Designation: ~~B483/B483M – 13~~ B483/B483M – 13$^{\varepsilon 1}$

Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications[1]

This standard is issued under the fixed designation B483/B483M; 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.

ε[1] NOTE—Table 1 was corrected editorially in June 2014.

1. Scope*

1.1 This specification covers aluminum and aluminum-alloy drawn tube and drawnpipe in straight lengths and tube in coils for general purpose applications in the alloys (Note 2), and tempers shown in Tables 1 and 2. Coiled tubes are generally available only as round tubes with a wall thickness not exceeding 0.083 in. [2.00 mm] and only in non-heat-treatable alloys.

NOTE 1—For drawn seamless tubes, see Specifications B210 and B210M, for tubes to be used in condensers and heat exchangers, Specifications B234 and B234M, and for seamless pipe, Specification B241/B241M. For extruded structural tube and pipe, see Specification B429.

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

1.2 Alloy and temper designations are in accordance with ANSI H35.1/H35.1(M). The equivalent Unified Number System alloy designations are those of Table 3 preceded by A9, for example A91060 for aluminum 1060 in accordance with Practice E527.

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 units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

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

2.2 *ASTM Standards:*[2]

B210 Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
B210M Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric)
B234 Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers
B234M Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers (Metric)
B241/B241M Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
B429 Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
B557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)
B597 Practice for Heat Treatment of Aluminum Alloys (Withdrawn 2002)[3]
B660 Practices for Packaging/Packing of Aluminum and Magnesium Products
B666/B666M Practice for Identification Marking of Aluminum and Magnesium Products
B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

[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 1, 2013. Published June 2013. Originally approved in 1983. Last previous edition approved in 2003 as B483/B483M~~B483/B483M-03,~~ 03, which was withdrawn January 2012 and reinstated in May 2013. DOI: ~~10.1520/B0483_B0483M-13~~10.1520/B0483_B0483M-13E01.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

TABLE 1 Tensile Property Limits, Tube[A,B]

