Designation: A 325 – 09

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

Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength[1]

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. 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[2] covers two types of quenched and tempered steel heavy hex structural bolts having a minimum tensile strength of 120 ksi for sizes 1.0 in. and less and 105 ksi for sizes over 1.0 to 1½ in., inclusive.

1.2 The bolts are intended for use in structural connections. These connections are covered under the requirements of the Specification for Structural Joints Using ASTM A 325 or A 490 Bolts, approved by the Research Council on Structural Connections, endorsed by the American Institute of Steel Construction and by the Industrial Fastener Institute.[3]

1.3 The bolts are furnished in sizes ½ to 1½ in., inclusive. They are designated by type, denoting chemical composition as follows:

Type	Description
Type 1	Medium carbon, carbon boron, or medium carbon alloy steel.
Type 2	Withdrawn in November 1991.
Type 3	Weathering steel.

NOTE 1—Bolts for general applications, including anchor bolts, are covered by Specification A 449. Also refer to Specification A 449 for quenched and tempered steel bolts and studs with diameters greater than 1½ in. but with similar mechanical properties.

1.4 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

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.

1.5 This specification is applicable to heavy hex structural bolts only. For bolts of other configurations and thread lengths with similar mechanical properties, see Specification A 449.

1.6 Terms used in this specification are defined in Terminology F 1789.

1.7 The following safety hazard caveat pertains only to the test methods portion, Section 10, of this specification: *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 *ASTM Standards:*[4]

A 194/A 194M Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

A 449 Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

A 490 Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

A 563 Specification for Carbon and Alloy Steel Nuts

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

B 695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

D 3951 Practice for Commercial Packaging

F 436 Specification for Hardened Steel Washers

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F 788/F 788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series

F 959 Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

F 1136 Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

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

Current edition approved Jan. 1, 2009. Published January 2009. Originally approved in 1964. Last previous edition approved in 2007 as A 325 – 07a.

[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 (AISC), One E. Wacker Dr., Suite 700, Chicago, IL 60601-2001, http://www.aisc.org.

[4] 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.**

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS

Not for Resale

F 1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
F 1789 Terminology for F16 Mechanical Fasteners
F 2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
G 101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

2.2 *ASME Standards:*[5]

B 1.1 Unified Screw Threads
B 18.2.6 Fasteners for Use in Structural Applications
B 18.24 Part Identification Number (PIN) Code System Standard for B18 Fastener Products

3. Ordering Information

3.1 Orders for heavy hex structural bolts under this specification shall include the following:

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

3.1.2 Size, including nominal bolt diameter, thread pitch, and bolt length.

3.1.3 Name of product, heavy hex structural bolts.

3.1.4 When bolts threaded full length are required, Supplementary Requirement S1 shall be specified.

3.1.5 Type of bolt: Type 1 or 3. When type is not specified, either Type 1 or Type 3 shall be furnished at the supplier's option.

3.1.6 ASTM designation and year of issue.

3.1.7 Other components such as nuts, washers, and compressible washer-type direct-tension indicators, if required.

3.1.7.1 When such other components are specified to be furnished, also state "Nuts, washers, and direct tension indicators, or combination thereof, shall be furnished by lot number."

3.1.8 *Zinc Coating*—Specify the zinc coating process required, for example, hot dip, mechanically deposited, Zinc/Aluminum Corrosion Protective Coating or no preference (see 4.3).

3.1.9 *Other Finishes*—Specify other protective finish, if required.

3.1.10 Test reports, if required (see Section 13).

3.1.11 Supplementary or special requirements, if required.

3.1.12 For establishment of a part identifying system, see ASME B 18.24.

NOTE 3—A typical ordering description follows: 1000 pieces 1⅛-7 UNC in. dia × 4 in. long heavy hex structural bolt, *Type 1 ASTM A 325–02*, each with one hardened washer, ASTM F 436 Type 1, and one heavy hex nut, ASTM A 563 Grade DH. Each component hot-dip zinc-coated. Nuts lubricated.

