



Designation: B 313/B 313M – 02

## Standard Specification for Aluminum and Aluminum-Alloy Round Welded Tubes<sup>1</sup>

This standard is issued under the fixed designation B 313/B 313M; 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 tubes made from formed sheet and seam welded by continuous methods.

1.2 Alloy (Note 1) 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.

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

NOTE 2—For the requirements for sheet see Specification B 209.

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 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate<sup>2</sup>

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products<sup>2</sup>

B 557M Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products [Metric]<sup>2</sup>

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products<sup>2</sup>

B 666/B 666M Practice for Identification Marking of Alu-

minum and Magnesium Products<sup>2</sup>

B 918 Practice for Heat Treatment of Wrought Aluminum Alloys<sup>2</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>3</sup>

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys<sup>4</sup>

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition<sup>4</sup>

E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique<sup>4</sup>

E 527 Practice for Numbering Metals and Alloys (UNS)<sup>5</sup>

E 607 Test Method for Atomic Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere<sup>4</sup>

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis<sup>4</sup>

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 Discharge<sup>4</sup>

#### 2.3 ANSI Standards:

H35.1 Alloy and Temper Designation Systems for Aluminum<sup>2</sup>

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

H35.2 Dimensional Tolerances for Aluminum Mill Products<sup>2</sup>

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

#### 2.4 Military Standard:

MIL-STD-129 Marking for Shipment and Storage<sup>6</sup>

#### 2.5 AMS Specification:

AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials<sup>7</sup>

<sup>1</sup> This specification is under the jurisdiction of the 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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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 01.01.

<sup>6</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

<sup>7</sup> Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

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

**TABLE 1 Chemical Composition Limits<sup>A,B,C</sup>**

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Tita- nium	Other Elements <sup>D</sup>		Aluminum
									Each	Total <sup>E</sup>	
1100	<i>F</i>	<i>F</i>	0.05–0.20	0.05	...	...	0.10	...	0.05	0.15	99.0 min <sup>G</sup>
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...	0.10	...	0.05	0.15	remainder
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 clad with alloy 7072		...	...	...	...	...	...	...	...	...
3005	0.6	0.7	0.30	1.0–1.5	0.20–0.6	0.10	0.25	0.10	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
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
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 <sup>H</sup>	<i>I</i>	<i>I</i>	0.10	0.10	0.10	...	0.8–1.3	...	0.05	0.15	remainder

<sup>A</sup> Limits are in percent maximum unless shown as a range or stated otherwise.

<sup>B</sup> Analysis shall be made for the elements for which limits are shown in this table.

<sup>C</sup> 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 righthand place of figures used in expressing the specified limit, in accordance with the rounding method of Practice E 29.

<sup>D</sup> *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.

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

<sup>F</sup> Iron plus silicon shall not exceed 0.95 %.

<sup>G</sup> 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.

<sup>H</sup> Composition of cladding alloy as applied during the course of manufacture. Samples from finished tube shall not be required to conform to these limits.

<sup>I</sup> Iron plus silicon shall not exceed 0.7 %.

## 2.6 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)<sup>6</sup>

## 3. Terminology

### 3.1 Definitions:

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

3.1.2 *supplier*—includes only the category of jobbers and distributors as distinct from producers.

3.1.3 *welded tube*—a tube produced by forming and seam-welding sheet longitudinally.

### 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),

NOTE 3—For inch-pound orders specify Specification B 313; for metric orders specify Specification B 313M. Do not mix units.

4.1.2 Quantity in pieces or pounds, [kilograms]

4.1.3 Alloy (6.1),

4.1.4 Temper (Section 8),

4.1.5 Size (outside 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,

4.2.2 Special tension tests required other than tension tests performed on specimens taken from the sheet prior to welding (8.2),

4.2.3 Whether pressure or burst test is required and test description if methods 1, 2, or 3 of 9.1 are not suitable,

4.2.4 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (Section 13),

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

4.2.6 Whether marking for identification is required (15.1), and

4.2.7 Whether Practices B 660 applies, if so, the levels of preservation, packaging, and, packing required (16.3).

## 5. Responsibility for Quality Assurance

5.1 *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.

5.2 *Lot Definition*—An inspection lot shall be defined as follows:

5.2.1 For heat-treated tempers, an inspection lot shall consist of an identifiable quantity of 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.

