
REGISTRATION RECORD SERIES
PURPLE SHEETS

Designations and Chemical Composition Limits for Aluminum Powders and Aluminum Alloy Powders



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FOREWORD

Listed herein are designations and chemical composition limits for aluminum and aluminum alloys in the form of powders as registered with the Aluminum Association. This list is maintained by the Technical Committee on Product Standards (TCPS) of the Aluminum Association. The designations of these compositions were assigned in conformance with the system adopted by The Aluminum Association and approved by the American National Standards Institute Incorporated as an American Standard (see American National Standard Alloy and Temper Designation Systems for Aluminum ANSI H35.1). Additions may be made as required, and alloys will be deleted when no longer in commercial use.

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

This registration record is not intended to address all regulatory requirements that may be imposed by local, national or international governing bodies. Regulatory requirements, which vary by region and end use, can further restrict the chemical composition within the registered limits. When applicable, inclusion of such requirements in the sales agreement is advised.

TABLE 1: REGISTERED DESIGNATIONS AND CHEMICAL COMPOSITION LIMITS FOR POWDERS^{1,2,3,4,5,6}

Only composition limits which are identical to those listed herein for a registered designation are applicable to that designation.

Designation		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	O	Be	Pb	Sn	Zr	Additional Elements	Others		Al Minimum
AA No.	Date Registered																Each	Total	
2A05.50	10/12/2020	0.10	0.08	4.2-5.0	-	0.20-0.35	-	-	-	3.0-3.9	0.10	-	-	-	-	Ag: 0.6-0.9 B: 1.25-1.55 ⁸ K: 0.08	0.08	0.17	Rem.
2A05.51 ⁹	10/12/2020	0.10	0.08	4.2-5.0	-	0.20-0.35	-	-	-	3.0-3.9	0.15	-	-	-	-	Ag: 0.6-0.9 B: 1.25-1.55 ⁸ K: 0.08	0.08	0.17	Rem.
2B05.50	10/12/2020	0.10	0.08	4.2-5.0	-	0.20-0.35	-	-	-	2.0-2.6	0.10	-	-	-	-	Ag: 0.6-0.9 B: 0.8-1.05 ⁸ K: 0.08	0.08	0.17	Rem.
3A20.50	12/16/2020	10.5-11.3	0.10-0.30	0.30-0.8	0.30-0.7	0.30-0.7	-	-	0.03	0.12-0.25	0.50	-	-	-	-	-	0.05	0.15	Rem.
3A60.50	01/15/2020	9.0-11.0	0.40	0.03	0.10	0.25-0.45	-	0.05	0.10	0.15	0.10	0.002	0.05	0.05	-	-	0.05	0.15	Rem.
3A60.51 ⁹	01/15/2020	9.0-11.0	0.40	0.03	0.10	0.25-0.45	-	0.05	0.10	0.15	0.15	0.002	0.05	0.05	-	-	0.05	0.15	Rem.
3A90.50	12/16/2020	7.5-8.5	0.6-1.2	1.0-1.5	0.6-0.9	0.50-1.0	0.15-.4.0	1.2-1.6	-	-	0.50	-	-	-	0.20-0.50	V: 0.10-0.30	0.05	0.15	Rem.
5A53.50	12/16/2020	0.12	0.15	-	-	4.2-5.0	-	-	-	-	0.20	0.005	-	-	0.6-0.8	Sc: 0.25-0.50 Ca: 0.005-0.15	0.05	0.15	Rem.
7A75.50	02/07/2019	0.40	0.40	1.1-2.1	0.30	3.0-4.6	0.10	0.05	7.1-9.0	0.20	0.50	0.0003	-	0.05	-	-	0.05	0.25	Rem.
7A75.51 ⁹	02/07/2019	0.12	0.15	1.2-2.0	0.10	3.2-4.4	0.05	0.05	7.3-8.7	0.10	0.50	0.0003	-	0.05	-	-	0.05	0.15	Rem.
7A77.50	02/07/2019	0.40	0.40	1.1-2.1	0.30	3.0-4.6	0.10	0.05	7.1-9.0	0.15	0.50	0.0003	-	0.05	0.50-2.8	-	0.05	0.25	Rem.
7A77.51 ⁹	02/07/2019	0.12	0.15	1.2-2.0	0.10	3.2-4.4	0.05	0.05	7.3-8.7	0.10	0.50	0.0003	-	0.05	0.50-2.8	-	0.05	0.15	Rem.
8A01.50	08/16/2019	-	-	-	-	8.5-9.5	-	-	-	-	0.20	-	-	-	-	Ce: 9.5-10.5	0.10	0.20	Rem.
8A02.50	08/16/2019	-	-	-	-	4.5-5.5	-	-	-	-	0.20	-	-	-	-	Ce: 9.5-10.5	0.10	0.20	Rem.
8A03.50	08/16/2019	-	-	-	-	8.5-9.5	-	-	-	-	0.20	-	-	-	-	Ce:12.5-13.5	0.10	0.20	Rem.
8A55.50	05/06/2019	0.15	5.0-6.1	-	-	-	-	-	-	-	0.20	-	-	-	-	Ce: 2.9-4.0 La: 1.6-2.5	0.05	0.15	Rem.
8A61.50	02/28/2022	0.50	0.8-1.4	-	-	-	-	-	-	-	0.6	-	-	-	0.9-1.4	-	0.20	0.50	Rem.
8A81.50	02/28/2022	0.50	0.50	1.5-2.5	3.0-4.5	-	-	2.0-3.5	-	-	0.6	-	-	-	0.7-1.3	-	0.20	0.50	Rem.

