Designation: B928/B928M – 15

Standard Specification for High Magnesium Aluminum-Alloy Products for Marine Service and Similar Environments[1]

This standard is issued under the fixed designation B928/B928M; 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 high magnesium aluminum-alloy products in the mill finish condition that are intended for marine hull construction and other marine applications where frequent or constant direct contact with seawater is expected and for similar environments (Note 1). Aluminum alloy products covered by this specification include the alloy-tempers of flat sheet, coiled sheet, and plate shown in Table 2 [Table 3] and Table 4 [Table 5], and alloy-tempers of extruded profiles shown in Table 6 [Table 7].

NOTE 1—There are other aluminum alloy-temper products that may be suitable for use in marine and similar environments, but which may not require the corrosion resistance testing specified by B928/B928M. See Specification B209 or B209M for other aluminum sheet and plate alloy-temper products. For other aluminum extruded alloy-temper products see Specification B221 or B221M and/or other relevant specifications for aluminum extruded products.

1.2 Alloy and temper designations are in accordance with ANSI H35.1/H35.1 (M). The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9, for example, A95083 for 5083 in accordance with Practice E527.

1.3 The values stated in either SI units (Table 3 and Table 5) or inch-pound units (Table 2 and Table 4) 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 each other. Combining values from the two systems may result in non-conformance with the standard.

1.4 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see Annex A2.

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 the date of material purchase, unless otherwise noted, 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)

B221 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B221M Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (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

B985 Practice for Sampling Aluminum Ingots, Billets, Castings and Finished or Semi-Finished Wrought Aluminum Products for Compositional Analysis

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

E50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

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

[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 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.

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

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
G66 Test Method for Visual Assessment of Exfoliation Corrosion Susceptibility of 5XXX Series Aluminum Alloys (ASSET Test)
G67 Test Method for Determining the Susceptibility to Intergranular Corrosion of 5XXX Series Aluminum Alloys by Mass Loss After Exposure to Nitric Acid (NAMLT Test)

2.3 *ANSI Standards:*[4]
H35.1/H35.1 (M) Alloy and Temper Designation Systems for Aluminum
H35.2 Dimensional Tolerances for Aluminum Mill Products
H35.2(M) Dimensional Tolerances for Aluminum Mill Products

2.4 *Other Standards:*
CEN EN 14242 Aluminum and Aluminum Alloys—Chemical Analysis—Inductively Coupled Plasma Optical Emission Spectral Analysis[5]

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 *exfoliation, n*—corrosion that proceeds laterally from the sites of initiation along planes parallel to the original rolling surface, generally at grain boundaries, forming corrosion products that force metal away from the body of the material, giving rise to a layered appearance.

3.2.2 *high magnesium aluminum alloys, n*—in the general sense, includes those 5xxx alloys containing 3 % or more nominal magnesium.

3.2.3 *intergranular corrosion, n*—corrosion that preferentially occurs at, or adjacent to, the grain boundaries of a metal or alloy.

3.2.4 *lot, n*—an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, cast or melt lot, and thickness, subjected to inspection at one time.

3.2.5 *sensitization, n*—the development of a continuous or nearly continuous grain boundary precipitate in 5xxx alloy-temper material, that causes the material to be susceptible to intergranular forms of corrosion.

3.2.6 *stress-corrosion cracking, n*—a cracking process that requires the simultaneous action of a corrodent, and sustained tensile stress. (This excludes corrosion-reduced sections, which fail by fast fracture. It also excludes intercrystalline or transcrystalline corrosion which can disintegrate an alloy without either applied or residual stress.)

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 [kilograms],

4.1.3 Alloy (see 7.1 and Table 1),

4.1.4 Temper (see 8.1 and Table 2 [Table 3] and Table 4 [Table 5] for sheet and plate or Table 6 [Table 7] for extrusions),

4.1.5 For sheet, whether flat or coiled, and

4.1.6 For sheet and plate, dimensions (thickness, width, and length or coil size).

4.1.7 For extruded products, dimensions and tolerances including but not limited to the following:

4.1.7.1 For rod and round wire—diameter.

4.1.7.2 For square cornered bar and wire—width and depth.

4.1.7.3 For sharp cornered hexagonal or octagonal bar and wire—distance across the flats.

4.1.7.4 For round tube—outside or inside diameter and wall thickness.

4.1.7.5 For square or sharp cornered tube other than round—distance across flats and wall thickness.

4.1.7.6 For round cornered bars, profiles, tube other than round, square, rectangular, hexagonal, or octagonal with sharp corners a drawing is required showing all dimensions and tolerances relevant for the manufacture of the product to requirements.

4.1.7.7 Length.

4.2 Additionally, orders for material to this specification shall include the following information when required by the purchaser:

4.2.1 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (see 12.1),

4.2.2 Whether Practices B660 applies and, if so, the levels of preservation, packaging, and packing required (see 16.3),

4.2.3 Whether certification is required (see Section 14),

4.2.4 Whether G66 and G67 testing is the required lot release method for the H116 and H321 tempers (see 9.5),

4.2.5 Whether the G66 and G67 test results are to be included in the certification (see Section 14), and

4.2.6 Whether tensile testing should be in the longitudinal or long transverse direction (see 8.1.5).

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. Producers may use their own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser in the order or at the time of contract signing.

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

[4] Available from Aluminum Association, Inc., 1400 Crystal Dr., Suite 430, Arlington, VA, 22202, http://www.aluminum.org.

[5] Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000 Brussels, http://www.cenorm.be.

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 ensure that material conforms to prescribed requirements.

6. General Quality

6.1 Unless otherwise specified, the material shall be supplied in the mill finish, shall be uniform as defined by the requirements of this specification and shall be commercially sound. Any requirement not so covered is subject to negotiation between producer and purchaser.

6.2 Each coil, sheet and plate, or extrusion lot shall be examined to determine conformance to this specification with respect to general quality and identification marking. On approval of the purchaser, however, the producer may use a system of statistical quality control for such examinations.

7. Chemical Composition

7.1 *Limits*—The sheet and plate shall conform to the chemical composition limits specified in Table 1. Conformance shall be determined by the producer, by taking samples in accordance with Practices E716 when the ingots are poured and analyzing those samples in accordance with Test Methods 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 producer has determined the chemical composition during pouring of the ingots, they shall not be required to sample and analyze the finished product.

7.2 If it becomes necessary to analyze the finished or semifinished product for conformance to chemical composition limits, the methods of sampling and methods of analysis shall be as provided in the following:

7.2.1 *Methods of Sampling*—Samples for chemical analysis shall be taken in accordance with Practice B985.

7.2.2 *Methods of Analysis*—Analysis shall be performed in accordance with Test Methods E607, E1251, or E34, or CEN EN 14242 (ICP method).

8. Tensile Properties of Material as Supplied

8.1 *Tensile Properties for Sheet and Plate Products:*

8.1.1 *Limits*—The sheet and plate shall conform to the requirements for tensile properties as specified in Table 2 [Table 3] or Table 4 [Table 5]. Table 2 [Table 3] includes specification limits for tensile properties in the longitudinal direction. Table 4 [Table 5] includes specification limits for tensile properties in the long transverse direction.

8.1.1.1 Tensile property limits for sizes not covered in Table 2 [Table 3] or Table 4 [Table 5] shall be as agreed upon between the producer and purchaser and shall be so specified in the contract or purchase order.

8.1.2 *Number of Samples*—One sample shall be taken from each end of each parent coil, or parent plate, but no more than one sample per 2000 lb [1000 kg] of sheet or 4000 lb [2000 kg] of plate, or part thereof, in a lot shall be required. Other procedures for selecting samples may be employed if agreed upon between the producer and purchaser.

8.1.3 *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 or B557M, with the exception that the test direction will be as specified in 8.1.5.

8.1.4 *Test Methods*—The tension test shall be made in accordance with Test Methods B557 or B557M.

8.1.5 *Testing Direction*—Tensile testing shall be in the longitudinal direction unless the long transverse direction is specified in the contract or purchase order. Tensile testing direction shall be noted on all documentation.

8.2 *Tensile Properties for Extruded Products:*

8.2.1 *Limits*—The material shall conform to the tensile property requirements specified in Table 6 [Table 7].

8.2.1.1 The elongation requirements shall not be applicable to the following:

(1) Material of such dimensions that a standard test specimen cannot be taken in accordance with Test Methods B557 or B557M and of such a profile that it cannot be satisfactorily tested in full section.

(2) Material thinner than 0.062 in [1.5 mm].

