



**Designation: B 211M – 01
METRIC**

Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire [Metric]¹

This standard is issued under the fixed designation B 211M; 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 B 221M for aluminum and aluminum-alloy extruded bars, rods, wire, shapes, and tubes; and Specification B 316M 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 E 527.

1.3 This specification is the metric counterpart of Specification B 211.

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:

B 557M Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products [Metric]²

B 594 Practice for Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications²

B 597 Practice for Heat Treatment of Aluminum Alloys²

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products²

B 666/B 666M Practice for Identification Marking of Aluminum and Magnesium Products²

E 29 Practice for Using Significant Digits in Test Data to

Determine Conformance with Specifications³

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys⁴

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition⁴

E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁴

E 290 Test Method for Semi-Guided Bend Test for Ductility of Metallic Materials⁵

E 527 Practice for Numbering Metals and Alloys (UNS)⁶

E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere⁷

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis⁷

E 1004 Test Method for Electromagnetic (Eddy-Current) Measurements of Electrical Conductivity⁸

E 1251 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge⁷

G 47 Test Method for Determining Susceptibility to Stress-Corrosion Cracking of High-Strength Aluminum-Alloy Products⁹

2.3 ANSI Standards:

H35.1M Alloy and Temper Designation Systems for Aluminum¹⁰

H35.2M Dimensional Tolerances for Aluminum Mill Products¹⁰

2.4 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)¹¹

2.5 Military Standard:

MIL-STD-129 Marking for Shipment and Storage¹¹

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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² *Annual Book of ASTM Standards*, Vol 02.02.

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ *Annual Book of ASTM Standards*, Vol 03.05.

⁵ *Annual Book of ASTM Standards*, Vol 03.01.

⁶ *Annual Book of ASTM Standards*, Vol 01.01.

⁷ *Annual Book of ASTM Standards*, Vol 03.06.

⁸ *Annual Book of ASTM Standards*, Vol 03.03.

⁹ *Annual Book of ASTM Standards*, Vol 03.02.

¹⁰ Available from ANSI, 25 W. 43rd St., 4th Floor, New York, NY 10036.

¹¹ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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



TABLE 1 Chemical Composition Limits^{A,B,C}

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Bismuth	Lead	Titanium	Other Elements ^D		Aluminum
											Each	Total ^E	
1060	0.25	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
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
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
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
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...	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
Alclad 5056	5056 alloy clad with 6253 alloy		...	...	...	...	...	...	...	...	...	...	...
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
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
6253 ^J	^K 0.50		0.10	...	1.0–1.5	0.04–0.35	1.6–2.4	...	...	...	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

^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 E 29.

^D *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.

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

^H Beryllium 0.0003 maximum for welding electrode and welding rod only.

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

^J Composition of cladding alloy as applied during the course of manufacture. Samples from finished wire shall not be required to conform to these limits.

^K 45 to 65 % of actual magnesium content.

2.6 Aerospace Material Specification:

AMS-H-6088 Heat Treatment of Aluminum Alloys¹²

3. Terminology

3.1 Definitions:

3.1.1 *bar*—a solid product that is long in relation to cross section, which is square or rectangular (excluding plate and flattened wire) with sharp or rounded corners or edges, or is a regular hexagon or octagon, and in which at least one perpendicular distance between parallel faces is over 10 mm.

3.1.2 *cold-finished bar*—bar brought to final dimensions by cold working to obtain improved surface finish and dimensional tolerances.

3.1.3 *rod*—a solid round section over 10 mm in diameter, whose length is great in relation to its diameter.

3.1.4 *cold-finished rod*—rod brought to final dimensions by cold working to obtain improved surface finish and dimensional tolerances.

3.1.5 *wire*—a solid section long in relation to its cross-sectional dimensions, having a cross section that is round, hexagonal, or octagonal and whose diameter, width, or greatest

distance between parallel faces is up through 10 mm, or having a symmetrical cross section that is square or rectangular (excluding flattened wire) with sharp or rounded corners or edges.

3.1.6 *drawn wire*—wire brought to final dimensions by drawing through a die.

3.1.7 *alclad wire*—wire having on its surface a metallurgically bonded aluminum or aluminum-alloy coating that is anodic to the core alloy to which it is bonded, thus electrolytically protecting the core alloy against corrosion.

3.1.8 *flattened wire*—a solid section having two parallel flat surfaces and rounded edges produced by roll-flattening round wire.

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

3.1.10 *producer*—the primary manufacturer of the material.

3.1.11 *supplier*—includes only the category of jobbers and distributors as distinct from producers.

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.

¹² Available from the Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, PA 15096-0001.



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 √ <i>A</i>)
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								
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
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
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	...	...	...	...	...

