



Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers¹

This standard is issued under the fixed designation B 234; 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.

1. Scope*

1.1 This specification² covers aluminum-alloy (Note 1) drawn seamless round tube in straight lengths designated as shown in Table 1, for use in surface condensers, evaporators, and heat exchangers.

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

NOTE 2—For drawn seamless tubes used in general applications, see Specification B 210B 210; for extruded tubes see Specification B 221B 221; for seamless pipe see Specification B 241/B 241MB 241/B 241M; and for structural pipe and tube see Specification B 429B 429.

1.2 Alloy and temper designations are in accordance with ANSI H35.1. The equivalent Unified Numbering System alloy designations are those of Table 2 preceded by A9, for example, A91060 for aluminum 1060, in accordance with Practice E 527E 527.

1.3 A complete metric companion to Specification B 234 has been developed—B 234M; 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:~~ ASTM Standards:

B 210 Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes³

B 221 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes³

B 241/B 241M Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube³

B 429 Specification for Aluminum-Alloy Extruded Structural Pipe and Tube³

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

~~B 597 Practice for Heat Treatment of Aluminum Alloys~~³ Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products³

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products³

B 666 ~~Practice for Identification Marking of Aluminum Products~~³ Practice for Identification Marking of Aluminum and Magnesium Products³

B 918 Practice for Heat Treatment of Wrought Aluminum Alloys³

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys⁵

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition⁵

E 215 Practice for Standardizing Equipment for Electromagnetic Examination of Seamless Aluminum-Alloy Tube⁶

E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁵

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 For ASME Boiler and Pressure Vessel Code applications see related Specification SB-234 in Section II of that Code.

³ *Annual Book of ASTM Standards*, Vol 02.02.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ *Annual Book of ASTM Standards*, Vol 03.05.

⁶ *Annual Book of ASTM Standards*, Vol 03.03.

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

TABLE 1 Tensile Property Limits^{A,B}

Alloy	Temper	Wall Thickness, in.	Tensile Strength, min, ksi	Yield Strength, (0.2 % offset), min, ksi	Elongation in 2 in., or 4 × Dia, ^C min, %	
					Full-Section Specimen	Cut-Out Specimen
1060	H14	0.010–0.200	12.0	10.0	...	...
3003	{ H14 { H25	{ 0.010–0.024	20.0	17.0	3	...
		{ 0.025–0.049	20.0	17.0	5	3
		{ 0.050–0.200	20.0	17.0	8	4
Alclad 3003	{ H14 { H25	{ 0.010–0.024	19.0	16.0	...	...
		{ 0.025–0.049	19.0	16.0	5	3
		{ 0.050–0.200	19.0	16.0	8	4
5052	{ H32 { H34	0.010–0.200	31.0	23.0	...	...
		0.010–0.200	34.0	26.0	...	...
5454	{ H32 { H34	0.010–0.050	36.0	26.0	...	5
		0.051–0.200	36.0	26.0	...	8
		0.010–0.050	39.0	29.0	...	4
6061	{ T4 { T6	0.025–0.049	30.0	16.0	16	...
		0.050–0.200	30.0	16.0	18	...
		0.025–0.049	42.0	35.0	10	8
		0.050–0.200	42.0	35.0	12	10

^A To determine conformance to this specification, each value for ultimate 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 E 29E 29.

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

^C Elongation of full-section and cut-out sheet-type specimens is measured in 2 in., of cut-out round specimens, in 4 × specimen diameter.

TABLE 2 Chemical Composition Limits^{A,B,C}

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	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
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										
5052	0.25	0.40	0.10	0.10	2.2–2.8	0.15–0.35	0.10	...	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 ^H	0.7 Si + Fe		0.10	0.10	0.10	...	0.8–1.3	...	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 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 29E 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 this 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 Vanadium 0.05 max.

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

^H Composition of cladding alloy as applied during the course of manufacture. The sample from finished tube shall not be required to conform to these limits.

E 527 Practice for Numbering Metals and Alloys (UNS)⁷

E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere⁵

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis⁵

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 Discharge⁵

2.3 ANSI Standards:

⁷ Annual Book of ASTM Standards, Vol 01.01.

H35.1 Alloy and Temper Designation Systems for Aluminum³

H35.2 Dimensional Tolerances for Aluminum Mill Products³

2.4 *Federal Standard:*

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

2.5 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage⁸

2.6 ~~Military~~ *AMS Specification:*

~~MIL-H-6088 Heat Treatment of Aluminum Alloys⁹~~ AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials⁹

3. Terminology

3.1 *Definitions:*

3.1.1 *tube*—a hollow wrought product that is long in relation to its cross section, which is round, a regular hexagon, a regular octagon, elliptical, or square or rectangular with sharp or rounded corners, and that has uniform wall thickness except as may be affected by corner radii.

3.1.2 *drawn seamless tube*—a tube produced from hollow ingot and brought to final dimensions by drawing through a die.

3.1.3 *alclad tube*—a composite tube product composed of an aluminum alloy core having on either the inside or outside surface a metallurgically bonded aluminum or aluminum alloy coating that is anodic to the core, thus electrolytically protecting the core against corrosion.

3.1.4 *heat exchange tube*—a tube for use in apparatus in which fluid inside the tube will be heated or cooled by fluid outside the tube. The term usually is not applied to coiled tube or to tube for use in refrigerators or radiators.

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

3.1.6 *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 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 8),

4.1.5 Outside or inside diameter, wall thickness, and length,

4.1.6 For alloy Alclad 3003, state clad inside or outside (12.1).

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 597B 597~~

4.2.1 Whether heat treatment in accordance with Practice B 918B 918 is required (9.2),

4.2.2 Whether cut ends of tube are to be deburred (Section 14),

4.2.3 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (Section 15),

4.2.4 Whether certification of the material is required (Section 17),

4.2.5 Whether marking for identification is required (Section 18), and

4.2.6 Whether Practices B 660B 660 applies and, if so, the level of preservation, packaging, and packing required (19.3).

5. Manufacture

5.1 The tube shall be produced by drawing an extruded tube made from hollow extrusion ingot (cast in hollow form or pierced) and extruded by use of the die and mandrel method.

6. Responsibility for 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 his own or any other

³ Annual Book of ASTM Standards, Vol 03.06.

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

⁹ 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.