



Designation: B 316/B 316M – 00

Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods¹

This standard is issued under the fixed designation B 316/B 316M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This specification covers wire and rod in the alloys (Note 1) shown in Table 1 and the tempers shown in Table 2 [Table 3] and Table 4 [Table 5], suitable for manufacturing rivets and other similar items by cold-heading operations.

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

NOTE 2—For rolled or cold-finished wire and rod, see Specification B 211, and for extruded wire and rod, see Specification B 221.

1.2 Alloy and temper designations are in accordance with ANSI H35.1 [H35.1M]. The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9, for example, A91100 for aluminum 1100 in accordance with Practice E 527.

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

1.4 The values stated in either inch-pound or SI units are to be regarded separately as standard. The SI units are shown either in brackets or in separate tables. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems will result in nonconformance with the specification.

2. Referenced Documents

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

2.2 ASTM Standards:

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products²

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

B 565 Method for Shear Testing of Aluminum and

Aluminum-Alloy Rivets and Cold-Heading Wire and Rods²

B 597 Practice for Heat Treatment of Aluminum Alloys²

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products²

B 666/B 666M Practice for Identification Marking of Aluminum Products²

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications³

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum Base Alloys⁴

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition⁴

E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁴

E 527 Practice for Numbering Metals and Alloys (UNS)⁵

E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere⁶

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis⁶

E 1004 Test Method for Electromagnetic (Eddy-Current) Measurements of Electrical Conductivity⁷

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 Discharge⁶

2.3 ANSI Standards:

H35.1 Alloy and Temper Designation Systems for Aluminum²

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

H35.2 Dimensional Tolerances for Aluminum Mill Products²

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 *Annual Book of ASTM Standards*, Vol 02.02.

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ *Annual Book of ASTM Standards*, Vol 03.05.

⁵ *Annual Book of ASTM Standards*, Vol 01.01.

⁶ *Annual Book of ASTM Standards*, Vol 03.06.

⁷ *Annual Book of ASTM Standards*, Vol 03.03.

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

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H35.2M Dimensional Tolerances for Aluminum Mill Products [Metric]

2.4 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage⁸

2.5 *Military Specification:*

AMS-H-6088 Heat Treatment of Aluminum Alloys⁸

2.6 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁸

3. Terminology

3.1 *Definitions:*

3.1.1 *rod*—a solid product 0.375 in. or greater [over 10 mm] in diameter, that is long in relation to cross section.

3.1.2 *cold-heading rod*—rod of a quality suitable for use in the manufacture of cold-headed products such as rivets and bolts.

3.1.3 *rivet rod*—see *cold-heading rod*.

3.1.4 *wire*—a solid wrought product that is long in relation to its cross section, which is square or rectangular with sharp or rounded corners or edges, or is round, a regular hexagon, or a regular octagon, and whose diameter or greatest perpendicular distances between parallel faces (except for flattened wire) is less than 0.375 in. [up through 10 mm]

3.1.5 *cold-heading wire*—wire of a quality suitable for use in the manufacture of cold-headed products such as rivets and bolts.

3.1.6 *rivet wire*—see *cold-heading wire*.

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

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *capable of*—The term *capable of* as used in this specification means that the test need not be performed by the producer of the material. However, should subsequent testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

4. Ordering Information

4.1 Orders for material to this specification shall include the following information:

NOTE 3—For inch-pound orders specify B 316; for metric orders specify B 316M. Do not mix units.

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),

4.1.4 Temper (see 8.1),

4.1.5 Diameter,

4.1.6 Form-coiled or straight lengths,

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 (Section 13),

4.2.2 Whether certification is required (Section 15),

4.2.3 Whether marking for identification is required (Section 16), and

4.2.4 Whether Practices B 660 applies and, if so, the levels of preservation, packaging, and packing required (17.3).

5. Materials and Manufacture

5.1 The products covered by this specification shall be produced by extruding, rolling, or drawing, or a combination thereof, at the option of the producer.

6. Responsibility for Quality Assurance

6.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. 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 assure that material conforms to prescribed requirements.

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

6.2.1 For heat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal diameter traceable to a heat-treat lot or lots, and subjected to inspection at one time.

