INTERNATIONAL

~~Designation:B211M–03~~ Designation: B211M – 12

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

This standard is issued under the fixed designation B211M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This specification covers 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 B221M 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 H35.1M. The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9, for example, A91100 for aluminum 1100 in accordance with Practice E527.

1.3 This specification is the metric counterpart of Specification B211.

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 procurement form a part of this specification to the extent referenced herein.

2.2 *ASTM Standards:*[2]

B221M Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
B316/B316M Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods
B557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)
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 ~~E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition~~
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

[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.

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Current edition approved Jan. 15, 2012. Published March 2012. Originally approved in 1979. Last previous edition approved in 2003 as B211M-03. DOI: 10.1520/B0211M-12.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards 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	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Bismuth	Lead	Titanium	Boron	Lead	Tin	Other Elements[E] Each	Other Elements[E] Total[EF]	Aluminum
1060	0.25	0.35	0.05	0.03	0.03	...	0.05	...	...		0.03	0.03[F]	...	99.60 min[G]		
1060	110.25	0.35	0.05	0.03	0.03	...	0.05	...	...		0.03	0.03[F]	...	99.60 min[G]		
1100[H]	0.95 Si + Fe		0.05–0.20	0.05	...	...		0.10			...	...	...	0.05	0.15	99.00 min[G]
1100[H]	0.95 Si + Fe		0.05–0.20	0.05	...	...	...	0.10	...		...	...	...	0.05	0.15	99.00 min[H]
2011	0.40	0.7	5.0–6.0	...	...	...		0.30			0.20–0.6	0.20–0.6	...	0.05	0.15	remainder
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		...	...	0.15	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		...	...	0.15	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		...	...	0.15	0.05	0.15	remainder
2219	0.20	0.30	5.8–6.8	0.20–0.40	0.02	...		0.10			...	...	0.02–0.10	0.05[I]	0.15[I]	remainder
2219	0.20	0.30	5.8–6.8	0.20–0.40	0.02	...	...	0.10	0.02–0.10		...	...	0.02–0.10	0.05[I]	0.15[I]	remainder
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...		0.10			...	...	...	0.05	0.15	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
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
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[H]	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[G]	0.25	0.40	0.10	0.10	3.1–3.9	0.15–0.35	...	0.20	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		...	...	0.15	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		...	...	0.15	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			0.40–0.7	0.40–0.7	0.15	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

[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.

[EF] 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.

[F] Vanadium 0.05% max.

[G] ThBe arylumlinum content is the difference between 1 00.00%03 mand the sximum of all theother m wetallic elements and silicon prg eslenct in amounts of 0.010% or morde each, round wed to the second decimal beforedetermining the sum rod only.

[H] BThery alluminum content is the difference between 100.0003 m % aximnd the sum of all the other w metaldlingc elements and silicon present in amounts of 0.010 % or modre each, round welding r tod the second decimaly before determining the sum.

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

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:*

H35.1M Alloy and Temper Designation Systems for Aluminum[3]

H35.2M Dimensional Tolerances for Aluminum Mill Products[3]

2.4 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[4]

2.5 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage[4]

2.6 *Aerospace Material Specification:*

[3] Available from ANSI, 25 W. 43rd St., 4th Floor, New York, NY 10036.

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

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

AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials[5]

2.7 *The Aluminum Association:*

International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys[6]

2.8 *Other Standards:*

CEN EN 14242 Aluminium and Aluminium Alloys–Chemical Analysis–Inductively Coupled Plasma Optical Emission Spectral Analysis[7]

3. Terminology

3.1 *Definitions:* ~~Refer to Terminology~~

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

~~3.1.1~~

3.1.2 *flatten and slit wire*—flatten 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.~~ 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 number,

4.1.2 Quantity in pieces or kilograms,

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,

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

TABLE 2 Mechanical Property Limits[A,B]

