	0.15	rem
4010	...	...	6.5-7.5	0.20	0.20	0.10	0.30-0.45	...	...	0.10	...	...	(a)	0.20	0.05	0.15	rem
4011	...	...	6.5-7.5	0.20	0.20	0.10	0.45-0.7	...	...	0.10	...	...	0.04-0.07 Be	0.04-0.20	0.05	0.15	rem
4013	...	...	3.5-4.5	0.35	0.05-0.20	0.03	0.05-0.20	...	...	0.05	...	...	(p)	0.02	0.05	0.15	rem
4032	A94032	...	11.0-13.5	1.0	0.50-1.3	...	0.8-1.3	0.10	0.50-1.3	0.25	...	...	...	...	0.05	0.15	rem
4043	A94043	AlSi5	4.5-6.0	0.8	0.30	0.05	0.05	...	...	0.10	...	...	(a)	0.20	0.05	0.15	rem
4343	A94343	...	6.8-8.2	0.8	0.25	0.10	...	...	...	0.20	...	...	...	...	0.05	0.15	rem
4543	A94543	...	5.0-7.0	0.50	0.10	0.05	0.10-0.40	0.05	...	0.10	...	...	...	0.10	0.05	0.15	rem
4643	A94643	...	3.6-4.6	0.8	0.10	0.05	0.10-0.30	...	...	0.10	...	...	(a)	0.15	0.05	0.15	rem
4044	A94044	...	7.8-9.2	0.8	0.25	0.10	...	...	...	0.20	...	...	...	...	0.05	0.15	rem
4045	A94045	...	9.0-11.0	0.8	0.30	0.05	0.05	...	...	0.10	...	...	...	0.20	0.05	0.15	rem
1415	A94145	...	9.3-10.7	0.8	3.3-4.7	0.15	0.15	0.15	...	0.20	...	...	(a)	...	0.05	0.15	rem
4047	A94047	AlSi12	11.0-13.0	0.8	0.30	0.15	0.10	...	...	0.20	...	...	(a)	...	0.05	0.15	rem
5005	A95005	AlMg1	0.30	0.7	0.20	0.20	0.50-1.1	0.10	...	0.25	...	...	...	...	0.05	0.15	rem
5205	...	AlMg1(B)	0.15	0.7	0.03-0.10	0.10	0.6-1.0	0.10	...	0.05	...	...	...	...	0.05	0.15	rem
5006	A95006	...	0.40	0.8	0.10	0.40-0.8	0.8-1.3	0.10	...	0.25	...	...	...	0.10	0.05	0.15	rem
5010	A95010	...	0.40	0.7	0.25	0.10-0.30	0.20-0.6	0.15	...	0.30	...	...	...	0.10	0.05	0.15	rem
5013	...	...	0.20	0.25	0.03	0.30-0.50	3.2-3.8	0.03	0.03	0.10	...	...	0.05 Zr(g)	0.10	0.05	0.15	rem
5014	...	...	0.40	0.40	0.20	0.20-0.9	4.0-5.5	0.20	...	0.7-1.5	...	...	...	0.20	0.05	0.15	rem
5016	A95016	...	0.25	0.6	0.20	0.40-0.7	1.4-1.9	0.10	...	0.15	...	...	...	0.05	0.05	0.15	rem
5017	...	...	0.40	0.7	0.18-0.28	0.6-0.8	1.9-2.2	...	...	...	...	...	...	0.09	0.05	0.15	rem
5040	A95040	...	0.30	0.7	0.25	0.9-1.4	1.0-1.5	0.10-0.30	...	0.25	...	...	...	...	0.05	0.15	rem
5042	A95042	...	0.20	0.35	0.15	0.20-0.50	3.0-4.0	0.10	...	0.25	...	...	...	0.10	0.05	0.15	rem
5043	A95043	...	0.40	0.7	0.05-0.35	0.7-1.2	0.7-1.3	0.05	...	0.25	0.05	0.05	...	0.10	0.05	0.15	rem
5049	...	...	0.40	0.50	0.10	0.50-1.1	1.6-2.5	0.30	...	0.20	...	...	...	0.10	0.05	0.15	rem
5050	A95050	AlMg1.5(C)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		AlMg1.5	0.40	0.7	0.20	0.10	1.1-1.8	0.10	...	0.25	...	...	...	...	0.05	0.15	rem

(continued)

(a) 0.0008 Be max for welding electrode and filler wire only. (b) (Si + Fe + Cu) = 0.50 max. (c) Obsolete. (d) 0.14 (Si + Fe) max. (e) 0.02 B max. (f) 0.01 B max. (g) 0.003 Pb max. (h) 0.05 to 0.20 Cd. (i) 0.20 Bi, 0.8 to 1.5 Pb, 0.20 Sn. (j) 0.20 to 0.6 Bi, 0.20 to 0.6 Pb. (k) A (Zr + Ti) limit of 0.20% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (l) 0.40 (Si + Fe) max. (m) 0.05 to 0.20 Cd, 0.03 to 0.08 Sn. (n) 1.9 to 2.6 Li. (o) 1.7 to 2.3 Li. (p) 0.6 to 1.5 Bi, 0.05 Cd max. (q) 0.0008 Be max, 0.05 to 0.25 Zr. (r) 45 to 65% of Mg. (s) 0.40 to 0.7 Bi, 0.40 to 0.7 Pb. (t) 0.25 to 0.40 Ag. (u) 0.15 (Mn + Cr) min. (v) 0.08 to 0.20 Zr, 0.08 to 0.25 (Zr + Ti). (w) 0.20 (Ti + Zr) max. (x) 0.10 to 0.40 Co, 0.05 to 0.30 O. (y) A (Zr + Ti) limit of 0.25% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (z) 0.20 to 0.50 O. (aa) 0.001 B max, 0.003 Cd max, 0.001 Co max, 0.008 Li max. (bb) 0.10 to 0.50 Bi, 0.10 to 0.25 Sn. (cc) 1.0 (Si + Fe) max. (dd) 0.02 to 0.08 Zr. (ee) 2.2 to 2.7 Li. (ff) 2.4 to 2.8 Li. (gg) 2.1 to 2.7 Li. (hh) 2.3 to 2.9 Li

Source: Ref 2, 3, 4

Alloy and Temper Designation Systems for Aluminum and Aluminum Alloys / 19

Table 2 (continued)

Grade designation			Composition, wt%															
Aluminum Association	UNS No.	ISO No. R209	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ga	V	Specified other elements	Unspecified other elements		Al, minimum		
														Each	Total			
5150	---	---	0.08	0.10	0.10	0.03	1.3-1.7	---	---	0.10	---	---	---	---	0.06	0.03	0.10	rem
5250	A95250	---	0.08	0.10	0.10	0.05-0.15	1.3-1.8	---	---	0.05	0.03	0.05	---	---	---	0.03	0.10	rem
5051	A95051	AlMg2	0.40	0.7	0.25	0.20	1.7-2.2	0.10	---	0.25	---	---	---	---	0.10	0.05	0.15	rem
5151	A95151	---	0.20	0.35	0.15	0.10	1.5-2.1	0.10	---	0.15	---	---	---	---	0.10	0.05	0.15	rem
5251	---	AlMg2	0.40	0.50	0.15	0.10-0.50	1.7-2.4	0.15	---	0.15	---	---	---	---	0.15	0.05	0.15	rem
5351	A95351	---	0.08	0.10	0.10	0.10	1.6-2.2	---	---	0.05	---	0.05	---	---	---	0.03	0.10	rem
5451	A95154	AlMg3.5	0.25	0.40	0.10	0.10	1.8-2.4	0.15-0.35	0.05	0.10	---	---	---	---	0.05	0.05	0.15	rem
5052	A95052	AlMg2.5	0.25	0.40	0.10	0.10	2.2-2.8	0.15-0.35	---	0.10	---	---	---	---	---	0.05	0.15	rem
5252	A95252	---	0.08	0.10	0.10	0.10	2.2-2.8	---	---	0.05	---	0.05	---	---	---	0.03	0.10	rem
5352	A95352	---	0.45 (Si + Fe)	0.10	0.10	0.10	2.2-2.8	0.10	---	0.10	---	---	---	---	0.10	0.05	0.15	rem
5552	A95652	---	0.04	0.05	0.10	0.10	2.2-2.8	---	---	0.05	---	0.05	---	---	---	0.03	0.10	rem
5652	A95652	---	0.40 (Si + Fe)	0.04	0.01	0.01	2.2-2.8	0.15-0.35	---	0.10	---	---	---	---	---	0.05	0.15	rem
5154	---	AlMg3.5	0.25	0.40	0.10	0.10	3.1-3.9	0.15-0.35	---	0.20	---	---	(a)	---	0.20	0.05	0.15	rem
5254	A95254	---	0.45 (Si + Fe)	0.05	0.01	0.01	3.1-3.9	0.15-0.35	---	0.20	---	---	---	---	0.05	0.05	0.15	rem
5454	A95454	AlMg3Mn	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	rem
5554	A95554	AlMg3Mn(A)	0.25	0.40	0.10	0.50-1.0	2.4-3.0	0.05-0.20	---	0.25	---	---	(a)	0.05-0.20	0.05	0.15	rem	
5654	A95654	---	0.45 (Si + Fe)	0.05	0.01	0.01	3.1-3.9	0.15-0.35	---	0.20	---	---	(a)	0.05-0.15	0.05	0.15	rem	
5754	A95754	AlMg3	0.40	0.40	0.10	0.50	2.6-3.6	0.30	---	0.20	---	---	0.10-0.6 (Mn + Cr)	0.15	0.05	0.15	rem	
5854	---	---	0.45 (Si + Fe)	0.10	0.10	0.10-0.50	3.1-3.9	0.15-0.35	---	0.20	---	---	---	0.20	0.05	0.15	rem	
5056	A95056	AlMg5	---	0.10	0.10	0.10-0.50	3.1-3.9	0.15-0.35	---	0.20	---	---	---	0.20	0.05	0.15	rem	
5356	A95356	AlMg5Cr	0.30	0.40	0.10	0.05-0.20	4.5-5.6	0.05-0.20	---	0.10	---	---	---	---	0.05	0.15	rem	
5456	A95456	AlMg5Cr(A)	0.25	0.40	0.10	0.05-0.20	4.5-5.5	0.05-0.20	---	0.10	---	---	(a)	0.06-0.20	0.05	0.15	rem	
5556	A95556	AlMg5Mn1	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	rem	
5357	A95357	---	0.12	0.17	0.20	0.15-0.45	0.8-1.2	---	---	0.05	---	---	(a)	0.05-0.20	0.05	0.15	rem	
5457	A95457	---	0.08	0.10	0.20	0.15-0.45	0.8-1.2	---	---	0.05	---	0.05	---	---	0.03	0.10	rem	
5557	A95557	---	0.10	0.12	0.15	0.10-0.40	0.40-0.8	---	---	---	---	0.05	---	---	0.03	0.10	rem	
5657	A95657	---	0.08	0.10	0.10	0.03	0.6-1.0	---	---	0.05	0.03	0.05	---	---	0.02	0.05	rem	
5280	---	---	0.35 (Si + Fe)	0.10	0.20-0.7	3.5-4.5	0.05-0.25	---	---	1.5-2.8	---	---	(q)	---	0.05	0.15	rem	
5082	A95082	---	0.20	0.35	0.15	0.15	4.0-5.0	0.15	---	0.25	---	---	---	0.10	0.05	0.15	rem	
5182	A95182	---	0.20	0.35	0.15	0.20-0.50	4.0-5.0	0.10	---	0.25	---	---	---	0.10	0.05	0.15	rem	
5083	A95083	AlMg4.5Mn	0.40-0.7	0.40	0.10	0.40-1.0	4.0-4.9	0.05-0.25	---	0.25	---	---	---	0.15	0.05	0.15	rem	
5183	A95183	AlMg4.5Mn	0.40-0.7(A)	0.40	0.10	0.50-1.0	4.3-5.2	0.05-0.25	---	0.25	---	---	(a)	0.15	0.05	0.15	rem	
5283	---	---	0.30	0.30	0.03	0.50-1.0	4.5-5.1	0.05	0.03	0.10	---	---	0.05 Zr	0.03	0.05	0.15	rem	
5086	A95086	AlMg4	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	rem	
6101	A96101	E-AlMgSi	0.30-0.7	0.50	0.10	0.03	0.35-0.8	0.03	---	0.10	---	---	0.06 B	---	0.03	0.10	rem	
6201	A96201	---	0.50-0.9	0.50	0.10	0.03	0.6-0.9	0.03	---	0.10	---	---	0.06 B	---	0.03	0.10	rem	
6301	A96301	---	0.50-0.9	0.7	0.10	0.15	0.6-0.9	0.10	---	0.25	---	---	---	0.15	0.05	0.15	rem	
6002	---	---	0.6-0.9	0.25	0.10-0.25	0.10-0.20	0.45-0.7	0.05	---	---	---	---	0.09-0.14 Zr	0.08	0.05	0.15	rem	
6003	A96003	AlMg1Si	0.35-1.0	0.6	0.10	0.8	0.8-1.5	0.35	---	0.20	---	---	---	0.10	0.05	0.15	rem	
6103	---	---	0.35-1.0	0.6	0.20-0.30	0.8	0.8-1.5	0.35	---	0.20	---	---	---	0.10	0.05	0.15	rem	
6004	A96004	---	0.30-0.6	0.10-0.30	0.10	0.20-0.6	0.40-0.7	---	---	0.05	---	---	---	---	0.05	0.15	rem	
6005	A96005	AlSiMg	0.6-0.9	0.35	0.10	0.10	0.40-0.6	0.10	---	0.10	---	---	---	0.10	0.05	0.15	rem	
6105	A96105	---	0.6-1.0	0.35	0.10	0.10	0.45-0.8	0.10	---	0.10	---	---	---	0.10	0.05	0.15	rem	
6205	A96205	---	0.6-0.9	0.7	0.20	0.05-0.15	0.40-0.6	0.05-0.15	---	0.25	---	---	0.05-0.15 Zr	0.15	0.05	0.15	rem	
6006	A96006	---	0.20-0.6	0.35	0.15-0.30	0.15-0.20	0.45-0.9	0.10	---	0.10	---	---	---	0.10	0.05	0.15	rem	
6106	---	---	0.30-0.6	0.35	0.25	0.05-0.20	0.40-0.8	0.20	---	0.10	---	---	---	---	0.05	0.10	rem	
X6206	---	---	0.35-0.7	0.35	0.20-0.50	0.13-0.30	0.45-0.8	0.10	---	0.20	---	---	---	0.10	0.05	0.15	rem	
6007	A96007	---	0.9-1.4	0.7	0.20	0.05-0.25	0.6-0.9	0.05-0.25	---	0.25	---	---	0.05-0.20 Zr	0.15	0.05	0.15	rem	
6008	---	---	0.50-0.9	0.35	0.30	0.30	0.40-0.7	0.30	---	0.20	---	0.05-0.20	---	0.10	0.05	0.15	rem	
6009	A96009	---	0.6-1.0	0.50	0.15-0.6	0.20-0.8	0.40-0.8	0.10	---	0.25	---	---	---	0.10	0.05	0.15	rem	
6010	A96010	---	0.8-1.2	0.50	0.15-0.6	0.20-0.8	0.6-1.0	0.10	---	0.25	---	---	---	0.10	0.05	0.15	rem	
6110	A96110	---	0.7-1.5	0.8	0.20-0.7	0.20-0.7	0.50-1.1	0.04-0.25	---	0.30	---	---	---	0.15	0.05	0.15	rem	
6011	A96011	---	0.6-1.2	1.0	0.40-0.9	0.8	0.6-1.2	0.30	0.20	1.5	---	---	---	0.20	0.05	0.15	rem	
6111	A96111	---	0.7-1.1	0.40	0.50-0.9	0.15-0.45	0.50-1.0	0.10	---	0.15	---	---	---	0.10	0.05	0.15	rem	
6012	---	---	0.6-1.4	0.50	0.10	0.40-1.0	0.6-1.2	0.30	---	0.30	---	---	0.7 Bi, 0.40-2.0 Pb	0.20	0.05	0.15	rem	
X6013	---	---	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	rem	
6014	---	---	0.30-0.6	0.35	0.25	0.05-0.20	0.40-0.8	0.20	---	0.10	---	0.05-0.20	---	0.10	0.05	0.15	rem	
6015	---	---	0.20-0.40	0.10-0.30	0.10-0.25	0.10	0.8-1.1	0.10	---	0.10	---	---	---	0.10	0.05	0.15	rem	
6016	---	---	1.0-1.5	0.50	0.20	0.20	0.25-0.6	0.10	---	0.20	---	---	---	0.15	0.05	0.15	rem	
6017	A96017	---	0.55-0.7	0.15-0.30	0.05-0.20	0.10	0.45-0.6	0.10	---	0.05	---	---	---	0.05	0.05	0.15	rem	
6151	A96151	---	0.6-1.2	1.0	0.35	0.20	0.45-0.8	0.15-0.35	---	0.25	---	---	---	0.15	0.05	0.15	rem	
6351	A96351	AlSi1Mg0.5Mn	0.7-1.3	0.50	0.10	0.40-0.8	0.40-0.8	---	---	0.20	---	---	---	0.20	0.05	0.15	rem	
6951	A96951	---	0.20-0.50	0.8	0.15-0.40	0.10	0.40-0.8	---	---	0.20	---	---	---	---	0.05	0.15	rem	
6053	A96053	---	(r)	0.35	0.10	---	1.1-1.4	0.15-0.35	---	0.10	---	---	---	---	0.05	0.15	rem	
6253	A96253	---	(r)	0.50	0.10	---	1.0-1.5	0.04-0.35	---	1.6-2.4	---	---	---	---	0.05	0.15	rem	