ALLOY AND TEMPER	SPECIFIED WALL THICKNESS in. [mm]	TENSILE STRENGTH - ksi [MPa]				Elongation in 2 in. [50 mm] or 4× Diameter,[C] min, %[J]		
		ULTIMATE		YIELD[D] (0.2% Offset), ksi [MPa]		FULL SECTION SPECIMEN[E]	Cut-Out Specimen[F]	
		min.	max.	min.	max.		In 50 mm	In 5× Diameter (5.65 $\sqrt{A}$)[G]
1060[F,I]								
1060-O	0.010-0.500 [0.25-12.50]	8.5 [60]	13.5 [95]	2.5 [15]	. . [. .]	. .	. .	. .
1060-H12	0.010-0.500 [0.25-12.50]	10.0 [70]	. . [. .]	4.0 [30]	. . [. .]	. .	. .	. .
1060-H14	0.010-0.500 [0.25-12.50]	12.0 [85]	. . [. .]	10.0 [70]	. . [. .]	. .	. .	. .
1060-H18	0.010-0.500 [0.25-12.50]	16.0 [110]	. . [. .]	13.0 [90]	. . [. .]	. .	. .	. .
1060-H113[K]	0.010-0.500 [.025-12.50]	8.5 [60]	. . [. .]	2.5 [15]	. . [. .]	. .	. .	. .
1100[F,I]								
1100-O	0.014-0.500 [0.36-12.50]	11.0 [75]	15.5 [105]	3.5 [25]	. . [. .]	. .	. .	. .
1100-H12	0.014-0.500 [0.36-12.50]	14.0 [95]	. . [. .]	11.0 [75]	. . [. .]	. .	. .	. .
1100-H14	0.014-0.500 [0.36-12.50]	16.0 [110]	. . [. .]	14.0 [95]	. . [. .]	. .	. .	. .
1100-H16	0.014-0.500 [0.36-12.50]	19.0 [130]	. . [. .]	17.0 [115]	. . [. .]	. .	. .	. .
1100-H18	0.014-0.500 [0.36-12.50	22.0 [150]	. . [. .]	20.0 [140]	. . [. .]	. .	. .	. .
1100-H113[K]	0.014-0.500 [0.36-12.50]	11.0 [75]	. . [. .]	3.5 [25]	. . [. .]	. .	. .	. .
3003[F,I]								
3003-O	0.010-0.024 [0.25-0.63]	14.0 [95]	19.0 [130]	5.0 [35]	. . [. .]	. .	. .	. .
	0.025-0.049 [0.63-1.20]	14.0 [95]	19.0 [130]	5.0 [35]	. . [. .]	30	20	. .
	0.050-0.259 [1.20-6.30]	14.0 [95]	19.0 [130]	5.0 [35]	. . [. .]	35	25	. .
	0.260-0.500 [6.30-12.50]	14.0 [95]	19.0 [130]	5.0 [35]	. . [. .]	. .	30	27
3003-H12	0.010-0.500 [0.25-12.50]	17.0 [115]	. . [. .]	12.0 [85]	. . [. .]	. .	. .	
3003-H14	0.010-0.024 [0.25-0.63]	20.0 [140]	. . [. .]	17.0 [115]	. . [. .]	3	. .	. .
	0.025-0.049 [0.63-1.20]	20.0 [140]	. . [. .]	17.0 [115]	. . [. .]	5	3	. .
	0.050-0.259 [1.20-6.30]	20.0 [140]	. . [. .]	17.0 [115]	. . [. .]	8	4	. .
	0.260-0.500 [6.30-12.50]	20.0 [140]	. . [. .]	17.0 [115]	. . [. .]	. .	. .	. .
3003-H16	0.010-0.024 [0.25-0.63]	24.0 [165]	. . [. .]	21.0 [145]	. . [. .]	. .	. .	. .
	0.025-0.049 [0.63-1.20]	24.0 [165]	. . [. .]	21.0 [145]	. . [. .]	3	2	. .
	0.050-0.259 [1.20-6.30]	24.0 [165]	. . [. .]	21.0 [145]	. . [. .]	5	4	. .
	0.260-0.500 [6.30-12.50]	24.0 [165]	. . [. .]	21.0 [145]	. . [. .]	. .	. .	. .
3003-H18	0.010-0.024 [0.25-0.63]	27.0 [185]	. . [. .]	24.0 [165]	. . [. .]	2	. .	. .
	0.025-0.049 [0.63-1.20]	27.0 [185]	. . [. .]	24.0 [165]	. . [. .]	3	2	. .
	~~0.050-0.0259 [1.20-6.30]~~	~~27.0 [185]~~	~~. . [. .]~~	~~24.0 [165]~~	~~. . [. .]~~	~~5~~	~~3~~	~~. .~~
	0.050-0.259† [1.20-6.30]	27.0 [185]	. . [. .]	24.0 [165]	. . [. .]	5	3	. .
0.260-0.500 [6.30-12.50	27.0 [185]	. . [. .]	24.0 [165]	. . [. .]	. .	. .		
3003-H113[K]	0.010-0.500 [0.25-12.50]	14.0 [95]	. . [. .]	5.0 [35]	. . [. .]	. .	. .	
5050[F,I]								
5050-O	0.010-0.500 [0.25-12.70]	18.0 [125]	24.0 [165]	6.0 [40]	. . [. .]	. .	. .	. .
5050-H32	0.010-0.500 [0.25-12.70]	22.0 [150]	. . [. .]	16.0 [110]	. . [. .]	. .	. .	. .
5050-H34	0.010-0.500 [0.25-12.70	25.0 [170]	. . [. .]	20.0 [140]	. . [. .]	. .	. .	. .
5050-H36	0.010-0.500 [0.25-12.70]	27.0 [185]	. . [. .]	22.0 [150]	. . [. .]	. .	. .	. .
5050-H38	0.010-0.500 [0.25-12.70]	29.0 [200]	. . [. .]	24.0 [165]	. . [. .]	. .	. .	. .
5052[F,I]								
~~5052-O~~	~~0.010-0.450 [0.25-11.50]~~	~~25.0 [170~~	~~35.0 [240]~~	~~10.0 [70]~~	~~. . [. .]~~	~~. .~~	~~. .~~	~~. .~~
5052-O	0.010-0.450 [0.25-11.50]	25.0 [170]	35.0 [240]	10.0 [70]	. . [. .]	. .	. .	. .
~~5052-H2~~	~~0.010-0.450 [0.25-11.50]~~	~~31.0 [215]~~	~~. . [. .]~~	~~23.0 [160]~~	~~. . [. .]~~	~~. .~~	~~. .~~	~~. .~~
5052-H32†	0.010-0.450 [0.25-11.50]	31.0 [215]	. . [. .]	23.0 [160]	. . [. .]	. .	. .	. .
5052-H34	0.010-0.450 [0.25-11.50]	34.0 [235]	. . [. .]	26.0 [180]	. . [. .]	. .	. .	. .
5052-H36	0.010-0.450 [0.25-11.50]	37.0 [255]	. . [. .]	29.0 [200]	. . [. .]	. .	. .	. .
5052-H38	0.010-0.450 [0.25-11.50]	39.0 [270]	. . [. .]	31.0 [215]	. . [. .]	. .	. .	. .
6061								
6061-O	0.018-0.500 [0.45-12.50]	. . [. .]	22.0 [150]	. . [. .]	14.0 [95]	15	15	13
6061-T4	0.025-0.049 [0.63-1.20]	30.0 [200]	. . [. .]	16.0 [110]	. . [. .]	16	14	. .
	0.050-0.259 [1.20-6.30]	30.0 [200]	. . [. .]	16.0 [110]	. . [. .]	18	16	. .
	0.260-0.500 [6.30-12.50]	30.0 [200]	. . [. .]	16.0 [110]	. . [. .]	20	18	16
6061-T42[G,H]	0.025-0.049 [0.63-1.20]	30.0 [200]	. . [. .]	14.0 [110]	. . [. .]	16	14	. .
	0.050-0.259 [1.20-6.30]	30.0 [200]	. . [. .]	14.0 [110]	. . [. .]	18	16	. .
	0.260-0.500 [6.30-12.50]	30.0 [200]	. . [. .]	14.0 [110]	. . [. .]	20	18	16
6061-T6 and T62[G,H]	0.025-0.049 [0.63-1.20]	42.0 [290]	. . [. .]	35.0 [240]	. . [. .]	10	8	. .
	0.050-0.259 [1.20-6.30]	42.0 [290]	. . [. .]	35.0 [240]	. . [. .]	12	10	. .
	0.260-0.500 [6.30-12.50]	42.0 [290]	. . [. .]	35.0 [240]	. . [. .]	14	12	10
6063								
6063-O	0.018-0.500 [0.45-12.50]	. . [. .]	19.0 [130]	. . [. .]	. . [. .]	. .	. .	. .
6063-T4 and T42[G,H]	0.025-0.049 [0.63-1.20]	22.0 [150]	. . [. .]	10.0 [70]	. . [. .]	16	14	. .
	0.050-0.259 [1.20-6.30]	22.0 [150]	. . [. .]	10.0 [70]	. . [. .]	18	16	. .
	0.260-0.500 [6.30-12.50]	22.0 [150]	. . [. .]	10.0 [70]	. . [. .]	20	18	16