Temper	Specified Diameter or Thickness, mm		Tensile Strength, MPa		Yield Strength[C] (0.2 % offset), MPa		Elongation,[C,D] min, %	
	over	through	min	max	min	max	in 50 mm	in 5 × ~~diameter~~ ($5.65\sqrt{A}$) diameter ($5.65\sqrt{A}$)
				~~Aluminum 1060~~				
~~O~~	~~...~~	~~3.20~~	~~55~~	~~...~~	~~...~~	~~...~~	~~...~~	~~...~~
	~~3.20~~	~~...~~	~~55~~	~~...~~	~~15~~	~~...~~	~~25~~	~~22~~
~~H14~~	~~...~~	~~10.00~~	~~85~~	~~...~~	~~70~~	~~...~~	~~...~~	~~...~~
~~H18~~	~~...~~	~~10.00~~	~~110~~	~~...~~	~~90~~	~~...~~	~~...~~	~~...~~
				Aluminum 1100				
O	...	3.20	75	105	...	...	...	...
	3.20	...	75	105	20	...	25	22
H12	...	10.00	95	...	...	...	...	...
H14	...	10.00	110	...	...	...	...	...
H16	...	10.00	130	...	...	...	...	...
H18	...	10.00	150	...	...	...	...	...
H112	all		75	...	20	...	...	...
F	all		[E]	...	[E]	...	...	...
				Alloy 2011				

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

~~[6] The Aluminum Association, 900 19th Street, NW, Washington, DC 20006.~~

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

[7] 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, mm		Tensile Strength, MPa		Yield Strength[C] (0.2 % offset), MPa		Elongation,[C,D] min, %	
	over	through	min	max	min	max	in 50 mm	in 5 × ~~diameter~~ ~~(5.65 $\sqrt{A}$)~~ diameter (5.65 $\sqrt{A}$)
T3	3.20	40.00	310	...	260	...	10	9
	40.00	50.00	295	...	235	...	...	10
	50.00	90.00	290	...	205	...	...	12
T4 and T451[F]	3.20	200.00	275	...	125	...	16	14
T6 and T651	10.00	160.00	370	...	275	...	10	9
T8	3.20	80.00	370	...	275	...	10	9
				Alloy 2014[G]				
O	...	3.20	...	240	...	...	...	...
	3.20	200.00	...	240	...	...	12	10
T4, T42[H], and T451[F]	...	3.20	380	...	...	...	...	...
	3.20	200.00[I]	380	...	220	...	16	14
T6, T62[H], and T651[F]	...	3.20	450	...	...	...	...	...
	3.20	200.00[I]	450	...	380	...	8	7
				Alloy 2017[G]				
O	...	3.20	...	240	...	...	...	...
	3.20	200.00	...	240	...	...	16	14
T4, T42[H], and T451[F]	...	3.20	380	...	...	...	...	...
	3.20	200.00[I,J]	380	...	220	...	12	10
				Alloy 2024[G]				
O	...	3.20	...	240	...	...	...	...
	3.20	200.00	...	240	...	...	16	14
T36	...	3.20	475	...	...	...	...	...
	3.20	10.00	475	...	360	...	10	...
T4[K]	...	3.20	425	...	...	...	...	...
	3.20	12.50	425	...	310[K]	...	10	...
	12.50	120.00[L]	425	...	290	...	...	9
	120.00	160.00[M]	425	...	275	...	...	9
	160.00	200.00[M]	425	...	260	...	...	9
T42[H]	...	3.20	400	...	...	...	...	...
	3.20	25.00	425	...	275	...	10	9
	25.00	160.00[L]	425	...	275	...	...	9
T351[F]	12.50	160.00[L]	425	...	310	...	...	9
	160.00	200.00	425	...	310	...	...	8
T6	...	3.20	425	...	...	...	...	...
	3.20	160.00[L]	425	...	345	...	5	4
T62[H]	...	3.20	415	...	...	...	...	...
	3.20	160.00[L]	415	...	315	...	5	4
T851[F]	12.50	160.00[L]	455	...	400	...	...	4
				Alloy 2219				
T851[F]	12.50	50.00	400	...	275	...	...	3
	50.00	100.00	395	...	270	...	...	3
				Alloy 3003				
O	...	3.20	95	130	...	...	...	...
	3.20	...	95	130	35	...	25	22
H12	...	10.00	115	...	...	...	...	...
H14	...	10.00	140	...	...	...	...	...
H16	...	10.00	165	...	...	...	...	...
H18	...	10.00	185	...	...	...	...	...
H112	all		95	...	35	...	...	...
F	all		[E]	...	[E]	...	...	...
				Alloy 4032				
T86	10.00	20.00	350	...	315	...	4	3
				Alloy 5052				
O	...	3.20	170	220	...	...	...	...
	3.20	...	170	220	65	...	25	22
H32	...	3.20	215	...	...	...	...	...
	3.20	10.00	215	...	160	...	...	...
H34	...	3.20	235	...	...	...	...	...
	3.20	10.00	235	...	180	...	...	...
H36	...	3.20	255	...	...	...	...	...
	3.20	10.00	255	...	200	...	...	...

