~~Designation:B211–12~~ Designation: B211 – 12$^{\varepsilon 1}$

Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire[1]

This standard is issued under the fixed designation B211; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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

ε[1] NOTE—Table 1 was corrected editorially in June 2012.

1. Scope*

1.1 This specification[2] covers rolled or cold-finished bar, rod, and wire in alloys (Note 1) and tempers as shown in Table 2.

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

NOTE 2—The term *cold finished* is used to indicate the type of surface finish, sharpness of angles, and dimensional tolerances produced by drawing through a die.

NOTE 3—See Specification B221 for aluminum and aluminum-alloy extruded bars, rods, wire, shapes, and tubes; and Specification B316/B316M for aluminum and aluminum-alloy rivet and cold-heading wire and rods.

1.2 Alloy and temper designations are in accordance with ANSI H35.1. The equivalent UNS alloy designations are those of Table 1 preceded by A9, for example, A91100 for aluminum 1100 in accordance with Practice E527.

1.3 A complete metric companion to Specification B211 has been developed—B211M; therefore, no metric equivalents are presented in this specification.

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

2. Referenced Documents

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

2.2 *ASTM Standards:*[3]

B221 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B316/B316M Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods

B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products

B594 Practice for Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications

B660 Practices for Packaging/Packing of Aluminum and Magnesium Products

B666/B666M Practice for Identification Marking of Aluminum and Magnesium Products

B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

B918 Practice for Heat Treatment of Wrought Aluminum Alloys

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

E290 Test Methods for Bend Testing of Material for Ductility

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere

E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis

E1004 Test Method for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method

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

Current edition approved ~~Jan. 15, 2012.~~ . Published March 2012. Originally approved in 1946. Last previous edition approved in 2003 as B211–03. DOI: 10.1520/B0211-12.

[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SB-211 in Section II of that Code.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

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

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

Alloy	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti†	Bi	Pb	Sn†	Other Elements[E]		Aluminum
													Each	Total[F]	
1100	0.95 Si + Fe		0.05–0.20	0.05	...	...	...	0.10	...	...	...	...	0.05	0.15	99.00 min[G]
2011	0.40	0.7	5.0–6.0	...	...	...	...	0.30	...	0.20–0.6	0.20–0.6	...	0.05	0.15	remainder
~~2014~~	~~0.50–1.2~~	~~0.7~~	~~3.9–5.0~~	~~0.40–1.2~~	~~0.20–0.8~~	~~0.10~~	~~...~~	~~0.25~~	~~...~~	~~...~~	~~...~~	~~0.15~~	~~0.05~~	~~0.15~~	~~remainder~~
2014	0.50–1.2	0.7	3.9–5.0	0.40–1.2	0.20–0.8	0.10	...	0.25	0.15	...	...	...	0.05	0.15	remainder
~~2017~~	~~0.20–0.8~~	~~0.7~~	~~3.5–4.5~~	~~0.40–1.0~~	~~0.40–0.8~~	~~0.10~~	~~...~~	~~0.25~~	~~...~~	~~...~~	~~...~~	~~0.15~~	~~0.05~~	~~0.15~~	~~remainder~~
2017	0.20–0.8	0.7	3.5–4.5	0.40–1.0	0.40–0.8	0.10	...	0.25	0.15	...	...	...	0.05	0.15	remainder
~~2024~~	~~0.50~~	~~0.50~~	~~3.8–4.9~~	~~0.30–0.9~~	~~1.2–1.8~~	~~0.10~~	~~...~~	~~0.25~~	~~...~~	~~...~~	~~...~~	~~0.15~~	~~0.05~~	~~0.15~~	~~remainder~~
2024	0.50	0.50	3.8–4.9	0.30–0.9	1.2–1.8	0.10	...	0.25	0.15	...	...	...	0.05	0.15	remainder
~~2219~~	~~0.20~~	~~0.30~~	~~5.8–6.8~~	~~0.20–0.40~~	~~0.02~~	~~...~~	~~...~~	~~0.10~~	~~...~~	~~...~~	~~...~~	~~0.02–0.10~~	~~0.05[H]~~	~~0.15[H]~~	~~remainder~~
2219	0.20	0.30	5.8–6.8	0.20–0.40	0.02	...	...	0.10	0.02–0.10	...	...	...	0.05[H]	0.15[H]	remainder
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...	...	0.10	...	...	...	...	0.05	0.15	remainder
4032	11.0–13.5	1.0	0.50–1.3	...	0.8–1.3	0.10	0.5–1.3	0.25	...	...	...	...	0.05	0.15	remainder
5052	0.25	0.40	0.10	0.10	2.2–2.8	0.15–0.35	...	0.10	...	...	...	...	0.05	0.15	remainder
5056	0.30	0.40	0.10	0.05–0.20	4.5–5.6	0.05–0.20	...	0.10	...	...	...	...	0.05	0.15	remainder
~~5154[I]~~	~~0.25~~	~~0.40~~	~~0.10~~	~~0.10~~	~~3.1–3.9~~	~~0.15–0.35~~	~~...~~	~~0.20~~	~~...~~	~~...~~	~~...~~	~~0.20~~	~~0.05~~	~~0.15~~	~~remainder~~
5154[I]	0.25	0.40	0.10	0.10	3.1–3.9	0.15–0.35	...	0.20	0.20	...	...	...	0.05	0.15	remainder
6013	0.6–1.0	0.50	0.6–1.1	0.20–0.8	0.8–1.2	0.10	...	0.25	0.10	...	...	...	0.05	0.15	remainder
6020	0.40–0.9	0.50	0.30–0.9	0.35	0.6–1.2	0.15	...	0.20	0.15	...	0.05	0.9–1.5	0.05	0.15	remainder
~~6061~~	~~0.40–0.8~~	~~0.7~~	~~0.15–0.40~~	~~0.15~~	~~0.8–1.2~~	~~0.04–0.35~~	~~...~~	~~0.25~~	~~...~~	~~...~~	~~...~~	~~0.15~~	~~0.05~~	~~0.15~~	~~remainder~~
6061	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.35	...	0.25	0.15	...	...	...	0.05	0.15	remainder
~~6110~~	~~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~~	~~remainder~~
6110	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	remainder
~~6262~~	~~0.40–0.8~~	~~0.7~~	~~0.15–0.40~~	~~0.15~~	~~0.8–1.2~~	~~0.04–0.14~~	~~...~~	~~0.25~~	~~...~~	~~0.40–0.7~~	~~0.40–0.7~~	~~0.15~~	~~0.05~~	~~0.15~~	~~remainder~~
6262	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.14	...	0.25	0.15	0.40–0.7	0.40–0.7	...	0.05	0.15	remainder
~~7075~~	~~0.40~~	~~0.50~~	~~1.2–2.0~~	~~0.30~~	~~2.1–2.9~~	~~0.18–0.28~~	~~...~~	~~5.1–6.1~~	~~...~~	~~...~~	~~...~~	~~0.20~~	~~0.05~~	~~0.15~~	~~remainder~~
7075	0.40	0.50	1.2–2.0	0.30	2.1–2.9	0.18–0.28	...	5.1–6.1	0.20	...	...	...	0.05	0.15	remainder

