Designation: B 928 – 04

Standard Specification for High Magnesium Aluminum-Alloy Sheet and Plate for Marine Service[1]

This standard is issued under the fixed designation B 928; 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 (Note 1) marine application aluminum-alloy (Note 2), in those alloy-tempers shown in Table 2 [Table 3], for flat sheet, coiled sheet, and plate, in the mill finish:

NOTE 1—The term high magnesium in the general sense includes those alloys containing 3 % or more nominal magnesium.

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

1.2 Alloy and temper designations are in accordance with ANSI H35.1 [H35.1M]. The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9, for example, A95083 for 5083 in accordance with Practice E 527.

1.3 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 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.

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]

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

B 557M Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products [Metric]

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

B 666/B 666M Practice for Identification Marking of Aluminum and Magnesium Products

B 881 Terminology Related to Aluminum- and Magnesium-Alloy Products

E 3 Practice for Preparation of Metallographic Specimens

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

E 407 Test Methods for Microetching Metals and Alloys

E 527 Practice for Numbering Metals and Alloys (UNS)

E 607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere

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

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

G 66 Test Method for Visual Assessment of Exfoliation Corrosion Susceptibility of 5xxx Series Aluminum Alloys (ASSET Test)

G 67 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:*

H35.1 Alloy and Temper Designation Systems for Aluminum[3]

H35.1(M) Alloy and Temper Designation Systems for Aluminum[3]

H35.2 Dimensional Tolerances for Aluminum Mill Products[3]

[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.

[3] Available in the Related Materials section (gray pages) of the *Annual Book of ASTM Standards*, Vol 02.02.

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

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

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	0.4 to0.9	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 E 29.
[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.

TABLE 2 Mechanical Property Limits, 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	...	39.0	...	10
	0.250 to 0.787	54.0	...	39.0	...	10
	0.788 to 1.575	52.0	...	38.0	...	10
H321	0.078 to 0.249	54.0	...	39.0	...	10
	0.250 to 0.787	54.0	...	39.0	...	10
	0.788 to 1.575	52.0	...	38.0	...	10
			Alloy 5083			
H116	0.063 to 0.499	44.0	. . .	31.0	. . .	10
	0.500 to 1.250	44.0	. . .	31.0	. . .	12
	1.251 to 1.500	44.0	. . .	31.0	. . .	12
	1.501 to 3.000	41.0	. . .	29.0	. . .	12
H321	0.188 to 1.500	44.0	56.0	31.0	43.0	12
	1.501 to 3.000	41.0	56.0	29.0	43.0	12
			Alloy 5086			
H116	0.063 to 0.249	40.0	. . .	28.0	. . .	8
	0.250 to 0.499	40.0	. . .	28.0	. . .	10
	0.500 to 1.250	40.0	. . .	28.0	. . .	10
	1.251 to 2.000	40.0	. . .	28.0	. . .	10
			Alloy 5383			
H116	0.118 to 0.500	48.0	...	33.0	...	10
	0.501 to 2.000	48.0	...	33.0	...	10
H321	0.118 to 0.500	48.0	...	33.0	...	10
	0.501 to 2.000	48.0	...	33.0	...	10
			Alloy 5456			
H116	0.063 to 0.499	46.0	. . .	33.0	. . .	10
	0.500 to 1.250	46.0	. . .	33.0	. . .	12
	1.251 to 1.500	44.0	. . .	31.0	. . .	12
	1.501 to 3.000	41.0	. . .	29.0	. . .	12
	3.001 to 4.000	40.0	. . .	25.0	. . .	12
H321	0.188 to 0.499	46.0	59.0	33.0	46.0	12
	0.500 to 1.500	44.0	56.0	31.0	44.0	12
	1.501 to 3.000	41.0	54.0	29.0	43.0	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 E 29.
[B] The basis for establishment of mechanical property limits is shown in Annex A1.

H35.2(M) Dimensional Tolerances for Aluminum Mill Products[3]

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *exfoliation*—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.

