Designation: A 325 – 00

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 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 of the Engineering Foundation.[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Type 2	Withdrawn in November 1991.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. Atmospheric corrosion resistance and weathering characteristics are comparable to that of steels in Specifications A 242/A 242M, A 588/A 588M, and A 709/A 709M. 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.

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.

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.

1.4 The following safety hazards 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:*

A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware[4]

A 194/A 194M Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service[5]

A 242/A 242M Specification for High-Strength Low-Alloy Structural Steel[6]

A 449 Specification for Quenched and Tempered Steel Bolts and Studs[7]

A 490 Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength[7]

A 563 Specification for Carbon and Alloy Steel Nuts[7]

A 588/A 588M Specification for High-Strength Low-Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4 in. [100 mm] Thick[6]

A 709/A 709M Specification for Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges[6]

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[8]

B 695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel[9]

D 3951 Practice for Commercial Packaging[10]

F 436 Specification for Hardened Steel Washers[7]

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets[7]

F 788/F 788M Specification for Surface Discontinuities of

[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 July 10, 2000. Published September 2000. Originally published as A 325 – 64. Last previous edition A 325 – 97.

[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, Wrigley Building, 400 N. Michigan Ave., Chicago, IL 60611.

[4] *Annual Book of ASTM Standards*, Vol 01.06.
[5] *Annual Book of ASTM Standards*, Vol 01.01.
[6] *Annual Book of ASTM Standards*, Vol 01.04.
[7] *Annual Book of ASTM Standards*, Vol 01.08.
[8] *Annual Book of ASTM Standards*, Vol 01.03.
[9] *Annual Book of ASTM Standards*, Vol 02.05.
[10] *Annual Book of ASTM Standards*, Vol 15.09.

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

Bolts, Screws, and Studs, Inch and Metric Series[7]
F 959 Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners[7]
G 101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels[11]
2.2 *ANSI/ASME Standards:*[12]
B 1.1 Unified Screw Threads
B 18.2.1 Square and Hex Bolts and Screws
B 18.18.3M Inspection and Quality Assurance for Special Purpose Fasteners
2.3 *Military Standard:*[13]
MIL-STD-105 Sampling Procedure and Tables for Inspection by Attributes

3. Ordering Information

3.1 Orders for 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 and length (see 3.1.3.1).

3.1.2.1 Bolts threaded full length, specify Supplementary Requirements S1.

3.1.3 Name of product.

3.1.3.1 Heavy Hex Structural Bolts are supplied unless otherwise specified. For bolts other than Heavy Hex Structural, dimensional requirements must be specified on the purchase inquiry and order. The thread length may not be changed except as provided in Supplementary Requirements S1.

3.1.4 Type of bolt, that is, Type 1 or 3.

3.1.5 ASTM designation and year of issue.

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

3.1.6.1 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".

3.1.7 Accessories such as nuts and washers, when required.

3.1.8 *Zinc Coating*—Specify the zinc coating process required, for example, hot dip, mechanically deposited, 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 14).

3.1.11 Special requirements.

NOTE 3—A typical ordering description follows: 1000 pieces 1 in. dia × 4 in. long Heavy Hex Structural Bolt, *Type 1 ASTM A 325-XX*; 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 Unless otherwise specified, all nuts used on these bolts shall conform to the requirements of Specifications A 194/A 194M or A 563, shall be heavy hex, and shall be of the class and surface finish for each type of bolt as follows:

[11] *Annual Book of ASTM Standards*, Vol 03.02.
[12] Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.
[13] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

Bolt Type and Finish	Nut Class and Finish
1, plain (noncoated)	A 563-C, c 3, D, DH, DH3, plain A 194-2, 2H, plain
1, zinc coated	A 563-DH, zinc coated A 194-2H, zinc coated (see 3.2.2)
3, plain	A 563-C3, DH3, plain

3.2.2 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 Unless otherwise specified, all washers used on these bolts shall conform to the requirements of Specifications F 436 or F 959 and shall be of 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
3, plain	weathering steel, plain

4. Materials and Manufacture

4.1 *Heat Treatment*—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.

4.2 *Threading*—Threads of bolts may be cut or rolled.

4.3 *Zinc Coatings, Hot-dip and Mechanically Deposited*:

4.3.1 When zinc-coated fasteners are required, the purchaser shall specify the zinc coating process, for example, hot dip, mechanically deposited, 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 Class C of Specification A 153.