TABLE 1 Chemical Composition Limits[A,B,C,H]

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Other Elements[D]		Aluminum
									Each	Total[E]	
5059	0.45	0.50	0.25	0.6 to 1.2	5.0 to 6.0	0.25	0.40 to 0.9	0.20	0.05[F]	0.15	remainder
5083	0.40	0.40	0.10	0.40 to 1.0	4.0 to 4.9	0.05 to 0.25	0.25	0.15	0.05	0.15	remainder
5086	0.40	0.50	0.10	0.20 to 0.7	3.5 to 4.5	0.05 to 0.25	0.25	0.15	0.05	0.15	remainder
5383	0.25	0.25	0.20	0.7 to 1.0	4.0 to 5.2	0.25	0.40	0.15	0.05[G]	0.15	remainder
5456	0.25	0.40	0.10	0.50 to 1.0	4.7 to 5.5	0.05 to 0.20	0.25	0.20	0.05	0.15	remainder

[A] Limits are in weight 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 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 E29.
[D] Others include listed elements for which no specific limit is shown, as well as unlisted metallic elements, but doesn't include elements shown with composition limits in the footnotes. 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] 0.05 to 0.25 Zr.
[G] 0.20 Zr max.
[H] In case of 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.

TABLE 2 Longitudinal Mechanical Property Limits for Sheet and Plate Products, Inch-Pound Units[A,B]

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	
			Alloy 5059			
H116	0.078 to 0.249	54.0	64.0	39.0	...	10
	0.250 to 0.787	54.0	64.0	39.0	...	10
	0.788 to 1.575	52.0	64.0	38.0	...	10
H321	0.078 to 0.249	54.0	64.0	39.0	...	10
	0.250 to 0.787	54.0	64.0	39.0	...	10
	0.788 to 1.575	52.0	64.0	38.0	...	10
			Alloy 5083			
H116	0.063 to 0.499	44.0	56.0	31.0	. . .	10
	0.500 to 1.250	44.0	56.0	31.0	. . .	12
	1.251 to 1.500	44.0	56.0	31.0	. . .	12
	1.501 to 3.000	41.0	56.0	29.0	. . .	12
H321	0.125 to 0.187	44.0	56.0	31.0	. . .	10
	0.188 to 1.500	44.0	56.0	31.0	. . .	12
	1.501 to 3.000	41.0	56.0	29.0	. . .	12
H128[C]	0.157 to 0.499	44.0	56.0	31.0	. . .	10
	0.500 to 1.500	44.0	56.0	31.0	. . .	12
	1.501 to 3.000	41.0	56.0	29.0	. . .	12
			Alloy 5086			
H116	0.063 to 0.249	40.0	52.0	28.0	. . .	8
	0.250 to 0.499	40.0	52.0	28.0	. . .	10
	0.500 to 1.250	40.0	52.0	28.0	. . .	10
	1.251 to 2.000	40.0	52.0	28.0	. . .	10
H321[C]	0.063 to 0.249	40.0	52.0	28.0	. . .	8
	0.250 to 0.320	40.0	52.0	28.0	. . .	9
			Alloy 5383			
H116	0.118 to 0.500	48.0	*58.0*[C]	33.0	...	10
	0.501 to 2.000	48.0	*58.0*[C]	33.0	...	10
H321	0.118 to 0.500	48.0	58.0	33.0	...	10
	0.501 to 2.000	48.0	58.0	33.0	...	10
			Alloy 5456			
H116	0.063 to 0.499	46.0	59.0	33.0	. . .	10
	0.500 to 1.250	46.0	56.0	33.0	. . .	12
	1.251 to 1.500	44.0	56.0	31.0	. . .	12
	1.501 to 3.000	41.0	54.0	29.0	. . .	12
	3.001 to 4.000	40.0	54.0	25.0	. . .	12
H321	0.100 to 0.187	48.0	59.0	34.0	. . .	10
	0.188 to 0.499	46.0	59.0	33.0	. . .	12
	0.500 to 1.500	44.0	56.0	31.0	. . .	12
	1.501 to 3.000	41.0	54.0	29.0	. . .	12

[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 to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.
[B] The basis for establishment of mechanical property limits is shown in Annex A1.
[C] *Tentative—properties subject to revision.*

8.2.1.2 Tensile property limits for sizes not covered in Table 6 [Table 7] shall be as agreed upon between the producer and the purchaser and shall be so specified in the contract or purchase order.

8.2.2 *Number of Specimens:*

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

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

8.2.2.3 Other procedures for selecting samples may be employed if agreed upon between the producer and the purchaser.

8.2.3 Geometry of test specimens and the location in the product from which they are taken shall be as specified in Test Methods B557 [B557M].

8.2.4 *Test Methods*—The tension tests shall be made in accordance with Test Methods B557 [B557M].

9. Exfoliation and Intergranular Corrosion Resistance for H116 and H321 Tempers

9.1 The alloys produced as H116 and H321 tempers shown in Table 2 [Table 3], Table 4 [Table 5], and Table 6 [Table 7] are manufactured and corrosion tested in the as-produced condition. (See Notes 2 and 3.)

NOTE 2—*Background Information*—Aluminum-magnesium-alloy products that have a continuous or nearly continuous grain boundary precipitate are susceptible to intergranular forms of corrosion (that is, IGC, SCC, or exfoliation corrosion). Examples of varying degrees of grain boundary precipitate continuity are shown in Figs. 1-3. The term "sensitization" is used to describe the development of this susceptible microstructure. The type of corrosion that occurs in a sensitized 5xxx alloy will depend primarily on the morphology of the grain structure and on the residual and applied stresses that are present. The extent of corrosion that will occur depends on the degree of continuity of the grain boundary precipitation and the corrosiveness of the environment. Both recrystallized and unrecrystallized 5xxx alloys that have been sensitized, are susceptible to

TABLE 3 Longitudinal Mechanical Property Limits for Sheet and Plate Products, [SI Units][A,B]

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]	
	over	through	min	max	min	max	in 50 mm	in 5× Diameter
				Alloy 5059				
H116	1.99	6.30	370	440	270	...	10	...
	6.30	12.50	370	440	270	...	10	...
	12.50	20.00	370	440	270	...	...	10
	20.00	40.00	360	440	260	...	...	10
H321	1.99	6.30	370	440	270	...	10	...
	6.30	12.50	370	440	270	...	10	...
	12.50	20.00	370	440	270	...	...	10
	20.00	40.00	360	440	260	...	...	10
				Alloy 5083				
H116	1.60	12.50	305	385	215	. . .	10	. . .
	12.50	30.00	305	385	215	. . .	. . .	10
	30.00	40.00	305	385	215	. . .	. . .	10
	40.00	80.00	285	385	200	. . .	. . .	10
H321	3.20	5.00	305	385	215	. . .	10	. . .
	5.00	12.50	305	385	215	. . .	12	. . .
	12.50	40.00	305	385	215	. . .	. . .	10
	40.00	80.00	285	385	200	. . .	. . .	10
H128[D]	4.00	12.50	305	385	215	. . .	10	. . .
	12.50	40.00	305	385	215	. . .	. . .	10
	40.00	80.00	285	385	200	. . .	. . .	10
				Alloy 5086				
H116	1.60	6.30	275	360	195	. . .	8	. . .
	6.30	12.50	275	360	195	. . .	10	. . .
	12.50	30.00	275	360	195	. . .	. . .	9
	30.00	50.00	275	360	195	. . .	. . .	9
H321[D]	1.60	6.30	275	360	195	. . .	8	. . .
	6.30	8.00	275	360	195	. . .	9	. . .
				Alloy 5383				
H116	3.00	12.50	330	*400*[D]	230	...	10	...
	12.50	50.00	330	*400*[D]	230	...	...	10
H321	3.00	12.50	330	400	230	...	10	...
	12.50	50.00	330	400	230	...	...	10
				Alloy 5456				
H116	1.60	12.50	315	405	230	. . .	10	. . .
	12.50	30.00	315	385	230	. . .	. . .	10
	30.00	40.00	305	385	215	. . .	. . .	10
	40.00	80.00	285	370	200	. . .	. . .	10
	80.00	110.00	275	370	170	. . .	. . .	10
H321	2.50	4.00	330	405	235	. . .	10	. . .
	4.00	12.50	315	405	230		12	. . .
	12.50	40.00	305	385	215		. . .	10
	40.00	80.00	285	370	200		. . .	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 %, both in accordance with the rounding method of Practice E29.
[B] The basis for establishment of mechanical property limits is shown in Annex A1.
[C] Elongations in 50 mm apply for thicknesses up through 12.50 mm and in 5× diameter for thicknesses over 12.50 mm.
[D] *Tentative—properties subject to revision.*

TABLE 4 Long Transverse Mechanical Property Limits for Sheet and Plate Products, Inch-Pound Units[A,B]

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	
			Alloy 5083			
H116	0.118 to 0.249	44.0	. . .	31.0	. . .	10
	0.250 to 0.499	44.0	. . .	31.0	. . .	10
H321	0.118 to 0.236	44.0	55.0	31.0	. . .	10
H128[C]	0.157 to 0.499	44.0	56.0	31.0	. . .	10
	0.500 to 1.500	44.0	56.0	31.0	. . .	12
	1.501 to 3.000	41.0	56.0	29.0	. . .	12
			Alloy 5086			
H321[C]	0.250 to 0.320	40.0	52.0	28.0	. . .	10

[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 to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.
[B] The basis for establishment of mechanical property limits is shown in Annex A1.
[C] *Tentative—properties subject to revision.*

TABLE 5 Long Transverse Mechanical Property Limits for Sheet and Plate Products, [SI Units][A,B]

Temper	Specified Thickness, mm		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C]	
	over	through	min	max	min	max	in 50 mm	in 5x Diameter
				Alloy 5083				
H116	3.00	6.00	305	. . .	215	. . .	10	. . .
	6.00	12.50	305	. . .	215	. . .	10	. . .
H321	3.00	6.00	305	380	215	. . .	10	. . .
H128[D]	4.00	12.50	305	385	215	. . .	10	. . .
	12.50	40.00	305	385	215	. . .	. . .	10
	40.00	80.00	285	385	200	. . .	. . .	10
				Alloy 5086				
H321[D]	6.30	8.00	275	360	195	. . .	10	. . .