3.2 *Recommended Nuts*:

3.2.1 Nuts conforming to the requirements of Specification A 563 are the recommended nuts for use with Specification A 325 heavy hex structural bolts. The nuts shall be of the class and have a surface finish for each type of bolt as follows:

Bolt Type and Finish	Nut Class and Finish
1, plain (noncoated)	A 563-C, C 3, D, DH, DH3, plain
1, zinc coated	A 563-DH, zinc coated
1, coated in accordance with Specification F 1136, Grade 3	A 563–DH coated in accordance with Specification F 1136, Grade 5
3, plain	A 563-C3, DH3, plain

3.2.2 Alternatively, nuts conforming to Specification A 194/A 194M Gr. 2H are considered a suitable substitute for use with Specification A 325 Type 1 heavy hex structural bolts.

3.2.3 When Specification A 194/A 194M Gr. 2H zinc-coated nuts are supplied, the zinc coating, overtapping, lubrication, and rotational capacity testing shall be in accordance with Specification A 563.

3.3 *Recommended Washers*:

3.3.1 Washers conforming to Specification F 436 are the recommended washers for use with Specification A 325 heavy hex structural bolts. The washers shall have a surface finish for each type of bolt as follows:

Bolt Type and Finish	Washer Finish
1, plain (uncoated)	plain (uncoated)
1, zinc coated	zinc coated
1, coated in accordance with Specification F 1136, Grade 3	coated in accordance with Specification F 1136, Grade 3
3, plain	weathering steel, plain

3.4 *Other Accessories*:

3.4.1 When compressible washer type direct tension indicators are specified to be used with these bolts, they shall conform to Specification F 959, Type 325.

4. Materials and Manufacture

4.1 *Heat Treatment*:

4.1.1 Type 1 bolts produced from medium carbon steel shall be quenched in a liquid medium from the austenitizing temperature. Type 1 bolts produced from medium carbon steel to which chromium, nickel, molybdenum, or born were intentionally added shall be quenched only in oil from the austenitizing temperature.

4.1.2 Type 3 bolts shall be quenched only in oil from the austenitizing temperature.

4.1.3 Type 1 bolts, regardless of the steel used, and Type 3 bolts shall be tempered by reheating to not less than 800°F.

4.2 *Threading*—Threads shall be cut or rolled.

4.3 *Zinc Coatings, Hot-Dip and Mechanically Deposited, Zinc/Aluminum Corrosion Protective Coating*:

4.3.1 When zinc-coated fasteners are required, the purchaser shall specify the zinc coating process, for example, hot dip, mechanically deposited, Zinc/Aluminum Corrosion Protective Coating, or no preference.

4.3.2 When hot-dip is specified, the fasteners shall be zinc-coated by the hot-dip process and the coating shall conform to the coating weight/thickness and performance requirements of Specification F 2329.

[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

4.3.3 When mechanically deposited is specified, the fasteners shall be zinc-coated by the mechanical deposition process and the coating shall conform to the coating weight/thickness and performance requirements of Class 55 of Specification B 695.

4.3.4 When Zinc/Aluminum Corrosion Protective Coating is specified, the coating shall conform to the coating weight/thickness and performance requirements of Grade 3 of Specification F 1136.

4.3.5 When no preference is specified, the supplier shall furnish either a hot-dip zinc coating in accordance with Specification F 2329, a mechanically deposited zinc coating in accordance with Specification B 695, Class 55, or a Zinc/Aluminum Corrosion Protective Coating in accordance with Specification F 1136, Grade 3. Threaded components (bolts and nuts) shall be coated by the same zinc-coating process and the supplier's option is limited to one process per item with no mixed processes in a lot.

4.4 *Lubrication*—When zinc-coated nuts are ordered with the bolts, the nuts shall be lubricated in accordance with Specification A 563, Supplementary Requirement S1, to minimize galling.

4.5 *Secondary Processing*:

4.5.1 If any processing, which can affect the mechanical properties or performance of the bolts, is performed after the initial testing, the bolts shall be retested for all specified mechanical properties and performance requirements affected by the reprocessing.

4.5.2 When the secondary process is heat treatment, the bolts shall be tested for all specified mechanical properties. Hot dip zinc-coated bolts shall be tested for all specified mechanical properties and rotational capacity. If zinc-coated nuts are relubricated after the initial rotational capacity tests, the assemblies shall be retested for rotational capacity.

5. Chemical Composition

5.1 Type 1 bolts shall be plain carbon steel, carbon boron steel, alloy steel or alloy boron steel at the manufacturer's option, conforming to the chemical composition specified in Table 1.