(continued)

(a) 0.0008 Be max for welding electrode and filler wire only. (b) (Si + Fe + Cu) = 0.50 max. (c) Obsolete. (d) 0.14 (Si + Fe) max. (e) 0.02 B max. (f) 0.01 B max. (g) 0.003 Pb max. (h) 0.05 to 0.20 Cd. (i) 0.20 Bi, 0.8 to 1.5 Pb, 0.20 Sn. (j) 0.20 to 0.6 Bi, 0.20 to 0.6 Pb. (k) A (Zr + Ti) limit of 0.20% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (l) 0.40 (Si + Fe) max. (m) 0.05 to 0.20 Cd, 0.03 to 0.08 Sn. (n) 1.9 to 2.6 Li. (o) 1.7 to 2.3 Li. (p) 0.6 to 1.5 Bi, 0.05 Cd max. (q) 0.0008 Be max, 0.05 to 0.25 Zr. (r) 45 to 65% of Mg. (s) 0.40 to 0.7 Bi, 0.40 to 0.7 Pb. (t) 0.

20 / Specific Metals and Alloys

Table 2 (continued)

Grade designation			Composition, wt%														
Aluminum Association	UNS No.	ISO No. R209	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ga	V	Specified other elements	Ti	Unspecified other elements		Al, minimum
													Each	Total	Each	Total	
6060	A96060	AlMgSi	0.30-0.6	0.10-0.30	0.10	0.10	0.35-0.6	0.05	...	0.15	...	...	...	0.10	0.05	0.15	rem
6061	A96061	AlMg1SiCu	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	rem
6261	A96261	...	0.40-0.7	0.40	0.15-0.40	0.20-0.35	0.7-1.0	0.10	...	0.20	...	...	...	0.10	0.05	0.15	rem
6162	A96162	...	0.40-0.8	0.50	0.20	0.10	0.7-1.1	0.10	...	0.25	...	...	...	0.10	0.05	0.15	rem
6262	A96262	AlMg1SiPb	0.40-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.04-0.14	...	0.25	...	...	(s)	0.15	0.05	0.15	rem
6063	A96063	AlMg0.5Si	0.20-0.6	0.35	0.10	0.10	0.45-0.9	0.10	...	0.10	...	...	...	0.10	0.05	0.15	rem
6463	A96463	AlMg0.7Si	0.20-0.6	0.15	0.20	0.05	0.45-0.9	...	...	0.05	...	...	...	...	0.05	0.15	rem
6763	A96763	...	0.20-0.6	0.08	0.04-0.16	0.03	0.45-0.9	...	...	0.03	...	0.05	...	...	0.03	0.10	rem
6863	...	...	0.40-0.6	0.15	0.05-0.20	0.05	0.50-0.8	0.05	...	0.10	...	...	...	0.10	0.05	0.15	rem
6066	A96066	...	0.9-1.8	0.50	0.7-1.2	0.6-1.1	0.8-1.4	0.40	...	0.25	...	...	...	0.20	0.05	0.15	rem
6070	A96070	...	1.0-1.7	0.50	0.15-0.40	0.40-1.0	0.50-1.2	0.10	...	0.25	...	...	...	0.15	0.05	0.15	rem
6081	...	...	0.7-1.1	0.50	0.10	0.10-0.45	0.6-1.0	0.10	...	0.20	...	...	...	0.15	0.05	0.15	rem
6181	...	AlSiMg0.8	0.8-1.2	0.45	0.10	0.15	0.6-1.0	0.10	...	0.20	...	...	...	0.10	0.05	0.15	rem
6082	...	AlSi1MgMn	0.7-1.3	0.50	0.10	0.40-1.0	0.6-1.2	0.25	...	0.20	...	...	...	0.10	0.05	0.15	rem
7001	A97001	...	0.35	0.40	1.6-2.6	0.20	2.6-3.4	0.18-0.35	...	6.8-8.0	...	...	...	0.20	0.05	0.15	rem
7003	...	...	0.30	0.35	0.20	0.30	0.50-1.0	0.20	...	5.0-6.5	...	...	0.05-0.25 Zr	0.20	0.05	0.15	rem
7004	A97004	...	0.25	0.35	0.05	0.20-0.7	1.0-2.0	0.05	...	3.8-4.6	...	...	0.10-0.20 Zr	0.05	0.05	0.15	rem
7005	A97005	...	0.35	0.40	0.10	0.20-0.7	1.0-1.8	0.06-0.20	...	4.0-5.0	...	...	0.08-0.20 Zr	0.01-0.06	0.05	0.15	rem
7008	A97008	...	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	rem
7108	A97108	...	0.10	0.10	0.05	0.05	0.7-1.4	...	...	4.5-5.5	...	...	0.12-0.25 Zr	0.05	0.05	0.15	rem
7009	...	...	0.20	0.20	0.6-1.3	0.10	2.1-2.9	0.10-0.25	...	5.5-5.6	...	...	(t)	0.20	0.05	0.15	rem
7109	...	...	0.10	0.15	0.8-1.3	0.10	2.2-2.7	0.04-0.08	...	5.8-6.5	...	...	0.10-0.20 Zr	0.10	0.05	0.15	rem
7010	...	AlZn6MgCu	0.12	0.15	1.5-2.0	0.10	2.1-2.6	0.05	0.05	5.7-6.7	...	...	0.10-0.16 Zr	0.06	0.05	0.15	rem
7011	A97011(c)	...	0.15	0.20	0.05	0.10-0.30	1.0-1.6	0.05-0.20	...	4.0-5.5	...	...	...	0.05	0.05	0.15	rem
7012	...	...	0.15	0.25	0.8-1.2	0.08-0.15	1.8-2.2	0.04	...	5.8-6.5	...	...	0.10-0.18 Zr	0.02-0.08	0.05	0.15	rem
7013	A97013	...	0.6	0.7	0.10	1.0-1.5	...	...	...	1.5-2.0	...	...	...	...	0.05	0.15	rem
7014	...	...	0.50	0.50	0.30-0.7	0.30-0.7	2.2-3.2	...	0.10	5.2-6.2	...	...	0.20	...	0.05	0.15	rem
7015	...	...	0.20	0.30	0.06-0.15	0.10	1.3-2.1	0.15	...	4.6-5.2	...	...	(Ti + Zr)	0.10	0.05	0.15	rem
7016	A97016	...	0.10	0.12	0.45-1.0	0.03	0.8-1.4	...	...	4.0-5.0	...	0.05	...	0.03	0.03	0.10	rem
7116	...	...	0.15	0.30	0.50-1.1	0.05	0.8-1.4	...	...	4.2-5.2	0.03	0.05	...	0.05	0.05	0.15	rem
7017	...	...	0.35	0.45	0.20	0.05-0.50	2.0-3.0	0.35	0.10	4.0-5.2	...	...	0.10-0.25 Zr	0.15	0.05	0.15	rem
7018	...	...	0.35	0.45	0.20	0.15-0.50	0.7-1.5	0.20	0.10	4.5-5.5	...	...	(u)	0.15	0.05	0.15	rem
7019	...	...	0.35	0.45	0.20	0.15-0.50	1.5-2.5	0.20	0.10	3.5-4.5	...	...	0.10-0.25 Zr	0.15	0.05	0.15	rem
7020	...	AlZn4.5Mg1	0.35	0.40	0.20	0.05-0.50	1.0-1.4	0.10-0.35	...	4.0-5.0	...	...	(v)	...	0.05	0.15	rem
7021	A97021	...	0.25	0.40	0.25	0.10	1.2-1.8	0.05	...	5.0-6.0	...	...	0.08-0.18 Zr	0.10	0.05	0.15	rem
7022	...	...	0.50	0.50	0.50-1.0	0.10-0.40	2.6-3.7	0.10-0.30	...	4.3-5.2	...	...	0.20	...	0.05	0.15	rem
7023	...	...	0.50	0.50	0.50-1.0	0.10-0.6	2.0-3.0	0.05-0.35	...	4.0-6.0	...	...	(Ti + Zr)	0.10	0.05	0.15	rem
7024	...	...	0.30	0.40	0.10	0.10-0.6	0.50-1.0	0.05-0.35	...	3.0-5.0	...	...	...	0.10	0.05	0.15	rem
7025	...	...	0.30	0.40	0.10	0.10-0.6	0.8-1.5	0.05-0.35	...	3.0-5.0	...	...	...	0.10	0.05	0.15	rem
7026	...	...	0.08	0.12	0.6-0.9	0.05-0.20	1.5-1.9	...	...	4.6-5.2	...	...	0.09-0.14 Zr	0.05	0.03	0.10	rem
7027	...	...	0.25	0.40	0.10-0.30	0.10-0.40	0.7-1.1	...	...	3.5-4.5	...	...	0.05-0.30 Zr	0.10	0.05	0.15	rem
7028	...	...	0.35	0.50	0.10-0.30	0.15-0.6	1.5-2.3	0.20	...	4.5-5.2	...	...	0.08-0.25 Zr	0.05	0.05	0.15	rem
7029	A97029	...	0.10	0.12	0.50-0.9	0.03	1.3-2.0	...	...	4.2-5.2	...	0.05	...	0.05	0.03	0.10	rem
7129	A97129	...	0.15	0.30	0.50-0.9	0.10	1.3-2.0	0.10	...	4.2-5.2	0.03	0.05	...	0.05	0.05	0.15	rem
7229	...	...	0.06	0.08	0.50-0.9	0.03	1.3-2.0	...	...	4.2-5.2	...	0.05	...	0.05	0.03	0.10	rem
7030	...	...	0.20	0.30	0.20-0.40	0.05	1.0-1.5	0.04	...	4.8-5.9	0.03	...	0.03 Zr	0.03	0.05	0.15	rem
7039	A97039	...	0.30	0.40	0.10	0.10-0.40	2.3-3.3	0.15-0.25	...	3.5-4.5	...	...	...	0.10	0.05	0.15	rem
7046	A97046	...	0.20	0.40	0.25	0.30	1.0-1.6	0.20	...	6.6-7.6	...	...	0.10-0.18 Zr	0.06	0.05	0.15	rem
7146	A97146	...	0.20	0.40	...	...	1.0-1.6	...	...	6.6-7.6	...	...	0.10-0.18 Zr	0.06	0.05	0.15	rem
7049	A97049	...	0.25	0.35	1.2-1.9	0.20	2.0-2.9	0.10-0.22	...	7.2-8.2	...	...	...	0.10	0.05	0.15	rem
7149	A97149	...	0.15	0.20	1.2-1.9	0.20	2.0-2.9	0.10-0.22	...	7.2-8.2	...	...	...	0.10	0.05	0.15	rem
7050	A97050	AlZn6CuMgZr	0.12	0.15	2.0-2.6	0.10	1.9-2.6	0.04	...	5.7-6.7	...	...	0.08-0.15 Zr	0.06	0.05	0.15	rem
7150	A97150	...	0.12	0.15	1.9-2.5	0.10	2.0-2.7	0.04	...	5.9-6.9	...	...	0.08-0.15 Zr	0.06	0.05	0.15	rem
7051	...	...	0.35	0.45	0.15	0.10-0.45	1.7-2.5	0.05-0.25	...	3.0-4.0	...	...	...	0.15	0.05	0.15	rem
7060	...	...	0.15	0.20	1.8-2.6	0.20	1.3-2.1	0.15-0.25	...	6.1-7.5	...	...	0.003 Pb	0.10	0.05	0.15	rem
X7064	...	...	0.12	0.15	1.8-2.4	...	1.9-2.9	0.06-0.25	...	6.8-8.0	...	...	(x)	0.10-0.50 Zr	0.05	0.15	rem
7072	A97072	AlZn1	0.7 (Si + Fe)	0.10	0.10	0.10	...	...	...	0.8-1.3	...	...	...	...	0.05	0.15	rem
7472	A97472	...	0.25	0.6	0.05	0.05	0.9-1.5	...	...	1.3-1.9	...	...	...	...	0.05	0.15	rem
7075	A97075	AlZn5.5 MgCu	0.40	0.50	1.2-2.0	0.30	2.1-2.9	0.18-0.28	...	5.1-6.1	...	...	(y)	0.20	0.05	0.15	rem
7175	A97175	...	0.15	0.20	1.2-2.0	0.10	2.1-2.9	0.18-0.28	...	5.1-6.1	...	...	...	0.10	0.05	0.15	rem
7475	A97475	AlZn5.5MgCu(A)	0.10	0.12	1.2-1.9	0.06	1.9-2.6	0.18-0.25	...	5.2-6.2	...	...	...	0.06	0.05	0.15	rem
7076	A97076	...	0.40	0.6	0.30-1.0	0.30-0.8	1.2-2.0	...	...	7.0-8.0	...	...	...	0.20	0.05	0.15	rem