TABLE 1 *Continued*

ALLOY AND TEMPER	SPECIFIED WALL THICKNESS in. [mm]	TENSILE STRENGTH - ksi [MPa]				Elongation in 2 in. [50 mm] or 4× Diameter,[C] min, %[J]		
		ULTIMATE		YIELD[D] (0.2% Offset), ksi [MPa]		FULL SECTION SPECIMEN[E]	Cut-Out Specimen[F]	
		min.	max.	min.	max.		In 50 mm	In 5× Diameter (5.65 $\sqrt{A}$)[G]
6063-T6 and T62[G,H]	0.025-0.049 [0.63-1.20]	33.0 [230]	. . [. .]	28.0 [195]	. . [. .]	12	8	. .
	0.050-0.259 [1.20-6.30]	33.0 [230]	. . [. .]	28.0 [195]	. . [. .]	14	10	. .
	0.260-0.500 [6.30-12.50]	33.0 [230]	. . [. .]	28.0 [195]	. . [. .]	16	12	10
6063-T83	0.025-0.259 [0.63-6.30]	33.0 [230]	. . [. .]	30.0 [205]	. . [. .]	5	. .	. .
6063-T831	0.025-0.259 [0.63-6.30]	28.0 [195]	. . [. .]	25.0 [170]	. . [. .]	5	. .	. .
~~6063-T832~~	~~0.025-0.049 [0.63-1.20]~~	~~41.0 [285]~~	~~. . [. .]~~	~~36.0 [250]~~	~~. . [. .]~~	~~8~~	~~5~~	~~. .~~
	6063-T832 0.025-0.049 [0.63-1.20]	41.0 [285]	. . [. .]	36.0 [250]	. . [. .]	8	5	. .
	6063-T832 0.050-0.259 [1.20-6.30]	40.0 [275]	. . [. .]	35.0 [240]	. . [. .]	8	5	. .
~~0.051-0.500 [1.30-12.50]~~	~~50.0 [345]~~	~~. . [. .]~~	~~45.0 [310]~~	~~. . [. .]~~	~~10~~	~~8~~	~~. .~~	
6262								
6262-T6 and T62[G,H]	0.025-0.049 [0.63-1.20]	42.0 [290]	. . [. .]	35.0 [240]	. . [. .]	10	8	. .
	0.050-0.259 [1.20-6.30]	42.0 [290]	. . [. .]	35.0 [240]	. . [. .]	12	10	. .
	0.260-0.500 [6.30-12.50]	42.0 [290]	. . [. .]	35.0 [240]	. . [. .]	14	12	10
6262-T9	0.025-0.375 [0.63-10.00]	48.0 [330]	. . [. .]	44.0 [305]	. . [. .]	5	4	3

