Designation: F3125/F3125M – 22

# Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength[1]

This standard is issued under the fixed designation F3125/F3125M; 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 covers chemical, physical and mechanical requirements for quenched and tempered bolts manufactured from steel and alloy steel, in inch and metric dimensions, in two strength grades, two types and two styles.

1.1.1 This specification is a consolidation and replacement of six ASTM standards, including; A325, A325M, A490, A490M, F1852 and F2280.

1.1.2 This consolidated standard is to ensure alignment between standards with the same intended end use and to simplify the use and maintenance of structural bolt specifications.

1.2 *Intended Use:*

1.2.1 Bolts manufactured under this specification are intended for use in structural connections covered in the Specification for Structural Joints Using High-Strength Bolts, as approved by the Research Council on Structural Connections.

1.2.2 Bolts in this specification are furnished in sizes from ½ to 1-½ in. inclusive and from M12 to M36 inclusive.

1.3 *Classification,* Table 1*:*

1.3.1 Bolts are designated by grade, which indicates inch or metric strength and style.

1.3.2 Bolts are designated by type denoting raw material chemical composition.

1.3.3 Bolts are designated by style denoting Heavy Hex bolts or "Twist-Off" Style assemblies.

1.4 Terms used in this specification are defined in F1789.

1.5 *Units*—The values stated in either SI units or inch pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.6 Table footnotes are requirements. Notes are advisory.

1.7 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

A194/A194M Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

A354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

A449 Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

A563/A563M Specification for Carbon and Alloy Steel Nuts (Inch and Metric)

A751 Test Methods and Practices for Chemical Analysis of Steel Products

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

E709 Guide for Magnetic Particle Testing

E1444/E1444M Practice for Magnetic Particle Testing for Aerospace

[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 June 1, 2022. Published June 2022. Originally published in 2015. Last previous edition published in 2021 as F3125–21. DOI: 10.1520/F3125_F3125M–22.

[2] 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

**TABLE 1 Classification**

| Grade | Min. Strength | Type[A] | | Style |
|---|---|---|---|---|
| A325 | 120 ksi | 1 | 3 | Heavy Hex Head |
| A490 | 150 ksi | 1 | 3 | Heavy Hex Head |
| F1852 | 120 ksi | 1 | 3 | Twist-Off |
| F2280 | 150 ksi | 1 | 3 | Twist-Off |
| A325M | 830 MPa | 1 | 3 | Heavy Hex Head |
| A490M | 1040 MPa | 1 | 3 | Heavy Hex Head |

[A] Type 1 - 120 ksi (830 MPa) - carbon steel, carbon boron steel, alloy steel or alloy steel with boron addition
Type 3 - 120 ksi (830 MPa) or 150 ksi (1040 MPa) - weathering steel
Type 1 - 150 ksi (1040 MPa) - alloy steel or alloy steel with boron addition

F436/F436M Specification for Hardened Steel Washers Inch and Metric Dimensions
F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
F788 Specification for Surface Discontinuities of Bolts, Screws, Studs, and Rivets, Inch and Metric Series
F1136/F1136M Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
F1789 Terminology for F16 Mechanical Fasteners
F1940 Test Method for Process Control Verification to Prevent Hydrogen Embrittlement in Plated or Coated Fasteners
F2328 Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws, Studs, and Nuts
F2328M Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws, Studs, and Nuts (Metric)
F2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
F2660 Test Method for Qualifying Coatings for Use on F3125 Grade A490 Structural Bolts Relative to Environmental Hydrogen Embrittlement
F2833 Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
F3019/F3019M Specification for Chromium Free Zinc-Flake Composite, with or without Integral Lubricant, Corrosion Protective Coatings for Fasteners
F3393 Specification for Zinc-Flake Coating Systems for Fasteners
G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

2.2 *ASME Standards:*[3]
B1.1 Unified Screw Threads
B1.13M Metric Screw Threads
B18.18 Quality Assurance for Fasteners
B18.2.6 Fasteners for Use in Structural Applications
B18.2.6M Metric Fasteners for Use in Structural Applications

2.3 *IFI Standard:*[4]
IFI 144 Test Evaluation Procedures for Coating Qualification

2.4 *RCSC Standard:*[5]
Specification for Structural Joints Using High-Strength Bolts

## 3. Ordering Information

3.1 Orders for bolts under this specification shall include:

3.1.1 *ASTM designation.*

3.1.2 *Quantity:* Number of bolts or assemblies, including washers, if required.

