



Standard Specification for Aluminum and Aluminum-Alloy Formed and Arc-Welded Round Tube¹

This standard is issued under the fixed designation B 547/B 547M; 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 (Note 1) formed and arc-welded round tube in diameters 9 to 60 in. [230 to 1520 mm], made from formed sheet or plate, butt welded by gas-tungsten or gas-metal arc-welding methods with or without the use of filler metal.

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

NOTE 2—The requirements for the sheet and plate used are the same as in Specifications B 209 or B 209M.

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, A91100 for aluminum 1100 in accordance with Practice E 527.

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 the 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 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate²
- B 209M Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]²
- 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 918 Practice for Heat Treatment of Wrought 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 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)⁵

E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere⁴

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis⁴

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 Discharge⁴

2.3 ANSI Standards:

H35.1 Alloy and Temper Designation Systems for Aluminum²

H35.1M Alloy and Temper Designation Systems for Aluminum [Metric]²

2.4 ASME Code:

Boiler and Pressure Vessel Code; Section IX, Welding Qualifications⁶

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 01.01.

⁶ Available from American Society of Mechanical Engineers, 345 E. 47th St. New York, NY 10017.

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

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Other Elements ^D		Aluminum
									Each	Total ^E	
1100	0.95 Si + Fe		0.05–0.20	0.05	0.10	...	0.05	0.15	99.00 min ^F
3003	0.6	0.7	0.05–0.20	1.0–1.5	0.10	...	0.05	0.15	remainder
Alclad 3003	3003 alloy clad with 7072 alloy										
3004	0.30	0.7	0.25	1.0–1.5	0.8–1.3	...	0.25	...	0.05	0.15	remainder
Alclad 3004	3004 alloy clad with 7072 alloy										
5050	0.40	0.7	0.20	0.10	1.1–1.8	0.10	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
5083	0.40	0.40	0.10	0.40–1.0	4.0–4.9	0.05–0.25	0.25	0.15	0.05	0.15	remainder
5086	0.40	0.50	0.10	0.20–0.7	3.5–4.5	0.05–0.25	0.25	0.15	0.05	0.15	remainder
5154	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
5454	0.25	0.40	0.10	0.50–1.0	2.4–3.0	0.05–0.20	0.25	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
7072 ^G	0.7 Si + Fe		0.10	0.10	0.10	...	0.8–1.3	...	0.05	0.15	remainder

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

^BAnalysis shall be made for the elements for which limits are shown in this table.

^CFor 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 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.

^FThe 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.

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

Boiler and Pressure Vessel Code; Section VIII, Div. 1 and 2, Pressure Vessels⁶

2.5 *AWS Standard*:

A5.10 Aluminum and Aluminum Alloy Welding Rods and Bare Electrodes⁷

2.6 *Federal Standard*:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁸

2.7 *Military Standard*:

MIL-STD-129 Marking for Shipment and Storage⁸

2.8 *AMS Specification*:

AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials⁹

3. Terminology

3.1 *Definitions*:

3.1.1 *tube*—a hollow round product of uniform wall thickness that is long in relation to its cross section:

3.1.2 *arc-welded tube*—a tube made from sheet or plate formed by positioning two opposite edges of the metal together and butt welded by either the gas-tungsten or gas-metal arc-welding method, with or without the use of filler metal. Individually fabricated tubes may be welded together to produce the ordered length.

3.1.3 *sheet*—a rolled product that is rectangular in cross section with thickness less than 0.250 in. but not less than 0.006 in. [over 0.15 through 6.30 mm] with slit, sheared, or sawed edges.

3.1.4 *alclad sheet and plate*—composite sheet (and plate) having on both surfaces 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.

3.1.5 *coiled sheet*—sheet in coils with slit edges.

3.1.6 *flat sheet*—sheet with sheared, slit, or sawed edges, which has been flattened or leveled.

3.1.7 *plate*—a rolled product that is rectangular in cross section with thickness not less than 0.250 in. [over 6.30 mm] with sheared or sawed 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),

NOTE 3—For inch-pound orders specify Specification B 547; for metric orders specify Specification B 547M. Do not mix units.