TABLE 2: CALCULATED THEORETICAL DENSITIES OF ACTIVE POWDERS

Density is dependent upon composition and nominal theoretical density is determined by computation rather than by a weight method. The values shown below have been computed in accordance with the Aluminum and Aluminum Alloy Density Calculation Procedure appearing on pages 2-13 and 2-14 of *Aluminum Standards and Data*. These calculated densities are nominal, theoretical values and should not be specified as engineering requirements but may be used in calculating nominal values for weight per unit length, weight per unit area, covering area, etc, and for estimating density for products made from powders.

Limiting the expression of density to the number of decimal places indicated is based on the fact that composition changes are discernible for most alloys. The expression of density to more decimal places than allowed by the following implies higher precision than is justified and should not be used.

1. Alloys listed below which have a minimum aluminum content of 99.35% or greater have nominal density values which are rounded in the US customary system (lbs/in.³) to the nearest multiple of 0.0005 and in the metric system [(kg/m³) x 10³] to the nearest multiple of 0.005.
2. Alloys listed below which have a minimum aluminum content of less than 99.35% have nominal density values which are rounded in the US customary system (lbs/in.³) to the nearest multiple of 0.001 and in the metric system [(kg/m³) x 10³] to the nearest multiple of 0.01.

The US customary (lbs/in.³) unit values are derived from metric values and subsequently rounded and are not to be back-converted to metric values.

Prior to 2009, the nominal density of alloys having a combination of elements may not have been calculated according to the current Aluminum and Aluminum Alloy Density Calculation Procedure appearing on Pages 2-13 and 2-14 of *Aluminum Standards and Data*. However, the nominal density of alloys published prior to 2009 shall not be revised.

Designation	Density		Designation	Density	
	lbs/in. ³	kg/m ³ x 10 ³		lbs/in. ³	kg/m ³ x 10 ³
2A05.50	0.102	2.83	7A77.51	0.103	2.85
2A05.51	0.102	2.83	7A75.50	0.102	2.82
2B05.50	0.102	2.82	7A75.51	0.102	2.82
3A20.50	0.096	2.67	8A01.50	0.099	2.74
3A60.50	0.096	2.66	8A02.50	0.101	2.80
3A60.51	0.096	2.66	8A03.50	0.101	2.79
3A90.50	0.099	2.74	8A55.50	0.105	2.90
5A53.50	0.096	2.65	8A61.50	0.099	2.73
7A77.50	0.103	2.85	8A81.50	0.104	2.88