(continued)

(a) 0.0008 Be max for welding electrode and filler wire only. (b) (Si + Fe + Cu) = 0.50 max. (c) Obsolete. (d) 0.14 (Si + Fe) max. (e) 0.02 B max. (f) 0.01 B max. (g) 0.003 Pb max. (h) 0.05 to 0.20 Cd. (i) 0.20 Bi, 0.8 to 1.5 Pb, 0.20 Sn. (j) 0.20 to 0.6 Bi, 0.20 to 0.6 Pb. (k) A (Zr + Ti) limit of 0.20% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (l) 0.40 (Si + Fe) max. (m) 0.05 to 0.20 Cd, 0.03 to 0.08 Sn. (n) 1.9 to 2.6 Li. (o) 1.7 to 2.3 Li. (p) 0.6 to 1.5 Bi, 0.05 Cd max. (q) 0.0008 Be max, 0.05 to 0.25 Zr. (r) 45 to 65% of Mg. (s) 0.40 to 0.7 Bi, 0.40 to 0.7 Pb. (t) 0.25 to 0.40 Ag. (u) 0.15 (Mn + Cr) min. (v) 0.08 to 0.20 Zr, 0.08 to 0.25 (Zr + Ti). (w) 0.20 (Ti + Zr) max. (x) 0.10 to 0.40 Co, 0.05 to 0.30 O. (y) A (Zr + Ti) limit of 0.25% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (z) 0.20 to 0.50 O. (aa) 0.001 B max, 0.003 Cd max, 0.001 Co max, 0.008 Li max. (bb) 0.10 to 0.50 Bi, 0.10 to 0.25 Sn. (cc) 1.0 (Si + Fe) max. (dd) 0.02 to 0.08 Zr. (ee) 2.2 to 2.7 Li. (ff) 2.4 to 2.8 Li. (gg) 2.1 to 2.7 Li. (hh) 2.3 to 2.9 Li
 Source: Ref 2, 3, 4

Table 2 (continued)

Grade designation			Composition, wt%											Specified other elements		Unspecified other elements		Al, minimum
Aluminum Association	ISO No. R209	UNS No.	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ga	V	Ti	Each	Total	Al, minimum		
			7277	A97277	0.50	0.7	0.8-1.7	...	1.7-2.3	0.18-0.35	...	3.7-4.3					...	...	0.10	0.05	0.15	rem
7178	A97178	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	rem	
7278	...	0.15	0.20	1.6-2.2	0.02	2.5-3.2	0.17-0.25	...	6.6-7.4	0.03	0.05	0.03	0.03	0.10	rem			
7079	A97079	0.30	0.40	0.40-0.8	0.10-0.30	2.9-3.7	0.10-0.25	...	3.8-4.8	...	...	0.10	0.05	0.15	rem	
7179	A97179	0.15	0.20	0.40-0.8	0.10-0.30	2.9-3.7	0.10-0.25	...	3.8-4.8	...	...	0.10	0.05	0.15	rem	
7090	A97090	0.12	0.15	0.6-1.3	...	2.0-3.0	...	...	7.3-8.7	...	...	1.0-1.9 Co	...	0.05	0.15	rem
7091	A97091	0.12	0.15	1.1-1.8	...	2.0-3.0	...	...	5.8-7.1	...	...	0.20-0.6 Co	...	0.05	0.15	rem
8001	A98001	0.17	0.45-0.7	0.15	...	...	...	0.9-1.3	0.05	...	...	(aa)	...	0.05	0.15	rem
8004	...	0.15	0.15	0.03	0.02	0.02	...	...	0.03	...	...	0.30-0.7	0.02	0.15	rem	
8005	...	0.20-0.50	0.40-0.8	0.05	...	0.05	...	...	0.05	...	...	...	0.05	0.15	rem	
8006	A98006	0.40	1.2-2.0	0.30	0.30-1.0	0.10	...	...	0.10	...	...	...	0.05	0.15	rem	
8007	A98007	0.40	1.2-2.0	0.10	0.30-1.0	0.10	...	...	0.8-1.8	...	...	...	0.05	0.15	rem	
8008	...	0.6	0.9-1.6	0.20	0.50-1.0	...	...	...	0.10	...	...	0.10	0.05	0.15	rem	
8010	...	0.40	0.35-0.7	0.10-0.30	0.10-0.8	0.10-0.50	0.20	...	0.40	...	...	0.10	0.05	0.15	rem	
8011	A98011	0.50-0.9	0.6-1.0	0.10	0.20	0.05	0.05	...	0.10	...	...	0.08	0.05	0.15	rem	
8111	A98111	0.30-1.1	0.40-1.0	0.10	0.10	0.05	0.05	...	0.10	...	...	0.08	0.05	0.15	rem	
8112	A98112	1.0	1.0	0.40	0.6	0.7	0.20	...	1.0	...	...	0.20	0.05	0.15	rem	
8014	A98014	0.30	1.2-1.6	0.20	0.20-0.6	0.10	...	...	0.10	...	...	0.10	0.05	0.15	rem	
8017	A98017	0.10	0.55-0.8	0.10-0.20	...	0.01-0.05	...	...	0.05	...	...	0.04 B, 0.003 Li	...	0.03	0.10	rem
8020	A98020	0.10	0.10	0.005	0.005	...	...	...	0.005	...	0.05	(bb)	...	0.03	0.10	rem
8030	A98030	0.10	0.30-0.8	0.15-0.30	...	0.05	...	...	0.05	...	...	0.001-0.04 B	...	0.03	0.10	rem
8130	A98130	0.15 (cc)	0.40-1.0(cc)	0.05-0.15	...	...	...	...	0.10	...	...	...	...	0.03	0.10	rem
8040	A98040	1.0 (Si + Fe)	0.20	0.05	...	...	...	...	0.20	...	...	0.10-0.30 Zr	...	0.05	0.15	rem
8076	A98076	0.10	0.6-0.9	0.04	...	0.08-0.22	...	...	0.05	...	...	0.04 B	...	0.03	0.10	rem
8176	A98176	0.03-0.15	0.40-1.0	...	...	...	...	...	0.10	0.03	...	...	...	0.05	0.15	rem
8276	...	0.25	0.50-0.8	0.035	0.01	0.02	0.01	...	0.05	0.03	...	0.03 (V + Ti)(e)	...	0.03	0.10	rem		
8077	A98077	0.10	0.10-0.40	0.05	...	0.10-0.30	...	...	0.05	...	...	0.05 B (dd)	...	0.03	0.10	rem
8177	A98177	0.10	0.25-0.45	0.04	...	0.04-0.12	...	...	0.05	...	...	0.04 B	...	0.03	0.10	rem
8079	A98079	0.05-0.30	0.7-1.3	0.05	...	...	...	...	0.10	...	...	...	...	0.05	0.15	rem
8280	A98280	1.0-2.0	0.7	0.7-1.3	0.10	...	...	0.20-0.7	0.05	...	...	5.5-7.0 Sn	0.10	0.05	0.15	rem
8081	A98081	0.7	0.7	0.7-1.3	0.10	...	...	...	0.05	...	...	18.0-22.0 Sn	0.10	0.05	0.15	rem
8090	...	0.20	0.30	1.0-1.6	0.10	0.6-1.3	0.10	...	0.25	...	...	0.04-0.16 Zr	0.10	0.05	0.15	rem
8091	...	0.30	0.50	1.6-2.2	0.10	0.50-1.2	0.10	...	0.25	...	...	0.08-0.16 Zr	0.10	0.05	0.15	rem
X8092	...	0.10	0.15	0.50-0.8	0.05	0.9-1.4	0.05	...	0.10	...	...	0.08-0.15 Zr	0.15	0.05	0.15	rem
X8192	...	0.10	0.15	0.40-0.7	0.05	0.9-1.4	0.05	...	0.10	...	...	0.08-0.15 Zr	0.15	0.05	0.15	rem

(a) 0.0008 Be max for welding electrode and filler wire only. (b) (Si + Fe + Cu) = 0.50 max. (c) Obsolete. (d) 0.14 (Si + Fe) max. (e) 0.02 B max. (f) 0.01 B max. (g) 0.003 Pb max. (h) 0.05 to 0.20 Cd. (i) 0.20 Bi, 0.8 to 1.5 Pb, 0.20 Sn. (j) 0.20 to 0.6 Bi, 0.20 to 0.6 Pb. (k) A (Zr + Ti) limit of 0.20% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (l) 0.40 (Si + Fe) max. (m) 0.05 to 0.20 Cd, 0.03 to 0.08 Sn. (n) 1.9 to 2.6 Li. (o) 1.7 to 2.3 Li. (p) 0.6 to 1.5 Bi, 0.05 Cd max. (q) 0.0008 Be max, 0.05 to 0.25 Zr. (r) 45 to 65% of Mg. (s) 0.40 to 0.7 Bi, 0.40 to 0.7 Pb. (t) 0.25 to 0.40 Ag. (u) 0.15 (Mn + Cr) min. (v) 0.08 to 0.20 Zr, 0.08 to 0.25 (Zr + Ti). (w) 0.20 (Ti + Zr) max. (x) 0.10 to 0.40 Co, 0.05 to 0.30 O. (y) A (Zr + Ti) limit of 0.25% maximum may be used for extruded and forged products when the supplier or producer and the purchaser have so agreed. (z) 0.20 to 0.50 O. (aa) 0.001 B max, 0.003 Cd max, 0.001 Co max, 0.008 Li max. (bb) 0.10 to 0.50 Bi, 0.10 to 0.25 Sn. (cc) 1.0 (Si + Fe) max. (dd) 0.02 to 0.08 Zr. (ee) 2.2 to 2.7 Li. (ff) 2.4 to 2.8 Li. (gg) 2.1 to 2.7 Li. (hh) 2.3 to 2.9 Li
Source: Ref 2, 3, 4

F, As-Fabricated. This is applied to products shaped by cold working, hot working, or casting processes in which no special control over thermal conditions or strain hardening is employed. For wrought products, there are no mechanical property limits.