TABLE 3 Mechanical Property Limits [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 (5.65 $\sqrt{A}$)
				Alloy 5059				
H116	1.99	6.30	370	...	270	...	10	...
	6.30	12.50	370	...	270	...	10	...
	12.50	20.00	370	...	270	...	...	10
	20.00	40.00	360	...	260	...	...	10
H321	1.99	6.30	370	...	270	...	10	...
	6.30	12.50	370	...	270	...	10	...
	12.50	20.00	370	...	270	...	...	10
	20.00	40.00	360	...	260	...	...	10
				Alloy 5083				
H116	1.60	12.50	305	. . .	215	. . .	10	. . .
	12.50	30.00	305	. . .	215	. . .	. . .	10
	30.00	40.00	305	. . .	215	. . .	. . .	10
	40.00	80.00	285	. . .	200	. . .		10
H321	4.00	12.50	305	385	215	295	12	. . .
	12.50	40.00	305	385	215	295	. . .	10
	40.00	80.00	285	385	200	295	. . .	10
				Alloy 5086				
H116	1.60	6.30	275	. . .	195	. . .	8	. . .
	6.30	12.50	275	. . .	195	. . .	10	. . .
	12.50	30.00	275	. . .	195	. . .	. . .	9
	30.00	50.00	275	. . .	195	. . .	. . .	9
				Alloy 5383				
H116	3.00	12.70	330	...	230	...	10	10
	12.70	50.80	330	...	230	...	...	10
H321	3.00	12.70	330	...	230	...	10	10
	12.70	50.80	330	...	230	...	...	10
				Alloy 5456				
H116	1.60	12.50	315	. . .	230	. . .	10	. . .
	12.50	30.00	315	. . .	230	. . .	. . .	10
	30.00	40.00	305	. . .	215	. . .	. . .	10
	40.00	80.00	285	. . .	200	. . .	. . .	10
	80.00	110.00	275	. . .	170	. . .	. . .	10
H321	4.00	12.50	315	405	230	315	12	. . .
	12.50	40.00	305	385	215	305	. . .	10
	40.00	80.00	285	370	200	295	. . .	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 E 29.

[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 (5.65 $\sqrt{A}$) for thicknesses over 12.50 mm where *A* is the cross-sectional area of the specimen.

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

3.2.3 *sensitization*—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.

3.2.4 *stress-corrosion cracking*—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]),

4.1.5 For sheet, whether flat or coiled, and

4.1.6 Dimensions (thickness, width, and length or coil size).

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 11.1),

4.2.2 Whether Practices B 660 applies and, if so, the levels of preservation, packaging, and packing required (see 15.3), and

4.2.3 Whether certification is required (see Section 13).

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. 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 in the order or at the time of contract signing. 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.

5.2 *Lot Definition*—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.

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 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 the analysis of samples taken at the time the ingots are cast or samples taken from the finished or semifinished product. If the producer has determined the chemical composition of the material during the course of manufacture, additional sampling and analysis of the finished product shall not be required.

7.2 *Number of Samples*—The number of samples taken for determination of chemical composition shall be as follows:

7.2.1 When samples are taken at the time the ingots are cast, at least one sample shall be taken for each group of ingots cast simultaneously from the same source of molten metal.

7.2.2 When samples are taken from the finished or semifinished product, a sample shall be taken to represent each 4000 lb [2000 kg] or fraction thereof, of material in the lot, except that not more than one sample shall be required per piece.

7.3 *Methods of Sampling*—Samples for determination of chemical composition shall be taken in accordance with one of the following methods:

7.3.1 Samples for chemical analysis shall be taken by drilling, sawing, milling, turning, or clipping a representative piece or pieces to obtain a prepared sample of not less than 75 g. Sampling shall be in accordance with Practice E 55.

7.3.2 Sampling for spectrochemical analysis shall be in accordance with Practices E 716. Samples for other methods of analysis shall be suitable for the form of material being analyzed and the type of analytical method used.

7.4 *Methods of Analysis*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Methods E 34), or spectrochemical (Test Methods E 607 and E 1251) methods. Other methods may be used only when no published ASTM method is available. In case of dispute, the methods of analysis shall be as agreed upon between the producer and purchaser.

8. Tensile Properties of Material as Supplied

8.1 *Limits*—The sheet and plate shall conform to the requirements for tensile properties as specified in Table 2 [Table 3].

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

8.2 *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.

8.3 *Test Specimens*—Geometry of test specimens and the location in the product from which they are taken shall be as specified in Test Methods B 557 or B 557M.

8.4 *Test Methods*—The tension test shall be made in accordance with Test Methods B 557 or B 557M.

