Designation: A325M – 14

Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric)[1]

This standard is issued under the fixed designation A325M; 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.

1. Scope*

1.1 This specification[2] covers two types of quenched and tempered, steel, metric heavy hex structural bolts having a minimum tensile strength of 830 MPa (Note 1).

1.2 The bolts are intended for use in structural connections. These connections are comparable to those covered under the requirements of the Specification for Structural Joints Using High-Strength Bolts, approved by the Research Council on Structural Connections; endorsed by the American Institute of Steel Construction and by the Industrial Fastener Institute.

1.3 The bolts are furnished in sizes M12 to M36 inclusive. They are designated by type denoting chemical composition as follows:

1.3.1 *Type 1*—Medium-carbon, carbon boron, medium carbon alloy, or alloy boron steel.

1.3.2 *Type 2*—Withdrawn in 2003.

1.3.3 *Type 3*—Weathering Steel.

1.4 This specification is applicable to metric heavy hex, structural bolts only.

1.5 Terms used in this specification are defined in Terminology F1789.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

NOTE 1—This specification is the metric companion to the inch pound Specification A325.

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:*[3]

A153/A153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A563M Specification for Carbon and Alloy Steel Nuts (Metric)

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

B695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

D3951 Practice for Commercial Packaging

F436M Specification for Hardened Steel Washers (Metric)

F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric)

F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series

F959M Specification for Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners (Metric)

F1136M Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners (Metric) (Withdrawn 2011)[4]

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

F1789 Terminology for F16 Mechanical Fasteners

G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

2.2 *ASME Standards:*[5]

B 1.13M Metric Screw Threads

B 18.2.3.7M Metric Heavy Hex Structural Bolts

[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.

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

[3] 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.

[4] The last approved version of this historical standard is referenced on www.astm.org.

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

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

B 18.18.3M Inspection and Quality Assurance for Special Purpose Fasteners
B 18.24 Part Identifying Number (PIN) Code System Standard for B18 Fastener Products

2.3 *RCSC Standard:*[6]
Specification for Structural Joints Using High-Strength Bolts

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 Type 3. When the 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.

3.1.8 *Zinc Coating*—Specify the zinc-coating process required, for example, hot-dip, mechanically deposited, Zinc Aluminium 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 B18.24.

NOTE 2—A typical ordering description follows: 1000 pieces, M24×3×100, heavy hex structural bolts, Type 1 ASTM A325M - 03, each with one hardened washer and one heavy hex nut, mechanically deposited zinc coating (see 3.1.8 for any special requirements).

3.2 *Recommended Nuts:*

3.2.1 Nuts conforming to the requirements of Specification A563M are the recommended nuts for use with A325M metric 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 Specification
1, plain (noncoated)	A563M—8S or 8S3, plain
1, zinc-coated	A563M—10S, zinc-coated
1, coated in accordance with Specification F1136M, Grade 3	A563M—10S coated in accordance with Specification F1136M, Grade 5
3, plain	A563M—8S3, plain

3.3 *Recommended Washers:*

3.3.1 Washers conforming to Specification F436M are the recommended washers for use with Specification A325M Metric 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 F1136M, Grade 3	coated in accordance with Specification F1136M
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 the requirements in Specification F959M Type 8.8.

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.

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] Available from American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 700, Chicago, IL 60601-2001, http://www.aisc.org.

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.

4.1.2 Type 1 bolts produced from carbon steel to which chromium, nickel, molybdenum, or boron were intentionally added shall be quenched only in oil from the austenitizing temperature.

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

4.1.4 Type 1 bolts, regardless of the steel used, and Type 3 bolts, shall be tempered by reheating to not less than 427°C.

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

4.3 *Zinc Coatings, Hot-dip and Mechanically Deposited and 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 Class C of Specification A153/A153M.

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 B695.

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 F1136M.

4.3.5 When no preference is specified, the supplier shall furnish either a hot-dip zinc coating in accordance with Specification A153/A153M, Class C, or a mechanically deposited zinc coating in accordance with Specification B695, Class 55, or a Zinc/Aluminum Corrosion Protective Coating in accordance with Specification F1136M, 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 A563M, 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. See 10.2, Note 3.

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 G101 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 Table 1 or Table 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 A751.

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 6.2.1.1 for long bolts, and 6.2.1.2 for short bolts, sizes M24 and smaller having a nominal length of 2-¼ D and longer; and sizes larger than M24 having a nominal length of 3D 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.

TABLE 3 Hardness Requirements for Bolts

Bolt Size, mm	Bolt Length, mm	Brinell		Rockwell C	
		Min	Max	Min	Max
M12 to M24, incl	Less than 2*D*	253	319	25	34
	2*D* and over	. . .	319	. . .	34
M25 to M36, incl	Less than 3*D*	253	319	25	34
	3*D* and over	. . .	319	. . .	34

D = Nominal diameter or thread size.

