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Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes¹

This standard is issued under the fixed designation B 210; 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 specification² covers aluminum and aluminum-alloy drawn seamless tubes in straight lengths and coils for general purpose and pressure applications in alloys (Note 2),

temper, and thicknesses shown in Table 1. Coiled tubes are generally available only as round tubes with a wall thickness not exceeding 0.083 in. and only in nonheat-treatable alloys.

¹ This specification is under the jurisdiction of ASTM Committee B-7 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-210 in Section II of that Code.

TABLE 1 Tensile Property Limits^{A,B}

Temper	Specified Wall Thickness, ^C in.	Tensile Strength, ksi		Yield Strength ^D (0.2 % offset), min, ksi	Elongation in 2 in. or 4 × Diameter, ^E min, %	
		min	max		Full-Section Specimen	Cut-Out Specimen
Aluminum 1060 ^F						
O	0.018–0.500	8.5	13.5	2.5	...	...
H12		10.0	...	4.0	...	...
H14		12.0	...	10.0	...	...
H18		16.0	...	13.0	...	...
H113 ^G		8.5	...	2.5	...	...
Aluminum 1100 ^F						
O	0.018–0.500	11.0	15.5	3.5	...	...
H12		14.0	...	11.0	...	...
H14		16.0	...	14.0	...	...
H16		19.0	...	17.0	...	...
H18		22.0	...	20.0	...	...
H113 ^G		11.0	...	3.5	...	...
Alloy 2011						
T3	0.018–0.049	47.0	...	40.0	...	...
	0.050–0.500	47.0	...	40.0	10	8
T4511	0.018–0.049	44.0	...	25.0	...	...
					20	18
	0.050–0.259	44.0	...	25.0	...	...
	0.260–0.500	44.0	...	25.0	20	20
Alloy 2014						
O	0.018–0.500	...	32.0	16.0 max	...	...
T4, T42 ^H	0.018–0.024	54.0	...	30.0	10	...
	0.025–0.049	54.0	...	30.0	12	10
	0.050–0.259	54.0	...	30.0	14	10
	0.260–0.500	54.0	...	30.0	16	12
T6, T62 ^H	0.018–0.024	65.0	...	55.0	7	...
	0.025–0.049	65.0	...	55.0	7	6
	0.050–0.259	65.0	...	55.0	8	7
	0.260–0.500	65.0	...	55.0	9	8
Alloy 2024						
O	0.018–0.500	...	32.0	15.0 max	...	...