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 50 of Specification B 695.

4.3.4 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification A 153, Class C, or a mechanically deposited zinc coating in accordance with Specification B 695, Class 50. 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*—If heat treatment, zinc coating, lubrication, or other processing affecting properties is performed by a subcontractor, the fasteners shall be inspected after such processing by the party responsible for supplying the fasteners to the user or installer. Heat treated fasteners shall be tested for all mechanical properties; hot dip zinc coated fasteners for all mechanical properties and rotational capacity; mechanically zinc coated fasteners for rotational capacity; and lubricated fasteners for rotational capacity.

5. Chemical Composition

5.1 Type 1 bolts shall be plain carbon steel, carbon/boron steel, or alloy steel, at the manufacturers 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 may be made by the purchaser from finished material representing each lot of bolts. The chemical composition thus determined shall conform to the requirements specified in 5.1 or 5.2.

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

5.5 For Type 1 bolts made from plain carbon steel or alloy steel, heats of steel to which boron has been intentionally

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
Boron	see 5.5 and 5.6	

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
Boron	see 5.5 and 5.6	
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.

TABLE 2 Chemical Requirements for Type 3 Bolts

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	0.040 max	0.06–0.12	0.035 max	0.040 max	0.040 max	0.040 max
Product analysis	0.045 max	0.06–0.125	0.040 max	0.045 max	0.045 max	0.045 max
Sulfur:						
Heat analysis	0.050 max	0.050 max	0.040 max	0.050 max	0.040 max	0.040 max
Product analysis	0.055 max	0.055 max	0.045 max	0.055 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	...	...	0.020 min	...	...	...
Product analysis	...	...	0.010 min	...	...	...
Molybdenum:						
Heat analysis	...	0.06 max	...	0.10 max	...	...
Product analysis	...	0.07 max	...	0.11 max	...	...
Titanium:						
Heat analysis	...	...	...	0.05 max	...	...
Product analysis	...	...	...	...	...	...

[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.

added shall not be permitted.

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

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

6. Mechanical Properties

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

6.2 *Tensile Properties*:

6.2.1 Bolts having a length of 3 times the diameter or longer (see 6.2.3) shall be tested full size and shall conform to the tensile strength and proof load or alternative proof load specified in Table 4.

6.2.2 Bolts having a length less than 3 times the diameter are not subject to tensile tests, except as permitted in 6.2.3.

6.2.3 Bolts having a length of 2 times the diameter or longer may be tested full size for tensile properties whenever test equipment is available. In such cases reference to "3 times the diameter" in Table 3, 6.2.1, and 6.2.2 shall be considered to be "2 times the diameter".

TABLE 3 Hardness Requirements for Bolts

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

[A] Bolts having a length less than 3 times the diameter are subject only to minimum/maximum hardness. Such lengths cannot be reasonably tensile tested. D = Nominal diameter or thread size.

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

6.3 *Rotational Capacity Test:*

TABLE 4 Tensile Requirements for Full Size Bolts

Bolt Size, Threads per Inch and Series Designation	Stress Area,[A] in.^{2}	Tensile Strength,[B] min, lbf	Proof Load,[B] Length Measurement Method	Alternative Proof Load,[B] Yield Strength Method, min
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
–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
1⅛–8 UN	0.790	82 950	58 450	64 000
1¼–7 UNC	0.969	101 700	71 700	78 500
1¼–8 UN	1.000	105 000	74 000	81 000
1⅜–6 UNC	1.155	121 300	85 450	93 550
1⅜–8 UN	1.233	129 500	91 250	99 870
1½–6 UNC	1.405	147 500	104 000	113 800
1½–8 UN	1.492	156 700	110 400	120 850

[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
½to 1, incl	120 000 psi	85 000 psi	92 000 psi
1⅛ to 1½, incl	105 000 psi	74 000 psi	81 000 psi

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 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 5. The test shall be performed by the responsible party (see Section 15) prior to shipment after zinc coating and lubrication of nuts.

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 5.

6.3.3.2 Inability to remove the nut after installing to the rotation specified in Table 5.

TABLE 5 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

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 The bolts shall be full-body conforming to the dimensions for Heavy Hex Structural Bolts specified in ANSI/ASME B18.2.1.