O, Annealed. O applies to wrought products that are annealed to obtain lowest-strength temper and to cast products that are annealed to improve ductility and dimensional stability. The O may be followed by a digit other than zero.

H, Strain-Hardened (Wrought Products Only). This indicates products that have been strengthened by strain hardening, with or without supplementary thermal treatment to produce some reduction in strength. The H is always followed by two or more digits, as discussed in the section

“System for Strain-Hardened Products” in this article.

W, Solution Heat-Treated. This is an unstable temper applicable only to alloys whose strength naturally (spontaneously) changes at room temperature over a duration of months or even years after solution heat treatment. The designation is specific only when the period of natural aging is indicated (for example, W 1/2 h). See also the discussion of the Tx51, Tx52, and Tx54 tempers in the section “System for Heat-Treatable Alloys” in this article.

T, Solution Heat-Treated. This applies to alloys whose strength is stable within a few weeks of solution heat treatment. The T is always followed by one or more digits, as discussed in the section “System for Heat-Treatable Alloys” in this article.

System for Strain-Hardened Products

Temper designations for wrought products that are strengthened by strain hardening consist of an H followed by two or more digits. The first digit following the H indicates the specific sequence of basic operations.

H1, Strain-Hardened Only. This applies to products that are strain hardened to obtain the desired strength without supplementary thermal treatment. The digit following the H1 indicates the degree of strain hardening.

H2, Strain-Hardened and Partially Annealed. This pertains to products that are strain-hardened more than the desired final amount and then reduced in strength to the desired level by partial annealing. The digit following the H2 indicates the degree of

Table 3 Composition of unalloyed and alloyed aluminum castings (xxx.0) and ingots (xxx.1 or xxx.2)

Grade designation				Composition, wt%										Unspecified other elements		Al, min(d)
Alumi-num Association(a)	UNS No.	ISO(b)	Product(c)	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Sn	Ti	Each	Total	Al, min(d)
100.1	A01001	AI99.0	Ingot	0.15	0.6-0.8	0.10	(e)	...	(e)	...	0.05	...	(e)	0.03(e)	0.10	99.00
130.1	A01301	...	Ingot	(f)	0.10	0.10	(e)	...	(e)	...	0.05	...	(e)	0.03(e)	0.10	99.30
150.1	A01501	AI99.5	Ingot	(g)	(g)	0.05	(e)	...	(e)	...	0.05	...	(e)	0.03(e)	0.10	99.50
160.1	A01601	AI99.8	Ingot	0.10(g)	0.25(g)	...	(e)	...	(e)	...	0.05	...	(e)	0.03(e)	0.10	99.60
170.1	A01701	AI99.7	Ingot	(h)	(h)	...	(e)	...	(e)	...	0.05	...	(e)	0.03(e)	0.10	99.70
201.0	A02010	...	S	0.10	0.15	4.0-5.2	0.20-0.50	0.15-0.55	...	...	...	...	0.15-0.35	0.05(i)	0.10	rem
201.2	A02012	...	Ingot	0.10	0.10	4.0-5.2	0.20-0.50	0.20-0.55	...	...	...	...	0.15-0.35	0.05(i)	0.10	rem
A201.0	A12010	...	S	0.05	0.10	4.0-5.0	0.20-0.40	0.15-0.35	...	...	...	...	0.15-0.35	0.03(i)	0.10	rem
A201.1	A12011	...	Ingot	0.05	0.07	4.5-5.0	0.20-0.40	0.20-0.35	...	...	...	...	0.15-0.35	0.03(i)	0.10	rem
B201.0	A22010	...	S	0.05	0.05	4.5-5.0	0.20-0.50	0.25-0.35	...	...	...	...	0.15-0.35	0.05(j)	0.15	rem
203.0	A02030	...	S	0.30	0.50	4.5-5.5	0.20-0.30	0.10	...	1.3-1.7	0.10	...	0.15-0.25(k)	0.05(l)	0.20	rem
203.2	A02032	...	Ingot	0.20	0.35	4.8-5.2	0.20-0.30	0.10	...	1.3-1.7	0.10	...	0.15-0.25(k)	0.05(l)	0.20	rem
204.0	A02040	3522 AlCu4MgTi														
		R164 AlCu4MgTi														
		R2147 AlCu4MgTi	S, P	0.20	0.35	4.2-5.0	0.10	0.15-0.35	...	0.05	0.10	0.05	0.15-0.30	0.05	0.15	rem
204.2	A02042	...	Ingot	0.15	0.10-0.20	4.2-4.9	0.05	0.20-0.35	...	0.03	0.05	0.05	0.15-0.25	0.05	0.15	rem
206.0	A02060	...	S, P	0.10	0.15	4.2-5.0	0.20-0.50	0.15-0.35	...	0.05	0.10	0.05	0.15-0.30	0.05	0.15	rem
206.2	A02062	...	Ingot	0.10	0.10	4.2-5.0	0.20-0.50	0.20-0.35	...	0.03	0.05	0.05	0.15-0.25	0.05	0.15	rem
A206.0	A12060	...	S, P	0.05	0.10	4.2-5.0	0.20-0.50	0.15-0.35	...	0.05	0.10	0.05	0.15-0.30	0.05	0.15	rem
A206.2	A12062	...	Ingot	0.05	0.07	4.2-5.0	0.20-0.50	0.20-0.35	...	0.03	0.05	0.05	0.15-0.25	0.05	0.15	rem
208.0	A02080	...	S, P	2.5-3.5	1.2	3.5-4.5	0.50	0.10	...	0.35	1.0	...	0.25	...	0.50	rem
208.1	A02081	...	Ingot	2.5-3.5	0.9	3.5-4.5	0.50	0.10	...	0.35	1.0	...	0.25	...	0.50	rem
208.2	A02082	...	Ingot	2.5-3.5	0.8	3.5-4.5	0.30	0.03	...	...	0.20	...	0.20	...	0.30	rem
213.0	A02130	...	S, P	1.0-3.0	1.2	6.0-8.0	0.6	0.10	...	0.35	2.5	...	0.25	...	0.50	rem
213.1	A02131	...	Ingot	1.0-3.0	0.9	6.0-8.0	0.6	0.10	...	0.35	2.5	...	0.25	...	0.50	rem
222.0	A02220	...	S, P	2.0	1.5	9.2-10.7	0.50	0.15-0.35	...	0.50	0.8	...	0.25	...	0.35	rem
222.1	A02221	...	Ingot	2.0	1.2	9.2-10.7	0.50	0.20-0.35	...	0.50	0.8	...	0.25	...	0.35	rem
224.0	A02240	...	S, P	0.06	0.10	4.5-5.5	0.20-0.50	...	...	...	...	...	0.35	0.03(m)	0.10	rem
224.2	A02242	...	Ingot	0.02	0.04	4.5-5.5	0.20-0.50	...	...	...	...	...	0.25	0.03(m)	0.10	rem
240.0	A02400	...	S	0.50	0.50	7.0-9.0	0.30-0.7	5.5-6.5	...	0.30-0.7	0.10	...	0.20	0.05	0.15	rem
240.1	A02401	...	Ingot	0.50	0.40	7.0-9.0	0.30-0.7	5.6-6.5	...	0.30-0.7	0.10	...	0.20	0.05	0.15	rem
242.0	A02420	3522 AlCu4Ni2Mg2														
		R164 AlCu4Ni2Mg2	S, P	0.7	1.0	3.5-4.5	0.35	1.2-1.8	0.25	1.7-2.3	0.35	...	0.25	0.05	0.15	rem
242.1	A02421	...	Ingot	0.7	0.8	3.5-4.5	0.35	1.3-1.8	0.25	1.7-2.3	0.35	...	0.25	0.05	0.15	rem
242.2	A02422	...	Ingot	0.6	0.6	3.5-4.5	0.10	1.3-1.8	...	1.7-2.3	0.10	...	0.20	0.05	0.15	rem
A242.0	A12420	...	S	0.6	0.8	3.7-4.5	0.10	1.2-1.7	0.15-0.25	1.8-2.3	0.10	...	0.07-0.20	0.05	0.15	rem
A242.1	A12421	...	Ingot	0.6	0.6	3.7-4.5	0.10	1.3-1.7	0.15-0.25	1.8-2.3	0.10	...	0.07-0.20	0.05	0.15	rem
A242.2	A12422	...	Ingot	0.35	0.6	3.7-4.5	0.10	1.3-1.7	0.15-0.25	1.8-2.3	0.10	...	0.07-0.20	0.05	0.15	rem
243.0(a)	A02430	...	S	0.35	0.40	3.5-4.5	0.15-0.45	1.8-2.3	0.20-0.40	1.9-2.3	0.05	...	0.06-0.20	0.05(n)	0.15	rem
243.1	A02431	...	Ingot	0.35	0.30	3.5-4.5	0.15-0.45	1.9-2.3	0.20-0.40	1.9-2.3	0.05	...	0.06-0.20	0.05(n)	0.15	rem
295.0	A02950	...	S	0.7-1.5	1.0	4.0-5.0	0.35	0.03	...	...	0.35	...	0.25	0.05	0.15	rem
295.1	A02951	...	Ingot	0.7-1.5	0.8	4.0-5.0	0.35	0.03	...	...	0.35	...	0.25	0.05	0.15	rem
295.2	A02952	...	Ingot	0.7-1.2	0.8	4.0-5.0	0.30	0.03	...	...	0.30	...	0.20	0.05	0.15	rem
296.0	A02960	...	P	2.0-3.0	1.2	4.0-5.0	0.35	0.05	...	0.35	0.50	...	0.25	...	0.35	rem
296.1	A02961	...	Ingot	2.0-3.0	0.9	4.0-5.0	0.35	0.05	...	0.35	0.50	...	0.25	...	0.35	rem
296.2	A02962	...	Ingot	2.0-3.0	0.8	4.0-5.0	0.30	0.35	...	...	0.30	...	0.20	0.05	0.15	rem
305.0	A03050	...	S, P	4.5-5.5	0.6	1.0-1.5	0.50	0.10	0.25	...	0.35	...	0.25	0.05	0.15	rem
305.2	A03052	...	Ingot	4.5-5.5	0.14-0.25	1.0-1.5	0.05	...	...	...	0.05	...	0.20	0.05	0.15	rem
A305.0	A13050	...	S, P	4.5-5.5	0.20	1.0-1.5	0.10	0.10	...	...	0.10	...	0.20	0.05	0.15	rem
A305.1	A13051	...	Ingot	4.5-5.5	0.15	1.0-1.5	0.10	0.10	...	...	0.10	...	0.20	0.05	0.15	rem
A305.2	A13052	...	Ingot	4.5-5.5	0.13	1.0-1.5	0.05	...	...	...	0.05	...	0.20	0.05	0.15	rem
308.0	A03080	...	S, P	5.0-6.0	1.0	4.0-5.0	0.50	0.10	...	...	1.0	...	0.25	...	0.50	rem
308.1	A03081	...	Ingot	5.0-6.0	0.8	4.0-5.0	0.50	0.10	...	...	1.0	...	0.25	...	0.50	rem
308.2	A03082	...	Ingot	5.0-6.0	0.8	4.0-5.0	0.30	0.10	...	...	0.50	...	0.20	...	0.50	rem
319.0	A03190	3522 AlSi5Cu3														
		3522 AlSi5Cu3Mn														
		3522 AlSi6Cu4														
		3522 AlSi6Cu4Mn														
		R164 AlSi5Cu3														
		R164 AlSi5Cu3Fe														
		R164 AlSi6Cu4	S, P	5.5-6.5	1.0	3.0-4.0	0.50	0.10	...	0.35	1.0	...	0.25	...	0.50	rem
319.1	A03191	...	Ingot	5.5-6.5	0.8	3.0-4.0	0.50	0.10	...	0.35	1.0	...	0.25	...	0.50	rem
319.2	A03192	...	Ingot	5.5-6.5	0.6	3.0-4.0	0.10	0.10	...	0.10	0.10	...	0.20	...	0.20	rem
A319.0	A13190	3522 AlSi5Cu3														
		3522 AlSi5Cu3Mn														
		3522 AlSi6Cu4														
		3522 AlSi6Cu4Mn														
		R164 AlSi5Cu3														
		R164 AlSi5Cu3Fe														
		R164 AlSi6Cu4	S, P	5.5-6.5	1.0	3.0-4.0	0.50	0.10	...	0.35	3.0	...	0.25	...	0.50	rem