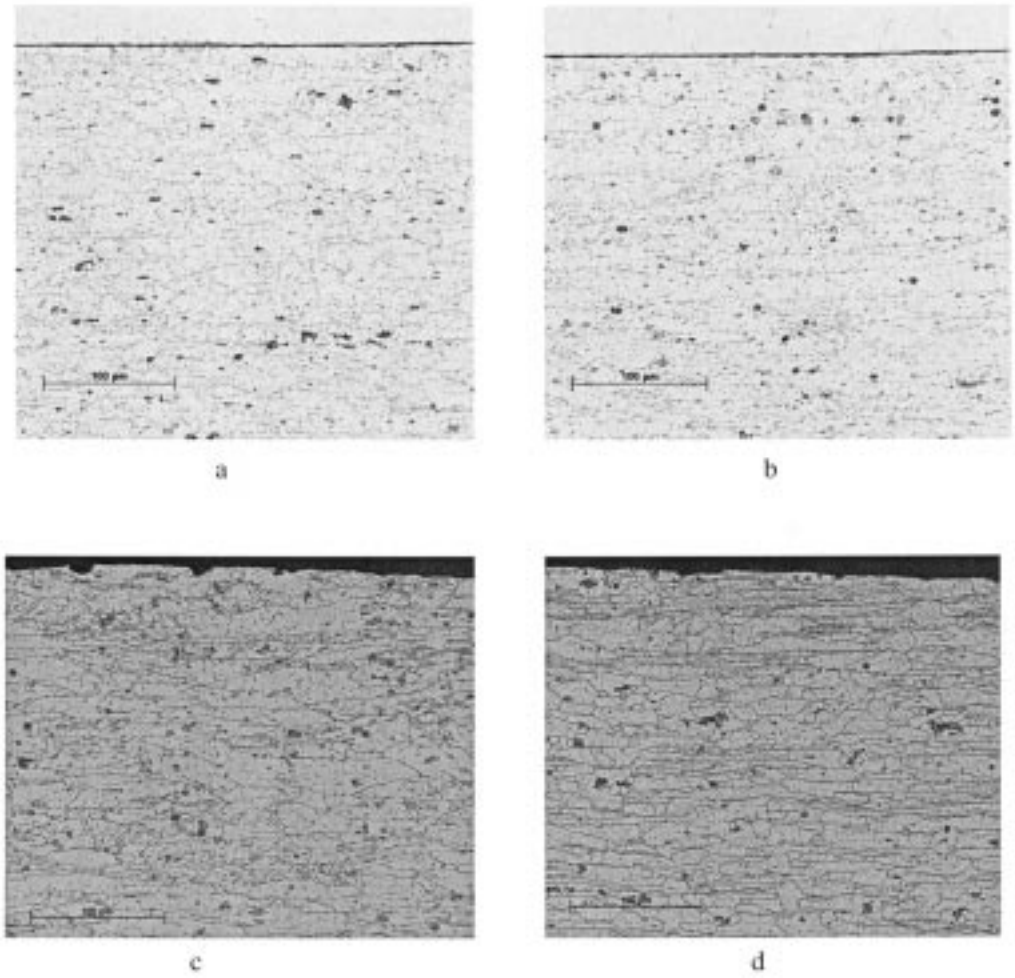
9. Exfoliation and Intergranular Corrosion Resistance

9.1 Only the Alloy-Tempers shown in Table 2 [Table 3] are manufactured and corrosion tested for intended use in marine hull construction or in marine applications where frequent or constant direct contact with seawater is expected. See Notes 3 and 4. (**Warning**—It is possible to meet the requirements of Test Method G 66 (ASSET) and fail the requirements of Test Method G 67 (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 9.5), and for surveillance (see 9.8).)

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 intergranular corrosion and stress corrosion cracking. Cold forming also increases susceptibility to intergranular corrosion and stress corrosion cracking.

NOTE 4—*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, IG, SCC, or exfoliation corrosion). Examples of varying degrees of grain boundary precipitate are shown in Fig. 1. 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. Re-crystallized 5xxx alloys that have been sensitized, are susceptible to intergranular corrosion, and when subjected to sustained tensile stress, may exhibit intergranular stress corrosion cracking. Un-re-crystallized 5xxx alloys that have been sensitized are susceptible to exfoliation corrosion.

