



Designation: F3148 – 17a

Standard Specification for High Strength Structural Bolt Assemblies, Steel and Alloy Steel, Heat Treated, 144ksi Minimum Tensile Strength, Inch Dimensions¹

This standard is issued under the fixed designation F3148; 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, dimensional, physical and mechanical requirements for quenched and tempered bolts manufactured from steel and alloy steel, in inch dimensions. The bolts are available as structural bolting assemblies which include a fixed spline bolt, a suitable nut and at least one washer covered by reference herein.

1.2 Intended Use:

1.2.1 Bolts manufactured under this specification, and structural bolting assemblies supplied under this specification, are intended for use in structural connections covered in the Specification for Structural Joints Using High-Strength Bolts and installed using the torque-and-angle or part turn/combined installation method.

1.2.2 Structural bolting assemblies in this specification are furnished in nominal diameters from 1/2 to 1-1/4 in. inclusive.

1.3 Classification:

1.3.1 Structural bolting assemblies are designated as Grade 144.

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

Type 1 - 144ksi - carbon steel, carbon boron steel, alloy steel or alloy steel with boron addition

Type 3 - 144ksi - weathering steel

1.4 Terms used in the specification are defined in Terminology [F1789](#).

1.4.1 *Torque-and-Angle Fixed-Spline Structural Bolt*—bolt that includes an integral fixed-spline end which extends beyond the threaded portion of the bolt and is used as a component of a torque-and-angle fixed-spline structural bolting assembly.

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 May 15, 2017. Published June 2017. Originally approved in 2015. Last previous edition approved in 2017 as F3148-17. DOI: 10.1520/F3148-17A

1.4.2 *Torque-and-Angle Fixed-Spline Structural Bolting Assembly*²— a fastener assembly comprised of a torque-and-angle fixed-spline bolt with a suitable nut and at least one washer, installed and tightened using a special electric wrench and socket system which has an inner socket that engages the fixed-spline end of the bolt and with an outer socket that engages and turns the nut, in two separate and distinct operations, the first is a controlled torque application and the second is a specified angle.

1.4.3 *Combined Method*—A tightening method comprised of two steps, the first tightening step using a torque regulating tool and the second tightening step in which a specified turn is applied to the turned part of the assembly. Also known as the ‘part turn method’.

1.5 *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.*

1.6 ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

1.7 *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 The torque-and-angle fixed-spline structural bolting system has a patent application pending. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patent-pending item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

2. Referenced Documents

2.1 ASTM Standards:³

- A563 Specification for Carbon and Alloy Steel Nuts
- A751 Test Methods, Practices, and Terminology 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
- 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, and Studs, 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
- F2328 Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws, Studs, and Nuts
- F2833 Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
- G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

2.2 ASME Standards:⁴

- B 1.1 Unified Screw Threads
- B 18.2.6 Fasteners for Use in Structural Applications
- B 18.18 Quality Assurance for Fasteners

2.3 RCSC:⁵

- Specification for Structural Joints Using High-Strength Bolts

3. Ordering Information

3.1 Orders for structural bolting assemblies under this specification shall include:

3.2 Mandatory ordering information:

- 3.2.1 ASTM F3148 designation and revision,
- 3.2.2 *Quantity*—Number of assemblies,
- 3.2.3 Grade 144,
- 3.2.4 *Size*—Including nominal diameter and bolt length,
- 3.2.5 *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.

3.2.6 *Coatings or finishes*—If other than plain finish, specify the coating process or finish required, see **Table 1**.

3.3 Additional ordering information when specified by purchaser;

- 3.3.1 Test reports, see Section 15.
- 3.3.2 Additional details of other assembly components.
- 3.3.3 Rotational capacity testing of assemblies per **Annex A1**.
- 3.3.4 Observation or inspection requirements. See 14.2.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁵ Research Council on Structural Connections (RCSC) <http://www.boltcouncil.org/>

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.

TABLE 1 Permitted Coatings^G

	B695 ^{A,F}		F1136/F1136M ^{D,F}		F2833 ^{E,F}	
	Nut Pitch Dia. Overtap ^B in.	Bolt Pitch OS After Coating ^C in.	Nut Pitch Dia. Overtap ^B in.	Bolt Pitch OS After Coating ^C in.	Nut Pitch Dia. Overtap ^B in.	Bolt Pitch OS After Coating ^C in.
Bolt	Class 55	Grade 3	Grade 3	Grade 1	Grade 1	Grade 1
Nut	Class 55	Grade 5	Grade 5	Grade 1	Grade 1	Grade 1
Washer	Class 55	Grade 3	Grade 3	Grade 1	Grade 1	Grade 1
1/2-13 UNC	0.018	0.012	0.009	0.006	0.009	0.006
5/8-11 UNC	0.020	0.013	0.010	0.007	0.010	0.007
3/4-10 UNC	0.020	0.013	0.010	0.007	0.010	0.007
7/8-9 UNC	0.022	0.015	0.011	0.008	0.011	0.008
1-8 UNC	0.024	0.016	0.012	0.008	0.012	0.008
1 1/8-7 UNC	0.024	0.016	0.012	0.008	0.012	0.008
1 1/4-7 UNC	0.024	0.016	0.012	0.008	0.012	0.008

^A Supplementary nut lubrication to A563 S1, S2 or S3 is required for mechanically deposited zinc coatings.