5.2.2 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.

**TABLE 2 Tensile Property Limits, Inch-Pound Units<sup>A,B,C</sup>**

Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in., or 4× Diameter, min, %
		min	max	min	max	
Aluminum 1100						
O	0.032–0.050	11.0	15.5	3.5	...	25
	0.051–0.125	11.0	15.5	3.5	...	30
H12	0.032–0.050	14.0	19.0	11.0	...	6
	0.051–0.113	14.0	19.0	11.0	...	8
	0.114–0.125	14.0	19.0	11.0	...	9
H14	0.032–0.050	16.0	21.0	14.0	...	4
	0.051–0.113	16.0	21.0	14.0	...	5
	0.114–0.125	16.0	21.0	14.0	...	6
H16	0.032–0.050	19.0	24.0	17.0	...	3
	0.051–0.125	19.0	24.0	17.0	...	4
H18	0.032–0.050	22.0	...	...	...	3
	0.051–0.125	22.0	...	...	...	4
Alloy 3003						
O	0.032–0.050	14.0	19.0	5.0	...	23
	0.051–0.125	14.0	19.0	5.0	...	25
H12	0.032–0.050	17.0	23.0	12.0	...	5
	0.051–0.113	17.0	23.0	12.0	...	6
	0.114–0.125	17.0	23.0	12.0	...	7
H14	0.032–0.050	20.0	26.0	17.0	...	4
	0.051–0.113	20.0	26.0	17.0	...	5
	0.114–0.125	20.0	26.0	17.0	...	6
H16	0.032–0.050	24.0	30.0	21.0	...	3
	0.051–0.125	24.0	30.0	21.0	...	4
H18	0.032–0.050	27.0	...	24.0	...	3
	0.051–0.125	27.0	...	24.0	...	4
Alloy 3004						
O	0.032–0.050	22.0	29.0	8.5	...	16
	0.051–0.125	22.0	29.0	8.5	...	18
H32	0.032–0.050	28.0	35.0	21.0	...	4
	0.051–0.113	28.0	35.0	21.0	...	5
	0.114–0.125	28.0	35.0	21.0	...	6
H34	0.032–0.050	32.0	38.0	25.0	...	3
	0.051–0.113	32.0	38.0	25.0	...	4
	0.114–0.125	32.0	38.0	25.0	...	5
H36	0.032–0.050	35.0	41.0	28.0	...	3
	0.051–0.125	35.0	41.0	28.0	...	4
H38	0.032–0.050	38.0	...	31.0	...	3
	0.051–0.125	38.0	...	31.0	...	4
Alloy Alclad 3004						
O	0.032–0.050	21.0	28.0	8.0	...	18
	0.051–0.125	21.0	28.0	8.0	...	16
H32	0.032–0.050	27.0	34.0	20.0	...	4
	0.051–0.113	27.0	34.0	20.0	...	5
	0.114–0.125	27.0	34.0	20.0	...	6
H34	0.032–0.050	31.0	37.0	24.0	...	3
	0.051–0.113	31.0	37.0	24.0	...	4
	0.114–0.125	31.0	37.0	24.0	...	5