† Values corrected editorially in June 2012.

[A] Limits are in mass percent maximum unless otherwise shown.

[B] Analysis shall be made for the elements for which limits are shown in this table.

[C] For purposes of determining conformance to these limits, an observed value or a calculated value obtained from analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the specified limit, in accordance with the rounding-off method of Practice E29.

[D] In case of any discrepancy in the values listed in Table 3 when compared with those listed in the "Teal Sheets" (International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys), the composition limits registered with The Aluminum Association and published in the "Teal Sheets" shall be considered the controlling composition.

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

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

[G] The aluminum content is the difference between 100.00 % and the sum of all other metallic elements and silicon present in amounts of 0.010 % or more each, rounded to the second decimal before determining the sum.

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

[I] Beryllium 0.0003 maximum for welding electrode and welding rod only.

E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry

G47 Test Method for Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products

2.3 *ANSI Standards:*

H35.1 Alloy and Temper Designation Systems for Aluminum[4]

H35.2 Dimensional Tolerances for Aluminum Mill Products[4]

2.4 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[5]

2.5 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage[5]

2.6 *Aerospace Material Specification:*

AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials[6]

2.7 *The Aluminum Association:*

International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys[7]

2.8 *Other Standards:*

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

[5] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[6] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

[7] Available from The Aluminum Association, Inc. 1525 Wilson Boulevard, Arlington, VA 22209, www.aluminum.org

CEN EN 14242 Aluminium and Aluminium Alloys–Chemical Analysis–Inductively Coupled Plasma Optical Emission Spectral Analysis[8]

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology B881 for definitions of product terms in this specification.

