Designation: B547/B547M – 10

Standard Specification for Aluminum and Aluminum-Alloy Formed and Arc-Welded Round Tube[1]

This standard is issued under the fixed designation B547/B547M; 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 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 B209 or B209M.

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 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 SI units or inch-pound units are to be regarded separately as standard. 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 non-conformance with the standard.

1.4.1 The SI units are shown either in brackets or in separate tables.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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:*[2]

B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

B209M Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

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)

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

B918 Practice for Heat Treatment of Wrought Aluminum Alloys

B947 Practice for Hot Rolling Mill Solution Heat Treatment for Aluminum Alloy Plate

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

E227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique (Withdrawn 2002)[3]

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

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 Spark Atomic Emission Spectrometry

E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry

[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, 2010. Published June 2010. Originally approved in 1971. Last previous edition approved in 2002 as B547/B547M–02. DOI: 10.1520/B0547_B0547M-10.

[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 Chemical Composition Limits[A,B,C]

NOTE 1—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" should be considered the controlling composition. The "Teal Sheets" are available at http://www.aluminum.org/tealsheets.

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

[A] Limits are in percent maximum unless shown as a range or stated otherwise.
[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 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 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 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.
[F] 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.
[G] Composition of cladding alloy as applied during the course of manufacture. Samples from finished tube shall not be required to conform to these limits.

2.3 *ANSI Standards:*[4]
H35.1/H35.1M Alloy and Temper Designation Systems for Aluminum
2.4 *ASME Code:*[5]
Boiler and Pressure Vessel Code; Section IX, Welding Qualifications
Boiler and Pressure Vessel Code; Section VIII, Div. 1 and 2, Pressure Vessels
2.5 *AWS Standard:*[6]
A5.10 Aluminum and Aluminum Alloy Welding Rods and Bare Electrodes
2.6 *Federal Standard:*[7]
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
2.7 *Military Standard:*[7]
MIL-STD-129 Marking for Shipment and Storage
2.8 *AMS Specification:*[8]
AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials
2.9 *Other Standard:*[9]
EN 14242 Aluminum and Aluminum Alloys – Chemical Analysis – Inductively Coupled Plasma Optical Emission Spectral Analysis

3. Terminology

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

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 B547; for metric orders specify Specification B547M. 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 [Table 3]),

[4] Available from Aluminum Association, Inc., 1525 Wilson Blvd., Suite 600, Arlington, VA 22209, http://www.aluminum.org.
[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.
[6] Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, http://www.aws.org.
[7] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.
[8] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.
[9] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be or http://www.cen.eu/esearch.

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
	0.500	15.0	...	6.0	...	12
Alloy Alclad 3003						
O	0.125–0.249	13.0	18.0	4.5	...	25
	0.250–0.499	13.0	18.0	4.5	...	23
	0.500	14.0[E]	19.0[E]	5.0[E]	...	23
H12	0.125–0.161	16.0	22.0	11.0	...	7
	0.162–0.249	16.0	22.0	11.0	...	8
	0.250–0.499	16.0	22.0	11.0	...	9
	0.500	17.0[E]	23.0[E]	12.0[E]	...	10
H14	0.125–0.161	19.0	25.0	16.0	...	6
	0.162–0.249	19.0	25.0	16.0	...	7
	0.250–0.499	19.0	25.0	16.0	...	8
	0.500	20.0[E]	26.0[E]	17.0[E]	...	10
H112	0.250–0.499	16.0	...	9.0	...	8
	0.500	15.0[E]	...	6.0[E]	...	12
Alloy 3004						
O	0.125–0.249	22.0	29.0	8.5	...	18
	0.250–0.500	22.0	29.0	8.5	...	16
H32	0.125–0.500	28.0	35.0	21.0	...	6
H34	0.125–0.500	32.0	38.0	25.0	...	5
H36	0.125–0.162	35.0	41.0	28.0	...	4
Alloy Alclad 3004						
O	0.125–0.249	21.0	28.0	8.0	...	18
	0.250–0.499	21.0	28.0	8.0	...	16
	0.500	22.0[E]	29.0[E]	8.5[E]	...	16
H32	0.125–0.249	27.0	34.0	20.0	...	6
	0.250–0.499	27.0	34.0	20.0	...	6
	0.500	28.0[E]	35.0[E]	21.0[E]	...	6
H34	0.125–0.249	31.0	37.0	24.0	...	5
	0.250–0.499	31.0	37.0	24.0	...	5
	0.500	32.0[E]	38.0[E]	25.0[E]	...	5
H36	0.125–0.162	34.0	40.0	27.0	...	4
Alloy 5050						
O	0.125–0.249	18.0	24.0	6.0	...	22
	0.250–0.500	18.0	24.0	6.0	...	20
H32	0.125–0.249	22.0	28.0	16.0	...	6
H34	0.125–0.249	25.0	31.0	20.0	...	5
H36	0.125–0.162	27.0	33.0	22.0	...	4
Alloy 5052						
O	0.125–0.249	25.0	31.0	9.5	...	20
	0.250–0.500	25.0	31.0	9.5	...	18
H32	0.125–0.249	31.0	38.0	23.0	...	9
	0.250–0.499	31.0	38.0	23.0	...	11
	0.500	31.0	38.0	23.0	...	12
H34	0.125–0.249	34.0	41.0	26.0	...	7
	0.250–0.500	34.0	41.0	26.0	...	10
H36	0.125–0.162	37.0	44.0	29.0	...	4
H112	0.250–0.499	28.0	...	16.0	...	7
	0.500	25.0	...	9.5	...	12
Alloy 5083						
O	0.125–0.500	40.0	51.0	18.0	29.0	16
H32	0.188–0.500	44.0	56.0	31.0		12
Alloy 5086						

