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1.3.2 *Type 2*—Withdrawn in 2003.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