3.1.2 *flattened and slit wire*—Flattened wire which has been slit to obtain square edges.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *capable of*—The term *capable of* as used in this specification means that the test need not be performed by the producer of the material. However, should subsequent testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

4. Ordering Information

4.1 Orders for material to this specification shall include the following information:

4.1.1 This specification designation (which includes the number, the year, and the revision letter, if applicable),

4.1.2 Quantity in pieces or pounds,

4.1.3 Alloy (Section 7),

4.1.4 Temper (Section 9),

4.1.5 *Product Form*, Rolled or cold finished bar, rolled or cold finished rod, or wire,

4.1.6 *Geometry and Dimensions*, Diameter for rounds; distance across flats for square-cornered squares, hexagons, or octagons; width and depth for square-cornered rectangles (orders for squares, hexagons, octagons, or rectangles with rounded corners usually require a drawing),

4.1.7 Length, and

4.1.8 Tensile property limits and dimensional tolerances for sized not covered in Table 2 and in ANSI H35.2, respectively.

4.2 Additionally, orders for material to this specification shall include the following information when required by the purchaser:

4.2.1 Whether heat treatment in accordance with Practice B918 is required (8.2),

4.2.2 Whether 7075-O material is required to develop requirements for T73 temper (see 10.1.2),

4.2.3 Whether bend testing is required for 2017, 2024, or 3003 (Section 12),

4.2.4 When specified finish of bar and rod is not required (Section 15),

4.2.5 Whether marking for identification is required (Section 16),

4.2.6 Whether ultrasonic inspection is required (Section 17, Table 3),

4.2.7 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (Section 19),

4.2.8 Whether certification is required (Section 21), and

4.2.9 Whether Practices B660 apply, and if so, the levels of preservation, packaging, and packing required (Section 22).

5. Manufacture

5.1 The products covered by this specification shall be produced either by hot extruding and cold finishing or by hot rolling with or without cold finishing, at the option of the producer.

TABLE 2 Mechanical Property Limits[A]

Temper	Specified Diameter or Thickness, in.	Tensile Strength, ksi		Yield Strength[B] (0.2 % offset), min, ksi	Elongation[B] in 2 in. or 4 × Diameter, min, %
		min	max		
		Aluminum 1100			
O	0.124 and under	11.0	15.5	...	...
	0.125 and over	11.0	15.5	3.0	25
H12	0.374 and under	14.0	...	...	...
H14	0.374 and under	16.0	...	...	...
H16	0.374 and under	19.0	...	...	...
H18	0.374 and under	22.0	...	...	...
H112	all	11.0	...	3.0	...
F	all	[C]	...	[C]	...
		Alloy 2011			
T3	0.125–1.500	45.0	...	38.0	10

[8] Available from European Committee for Standardization, Central Secretariat (CEN), rue de Stassart 36, B1050 Brussels, Belgium. http://www.cen.eu/esearch

TABLE 2 *Continued*

Temper	Specified Diameter or Thickness, in.	Tensile Strength, ksi		Yield Strength[B] (0.2 % offset), min, ksi	Elongation[B] in 2 in. or 4 × Diameter, min, %
		min	max		
	1.501–2.000	43.0	...	34.0	12
	2.001–3.500	42.0	...	30.0	12
T4 and T451[D]	0.125–8.000	40.0	...	18.0	16
T6 and T651	0.375–6.500	54.0	...	40.0	10
T8	0.125–3.250	54.0	...	40.0	10
		Alloy 2014[E]			
O	0.124 and under	...	35.0	...	...
	0.125–8.000	...	35.0	...	12
T4, T42[F], and T451[D]	0.124 and under	55.0	...	...	...
	0.125–8.000[G]	55.0	...	32.0	16
T6, T62[F], and T651[D]	0.124 and under	65.0	...	...	...
	0.125–8.000[G]	65.0	...	55.0	8
		Alloy 2017[E]			
O	0.124 and under	...	35.0	...	...
	0.125–8.000	...	35.0	...	16
T4, T42[F], and T451[D]	0.124 and under	55.0	...	...	...
	0.125–8.000[H]	55.0	...	32.0	12
		Alloy 2024[E]			
O	0.124 and under	...	35.0	...	...
	0.125–8.000	...	35.0	...	16
T36	0.124 and under	69.0	...	...	...
	0.125–0.375	69.0	...	52.0	10
T4[I]	0.124 and under	62.0	...	...	...
	0.125–0.499	62.0	...	45.0[I]	10
	0.500–4.500[G]	62.0	...	42.0[I]	10
	4.501–6.500[J]	62.0	...	40.0	10
	6.501–8.000[J]	58.0	...	38.0	10
T42[F]	0.124 and under	62.0	...	...	...
	0.125–1.000	62.0	...	40.0	10
	1.001–6.500[G]	62.0	...	40.0	10
T351[D]	0.500–6.500[G]	62.0	...	45.0	10
	6.501–8.000	62.0	...	45.0	9
T6	0.124 and under	62.0	...	...	...
	0.125–6.500[G]	62.0	...	50.0	5
T62[F]	0.124 and under	60.0	...	...	...
	0.125–6.500[G]	60.0	...	46.0	5
T851[D]	0.500–6.500[G]	66.0	...	58.0	5
		Alloy 2219			
T851[D]	0.500–2.000	58.0	...	40.0	4
	2.001–4.000	57.0	...	39.0	4
		Alloy 3003			
O	all	14.0	19.0	5.0	25
H12	0.374 and under	17.0	...	...	...
H14	0.374 and under	20.0	...	...	...
H16	0.374 and under	24.0	...	...	...
H18	0.374 and under	27.0	...	...	...
H112	all	14.0	...	5.0	...
F	all	[C]	...	[C]	...
		Alloy 4032			
T86	0.375–0.750	51.0	...	46.0	4
		Alloy 5052			
O	0.124 and under	...	32.0	...	...
	0.125 and over	25.0	32.0	9.5	25
H32	0.124 and under	31.0	...	...	...
	0.125–0.374	31.0	...	23.0	...
H34	0.374 and under	34.0	...	26.0	...
H36	0.124 and under	37.0	...	...	...
	0.125–0.374	37.0	...	29.0	...
H38	0.374 and under	39.0	...	...	...
F	all	[C]		[C]	...
		Alloy 5056			
O	0.124 and under	...	46.0	...	...
	0.125 and over	...	46.0	...	20