^B Nut overtap shall not exceed this amount unless agreed upon between the purchaser and user. If a larger overtap is used or required, coated structural bolt assemblies shall pass the RC test requirements per F3148, **Annex A1** as proof of assembly, ductility and thread strength.

^C Bolt pitch oversize limit in case of dispute. Material within the plain gage limits which meets the coating thickness requirements and assemblies freely need not be measured to this tolerance.

^D Grade 5 of this coating meets the supplementary lubrication requirements of A563 S1.

^E Grade 1 of this coating meets the supplementary lubrication requirements of A563 S1.

^F Nuts overtapped for coating shall be proof load tested to a minimum of 175 000 psi.

^G Other finishes – specify other protective finish, if required.

OS= Oversize

- 3.3.5 Country of origin.
- 3.3.6 Supplementary requirements.

NOTE 1—A typical description follows: 1000 pieces 3/4-10 × 3 in. ASTM F3148-15, Grade 144, Type 1, each with one hardened ASTM F436/F436M Type 1 washer, and one A563 Grade DH heavy hex nut.

4. Dimensions

4.1 *Head and Body:*

4.1.1 Bolts shall be round head conforming to the dimensions specified in **Table 2**.

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

4.2 *Threads:*

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

4.2.2 Coated bolt threads shall be as specified in **Table 2** before coating.

4.3 The gauging limit for coated bolts shall be verified during manufacture. In case of dispute, a calibrated thread ring gauge of the same size as the oversize limit in **Table 1** (Class X tolerance, gauge tolerance plus) shall be used to verify conformance. The gauge shall assemble with hand effort following application of light machine oil to prevent galling and damage to the gauge. These inspections, when performed to resolve controversy, shall be conducted at the frequency specified in the quality assurance provisions of ASME B 18.18.

NOTE 2—It is the intent of this specification that coated nuts and bolts assemble freely when ordered together. It is recognized that the batch nature of coating processes and the cumulative effect of coating thickness may create intermittent assembly problems.

5. Product Marking

5.1 At a minimum all assemblies shall be marked as required in **Table 2**. Marking shall be on the bolt head and shall be raised or depressed, at the manufacturer’s option. The marking shall be visible after coating.

5.2 Grade/Type marking, the manufacturer’s mark, and the private label distributor’s mark (if used), shall be in separate and distinct locations.

6. Chemical Composition

6.1 Type 1 bolts shall be carbon steel, carbon boron steel, alloy steel or alloy steel with Boron addition at the manufacturer’s option, conforming to the chemical composition specified in **Table 3**.

6.2 Type 3 bolts shall be weathering steel and shall conform to the chemical compositions A or B specified in **Table 3**. Optionally, the chemical composition may have a Corrosion Index of 6 or greater, as calculated from the Heat Analysis, and as described in Guide **G101** Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels.

6.3 Product analysis made on finished bolts representing each lot shall conform to the product analysis requirements specified in **Table 3**, Footnote A.

6.4 Heats to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted.

6.5 Chemical analysis shall be performed in accordance with Test Methods, Practices, and Terminology **A751**.

7. Materials and Manufacture

7.1 Structural bolting assemblies shall be certified, supplied and installed as matched sets. These assemblies shall be capable of developing a minimum predetermined initial and final tension when installed using an appropriate fixed spline-drive installation tool. See **Appendix X1**.

7.2 *Production Method:*

7.2.1 Bolts shall be cold formed, warm formed, hot formed, hot forged, machined, or any combination thereof.

7.3 *Heat Treatment:*

7.3.1 All Bolts shall be quenched in oil from the austenitizing temperature.

7.3.2 All Bolts shall be tempered by reheating to not less than 800°F/427°C.

7.4 Threads shall be rolled or cut.

7.5 *Coatings and Other Finishes:*

7.5.1 Coatings, including supplementary lubrication and nut oversize requirements are provided in **Table 1**.

7.5.2 When coated assemblies are required, the purchaser shall specify the coating process and any additional special requirements.

7.5.3 Threaded components of assemblies (bolts and nuts) shall be coated by the same process, limited to one process per item with no mixed processes in a component lot.

7.5.4 Nut and washer components of the assemblies shall be in accordance with **Table 2**.

7.6 *Secondary Processing:*

7.6.1 Lot control and full traceability shall be maintained throughout all outside or secondary processes.

7.6.2 Lots to which secondary processing has been performed by any party after sale from the manufacturer must be traceable using a lot number which differs from the manufacturer’s original lot number.

7.6.3 If processing that can affect mechanical or performance properties is performed after initial testing, the bolts or assemblies, or both, shall be retested for all specified mechanical properties and performance requirements affected by the processing.

7.6.4 When the secondary process is heat treatment, the bolts shall be tested for all specified mechanical properties.

TABLE 2 Dimensions, Threads, Marking, and Matching Components

	Type 1	Type 3
Round Head Dimensions, ASME ^A	B18.2.6	B18.2.6
Thread Fit, ASME	B1.1 UNC 2A	B1.1 UNC 2A
Grade Marking	144	144
Nut	A563 DH	A563 DH3
Flat Washer	F436/F436M – 1	F436/F436M – 3

^A All dimensions except spline geometry