



AMERICAN NATIONAL
STANDARD

ANSI/ASTM A 325 – 79

American Association
State Highway and
Transportation Officials
Standard AASHTO No.: M 164

Standard Specification for HIGH-STRENGTH BOLTS FOR STRUCTURAL STEEL JOINTS¹

This standard is issued under the fixed designation A 325; 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.

This specification has been approved for use by agencies of the Department of Defense and for listing in the DOD Index of Specifications and Standards.

1. Scope

1.1 This specification² covers the chemical and mechanical requirements of various types of quenched and tempered steel bolts commonly known as “high-strength structural bolts,” intended for use in structural joints that are covered under requirements of the Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts,³ issued by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation. The various types of bolts covered in this specification are:

1.1.1 *Type 1* – Bolts made of medium-carbon steel, supplied in sizes $\frac{1}{2}$ to $1\frac{1}{2}$ in., inclusive, in diameter.

1.1.2 *Type 2* – Bolts made from what is generally described as low-carbon martensite steel, supplied in sizes $\frac{1}{2}$ to $1\frac{1}{2}$ in., inclusive, in diameter.

1.1.3 *Type 3* – Bolts, $\frac{1}{2}$ to $1\frac{1}{2}$ in., inclusive, in diameter having atmospheric corrosion resistance and weathering characteristics comparable to that of the steels covered in Specification A 588, Specification A 242, and Specification A 709 (these steels have atmospheric corrosion resistance approximately two times that of carbon structural steel with copper).

1.2 When the bolt type is not specified, either Type 1 or Type 2 may be supplied at the option of the manufacturer. Type 3 bolts may be supplied by the manufacturer if agreed by the purchaser. Where elevated temperature applications are involved, Type 1 bolts shall be specified by the purchaser on the order.

1.3 When atmospheric corrosion resistance is required, Type 3 bolts shall be specified by the purchaser in any inquiry or order.

NOTE 1 – Bolts for general applications, including anchor bolts, are covered by ASTM Specification A 449, for Quenched and Tempered Steel Bolts and Studs.⁴ Also refer to Specification A 449 for quenched and tempered steel bolts and studs with diameters greater than $1\frac{1}{2}$ in., but with similar mechanical properties.

1.4 This specification provides that heavy hex structural bolts shall be furnished unless other dimensional requirements are stipulated in the purchase inquiry and order.

1.5 When galvanized high-strength structural bolts are specified, the bolts shall be either Type 1 or 2, at the manufacturer's option, unless otherwise ordered by the purchaser. Bolts shall be hot-dip galvanized, or, with the approval of the purchaser, bolts may be mechanically galvanized. Galvanized bolts and nuts shall be shipped in the same container.

1.6 Suitable nuts are covered in Specification A 563. Unless otherwise specified, nuts shall be heavy hex, and the grade and surface finish of nut for each type of bolt shall be as follows:

¹ This specification is under the jurisdiction of ASTM Committee F-16 on Fasteners, and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets, and Washers.

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² For ASME Boiler and Pressure Vessel Code applications see related Specification SA-325 in Section II of that Code.

³ Published by American Institute of Steel Construction, New York, N. Y.

⁴ Annual Book of ASTM Standards, Part 4.



Bolt Type	Nut Grade and Finish
1 and 2, plain (noncoated)	C, plain
1 and 2, galvanized	DH, galvanized
3	C3

1.6.1 Grades 2 and 2H nuts, as specified in Specification A 194, and Grades D and DH nuts, as specified in Specification A 563, are acceptable alternatives for Grade C nuts. Grade 2H nuts, as specified in Specification A 194, are acceptable alternatives for Grade DH nuts. Type DH3 nuts are acceptable alternatives for C3 nuts.

1.7 Suitable hardened washers are covered in Specification F 436. Unless otherwise specified, galvanized washers shall be furnished when galvanized bolts are specified, and Type 3 weathering steel washers shall be furnished when Type 3 bolts are specified.

NOTE 2—A complete metric companion to Specification A 325 has been developed—Specification A 325M; therefore no metric equivalents are presented in this specification.

2. Applicable Documents

2.1 ASTM Standards:

- A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware⁵
- A 194 Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service⁶
- A 242 Specification for High-Strength Low-Alloy Structural Steel⁴
- A 370 Methods and Definitions for Mechanical Testing of Steel Products⁷
- A 490 Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints⁴
- A 563 Specification for Carbon and Alloy Steel Nuts^{4,6}
- A 588 Specification for High-Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 in. Thick⁴
- A 709 Specification for Structural Steel for Bridges⁴
- B 454 Specification for Mechanically Deposited Coatings of Cadmium and Zinc on Ferrous Metals⁸
- F 436 Specification for Hardened Steel Washers for Use with High-Strength Bolts⁴

2.2 American National Standards:⁹

ANSI B1.1 Unified Screw Threads

ANSI B18.2.1 Square and Hex Bolts and Screws

2.3 Military Standard:¹⁰

MIL-STD-105D Sampling Procedure and Tables for Inspection by Attributes

3. Ordering Information

3.1 Orders for products under this specification shall include the following:

3.1.1 Quantity (number of pieces of bolts and accessories),

3.1.2 Name of products, including accessories such as nuts and washers when desired,

3.1.3 Coating if required (that is, hot dip galvanized, or mechanical galvanized),

3.1.4 Dimensions including nominal bolt diameter and length. For bolts of dimensional requirements other than heavy hex structural bolts (see 1.4) it is normally necessary to specify grip length,

3.1.5 Type of bolt (that is, Type 1, 2 or 3). Note that Type 1 and 2 bolts may be shipped at the manufacturer's option if type has not been specified by the purchaser.