4.1.2 Quantity in pieces or pounds [kilograms],

4.1.3 Alloy (Section 7 and Table 1),

4.1.4 Temper (Section 9 and Table 2 [2 M]),

4.1.5 Size (outside or inside diameter, wall thickness, and length),

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 B 918 is required (8.2),

⁷ Available from American Welding Society, 2501 NW 7th St., Miami, FL 33125.

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

⁹ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

4.2.2 Whether tension tests of the tube are required in addition to those of the sheet or plate prior to welding (see 10.1),

4.2.3 Whether air-pressure tests are required (Section 11),

4.2.4 Whether hydrostatic tests are required (Section 12),

4.2.5 Whether weld areas of tube required “spot” or “full” radiographic examination (Section 13),

4.2.6 Whether inspection or witness of inspection and tests by the purchaser’s representative is required prior to material shipment (Section 17),

4.2.7 Whether certification is required (Section 19),

4.2.8 Whether marking for identification is required (see 20.1), and whether special marking for hydrostatic and radiographic tests is required (see 20.2),

4.2.9 Whether special packaging is required (Section 21), if Practices B 660 applies, and the levels required.

5. Materials and Manufacture

5.1 The tube shall be made by roll forming (or other suitable forming) sheet or plate into a circular contour with the longitudinal edges butted together for welding, or

5.2 The sheet or plate shall be roll formed so that the edges are butted together in a helical pattern around the circumference of the tube.

5.3 The edges shall be welded together by a gas-shielded-arc process, qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

5.4 Filler metal shall be in accordance with AWS Specification A 5.10.

5.5 Any butt-joint configuration (square, Vee, J, bevel-groove, etc.) may be used on either or both sides (single or double groove) at the option of the producer within the capability or limitations of his welding equipment. Whether welded from one side (square-butt or single-groove) or both sides (square-butt or double-groove) the face reinforcement and root reinforcement shall not increase the joint thickness by

more than 50 % of the wall thickness or 1/8 in. [3 mm], whichever is smaller. The reinforcements may be dressed to this dimension or removed entirely at the manufacturer’s option. The weld shall show complete penetration. Back welding is permitted only when (or provided that) it is part of the original welding process; it must not be employed only as a repair procedure for areas of unsatisfactory penetration. The weld bead shall show no evidence of under filling on either the root or reinforcement side. The toe of the weld shall blend smoothly into the parent material with no undercutting or overlapping. If tubing is produced by welding individually fabricated sections together, longitudinal butt welds shall be positioned so as to be at least 45° apart.

6. Quality Assurance

6.1 *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer or supplier is responsible for the performance of all inspection and test requirements specified herein. Except as otherwise specified in the contract or order, the producer or supplier may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. 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 assure that the 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 all 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 all material of the same mill form, alloy, temper, and nominal dimensions subjected to inspection at one time.

TABLE 2 Mechanical Property Limits (Inch-Pound Units)^{A,B,C}

Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in., or 4 × Diameter, ^D min, %
		min	max	min	max	
Alloy 1100						
O	0.125–0.249	11.0	15.5	3.5	...	30
	0.250–0.500	11.0	15.5	3.5	...	28
H12	0.125–0.499	14.0	19.0	11.0	...	9
	0.500	14.0	19.0	11.0	...	12
H14	0.125–0.499	16.0	21.0	14.0	...	6
	0.500	16.0	21.0	14.0	...	10
H16	0.125–0.162	19.0	24.0	17.0	...	4
Alloy 3003						
O	0.125–0.249	14.0	19.0	5.0	...	25
	0.250–0.500	14.0	19.0	5.0	...	23
H12	0.125–0.161	17.0	23.0	12.0	...	7
	0.162–0.249	17.0	23.0	12.0	...	8
	0.250–0.499	17.0	23.0	12.0	...	9
	0.500	17.0	23.0	12.0	...	10
H14	0.125–0.161	20.0	26.0	17.0	...	6
	0.162–0.249	20.0	26.0	17.0	...	7
	0.250–0.499	20.0	26.0	17.0	...	8
	0.500	20.0	26.0	17.0	...	10
H16	0.125–0.162	24.0	30.0	21.0	...	4
H112	0.250–0.499	17.0	...	10.0	...	8