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American Association State
Highway and Transportation Officials Standard
AASHTO No.: M 228

Standard Specification for Steel Structural Rivets¹

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

1. Scope

1.1 This specification covers three grades of steel rivets in diameters from 1/2 to 1 1/2 in. (13 to 38 mm), inclusive, for structural fabricating purposes. The grades are as follows:

1.1.1 Grade 1 is a carbon steel rivet for general purposes.

1.1.2 Grade 2 is a carbon-manganese steel rivet suitable, with proper riveting technique, for use with high-strength carbon and high-strength low-alloy structural steels.

1.1.3 Grade 3 is similar to Grade 2 with enhanced atmospheric corrosion resistance and weathering characteristics comparable to that of steels in Specification A 588/A 588M. The atmospheric corrosion resistance of these steels is substantially better than that of carbon steel with or without copper addition (see 5.2). When properly exposed to the atmosphere, these steels can be used bare (uncoated) for many applications.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

A 588/A588M Specification for High-Strength Low-Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4 in. [100 mm] Thick²

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products³

D 3951 Practice for Commercial Packaging⁴

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets⁵

G 101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels⁶

2.2 American National Standard:

B 18.1.2 Large Rivets (1/2 Inch Nominal Diameter and Larger)⁷

2.3 Military Standard:

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes⁸

3. Ordering Information

3.1 Orders for rivets under this specification shall include:

3.1.1 Quantity (number of pieces of rivets),

3.1.2 Name of product, including head type,

3.1.3 Dimensions including nominal diameter and length,

3.1.4 Limits on alloying elements, if required (see 5.2),

3.1.5 Lot testing, if required (see 8.2),

3.1.6 Test report, if required (see 14.1),

3.1.7 Additional package marking, if required (see 17.2),

3.1.8 ASTM designation, including grade and date of issue, and

3.1.9 Any special requirements.

Example—10 000 pieces, Steel Button Head Rivets, 1/2 × 1 in., Test Report Required, ASTM A 502, Grade 1, dated ____ .

4. Materials and Manufacture

4.1 *Process*—the steel for rivets shall be made by the open-hearth, basic-oxygen, or electric-furnace process.

4.2 *Heading*—Rivets may be made by the hot or cold heading process. It is expected that these rivets ordinarily will be hot driven.

5. Chemical Composition

5.1 The rivets shall conform to the heat analysis requirements for chemical composition given in Table 1.

5.2 For Grade 3 rivets, various combinations of alloying elements will be required to meet the atmospheric corrosion or hardness requirements, or both. Maximum limits may be specified for the number and amount of alloy elements by mutual agreement between purchaser and producer at the time of ordering. See Guide G 101 for methods of estimating the atmospheric corrosion resistance of low alloy steels.

¹ This specification is under the jurisdiction of ASTM Committee F-16 on Fasteners, and is the direct responsibility of Subcommittee F 16.02 on Steel Bolts, Nuts, Rivets, and Washers.

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² Annual Book of ASTM Standards, Vol 01.04.

³ Annual Book of ASTM Standards, Vol 01.03.

⁴ Annual Book of ASTM Standards, Vol. 15.09.

⁵ Annual Book of ASTM Standards, Vol 15.08.

⁶ Annual Book of ASTM Standards, Vol 03.02.