**TABLE 2** *Continued*

Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in., or 4× Diameter, min, %
		min	max	min	max	
H36	0.032–0.050	34.0	40.0	27.0	...	3
	0.051–0.125	34.0	40.0	27.0	...	4
H38	0.032–0.050	37.0	...	...	...	3
	0.051–0.125	37.0	...	...	...	4
Alloy 3005						
O	0.032–0.050	17.0	24.0	6.5	...	18
	0.051–0.125	17.0	24.0	6.5	...	20
H12	0.032–0.050	20.0	27.0	17.0	...	2
	0.051–0.113	20.0	27.0	17.0	...	3
	0.114–0.125	20.0	27.0	17.0	...	4
H14	0.032–0.050	24.0	31.0	21.0	...	2
	0.051–0.113	24.0	31.0	21.0	...	3
	0.114–0.125	24.0	31.0	21.0	...	4
H16	0.032–0.113	28.0	35.0	25.0	...	2
	0.114–0.125	28.0	35.0	25.0	...	3
H18	0.032–0.125	32.0	...	29.0	...	2
Alloy 5050						
O	0.032–0.113	18.0	24.0	6.0	...	20
	0.113–0.125	18.0	24.0	6.0	...	22
H32	0.032–0.050	22.0	28.0	16.0	...	4
	0.051–0.125	22.0	28.0	16.0	...	6
H34	0.032–0.050	25.0	31.0	20.0	...	4
	0.051–0.125	25.0	31.0	20.0	...	5
H36	0.032–0.050	27.0	33.0	22.0	...	3
	0.051–0.125	27.0	33.0	22.0	...	4
H38	0.032–0.050	29.0	...	...	...	3
	0.051–0.125	29.0	...	...	...	4
Alloy 5052						
O	0.032–0.050	25.0	31.0	9.5	...	18
	0.051–0.113	25.0	31.0	9.5	...	19
	0.114–0.125	25.0	31.0	9.5	...	20
H32	0.032–0.050	31.0	38.0	23.0	...	5
	0.051–0.113	31.0	38.0	23.0	...	7
	0.114–0.125	31.0	38.0	23.0	...	9
H34	0.032–0.050	34.0	41.0	26.0	...	4
	0.051–0.113	34.0	41.0	26.0	...	6
	0.114–0.125	34.0	41.0	26.0	...	7
H36	0.032–0.125	37.0	44.0	29.0	...	4
H38	0.032–0.125	39.0	...	32.0	...	4
Alloy 5086						
O	0.032–0.050	35.0	44.0	14.0	...	15
	0.051–0.125	35.0	44.0	14.0	...	18
H32	0.032–0.050	40.0	47.0	28.0	...	6
	0.051–0.125	40.0	47.0	28.0	...	8
H34	0.032–0.050	44.0	51.0	34.0	...	5
	0.051–0.125	44.0	51.0	34.0	...	6
H36	0.032–0.050	47.0	54.0	38.0	...	4
	0.051–0.125	47.0	54.0	38.0	...	6
Alloy 5154						

**TABLE 2** *Continued*

Temper	Specified Thickness, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in., or 4× Diameter, min, %
		min	max	min	max	
O	0.032–0.050	30.0	41.0	11.0	...	14
	0.051–0.113	30.0	41.0	11.0	...	16
	0.114–0.125	30.0	41.0	11.0	...	18
H32	0.032–0.050	36.0	43.0	26.0	...	5
	0.051–0.125	36.0	43.0	26.0	...	8
H34	0.032–0.050	39.0	46.0	29.0	...	4
	0.051–0.125	39.0	46.0	29.0	...	6
Alloy 5154						
H36	0.032–0.050	42.0	49.0	32.0	...	3
	0.051–0.113	42.0	49.0	32.0	...	4
	0.114–0.125	42.0	49.0	32.0	...	5
H38	0.032–0.050	45.0	...	35.0	...	3
	0.051–0.113	45.0	...	35.0	...	4
	0.114–0.125	45.0	...	35.0	...	5
Alloy 6061						
O	0.032–0.125	...	22.0	...	12.0	16
T4	0.032–0.125	30.0	...	16.0	...	16
T6	0.032–0.125	42.0	...	35.0	...	10

<sup>A</sup> Determination of tensile and yield strengths across the weld are not usually made on a routine basis. However, such determination, if made would show strength about 85 % of those of the parent material except for T6 temper of 6061 which would show 30.0 ksi ultimate tensile strength.

<sup>B</sup> To determine conformance with the values in this table each value for tensile and 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.

<sup>C</sup> The basis for establishment of mechanical property limits is shown in Annex A1.