TABLE 2 *Continued*

Temper	Specified Diameter or Thickness, in.	Tensile Strength, ksi		Yield Strength[B] (0.2 % offset), min, ksi	Elongation[B] in 2 in. or 4 × Diameter, min, %
		min	max		
H111	0.374 and under	44.0	...	...	...
H12	0.374 and under	46.0	...	...	...
H32	0.374 and under	44.0	...	...	...
H14	0.374 and under	52.0	...	...	...
H34	0.374 and under	50.0	...	...	...
H18	0.374 and under	58.0	...	...	...
H38	0.374 and under	55.0	...	...	...
H192	0.374 and under	60.0	...	...	...
H392	0.374 and under	58.0	...	...	...
		Alloy 5154			
O	all	30.0	41.0	11.0	25
H32	0.374 and under	36.0	...	...	...
H34	0.374 and under	39.0	...	...	...
H36	0.374 and under	42.0	...	...	...
H38	0.374 and under	45.0	...	...	...
H112	all	30.0	...	11.0	...
		Alloy 6013			
T651	0.500–4.000	56.0	...	52.0	7
T8	0.750–1.500	58.0	...	56.0	8
	1.501–5.500	57.0	...	55.0	7
		Alloy 6020			
T8	0.187–0.375	43.0	...	40.0	12
	0.376–1.999	42.0	...	39.0	12
	2.000–3.250	39.0	...	36.0	12
		Alloy 6061[E]			
O	0.124 and under	...	22.0	...	...
	0.125–8.000	...	22.0	...	18
T4 and T451[D]	0.124 and under	30.0	...	...	...
	0.125–8.000[H]	30.0	...	16.0	18
T42[F]	0.125–8.000[H]	30.0	...	14.0	18
T6, T62[F], and T651[D]	0.124 and under	42.0	...	...	...
	0.125–8.000[H]	42.0	...	35.0	10
T89 and T94	0.374 and under	54.0	...	47.0	...
		Alloy 6110			
T9	0.374 and under	65.0	...	63.0	2
		Alloy 6262			
T6 and T651[D]	0.125–8.000[G]	42.0	...	35.0	10
T8	0.750–2.000	45.0	...	43.0	12
T9	0.125–2.000	52.0	...	48.0	5
	2.001–3.000	50.0	...	46.0	5
		Alloy 7075[E]			
O	0.124 and under	...	40.0	...	...
	0.125–8.000	...	40.0	...	10
T6, T62	0.124 and under	77.0	...	66.0	...
	0.125–4.000[K]	77.0	...	66.0	7
T651	0.124 and under	77.0	...	66.0	...
	0.125–4.000[K]	77.0	...	66.0	7
	4.001–6.000	75.0	...	64.0	7
	6.001–7.000	73.0	...	62.0	7
T73 and T7351[D]	0.124 and under	68.0	...	...	...
	0.125–4.000	68.0	...	56.0	10
	4.001–5.000	66.0		55.0	8
	5.001–6.000	64.0		52.0	8