TABLE 3: REGISTERED CHEMICAL COMPOSITION LIMITS OF INACTIVE POWDERS AND POWDER PRODUCTS^{1,2,3,4,5,6}

Designation		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	O	Be	Pb	Sn	Zr	Additional Elements	Others		Al Minimum
AA No.	Date Registered																Each	Total	
2A05.60L	10/12/2020	0.10	0.08	4.2-5.0	-	0.20-0.35	-	-	-	3.0-3.9	0.10	-	-	-	-	Ag: 0.6-0.9 B: 1.25-1.55 ⁸ K: 0.08	0.08	0.17	Rem.
2A05.61L ⁹	10/12/2020	0.10	0.08	4.2-5.0	-	0.20-0.35	-	-	-	3.0-3.9	0.15	-	-	-	-	Ag: 0.6-0.9 B: 1.25-1.55 ⁸ K: 0.08	0.08	0.17	Rem.
2B05.60	10/12/2020	0.10	0.08	4.2-5.0	-	0.20-0.35	-	-	-	2.0-2.6	0.10	-	-	-	-	Ag: 0.6-0.9 B: 0.8-1.05 ⁸ K: 0.08	0.08	0.17	Rem.
7A75.60L	02/07/2019	0.40	0.40	1.1-2.1	0.30	1.8-2.9	0.10	0.05	4.5-6.1	0.10	0.50	-	-	0.05	-	-	0.05	0.25	Rem.
7A75.61L ⁹	02/07/2019	0.12	0.15	1.2-2.0	0.10	2.0-2.7	0.05	0.05	4.7-5.8	0.10	0.50	-	-	0.05	-	-	0.05	0.15	Rem.
7A77.60L	02/07/2019	0.40	0.40	1.1-2.1	0.30	1.8-2.9	0.10	0.05	4.5-6.1	0.10	0.50	-	-	0.05	0.50-2.8	-	0.05	0.25	Rem.
7A77.61L ⁹	02/07/2019	0.12	0.15	1.2-2.0	0.10	2.0-2.7	0.05	0.05	4.7-5.8	0.10	0.50	-	-	0.05	0.50-2.8	-	0.05	0.15	Rem.
8A01.60L	08/16/2019	-	-	-	-	8.5-9.5	-	-	-	-	0.6	-	-	-	-	Ce: 9.5-10.5	0.10	0.20	Rem.
8A02.60L	08/16/2019	-	-	-	-	4.5-5.5	-	-	-	-	0.6	-	-	-	-	Ce: 9.5-10.5	0.10	0.20	Rem.
8A03.60L	08/16/2019	-	-	-	-	8.5-9.5	-	-	-	-	0.6	-	-	-	-	Ce:12.5-13.5	0.10	0.20	Rem.
8A55.60L	05/06/2019	0.15	5.0-6.1	-	-	-	-	-	-	-	0.6	-	-	-	-	Ce: 2.9-4.0 La: 1.6-2.5	0.05	0.15	Rem.

RECOMMENDATION FOR CHEMICAL COMPOSITION LIMITS OF POWDERS

1. Composition is in weight percentage maximum unless shown as a range or a minimum.

Standard limits for alloying elements and impurities are expressed to the following places:

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

2. Except for "Aluminum" and "Others", analysis is required for elements for which specific limits are shown. For purposes of determining conformance to these limits, an observed value or calculated value obtained from analysis is rounded off to the nearest unit in the last right-hand digit used in expressing the specified limit, in accordance with the following:
 3. When the digit next beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained.

When the digit next beyond the last place to be retained is greater than 5, increase by 1 the digit in the last place retained.

When the digit next beyond the last place to be retained is 5, and there are no digits beyond this 5, or only zeros, increase by 1 the digit in the last place retained if it is odd, leave the digit unchanged if it is even. Increase by 1 the digit in the last place retained if there are non-zero digits beyond this 5.
3. Registrations for alloy powders shall contain a maximum percentage oxygen content. Oxygen may be either an impurity element with a specified maximum or an alloying element with a specified range.
4. "Others" includes listed elements for which no specific limit is shown as well as unlisted metallic elements. The producer may analyze samples for trace elements not specified in the registration or specification. However, such analysis is not required and may not cover all metallic "Others" elements. Should any analysis by the producer or purchaser establish that an "Others" element exceeds the limit of "Each" or that the aggregate of several "Others" elements exceeds the limits of "Total", the material shall be considered non-conforming.
5. The sum of those "Others" metallic elements 0.010 percent or more each, is expressed to the second decimal before determining the sum.
6. The aluminum content for unalloyed aluminum not made by a refining process is the difference between 100.00 percent and the sum of all other analyzed metallic elements together with silicon and oxygen present in amounts of 0.010 percent or more each, expressed to the second decimal before determining the sum. For alloys and unalloyed aluminum not made by a refining process, when the specified maximum limit is 0.XX, an observed value or a calculated value greater than 0.005 but less than 0.010% is rounded off and shown as "less than 0.01".
7. The aluminum content for unalloyed aluminum made by a refining process is the difference between the 100.00 percent and the sum of all other metallic elements together with silicon and oxygen present in amounts of 0.0010 percent or more each, expressed to the third decimal before determining the sum, which is rounded to the second decimal before subtracting. For unalloyed aluminum made by a refining process, when the specified maximum limit is 0.0XX, an observed value or a calculated value greater than 0.0005 but less than 0.0010% is rounded off and shown as "less than 0.001."