6.2.2 For nonheat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal diameter subjected to inspection at one time.

7. Chemical Composition

7.1 *Limits*—The material shall conform to the chemical composition limits specified in Table 1. The producer shall determine conformance by analyzing samples taken when the ingots are poured, or by analyzing samples taken from the finished or semifinished product. If the producer has determined the chemical composition of the material during the course of manufacture, he shall not be required to sample and analyze the finished product.

NOTE 4—It is standard practice in the United States aluminum industry to determine conformance to the chemical composition limits prior to further processing of ingots into wrought products. Due to the continuous nature of the process, it is not practical to keep a specific ingot analysis identified with a specific quantity of finished material.

7.2 *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 poured, at least one sample shall be taken for each group of ingots poured 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, in the lot. Only one sample shall be taken from any one piece.

7.3 *Methods of Sampling*—Samples for

⁸ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

chemical composition shall be taken in accordance with one of the following methods:

7.3.1 Samples for chemical analysis shall be taken from the material 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 227, 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 agreed upon between the producer and the purchaser.

8. Mechanical Properties

8.1 *Tensile Properties of Material as Supplied*—The material shall conform to the tensile strength requirements specified in Table 2 [Table 3].

8.2 *Mechanical Properties of Material after Heat Treatment*—In addition to the requirements of 8.1, heat-treatable material ordered in the annealed or strain-hardened tempers and subsequently solution heat treated (T4) or solution and precipitation heat treated (T6, T61, T62, T7, or T73), shall conform to the requirements of Table 4 [Table 5] for either tensile strength or shear strength, at the producer's option. However, the material shall be capable of meeting both the tensile and shear strength requirements.

8.3 Number of Specimens:

8.3.1 One tension test specimen shall be taken for each 1000 lb or fraction thereof in the lot to determine compliance with 8.1. Only one specimen shall be taken from any one piece.

8.3.2 The number of tests to determine compliance with 8.2 shall be the same as in 8.3.1.

8.4 Test Methods:

8.4.1 The tension tests shall be made in accordance with Test Methods B 557 [B 557M].

8.4.2 The shear tests shall be made in accordance with Method B 565.

9. Heat Treatment

9.1 Unless specified in 9.2, producer or supplier heat treatment for the applicable tempers in Table 4 shall be in accordance with AMS-H-6088.

9.2 When specified, heat treatment for the applicable tempers in Table 4 shall be in accordance with Practice B 597.

9.3 Alloy 7277 rivets are hot driven only at metal temperatures between 850 and 975°F [455 and 525°C]. Producer confirmation of heat-treat response to the T62 temper requires solution heat treatment at a metal temperature of 860 to 920°F [460 to 495°C] for approximately 30 min, and then a two step precipitation heat treatment. The first step is a 4-h soaking time at a metal temperature of 210°F [100°C] followed by cooling to room temperature, and the second step is an 8-h soaking time at 315°F [155°C] metal temperature.

10. Stress-Corrosion Resistance

10.1 For lot acceptance purposes, resistance to stress-corrosion cracking for each lot of 7050-T7 and 7075-T73 material shall be established by testing the previously selected tension-test samples to the criteria shown in Table 6.

10.2 The producer shall maintain records of all lots so tested and make them available for examination at the producer's facility.

11. Dimensional Tolerances

11.1 Variations from the specified diameter, length, and straightness shall not exceed the permissible variations prescribed in Tables 9.3, 9.9, and 9.12 of ANSI H35.2. [H35.2M]

12. General Quality

12.1 Unless otherwise specified, the material shall be supplied in the mill finish and 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.

13. Source Inspection

13.1 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.

13.2 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 not unnecessary interference with the producer's operations.

14. Retest and Rejection

14.1 If any material fails to conform to all of the applicable requirements of this specification, it shall be cause for rejection of the inspection lot.

14.2 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 re-test shall meet the requirements of the specification or the lot shall be subject to rejection.

14.3 Material in which defects are discovered subsequent to inspection may be rejected.

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

15. Certification

15.1 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 been found to meet the requirements.

16. Identification Marking of Product

16.1 When specified in the contract or purchase order, all