TABLE 2 *Continued*

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	
O	0.125–0.249	35.0	44.0	14.0	...	18
	0.250–0.500	35.0	44.0	14.0	...	16
H32	0.125–0.249	40.0	47.0	28.0	...	8
	0.250–0.500	40.0	47.0	28.0	...	12
H34	0.125–0.249	44.0	51.0	34.0	...	6
	0.250–0.500	44.0	51.0	34.0	...	10
H36	0.125–0.162	47.0	54.0	38.0	...	6
			Alloy 5154			
O	0.125–0.500	30.0	41.0	11.0	...	18
H32	0.125–0.249	36.0	43.0	26.0	...	8
	0.250–0.500	36.0	43.0	26.0	...	12
H34	0.125–0.161	39.0	46.0	29.0	...	6
	0.162–0.249	39.0	46.0	29.0	...	7
	0.250–0.500	39.0	46.0	29.0	...	10
H36	0.125–0.162	42.0	49.0	32.0	...	5
			Alloy 5454			
O	0.125–0.500	31.0	41.0	12.0	...	18
H32	0.125–0.249	36.0	44.0	26.0	...	8
	0.250–0.500	36.0	44.0	26.0	...	12
H34	0.125–0.161	39.0	47.0	29.0	...	6
	0.162–0.249	39.0	47.0	29.0	...	7
	0.250–0.500	39.0	47.0	29.0	...	10
H112	0.250–0.499	32.0	...	18.0	...	8
	0.500	31.0	...	12.0	...	11
			Alloy 6061			
T4	0.125–0.249	30.0	...	16.0	...	16
T451[F]	0.250–0.500	30.0	...	16.0	...	18
T6	0.125–0.249	42.0	...	35.0	...	10
T6, T651[F]	0.250–0.499	42.0	...	35.0	...	10
	0.500	42.0	...	35.0	...	9

[A] To 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 for elongation shall be rounded to the nearest 0.5 % in accordance with the rounding-off method of Practice E29.
[B] See 10.2.2 for minimum mechanical properties across the weld area of the tube.
[C] See Annex A1 for basis for establishment of mechanical property limits.
[D] Elongation of sheet type specimens is measured in 2 in.; of round specimens, in 4× specimen diameter.
[E] The tension test specimen from plate 0.500 in. and thicker is machined from the core and does not include the cladding alloy.
[F] For stress-relieved tempers (T451 and T651), characteristics and properties other than those specified may differ somewhat from the corresponding characteristics and properties of material in the basic temper.

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 B918 is required (8.2) or whether heat treatment in accordance with Practice B947 is acceptable,

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 B660 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 ⅛ in. [3 mm], whichever is smaller. The reinforcements may be dressed to this dimension or removed entirely at the manufacturer's

TABLE 3 Mechanical Property Limits, [SI Units][A,B,C]