3.1.3 *Size:* Including nominal bolt diameter and bolt length, and thread pitch if other than standard.

3.1.4 *Grade:* A325, A490, F1852, F2280 or A325M, A490M.

3.1.5 *Type:* Type 1 or Type 3. When Type is not specified either Type 1 or Type 3 may be furnished at the supplier's option.

3.1.6 *Style:* Heavy Hex or Twist-Off Style.

3.1.7 *Coatings or finishes:* If other than plain finish, specify the coating process or finish required, see Annex A1.

3.2 *Test reports,* see Section 14.

3.3 Additional details of other assembly components such as nuts and washers, if required.

3.4 Rotational capacity testing of matched sets or assemblies in accordance with Annex A2, as required in 8.1.5 and when requested by the purchaser.

3.5 Heavy Hex bolts may be ordered individually, packaged with nuts, packaged with nuts and washers, or as assemblies.

3.6 Any special observation or inspection requirements shall be specified at the time of inquiry and at the time of order. See Section 13.2.

3.7 Any supplementary requirements.

3.8 Country of origin requirements, if any.

NOTE 1—A typical description follows: 1000 pieces ¾ in.× 3 in. ASTM F3125–19, Grade A325 Heavy Hex Bolt, Type 1, each with one ASTM F436/F436M Type 1 Hardened Washer, and one A563/A563M Grade DH Heavy Hex Nut.

NOTE 2—Bolts are sometimes detailed with names such as A325 HS, A325 SC, A325 X or A490 N. These names relate to connection design and bolt installation, but do not change the manufacturing requirements and are preferably not shown on bolt orders.

## 4. Dimensions

4.1 *Head and Body:*

4.1.1 Bolts shall conform to the dimensions specified in Table 2 for Heavy Hex or Twist-Off bolts.

4.1.2 The thread length shall not be changed except as provided in Supplementary Requirement S1 or S2. Other dimensions shall not be changed except in accordance with Supplementary Requirement S2.

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

[4] Industrial Fasteners Institute (IFI), 6363 Oak Tree Blvd. Independence, OH 44131. http://www.indfast.org

[5] Research Council on Structural Connections (RCSC), http://boltcouncil.org

**TABLE 2 Dimensions, Threads, Marking, Matching Components**

| | Inch | | | | Metric | | | |
|---|---|---|---|---|---|---|---|---|
| | 120 ksi Min Tensile | | 150 ksi Min Tensile | | 830 MPa Min Tensile | | 1040 MPa Min Tensile | |
| | Type 1 | Type 3 | Type 1 | Type 3 | Type 1 | Type 3 | Type 1 | Type 3 |
| **Style - Heavy Hex Bolts** | | | | | | | | |
| Dimensions, ASME[B] | B18.2.6 | B18.2.6 | B18.2.6 | B18.2.6 | B18.2.6M | B18.2.6M | B18.2.6M | B18.2.6M |
| Thread Fit, ASME[B] | B1.1 UNC 2A | B1.1 UNC 2A | B1.1 UNC 2A | B1.1 UNC 2A | B1.13M MC 6g | B1.13M MC 6g | B1.13M MC 6g | B1.13M MC 6g |
| Grade Marking[A,D] | A325 | A325 | A490 | A490 | A325M | A325M | A490M | A490M |
| **Style - Twist-Off Bolts** | | | | | | | | |
| Dimensions, ASME[B] | B18.2.6 | B18.2.6 | B18.2.6 | B18.2.6 | [F] | [F] | [F] | [F] |
| Thread Fit, ASME[B] | B1.1 UNC 2A | B1.1 UNC 2A | B1.1 UNC 2A | B1.1 UNC 2A | [F] | [F] | [F] | [F] |
| Grade Marking[A,D] | A325TC | A325TC | A490TC | A490TC | [F] | [F] | [F] | [F] |
| Alt. Marking[A,C] | A325 | A325 | A490 | A490 | [F] | [F] | [F] | [F] |
| **Recommended Nut and Washer** | | | | | | | | |
| Plain Nut | A563/A563M DH | A563/A563M DH3 | A563/A563M DH | A563/A563M DH3 | A563/A563M 10S | A563/A563M 10S3 | A563/A563M 10S | A563/A563M 10S3 |
| Suitable Alternative[E] | DH3, D, C, C3 | C3 | | | 8S, 8S3, 10S3 | 8S3 | 10S3 | |
| Coated Nut | A563/A563M DH | A563/A563M DH3 | A563/A563M DH | A563/A563M DH3 | A563/A563M 10S | A563/A563M 10S3 | A563/A563M 10S | A563/A563M 10S3 |
| Flat, Bevel or Thick Washer if used | F436/F436M - 1 | F436/F436M - 3 | F436/F436M - 1 | F436/F436M - 3 | F436/F436M - 1 | F436/F436M - 3 | F436/F436M - 1 | F436/F436M - 3 |