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



Documents

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TABLE 1 *Continued*

Temper	Specified Wall Thickness, ^C in.	Tensile Strength, ksi		Yield Strength ^D (0.2 % offset), min, ksi	Elongation in 2 in. or 4 × Diameter, ^E min, %	
		min	max		Full-Section Specimen	Cut-Out Specimen
T3 ^H	0.018–0.024	64.0	...	42.0	10	...
	0.025–0.049	64.0	...	42.0	12	10
	0.050–0.259	64.0	...	42.0	14	10
	0.260–0.500	64.0	...	42.0	16	12
T42 ^H	0.018–0.024	64.0	...	40.0	10	...
	0.025–0.049	64.0	...	40.0	12	10
	0.050–0.259	64.0	...	40.0	14	10
	0.260–0.500	64.0	...	40.0	16	12
Alloy 3003 ^F						
O	0.010–0.024	14.0	19.0	5.0	...	...
	0.025–0.049	14.0	19.0	5.0	30	20
	0.050–0.259	14.0	19.0	5.0	35	25
	0.260–0.500	14.0	19.0	5.0	...	30
H12	0.010–0.500	17.0	...	12.0	...	...
H14	0.010–0.024	20.0	...	17.0	3	...
	0.025–0.049	20.0	...	17.0	5	3
	0.050–0.259	20.0	...	17.0	8	4
	0.260–0.500	20.0	...	17.0	...	...
H16	0.010–0.024	24.0	...	21.0	...	...
	0.025–0.049	24.0	...	21.0	3	2
	0.050–0.259	24.0	...	21.0	5	4
	0.260–0.500	24.0	...	21.0	...	...
H18	0.010–0.024	27.0	...	24.0	2	...
	0.025–0.049	27.0	...	24.0	3	2
	0.050–0.259	27.0	...	24.0	5	3
	0.260–0.500	27.0	...	24.0	...	...
H113 ^G	0.010–0.500	14.0	...	5.0	...	...
Alloy Alclad 3003						
O	0.010–0.024	13.0	19.0	4.5	...	...
	0.025–0.049	13.0	19.0	4.5	30	20
	0.050–0.259	13.0	19.0	4.5	35	25
	0.260–0.500	13.0	19.0	4.5	...	30
H14	0.010–0.024	19.0	...	16.0	...	...
	0.025–0.049	19.0	...	16.0	5	...
	0.050–0.259	19.0	...	16.0	8	4
	0.260–0.500	19.0	...	16.0	...	...
H18	0.010–0.500	26.0	...	23.0	...	...
H113 ^G	0.050–0.500	13.0	...	4.5	...	...
Alloy 3102 ^F						
O	0.018–0.049	11.0	17.0	3.5	30 ^I	20 ^I
	0.050–0.065	11.0	17.0	3.5	35	25
Alloy Alclad 3102 ^F						
O	0.018–0.049	10.0	17.0	3.5	30 ^I	20 ^I
	0.050–0.065	10.0	17.0	3.5	35	25
Alloy 3303 ^F						
O	0.010–0.024	14.0	19.0	5.0	...	...
	0.025–0.049	14.0	19.0	5.0	30	20
	0.050–0.065	14.0	19.0	5.0	35	25
Alloy Alclad 3303 ^F						
O	0.010–0.024	13.0	19.0	4.5	...	...
	0.025–0.049	13.0	19.0	4.5	30	20
	0.050–0.065	13.0	19.0	4.5	35	25
Alloy 5005 ^F						
O ^F	0.018–0.500	15.0	21.0	5.0	...	...
Alloy 5050 ^F						
O ^F	0.018–0.500	18.0	24.0	6.0	...	...
H32		22.0	...	16.0	...	...
H34		25.0	...	20.0	...	...
H36		27.0	...	22.0	...	...
H38		29.0	...	24.0	...	...
Alloy 5052 ^F						

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TABLE 1 *Continued*

Temper	Specified Wall Thickness, ^C in.	Tensile Strength, ksi		Yield Strength ^D (0.2 % offset), min, ksi	Elongation in 2 in. or 4 × Diameter, ^E min, %	
		min	max		Full-Section Specimen	Cut-Out Specimen
O ^F	0.018–0.450	25.0	35.0	10.0	...	...
H32		31.0	...	23.0	...	...
H34		34.0	...	26.0	...	...
H36		37.0	...	29.0	...	...
H38		39.0	...	24.0	...	...
Alloy 5083 ^F						
O ^F	0.018–0.450	39.0	51.0	16.0	...	14
Alloy 5086 ^F						
O ^F	0.018–0.450	35.0	46.0	14.0	...	...
H32		40.0	...	28.0	...	...
H34		44.0	...	34.0	...	...
H36		47.0	...	38.0	...	...
Alloy 5154 ^F						
O	0.010–0.450	30.0	41.0	11.0	10	10
H34		39.0	...	29.0	5	5
H38		45.0	...	34.0	...	...
Alloy 5456 ^F						
O	0.018	41.0	53.0	19.0	...	14
Alloy 6061						
O	0.018–0.500	...	22.0	14.0 max	15	15
T4	0.025–0.049	30.0	...	16.0	16	14
	0.050–0.259					
	0.260–0.500	30.0	...	16.0	18	16
		30.0	...	16.0	20	18
T42 ^H	0.025–0.049	30.0	...	14.0	16	14
	0.050–0.259	30.0	...	14.0	18	16
	0.260–0.500	30.0	...	14.0	20	18
T6, T62 ^H	0.025–0.049	42.0	...	35.0	10	8
	0.050–0.259	42.0	...	35.0	12	10
	0.260–0.500	42.0	...	35.0	14	12
Alloy 6063						
O	0.018–0.500	...	19.0	...	...	...
T4, T42 ^H	0.025–0.049	22.0	...	10.0	16	14
	0.050–0.259	22.0	...	10.0	18	16
	0.260–0.500	22.0	...	10.0	20	18
T6, T62 ^H	0.025–0.049	33.0	...	28.0	12	8
	0.050–0.259	33.0	...	28.0	14	10
	0.260–0.500	33.0	...	28.0	16	12
T83	0.025–0.259	33.0	...	30.0	5	...
T831	0.025–0.259	28.0	...	25.0	5	...
T832	0.025–0.049	41.0	...	36.0	8	5
	0.050–0.259	40.0	...	35.0	8	5
Alloy 6262						
T6, T62 ^H	0.025–0.049	42.0	...	35.0	10	8
	0.050–0.259	42.0	...	35.0	12	10
	0.260–0.500	42.0	...	35.0	14	12
T9	0.025–0.375	48.0	...	44.0	5	4
Alloy 7075						
O	0.025–0.049	...	40.0	21.0 max	10	8
	0.050–0.500	...	40.0	21.0 max	12	10
T6, T62 ^H	0.025–0.259	77.0	...	66.0	8	7
	0.260–0.500	77.0	...	66.0	9	8
T73 ^J	0.025–0.259	66.0	...	56.0	10	8
	0.260–0.500	66.0	...	56.0	12	10