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength, (0.2 % offset), MPa		Elongation in 50 mm, min, %
	Over	Through	max	min	min	max	
			Aluminum 1100				
0	3.15	6.30	75	105	25	...	30
	6.30	12.50	75	105	25	...	28
H12	3.15	6.30	95	130	75	...	8
	6.30	12.50	95	130	75	...	10
H14	3.15	6.30	110	145	95	...	5
	6.30	12.50	110	145	95	...	7
H16	3.15	4.00	130	165	115	...	4
			Alloy 3003				
0	3.15	6.30	95	130	35	...	25
	6.30	12.50	95	130	35	...	23
H12	3.15	6.30	120	160	85	...	6
	6.30	12.50	120	160	85	...	9
H14	3.15	6.30	140	180	115	...	5
	6.30	12.50	140	180	115	...	8
H16	3.15	4.00	165	205	145	...	4
H112	6.30	12.50	115	...	70	...	8
			Alloy Alclad 3003				
0	3.15	6.30	90	125	30	...	25
	6.30	12.50	90	125	30	...	23
H12	3.15	6.30	115	155	80	...	6
	6.30	12.50	115	155	80	...	9
H14	3.15	6.30	135	175	110	...	5
	6.30	12.50	135	175	110	...	8
H112	6.30	12.50	110	...	65	...	8
			Alloy 3004				
0	3.15	6.30	150	200	60	...	18
	6.30	12.50	150	200	60	...	16
H32	3.15	6.30	190	240	145	...	5
	6.30	12.50	190	240	145	...	6
H34	3.15	6.30	220	265	170	...	4
	6.30	12.50	220	265	170	...	5
H36	3.15	4.00	240	285	190	...	4
			Alloy Alclad 3004				
0	3.15	6.30	145	195	55	...	18
	6.30	12.50	145	195	55	...	16
H32	3.15	6.30	185	235	140	...	5
	6.30	12.50	185	235	140	...	6
H34	3.15	6.30	215	260	165	...	4
	6.30	12.50	215	260	165	...	5
H36	3.15	4.00	235	280	185	...	4
			Alloy 5050				
0	3.15	6.30	125	165	40	...	20
	6.30	12.50	125	165	40	...	20
H32	3.15	6.30	150	195	110	...	6
H34	3.15	6.30	170	215	140	...	5
H36	3.15	4.00	185	230	150	...	4
			Alloy 5052				
0	3.15	6.30	170	215	65	...	19
	6.30	12.50	170	215	65	...	18
H32	3.15	6.30	215	265	160	...	7
	6.30	12.50	215	265	160	...	11
H34	3.15	6.30	235	285	180	...	6
	6.30	12.50	235	285	180	...	10
H36	3.15	4.00	255	305	200	...	4
H112	6.30	12.50	190	...	110	...	7
			Alloy 5083				
0	3.15	6.30	275	350	125	200	16
	6.30	12.50	270	345	115	200	16
H32	4.75	12.50	305	385	215		12
			Alloy 5086				
0	3.15	6.30	240	305	95	...	18
	6.30	12.50	240	305	95	...	16
H32	3.15	6.30	275	325	195	...	8
	6.30	12.50	275	325	195	...	12
H34	3.15	6.30	300	350	235	...	6
	6.30	12.50	300	350	235	...	10
H36	3.15	4.00	325	375	260	...	6
			Alloy 5154				
0	3.15	6.30	205	285	75	...	16
	6.30	12.50	205	285	75	...	18
H32	3.15	6.30	250	300	180	...	8
	6.30	12.50	250	300	180	...	12
H34	3.15	6.30	270	320	200	...	6

TABLE 3 *Continued*

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength, (0.2 % offset), MPa		Elongation in 50 mm, min, %
	Over	Through	max	min	min	max	
	6.30	12.50	270	320	200	...	10
H36	3.15	4.00	290	340	220	...	4
			Alloy 5454				
0	3.15	6.30	215	285	85	...	16
	6.30	12.50	215	285	85	...	18
H32	3.15	6.30	250	305	180	...	8
	6.30	12.50	250	305	180	...	12
H34	3.15	6.30	270	325	200	...	6
	6.30	12.50	270	325	200	...	10
H112	6.30	12.50	220	...	125	...	8
			Alloy 6061				
T4	3.15	6.30	205	...	110	...	16
T451[D]	6.30	12.50	205	...	110	...	18
T6	3.15	6.30	290	...	240	...	10
T651[D]	6.30	12.50	290	...	240	...	10

[A] To determine conformance to this specification, each value for tensile strength and for yield strength shall be rounded to the nearest 1 MPa, and each value for elongation to the nearest 0.5 % in accordance with the rounding-off method of Practice E29.
[B] See 10.2.2 for minimum mechanical properties across the weld area of the tube.
[C] See Annex A1 for basis for establishment of mechanical property limits.
[D] For stress-relieved tempers (T451 and T651), characteristics and properties other than those specified may differ somewhat from the corresponding characteristics and properties of material in the basic temper.

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.

7. Chemical Composition Requirements

7.1 *Limits:*

7.1.1 The tube shall conform to the chemical composition limits prescribed in Table 1. Conformance shall be determined by the manufacturer of the sheet and plate used to produce the tube by analyzing samples taken at the time the ingots are poured, in accordance with E716 and analyzed in accordance with E607, E1251, E34 or EN 14242. At least one sample shall be taken for each group of ingots poured simultaneously from the same source of molten metal. If the tube manufacturer uses sheet or plate whose chemical composition has been determined by analyzing samples taken at the time the ingots were poured, they shall not be required to sample and analyze the finished product.

NOTE 4—It is standard practice in the United States aluminum industry to determine conformance to the chemical 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.

7.1.2 The specific filler metal alloy shall be selected by the manufacturer from Table number A2 of AWS Specification A 5.10; however, the filler alloy selected shall ensure conformance with the requirement of 10.2.2.

7.2 If it becomes necessary to analyze the finished or semifinished product for conformance to chemical composition limits, the method used to sample the finished or semifinished product 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 the finished tube or semifinished sheet or plate stock, a sample shall be taken to represent each 4000 lb [2000 kg] or fraction thereof of material in the lot from which the tube is fabricated, except that no more than one sample shall be required per piece.