[A] A325 and A325M bolts lengths up to 4D which are fully threaded but which are not required to be fully threaded by the relevant ASME standard shall be marked with a "T", see Supplementary Requirement S1. Bolts with any other non-standard dimensions, including non-standard thread length (except for bolts up to 4D threaded fully and marked with "T" per S1 requirement), shall be marked with an "S", see Supplementary Requirement S2.
[B] Manufactured to the latest revision at the time of manufacture, UNC for inch series and Metric Coarse (MC) for Metric Series.
[C] Previously used markings may be sold and used indefinitely, bolts must be manufactured to current marking requirements upon initial publication of this standard.
[D] Other distinguishing markings for type 3 are permitted at the manufacturers option.
[E] ASTM A194/A194M 2H Heavy Hex inch Nuts may be used in place of A563/A563M DH nuts on type 1 A325, A490, F1852 and F2280 bolts. 2H Heavy Hex metric Nuts may be used in place of A563/A563M 10S nuts on type 1 A325M and A490M bolts. When coated 2H nuts are used in place of DH or 10S nuts, the same requirements of A563/A563M and this specification, including Annex A1, shall apply. These requirements include, but are not limited to, thread dimensions and overtapping allowances, coating grade, lubrication requirements, and proof load testing.
[F] Metric dimensions and requirements for this style have not been established.

**TABLE 3 Chemical Requirements[A]**

| Heat Analysis | 120 ksi/830 MPa Minimum | | | | 150 ksi/1040 MPa Minimum | |
|---|---|---|---|---|---|---|
| | Grade A325, A325M, F1852 | | | | Grade A490, A490M, F2280 | |
| | Type 1 | Type 3 | | | Type 1 | Type 3 |
| | Carbon or Alloy Steel with or without Boron | Composition A | Composition B | Based on Corrosion Index[B] | Alloy Steel with or without Boron | Based on Corrosion Index[B] |
| Carbon | 0.30 - 0.52 | 0.33 - 0.40 | 0.38 -0.48 | 0.30 - 0.52 max | 0.30 - 0.48[C] | 0.30 - 0.53 |
| Manganese | 0.60 min | 0.90 - 1.20 | 0.70 - 0.90 | 0.60 min | 0.60 min | 0.60 min |
| Phosphorus, max | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 |
| Sulfur, max | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| Silicon | 0.15 - 0.30 | 0.15 - .30 | 0.30 - 0.50 | [D] | [D] | [D] |
| Boron | 0.003 max | [D] | [D] | [D] | 0.003 max | [D] |
| Copper | [D] | 0.25 - 0.45 | 0.20 - 0.40 | 0.20 - 0.60 | [D] | 0.20 - 0.60 |
| Nickel | [D] | 0.25 - 0.45 | 0.50 - 0.80 | 0.20[E] min | [D] | 0.20[E] min |
| Chromium | [D] | 0.45 - 0.65 | 0.50 - 0.75 | 0.45 min | [D] | 0.45 min |
| Vanadium | [D] | [D] | [D] | [D] | [D] | [D] |
| Molybdenum | [D] | [D] | 0.06 max | 0.10[E] min | [D] | 0.10[E] min |
| Titanium | [D] | [D] | [D] | [D] | [D] | [D] |

[A] Based on heat analysis.
[B] See 6.3.
[C] Carbon requirement is 0.35-0.53 for 1-½ in. and M36 diameter bolts.
[D] Not Specified.
[E] Material that satisfies the criteria for either Nickel or Molybdenum shall be considered as satisfying the requirements for both elements.

4.1.3 Bolts with thread lengths or dimensional requirements which differ from this specification may also be ordered under Specification A449 or A354. Users should note that A449 and A354 are not exact equivalents to the structural grades in this specification.

4.2 *Threads:*

4.2.1 Uncoated bolt threads shall be as specified in Table 2.

4.2.2 Coated bolts shall have threads meeting Table 2 requirements before coating.