5.2 Type 3 bolts shall be weathering steel and shall conform to one of the chemical compositions specified 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. See Guide G 101 for methods of estimating the atmospheric corrosion resistance of low alloy steels.

5.3 Product analyses made on finished bolts representing each lot shall conform to the product analysis requirements specified in Tables 1 and 2, as applicable.

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

5.5 Compliance with 5.4 shall be based on certification that heats of steel having any of the listed elements intentionally added were not used to produce the bolts.

5.6 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology A 751.

TABLE 1 Chemical Requirements for Type 1 Bolts

Element	Carbon Steel	
	Heat Analysis	Product Analysis
Carbon	0.30–0.52	0.28–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.048
Sulfur, max	0.050	0.058
Silicon	0.15–0.30	0.13–0.32

Element	Carbon Boron Steel	
	Heat Analysis	Product Analysis
Carbon	0.30–0.52	0.28–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.048
Sulfur, max	0.050	0.058
Silicon	0.10–0.30	0.08–0.32
Boron	0.0005–0.003	0.0005–0.003

Element	Alloy Steel	
	Heat Analysis	Product Analysis
Carbon	0.30–0.52	0.28–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Silicon	0.15–0.35	0.13–0.37
Alloying Elements	[A]	[A]

	Alloy Boron Steel	
	Heat Analysis	Product Analysis
Carbon	0.30–0.52	0.28–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Silicon	0.15–0.35	0.13–0.37
Boron	0.0005–0.003	0.0005–0.003
Alloying Elements	[A]	[A]

[A] Steel, as defined by the American Iron and Steel Institute, shall be considered to be alloy when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: Manganese, 1.65 %; silicon, 0.60 %; copper, 0.60 % or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99 %, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

6. Mechanical Properties

6.1 *Hardness*—The bolts shall conform to the hardness specified in Table 3.

6.2 *Tensile Properties*:

6.2.1 Except as permitted in 6.2.2 for long bolts and 6.2.3 for short bolts, sizes 1.00 in. and smaller having a length of 2¼ *D* and longer, and sizes larger than 1.00 in. having a length of 3*D* and longer, shall be wedge tested full size and shall conform to the minimum wedge tensile load and proof load or alternative proof load specified in Table 4. The load achieved during proof load testing shall be equal to or greater than the specified proof load.

6.2.2 When the length of the bolt makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements specified in Table 5. When bolts

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 2 Chemical Requirements for Type 3 Heavy Hex Structural Bolts[A]

Element	Composition, %					
	Type 3 Bolts[A]					
	A	B	C	D	E	F
Carbon:						
Heat analysis	0.33–0.40	0.38–0.48	0.15–0.25	0.15–0.25	0.20–0.25	0.20–0.25
Product analysis	0.31–0.42	0.36–0.50	0.14–0.26	0.14–0.26	0.18–0.27	0.19–0.26
Manganese:						
Heat analysis	0.90–1.20	0.70–0.90	0.80–1.35	0.40–1.20	0.60–1.00	0.90–1.20
Product analysis	0.86–1.24	0.67–0.93	0.76–1.39	0.36–1.24	0.56–1.04	0.86–1.24
Phosphorus:						
Heat analysis	0.035 max	0.06–0.12	0.035 max	0.035 max	0.035 max	0.035 max
Product analysis	0.040 max	0.06–0.125	0.040 max	0.040 max	0.040 max	0.040 max
Sulfur:						
Heat analysis	0.040 max	0.040 max	0.040 max	0.040 max	0.040 max	0.040 max
Product analysis	0.045 max	0.045 max	0.045 max	0.045 max	0.045 max	0.045 max
Silicon:						
Heat analysis	0.15–0.35	0.30–0.50	0.15–0.35	0.25–0.50	0.15–0.35	0.15–0.35
Product analysis	0.13–0.37	0.25–0.55	0.13–0.37	0.20–0.55	0.13–0.37	0.13–0.37
Copper:						
Heat analysis	0.25–0.45	0.20–0.40	0.20–0.50	0.30–0.50	0.30–0.60	0.20–0.40
Product analysis	0.22–0.48	0.17–0.43	0.17–0.53	0.27–0.53	0.27–0.63	0.17–0.43
Nickel:						
Heat analysis	0.25–0.45	0.50–0.80	0.25–0.50	0.50–0.80	0.30–0.60	0.20–0.40
Product analysis	0.22–0.48	0.47–0.83	0.22–0.53	0.47–0.83	0.27–0.63	0.17–0.43
Chromium:						
Heat analysis	0.45–0.65	0.50–0.75	0.30–0.50	0.50–1.00	0.60–0.90	0.45–0.65
Product analysis	0.42–0.68	0.47–0.83	0.27–0.53	0.45–1.05	0.55–0.95	0.42–0.68
Vanadium:						
Heat analysis	[B]	[B]	0.020 min	[B]	[B]	[B]
Product analysis	[B]	[B]	0.010 min	[B]	[B]	[B]
Molybdenum:						
Heat analysis	[B]	0.06 max	[B]	0.10 max	[B]	[B]
Product analysis	[B]	0.07 max	[B]	0.11 max	[B]	[B]
Titanium:						
Heat analysis	[B]	[B]	[B]	0.05 max	[B]	[B]
Product analysis	[B]	[B]	[B]	0.06 max	[B]	[B]