[A] To determine conformance to this specification, each value for tensile strength shall be rounded to the nearest 1 MPa and each value for elongation to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.
[B] The basis for establishment of mechanical property limits is shown in Annex A1.
[C] Elongations in 50 mm apply for thicknesses up through 12.50 mm and in 5× diameter for thicknesses over 12.50 mm.
[D] *Tentative—properties subject to revision.*

TABLE 6 Longitudinal Mechanical Property Limits for Extruded Profiles, Inch-Pound Units[A,B]

Temper	Specified Section or Wall Thickness, in.	Area, in.^{2}	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in. or 4× Diameter, min, %[C,D]
			min	max	min	max	
				Alloy 5383			
H116	0.078-0.315	Up thru 2.5	45.0	53.0	28.0	. . .	12

[A] To determine conformance to this specification, each value shall be rounded to the nearest 0.1 ksi for strength and nearest 0.5 % for elongation in accordance with the rounding-off method of Practice E29.
[B] The basis for establishment of tensile property limits is shown in Annex A1.
[C] Elongation of full-section and cut-out sheet-type specimens is measured in 2 in. Elongation of cut-out round specimens is measured in 4× specimen diameter.
[D] See 8.2.1 for conditions under which measurements are not required.

TABLE 7 Longitudinal Mechanical Property Limits for Extruded Profiles, [SI Units][A,B]

Temper	Specified Section or Wall Thickness, mm		Area, mm^2		Tensile Strength, MPa		Yield Strength (0.2 % offset), MPa		Elongation, min, %[C,D]	
	over	thru	over	thru	min	max	min	max	On 50 mm	in 5x Diameter ($5.65\sqrt{A}$)
						Alloy 5383				
H116	2.00	8.00		1600	310	365	190	.	12	

[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 %, both in accordance with the rounding method of Practice E29.
[B] The basis for establishment of mechanical property limits is shown in Annex A1.
[C] Elongations in 50 mm apply to rectangular bar up through 12.5 mm thickness from which a standard rectangular tension test specimen is machined. The 5× diameter ($5.65\sqrt{A}$) requirements, where A is cross-sectional area of the specimen, apply to round specimens tested in full-section or to standard or proportional, round-machined, tension test specimens.
[D] See 8.2.1 for conditions under which measurements are not required.

intergranular corrosion, and when subjected to sustained tensile stress, may exhibit intergranular stress corrosion cracking. Unrecrystallized 5xxx alloys that have been sensitized are also susceptible to exfoliation corrosion.

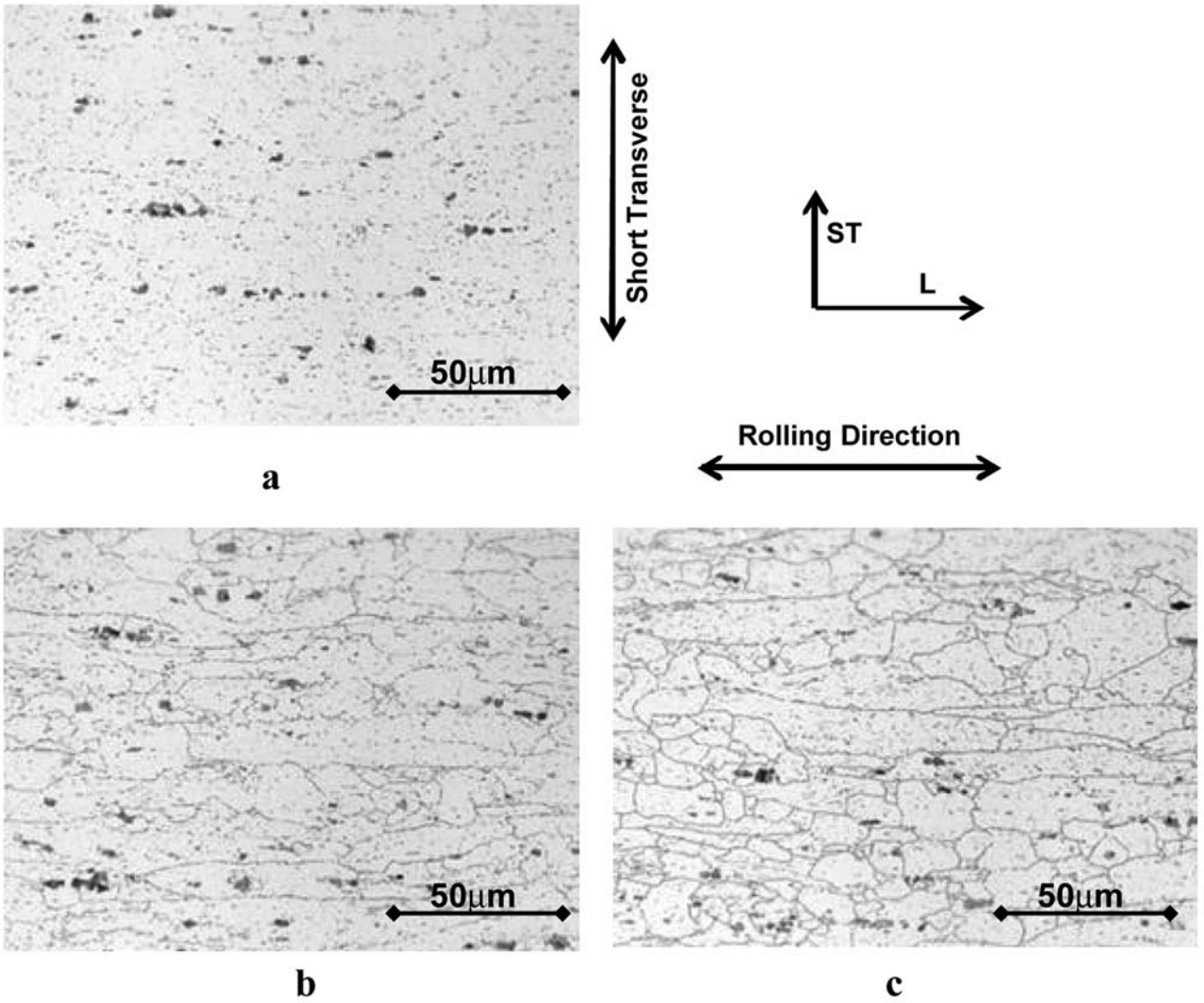
NOTE 3—Alloys 5059, 5083, 5086, 5383, and 5456 should not be used for service, which provides prolonged exposure to temperatures exceeding 150°F [65°C] (whether continuous exposure or discontinuous exposure) because of the risk of sensitization and the resulting susceptibility to exfoliation and other forms of intergranular corrosion and stress corrosion cracking. Cold forming can also increase susceptibility to intergranular corrosion and stress corrosion cracking.

Warning—It is possible to meet the requirements of Test Method G66 (ASSET) and fail the requirements of Test Method G67 (NAMLT). Therefore both tests shall be performed for process qualification (see 9.4), for lot release, that is, in developing producer-established reference photomicrographs (see 9.6), and for surveillance (see 9.8).

9.2 *Exfoliation-Corrosion Resistance*—Sheet and plate in the H116 and H321 tempers listed in Table 2 [Table 3] and Table 4 [Table 5] or extrusions in the H116 temper listed in Table 6 [Table 7] shall be capable of exhibiting no evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to the test described in Test Method G66 (ASSET).