⁷ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

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



TABLE 1 Chemical Requirements

	Grade 1		Grade 2		Grade 3 ^{A,B}			
	Heat Analysis, %	Product Analysis, ^C %	Heat Analysis, %	Product Analysis, %	Class A		Class B	
					Heat Analysis, %	Product Analysis, %	Heat Analysis, %	Product Analysis, %
Carbon	0.13–0.25	0.11–0.27	0.19–0.30	0.16–0.33	0.10–0.19	0.09–0.20	0.20 max	0.21 max
Manganese	0.30–0.90	0.27–0.93	1.20–1.65	1.14–1.71	0.90–1.25	0.86–1.29	0.75–1.25	0.71–1.29
Phosphorus, max								
acid	0.06	0.070	0.06	0.070	...	...	...	...
basic	0.04	0.048	0.04	0.048	0.04	0.045	0.04	0.045
Sulfur, max	0.05	0.058	0.05	0.058	0.05	0.055	0.05	0.055
Silicon	...	...	0.10–0.35	0.08–0.37	0.15–0.35	0.13–0.37	0.15–0.35	0.13–0.37
Nickel	...	...	...	...	...	...	0.25–0.50	0.22–0.53
Chromium	...	...	...	...	0.40–0.65	0.37–0.68	0.40–0.70	0.37–0.73
Copper	...	...	...	...	0.25–0.40	0.22–0.43	0.20–0.40	0.17–0.43
Copper, when copper bearing steel is specified, min	0.20	0.18	0.20	0.18	...	...	...	...
Vanadium	...	...	...	...	0.02–0.10	0.01–0.11	0.01–0.10	0.11 max

^AA and B are classes of material used for Grade 3 rivets. Selection of a class shall be at the option of the rivet manufacturer.

^BSee 5.2.

^CProduct analysis is not applicable to rivets made from rimmed steel or merchant quality bars.

5.3 Application of heats of steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted.

5.4 Product analysis may be made by the purchaser from finished rivets representing each lot. The chemical composition shall conform to the requirements in Table 1 on Product Analysis. Product Analysis is not applicable to Grade 1 rivets made from rimmed steel or merchant quality bars.

6. Mechanical Properties

6.1 The rivets shall conform to the hardness requirements shown in Table 2.

6.2 Brinell hardness shall be measured at only one point. Rockwell hardness shall be measured at three points, equally spaced about the axis of the rivet, and the hardness shall be taken as the arithmetic average of the three measurements.

7. Dimensions

7.1 Dimensions of rivets, unless otherwise specified, shall conform to those of one of the head types provided in ANSI B 18.1.2.

8. Number of Tests and Retests

8.1 The requirements of this specification shall be met in continuous mass production for stock, and the manufacturer shall make sample inspections, including visual soundness inspection in 7.1, to ensure that the product conforms to the specified requirements. Additional tests of individual shipments of material are not ordinarily contemplated. Individual heats of steel are not identified in the finished product.

8.2 Additional tests of individual shipments of rivets are not ordinarily required but when such additional tests are specified on the purchase order, a lot for the purpose of selecting test samples shall consist of all rivets in the shipment which have the following common characteristics:

- 8.2.1 One type of head,
- 8.2.2 One nominal diameter, and
- 8.2.3 One nominal length.

8.3 From each lot, the number of tests for each requirement shall be as follows:

Number of Pieces in Lot	Number of Samples
800 and under	1
801 to 8 000	2
8 001 to 22 000	3
Over 22 000	5

8.4 Should any specimen fail to meet the requirements of its specified test, double the number of specimens from the same lot shall be tested for the property in which failure was found and all the additional specimens shall meet the specification requirements.

9. Test Specimens

9.1 Rivets used for testing shall be heat treated in the following manner prior to testing:

9.1.1 *Grade 1*—Normalize by air cooling from above the transformation range.

9.1.2 *Grade 2*—Anneal by heating to 1450°F (790°C), holding for 30 min at temperature and cooling in the furnace.

9.1.3 *Grade 3*—Heat treatment of test samples is not a requirement; however, at the option of the manufacturer, normalizing of test samples is permitted.

9.2 If any test specimen shows defective preparation, it may be discarded and another specimen substituted.

10. Visual Inspection for Head Bursts and Duds

10.1 The rivets shall be inspected for cracks (bursts) and duds and shall meet the Acceptable Quality Level (Note) specified in Table 3. AQL sampling and inspection shall be conducted in accordance with the sample size, acceptance, and rejection values given in Table 4.

TABLE 2 Hardness Requirements

	Grade 1		Grade 2		Grade 3 ^A	
	Min	Max	Min	Max	Min	Max
Rockwell, B	55	72	76	85	76	93
Brinell, 500-kgf (4900-N), 10-mm ball	103	126	137	163	137	197

^ASee 5.2.