RECOMMENDATION FOR DESIGNATIONS OF POWDERS

This Recommendation is based on the designation system for aluminum and aluminum alloy powders which was adopted in the U.S. in 2019, and became a national standard in 2022.

Designations, registered in accordance with this Recommendation, may be used by any country. For use, see Appendixes A, B, and C.

A designation assigned in conformance with this Recommendation shall only be used to indicate an aluminum or aluminum alloy powder having chemical composition limits identical to those registered with the Aluminum Association and published herein.

No changes in the composition limits are allowed after the registration is final.

1. Scope

This Recommendation describes a system of six alphanumeric characters for designating aluminum and aluminum alloy powders¹.

The alloy designation system has the following structure: **wZab.yv** where:

- w** = Alloy Group (1-8), determined by major alloying element.
(see Section 2. **Alloys Groups** below).
- Z** = Alloy Modification. The letter 'A' denotes the original alloy in an alloy family, and alloy modifications are denoted by letters 'B' through 'Z.' The Reserve Numeral 'v' may also be used to denote modification when there are more modification in an alloy family than the Alloy Modification letter 'Z' allows for.
(see Section 3. **Alloy Modifications** below).
- ab** = Alloy Family, with numerals 00 through 99 (minimum Al content for Alloy Group 1, and arbitrary for Groups 2-8).
(see Section 4. **Alloy Family** below).
- y** = Alloy Form. The numeral 5 designates a powder alloy¹
(see Section 5. **Alloy Form** below).
- v** = Reserve numeral maintained as '0' by default. Values 1 through 9 may be used in combination with Alloy Modification letter to increase the total number of modifications available for each Alloy Family. May also be used as a unique identifier.¹
(see Section 6. **Reserve Numeral** below).

2. Alloy Groups^{2,3,4,5,6}

The first of the six alphanumeric characters in the designation, denoted by "w" in "wZab.yv" is a numerical digit that indicates the alloy group as follows:

Aluminum, 99.00% and greater	1Zab.yv
Aluminum alloys grouped by major alloying elements:	
Copper	2Zab.yv
Silicon, with added Copper and/or Magnesium	3Zab.yv
Silicon	4Zab.yv
Magnesium	5Zab.yv
Magnesium and Silicon	6Zab.yv
Zinc	7Zab.yv
Other Element	8Zab.yv

1Zab.yv Group

The designation assigned shall be in the 1Zab.yv group whenever the minimum aluminum content is specified as 99.00% and greater. In the 1Zab.yv group, the numerical digits in the third and fourth positions in the designation, denoted by "ab" in "1Zab.yv", indicate the minimum aluminum percentage⁶. These digits are the same as the two digits to the right of the decimal point in minimum aluminum percentage when it is expressed to the nearest 0.01%.

2Zab.yv through 8Zab.yv Groups

The alloy designation in the 2Zab.yv through 8Zab.yv groups is determined by the alloying element (Mg₂Si for 6Zab.yv alloys) present in the greatest mean percentage. If the greatest mean percentage is common to more than one alloying element, the choice of group shall be in order of group sequence Cu, Si with added Cu and/or Mg, Si, Mg, Mg₂Si, Zn, or Others. In the 2Zab.yv through 8Zab.yv alloy groups, the numerical digits in the third and fourth positions in the designation, denoted by "ab", have no special significance but serve only to identify the different aluminum alloys in the group. Where possible, they should resemble existing wrought or cast alloys as outlined under 4. **Alloy Family** below.

All Groups

The composition of any powder registration shall always report the maximum chemical composition limit of oxygen.

3. Alloy Modifications

In the second position of the designation, denoted by "Z" in "wZab.yv", an original powder alloy is indicated by the capital letter "A". A modification of the original powder alloy is indicated by a serial letter in the second position assigned in alphabetical sequence starting with "B", but omitting I, O, Q and X. If more than 21 alloy modifications are required for any alloy family, the Reserve Numeral 'v' may assume values from 1 to 9. In combination with the alloy modification letter, this allows for a total of 219 modifications for any original powder alloy.