9.2 *Exfoliation-Corrosion Resistance*—The alloy-tempers listed in Table 2 [Table 3] shall be capable of exhibiting no



Examples of four 5xxx microstructures with varying degrees of grain boundary precipitate continuity. Example *a* and *b* have discontinuous grain boundary precipitation and passed Test Method G 67 (mass loss less than 15 mg/cm^2), example *c* has semi-continuous grain boundary precipitation and tested questionable in Test Method G 67 (mass loss greater than 15 mg/cm^2 but less than 25 mg/cm^2), and example *d* has a continuous network of grain boundary precipitation and failed Test Method G 67 (mass loss greater than 25 mg/cm^2) (see 9.1). (**Warning**—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 in lieu 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 Susceptibility to Intergranular Corrosion

evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to the test described in Test Method G 66 (ASSET).

9.3 *Intergranular-Corrosion Resistance*—The marine application alloy-tempers listed in Table 2 [Table 3] shall be capable of exhibiting resistance to intergranular corrosion in accordance with Test Method G 67 (NAMLT) and as shown below:

9.3.1 Interpretation of Test Method G 67 test results:

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

9.3.1.2 *Fail*—Samples with mass loss greater than 160 mg/in.^{2} [25 mg/cm^2], shall be rejected.

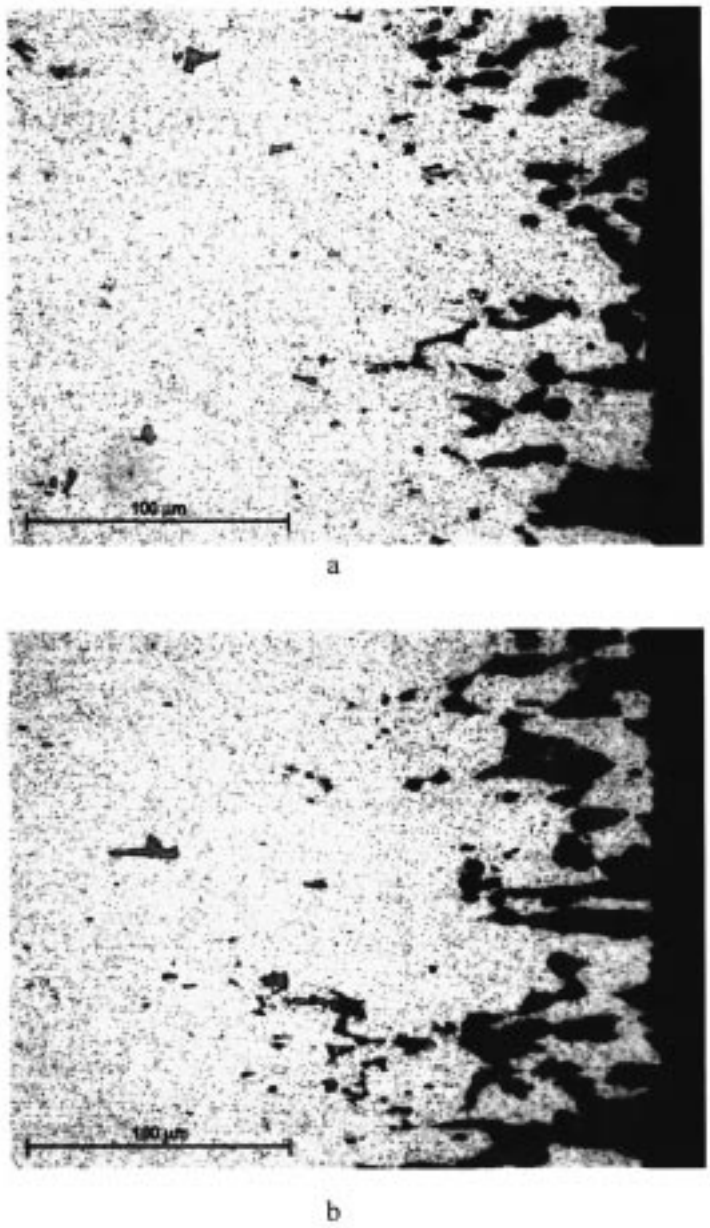
9.3.1.3 *Questionable*—Samples with mass loss greater than 100 mg/in.^{2} [15 mg/cm^2] but less than 160 mg/in.^{2} [25 mg/cm^2] shall be questionable.

9.3.2 Test Method G 67 corroded test coupons testing "questionable," shall be prepared, etched, and examined metallographically to determine if the loss of mass was a result of intergranular attack or general attack (see examples shown in Fig. 2):

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

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

9.4 *Process Qualification* (see 9.1)—For material produced to this specification, the producer's production process shall be qualified prior to production to this specification, by sampling and testing material to establish the relationship between microstructure and resistance to corrosion.