Temper	Specified Diameter or Thickness, in.	Bend Diameter Factor, N
	Alloy 2017	
T4, T42, and T451	0.124 and under	3[L]
	0.125–8.000[H]	6[L]
	Alloy 2024	
O	0.124 and under	1
T351, T4, T42	0.124 and under	3
	0.125–6.500	6
	Alloy 3003	

Temper	Specified Diameter or Thickness, in.	Bend Diameter Factor, N
O	all	0
H12	0.374 and under	2
H14	0.374 and under	2
H16	0.374 and under	8

[A] To determine conformance to this specification, each value for tensile strength and for yield strength shall be rounded to the nearest 0.1 ksi and each value for elongation to the nearest 0.5 %, both in accordance with the rounding-off method of Practice E29. The basis for establishment of tensile property limits is shown in Annex A1.

[B] The measurement of yield strength and elongation is not required for wire less than 0.125 in. in thickness or diameter.

[C] There are no tensile requirements for material in the F temper but it usually can be expected that material 1½ in. or less in thickness or diameter (except sections over 4 in. in width) will have a strength about equivalent to the H14 or H34 temper. As size increases the strength decreases to nearly that of the O temper.

[D] For stress-relieved tempers, characteristics and properties other than those specified may differ somewhat from the corresponding characteristics and properties of material in the basic tempers.

[E] Also available in the F temper for which no properties are specified and no tension tests are performed but for which tests are performed for confirmation of heat-treat response as required by Section 10.

[F] Material in the T42 or T62 tempers is not available from the materials producers. These properties can usually be obtained by the user when material is properly solution heat treated or solution and precipitation heat treated from the O or F temper. These properties also apply to samples of material in the O or F temper that are solution heat treated or solution and precipitation heat treated by the producer to determine that the material will respond to proper heat treatment. Properties attained by the user, however, may be lower than those listed if the material has been formed or otherwise cold or hot worked, particularly in the O temper, prior to solution heat treatment.

[G] Properties listed for this full size increment are applicable to rod. Properties listed are also applicable to square, rectangular, hexagonal, or octagonal bar having a maximum thickness of 4 in. and a maximum cross-sectional area of 36 $in.^2$.

[H] For bar, maximum cross-sectional area is 50 $in.^2$.

[I] Minimum yield strength for 2024-T4 wire and rod 0.125 in. and larger in thickness or diameter, produced in coil form for both straight length and coiled products, is 40.0 ksi.

[J] Properties listed for this size increment are applicable to rod only.

[K] For rounds, maximum diameter is 4 in.; for square, hexagonal, or octagonal bar, maximum thickness is 3½ in.; for rectangular bar, maximum thickness is 3 in. with corresponding maximum width of 6 in.; for rectangular bar less than 3 in. in thickness, maximum width is 10 in.

[L] Bend diameter factor values stated for this full size increment apply to T4 product only. Values listed also apply to T451 product in the 0.500–8.000 in. size range.

6. Quality Assurance

6.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use their own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser in the order or at the time of contract signing. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

6.2 *Lot Definition*—An inspection lot shall be defined as follows:

6.2.1 For heat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions traceable to a heat-treat lot or lots, and subjected to inspection at one time.

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

7. Chemical Composition

7.1 *Limits*—The bars, rods, and wire shall conform to the chemical composition limits specified in Table 1. Conformance shall be determined by the producer by taking samples in accordance with E716 when the ingots are poured and analyzing those samples in accordance with E607, E1251, E34 or EN 14242. At least one sample shall be taken for each group of ingots poured simultaneously from the same source of molten metal. If the producer has determined the chemical composition of the material during pouring of the ingots, they shall not be required to sample and analyze the product.

NOTE 4—It is standard practice in the United States aluminum industry to determine conformance to the chemical composition limits prior to further processing of ingots into wrought products. Due to the continuous nature of the process, it is not practical to keep a specific ingot analysis identified with a specific quantity of finished material.

7.2 If it becomes necessary to analyze bars, rod or wire for conformance to chemical composition limits, the method used to sample for the determination of chemical composition shall be by agreement between the producer and the purchaser. Analysis shall be performed in accordance with E716, E607, E1251, E34 or EN 14242 (ICP method). The number of samples taken for determination of chemical composition shall be as follows:

7.2.1 When samples are taken from the finished or semifinished product, a sample shall be taken to represent each 4000 lb, or fraction thereof, in the lot, except that no more than one sample shall be required per piece.

7.3 Other methods of analysis or in the case of dispute may be by agreement between the producer and the purchaser.

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

8. Heat Treatment

8.1 Unless otherwise specified in 8.2, producer or supplier heat treatment for the applicable tempers in Table 2 shall be in accordance with AMS 2772.