3.1.6 ASTM designation and date of issue, and

3.1.7 Any special requirements.

NOTE 3—Two examples of ordering descriptions follow: (1) 1000 pieces, heavy hex structural bolts, each with one hardened washer, ASTM F 436 and one heavy hex nut, ASTM 563 Grade C, hot dip galvanized, 1 by 4, ASTM A 325 dated _____. (2) 1000 pieces, heavy hex structural bolts, no nuts or washers, 7/8 by 2 1/4 Type 1, ASTM A 325 dated _____, for hot-dip galvanizing.

4. Materials and Manufacture

4.1 Steel for bolts shall be made by the open-hearth, basic-oxygen, or electric-furnace process.

4.2 Bolts shall be heat treated by quenching in a liquid medium from above the austenitizing temperature and then tempering by reheating to a temperature of at least 800°F.

4.3 Threads of bolts may be cut or rolled.

4.4 Unless otherwise specified, galvanized bolts shall be hot-dip zinc coated in accordance with the requirements for Class C of Specification A 153. When specified by the purchaser to be mechanically galvanized,

⁵ Annual Book of ASTM Standards, Part 3.

⁶ Annual Book of ASTM Standards, Part 1.

⁷ Annual Book of ASTM Standards, Parts 1, 2, 3, 4, 5, and 10.

⁸ Annual Book of ASTM Standards, Parts 4 and 9.

⁹ May be obtained from American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

¹⁰ Available from Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, Pa. 19120.





bolts shall be mechanically zinc coated and the coating and coated products shall conform to the requirements for Class 50 of Specification B 454, or to the coating thickness, adherence, and quality requirements for Class C of Specification A 153.

4.5 If heat treatment is performed by a subcontractor the heat-treated material shall be returned to the manufacturer for testing.

5. Chemical Requirements

5.1 Type 1 and 2 bolts shall conform to the requirements as to chemical composition prescribed in Table 1.

5.2 Type 3 bolts shall conform to one of the chemical compositions prescribed in Table 2. The selection of the chemical composition, A, B, C, D, E, or F, shall be at the option of the bolt manufacturer.

5.3 Product analyses may be made by the purchaser from finished material representing each lot of bolts. The chemical composition thus determined shall conform to the requirements prescribed in 4.1 or 4.2.

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

6. Mechanical Requirements

6.1 Bolts shall not exceed the maximum hardness specified in Table 3. Bolts less than three diameters in length shall have hardness values not less than the minimum nor more than the maximum in hardness limits required in Table 3, as hardness is the only requirement.

6.2 Bolts 1 $\frac{1}{4}$ in. in diameter or less, other than those excepted in 6.1, shall be tested full size and shall conform to the tensile strength and either the proof load or alternative proof load requirements specified in Table 4.

6.3 Bolts larger than 1 $\frac{1}{4}$ in. in diameter, other than those excepted in 6.1, shall preferably be tested full size and when so tested shall conform to the tensile strength and either the proof load or alternative proof load requirements specified in Table 4. When equipment of sufficient capacity for full-size testing is not available, or when the length of the bolt makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements of Table 5. In

the event that bolts are tested by both full-size and by the machined test specimen methods, the full-size test shall govern if a controversy between the two methods exists.

6.4 For bolts on which hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event that there is controversy over low readings of hardness tests.

6.5 In addition, when galvanized bolts and nuts are supplied, the bolt/nut assembly shall be tested full size in an assembled joint as specified in 8.5. After the tightening test, the assembly shall show no signs of failure.

6.6 When hot-dip galvanized Type 2 bolts are supplied, they shall be tension tested after galvanizing in accordance with 6.2 or 6.3 depending on the diameter. The number of tests from each lot shall be in accordance with 9.2.4 or 9.3.4.

7. Dimensions

7.1 Bolts with hex heads shall be full-body bolts conforming to the dimensions for heavy hex structural bolts specified in the American National Standard for Square and Hex Bolts and Screws (ANSI B18.2.1).

7.2 Threads shall be the Unified Coarse Thread Series as specified in the American National Standard for Unified Screw Threads (ANSI B1.1), and shall have Class 2A tolerances. When specified, 8 pitch thread series may be used on bolts over 1 in. in diameter.

7.3 Unless otherwise specified, bolts to be used with nuts or tapped holes which have been tapped oversize, in accordance with Specification A 563, shall have Class 2A threads before hot dip or mechanical galvanizing. After galvanizing, the maximum limit of pitch and major diameter may exceed the Class 2A limit by the following amount:

Diameter, in. ⁴	Oversize Limit, in. ⁴
Up to $\frac{7}{16}$, incl	0.016
Over $\frac{7}{16}$ to 1, incl	0.021
Over 1	0.031

⁴ These values are the same as the minimum overlapping required for galvanized nuts in Specification A 563.

7.4 The gaging limit for bolts shall be verified during manufacture or use by assembly of a nut tapped as nearly as practical to the amount oversize shown above. In case of dispute, a calibrated thread ring gage of that