[A] A, B, C, D, E, and F are classes of material used for Type 3 bolts. Selection of a class shall be at the option of the bolt manufacturer.
[B] These elements are not specified or required.

TABLE 3 Hardness Requirements for Bolts

Bolt Size, in.	Bolt Length, in.	Brinell		Rockwell C	
		Min	Max	Min	Max
½ to 1, incl	Less than 2*D* [A]	253	319	25	34
	2*D* and over	. . .	319	. . .	34
1⅛ to 1½, incl	Less than 3*D* [A]	223	286	19	30
	3*D* and over	. . .	286	. . .	30

[A] Sizes 1.00 in. and smaller having a length shorter than 2*D* and sizes larger than 1.00 in. having a length shorter than 3*D* are subject only to minimum and maximum hardness.

D = Nominal diameter or thread size.

are tested by both full-size and machined specimen methods, the full-size test shall take precedence.

6.2.3 Sizes 1.00 in. and smaller having a length shorter than 2¼ *D* down to 2*D*, inclusive, that cannot be wedge tensile tested shall be axially tension tested full size and shall conform to the minimum tensile load and proof load or alternate proof load specified in Table 4. Sizes 1.00 in. and smaller having a length shorter than 2*D* that cannot be axially tensile tested shall be qualified on the basis of hardness.

6.2.4 For bolts on which both hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event of low hardness readings.

6.3 *Rotational Capacity Test:*

6.3.1 *Definition*—The rotational capacity test is intended to evaluate the presence of a lubricant, the efficiency of the lubricant, and the compatibility of assemblies as represented by the components selected for testing.

6.3.2 *Requirement*—Zinc-coated bolts, zinc-coated washers, and zinc-coated and lubricated nuts tested full size in an assembled joint or tension measuring device, in accordance with 10.2, shall not show signs of failure when subjected to the nut rotation in Table 6. The test shall be performed by the

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 4 Tensile Load Requirements for Full-Size Bolts

Bolt Size, Threads per Inch, and Series Designation	Stress Area,[A] in.^{2}	Tensile Load,[B] min, lbf	Proof Load,[B] Length Measurement Method	Alternative Proof Load,[B] Yield Strength Method
Column 1	Column 2	Column 3	Column 4	Column 5
½ –13 UNC	0.142	17 050	12 050	13 050
⅝ –11 UNC	0.226	27 100	19 200	20 800
¾ –10 UNC	0.334	40 100	28 400	30 700
⅞ –9 UNC	0.462	55 450	39 250	42 500
1–8 UNC	0.606	72 700	51 500	55 750
1⅛ –7 UNC	0.763	80 100	56 450	61 800
1¼ –7 UNC	0.969	101 700	71 700	78 500
1⅜ –6 UNC	1.155	121 300	85 450	93 550
1½ –6 UNC	1.405	147 500	104 000	113 800

[A] The stress area is calculated as follows:

$$As = 0.7854\,[D - (0.9743/n)]^2$$

where:
As = stress area, in.^{2},
D = nominal bolt size, and
n = threads per inch.

