



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

This standard is issued under the fixed designation A 325M; 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 specification² 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 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 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1.3.2 *Type 2*—Withdrawn in 2003.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 F 1789.

1.6 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.*

NOTE 1—This specification is the metric companion to the inch pound Specification A 325.

2. Referenced Documents

2.1 ASTM Standards:⁴

A 153/A 153M Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware—Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A 490M Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]

A 563M Specification for Carbon and Alloy Steel Nuts [Metric]

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 436M Specification for Hardened Steel Washers [Metric]

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

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

F 959M Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners [Metric]

F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

F 1789 Terminology for F16 Mechanical Fasteners

G 101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

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, Washers, 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 Available from American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 3400, 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.

2.2 *ASME Standards:*⁵

- B 1.13M Metric Screw Threads
- B 18.2.3.7M Metric Heavy Hex Structural Bolts
- 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

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, 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 A 325M - 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 A 563M are the recommended nuts for use with A 325M 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)	A 563M—8S or 8S3, plain
1, zinc-coated	A 563M—10S, zinc-coated
3, plain	A 563M—8S3, plain

3.3 *Recommended Washers:*

3.3.1 Washers conforming to Specification F 436M are the recommended washers for use with Specification A 325M 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
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 F 959M 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.
- 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:*

- 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/A 153M.

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

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

Element	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.

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 5055 of Specification B 695.

4.3.4 When no preference is specified, the supplier shall furnish either a hot-dip zinc coating in accordance with Specification A 153/A 153M, Class C, or a mechanically deposited zinc coating in accordance with Specification B 695, Class 5055. 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 563M, 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 4.

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,

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	<i>B</i>	<i>B</i>	0.020 min	<i>B</i>	<i>B</i>	<i>B</i>
Product analysis	<i>B</i>	<i>B</i>	0.010 min	<i>B</i>	<i>B</i>	<i>B</i>
Molybdenum:						
Heat analysis	<i>B</i>	0.06 max	<i>B</i>	0.10 max	<i>B</i>	<i>B</i>
Product analysis	<i>B</i>	0.07 max	<i>B</i>	0.11 max	<i>B</i>	<i>B</i>
Titanium:						
Heat analysis	<i>B</i>	<i>B</i>	<i>B</i>	0.05 max	<i>B</i>	<i>B</i>
Product analysis	<i>B</i>	<i>B</i>	<i>B</i>	0.06 max	<i>B</i>	<i>B</i>

^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.

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 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 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 Except as permitted in 6.2.2 for long bolts, and 6.2.3 for short bolts, sizes M24 and smaller having a length of 2-¼ D and longer; and sizes larger than M24 having a 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.

6.2.2 When the length of the bolt makes full size testing impractical, machined specimens shall be tested and shall conform to