The determination of whether an alloy is a modification of an original alloy is made on the basis of changes to the powder alloy composition, including alloying elements and their limits and/or changes to grain refining elements having both upper and lower limits. Changes only to impurity elements or grain refining elements having only maximum limits do not qualify as an alloy modification.

A modification of the original powder alloy⁷ is limited to any one or a combination of the following:

(a) Change of not more than the following amounts in the arithmetic mean of the limits for an individual alloying or grain refining element (see Recommendation Footnote 1 for definition of alloying element) or combination of elements expressed as an alloying element or both, with the exception of a change in only oxygen as an alloying element:

<u>Arithmetic Mean of Limits for Alloying Elements in Original Powder Alloy</u>	<u>Maximum Change</u>
Up through 1.0%	0.15
Over 1.0 through 2.0%	0.20
Over 2.0 through 3.0%	0.25
Over 3.0 through 4.0%	0.30
Over 4.0 through 5.0%	0.35
Over 5.0 through 6.0%	0.40
Over 6.0%	0.50

To determine compliance when maximum and minimum limits are specified for a combination of two or more elements in one alloy composition, the arithmetic mean of such combination is compared to the sum of the mean values of the same individual elements, or any combination thereof, in another alloy composition. Changes to one or both of the maximum or minimum limits that are completely within the limits of the original alloy does not qualify as a modification.

(b) Addition or deletion of not more than one alloying or grain refining element with limits having an arithmetic mean of not more than 0.30%, or addition or deletion of not more than one combination of elements expressed as an alloying element with limits having a combined arithmetic mean of not more than 0.40%.

(c) Change in limits for grain refining elements having both a minimum and maximum limit or the addition of minimum limits to one or more impurity or grain refining elements having only maximum limits in the original alloy.

(d) Changes in one or both of the maximum or minimum limits for oxygen with no restriction on the magnitude of change.

(e) Deletions or changes in limits of impurities or limits on additional impurities expressed singly or as a combination.

(f) Changes in maximum limits on grain refining elements or introduction of maximum limits for additional grain refining elements.

(g) Changes to limits on structural modifiers or introduction of additional structural modifiers. Structural modifiers include Na, Sr, Ca and P.

A powder alloy shall not be registered as a modification if it meets the requirements for an original powder alloy.

4. Alloy Family

The last two of the four digits before the decimal place, denoted by "ab" in "wZab.yv", collectively stand for the alloy family designated by a two-digit number ranging from 00 to 99. They have no special significance but serve only to identify the different aluminum alloys in the group. The alloy family designation should follow closely with that of wrought or cast alloys of similar chemical compositions, whenever reasonably possible, in accordance with Appendix A.6. Refer to the *International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys* (Teal Sheets) and the *Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot* (Pink Sheets).

5. Alloy Form¹

The numerical digit in the fifth position in the designation (first digit to the right of the decimal point), denoted by "y" in "wZab.yv", indicates the alloy form. The numeral 5 used in the designation as "wZab.5v" indicates that the alloy is of powder form. No numerals other than 5 are currently in use in the nomenclature to denote an alloy form.

6. Reserve Numeral¹

The numerical digit in the sixth position in the designation (second digit to the right of the decimal point), denoted by "v" in "wZab.yv", is maintained as '0' by default but can assume values from 0 to 9. Values 1 to 9 are used when there are more than 22 alloys in any alloy family and where the Alloy Modification letter alone cannot be used to designate all the modifications. When an alloy family uses up all 22 alloy modification letters, the reserve numeral may be incremented by 1 to reutilize the alloy modification letters. Through the combination of the Alloy Modification letter A to Z (omitting I, O, Q and X) and Reserve Number 0 to 9, each alloy family is capable of accommodating up to 220 alloys. An example of the total available alloy modification series with the help of the combination of the alloy modification Letter and the reserve numeral would thus be as follows: 2A39.50, 2B39.50, ...2Z39.50, 2A39.51, 2B39.51, ...2Z39.51, 2A39.52, ...2Z39.52.

Reserve Numerals 1 to 9 may also be circumstantially used as a unique identifier for miscellaneous or future requirement when supported by further explanation in the footnotes.