[B] Loads tabulated are based on the following:

Bolt Size, in.	Column 3	Column 4	Column 5
½ to 1, incl	120 000 psi	85 000 psi	92 000 psi
1⅛ to 1½ , incl	105 000 psi	74 000 psi	81 000 psi

responsible party (see Section 14) prior to shipment after zinc coating and lubrication of nuts (see 10.2 and Note 4).

6.3.3 *Acceptance Criterion*—The bolt and nut assembly shall be considered as non-conforming if the assembly fails to pass any one of the following specified requirements:

6.3.3.1 Inability to install the assembly to the nut rotation in Table 6.

6.3.3.2 Inability to remove the nut after installing to the rotation specified in Table 6.

6.3.3.3 Shear failure of the threads as determined by visual examination of bolt and nut threads following removal.

6.3.3.4 Torsional or torsional/tension failure of the bolt. Elongation of the bolt, in the threads between the nut and bolt head, is to be expected at the required rotation and is not to be classified as a failure.

7. Dimensions

7.1 *Head and Body*:

7.1.1 The bolts shall conform to the dimensions for heavy hex structural bolts specified in ASME B 18.2.6.

7.1.2 The thread length shall not be changed except as provided in Supplementary Requirement S1. Bolts with thread lengths other than those required by this specification shall be ordered under Specification A 449.

7.2 *Threads*:

7.2.1 *Uncoated*—Threads shall be the Unified Coarse Thread Series as specified in ASME B 1.1, and shall have Class 2A tolerances.

7.2.2 *Coated*—Unless otherwise specified, zinc-coated bolts to be used with zinc-coated nuts or tapped holes that are tapped oversize, in accordance with Specification A 563, shall have Class 2A threads before hot-dip or mechanically deposited zinc coating. After zinc coating, the maximum limits of pitch and major diameter shall not exceed the Class 2A limit by more than the following amounts:

Nominal Bolt Diameter (in.)	Oversize Limit, in.[A] Hot-Dip Zinc	Oversize Limit, in.[A] Mechanical Zinc
½	0.018	0.012
9⁄16 , ⅝ , ¾	0.020	0.013
⅞	0.022	0.015
1 to 1¼	0.024	0.016
1⅜ , 1½	0.027	0.018

[A] Hot-dip zinc nuts are tapped oversize after coating, and mechanical zinc-coated nuts are tapped oversize before coating.

7.2.3 The gaging limit for bolts shall be verified during manufacture. In case of dispute, a calibrated thread ring gage of the same size as the oversize limit in 7.2.2 (Class X tolerance, gage tolerance plus) shall be used to verify compliance. The gage shall assemble with hand effort following application of light machine oil to prevent galling and damage to the gage. These inspections, when performed to resolve controversy, shall be conducted at the frequency specified in the quality assurance provisions of ASME B 18.2.6.

8. Workmanship

8.1 The allowable limits, inspection, and evaluation of the surface discontinuities, quench cracks, forging cracks, head bursts, shear bursts, seams, folds, thread laps, voids, tool marks, nicks, and gouges shall be in accordance with Specification F 788/F 788M.

9. Number of Tests and Retests

9.1 *Testing Responsibility*:

9.1.1 Each lot shall be tested by the manufacturer prior to shipment in accordance with the lot identification control quality assurance plan in 9.2 through 9.5.

9.1.2 When bolts are furnished by a source other than the manufacturer, the Responsible Party as defined in 14 shall be responsible for assuring all tests have been performed and the bolts comply with the requirements of this specification (see 4.5).

9.2 *Purpose of Lot Inspection*—The purpose of a lot inspection program is to ensure that each lot conforms to the requirements of this specification. For such a plan to be fully effective it is essential that secondary processors, distributors, and purchasers maintain the identification and integrity of each lot until the product is installed.

9.3 *Lot Method*—All bolts shall be processed in accordance with a lot identification-control quality assurance plan. The manufacturer, secondary processors, and distributors shall identify and maintain the integrity of each production lot of bolts from raw-material selection through all processing operations and treatments to final packing and shipment. Each lot shall be assigned its own lot-identification number, each lot shall be tested, and the inspection test reports for each lot shall be retained.