7.1.1 Heavy Hex Structural Bolts shall be supplied, unless otherwise specified. For bolts other than Heavy Hex Structural, dimensional requirements must be specified on the purchase inquiry and order. The thread length may not be changed except as provided in Supplementary Requirement S1. Special thread lengths can be ordered under Specification A 449.

7.2 Threads shall be the Unified Coarse Thread Series as specified in ANSI/ASME 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 mechanically deposited zinc coating. After zinc coating, the maximum limit of pitch and major diameter may exceed the Class 2A limit by the following amount:

Diameter, in.[A]	Oversize Limit, in.[A]
¼	0.016
5⁄16, ⅜	0.017
7⁄16, ½	0.018
9⁄16 to ¾ incl	0.020
⅞	0.022
1.0 to 1¼ incl	0.024
1⅜, 1½	0.027

[A] These values are the same as the overtapping required for zinc-coated nuts in Specification A 563.

7.4 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 7.3 (Class X tolerance, gage tolerance plus) shall be used to verify compliance. Assembly of the gage, or the nut described above, must be possible with hand effort following application of light machine oil to prevent galling and damage to the gage. These inspections, when performed to resolve disputes, are to be performed at the frequency described in Table 6.

8. Workmanship

8.1 Surface discontinuity limits 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 production lot identification control quality assurance plan in 9.2 through 9.6.

9.1.2 When bolts are furnished by a source other than the manufacturer, the Responsible Party as defined in 15.1 shall be responsible for assuring all tests have been performed and the

TABLE 6 Sample Sizes and Acceptance Numbers for Inspection of Hot Dip or Mechanically Deposited Zinc-Coated Threads

Lot Size	Sample Size[A,B]	Acceptance Number[A]
2 to 90	13	1
91 to 150	20	2
151 to 280	32	3
281 to 500	50	5
501 to 1 200	80	7
1 201 to 3 200	125	10
3 201 to 10 000	200	14
10 001 and over	315	21

[A] Sample sizes of acceptance numbers are extracted from "Single Sampling Plan for Normal Inspection," Table IIA, MIL-STD-105.
[B] Inspect all bolts in the lot if the lot size is less than the sample size.

bolts comply with the requirements of this specification (see 4.5).

9.2 *Purpose of Lot Inspection*—The purpose of a production 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 *Production 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 *Production Lot Definition*—A production lot, for purposes of assigning an identification number and from which test samples shall be selected, shall consist of all bolts processed essentially together through all operations to the shipping container that are of the same nominal size, the same nominal length, and produced from the same mill heat of steel.

9.5 *Number of Tests*:

9.5.1 The minimum number of tests from each production lot shall conform to the following:

Test	Number of Pieces in Production Lot	Number of Tests	Acceptance Number
	800 and less	1	0
Hardness	801 to 8 000	2	0
Tensile	8 001 to 35 000	3	0
Proof Load	35 001 to 150 000	8	0
	150 001 and over	13	0
Rotational Capacity	150 000 and less	2	0
Coating Weight	250 000 and less	4	0
Dimensions	In accordance with the manufacturer's standard quality control practices. In the event of dispute, acceptance shall be based on the requirements for Final Inspection-Non Destructive shown in ASME/ANSI B 18.18.3M		
Thread fit			
Non Coated	Same as Dimensions		
Coated	In accordance with 7.4 and Table 6		
Head Bursts	In accordance with Section 11 and Table 7		

9.6 When tested in accordance with the required sampling plan, a lot shall be rejected if any of the test specimens fail to meet the applicable test requirements.

10. Test Methods

10.1 *Tensile and Hardness*:

10.1.1 Tensile and hardness tests shall be conducted in accordance with Test Methods F 606 using the wedge tension testing of full size product method to determine full size tensile strength.

10.1.2 Proof load shall preferably be determined using Method 1, Length Measurement.

10.1.3 Fracture shall be in the body or threads of the bolt without any fracture at the junction of the head and body.

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. 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 5 shall be applied. During rotation, the bolt head shall be restrained from turning.

11. Visual Inspection for Head Bursts

11.1 *Requirement*—Each lot shall be visually inspected for head bursts and shall meet an acceptable quality level of 2.5 as specified in Table 7.

11.2 *Testing*—AQL sampling and inspection shall be conducted in accordance with the sample size, acceptance, and rejection values specified in Table 7. Samples shall be picked at random.

11.3 *Definitions*:

11.3.1 *Burst*—A burst is an open break in the metal (material). Bursts can occur on the flats or corners of the heads of bolts.