FOOTNOTES

1. Prior to 2021, the Purple Sheets allowed for the registration of products made from powder feedstock. Registration of products has since been discontinued and the registered products have been moved to the table for Registered Chemical Composition Limits of Inactive Powders and Powder Products.

Until 2021, the alloy designation system employed the following structure: **wZab.yvS** where additionally:

y = Alloy Form. The numeral 5 designated powder alloys, whereas numeral 6 designated powder feedstock based product forms registered before 2021

v = Powder or Product Variations in chemical compositions. The numeral 0 designated an Original powder alloy or product composition; whereas numerals 1-9 permitted up to nine different variations for powders and products registered before 2021.

The determination of whether a powder alloy or product was a variation of an original registration or modification was made on the basis of conforming to a limited set of changes to the composition including changes to one or more impurity elements, grain refining elements having only maximum limits, structural modifiers and oxygen. Changes to alloying elements, with the exception of oxygen, or to grain refining elements having both maximum and minimum limits that were outside the existing limits of the original registration or modification, did not qualify the alloy as a variation.

A variation had the same alloying elements as the corresponding original registration or modification. The grain refining elements having both a maximum and minimum were also the same.

A variation was limited to one or more of the following:

(a) Changes in one or both of the maximum or minimum limits for oxygen with no restriction on the magnitude of change.

(b) Change in limits of impurities or limits on additional impurities expressed singly or as a combination.

(c) Changes in maximum limits on grain refining elements or introduction of maximum limits for additional grain refining elements.

(d) Changes to limits on structural modifiers or introduction of additional structural modifiers. Structural modifiers include Na, Sr, Ca and P.

S = Product Manufacturing Method. Suffix letters were assigned to denote the manufacturing method for making product from powder alloys. The following suffix letters were assigned:

L = chemical composition limits for laser powder bed fusion products

E = chemical composition limits for electron beam powder bed fusion products

D = chemical composition limits for laser direct powder deposit products

S = chemical composition for sintered products

C = chemical composition limits for cold spray products

The composition limits for products may be the same or differ from those of the powder feedstock from which they are made. Differences may be the result of alloying element pickup or loss, increases in the specified powder impurities, or the pickup of additional impurities during the product manufacturing process. The compositional differences may vary from manufacturing process to process.

2. For codification purposes, an alloying element is any element which is intentionally added for any purpose other than grain refinement and for which minimum and maximum limits are specified.

3. Standard limits for alloying elements and impurities are expressed to the following places:

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

(except that combined Si + Fe limits for 1Zab.yv designations must be expressed as 0.XX or 1.XX)

4. Standard limits for alloying elements and impurities are expressed in the following sequence: Silicon; Iron; Copper; Manganese; Magnesium; Chromium; Nickel; Zinc; Titanium; Oxygen (See Note 4); additional specified elements (see Note 1); Other (See Note 2) Elements, Each; Other Elements, Total; Aluminum (See Note 3).

Note 1—Additional specified elements having limits are inserted in alphabetical order by their chemical symbols between Oxygen and Other Elements, Each, or are specified in footnotes.

Note 2—"Others" includes listed elements for which no specific limit is shown as well as unlisted metallic elements. The producer may analyze samples for trace elements not specified in the registration or specification; however, such analysis is not required and may not cover all metallic "Others" elements. Should any analysis by the producer or the purchaser establish that an "Others" element exceeds the limit of "Each" or that the aggregate of several "Others" elements exceeds the limit of "Total", the material shall be considered non-conforming.

Note 3—Aluminum is specified as a minimum for unalloyed aluminum, and as a remainder for aluminum alloys.

Note 4—Alloy registrations for powders shall contain a maximum percentage oxygen content. Oxygen may be either an impurity element with a specified maximum or an alloying element with a specified range.

5. Individual element limits (i.e. maximum limits or a range) are required for elements having a combined maximum limit in excess of 0.10%. Individual element limits are not required for elements having a combined maximum limit of 0.10% or less.

6. The aluminum content for unalloyed aluminum made by a refining process is the difference between 100.00 percent and the sum of all other metallic elements together with silicon and oxygen present in amounts of 0.0010 percent or more each, expressed to the third decimal before determining the sum, which is rounded to the second decimal before subtracting; for unalloyed aluminum not made by a refining process it is the difference between 100.00 percent and the sum of all other analyzed metallic elements together with silicon and oxygen present in amounts of 0.010 percent or more each, expressed to the second decimal before determining the sum. For unalloyed aluminum made by a refining process, when the specified maximum limit is 0.0XX, an observed value or a calculated value greater than 0.0005 but less than 0.0010 percent is rounded off and shown as "less than 0.001". For alloys and unalloyed aluminum not made by a refining process, when the specified maximum limit is 0.XX, an observed value or a calculated value greater than 0.005 but less than 0.010 percent is rounded off and shown as "less than 0.01".