9.4 *Lot Definition*—A lot shall be a quantity of uniquely identified heavy hex structural bolts of the same nominal size

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 5 Tensile Strength Requirements for Specimens Machined from Bolts

Bolt Diameter, in.	Tensile Strength, min, psi (MPa)	Yield Strength, min, psi (MPa)	Elongation, in 4*D*, min, %	Reduction of Area, min, %
½ to 1, incl.	120 000 (825)	92 000 (635)	14	35
Over 1 to 1½	105 000 (725)	81 000 (560)	1435	

TABLE 6 Rotational Capacity Test for Zinc-Coated Bolts

Bolt Length, in.	Nominal Nut Rotation, degrees (turn)
Up to and including 4 × dia	240 (⅔)
Over 4 × dia, but not exceeding 8 × dia	360 (1)
Over 8 × dia, but not exceeding 12 × dia	420 (1⅙)
Over 12 × dia.	Test not applicable

and length produced consecutively at the initial operation from a single mill heat of material and processed at one time, by the same process, in the same manner so that statistical sampling is valid. The identity of the lot and lot integrity shall be maintained throughout all subsequent operations and packaging.

9.5 *Number of Tests*—The minimum number of tests from each lot for the tests specified below shall be as follows:

Tests	Number of Tests in Accordance With
Hardness, tensile strength, proof load, and rotational capacity	Guide F 1470
Coating weight/ thickness	The referenced coating specification[A]
Surface discontinuities	Specification F 788/ F 788M
Dimensions and thread fit	ASME B 18.2.6

[A] Guide F 1470 applies if the coating specification does not specify a testing frequency.

10. Test Methods

10.1 *Tensile, Proof Load, and Hardness*:

10.1.1 Tensile, proof load, and hardness tests shall be conducted in accordance with Test Methods F 606.

10.1.2 Tensile strength shall be determined using the Wedge or Axial Tension Testing Method of Full Size Product Method or the Machined Test Specimens Method depending on size and length as specified in 6.2.1-6.2.4. Fracture on full-size tests shall be in the body or threads of the bolt without a fracture at the junction of the head and body.

10.1.3 Proof load shall be determined using Method 1, Length Measurement, or Method 2, Yield Strength, at the option of the manufacturer.

10.2 *Rotational Capacity*—The zinc-coated bolt shall be placed in a steel joint or tension measuring device and assembled with a zinc-coated washer and a zinc-coated and lubricated nut with which the bolt is intended to be used (see Note 4). The nut shall have been provided with the lubricant described in the last paragraph of the Manufacturing Processes section of Specification A 563. The joint shall be one or more flat structural steel plates or fixture stack up with a total thickness, including the washer, such that 3 to 5 full threads of the bolt are located between the bearing surfaces of the bolt head and nut. The hole in the joint shall have the same nominal diameter as the hole in the washer. The initial tightening of the nut shall produce a load in the bolt not less than 10 % of the specified proof load. After initial tightening, the nut position shall be marked relative to the bolt, and the rotation shown in Table 6 shall be applied. During rotation, the bolt head shall be restrained from turning. After the tightening rotation has been applied, the assembly shall be taken apart and examined for compliance with 6.3.3.

NOTE 4—Rotational capacity tests shall apply only to matched assembly lots that contain one A 325 bolt, one A 563 lubricated nut, and one F 436 washer that have been zinc coated in accordance with either Specifications F 2329 or B 695. Both the bolt and nut components of the matched assembly shall be zinc coated using the same process.

11. Inspection

11.1 If the inspection described in 11.2 is required by the purchaser, it shall be specified in the inquiry and contract or order.

11.2 The purchaser's representative shall have free entry to all parts of the manufacturer's works, or supplier's place of business, that concern the manufacture or supply of the material ordered. The manufacturer or supplier shall afford the purchaser's representative all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspections required by the specification that are requested by the purchaser's representative shall be made before shipment, and shall be conducted as not to interfere unnecessarily with the operation of the manufacturer's works or supplier's place of business.

12. Rejection and Rehearing

12.1 Disposition of nonconforming bolts shall be in accordance with the Guide F 1470 section titled "Disposition of Nonconforming Lots."