**TABLE 3 Tensile Property Limits [SI Units]<sup>A,B,C</sup>**

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset, ) MPa		Elongation min, % in 50 mm
	over	through	min	max	min	max	
Aluminum 1100							
O	0.80	1.20	75	105	25	...	22
	1.20	3.20	75	105	25	...	30
H12	0.80	1.20	95	130	75	...	5
	1.20	3.20	95	130	75	...	8
H14	0.80	1.20	110	145	95	...	3
	1.20	3.20	110	145	95	...	5
H16	0.80	1.20	130	165	115	...	3
	1.20	3.20	130	165	115	...	4
H18	0.80	1.20	150	...	...	...	2
	1.20	3.20	150	...	...	...	4
Alloy 3003							
O	0.80	1.20	95	130	35	...	22
	1.20	3.20	95	130	35	...	25
H12	0.80	1.20	120	160	85	...	4
	1.20	3.20	120	160	85	...	6
H14	0.80	1.20	140	180	115	...	3
	1.20	3.20	140	180	115	...	5
H16	0.80	1.20	165	205	145	...	3
	1.20	3.20	165	205	145	...	4
H18	0.80	1.20	185	...	165	...	2
	1.20	3.20	185	...	165	...	4
Alloy 3004							
O	0.80	1.20	150	200	60	...	15
	1.20	3.20	150	200	60	...	18
H32	0.80	1.20	190	240	145	...	3
	1.20	3.20	190	240	145	...	5
H34	0.80	1.20	220	265	170	...	3
	1.20	3.20	220	265	170	...	4
H36	0.80	1.20	240	285	190	...	3
	1.20	3.20	240	285	190	...	4
H38	0.80	1.20	260	...	215	...	2
	1.20	3.20	260	...	215	...	4

**TABLE 3** *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset, ) MPa		Elongation min, % in 50 mm
	over	through	min	max	min	max	
Alloy Alclad 3004							
O	0.80	1.20	145	195	55	...	15
	1.20	3.20	145	195	55	...	18
H32	0.80	1.20	185	235	140	...	3
	1.20	3.20	185	235	140	...	5
H34	0.80	1.20	215	260	165	...	3
	1.20	3.20	215	260	165	...	4
H36	0.80	1.20	235	280	185	...	3
	1.20	3.20	235	280	185	...	4
H38	0.80	1.20	255	...	...	...	2
	1.20	3.20	255	...	...	...	4
Alloy 3005							
O	0.80	1.20	115	165	45	...	17
	1.20	3.20	115	165	45	...	20
H12	0.80	1.20	140	190	115	...	2
	1.20	3.20	140	190	115	...	3
H14	0.80	1.20	165	215	145	...	2
	1.20	3.20	165	215	145	...	3
H16	0.80	1.20	190	240	170	...	2
	1.20	3.20	190	240	170	...	2
H18	0.80	1.20	220	...	200	...	2
	1.20	3.20	220	...	200	...	2
Alloy 5050							
O	0.80	1.20	125	165	40	...	19
	1.20	3.20	125	165	40	...	20
H32	0.80	1.20	150	195	110	...	5
	1.20	3.20	150	195	110	...	6
H34	0.80	1.20	170	215	140	...	4
	1.20	3.20	170	215	140	...	5
H36	0.80	1.20	185	230	150	...	3
	1.20	3.20	185	230	150	...	4
H38	0.80	1.20	200	...	...	...	3
	1.20	3.20	200	...	...	...	4
Alloy 5052							
O	0.80	1.20	170	215	65	...	17
	1.20	3.20	170	215	65	...	19
H32	0.80	1.20	215	265	160	...	5
	1.20	3.20	215	265	160	...	6
H34	0.80	1.20	235	285	180	...	4
	1.20	3.20	235	285	180	...	6
H36	0.80	3.20	255	305	200	...	4
	0.80	3.20	270	...	220	...	4
Alloy 5086							
O	0.80	1.20	240	305	95	...	16
	1.20	3.20	240	305	95	...	18
H32	0.80	1.20	275	325	195	...	6
	1.20	3.20	275	325	195	...	8
H34	0.80	1.20	300	350	235	...	5
	1.20	3.20	300	350	235	...	6
H36	0.80	1.20	325	375	260	...	4
	1.20	3.20	325	375	260	...	6
Alloy 5154							
O	0.80	1.20	205	285	75	...	13
	1.20	3.20	205	285	75	...	16
H32	0.80	1.20	250	300	180	...	6
	1.20	3.20	250	300	180	...	8
H34	0.80	1.20	270	320	200	...	5
	1.20	3.20	270	320	200	...	6
H36	0.80	1.20	290	340	220	...	4
	1.20	3.20	290	340	220	...	4
H38	0.80	1.20	310	...	240	...	3
	1.20	3.20	310	...	240	...	4
Alloy 6061							
O	0.80	3.20	...	150	...	85	16
T4	0.80	3.20	205	...	110	...	16