^ASee Annex A1.^BTo 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 to

elongation to the nearest 0.5 % both in accordance with the rounding-off method of Practice E 29.

^cCoiled tube is generally available with a maximum wall thickness of 0.083 in. and only in nonheat-treatable alloys.

^dYield strength to be determined only on straight tube.

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

^fIn this alloy tube other than round is produced only in the F (as drawn) and O tempers. Properties for F temper are not specified or guaranteed.

^gBeginning with the 1982 issue the requirements for the H112 tempers were replaced by the H113 temper, applicable to other than round tube, which is fabricated by cold-forming annealed round tube and acquires some temper in this forming operation.

^hMaterial in the T42 or T62 tempers is not available from the material producers.

ⁱFor specified wall thickness under 0.025 in., elongation is not required.

^jMaterial in this temper exhibits improved resistance to stress corrosion compared to that of the T6 temper. The stress-corrosion resistance capability of individual lots is determined by testing the previously selected tension-test samples in accordance with the applicable electrical conductivity acceptance criteria of Table 2.

1.2 Alloy and temper designations are in accordance with ANSI H35.1. The equivalent Unified Numbering System alloy designations are those of Table 3 preceded by A9, for example, A91100 for aluminum designation 1100 in accordance with Practice E 527.

NOTE 1—See Specification B 483 for aluminum-alloy drawn tubes for general purpose applications; Specification B 234 for aluminum-alloy drawn seamless tubes for condensers and heat exchangers; and Specification B 241/B 241M for aluminum-alloy seamless pipe and seamless extruded tube.

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

1.3 A complete metric companion to Specification B 210 has been developed—Specification B 210M; 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:

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products³

B 597 Practice for Heat Treatment of Aluminum Alloys³

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

B 666/B 666M Practice for Identification Marking of Aluminum Products³

³ Annual Book of ASTM Standards, Vol 02.02.

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 101 Test Method for Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁵

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

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 Atmosphere⁸

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis⁸

E 1004 Test Method for Electromagnetic (Eddy-Current) Measurements of Electrical Conductivity⁶

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 Discharge⁸

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.

⁷ Annual Book of ASTM Standards, Vol 01.01.

⁸ Annual Book of ASTM Standards, Vol 03.06.

TABLE 2 Lot Acceptance Criteria for Resistance to Stress-Corrosion

Alloy and Temper	Lot Acceptance Criteria		Lot Acceptance Status
	Electrical Conductivity, ^{A,B} % IACS	Level of Mechanical Properties	
7075–T73	40.0 or greater	per specified requirements	acceptable
	38.0 through 39.9	per specified requirements and yield strength does not exceed minimum by more than 11.9 ksi	acceptable
	38.0 through 39.9	per specified requirements but yield strength exceeds minimum by 12.0 ksi or more	unacceptable ^C
	less than 38.0	any level	unacceptable ^C

^AThe electrical conductivity shall be determined in accordance with Test Method E 1004 in the following locations:

Wall Thickness, in.
Up through 0.100
0.101 and over

Location
surface of tensile sample
subsurface after removal of approximately 10 % of thickness.^{A,B}

^A For curved surfaces, the conductivity shall be measured on a machined flat spot; however, for small size tubes, a cut-out piece may be flattened and the conductivity determined.

^B When material is found to be unacceptable, it shall be reprocessed (additional precipitation heat treatment or resolution heat treatment and precipitation heat treatment).