[A] See 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 [MPa] and each value for elongation to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.
[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.
[D] Yield strength to be determined only on straight tube.
[E] Round tube 2 inches or less in outside diameter and square tube 1½ inches or less on a side are tested in full section unless the limitations of the testing machine precludes the use of such a specimen.
[F] For round tube over 2 inches in diameter, for square tube over 1½ inches on a side, for all sizes of tube other than round and square, or in those cases when a full section specimen cannot be used, a cut-out specimen is used.
[G] Elongations in 50 mm apply for tube tested in full-section, for sheet type specimens for tubes having a flat wall, and for similar curved specimens for tubes having a curved wall up to a maximum wall thickness of 12.50 mm. Elongations in 5D (5.65 $\sqrt{A}$), where D and A are diameter and cross-sectional area specimens, respectively, apply to round test specimens machined from wall thickness over 6.30 mm.
[H] Material in the T42 or T62 tempers is not available from the material producers.
[I] In 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.
[J] For specified wall thickness under 0.025 in. [0.63 mm] elongation is not required.
[K] The H113 temper applies to other than round tube which is fabricated from annealed round tube.
† Corrected editorially.

TABLE 2 Tensile Property Limits, Drawn Pipe[A,B,C]

Temper	Pipe Size, Designation	Tensile Strength, ksi [MPa]		Yield Strength[C] (0.2% Offset), ksi [MPa], min	Elongation, min, %		
		min	max		Elongation in 2 in. or 4× Diameter,[D] min, %	In 50 mm	In 5× Diameter (5.65 $\sqrt{A}$)[E]
			Alloy 3003				
H18	Under 1	27.0 [185]	...	24.0 [165]	4	[4]	...
H112	1 and over	14.0 [95]	...	5.0 [35]	25	[25]	[22]

[A] The basis for establishment of tensile property limits is shown in Annex A1.
[B] For purposes of determining conformance with this specification, each value for tensile strength and yield strength shall be rounded to the nearest 0.1 ksi, and each value for elongation shall be rounded to the nearest 0.5 %, both in accordance with the rounding-off method of Practice E29.
[C] Elongation of full-section and cut-out sheet-type specimens is measured in 2 in.; of round specimens, in 4× specimen diameter.
[D] For purposes of determining conformance with this specification, each value for ultimate strength and yield strength shall be rounded to the nearest 1 MPa, and each value for elongation shall be rounded to the nearest 0.5%, both in accordance with the rounding-off method of Practice E29.
[E] Elongation in 50 mm apply for pipe tested in full-section and to sheet type specimens taken from pipes having a wall up to 12.50 mm thick. Elongation in 5D (5.65 $\sqrt{A}$) where D and A are diameter and cross-sectional area of the specimens respectively, apply to round test specimens machined from wall thicknesses over 6.30 mm.

B918 Practice for Heat Treatment of Wrought Aluminum Alloys
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys
E215 Practice for Standardizing Equipment for Electromagnetic Testing of Seamless Aluminum-Alloy Tube
E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

TABLE 3 Chemical Composition Limits[A,B,C,I]

Alloy	Composition, %										
	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]
1100	0.95 Si + Fe		0.05–0.20	0.05	...	...	0.10	...	0.05	0.15	99.00 min[G]
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...	0.10	...	0.05	0.15	remainder
5005	0.30	0.7	0.20	0.20	0.50–1.1	0.10	0.25	...	0.05	0.15	remainder
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
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
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
6262	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.14	0.25	0.15	0.05[H]	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 method of Practice E29.
[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 %, maximum.
[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] Bismuth and lead each 0.40–0.7 %.
[I] In case there is a discrepancy in the values listed in Table 1 with those listed in the "International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys" (known as the "Teal Sheets"), the composition limits registered with the Aluminum Association and published in the "Teal Sheets" shall be considered the controlling composition. The "Teal Sheets" are available at http://www.aluminum.org/tealsheets.