9.3 *Intergranular-Corrosion Resistance*—Sheet and plate in the H116 and H321 tempers listed in Table 2 [Table 3] and Table 4 [Table 5] or extrusions in the H116 temper listed in Table 6 [Table 7] shall be capable of exhibiting resistance to intergranular corrosion as indicated by an acceptable mass-loss when tested in accordance with Test Method G67 (NAMLT). Test Method G67 mass loss results shall be interpreted as defined in 9.3.1 – 9.3.4.

9.3.1 *Pass*—Samples with mass loss no greater than 100 mg/in.^{2} [15 mg/cm^2], shall be accepted.



Specimens were prepared in accordance with 9.6.1 (Phosphoric Acid etched). (Photomicrographs are of as-produced material and were not subjected to Test Method G67 testing.) Metallographic examination is conducted ×500 magnification in accordance with 9.6.1.

Figure 1a has discontinuous grain boundary precipitation, typical of a mass-loss of no greater than 100 mg/in.^{2} [15 mg/cm^2] in Test Method G67.

Figure 1b has semi-continuous grain boundary precipitation and would likely fall in the mid-range, greater than 100 mg/in.^{2} [15 mg/cm^2] but less than or equal to 160 mg/in.^{2} [25 mg/cm^2] in Test Method G67.

Figure 1c has a continuous network of grain boundary precipitation, typical of a mass loss greater than 160 mg/in.^{2} [25 mg/cm^2] in Test Method G67.

Warning—These photomicrographs are examples of typical microstructures and due to variations in alloy, temper and process, they may or may not be similar to the microstructure of production sheet or plate. These photographs shall not be used instead of producer-established reference photographs for comparison with production material in surveillance or in determining process qualification or lot release.

FIG. 1 Examples of Microstructures with Varied Degrees of Grain Boundary Beta-phase Continuity, for Plate Product with *Partially Recrystallized* Grain Structure.

9.3.2 *Fail*—Samples with mass loss greater than 160 mg/in.^{2} [25 mg/cm^2] and the lots they represent, shall be rejected.

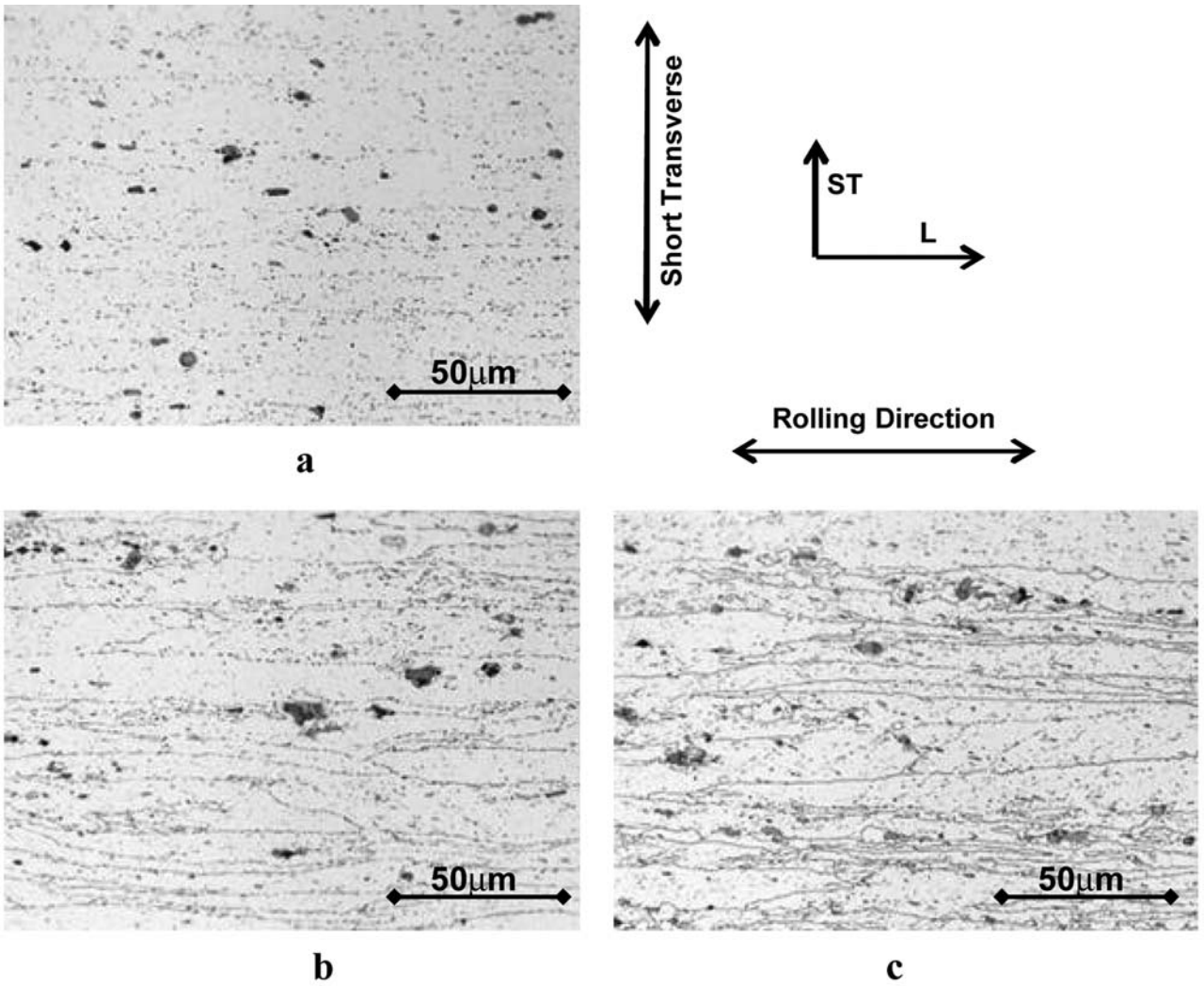
9.3.3 *Questionable*—Samples with mass loss greater than 100 mg/in.^{2} [15 mg/cm^2] but less than or equal to 160 mg/in.^{2} [25 mg/cm^2] shall be deemed questionable and shall be subjected to metallographic examination (see 9.3.4).

9.3.4 *Examination of Samples Deemed Questionable*—A longitudinal face perpendicular to the rolled or extruded surface of Test Method G67 corroded test coupons testing "questionable," shall be prepared (see Fig. 4). The exposed "corroded" surface of this sample shall be examined metallographically in the as-polished condition to determine if the loss of mass was a result of intergranular attack or general corrosion and pitting attack (see examples shown in Figs. 5 and 6). When preparing the polished metallographic sample, a rough-grinding step that removes at least 0.02 in. [0.5 mm] of metal should precede the final polishing step. A magnification of ×250 is recommended.

9.3.4.1 *Pass*—Samples exhibiting general or pitting attack with no intergranular attack shall be accepted.

9.3.4.2 *Fail*—Samples exhibiting intergranular attack and the lots they represent, shall be rejected.

9.4 *Process Qualification (see 9.1)*—For sheet and plate in the H116 and H321 tempers, the producer's production process shall be qualified prior to production to this specification, by



Specimens were prepared in accordance with 9.6.1 (Phosphoric Acid etched). (Photomicrographs are of as-produced material and were not subjected to Test Method G67 testing.) Metallographic examination is conducted ×500 magnification in accordance with 9.6.1.

Figure 2a has discontinuous grain boundary precipitation, typical of a mass-loss of no greater than 100 mg/in.^{2} [15 mg/cm^2] in Test Method G67.

Figure 2b has semi-continuous grain boundary precipitation and would likely fall in the mid-range, greater than 100 mg/in.^{2} [15 mg/cm^2] but less than or equal to 160 mg/in.^{2} [25 mg/cm^2] in Test Method G67.

Figure 2c has a continuous network of grain boundary precipitation, typical of a mass loss greater than 160 mg/in.^{2} [25 mg/cm^2] in Test Method G67.

Warning—These photomicrographs are examples of typical microstructures and due to variations in alloy, temper and process, they may or may not be similar to the microstructure of production sheet or plate. These photographs shall not be used instead of producer-established reference photographs for comparison with production material in surveillance or in determining process qualification or lot release.

FIG. 2 Examples of Microstructures with Varied Degrees of Grain Boundary Beta-phase Continuity, for Plate Product with Fully *Un-recrystallized* Grain Structure.

sampling and testing material to establish the relationship between microstructure and resistance to corrosion.