13. Certification

13.1 When specified on the purchase order, the manufacturer or supplier, whichever is the responsible party as defined in Section 14, shall furnish the purchaser a test reports that includes the following:

13.1.1 Heat analysis, heat number, and a statement certifying that heats having the elements listed in 5.4 intentionally added were not used to produce the bolts,

13.1.2 Results of hardness, tensile, and proof load tests,

13.1.3 Results of rotational capacity tests. This shall include the test method used (solid plate or tension measuring device); and the statement " Nuts lubricated" for zinc-coated nuts when shipped with zinc-coated bolts,

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

13.1.4 Zinc coating measured coating weight/thickness for coated bolts,

13.1.5 Statement of compliance of visual inspection for surface discontinuities (Section 8),

13.1.6 Statement of compliance with dimensional and thread fit requirements,

13.1.7 Lot number and purchase order number,

13.1.8 Complete mailing address of responsible party, and

13.1.9 Title and signature of the individual assigned certification responsibility by the company officers.

13.2 Failure to include all the required information on the test report shall be cause for rejection.

14. Responsibility

14.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

15. Product Marking

15.1 *Manufacturer's Identification*—All Type 1 and 3 bolts shall be marked by the manufacturer with a unique identifier to identify the manufacturer or private label distributor, as appropriate.

15.2 *Grade Identification*:

15.2.1 Type 1 bolts shall be marked "A 325."

15.2.2 Type 3 bolts shall be marked "A 325" with the "A 325" underlined. The use of additional distinguishing marks to indicate that the bolts are weathering steel shall be at the manufacturer's option.

15.3 *Marking Location and Methods*—All marking shall be located on the top of the bolt head and shall be either raised or depressed at the manufacturer's option.

15.4 *Acceptance Criteria*—Bolts which are not marked in accordance with these provisions shall be considered nonconforming and subject to rejection.

15.5 Type and manufacturer's or private label distributor's identification shall be separate and distinct. The two identifications shall preferably be in different locations and, when on the same level, shall be separated by at least two spaces.

16. Packaging and Package Marking

16.1 *Packaging*:

16.1.1 Unless otherwise specified, packaging shall be in accordance with Practice D 3951.

16.1.2 When zinc coated nuts are included on the same order as zinc coated bolts, the bolts and nuts shall be shipped in the same container.

16.1.3 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

16.2 *Package Marking*:

16.2.1 Each shipping unit shall include or be plainly marked with the following information:

16.2.1.1 ASTM designation and type,

16.2.1.2 Size,

16.2.1.3 Name and brand or trademark of the manufacturer,

16.2.1.4 Number of pieces,

16.2.1.5 Lot number; when nuts, washers or direct tension indicators, or combination thereof, are ordered with A 325 heavy hex structural bolts, the shipping unit shall be marked with the lot number in addition to the marking required by the applicable product specification,

16.2.1.6 Purchase order number, and

16.2.1.7 Country of origin.

17. Keywords

17.1 bolts; carbon steel; steel; structural; weathering steel

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the contract or order. Details of these supplementary requirements shall be agreed upon in writing between the manufacturer and purchaser. Supplementary requirements shall in no way negate any requirement of the specification itself.

S1. Bolts Threaded Full Length

S1.1 Bolts with nominal lengths equal to or shorter than four times the nominal bolt diameter shall be threaded full length. Bolts need not have a shoulder, and the distance from the underhead bearing surface to the first complete (full form) thread, as measured with a GO thread ring gage, assembled by hand as far as the thread will permit, shall not exceed the length of 2½ threads for bolt sizes 1 in. and smaller, and 3½ threads for bolt sizes larger than 1 in.

S1.2 Bolts shall be marked in accordance with Section 15, except that the symbol shall be " A 325 T" instead of "A 325."

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A 325–07a) that may impact the use of this standard. (Approved Jan. 1, 2009)

(*1*) *Revised*—4.3 to add provision for specifying Zinc/Aluminum Corrosion Protective Coating conforming to Specification F 1136.

(*2*) In 8.1 deleted Note 4 in regard to non injurious bursts.

Committee F16 has identified the location of selected changes to this standard since the last issue (A 325–07) that may impact the use of this standard. (Approved Dec. 1, 2007)

(*1*) Sections 4.3.3 and 4.3.5 were revised.

Committee F16 has identified the location of selected changes to this standard since the last issue (A 325–06) that may impact the use of this standard. (Approved Sept. 15, 2007.)

(*1*) Changed the referenced hot dip zinc coating specification from Specification A 153/A 153M Gr. C to Specification F 2329.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS

Not for Resale