TABLE 2 *Continued*

Temper	Specified Diameter or Thickness, mm		Tensile Strength, MPa		Yield Strength[C] (0.2 % offset), MPa		Elongation,[C,D] min, %	
	over	through	min	max	min	max	in 50 mm	in 5 × ~~diameter~~ ~~(5.65 $\sqrt{A}$)~~ diameter (5.65 $\sqrt{A}$)
H38	...	10.00	270	...	...	...	...	...
F	all		[E]	...	[E]	...	...	...
				Alloy 5056				
O	...	3.20	...	320	...	...	...	...
	3.20	...	...	320	...	...	20	18
H111	...	10.00	300	...	...	...	...	...
H12	...	10.00	315	...	...	...	...	...
H32	...	10.00	300	...	...	...	...	...
H14	...	10.00	360	...	...	...	...	...
H34	...	10.00	345	...	...	...	...	...
H18	...	10.00	400	...	...	...	...	...
H38	...	10.00	380	...	...	...	...	...
H192	...	10.00	415	...	...	...	...	...
H392	...	10.00	400	...	...	...	...	...
				Alloy 5154				
O	...	3.20	205	285	...	...	...	...
	3.20	...	205	285	75	...	25	22
H32	...	10.00	250	...	...	...	...	...
H34	...	10.00	270	...	...	...	...	...
H36	...	10.00	290	...	...	...	...	...
H38	...	10.00	310	...	...	...	...	...
H112	all		205	...	75	...	...	...
				Alloy 6013				
T651	12.50	100.00	385	...	360	...	...	6
T8	20.00	40.00	400	...	385	...	...	7
	40.00	140.00	395	...	380	...	...	6
				Alloy 6020				
T8	5.00	10.00	295	...	275	...	12	...
	10.00	50.00	290	...	270	...	12	10
	50.00	80.00	270	...	250	...	...	10
				Alloy 6061[G]				
O	...	3.20	...	155	...	...	...	...
	3.20	200.00	...	155	...	...	18	16
T4 and T451[F]	...	3.20	205	...	...	...	...	...
	3.20	200.00[J]	205	...	110	...	18	16
T42[H]	3.20	200.00[J]	205	...	95	...	18	16
T6, T62[H], and T651[F]	...	3.20	290	...	...	...	...	...
	3.20	200.00[J]	290	...	240	...	10	9
T89 and T94	...	10.00	370	...	325	...	...	...
				Alloy 6110				
T9	...	10.00	450	...	435	...	2	...
				Alloy 6262				
~~T6 and T651[F]~~	~~3.20~~	~~200.00[L]~~	~~290~~	~~...~~	~~240~~	~~...~~	~~10~~	~~9~~
~~T9~~	~~3.20~~	~~50.00~~	~~360~~	~~...~~	~~330~~	~~...~~	~~5~~	~~4~~
	~~50.00~~	~~80.00~~	~~345~~	~~...~~	~~315~~	~~...~~	~~...~~	~~4~~
T6 and T651[F]	3.20	200.00[L]	290	...	240	...	10	9
T8	20.00	50.00	310	...	295	...	12	10
T9	3.20	50.00	360	...	330	...	5	4
	50.00	80.00	345	...	315	...	...	4
				Alloy 7075[G]				
O	...	3.20	...	275	...	...	...	...
	3.20	200.00	...	275	...	...	10	9
T6, T62[H]	...	3.20	530	...	455	...	...	...
	3.20	100.00[N]	530	...	455	...	7	6
T651[F]	...	3.20	530	...	455	...	...	...
	3.20	100.00[N]	530	...	455	...	7	...
	100.00	160.00	515	...	440	...	7	...
	160.00	200.00	505	...	425	...	7	...

