



Designation: B 491/B 491M – 00

Standard Specification for Aluminum and Aluminum-Alloy Extruded Round Tubes for General-Purpose Applications¹

This standard is issued under the fixed designation B 491/B 491M; 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 aluminum and aluminum-alloy extruded round tubes either in coils or straight lengths, for general purpose applications such as refrigeration service, gas lines, oil lines, and instrument lines, in the alloys (Note 2) and tempers shown in Table 2 [Table 3], in outside diameters of 0.250 through 0.750 in. [6.00 through 20.00 mm]. For diameters over 0.500 through 0.750 in. [over 12.50 through 20.00 mm], the diameter and wall-thickness tolerances and eddy-current test parameters, if required, shall be agreed upon by the producer and the purchaser. Only tubes in aluminum 1200-H111 and 1235-H111 are sized after extrusion to minimize ovalness.

1.2 Alloy and temper designations are in accordance with ANSI H35.1[H35.1M]. The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9 (for example, A91050 for aluminum 1050) in accordance with Practice E 527.

NOTE 1—For extruded tubes see Specification B 221, and for drawn tubes for general-purpose applications see Specification B 483.

NOTE 2—Throughout this specification the term *alloy* in the general sense includes aluminum as well as aluminum alloy.

NOTE 3—For inch-pound orders specify B 491; for metric orders specify B 491M. Do not mix units.

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

1.4 The values stated in either inch-pound or SI units are to be regarded separately as standards. The SI units are shown either in brackets or in separate tables. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from two systems will result in nonconformance with the specification.

2. Referenced Documents

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

2.2 *ASTM Standards:*

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products²

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

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

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

B 807 Practice for Extrusion Press Solution Heat Treatment for Aluminum Alloys²

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 215 Practice for Standardizing Equipment for Electromagnetic Testing of Seamless Aluminum-Alloy Tube⁵

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

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

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 May 10, 2000. Published August 2000. Originally published as B 491–69. Last previous edition B 491/B 491M–95.

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 03.03.

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

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



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

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Vanadium	Titanium	Other Elements ^D		Aluminum
										Each	Total ^E	
1050	0.25	0.40	0.05	0.05	0.05	...	0.05	0.05	0.03	0.03	...	99.50 ^F
1100	0.95 Si + Fe		0.05–0.20	0.05	...	...	0.10	...	...	0.05	0.15	99.00 ^F
1200	1.00 Si + Fe		0.05	0.05	...	...	0.10	...	0.05	0.05	0.15	99.00 ^F
1235	0.65 Si + Fe		0.05	0.05	0.05	...	0.10	0.05	0.06	0.03	...	99.35 ^F
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...	0.10	...	...	0.05	0.15	remainder
3102	0.40	0.7	0.10	0.05–0.40	...	...	0.30	...	0.10	0.05	0.15	remainder
6063	0.20–0.6	0.35	0.10	0.10	0.45–0.9	0.10	0.10	...	0.10	0.05	0.15	remainder

^A Limits are in percent maximum unless shown as a range or otherwise stated.

^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 attained from analysis shall be rounded off to the nearest unit in the last right-hand place of figures used in expressing the specified limit, in accordance with the rounding 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 nonconforming.

^E Other Elements—Total shall be the sum of unspecified metallic elements 0.010 % or more, rounded to the second decimal before determining the sum.

^F The aluminum content shall be calculated by subtracting from 100.00 % the sum of all metallic elements present in amounts of 0.010 % or more each, rounded to the second decimal before determining the sum.

TABLE 2 Tensile Property Limits^{A,B}

Alloy	Temper	Specified Wall Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % Offset) min, ksi	Elongation in 2 in. min, %
			min	max		
1050 ^C	H112	0.032–0.050	8.5	14.5	2.5	25
1100 ^C	H112	0.032–0.050	11.0	...	3.0	25
1200 ^C	H111	0.032–0.050	11.0	17.0	9.5	25
	H112	0.032–0.050	10.0	16.0	3.0	25
1235 ^C	H111	0.032–0.050	11.0	...	7.5	30
	H112	0.032–0.050	9.0	15.0	3.0	25
3003 ^C	H112	0.032–0.050	14.0	...	5.0	25
3102	H112	0.032–0.050	11.0	18.0	4.0	25
6063	T1	0.032–0.050	17.0	...	9.0	12

^A The basis for establishment of mechanical property limits is shown in Annex A1.

^B 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 method of Practice E 29.

^C Tubes in this alloy are also available in the F (as extruded) temper. Tensile properties for F temper are not specified or guaranteed.

TABLE 3 Tensile Property Limits [SI Units]

Alloy	Temper	Specified Wall Thickness, mm	Tensile Strength, MPa		Yield Strength (0.2 % Offset) min, MPa	Elongation in 50 mm min, %
			min	max		
1050 ^A	H112	0.80–1.30	60	100	15	25
1100 ^A	H112	0.80–1.30	75	...	20	25
1200 ^A	H111	0.80–1.30	75	115	65	25
	H112	0.80–1.30	70	110	20	25
1235 ^A	H111	0.80–1.30	75	...	50	30
	H112	0.80–1.30	60	105	20	25
3003 ^A	H112	0.80–1.30	95	...	35	25
3102	H112	0.80–1.30	95	125	30	25
6063	T1	0.80–1.30	115	...	60	12

^A Tubes in this alloy are also available in the F (as extruded) temper. Tensile properties for F temper are not specified or guaranteed.

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

2.3 ANSI Standards:

H35.1 Alloy and Temper Designation Systems for Aluminum²

H35.1M Alloy and Temper Designation Systems for Aluminum (Metric)²

H35.2 Dimensional Tolerances for Aluminum Mill Products²

H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)²

2.4 Federal Standard:⁸

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

2.5 Military Standard:⁸

MIL-STD-129 Marking for Shipment and Storage

⁸ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPO D.



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