(continued)

(a) Serial letter prefix indicates modification: A, B, C, D, and F. (b) Per ISO standard No. R115 unless other standard (R164, R2147, or 3522) specified. (c) D, die casting; P, permanent mold; s, sand. Other products may pertain to the composition shown even though not listed. (d) The Al content for unalloyed aluminum by remelt is the difference between 100.00% and the sum of all other metallic elements present in amounts of 0.010% or more each, expressed to the second decimal before determining the sum. (e) (Mn + Cr + Ti + V) = 0.025% max. (f) Fe/Si ratio 2.5 min. (g) Fe/Si ratio 2.0 min. (h) Fe/Si ratio 1.5 min. (i) 0.40 to 1.0% Ag. (j) 0.50-1.0% Ag. (k) (Ti + Zr = 0.50 max. (l) 0.20 to 0.30% Sb; 0.20 to 0.30% Co; 0.10 to 0.30% Zr. (m) 0.05-0.15% V; 0.10-0.25% Zr. (n) 0.06-0.20% V. (o) For Fe > 0.45%, Mn content shall not be less than one-half Fe content. (p) 0.04-0.07% Be. (q) 0.10-0.30% Be. (r) 0.15-0.30% Be. (s) Axxx.1 ingot is used to produce xxx.0 and Axxx.0 castings. (t) (Mn + Cr) = 0.8% max. (u) 0.25% Pb max. (v) 0.02-0.04% Be. (w) 0.08-0.15% V. (x) Used to coat steel. (y) Used with Zn to coat steel. (z) 0.10% Pb max. (aa) 0.003-0.007% Be; 0.005% B max. (bb) 0.003-0.007% Be; 0.002% B max
Source: Ref 3, 4, 5

Table 3 (continued)

Grade designation				Composition, wt%											Unspecified other elements		Al, min(d)
Aluminum Association(a)	UNS No.	ISO(b)	Product(c)	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Sn	Ti	Each	Total		
A319.1	A13191	...	Ingot	5.5-6.5	0.8	3.0-4.0	0.50	0.10	...	0.35	3.0	...	0.25	...	0.50	rem	
B319.0	A23190	...	S, P	5.5-6.5	1.2	3.0-4.0	0.8	0.10-0.50	...	0.50	1.0	...	0.25	...	0.50	rem	
B319.1	A23191	...	Ingot	5.5-6.5	0.9	3.0-4.0	0.8	0.15-0.50	...	0.50	1.0	...	0.25	...	0.50	rem	
320.0	A03200	...	S, P	5.0-8.0	1.2	2.0-4.0	0.8	0.05-0.6	...	0.35	3.0	...	0.25	...	0.50	rem	
320.1	A03201	...	Ingot	5.0-8.0	0.9	2.0-4.0	0.8	0.10-0.6	...	0.35	3.0	...	0.25	...	0.50	rem	
324.0	A03240	...	P	7.0-8.0	1.2	0.40-0.6	0.50	0.40-0.7	...	0.30	1.0	...	0.20	0.15	0.20	rem	
324.1	A03241	...	Ingot	7.0-8.0	0.9	0.40-0.6	0.50	0.45-0.7	...	0.30	1.0	...	0.20	0.15	0.20	rem	
324.2	A03242	...	Ingot	7.0-8.0	0.6	0.40-0.6	0.10	0.45-0.7	...	0.10	0.10	...	0.20	0.05	0.15	rem	
328.0	A03280	...	S	7.5-8.5	1.0	1.0-2.0	0.20-0.6	0.20-0.6	0.35	0.25	1.5	...	0.25	...	0.50	rem	
328.1	A03281	...	Ingot	7.5-8.5	0.8	1.0-2.0	0.20-0.6	0.20-0.6	0.35	0.25	1.5	...	0.25	...	0.50	rem	
332.0	A03320	...	P	8.5-10.5	1.2	2.0-4.0	0.50	0.50-1.5	...	0.50	1.0	...	0.25	...	0.50	rem	
332.1	A03321	...	Ingot	8.5-10.5	0.9	2.0-4.0	0.50	0.6-1.5	...	0.50	1.0	...	0.25	...	0.50	rem	
332.2	A03322	...	Ingot	8.5-10.0	0.6	2.0-4.0	0.10	0.9-1.3	...	0.10	0.10	...	0.20	...	0.30	rem	
333.0	A03330	...	P	8.0-10.0	1.0	3.0-4.0	0.50	0.05-0.50	...	0.50	1.0	...	0.25	...	0.50	rem	
333.1	A03331	...	Ingot	8.0-10.0	0.8	3.0-4.0	0.50	0.10-0.50	...	0.50	1.0	...	0.25	...	0.50	rem	
A333.0	A13330	...	P	8.0-10.0	1.0	3.0-4.0	0.50	0.05-0.50	...	0.50	3.0	...	0.25	...	0.50	rem	
A333.1	A13331	...	Ingot	8.0-10.0	0.8	3.0-4.0	0.50	0.10-0.50	...	0.50	3.0	...	0.25	...	0.50	rem	
336.0	A03360	...	P	11.0-13.0	1.2	0.50-1.5	0.35	0.7-1.3	...	2.0-3.0	0.35	...	0.25	0.05	...	rem	
336.1	A03361	...	Ingot	11.0-13.0	0.9	0.50-1.5	0.35	0.8-1.3	...	2.0-3.0	0.35	...	0.25	0.05	...	rem	
336.2	A03362	...	Ingot	11.0-13.0	0.9	0.50-1.5	0.10	0.9-1.3	...	2.0-3.0	0.10	...	0.20	0.05	0.15	rem	
339.0	A03390	...	P	11.0-13.0	1.2	1.5-3.0	0.50	0.50-1.5	...	0.50-1.5	1.0	...	0.25	...	0.50	rem	
339.1	...	...	Ingot	11.0-13.0	0.9	1.5-3.0	0.50	0.6-1.5	...	0.50-1.5	1.0	...	0.25	...	0.50	rem
343.0	A03430	...	D	6.7-7.7	1.2	0.50-0.9	0.50	0.10	0.10	...	1.2-2.0	0.50	...	0.10	0.35	rem	
343.1	A03431	...	Ingot	6.7-7.7	0.9	0.50-0.9	0.50	0.10	0.10	...	1.2-1.9	0.50	...	0.10	0.35	rem	
354.0	A03540	...	P	8.6-9.4	0.20	1.6-2.0	0.10	0.40-0.6	...	...	0.10	...	0.20	0.05	0.15	rem
354.1	A03541	...	Ingot	8.6-9.4	0.15	1.6-2.0	0.10	0.45-0.6	...	...	0.10	...	0.20	0.05	0.15	rem
355.0	A03550	3522 AlSi5Cu1Mg	...	...	...	...	...	...	...	...	...	...	...	...	...	...
355.1	A03551	R164 AlSi5Cu1	S, P	4.5-5.5	0.6(o)	1.0-1.5	0.50(o)	0.40-0.6	0.25	...	0.35	...	0.25	0.05	0.15	rem	
355.2	A03552	...	Ingot	4.5-5.5	0.50(o)	1.0-1.5	0.50(o)	0.45-0.6	0.25	...	0.35	...	0.25	0.05	0.15	rem	
A355.0	A13550	...	S, P	4.5-5.5	0.14-0.25	1.0-1.5	0.05	0.50-0.6	...	...	0.05	...	0.20	0.05	0.15	rem
A355.2	A13552	...	Ingot	4.5-5.5	0.09	1.0-1.5	0.05	0.45-0.6	...	...	0.05	...	0.04-0.20	0.05	0.15	rem
C355.0	A33350	...	S, P	4.5-5.5	0.06	1.0-1.5	0.03	0.50-0.6	...	...	0.03	...	0.04-0.20	0.03	0.10	rem
C355.1	A33351	...	Ingot	4.5-5.5	0.20	1.0-1.5	0.10	0.40-0.6	...	...	0.10	...	0.20	0.05	0.15	rem
C355.2	A33352	...	Ingot	4.5-5.5	0.15	1.0-1.5	0.10	0.45-0.6	...	...	0.10	...	0.20	0.05	0.15	rem
356.0	A03560	3522 AlSi7Mg	...	...	...	...	...	...	...	...	...	...	...	...	...	...
356.1	A03561	R2147 AlSi7Mg	S, P	6.5-7.5	0.6(o)	0.25	0.35(o)	0.20-0.45	...	...	0.35	...	0.25	0.05	0.15	rem
356.2	A03562	...	Ingot	6.5-7.5	0.50(o)	0.25	0.35(o)	0.25-0.45	...	...	0.35	...	0.25	0.05	0.15	rem
A356.0	A13560	...	S, P	6.5-7.5	0.13-0.25	0.10	0.05	0.30-0.45	...	...	0.05	...	0.20	0.05	0.15	rem
A356.1	A13561	...	Ingot	6.5-7.5	0.20	0.20	0.10	0.25-0.45	...	...	0.10	...	0.20	0.05	0.15	rem
A356.2	A3562	...	Ingot	6.5-7.5	0.15	0.20	0.10	0.30-0.45	...	...	0.10	...	0.20	0.05	0.15	rem
B356.0	A23560	...	S, P	6.5-7.5	0.12	0.10	0.05	0.30-0.45	...	...	0.05	...	0.20	0.05	0.15	rem
B356.1	A23561	...	S, P	6.5-7.5	0.09	0.05	0.05	0.25-0.45	...	...	0.05	...	0.04-0.20	0.05	0.15	rem
B356.2	A23562	...	Ingot	6.5-7.5	0.06	0.03	0.03	0.30-0.45	...	...	0.03	...	0.04-0.20	0.03	0.10	rem
C356.0	A33560	...	S, P	6.5-7.5	0.07	0.05	0.05	0.25-0.45	...	...	0.05	...	0.04-0.20	0.05	0.15	rem
C356.2	A33562	...	Ingot	6.5-7.5	0.04	0.03	0.03	0.30-0.45	...	...	0.03	...	0.04-0.20	0.03	0.10	rem
F356.0	A63560	...	S, P	6.5-7.5	0.20	0.20	0.10	0.17-0.25	...	...	0.10	...	0.04-0.20	0.05	0.15	rem
F356.2	A63562	...	Ingot	6.5-7.5	0.12	0.10	0.05	0.17-0.25	...	...	0.05	...	0.04-0.20	0.05	0.15	rem
357.0	A03570	...	S, P	6.5-7.5	0.15	0.05	0.03	0.45-0.6	...	...	0.05	...	0.20	0.05	0.15	rem
357.1	A03571	...	Ingot	6.5-7.5	0.12	0.05	0.03	0.45-0.6	...	...	0.05	...	0.20	0.05	0.15	rem
A357.0	A13570	...	S, P	6.5-7.5	0.20	0.20	0.10	0.40-0.7	...	...	0.10	...	0.04-0.20	0.05(p)	0.15	rem
A357.2	A13572	...	Ingot	6.5-7.5	0.12	0.10	0.05	0.45-0.7	...	...	0.05	...	0.04-0.20	0.03(p)	0.10	rem
B357.0	...	...	S, P	6.5-7.5	0.09	0.05	0.05	0.40-0.6	...	...	0.05	...	0.04-0.20	0.05	0.15	rem
B357.2	A23572	...	Ingot	6.5-7.5	0.06	0.03	0.03	0.45-0.6	...	...	0.03	...	0.04-0.20	0.03	0.10	rem
C357.0	...	...	S, P	6.5-7.5	0.09	0.05	0.05	0.45-0.7	...	...	0.05	...	0.04-0.20	0.05(p)	0.15	rem
C357.2	...	...	Ingot	6.5-7.5	0.06	0.03	0.03	0.50-0.7	...	...	0.03	...	0.04-0.20	0.03(p)	0.10	rem
D357.0	...	...	S	6.5-7.5	0.20	...	0.10	0.55-0.6	...	...	...	...	0.10-0.20	0.05(p)	0.15	rem
358.0	A03580	...	S, P	7.6-8.6	0.30	0.20	0.20	0.40-0.6	0.20	...	0.20	...	0.10-0.20	0.05(q)	0.15	rem	
358.2	A03582	...	Ingot	7.6-8.6	0.20	0.10	0.10	0.45-0.6	0.05	...	0.10	...	0.12-0.20	0.05(r)	0.15	rem	
359.0	A03590	...	S, P	8.5-9.5	0.20	0.20	0.10	0.50-0.7	...	...	0.10	...	0.20	0.05	0.15	rem
359.2	A03592	...	Ingot	8.5-9.5	0.12	0.10	0.10	0.55-0.7	...	...	0.10	...	0.20	0.05	0.15	rem
360.0(s)	A03600(s)	3522 AlSi10Mg(s)	...	...	...	...	...	...	...	...	...	...	...	...	...	...
360.2	A03602	R2147 AlSi10Mg(s)	D	9.0-10.0	2.0	0.6	0.35	0.40-0.6	...	0.50	0.50	0.15	...	...	0.25	rem
A360.0(s)	A13600	...	D	9.0-10.0	0.7-1.1	0.10	0.10	0.45-0.6	...	0.10	0.10	0.10	...	...	0.20	rem
A360.1(s)	A13601(s)	...	Ingot	9.0-10.0	1.3	0.6	0.35	0.40-0.6	...	0.50	0.50	0.15	...	...	0.25	rem
A360.2	A13602(s)	...	Ingot	9.0-10.0	1.0	0.6	0.35	0.45-0.6	...	0.50	0.40	0.15	...	...	0.25	rem
361.0	A03610	...	D	9.5-10.5	0.6	0.10	0.05	0.45-0.6	...	...	0.05	...	...	0.05	0.15	rem