TABLE 2 *Continued*

Temper	Specified Diameter or Thickness, mm		Tensile Strength, MPa		Yield Strength[C] (0.2 % offset), MPa		Elongation,[C,D] min, %	
	over	through	min	max	min	max	in 50 mm	in 5 × ~~diameter~~ ~~(5.65 $\sqrt{A}$)~~ diameter (5.65 $\sqrt{A}$)
T73 and T7351[F]	...	3.20	470	...	...	...	...	...
	3.20	100.00	470	...	425	...	10	9
	100.00	120.00	455	...	380	...	8	9
	120.00	160.00	440	...	360	...	...	7
Temper	Specified Diameter or Thickness, mm						Bend Diameter Factor, N	
	over	through						
				Alloy 2017				
T4, T42, and T451	...	3.20					3[O]	
	3.20	200.00[J]					6[O]	
				Alloy 2024				
0	...	3.20					1	
T351, T4, T42	...	3.20					3	
	3.20	160.00					6	
				Alloy 3003				
0	all						0	
H12	...	10.00					2	
H14	...	10.00					2	
H16	...	10.00					8	

[A] To determine conformance to this specification, each value for tensile strength and for yield strength shall be rounded to the nearest 1 MPa and each value for elongation to the nearest 0.5 %, both in accordance with the rounding-off method of Practice E29.

[B] The basis for establishment of tensile property limits is shown in Annex A1.

[C] The measurement of yield strength and elongation is not required for wire up through 3.20 mm in thickness or diameter.

[D] Elongations in 50 mm apply to rectangular bar up through 12.5 mm thickness from which a standard rectangular tension test specimen is machined. The 5× diameter (5.65 ~~(5.65 $\sqrt{A}$)~~) requirements, where *D* and *A* are diameter and cross-sectional area of the specimen, respectively, apply to round specimens tested in full-section or to standard or proportional, round-machined, tension test specimens.

[E] There are no tensile requirements for material in the F temper but it usually can be expected that material 40 mm or less in thickness or diameter (except sections over 100 mm 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.

[F] 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.

[G] 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.

[H] 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 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.

[I] For rounds, maximum diameter is 200 mm; for square, rectangular, hexagonal, or octagonal bar, maximum thickness is 100 mm and maximum cross-sectional area is 23 000 mm^2.

[J] For bar, maximum cross-sectional area is 32 000 mm^2.

[K] Minimum yield strength for 2024-T4 wire and rod over 3.20 mm in thickness or diameter, produced in coil form for both straight length and coiled products, is 275 MPa.

[L] Properties listed for this size increment are applicable to rod with a maximum diameter of 160 mm and to square, rectangular, hexagonal, or octagonal bar having a maximum thickness of 100 mm and maximum cross-sectional area of 23 000 mm^2.

[M] Properties listed for this size increment are listed for rod only.

[N] For rounds, maximum diameter is 100 mm; for square, hexagonal, or octagonal bar, maximum thickness is 90 mm; for rectangular bar, maximum thickness is 80 mm, with corresponding maximum width of 150 mm; for rectangular bar less than 80 mm in thickness, maximum width is 250 mm.

[O] Bend diameter factor values stated for this full size increment apply to T4 product only. Values listed also apply to T451 produce in the 12.2-200 mm size range.

~~4.Ordering Information~~

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

~~4.1.1This specification number,~~

~~4.1.2Quantity in pieces or kilograms,~~

~~4.1.3Alloy (Section 7),~~

~~4.1.4Temper (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),~~

~~4.1.7Length,~~

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