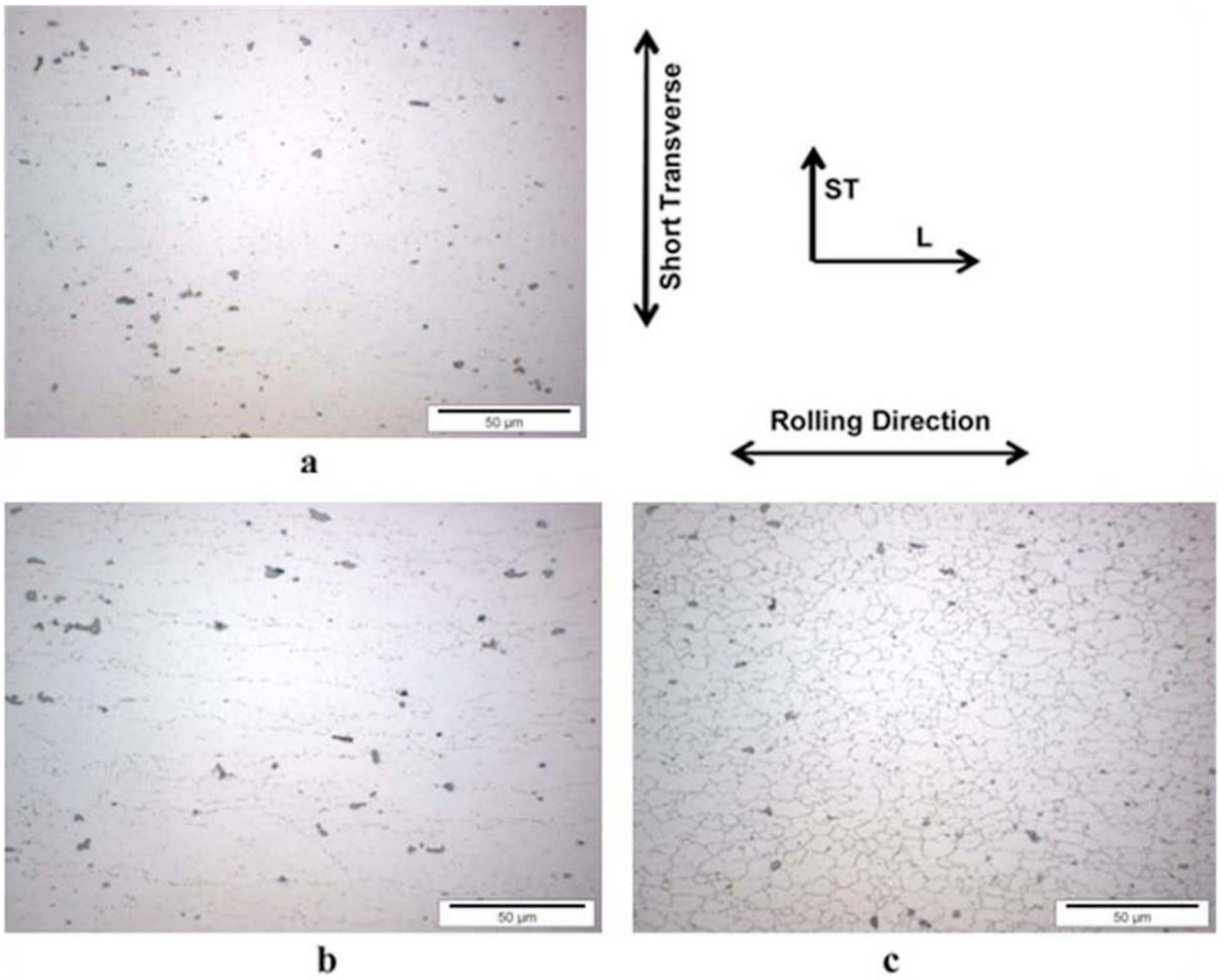
9.4.1 A reference photomicrograph, taken at ×500 after 3 minutes etching in a phosphoric acid etch that is 40 parts by volume of reagent grade (85 % concentration) phosphoric acid and 60 parts by volume distilled water at 95°F [35°C] (the etchant may be referred to as H_3PO_4 (40+60) as defined by Practice E50), shall be established for each of the alloy-tempers and thickness ranges shown in Table 2 [Table 3] and Table 4 [Table 5], and Table 6 [Table 7] shall be taken from a sample within that thickness range.

9.4.1.1 The reference photomicrographs shall be taken from samples (see 9.5 and 9.6 for sample location and preparation) which exhibit no evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to the test described in Test Method G66 (ASSET).

9.4.1.2 The samples from which the reference photomicrographs are taken shall also exhibit resistance to intergranular corrosion at a mass loss no greater than 100 mg/in.^{2} (15 mg/cm^2), when subjected to the test described in Test Method G67 (NAMLT).

9.4.2 Production practices shall not be changed after establishment of the reference photomicrograph except as provided in 9.8.

9.4.3 The producer shall maintain, at the producing facility, all records relating to the establishment of reference photomicrographs and production practices.



Specimens were prepared in accordance with 9.6.1 (Phosphoric Acid etched). (Photomicrographs are of as-produced material and were not subjected to Test Method G67 testing.) Metallographic examination is conducted ×500 magnification in accordance with 9.6.1.

Figure 3a has discontinuous grain boundary precipitation, typical of a mass-loss of no greater than 100 mg/in.^{2} [15 mg/cm^2] in Test Method G67.

Figure 3b has semi-continuous grain boundary precipitation and would likely fall in the mid-range, greater than 100 mg/in.^{2} [15 mg/cm^2] but less than or equal to 160 mg/in.^{2} [25 mg/cm^2] in Test Method G67.

Figure 3c has a continuous network of grain boundary precipitation, typical of a mass loss greater than 160 mg/in.^{2} [25 mg/cm^2] in Test Method G67.

Warning—These photomicrographs are examples of typical microstructures and due to variations in alloy, temper and process, they may or may not be similar to the microstructure of production sheet or plate. These photographs shall not be used instead of producer-established reference photographs for comparison with production material in surveillance or in determining process qualification or lot release.

Warning—It is possible to meet the requirements of Test Method G66 (ASSET) and fail the requirements of Test Method G67 (NAMLT). Therefore both tests shall be performed for process qualification (see 9.4), for lot release, that is, in developing producer-established reference photomicrographs (see 9.6), and for surveillance (see 9.8).

FIG. 3 Examples of Microstructures with Varied Degrees of Grain Boundary Beta-phase Continuity, for Extruded Profiles.

9.5 *Lot Release (see Note 3)*—Unless otherwise specified (see 4.2.4), the acceptability of each lot of sheet and plate in the H116 and H321 tempers shall be determined by either testing each lot to the requirements of 9.2 and 9.3, or by metallographic examination (see 9.6). In either option, one sample per lot shall be selected at mid-width from one end of a random coil or random sheet or plate and tested or examined.

9.6 *Metallographic Examination*—If this option is used, the microstructure of a sample from each production lot shall be compared to that of the producer-established reference photomicrograph of acceptable material, in the same thickness range (see 9.4).

9.6.1 A longitudinal section perpendicular to the rolled or extruded surface shall be prepared for metallographic examination (see Fig. 7) and shall be microetched for metallographic examination using a phosphoric acid etch that is 40 parts by volume of reagent grade (85 % concentration) phosphoric acid and 60 parts by volume distilled water for three minutes at 95°F [35°C]. (The etchant may be referred to as H_3PO_4(40+60) as defined by Practice E50). The metallographic examination shall be conducted at ×500 magnification.

9.6.2 The reference microstructure is characterized by being predominantly free of a continuous grain boundary network of aluminum-magnesium (Mg_2Al_3) precipitate.

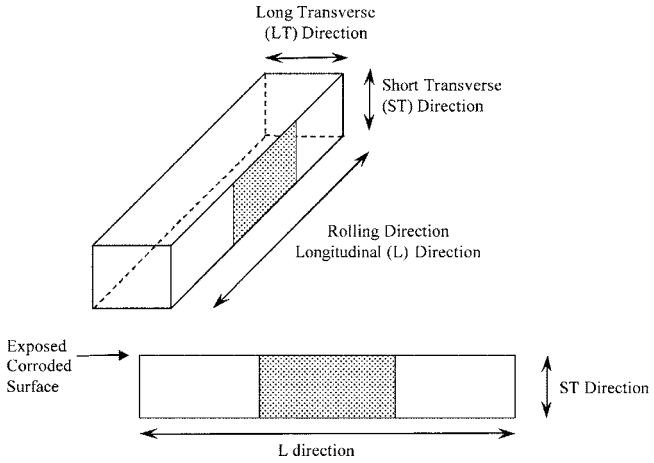


FIG. 4 Longitudinal Section of the Corroded G67 Sample, Showing Rolling Direction, Plane to be Polished, and Surface to be Metallographically Examined for Evidence of Intergranular Corrosion.

9.6.3 If the microstructure shows evidence of a continuous grain boundary network of aluminum-magnesium precipitate in excess of the producer-established reference photomicrographs of acceptable material (developed as described in 9.4), the lot is either rejected or tested for exfoliation-corrosion resistance and intergranular corrosion resistance in accordance with 9.2 and 9.3.