Photographs *a* and *b* are examples of more general pitting attack while photographs *c* and *d* are examples of an intergranular attack. Taken after testing to Test Method G 67 and etching with modified Keller's reagent (HF, HCL, HNO_3, and H_2O). (**Warning**—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 in lieu of producer-established reference photographs for comparison with production material in surveillance or in determining process qualification or lot release.)

FIG. 2 Examples of Test Method G 67 Corroded Test Coupon Microstructures with Varied Susceptibility to Intergranular Corrosion

9.4.1 A reference photomicrograph, taken at 500×, shall be established for each of the alloy-tempers and thickness ranges shown in Table 2 [Table 3], and shall be taken from a sample within that thickness range.

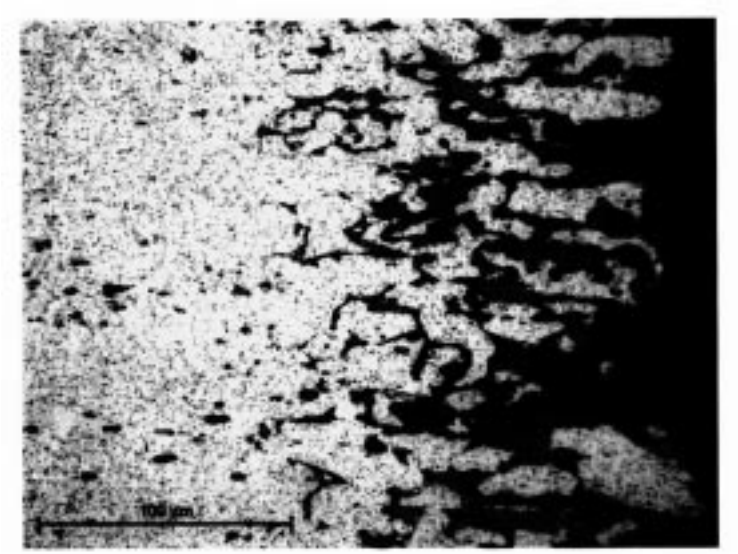
9.4.1.1 The reference photographs shall be taken from samples, (see 9.5 and 9.6 for sample location and preparation) which have exhibited no evidence of exfoliation corrosion and a pitting rating of PB or better when subjected to the test described in Test Method G 66 (ASSET).

9.4.1.2 The samples from which the reference photomicrographs are taken shall also have exhibited 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 G 67 (NAMLT).

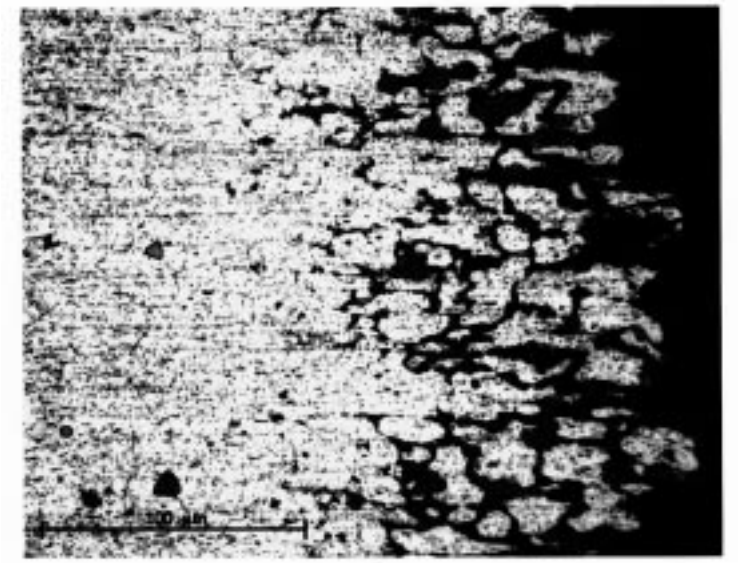
9.4.2 Production practices shall not be changed after establishment of the reference photomicrograph except as provided in 9.8.