TABLE 4 Tensile Load and Proof Load Requirements for Bolts Tested Full-Size

Nominal Diameter and Thread Pitch	Stress Area,[A] mm	Tensile Load,[B] min,	Proof Load,[B] Length Measurement Method	Alternative Proof Load,[B] Yield Strength Method
Column 1	Column 2	Column 3	Column 4	Column 5
M12 × 1.75	84.3	70	50.6	55.6
M16 × 2	157	130	94.2	104
M20 × 2.5	245	203	147	162
M22 × 2.5	303	251	182	200
M24 × 3	353	293	212	233
M27 × 3	459	381	275	303
M30 × 3.5	561	466	337	370
M36 × 4	817	678	490	539

[A] Stress Area, $mm^2 = 0.7854 (D - 0.9382P)^2$
where:
D = nominal bolt diameter, mm, and
P = thread pitch, mm.

[B] Loads tabulated are based on the following:

Column 3	Column 4	Column 5
830 MPa	600 MPa	660 MPa

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

6.2.1.2 Sizes M24 and smaller having a nominal length shorter than 2-¼ D down to 2D inclusive, which 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 M24 and smaller having a nominal length shorter than 2D and sizes larger than M24 with nominal lengths shorter than 3D, which cannot be axially tensile tested, shall be qualified on the basis of hardness.

6.2.2 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:*

TABLE 5 Tensile Strength Requirements for Specimens Machined from Bolts

Nominal Diameter, mm	Tensile Strength, min, MPa	Yield Strength, min, MPa	Elongation in 4D, min, %	Reduction of Area, min, %
M12 to M36 incl	830	660	14	35

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 responsible party (see Section 14) prior to shipment after zinc coating and lubrication of nuts. See 10.2, Note 3.

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 metric heavy hex structural bolts specified in ASME B18.2.3.7M.

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 F568M.

7.2 *Threads:*

7.2.1 *Uncoated*—Threads shall be Metric Coarse Thread Series as specified in ASME B1.13M and shall have Grade 6g tolerances.

7.2.2 *Coated:*

7.2.2.1 Unless otherwise specified, zinc-coated bolts, to be used with zinc-coated nuts or tapped holes, which are tapped oversize in accordance with Specification A563M, shall have 6g threads before hot-dip or mechanically deposited zinc coating. After zinc coating, the pitch diameter and major diameter shall not exceed the Class 6g limits by more than the following amounts:

TABLE 6 Rotational Capacity Test for Zinc-Coated Bolts

Nominal Bolt Length, mm	Nut Rotation, degrees (turn), min
2D and shorter	180 (½)
Over 2D to 3D incl	240 (⅔)
Over 3D to 4D incl	300 (⅚)
Over 4D to 8D incl	360 (1)
Over 8D	420 (1-⅙)

Nominal Bolt Diameter	Oversize Limit, mm[A]	
	Hot Dip Zinc	Mechanical Zinc
M12	0.36	0.24
M16	0.42	0.28
M20	0.53	0.35
M24	0.64	0.43
M27	0.64	0.43
M30	0.75	0.50
M36	0.86	0.58

[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 B18.2.6.

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 F788/F788M.

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 – 9.5.

9.1.2 When bolts are furnished by a source other than the manufacturer, the Responsible Party as defined in 14.1 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 and length produced consecutively at the initial operation from a single mill heat of material and processed at one time, by the same processor 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 F1470
Coating Weight / Thickness	The referenced coating specification[A]
Surface Discontinuities	Specification F788/F788M
Dimensions and Thread Fit	ASME B18.2.6

[A] Guide F1470 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 F606M.

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 nominal length as specified in 6.2.1 – 6.2.1.2. Fractures on full-size tests shall occur only in the bolt threads and no fracture shall occur 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 (Note 3)*—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 A563M. 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 3—Rotational capacity tests shall apply only to matched assembly lots that contain one A325M bolt, one A563M lubricated nut, and one F436M washer which have been zinc-coated in accordance with the requirements in 4.3. 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 Guide F1470 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 test reports which include the following:

13.1.1 Heat analysis, heat number, and a statement certifying that heats having the elements listed in 5.4 and 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,

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 "A325M" and "8S." In addition, bolts marked "8.8S" shall be an acceptable marking provided they also meet the requirements of ISO 7412.

15.2.2 Type 3 bolts shall be marked "A325M" (with the A325M) underlined) and "8S3." In addition, bolts marked "8.8S3" shall be an acceptable marking provided they also

meet requirements of ISO 7412. The use of additional distinguishing marks to indicate the bolts are weathering steel shall be at the manufacturer's discretion.

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. The base of the metric property class numerals 8S and 8S3 shall be positioned towards the closest periphery of the head.

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 (property class) 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 D3951.

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,
16.2.1.6 Purchase order number, and
16.2.1.7 Country of origin.

17. Keywords

17.1 alloy steel; bolts; carbon steel; metric; 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 M24 and smaller, and 3½ threads for bolt sizes larger than M24.

S1.2 Bolts shall be marked in accordance with Section 15 except that the symbol shall be "A 325MT" instead of "A325M".

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A325–13) that may impact the use of this standard. (Approved Sept. 1, 2014.)

(1) Revised—10.1.2 to limit acceptable fractures to threads only.

Committee F16 has identified the location of selected changes to this standard since the last issue (A325–09) that may impact the use of this standard. (Approved Feb. 15, 2013.)

(1) Revised Sections 6 and 10.1.2 to clarify "nominal" length.
(2) Revised 6.2, Table 3, and Table 4 to clarify testing requirements for large diameter bolts with short lengths.

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