9.7 *Sampling for Corrosion Testing*—Samples for Exfoliation Corrosion Resistance Testing and Intergranular Corrosion Testing should be selected in the same manner specified for lot release (see 9.5) and shall be taken from the same sheet, plate, or extrusion used for the metallographic test (see 9.6).

9.7.1 Exfoliation corrosion testing specimens prepared from the sample shall be full section thickness, except that for material 0.101 in. [2.50 mm] or more in thickness, 10 % of the thickness shall be removed, by machining, from one as-rolled or as-extruded surface. Both the machined surface and the remaining as-rolled surface shall be evaluated after exposure in accordance with Test Method G66.

9.7.2 Intergranular corrosion testing specimens prepared from the sample shall be full section thickness, except that material 1.0 in [25 mm] or more in thickness is to be reduced by one half the thickness or to 1 in. [25 mm], whichever is less while retaining one original as-produced surface in accordance with test specimen fabrication procedures outlined in Test Method G67.

9.8 *Surveillance (see Note 3)*—Each quarter, and after any significant process change, the producer shall perform at least one test for exfoliation corrosion and one test for intergranular corrosion in accordance with 9.2 and 9.3 for each alloy and thickness range of sheet and plate materials in Table 2 [Table 3] and Table 4 [Table 5], or extruded materials in Table 6 [Table 7] produced that quarter. Test Methods G66 and G67 samples shall be taken at random according to 9.5 and prepared according to 9.7.1 and 9.7.2. The producer shall maintain records of each lot so tested and make them available for examination at the producer's facility.

10. Exfoliation and Intergranular Corrosion Resistance for H128 Temper

10.1 The alloy produced as the H128 temper shown in Table 2 [Table 3] and Table 4 [Table 5] is manufactured and then corrosion tested after a post-production thermal treatment that is intended to demonstrate improved corrosion performance in ambient conditions (see Note 2 and Note 3).

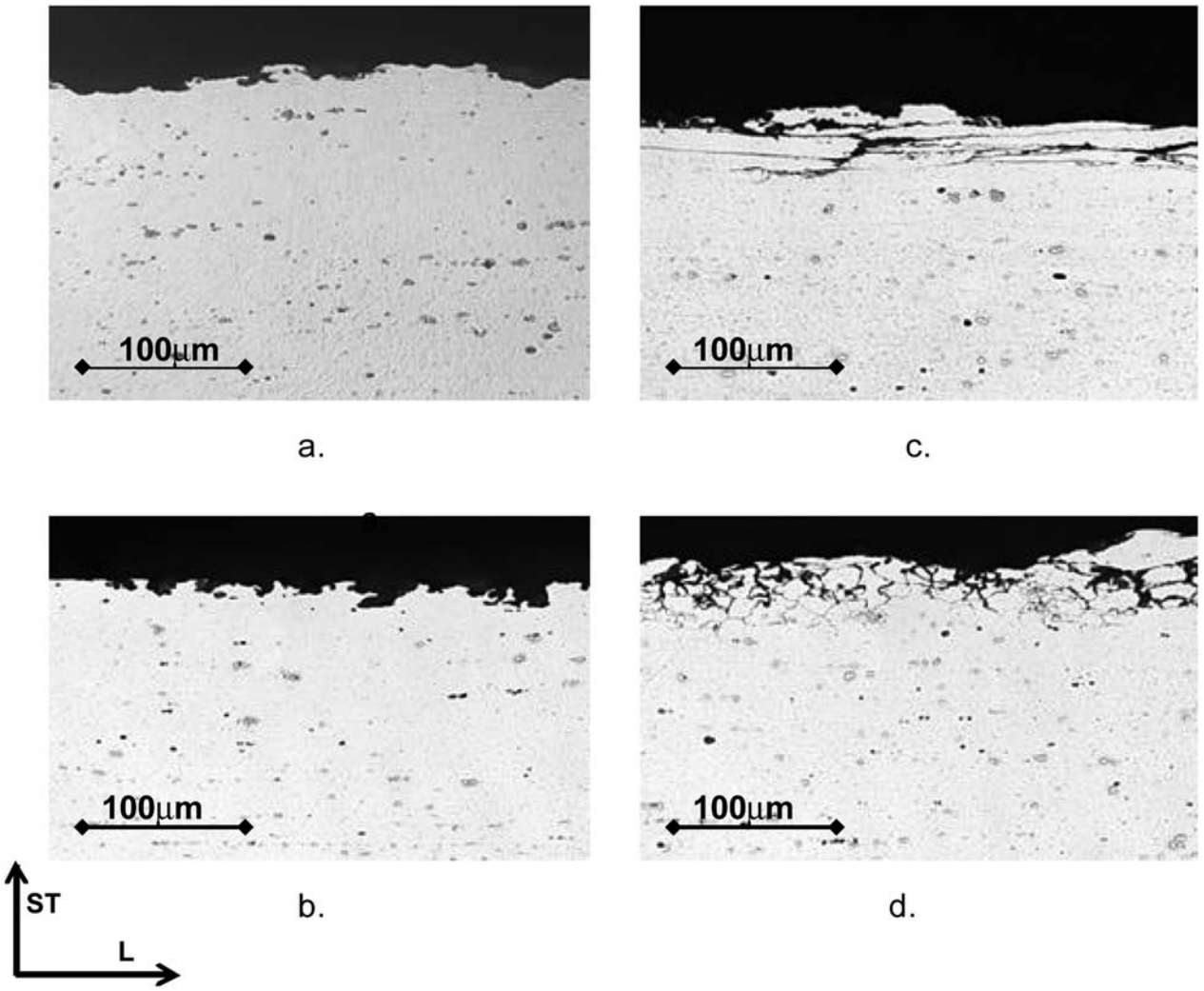
Warning—It is possible to meet the requirements of Test Method G66 (ASSET) and fail the requirements of Test Method G67 (NAMLT).

10.2 *Corrosion Resistance Limits, Lot Release Sampling, and Testing Requirements for Sheet and Plate in H128 Temper*—Corrosion resistance limits, lot release sampling, and testing requirements for the post-production thermally treated sheet and plate in the H128 temper are provided in the following:

10.2.1 *Exfoliation Corrosion Resistance Limits of Post-Production Thermally Treated Sheet and Plate in the H128 Temper*—Sheet and plate in the H128 temper listed in Table 2 [Table 3] and Table 4 [Table 5] shall be capable of exhibiting no evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to the test specified in 10.5.

10.2.2 *Intergranular-Corrosion Resistance Limits of Post-Production Thermally Treated Sheet and Plate in the H128 Temper*—Sheet and plate in the H128 temper listed in Table 2 [Table 3] and Table 4 [Table 5] shall be capable of exhibiting resistance to intergranular corrosion as indicated by a mass-loss no greater than 100 mg/in.^{2} [15 mg/cm^2] when subjected to the test specified in 10.6.

10.3 *Lot Release*—The acceptability of each lot of sheet and plate in the H128 tempers shall be determined by testing each lot to the requirements of 10.5 and 10.6.



The recommended magnification is ×250.

Figures 5a and 5b are examples of general corrosion and pitting attack. These samples are examples of material that would pass Specification B928/B928M in accordance with 9.3.4.

Figures 5c and 5d are examples of an intergranular attack and are examples of material that would fail Specification B928/B928M in accordance with 9.3.4. Figure 5c illustrates an example of an unrecrystallized microstructure, and Fig. 5d is an example of a partially recrystallized microstructure.

FIG. 5 Examples of Corrosion Morphology Produced by Test Method G67, for Plate with Varying Degrees of Sensitization, from Pitting and General Corrosion to Intergranular Corrosion. Metallography is in As-Polished Condition

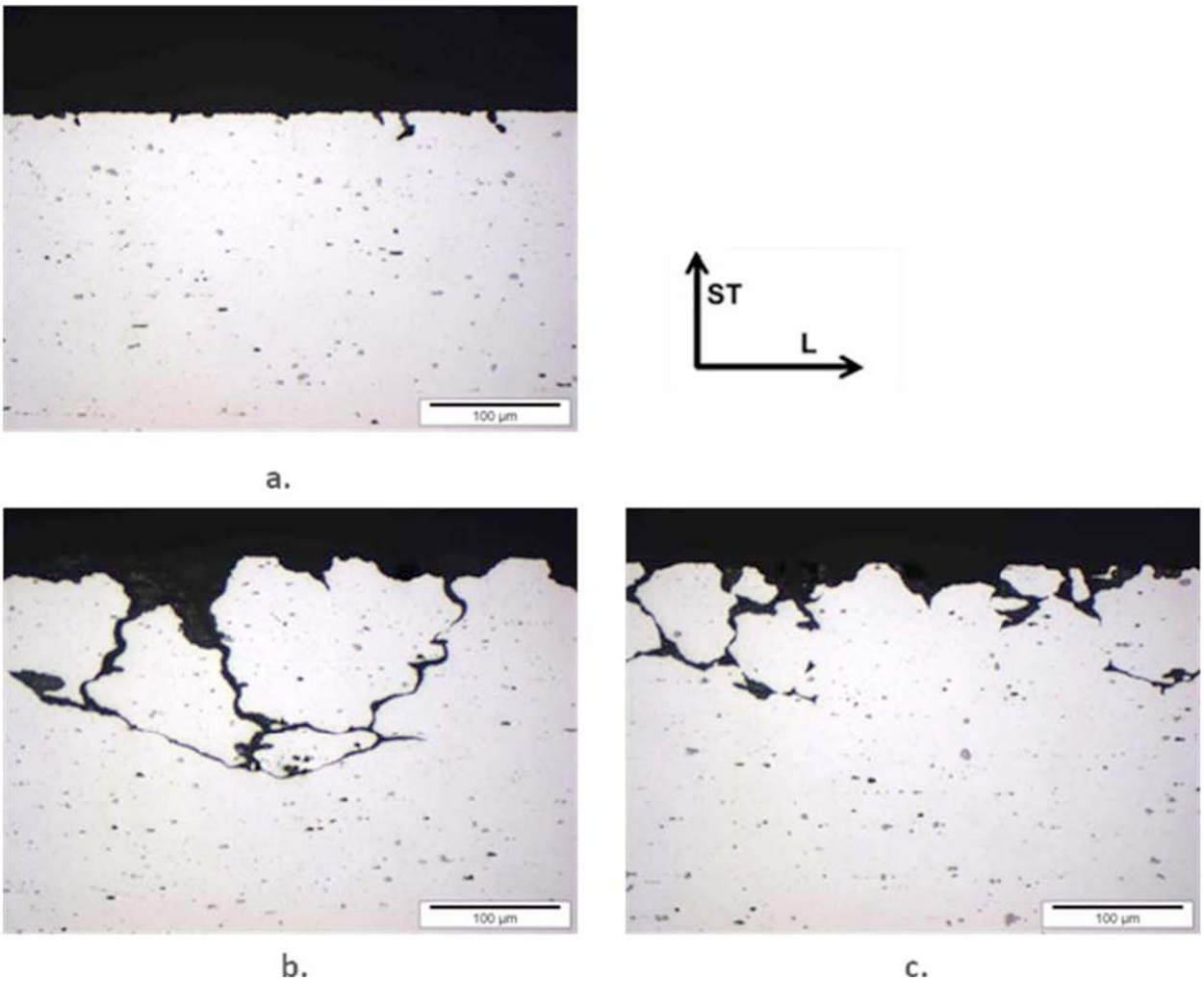
10.4 *Lot Release Sampling*—One sample per lot shall be selected at mid-width from one end of a random coil or random sheet or plate and tested.

10.5 *Exfoliation Corrosion Testing*—The exfoliation corrosion resistance test shall be performed as follows:

10.5.1 Lot release samples are to be given a post-production thermal treatment of seven days (-0/+8 h) at 212 ± 3°F [100 ± 2°C]. Exfoliation corrosion testing specimens prepared from the thermally treated sample shall be full section thickness, except that for material 0.101 in. [2.50 mm] or more in thickness, 10 % of the thickness shall be removed, by machining, from one as-rolled surface. Both the machined surface and the remaining as-rolled surface shall be tested in accordance with Test Method G66.

10.6 *Intergranular Corrosion Testing*—The intergranular-corrosion resistance test shall be performed as follows:

10.6.1 Lot release samples are to be given a post-production thermal treatment of seven days (-0/+8 h) at 212 ± 3°F [100 ± 2°C]. Intergranular corrosion testing specimens prepared from the thermally treated sample shall be full section thickness, except that material 1.0 in. [25 mm] or more in thickness is to be reduced by one half the thickness or to 1 in. [25 mm], whichever is less, while retaining one original surface in accordance with test specimen fabrication procedures outlined in G67. The intergranular test specimen shall be tested in accordance with G67.



The recommended magnification is ×250.

Figure 6a is an example of general corrosion and pitting attack from a sample of material that would pass Specification E50 in accordance with 9.3.4.

Figures 6b and 6c are examples of intergranular attack from a sample of material that would fail Specification B928/B928M in accordance with 9.3.4. Figure 6b illustrates an example of an unrecrystallized microstructure, and Fig. 6c is an example of a partially recrystallized microstructure.

FIG. 6 Examples of Corrosion Morphology Produced by Test Method G67, for Extruded Profiles with Varying Degrees of Sensitization, from Pitting and General Corrosion to Intergranular Corrosion. Metallography is in As-Polished Condition

11. Dimensional Tolerances

11.1 *Dimensional Tolerances for Sheet and Plate Products:*

11.1.1 *Thickness*—The thickness of flat sheet, coiled sheet, and plate shall not vary from that specified, by more than the respective permissible variations prescribed in Table 7.7a of ANSI H35.2 [H35.2M].

11.1.2 *Length, Width, Lateral Bow, Squareness, and Flatness*—Coiled sheet shall not vary in width or in lateral bow from that specified by more than the permissible variations prescribed in Table 7.11 and Table 7.12, respectively, of ANSI H35.2 [H35.2M]. Flat sheet and plate shall not vary in width, length, lateral bow, squareness, or flatness by more than the permissible variations prescribed in the ANSI H35.2 [H35.2M] tables listed in Table 8, except that where the tolerances for sizes ordered are not covered by this standard, the permissible variations shall be the subject of agreement between the purchaser and the producer, or the supplier and the purchaser, at the time the order is placed.

11.1.3 Dimensional tolerances for sizes not covered in ANSI H35.2 [H35.2M] shall be as agreed upon between the producer and purchaser or between the supplier and purchaser and shall be so specified in the contract or purchase order.

11.1.4 *Sampling for Inspection*—Examination for dimensional conformance shall be made to ensure conformance to the tolerance specified.

11.2 *Dimensional Tolerances for Extruded Profiles:*

11.2.1 *Dimensions*—Variations from the specified dimensions for the type of material ordered shall not exceed the permissible variations prescribed in the tables of ANSI H35.2 and H35.2 (M) (see Table 9).

11.2.1.1 Dimensional tolerances for sizes not covered in ANSI H35.2 and H35.2 (M) shall be agreed upon between the

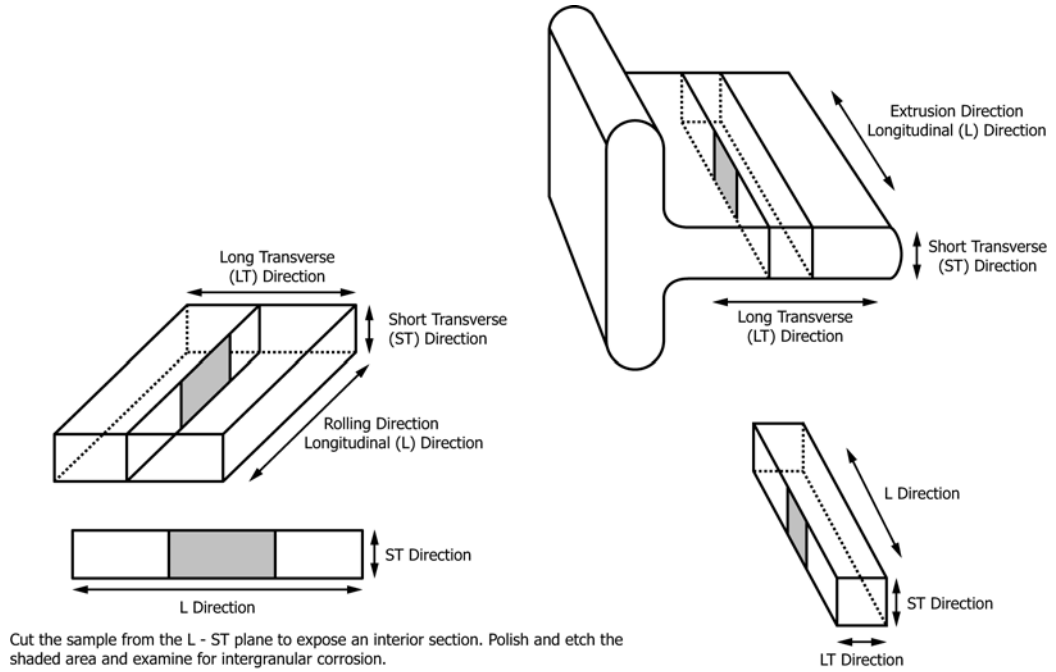


FIG. 7 Longitudinal Section Cut from Product, a. Showing Rolling Direction and Plane or b. Extrusion Direction and Plane to be Metallographically Prepared for Making a Reference Photomicrograph (see 9.4.1) and Metallographic Lot Release Testing (see 9.6).

TABLE 8 List of Tables in ANSI H35.2 and H35.2 (M) for Sheet and Plate

Table No.	Title
7.8	Width Tolerances—Sheared Flat Sheet and Plate
7.9	Length Tolerances—Sheared Flat Sheet and Plate
7.10	Width and Length Tolerances—Sawed Flat Sheet and Plate
7.11	Width Tolerances—Slit Coiled Sheet
7.12	Lateral Bow Tolerances—Coiled Sheet
7.13	Lateral Bow Tolerances—Flat Sheet and Plate
7.14	Squareness Tolerances—Flat Sheet and Plate
7.17	Flatness Tolerances—Flat Sheet
7.18	Flatness Tolerances—Sawed or Sheared Plate

TABLE 9 List of Tables in ANSI H35.2 and H35.2 (M) for Extruded Profiles

Table No.	Title
11.2	Cross-Sectional Dimension Tolerances
11.5	Length
11.6	Straightness—Pr
11.7	Twist— Pr
11.8	Flatness (Flat Surfaces)
11.10	Surface Roughness
11.11	Contour (Curved Surfaces)
11.12	Squareness of Cut Ends

purchaser and the producer and shall be specified in the contract or purchase order.

11.2.1.2 *Sampling for Inspection*—Examination for dimensional conformance shall be made to ensure conformance to the tolerance specified.

12. Source Inspection

12.1 If the purchaser desires that his representative inspect or witness the inspection and testing of the material prior to shipment, such agreement shall be made by the purchaser and producer as part of the purchase contract.

12.2 When such inspection or witness of inspection and testing is agreed upon, the producer shall afford the purchaser's representative all reasonable facilities to satisfy him that the material meets the requirements of this specification. Inspection and tests shall be conducted so there is no unnecessary interference with the producer's operations.

13. Retest and Rejection

13.1 If any material fails to conform to all of the applicable requirements of this specification, the inspection lot shall be rejected.

13.2 When there is evidence that a failed specimen was not representative of the inspection lot and when no other sampling plan is provided or approved by the purchaser through the contract or purchase order, at least two additional specimens shall be selected to replace each test specimen that failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection.

13.3 Material in which nonconforming conditions are discovered subsequent to inspection may be rejected at the option of the purchaser.

13.4 The producer or supplier is responsible only for material replacement, when the purchaser rejects material. As much as possible of the rejected material shall be returned to the producer or supplier by the purchaser.

14. Certification

14.1 The producer or supplier shall, on request (see 4.2.3), furnish to the purchaser a certificate stating that each lot has

been sampled, tested, and inspected in accordance with this specification, and has met the requirements.

14.2 When specified (see 4.2.5), the Test Methods G66 and G67 results shall be included on the certificate.

15. Identification Marking of Product

15.1 All sheet, plate, and extrusions shall be marked by the producer in accordance with Practice B666/B666M. When sheet product is supplied to the distributor in coil form, the distributor shall mark cut-to-length sheet in accordance with B666/B666M.

15.2 The requirements specified in 15.1 are minimum; marking systems that involve added information, larger characters, and greater frequencies are acceptable under this specification.

16. Packaging and Package Marking

16.1 The material shall be packaged to provide adequate protection during normal handling and transportation, and each package shall contain only one size, alloy, and temper of material unless otherwise agreed. The type of packaging and gross weight of containers shall, unless otherwise agreed, be at the producer's or supplier's discretion, provided that they are such as to ensure acceptance by common or other carriers for safe transportation at the most cost effective rate to the delivery point.

16.2 Each shipping container shall be marked with the purchase order number, material size, specification number, alloy and temper, gross and net weights, and the producer's name or trademark.

16.3 When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B660. The applicable levels shall be as specified in the contract or order.

17. Keywords

17.1 aluminum alloy; aluminum-alloy extrusion; aluminum-alloy plate; aluminum-alloy sheet; marine application; marine grade

ANNEXES

(Mandatory Information)

A1. BASIS FOR INCLUSION OF PROPERTY LIMITS

Mechanical property limits are established in accord with Section 6, Standards Section, of the most current edition of the Aluminum Standards and Data and the latest edition of the Aluminum Association publication "Tempers for Aluminum and Aluminum Alloy Products (Yellow and Tan Sheets)."

Limits are based on a statistical evaluation of the data indicating that at least 99 % of the population obtained from all standard material meets the limit with 95 % confidence. For the products described, mechanical property limits are based on the statistical analyses of at least 100 tests from at least five cast lots of standard production material with no more than ten observations from a given heat treat or inspection lot. Mechanical properties limits for press solution heat treated products have specific additional requirements which are provided in the "Tempers for Aluminum and Aluminum Alloy Products."

Limits denoted as "Tentative" by the Aluminum Association may be included. Requirements for tentative property registrations are defined in the latest edition of the Aluminum Association publication "Tempers for Aluminum and Aluminum Alloy Products." Tentative property limits are established at levels at which at least 99 % of the data conform at a confidence level of 95 %. Tentative property limits, which are subject to revision, shall be based on a statistical analysis of at least 30 tests from at least three cast lots of standard production material with no more than ten observations from a given heat treat or inspection lot. Where tentative property limits are listed, they shall be shown in italics and footnoted as Tentative in the standard.

All tests are performed in accordance with the appropriate ASTM test methods.

A2. ACCEPTANCE CRITERIA FOR INCLUSION OF NEW ALUMINUM AND ALUMINUM ALLOYS IN THIS SPECIFICATION

A2.1 Prior to acceptance for inclusion in this specification, the composition of wrought or cast aluminum or aluminum alloy shall be registered in accordance with ANSI H35.1/H35.1 (M). The Aluminum Association[4] holds the Secretariat of the Accredited Standards Committee H35 and administers the criteria and procedures for registration.

A2.2 If it is documented that the Aluminum Association could not or would not register a given composition, an alternative procedure and the criteria for acceptance shall be as follows:

A2.2.1 The designation submitted for inclusion does not utilize the same designation system as described in ANSI H35.1/H35.1 (M). A designation not in conflict with other designation systems or a trade name is acceptable.

A2.2.2 The aluminum or aluminum alloy has been offered for sale in commercial quantities within the prior twelve months to at least three identifiable users.

A2.2.3 The complete chemical composition limits are submitted.

A2.2.4 The composition is, in the judgment of the responsible subcommittee, significantly different from that of any other aluminum or aluminum alloy already in the specification.

A2.2.5 For codification purposes, an alloying element is any element intentionally added for any purpose other than grain refinement and for which minimum and maximum limits are specified. Unalloyed aluminum contains a minimum of 99.00 % aluminum.

A2.2.6 Standard limits for alloying elements and impurities are expressed to the following decimal places:

Less than 0.001 %	0.000X
0.001 to but less than 0.01 %	0.00X
0.01 to but less than 0.10 %	
Unalloyed aluminum made by a refining process	0.0XX
Alloys and unalloyed aluminum not made by a refining process	0.0X
0.10 through 0.55 % (It is customary to express limits of 0.30 through 0.55 % as 0.X0 or 0.X5.)	0.XX
Over 0.55 % (except that combined Si + Fe limits for 99.00 % minimum aluminum must be expressed as 0.XX or 1.XX)	0.X, X.X, and so forth.

A2.2.7 Standard limits for alloying elements and impurities are expressed in the following sequence: Silicon; Iron; Copper; Manganese; Magnesium; Chromium; Nickel; Zinc; Titanium (see Note A2.1); Other Elements, Each; Other Elements, Total; Aluminum (see Note A2.2).

NOTE A2.1—Additional specified elements having limits are inserted in alphabetical order of their chemical symbols between Titanium and other elements, each, or are specified in footnotes.

NOTE A2.2—Aluminum is specified as minimum for unalloyed aluminum and as a remainder for aluminum alloys.

SUMMARY OF CHANGES

Committee B07 has identified the location of selected changes to this standard since the last issue (B928/B928M – 14a) that may impact the use of this standard. (Approved June 1, 2015.)

(1) Tensile property data Table 6 [Table 7] and testing requirements for a high magnesium aluminum alloy extrusion product, 5383-H116 were added.
(2) Revised Sections 1, 4, 6, 8, 9, 11, and 15 to add references to extruded product.
(3) Deleted previous Note 1 and subsequent notes were renumbered.

Committee B07 has identified the location of selected changes to this standard since the last issue (B928/B928M – 14) that may impact the use of this standard. (Approved Oct. 1, 2014.)

(1) Corrected minimum elongation for 5083-H128 in Table 3.

Committee B07 has identified the location of selected changes to this standard since the last issue (B928/B928M–13) that may impact the use of this standard. (Approved May 1, 2014.)

(1) Expansion of gauge range for 5083-H128 and correction of max. UTS for 5086-H321.