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

9.5 *Lot Release* (see Note 3)—At the option of the producer, the acceptability of each lot of material shall be determined by either testing each lot to the requirements of 9.2 and 9.3, or by metallographic examination. In either option, one sample per



c



d

FIG. 2 *(continued)*

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

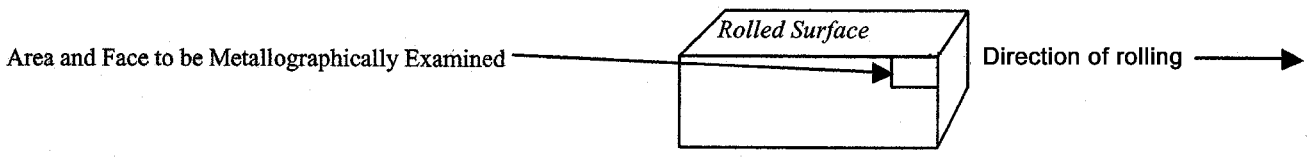


FIG. 3 Longitudinal Section cut from Product, Showing Rolling Direction and Orientation of Metallographical Sample.

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 surface shall be prepared for metallographic examination (see Symbol E in Fig. 1 of Practice E 3) and shall be microetched for metallographic examination using 40 % phosphoric acid etch for 3 min at 95°F [35°C] or using etchant No. 6 in accordance with Test Methods E 407, Table 2, for 2 min. The metallographic examination shall be of the area and face shown in Fig. 3 and 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.

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 or plate 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 surface. Both the machined surface and the remaining as-rolled surface shall be evaluated after exposure per Test Method G 66.

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 by 1 in. [25 mm], whichever is less while retaining one original as-fabricated surface in accordance with test specimen fabrication procedures outlined in Test Method G 67.

9.8 *Surveillance* (see Note 3)—For surveillance purposes, each quarter, or 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 the materials in Table 2 [Table 3] produced that quarter. Test Methods G 66 and G 67 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. Dimensional Tolerances

10.1 *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 Tables 7.7a of ANSI H35.2 [H35.2M].

10.2 *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 Tables 7.11 and Tables 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 following tables of ANSI H35.2 [H35.2M], 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:

ANSI H 35.2 and ANSI H 35.2M Table Numbers	Title
7.8	Width Tolerances—Sheared Flat Sheet and Plate
7.10	Width and Length Tolerances—Sawed Flat Sheet and Plate
7.9	Length Tolerances—Sheared Flat Sheet and Plate
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

10.3 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.

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

11. Source Inspection

11.1 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.

11.2 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.

12. Retest and Rejection

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

12.2 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.

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

12.4 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.

13. Certification

13.1 The producer or supplier shall, on request, 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. Identification Marking of Product

14.1 All sheet and plate shall be marked by the producer in accordance with Practice B 666/B 666M. When product is supplied to the distributor in coil form, the distributor shall mark cut-to-length sheet in accordance with B 666/B 666M.

14.2 The requirements specified in 14.1 are minimum; marking systems that involve added information, larger characters, and greater frequencies are acceptable under this specification.

15. Packaging and Package Marking

15.1 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.

15.2 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.

15.3 When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B 660. The applicable levels shall be as specified in the contract or order.

16. Keywords

16.1 aluminum alloy; aluminum-alloy plate; aluminum-alloy sheet; marine application; marine grade

ANNEXES

(Mandatory Information)

A1. BASIS FOR INCLUSION OF PROPERTY LIMITS

A1.1 Limits are established at a level at which a statistical evaluation of the data indicates that 99 % of the population obtained from all standard material meets the limit with 95 % confidence. For the products described, mechanical property limits for the respective size ranges are based on the analyses of at least 100 data from standard production material with no more than ten data from a given lot. All tests are performed in accordance with the appropriate ASTM test methods. For informational purposes, refer to "Statistical Aspects of Mechanical Property Assurance" in the Related Material section of the *Annual Book of ASTM Standards*, Vol 02.02.

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 or ANSI H35.1(M). The Aluminum Association[4] holds the Secretariat of ANSI H35 Committee 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. 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 %	0.XX
(It is customary to express limits of 0.30 through 0.55 % as 0.X0 or 0.X5.)	
Over 0.55 %	0.X, X.X, and so forth.

[4] The Aluminum Association, 900 19th Street, NW, Washington, DC 20006.

(except that combined Si + Fe limits
for 99.00 % minimum aluminum
must be expressed as 0.XX or 1.XX)

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

NOTE A2.1—Additional specified elements having limits are inserted in alphabetical order of their chemical symbols between zinc and titanium, 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 (B 928 – 03) that may impact the use of this standard. (Approved Feb. 1, 2004.)

(1) Added Alloys 5059 and 5383 to Table 1.
(2) Added Footnotes F and G to Table 1.
(3) Added sections for Alloys 5059 and 5383 in Table 2 and Table 3.
(4) Added Fig. 3 in Section 9.