11.3.2 *Defective Bolt*—A defective bolt, for the purposes of the visual inspection for bursts, shall be any bolt that contains

TABLE 7 Sample Sizes with Acceptance and Rejection Numbers for Inspection of Bursts 2.5 AQL

Lot Size	Sample Size[A,B]	Acceptance Number[A]	Rejection No.
2 to 8	2	0	1
9 to 15	3	0	1
16 to 25	5	0	1
26 to 150	20	1	2
151 to 280	32	2	3
281 to 500	50	3	4
501 to 1 200	80	5	6
1 201 to 3 200	125	7	8
3 201 to 10 000	200	10	11
10 001 to 35 000	315	14	15

[A] Sample sizes, acceptance numbers, and rejection numbers are extracted from "Single Sampling Plan for Normal Inspection," Table IIA, MIL-STD-105.
[B] Inspect all bolts in the lot if the lot size is less than the sample size.

a burst in the flat of the head which extends into the top crown surface of the head (chamfer circle) or the under-head bearing surface. In addition, bursts occurring at the intersection of two wrenching flats shall not reduce the width across corners below the specified minimum.

11.3.3 *Lot*—A lot, for the purposes of visual inspection, shall consist of all bolts of one type having the same nominal diameter and length made from the same heat of material and by the same production process and subsequently submitted for final inspection at one time.

11.4 *Acceptance Criteria*:

11.4.1 *Manufacturer*—If the number of defective bolts found during inspection by the manufacturer is greater than the acceptance number given in Table 7 for the sample size, all bolts in the lot shall be visually inspected and all defective bolts shall be removed and destroyed.

11.4.2 *Purchaser*—If the number of defective bolts found during inspection by the purchaser is greater than the acceptance number given in Table 7 for the sample size, the lot shall be subject to rejection.

12. Inspection

12.1 If the inspection described in 12.2 is required by the purchaser, it shall be specified in the inquiry and contract or order.

12.2 The inspector representing the purchaser 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 inspector 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.

13. Rejection and Rehearing

13.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the manufacturer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the manufacturer or supplier may make claim for a rehearing.

14. Certification

14.1 When specified on the purchase order, the manufacturer or supplier, whichever is the responsible party as defined in Section 15, shall furnish the purchaser a test report which includes the following:

14.1.1 Heat analysis, heat number, and a statement certifying that heats having the elements listed in 5.4 and 5.5 intentionally added were not used to produce the bolts,

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

14.1.3 Results of rotational capacity tests. This shall include the test method used (solid plate or tension measuring device); and the lubricant present for zinc coated nuts when shipped with zinc coated bolts,

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

14.1.5 Results of visual inspection for bursts,

14.1.6 Statement of compliance with dimensional and thread fit requirements,

14.1.7 Lot number and purchase order number,

14.1.8 Complete mailing address of responsible party, and

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

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

15. Responsibility

15.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser and certifies that the fastener was manufactured, sampled, tested and inspected in accordance with this specification and meets all of its requirements.

16. Product Marking

16.1 *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.

16.2 *Grade Identification*:

16.2.1 Type 1 bolts shall be marked "A 325." Additionally, the bolts may be marked with 3 radial lines 120 degrees apart.

16.2.2 Type 3 bolts shall be marked A 325 with the A 325 underlined. The manufacturer may add other distinguishing marks indicating the bolt is a weathering type.

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

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

16.5 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.

17. Packaging and Package Marking

17.1 *Packaging*:

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

17.1.2 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.

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

17.2 *Package Marking*:

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

17.2.1.1 ASTM designation and type,

17.2.1.2 Size,

17.2.1.3 Name and brand or trademark of the manufacturer,

17.2.1.4 Number of pieces,

17.2.1.5 Lot number; when nuts, washers or direct tension indicators, or combination thereof, are ordered with A325 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,
17.2.1.6 Purchase order number, and
17.2.1.7 Country of origin.

18. Keywords

18.1 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 16, except that the symbol shall be A 325 T instead of A 325.

SUMMARY OF CHANGES

This section identifies the location of selected changes to this standard that have been incorporated since the -97 issue. For the convenience of the user, Committee F16 has highlighted those changes that impact the use of this standard. This section may also include descriptions of the changes or reasons for the changes, or both.

(1) Added 3.1.6.1 and expanded 17.2.1.5 to require lot number identification for nuts, washers, and direct tension indicators when furnished with bolts.