(continued)

(a) Serial letter prefix indicates modification: A, B, C, D, and F. (b) Per ISO standard No. R115 unless other standard (R164, R2147, or 3522) specified. (c) D, die casting; P, permanent mold; s, sand. Other products may pertain to the composition shown even though not listed. (d) The Al content for unalloyed aluminum by remelt is the difference between 100.00% and the sum of all other metallic elements present in amounts of 0.010% or more each, expressed to the second decimal before determining the sum. (e) (Mn + Cr + Ti + V) = 0.025% max. (f) Fe/Si ratio 2.5 min. (g) Fe/Si ratio 2.0 min. (h) Fe/Si ratio 1.5 min. (i) 0.40 to 1.0% Ag. (j) 0.50-1.0% Ag. (k) Ti + Zr = 0.50 max. (l) 0.20 to 0.30% Sb; 0.20 to 0.30% Sn; 0.10 to 0.30% Zr. (m) 0.05-0.15% V; 0.10-0.25% Zr. (n) 0.06-0.20% V. (o) For Fe > 0.45%, Mn content shall not be less than one-half Fe content. (p) 0.04-0.07% Be. (q) 0.10-0.30% Be. (r) 0.15-0.30% Be. (s) Axxx.1 ingot is used to produce xxx.0 and Axxx.0 castings. (t) (Mn + Cr) = 0.8% max. (u) 0.25% Pb max. (v) 0.02-0.04% Be. (w) 0.08-0.15% V. (x) Used to coat steel. (y) Used with Zn to coat steel. (z) 0.10% Pb max. (aa) 0.003-0.007% Be; 0.005% B max. (bb) 0.003-0.007% Be; 0.002% B max

Source: Ref 3, 4, 5

Table 3 (continued)

Grade designation				Composition, wt%											Unspecified other elements		Al, min(d)
Aluminum Association(a)	UNS No.	ISO(b)	Product(c)	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Sn	Ti	Each	Total		
361.1	A03611	...	Ingot	9.5-10.5	0.8	0.50	0.25	0.45-0.6	0.20-0.30	0.20-0.30	0.40	0.10	0.20	0.05	0.15	rem	
363.0	A03630	...	S, P	4.5-6.0	1.1	2.5-3.5	(t)	0.15-0.40	(t)	0.25	3.0-4.5	0.25	0.20	(u)	0.30	rem	
363.1	A03631	...	Ingot	4.5-6.0	0.8	2.5-3.5	(t)	0.20-0.40	(t)	0.25	3.0-4.5	0.25	0.20	(u)	0.30	rem	
364.0	A03640	...	D	7.5-9.5	1.5	0.20	0.10	0.20-0.40	0.25-0.50	0.15	0.15	0.15	...	0.05(v)	0.15	rem	
364.2	A03642	...	Ingot	7.5-9.5	0.7-1.1	0.20	0.10	0.25-0.40	0.25-0.50	0.15	0.15	0.15	...	0.05(v)	0.15	rem	
369.0	A03690	...	D	11.0-12.0	1.3	0.50	0.35	0.25-0.45	0.30-0.40	0.05	1.0	0.10	...	0.05	0.15	rem	
369.1	A03691	...	Ingot	11.0-12.0	1.0	0.50	0.35	0.30-0.45	0.30-0.40	0.05	0.9	0.10	...	0.05	0.15	rem	
380.0(s)	A03800(s)	...	D	7.5-9.5	2.0	3.0-4.0	0.50	0.10	...	0.50	3.0	0.35	...	...	0.50	rem
380.2	A03802	...	Ingot	7.5-9.5	0.7-1.1	3.0-4.0	0.10	0.10	...	0.10	0.10	0.10	...	...	0.20	rem
A380.0(s)	A13800(s)	3522 AlSi8Cu3Fe															
		R164 AlSi8Cu3Fe....	D	7.5-9.5	1.3	3.0-4.0	0.50	0.10	...	0.50	3.0	0.35	...	...	0.50	rem
A380.1(s)	A13801(s)	...	Ingot	7.5-9.5	1.0	3.0-4.0	0.50	0.10	...	0.50	2.9	0.35	...	...	0.50	rem
A380.2	A13802	...	Ingot	7.5-9.5	0.6	3.0-4.0	0.10	0.10	...	0.10	0.10	...	...	0.05	0.15	rem
B380.0	A23800	...	D	7.5-9.5	1.3	3.0-4.0	0.50	0.10	...	0.50	1.0	0.35	...	...	0.50	rem
B380.1	A28801	...	Ingot	7.5-9.5	1.0	3.0-4.0	0.50	0.10	...	0.50	0.9	0.35	...	...	0.50	rem
383.0	A03830	...	D	9.5-11.5	1.3	2.0-3.0	0.50	0.10	...	0.30	3.0	0.15	...	...	0.50	rem
383.1	A03831	...	Ingot	9.5-11.5	1.0	2.0-3.0	0.50	0.10	...	0.30	2.9	0.15	...	...	0.50	rem
383.2	A03832	...	Ingot	9.5-11.5	0.6-1.0	2.0-3.0	0.10	0.10	...	0.10	0.10	0.10	...	...	0.20	rem
384.0	A03840	...	D	10.5-12.0	1.3	3.0-4.5	0.50	0.10	...	0.50	3.0	0.35	...	...	0.50	rem
384.1	A03841	...	Ingot	10.5-12.0	1.0	3.0-4.5	0.50	0.10	...	0.50	2.9	0.35	...	...	0.50	rem
384.2	A03842	...	Ingot	10.5-12.0	0.6-1.0	3.0-4.5	0.10	0.10	...	0.10	0.10	0.10	...	...	0.20	rem
A384.0	A13840	...	D	10.5-12.0	1.3	3.0-4.5	0.50	0.10	...	0.50	1.0	0.35	...	...	0.50	rem
A384.1	A13841	...	Ingot	10.5-12.0	1.0	3.0-4.5	0.50	0.10	...	0.50	0.9	0.35	...	...	0.50	rem
385.0	A03850	...	D	11.0-13.0	2.0	2.0-4.0	0.50	0.30	...	0.50	3.0	0.30	...	...	0.50	rem
385.1	A03851	...	Ingot	11.0-13.0	1.1	2.0-4.0	0.50	0.30	...	0.50	2.9	0.30	...	...	0.50	rem
390.0	A03900	...	D	16.0-18.0	1.3	4.0-5.0	0.10	0.45-0.65	...	...	0.10	...	0.20	0.10	0.20	rem
390.2	A03902	...	Ingot	16.0-18.0	0.6-1.0	4.0-5.0	0.10	0.50-0.65	...	...	0.10	...	0.20	0.10	0.20	rem
A390.0	A13900	...	S, P	16.0-18.0	0.50	4.0-5.0	0.10	0.45-0.65	...	...	0.10	...	0.20	0.10	0.20	rem
A390.1	A13901	...	Ingot	16.0-18.0	0.40	4.0-5.0	0.10	0.50-0.65	...	...	0.10	...	0.20	0.10	0.20	rem
B390.0	A23900	...	D	16.0-18.0	1.3	4.0-5.0	0.50	0.45-0.65	...	0.10	1.5	...	0.20	0.10	0.20	rem	
B390.1	A23901	...	Ingot	16.0-18.0	1.0	4.0-5.0	0.50	0.50-0.65	...	0.10	1.4	...	0.20	0.10	0.20	rem	
392.0	A03920	...	D	18.0-20.0	1.5	0.40-0.8	0.20-0.6	0.8-1.2	...	0.50	0.50	0.30	0.20	0.15	0.50	rem	
392.1	A03921	...	Ingot	18.0-20.0	1.1	0.40-0.8	0.20-0.6	0.9-1.2	...	0.50	0.40	0.30	0.20	0.15	0.50	rem	
393.0	A03930	...	S, P, D	21.0-23.0	1.3	0.7-1.1	0.10	0.7-1.3	...	2.0-2.5	0.10	...	0.10-0.20	0.05(w)	0.15	rem	
393.1	A03931	...	Ingot	21.0-23.0	1.0	0.7-1.1	0.10	0.8-1.3	...	2.0-2.5	0.10	...	0.10-0.20	0.05(w)	0.15	rem	
393.2	A03932	...	Ingot	21.0-23.0	0.8	0.7-1.1	0.10	0.8-1.3	...	2.0-2.5	0.10	...	0.10-0.20	0.05(w)	0.15	rem	
408.2(x)	A04082(x)	...	Ingot	8.5-9.5	0.6-1.3	0.10	0.10	...	...	...	0.10	...	...	0.10	0.20	rem
409.2(x)	A04092(x)	...	Ingot	9.0-10.0	0.6-1.3	0.10	0.10	...	...	...	0.10	...	...	0.10	0.20	rem
411.2(x)	A04112(x)	...	Ingot	10.0-12.0	0.6-1.3	0.20	0.10	...	...	...	0.10	...	...	0.10	0.20	rem
413.0(s)	A04130(s)	3522 AlSi12CuFe(s)															
		3522 AlSi12 Fe(s)															
		R164 AlSi12(s)															
		R164 AlSi12Cu(s)															
		R164 AlSi12CuFe(s)															
		R164 AlSi12Fe(s)															
		R2147 AlSi12(s).....	D	11.0-13.0	2.0	1.0	0.35	0.10	...	0.50	0.50	0.15	...	...	0.25	rem
413.2(s)	A04132(s)	...	Ingot	11.0-13.0	0.7-1.1	0.10	0.10	0.07	...	0.10	0.10	0.10	...	...	0.20	rem
A413.0(s)	A14130(s)	...	D	11.0-13.0	1.3	1.0	0.35	0.10	...	0.50	0.50	0.15	...	...	0.25	rem
A413.1(s)	A14131(s)	...	Ingot	11.0-13.0	1.0	1.0	0.35	0.10	...	0.50	0.40	0.15	...	...	0.25	rem
A413.2	A14132(s)	...	Ingot	11.0-13.0	0.6	0.10	0.05	0.05	...	0.05	0.05	0.05	...	...	0.10	rem
B413.0	A24130	...	S, P	11.0-13.0	0.50	0.10	0.35	0.05	...	0.05	0.10	...	0.25	0.05	0.20	rem	
B413.1	B24131	...	Ingot	11.0-13.0	0.40	0.10	0.35	0.05	...	0.05	0.10	...	0.25	0.05	0.20	rem	
435.2(y)	A04352(y)	...	Ingot	3.3-3.9	0.40	0.05	0.05	0.05	...	...	0.10	...	...	0.05	0.20	rem
443.0	A04430	...	S, P	4.5-6.0	0.8	0.6	0.50	0.05	0.25	...	0.50	...	0.25	...	0.35	rem	
443.1	A04431	...	Ingot	4.5-6.0	0.6	0.6	0.50	0.05	0.25	...	0.50	...	0.25	...	0.35	rem	
443.2	A04432	...	Ingot	4.5-6.0	0.6	0.10	0.10	0.05	...	...	0.10	...	0.20	0.05	0.15	rem
A443.0	A14430	...	S	4.5-6.0	0.8	0.30	0.50	0.05	0.25	...	0.50	...	0.25	...	0.35	rem	
A443.1	A14431	...	Ingot	4.5-6.0	0.6	0.30	0.50	0.05	0.25	...	0.50	...	0.25	...	0.35	rem	
B443.0	A24430	3522 AlSi5															
		R164 AlSi5.....	S, P	4.5-6.0	0.8	0.15	0.35	0.05	...	...	0.35	...	0.25	0.05	0.15	rem
B443.1	A24431	...	Ingot	4.5-6.0	0.6	0.15	0.35	0.05	...	...	0.35	...	0.25	0.05	0.15	rem
C443.0	A34430	R164 AlSi5Fe.....	D	4.5-6.0	2.0	0.6	0.35	0.10	...	0.50	0.50	0.15	...	...	0.25	rem
C443.1	A34431	...	Ingot	4.5-6.0	1.1	0.6	0.35	0.10	...	0.50	0.40	0.15	...	...	0.25	rem
C443.2	A34432	...	Ingot	4.5-6.0	0.7-1.1	0.10	0.10	0.05	...	...	0.10	...	...	0.05	0.15	rem
444.0	A04440	...	S, P	6.5-7.5	0.6	0.25	0.35	0.10	...	...	0.35	...	0.25	0.05	0.15	rem
444.2	A04442	...	Ingot	6.5-7.5	0.13-0.25	0.10	0.05	0.05	...	...	0.05	...	0.20	0.05	0.15	rem
A444.0	A14440	...	P	6.5-7.5	0.20	0.10	0.10	0.05	...	...	0.10	...	0.20	0.05	0.15	rem
A444.1	A14441	...	Ingot	6.5-7.5	0.15	0.10	0.10	0.05	...	...	0.10	...	0.20	0.05	0.15	rem
A444.2	A14442	...	Ingot	6.5-7.5	0.12	0.05	0.05	0.05	...	...	0.05	...	0.20	0.05	0.15	rem