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)[3]
E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis
E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry
2.3 *ANSI Standards:*[4]
H35.1/H35.1(M) Alloy and Temper Designation Systems
H35.2 Dimensional Tolerances for Aluminum Mill Products
H35.2M Dimensional Tolerances for Aluminum Mill Products [Metric]
2.4 *Military Standard:*[5]
MIL-STD-129 Marking for Shipment and Storage
2.5 *Military Specifications:*[5]
AMS 2770 Heat Treatment of Wrought Aluminum Alloy Parts
AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials
2.6 *Federal Standard:*[5]
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

3. Terminology

3.1 *Definitions*—Refer to Terminology ~~B~~B881 ~~881~~ for definitions of product terms used in this specification.

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 (7.1),
4.1.4 Temper (8.1),
4.1.5 Size and schedule number for pipe, cross-sectional dimensions for tube (outside diameter and wall thickness, or inside diameter and wall thickness for round tube; for tube other than round, square, rectangular, hexagonal, or octagonal with sharp corners, a drawing is required),

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
[5] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

4.1.6 Length (straight or coiled),
4.1.7 Nominal inside diameter of coils and weight or maximum outside diameter, if applicable,

4.2 Additionally, orders for materials to this specification shall include the following information when required by the purchaser:
4.2.1 Whether heat treatment shall be in accordance with Practice ~~B597~~B597 (9.2),
4.2.2 Whether testing for leaks is required (11.1),
4.2.3 Whether specified number of leaks are allowed, and the manner of marking leaks (11.1.3.2),
4.2.4 Whether inside cleanliness test is required on coiled tubes (12.2), and frequency of testing required,
4.2.5 Whether inspection or witness of inspection and tests by the ~~purchaser's~~purchaser' representative is required prior to material shipment (15.1),
4.2.6 Whether marking for identification is required (17.1),
4.2.7 Whether Practices B660 applies, and if so, the levels of preservation, packaging, and packing required (18.3),
4.2.8 Whether certification of the material by the producer is required (Section 19),
4.2.9 Whether threaded ends are required for pipe (14.3), and,
4.2.10 PIN (for Department of Defense only) (Annex A3).

5. Manufacture

5.1 The tube may be produced by drawing tube stock produced by extrusion through a bridge-type die or by die and mandrel methods, at the option of the producer, provided that the production method results in material that meets all requirements of this specification.

5.2 The ends of coils shall be crimped or otherwise sealed to avoid contamination during shipment.

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. Except as otherwise specified in the contract or order, the producer 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 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 an identifiable quantity of material of the same 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 an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions subjected to inspection at one time.

7. Chemical Composition

7.1 *Limits*—The material shall conform to the composition limits specified in Table 3. Conformance shall be determined by the producer by taking samples in accordance with E716 when ingots are poured and analyzing those samples in accordance with E607, E1251, E34 or EN14242. At least one sample shall be taken for each group of ingots poured simultaneously from the same source of molten metal. If the producer has determined the composition during pouring of the ingots, he shall not be required to sample and analyze the finished product.

NOTE 3—It is standard practice in the United States aluminum industry to determine conformance to the composition limits prior to further processing of ingots into wrought products. Due to the continuous nature of the process, it is not practical to keep a specific ingot analysis identified with a specific quantity of finished material.

7.2 If it becomes necessary to analyze material for conformance to chemical composition limits, the method used to sample for the determination of chemical composition shall be by agreement between the producer and the purchaser. Analysis shall be performed in accordance with E716, E607, E1251, E34 or EN 14242 (ICP method). The number of samples taken for determination of chemical composition shall be as follows:
7.2.1 When samples are taken from material each weighing 1 lb/linear ft [1.7 kg/linear m] or less, a sample shall be taken to represent each 2000 lb [1000 kg] or fraction thereof of material in the lot.
7.2.2 When samples are taken from material each weighing more than 1 lb/linear ft [1.7 kg/linear m], a sample shall be taken to represent each 6000 lb [3000 kg] or fraction thereof of material in the lot.

7.3 Other methods of analysis or in the case of dispute may be by agreement between the producer and the purchaser.

8. Tensile Properties

8.1 *Limits*—The material shall conform to the tensile properties in Tables 1 and 2.