7. The term "original" powder alloy as used in the Registration Record is defined based on the following guidelines:

(a) Only one aluminum or aluminum powder alloy in any alloy family (i.e., alloys having matching numerical digits in the first, third and fourth positions of the designation) is considered the "original" powder alloy, and it is always used as the basis for registration of a modification.

(b) All active and inactive alloys with the capital letter "A" in the second position of the designation are considered the "original" alloys for each specific alloy group.

(c) No designation changes are made to any and all of the currently registered original alloys whether active or inactive.

8. An exception to the recommendation on significant figures was allowed to accurately represent the chemical composition limit the alloy in production.
9. An exception to the recommendations on nomenclature, with respect to the order of priority for assigning alloy modification letters and reserve numerals, is observed due to conflicts with pre-existing nomenclature provisions.

APPENDIX A USE AND ASSIGNMENT OF POWDER DESIGNATIONS

USE OF DESIGNATIONS

A.1 Aluminum and aluminum alloy designations used in accordance with this Recommendation shall have chemical composition limits identical to the registered limits of that designation.

A.2 Designations that could be mistaken for a designation described in the Recommendation (shown on page 5) shall not be used for unregistered aluminum and aluminum alloys.

A.3 Aluminum and aluminum alloys in the form of powder having chemical composition limits that differ from registered designations should be submitted for the assignment of a designation.

ASSIGNMENT OF DESIGNATIONS

A.4 Designations for a new alloy registration shall be assigned in the following order of precedence:

A.4.1 Any proposed alloy having chemical composition limits that are identical to a registered designation shall use the registered designation.

A.4.2 A proposed alloy can qualify to be a modification of an original alloy. The designation for an alloy modification shall be assigned if the chemical composition limits meet the requirements for an alloy modification. A modification shall be indicated in the second position of the designation by the next available serial letter in alphabetical sequence starting with "B" but omitting I, O, Q and X.

A.4.3 A new original designation shall be assigned only for an alloy having different chemical composition limits which do not meet the requirements to qualify as a modification of any registered alloy. An original powder alloy shall be indicated by the capital letter "A" in the second position of the designation.

A.5 In considering requests for designation of a new alloy, the complete chemical composition limits shall be disclosed and judged to be reasonable and technically correct by the Technical Committee on Products and Standards.

A.6 Aluminum and aluminum powder alloys previously registered in the Wrought Aluminum and Aluminum Alloy Designation System (Teal Sheets) or in the Cast Aluminum and Aluminum Alloy Designation System (Pink Sheets) may be re-registered as original powder alloys in the Powder Aluminum and Aluminum Alloy Designation System, regardless of whether they are original alloys, modifications or variations in the prior system ; if:

A.6.1 The chemical composition limits for the original powder alloy in the powder designation system are identical to those of the original alloy, modification or variation in the prior registration system, except that an oxygen range or maximum limit shall be added if absent in the prior registration.

A.6.2 The requirements for "Sale of Alloy" and "Commercial Quantity" in Appendix C are met.

A.6.3 The powder alloy in the prior registration system is deactivated if not already inactive.

The original powder alloy designation may be chosen to reflect the previous powder registration in the wrought or casting alloy designation systems. For example, original powder alloy 8009 registered in the wrought alloy system may be re-registered in the powder designation system as original powder alloy 8A09.50; and powder alloy modification C360.2 registered in the cast alloy designation system may be re-registered in the powder alloy designation system as original powder alloy 3A60.50. Subsequent modifications of an original powder will be determined in accordance with the Recommendations on pages 4 and 5.

A.7 An original aluminum and aluminum alloy powder designation in this system may be chosen to reflect an existing alloy family in the Wrought Aluminum and Aluminum Alloy Designation System (Teal Sheets) or in the Cast Aluminum and Aluminum Alloy Designation Systems (Pink Sheets) if it meets one of the following:

A7.1 The original powder alloy in the powder designation system has similar limits on alloying elements and grain refining elements having both a maximum and minimum limit as those of an original alloy in the other system, except that an oxygen range or maximum limit shall be added here if absent in the prior registration.

A7.2 The original powder alloy meets the requirements of a modification or variation as applied to an original alloy in the other system, except that an oxygen range or maximum limit shall be added here if absent in the prior registration

A.7.3 The requirements for "Sale of Alloy" and "Commercial Quantity" in Appendix C are met.

For example, an original powder alloy in the powder designation system based on alloy family 6x63 in the wrought alloy designation system may be registered as 6A63.50; and an original powder alloy based on alloy family 357.0 in the cast

alloy designation system may be registered as 3A57.50. Subsequent modifications of an original powder alloy of powder alloy modifications will be determined in accordance with the Recommendations on pages 4 and 5.

A.8 Alloy family designations previously used in the Wrought Aluminum and Aluminum Alloy Designation System (Teal Sheets) or in the Cast Aluminum and Aluminum Alloy Designation System (Pink Sheets) should be avoided for original powder alloys not meeting the requirements of A.6 or A.7, until previously unused alloy family designations are exhausted in the relevant alloy group. When this occurs, inactive alloy family designations should be used first, followed by alloy family designations from less commonly produced active alloys.

APPENDIX B DEACTIVATION OF DESIGNATIONS

B.1 Designations in accordance with these Recommendations should be reviewed, at least once in every five years, to see if these alloys are still commercially active. If not, alloys should be proposed for deactivation. Any inactive alloy can still be reactivated when such need arises.

APPENDIX C GENERAL GUIDELINES FOR DETERMINING COMPLIANCE WITH "SALE OF ALLOY" AND "COMMERCIAL QUANTITY" FOR PURPOSES OF REGISTERING ALUMINUM AND ALUMINUM ALLOYS IN THE FORM OF POWDER

C.1 Sale of Alloy

The aluminum or aluminum alloy shall be offered for sale currently and shall have been sold within the 12 months immediately preceding the date of the registration request, in both cases in commercial quantities (C.2). Such sales shall have been made to external users/customers (i.e., internal use and/or transfer of an alloy within a company does not meet the stated criteria).

C.2 Commercial Quantity

C.2.1 The alloy has undergone bona fide production and is NOT a "laboratory" scale volume.

C.2.2 The alloy is fabricated in standard production facilities and is NOT a one-time production.

C.2.3 There is an expected and ongoing commercial demand and/or need for the alloy.

C.2.4 The alloy must be purchased and sold in a standard business context which indicates that the alloy is actually "sold" and not "given away" for uses such as promotional evaluations.

C.2.5 The alloy must be consistent in composition for any quantity of material. Powder mixtures, partially alloyed powders, and composite powders consisting of two or more differing nominal chemical compositions are not to be registered as an alloy.

OTHER ALUMINUM ASSOCIATION REGISTRATION RECORDS AND REFERENCES

- INTERNATIONAL ALLOY DESIGNATIONS AND CHEMICAL COMPOSITION LIMITS FOR WROUGHT ALUMINUM AND WROUGHT ALUMINUM ALLOYS (Teal Sheets).
- DESIGNATIONS AND CHEMICAL COMPOSITION LIMITS FOR ALUMINUM ALLOYS IN THE FORM OF CASTINGS AND INGOT (Pink Sheets).
- INTERNATIONAL DESIGNATIONS AND CHEMICAL COMPOSITION LIMITS FOR UNALLOYED ALUMINUM (Gold Sheets).
- INTERNATIONAL DESIGNATIONS AND CHEMICAL COMPOSITION LIMITS FOR ALUMINUM HARDENERS (Gray Sheets).
- COMPONENTS OF CLAD ALUMINUM ALLOY PRODUCTS (Lt. Green Sheets).
- TEMPERS FOR ALUMINUM AND ALUMINUM ALLOY PRODUCTS (Yellow Sheets).
- TEMPERS FOR ALUMINUM AND ALUMINUM ALLOY PRODUCTS—METRIC EDITION (Tan Sheets).
- ALUMINUM STANDARDS AND DATA
A reference book containing data on chemical compositions, mechanical and physical properties, tolerances and other information on aluminum mill products in general use, in U.S. Customary units.
- ALUMINUM STANDARDS AND DATA METRIC SI
- A reference book containing data on chemical compositions, mechanical and physical properties, tolerances and other information on aluminum mill products in general use, in Metric (SI) units.

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