(continued)

(a) Serial letter prefix indicates modification: A, B, C, D, and F. (b) Per ISO standard No. R115 unless other standard (R164, R2147, or 3522) specified. (c) D, die casting; P, permanent mold; s, sand. Other products may pertain to the composition shown even though not listed. (d) The Al content for unalloyed aluminum by remelt is the difference between 100.00% and the sum of all other metallic elements present in amounts of 0.010% or more each, expressed to the second decimal before determining the sum. (e) (Mn + Cr + Ti + V) = 0.025% max. (f) Fe/Si ratio 2.5 min. (g) Fe/Si ratio 2.0 min. (h) Fe/Si ratio 1.5 min. (i) 0.40 to 1.0% Ag. (j) 0.50-1.0% Ag. (k) Ti + Zr = 0.50 max. (l) 0.20 to 0.30% Sb; 0.20 to 0.30% Co; 0.10 to 0.30% Zr. (m) 0.05-0.15% V; 0.10-0.25% Zr. (n) 0.06-0.20% V. (o) For Fe > 0.45%, Mn content shall not be less than one-half Fe content. (p) 0.04-0.07% Be. (q) 0.10-0.30% Be. (r) 0.15-0.30% Be. (s) Axxx.1 ingot is used to produce xxx.0 and Axxx.0 castings. (t) (Mn + Cr) = 0.8% max. (u) 0.25% Pb max. (v) 0.02-0.04% Be. (w) 0.08-0.15% V. (x) Used to coat steel. (y) Used with Zn to coat steel. (z) 0.10% Pb max. (aa) 0.003-0.007% Be; 0.005% B max. (bb) 0.003-0.007% Be; 0.002% B max

Table 3 (continued)

Grade designation				Composition, wt%											Unspecified other elements		Al, min(d)
Aluminum Association(a)	UNS No.	ISO(b)	Product(c)	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Sn	Ti	Each	Total		
445.2(x)	A04452(x)	.....	Ingot	6.5-7.5	0.6-1.3	0.10	0.10	...	...	...	0.10	...	...	0.10	0.20	rem
511.0	A05110	.....	S	0.30-0.7	0.50	0.15	0.35	3.5-4.5	...	...	0.15	...	0.25	0.05	0.15	rem
511.1	A05111	.....	Ingot	0.30-0.7	0.40	0.15	0.35	3.6-4.5	...	...	0.15	...	0.25	0.05	0.15	rem
511.2	A05112	.....	Ingot	0.30-0.7	0.30	0.10	0.10	3.6-4.5	...	...	0.10	...	0.20	0.05	0.15	rem
512.0	A05120	.....	S	1.4-2.2	0.6	0.35	0.8	3.5-4.5	0.25	...	0.35	...	0.25	0.05	0.15	rem
512.2	A05122	.....	Ingot	1.4-2.2	0.30	0.10	0.10	3.6-4.5	...	...	0.10	...	0.20	0.05	0.15	rem
513.0	A05130	.....	P	0.30	0.40	0.10	0.30	3.5-4.5	...	...	1.4-2.2	...	0.20	0.05	0.15	rem
513.2	A05132	.....	Ingot	0.30	0.30	0.10	0.10	3.6-4.5	...	...	1.4-2.2	...	0.20	0.05	0.15	rem
514.0	A05140	.....	3522 AlMg3													
			R164 AlMg3;														
			R2147 AlMg3	S	0.35	0.50	0.15	0.35	3.5-4.5	0.15	...	0.25	0.05	0.15	rem
514.1	A05141	.....	Ingot	0.35	0.40	0.15	0.35	3.6-4.5	...	...	0.15	...	0.25	0.05	0.15	rem
514.2	A05142	.....	Ingot	0.30	0.30	0.10	0.10	3.6-4.5	...	...	0.10	...	0.20	0.05	0.15	rem
515.0	A05150	.....	D	0.50-1.0	1.3	0.20	0.40-0.6	2.5-4.0	...	...	0.10	...	...	0.05	0.15	rem
515.2	A05152	.....	Ingot	0.50-1.0	0.6-1.0	0.10	0.40-0.6	2.7-4.0	...	...	0.05	...	...	0.05	0.15	rem
516.0	A05160	.....	D	0.30-1.5	0.35-1.0	0.30	0.15-0.40	2.5-4.5	...	0.25-0.40	0.20	0.10	0.10-0.20	0.05(z)	...	rem
516.1	A05161	.....	Ingot	0.30-1.5	0.35-0.7	0.30	0.15-0.40	2.6-4.5	...	0.25-0.40	0.20	0.10	0.10-0.20	0.05(z)	...	rem
518.0	A05180	.....	D	0.35	1.8	0.25	0.35	7.5-8.5	...	0.15	0.15	0.15	...	...	0.25	rem
518.1	A05181	.....	Ingot	0.35	1.1	0.25	0.35	7.6-8.5	...	0.15	0.15	0.15	...	...	0.25	rem
518.2	A05182	.....	Ingot	0.25	0.7	0.10	0.10	7.6-8.5	...	0.05	...	0.05	...	...	0.10	rem
520.0	A05200	.....	3522 AlMg10													
			R164 AlMg10;														
			R2147 AlMg10	S	0.25	0.30	0.25	0.15	9.5-10.6	0.15	...	0.25	0.05	0.15	rem
520.2	A05202	.....	Ingot	0.15	0.20	0.20	0.10	9.6-10.6	...	...	0.10	...	0.20	0.05	0.15	rem
535.0	A05350	.....	S	0.15	0.15	0.05	0.10-0.25	6.2-7.5	...	...	...	...	0.10-0.25	0.05(aa)	0.15	rem
535.2	A05352	.....	Ingot	0.10	0.10	0.05	0.10-0.25	6.6-7.5	...	...	...	...	0.10-0.25	0.05(bb)	0.15	rem
A535.0	A15350	.....	S	0.20	0.20	0.10	0.10-0.25	6.5-7.5	...	...	...	...	0.25	0.05	0.15	rem
A535.1	A15351	.....	Ingot	0.20	0.15	0.10	0.10-0.25	6.6-7.5	...	...	...	...	0.25	0.05	0.15	rem
B535.0	A25350	.....	S	0.15	0.15	0.10	0.05	6.5-7.5	...	...	...	...	0.10-0.25	0.05	0.15	rem
B535.2	A25352	.....	Ingot	0.10	0.12	0.05	0.05	6.6-7.5	...	...	...	...	0.10-0.25	0.05	0.15	rem
705.0	A07050	.....	S, P	0.20	0.8	0.20	0.40-0.6	1.4-1.8	0.20-0.40	...	2.7-3.3	...	0.25	0.05	0.15	rem
705.1	A07051	.....	Ingot	0.20	0.6	0.20	0.40-0.6	1.5-1.8	0.20-0.40	...	2.7-3.3	...	0.25	0.05	0.15	rem
707.0	A07070	.....	S, P	0.20	0.8	0.20	0.40-0.6	1.8-2.4	0.20-0.40	...	4.0-4.5	...	0.25	0.05	0.15	rem
707.1	A07071	.....	Ingot	0.20	0.6	0.20	0.40-0.6	1.9-2.4	0.20-0.40	...	4.0-4.5	...	0.25	0.05	0.15	rem
710.0	A07100	.....	S	0.15	0.50	0.35-0.65	0.05	0.6-0.8	...	...	6.0-7.0	...	0.25	0.05	0.15	rem
710.1	A07101	.....	Ingot	0.15	0.40	0.35-0.65	0.05	0.65-0.8	...	...	6.0-7.0	...	0.25	0.05	0.15	rem
711.0	A07110	.....	P	0.30	0.7-1.4	0.35-0.65	0.05	0.25-0.45	...	...	6.0-7.0	...	0.20	0.05	0.15	rem
711.1	A07111	.....	Ingot	0.30	0.7-1.1	0.35-0.65	0.05	0.30-0.45	...	...	6.0-7.0	...	0.20	0.05	0.15	rem
712.0	A07120	.....	S	0.30	0.50	0.25	0.10	0.50-0.65	0.40-0.6	...	5.0-6.5	...	0.15-0.25	0.05	0.20	rem
712.2	A07122	.....	Ingot	0.15	0.40	0.25	0.10	0.50-0.65	0.40-0.6	...	5.0-6.5	...	0.15-0.25	0.05	0.20	rem
713.0	A07130	.....	S, P	0.25	1.1	0.40-1.0	0.6	0.20-0.50	0.35	0.15	7.0-8.0	...	0.25	0.10	0.25	rem
713.1	A07131	.....	Ingot	0.25	0.8	0.40-1.0	0.6	0.25-0.50	0.35	0.15	7.0-8.0	...	0.25	0.10	0.25	rem
771.0	A07710	.....	S	0.15	0.15	0.10	0.10	0.8-1.0	0.06-0.20	...	6.5-7.5	...	0.10-0.20	0.05	0.15	rem
771.2	A07712	.....	Ingot	0.10	0.10	0.10	0.10	0.85-1.0	0.06-0.20	...	6.5-7.5	...	0.10-0.20	0.05	0.15	rem
772.0	A07720	.....	S	0.15	0.15	0.10	0.10	0.6-0.8	0.06-0.20	...	6.0-7.0	...	0.10-0.20	0.05	0.15	rem
772.2	A07722	.....	Ingot	0.10	0.10	0.10	0.10	0.65-0.8	0.06-0.20	...	6.0-7.0	...	0.10-0.20	0.05	0.15	rem
850.0	A08500	.....	S, P	0.7	0.7	0.7-1.3	0.10	0.10	...	0.7-1.3	...	5.5-7.0	0.20	...	0.30	rem
850.1	A08501	.....	Ingot	0.7	0.50	0.7-1.3	0.10	0.10	...	0.7-1.3	...	5.5-7.0	0.20	...	0.30	rem
851.0	A08510	.....	S, P	2.0-3.0	0.7	0.7-1.3	0.10	0.10	...	0.30-0.7	...	5.5-7.0	0.20	...	0.30	rem
851.1	A08511	.....	Ingot	2.0-3.0	0.50	0.7-1.3	0.10	0.10	...	0.30-0.7	...	5.5-7.0	0.20	...	0.30	rem
852.0	A08520	.....	S, P	0.40	0.7	1.7-2.3	0.10	0.6-0.9	...	0.9-1.5	...	5.5-7.0	0.20	...	0.30	rem
852.1	A08521	.....	Ingot	0.40	0.50	1.7-2.3	0.10	0.7-0.9	...	0.9-1.5	...	5.5-7.0	0.20	...	0.30	rem
853.0	A08530	.....	S, P	5.5-6.5	0.7	3.0-4.0	0.50	...	...	...	5.5-7.0	0.20	...	0.30	rem	
853.2	A08532	.....	Ingot	5.5-6.5	0.50	3.0-4.0	0.10	...	...	...	5.5-7.0	0.20	...	0.30	rem	

(a) Serial letter prefix indicates modification: A, B, C, D, and F. (b) Per ISO standard No. R115 unless other standard (R164, R2147, or 3522) specified. (c) D, die casting; P, permanent mold; s, sand. Other products may pertain to the composition shown even though not listed. (d) The Al content for unalloyed aluminum by remelt is the difference between 100.00% and the sum of all other metallic elements present in amounts of 0.010% or more each, expressed to the second decimal before determining the sum. (e) $(\text{Mn} + \text{Cr} + \text{Ti} + \text{V}) = 0.025\%$ max. (f) Fe/Si ratio 2.5 min. (g) Fe/Si ratio 2.0 min. (h) Fe/Si ratio 1.5 min. (i) 0.40 to 1.0% Ag. (j) 0.50-1.0% Ag. (k) $\text{Ti} + \text{Zr} = 0.50$ max. (l) 0.20 to 0.30% Sb; 0.20 to 0.30% Co; 0.10 to 0.30% Zr. (m) 0.05-0.15% V; 0.10-0.25% Zr. (n) 0.06-0.20% V. (o) For Fe > 0.45%, Mn content shall not be less than one-half Fe content. (p) 0.04-0.07% Be. (q) 0.10-0.30% Be. (r) 0.15-0.30% Be. (s) Axxx.1 ingot is used to produce xxx.0 and Axxx.0 castings. (t) $(\text{Mn} + \text{Cr}) = 0.8\%$ max. (u) 0.25% Pb max. (v) 0.02-0.04% Be. (w) 0.08-0.15% V. (x) Used to coat steel. (y) Used with Zn to coat steel. (z) 0.10% Pb max. (aa) 0.003-0.007% Be; 0.005% B max. (bb) 0.003-0.007% Be; 0.002% B max
Source: Ref 3, 4, 5

strain hardening remaining after the product has been partially annealed.

H3, Strain-Hardened and Stabilized. This applies to products that are strain-hardened and whose mechanical properties are stabilized by a low-temperature thermal treatment or as a result of heat introduced during fabrication. Stabilization usually improves ductility. This designation applies only to those alloys that, unless stabilized, gradually age soften at room temperature. The digit follow-

ing the H3 indicates the degree of strain hardening remaining after stabilization.

Additional Temper Designations. For alloys that age soften at room temperature, each H2x temper has the same minimum ultimate tensile strength as the H3x temper with the same second digit. For other alloys, each H2x temper has the same minimum ultimate tensile strength as the H1x with the same second digit, and slightly higher elongation.

The digit following the designations H1, H2, and H3, which indicates the degree of strain hardening, is a numeral from 1 through 9. Numeral 8 indicates tempers with ultimate tensile strength equivalent to that achieved by about 75% cold reduction (temperature during reduction not to exceed 50 °C, or 120 °F) following full annealing. Tempers between 0 (annealed) and 8 are designated by numerals 1 through 7. Material having an ultimate tensile strength ap-

Table 4 ISO equivalents of wrought Aluminum Association international alloy designations

Aluminum Association international designation	ISO designation	Aluminum Association international designation	ISO designation
1050A	Al 99.5	5086	Al Mg4
1060	Al 99.6	5154	Al Mg3.5
1070A	Al 99.7		
1080A	Al 99.8	5154A	Al Mg3.5(A)
1100	Al 99.0 Cu	5183	Al Mg4.5Mn0.7(A)
		5251	Al Mg2
1200	Al 99.0	5356	Al Mg5Cr(A)
1350	E-Al 99.5	5454	Al Mg3Mn
	Al 99.3		
1370	E-Al 99.7	5456	Al Mg5Mn
2011	Al Cu6BiPb	5554	Al Mg3Mn(A)
		5754	Al Mg3
2014	Al Cu4SiMg	6005	Al SiMg
2014A	Al Cu4SiMg(A)	6005A	Al SiMg(A)
2017	Al Cu4MgSi		
2017A	Al Cu4MgSi(A)	6060	Al MgSi
2024	Al Cu4Mg1	6061	Al Mg1SiCu
		6063	Al Mg0.7Si
2030	Al Cu4PbMg	6063A	Al Mg0.7Si(A)
2117	Al Cu2.5Mg	6082	Al Si1MgMn
2219	Al Cu6Mn		
3003	Al Mn1Cu	6101	E-Al MgSi
3004	Al Mn1Mg1	6101A	E-Al MgSi(A)
		6181	Al Si1Mg0.8
3005	Al Mn1Mg0.5	6262	Al Mg1SiPb
3103	Al Mn1	6351	Al Si1Mg0.5Mn
3105	Al Mn0.5Mg0.5		
4043	Al Si5	7005	Al Zn4.5Mg1.5Mn
4043A	Al Si5(A)	7010	Al Zn6MgCu
		7020	Al Zn4.5Mg1
4047	Al Si12	7049A	Al Zn8MgCu
4047A	Al Si12(A)	7050	Al Zn6CuMgZr
5005	Al Mg1(B)		
5050	Al Mg1.5(C)	7075	Al Zn5.5MgCu
5052	Al Mg2.5	7178	Al Zn7MgCu
		7475	Al Zn5.5MgCu(A)
5056	Al Mg5Cr		Al Zn4Mg1.5Mn
5056A	Al Mg5		Al Zn6MgCuMn
5083	Al Mg4.5Mn0.7		

proximately midway between that of the 0 temper and the 8 temper is designated by the numeral 4, midway between the 0 and 4 tempers by the numeral 2, and midway between the 4 and 8 tempers by the numeral 6. Numeral 9 designates tempers whose minimum ultimate tensile strength exceeds that of the 8 temper by 10 MPa (2 ksi) or more. For two-digit H tempers whose second digits are odd, the standard limits for strength are the arithmetic mean of the standard limits for the adjacent two-digit H tempers whose second digits are even.

For alloys that cannot be sufficiently cold-reduced to establish an ultimate tensile strength applicable to the 8 temper (75% cold reduction after full annealing), the 6-temper tensile strength may be established by cold reduction of approximately 55% following full annealing, or the 4-temper tensile strength may be established by cold reduction of approximately 35% after full annealing.

When it is desirable to identify a variation of a two-digit H temper, a third digit (from 1 to 9) may be assigned. The third digit is used when the degree of control of temper or the mechanical properties are different from but close to those for the two-digit H temper designation to which it is added, or when some other characteristic is significantly

affected. The minimum ultimate tensile strength of a three-digit H temper is at least as close to that of the corresponding two-digit H temper as it is to either of the adjacent two-digit H tempers. Products in H tempers whose mechanical properties are below those of Hx1 tempers are assigned variations of Hx1. Some three-digit H temper designations have already been assigned for wrought products in all alloys:

Hx11 applies to products that incur sufficient strain hardening after final annealing to fail to qualify as 0 temper, but not so much or so consistent an amount of strain hardening to qualify as Hx1 temper.

H112 pertains to products that may acquire some strain hardening during working at elevated temperature and for which there are mechanical property limits.

Patterned or Embossed Sheet. Table 5 lists the three-digit H temper designations that have been assigned to patterned or embossed sheet.

System for Heat-Treatable Alloys

The temper designation system for wrought and cast products that are strengthened by heat treatment employs the W and T designations described in the section "Basic Temper Designations" in this article. The W designation denotes an unstable

temper, whereas the T designation denotes a stable temper other than F, O, or H. The T is followed by a number from 1 to 10, each number indicating a specific sequence of basic treatments.

T1, Cooled From an Elevated-Temperature Shaping Process and Naturally Aged to a Substantially Stable Condition. This designation applies to products that are not cold worked after an elevated-temperature shaping process such as casting or extrusion and for which mechanical properties have been stabilized by room-temperature aging. It also applies to products that are flattened or straightened after cooling from the shaping process, for which the effects of the cold work imparted by flattening or straightening are not accounted for in specified property limits.

T2, Cooled From an Elevated-Temperature Shaping Process, Cold Worked, and Naturally Aged to a Substantially Stable Condition. This variation refers to products that are cold worked specifically to improve strength after cooling from a hot-working process such as rolling or extrusion and for which mechanical properties have been stabilized by room-temperature aging. It also applies to products in which the effects of cold work, imparted by flattening or straightening, are accounted for in specified property limits.

T3, Solution Heat Treated, Cold Worked, and Naturally Aged to a Substantially Stable Condition. T3 applies to products that are cold worked specifically to improve strength after solution heat treatment and for which mechanical properties have been stabilized by room-temperature aging. It also applies to products in which the effects of cold work, imparted by flattening or straightening, are accounted for in specified property limits.

T4, Solution Heat Treated and Naturally Aged to a Substantially Stable Condition. This signifies products that are not cold worked after solution heat treatment and for which mechanical properties have been stabilized by room-temperature aging. If the products are flattened or straightened, the effects of the cold work imparted by flattening or straightening are not accounted for in specified property limits.

T5, Cooled From an Elevated-Temperature Shaping Process and Artificially Aged. T5 includes products that are not cold worked after an elevated-temperature shaping process such as casting or extrusion and for which mechanical properties have been substantially improved by precipitation heat treatment. If the products are flattened or straightened after cooling from the shaping process, the effects of the cold work imparted by flattening or straightening are not accounted for in specified property limits.

T6, Solution Heat Treated and Artificially Aged. This group encompasses products

Table 5 H temper designations for aluminum and aluminum alloy patterned or embossed sheet

Patterned or embossed sheet	Temper of sheet from which textured sheet was fabricated
H114.....	O
H124.....	H11
H224.....	H21
H324.....	H31
H134.....	H12
H234.....	H22
H334.....	H32
H144.....	H13
H244.....	H23
H344.....	H33
H154.....	H14
H254.....	H24
H354.....	H34
H164.....	H15
H264.....	H25
H364.....	H35
H174.....	H16
H274.....	H26
H374.....	H36
H184.....	H17
H284.....	H27
H384.....	H37
H194.....	H18
H294.....	H28
H394.....	H38
H195.....	H19
H295.....	H29
H395.....	H39

Source: Ref 1

that are not cold worked after solution heat treatment and for which mechanical properties or dimensional stability, or both, have been substantially improved by precipitation heat treatment. If the products are flattened or straightened, the effects of the cold work imparted by flattening or straightening are not accounted for in specified property limits.

T7, Solution Heat Treated and Overaged or Stabilized. T7 applies to wrought products that have been precipitation heat treated beyond the point of maximum strength to provide some special characteristic, such as enhanced resistance to stress-corrosion cracking or exfoliation corrosion. It applies to cast products that are artificially aged after solution heat treatment to provide dimensional and strength stability.

T8, Solution Heat Treated, Cold Worked, and Artificially Aged. This designation applies to products that are cold worked specifically to improve strength after solution heat treatment and for which mechanical properties or dimensional stability, or both, have been substantially improved by precipitation heat treatment. The effects of cold work, including any cold work imparted by flattening or straightening, are accounted for in specified property limits.

T9, Solution Heat Treated, Artificially Aged, and Cold Worked. This grouping is comprised of products that are cold worked specifically to improve strength after they have been precipitation heat treated.

T10, Cooled From an Elevated-Temperature Shaping Process, Cold Worked, and Artificially Aged. T10 identifies products that are cold worked specifically to improve strength after cooling from a hot-working process such as rolling or extrusion and for which mechanical properties have been substantially improved by precipitation heat treatment. The effects of cold work, including any cold work imparted by flattening or straightening, are accounted for in specified property limits.

Additional T Temper Variations. When it is desirable to identify a variation of one of the ten major T tempers described above, additional digits, the first of which cannot be zero, may be added to the designation.

Specific sets of additional digits have been assigned to stress-relieved wrought products:

Stress Relieved by Stretching, Compressing, or Combination of Stretching and Compressing. This designation applies to the following products when stretched to the indicated amounts after solution heat treatment or after cooling from an elevated-temperature shaping process:

Product form	Permanent set, %
Plate.....	1½-3
Rod, bar, shapes, and extruded tube.....	1-3
Drawn tube.....	½-3

- Tx51 applies specifically to plate, to rolled or cold-finished rod and bar, to die or ring forgings, and to rolled rings. These products receive no further straightening after stretching
- Tx510 applies to extruded rod, bar, shapes and tubing, and to drawn tubing. Products in this temper receive no further straightening after stretching
- Tx511 refers to products that may receive minor straightening after stretching to comply with standard tolerances

This variation involves stress relief by compressing.

- Tx52 applies to products that are stress relieved by compressing after solution heat treatment or after cooling from a hot-working process to produce a permanent set of 1 to 5%

The next designation is used for products that are stress relieved by combining stretching and compressing.

- Tx54 applies to die forgings that are stress relieved by restriking cold in the finish die. (These same digits—and 51, 52, and 54—may be added to the designation W

to indicate unstable solution-heat-treated and stress-relieved tempers)

Temper designations have been assigned to wrought products heat treated from the O or the F temper to demonstrate response to heat treatment:

- T42 means solution heat treated from the O or the F temper to demonstrate response to heat treatment and naturally aged to a substantially stable condition
- T62 means solution heat treated from the O or the F temper to demonstrate response to heat treatment and artificially aged

Temper designations T42 and T62 also may be applied to wrought products heat treated from any temper by the user when such heat treatment results in the mechanical properties applicable to these tempers.

System for Annealed Products

A digit following the “O” indicates a product in annealed condition having special characteristics. For example, for heat-treatable alloys, O1 indicates a product that has been heat treated at approximately the same time and temperature required for solution heat treatment and then air cooled to room temperature; this designation applies to products that are to be machined prior to solution heat treatment by the user. Mechanical property limits are not applicable.

Designation of Unregistered Tempers

The letter P has been assigned to denote H, T, and O temper variations that are negotiated between manufacturer and purchaser. The letter P follows the temper designation that most nearly pertains. The use of this type of designation includes situations where:

- The use of the temper is sufficiently limited to preclude its registration
- The test conditions are different from those required for registration with the Aluminum Association
- The mechanical property limits are not established on the same basis as required for registration with the Aluminum Association

Foreign Temper Designations

Unlike the agreement relating to wrought alloy designations, there is no Declaration of Accord for an international system of tempers to be registered with the Aluminum Association by foreign organizations. For the most part, the ANSI system is used, but because there is no international accord, reference to ANSI H35.1 properties and characteristics of aluminum alloy tempers registered with the Aluminum Association under ANSI 35.1 may not always reflect actual properties and characteristics associated with the particular alloy temper. In addition, temper designations may be created which are not registered with the Aluminum Association.

REFERENCES

1. "American National Standard Alloy and Temper Designation Systems for Aluminum," PP/2650/988/11, Aluminum Association, July 1988
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