8.2 *Number of Specimens:*

8.2.1 For material having a nominal weight of less than 1 lb/linear ft [1.7 kg/linear m], one tension test specimen shall be taken for each 1000 lb [500 kg] or fraction thereof in a lot.

8.2.2 For material having a nominal weight of 1 lb [1.7 kg] or more/linear ft [m], one tension test specimen shall be taken for each 1000 ft [300 m] or fraction thereof in a lot.

8.3 *Test Specimens*—Geometry of test specimens and the location in the product from which they are taken shall be as specified in Test Methods B557 and B557M.

8.4 *Test Methods*—The tension tests shall be made in accordance with Test Methods B557 and B557M.

9. Heat Treatment

9.1 Unless specified in 9.2, producer or supplier heat treatment for the applicable tempers in Table 1 shall be in accordance with AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials and possibly AMS 2770 Heat Treatment of Wrought Aluminum Alloy Parts.

9.2 When specified, heat treatment of applicable tempers in Table 1 shall be in accordance with Practice B918.

10. Heat Treatment and Reheat Treatment Capability

10.1 As-received material in the O or F temper and in alloys 6061 and 6063 (within the size limitations specified in Table 1 and without the imposition of cold work) shall, after proper solution heat treatment and natural aging for not less than 4 days at room temperature, conform to the properties specified in Table 1 for T42 temper material.

10.2 Material in alloy and tempers 6063-T4 and T6 shall, after proper resolution heat treatment and natural aging for not less than 4 days at room temperature, conform to the properties specified in Table 1 for the T42 temper.

NOTE 4—6061-T4 and T6 are excluded from this paragraph because experience has shown the reheat treated material may develop large recrystallized grains and may fail to develop the tensile properties shown in Table 1.

10.3 Material in T4 and T42 tempers shall, after proper precipitation heat treatment, conform to the properties specified in Table 1 for the T6 and T62 tempers, respectively.

11. Testing for Leaks (Tube)

11.1 When specified by the purchaser at the time of placing the order, tube shall be tested for leaks by one of the following methods at the option of the producer.

11.1.1 *Method 1*—Tubes 1.500 in. [40 mm] or less in diameter shall be tested pneumatically at not less than 60 psig [400 kPa] air pressure while immersed in water or other suitable liquid. Any evidence of leakage shall be cause for rejection.

11.1.2 *Method 2*—Tubes 1.500 in. [40 mm] or less in diameter shall be tested pneumatically at not less than 90 psig [600 KPa] air pressure with a gage which will indicate loss of pressure. There shall not be any loss of pressure during a test period of at least 15-s duration.

11.1.3 *Method 3*—Tubes shall be subjected to an eddy current test in accordance with the procedures described in Practice E215. Reference standards or secondary standards having equivalent eddy current response shall serve to define acceptance-rejection limits.

11.1.3.1 *For straight lengths* of tube reference standards described in Appendixes X1 and X2 of Practice E215 shall be used to standardize the equipment. Tubes 1.500 in. [40 mm] or less in diameter and maximum wall thickness of 0.083 in. [2.00 mm] that produce eddy current indications less than those from the 2A holes of the applicable reference standard or an equivalent secondary standard shall be acceptable. Any tube having a discontinuity that produces an eddy current indication equal to or greater than those from the 2A holes of the applicable reference standard or an equivalent secondary standard shall be rejected.

11.1.3.2 *For coiled tube* secondary standards having an equivalent eddy current response to No. 70 (0.028-in. [0.70-mm] diameter) and No. 60 (0.040-in. [1.00-mm] diameter) drill holes shall be used to standardize the equipment. Tubes 0.188 to 1 in. [5 to 25 mm] incl, in diameter and maximum wall thickness of 0.083 in. [2.00 mm] that produce eddy current indications less than those from the No. 60 hole of the secondary standard shall be acceptable. Any tube that produces an indication equal to or greater than those from the No. 60 hole of the secondary standard shall be rejected. Set-up procedures shall include a check to ensure that tubes containing defects giving responses equal to or greater than that from No. 60 hole are rejected at the speed of inspection. Tube in long coils may contain up to a specified number of defects per coil when agreed between the producer and purchaser. In a case where a specified number of defects per coil is allowed, the need for marking such defects in a coil shall be handled as agreed by the producer and purchaser.

12. Special Requirements for Coiled Tubes

12.1 *Expansion Test*—Coiled tube in the annealed temper only shall be capable of being expanded on a hardened ground tapered steel pin having an included angle of 60°, to the following amounts, without signs of cracks, ruptures, or other defects clearly visible to the unaided eye: