



Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength¹

This standard is issued under the fixed designation F2280; 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 two types of heat treated, steel, tension control bolt-nut-washer assemblies, also referred to as “sets,” having a tensile strength of 150 to 173 ksi. These assemblies are capable of developing a minimum predetermined tension when installed by applying torque to the nut, while at the same time applying a counter torque to separate the spline end from the body of the bolt using an appropriate spline drive installation tool.

1.2 An assembly consists of a tension control bolt with spline end (covered by this specification) and a suitable nut and washer covered by reference to applicable ASTM specifications.

1.3 The fastener assemblies are intended for use in structural connections. These connections, installation procedures, and the use of alternate design structural bolts are covered under the requirements of the “Specification for Structural Joints Using ASTM or A490 Bolts”, approved by the Research Council on Structural Connections.

1.4 The assemblies are available with either round (button or dome) heads, heavy hex structural heads, or alternate design heads described in Section 11, in sizes ½ to 1 ⅛ in. inclusive, in two types specified in Section 4.

1.5 Tension control bolts manufactured and marked in accordance with the requirements of Specification A490, and conforming to the dimensional and other requirements of this specification, will be considered an acceptable alternate under this specification for two years following initial publication.

1.6 *The following precautionary statement pertains only to the test method portions, Sections 15 and 16, 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:²

- A490 Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
- A563 Specification for Carbon and Alloy Steel Nuts
- A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- E709 Guide for Magnetic Particle Testing
- E1444 Practice for Magnetic Particle Testing
- F436 Specification for Hardened Steel Washers
- F606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
- F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
- 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
- G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

2.2 ASME Standards:³

- B1.1 Unified Inch Screw Threads
- B1.3M Screw Threads Gaging Systems for Dimensional Acceptability—Inch and Metric Screw Threads

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.

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

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

B18.2.6 Fasteners for Use in Structural Applications

2.3 Research Council on Structural Connections:⁴ Specification for Structural Joints Using ASTM A325 or A490 Bolts

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 The definition of terms used in this specification shall be as specified in Terminology F1789, unless otherwise defined herein.

3.1.2 *component lot*—component lot, for the purpose of assigning an identification number and from which test samples shall be selected, shall consist of all tension control bolts, all nuts or all washers processed essentially together through all operations to the shipping container, of which each component has the following common characteristics: heat number (mill heat); ASTM designation and grade or type, as applicable; nominal dimensions (size) and head style; and heat treatment lot.

3.1.3 *manufacturer*—entity that assembles, lubricates, tests, and certifies compliance with this specification.

3.1.4 *secondary processing*—any processing performed by any entity on the assemblies or individual components after initial testing.

4. Classification

4.1 The tension control bolts are designated by type denoting chemical composition as follows:

- 4.1.1 *Type 1*—Alloy steel, and
- 4.1.2 *Type 3*—Weathering steel.

5. Ordering Information

5.1 Orders for assemblies shall include the items of information below. Optional items not on the purchase order shall be considered as not being required (see Note 1):

- 5.1.1 Quantity of assemblies,
- 5.1.2 Size, include nominal tension control bolt diameter and length (without the spline end),
- 5.1.3 Name of product, that is, twist off type tension control bolt/nut/washer assemblies,
- 5.1.4 Head style (see 11.1.1),
- 5.1.5 Type of assembly, that is, Type 1 or Type 3,
- 5.1.6 ASTM designation and year of publication, and
- 5.1.7 Special requirements, if required.

NOTE 1—A typical order description follows: 2520 assemblies, 1 1/8 – 7 UNC in. diameter by 3 in. long Tension Control Bolt/Nut/Washer Assemblies, Round Heads, Type 1 ASTM F2280.

6. Materials and Manufacture

6.1 Heat Treatment:

6.1.1 Tension control bolts shall be heat treated by quenching in oil from the austenitizing temperature and then tempering by reheating to a temperature not less than 800°F.

⁴ Available from American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

6.2 *Thread*—The threads of tension control bolts shall be rolled.

6.3 Lubrication:

6.3.1 The assemblies shall be lubricated by the manufacturer to meet the Assembly Lot Tension requirements in Section 9.

6.3.2 Lubrication other than that applied by the manufacturer shall not be permitted, as the type and amount of lubrication is critical to meeting the minimum clamping forces specified.

6.4 *Secondary Processing*—Secondary processing shall not be permitted to an assembly lot.

6.5 Assembly:

6.5.1 The assemblies shall be of the type specified by the purchaser.

6.5.2 The assemblies shall consist of one tension control bolt, with one nut and one or more washer(s) assembled on the bolt and the nut threaded on the bolt a minimum of one turn.

6.5.3 Nuts and washers used on the assemblies shall conform to the requirements of the specifications below:

Assembly Type and Finish	Nut Specification, Class and Finish	Washer Specification, Type and Finish
Type 1 Plain	Specification A563 DH plain	Specification F436 Type 1 plain
Type 3 Weathering Steel	Specification A563 DH3 plain	Specification F436 Type 3 plain weathering steel

6.5.4 All nuts shall be heavy hex. All washers used in the assembly shall be circular and through hardened.

6.6 *Protective Coatings*—The bolts, nuts and washers shall not be coated by hot dip zinc coating, mechanical deposition or electroplating with zinc or other metallic coatings

7. Chemical Composition

7.1 Tension Control Bolts:

7.1.1 Type 1 tension control bolts shall be alloy steel conforming to the chemical composition in Table 1. The steel shall contain sufficient alloying elements to qualify it as an alloy steel.

7.1.2 Type 3 tension control bolts shall be weathering steel and shall conform to the chemical compositions specified in Table 2. See Guide G101 for method of estimating the atmospheric corrosion resistance of low alloy steels.

7.1.3 Product analysis made on finished bolts representing each lot shall conform to the product analysis requirements specified in Tables 1 and 2, as applicable.

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

7.1.5 For Type 1 bolts heats of steel, with intentionally added boron, or boron heat analysis exceeding 0.0035 %, shall not be permitted.

7.1.6 Compliance with 7.1.4 and 7.1.5 shall be based on certification that heats of steel having any of the listed elements intentionally added were not used to produce the bolts.

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

TABLE 1 Chemical Requirements for Type 1 Alloy Steel Tension Control Bolts

Alloy Steel		
Element	Composition %	
	Heat Analysis, %	Product Analysis, %
Carbon	0.30–0.48	0.28–0.50
Phosphorus, max	0.040	0.045
Manganese, min	0.60	0.57
Sulfur, max	0.040	0.045
Alloying Elements	A	A
Alloy Steel with Boron Addition		
Element	Composition %	
	Heat Analysis, %	Product Analysis, %
Carbon	0.30–0.48	0.28–0.50
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.045
Sulfur, max	0.040	0.045
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.

TABLE 2 Chemical Requirements for Type 3 Weathering Steel Tension Control Bolts

Element	Composition, %	
	Heat Analysis, %	Product Analysis, %
Carbon		
Sizes ¼ in. and smaller	0.20-0.53	0.19-0.55
Sizes ⅜ to 1½ in. incl.	0.30-0.53	0.28-0.55
Manganese, min	0.40	0.37
Phosphorus, max	0.035	0.040
Sulfur	0.040	0.045
Copper	0.20-0.60	0.17-0.63
Chromium	0.45-0.90	0.42-0.93
Nickel or	0.20-0.60	0.17-0.63
Molybdenum	0.15-0.25	0.14-0.26

7.2 *Nuts and Washers*—Chemical requirements for nuts and washers shall be in accordance with the applicable specification specified in 6.5.3.

8. Mechanical Property Requirements for Tension Control Bolts

8.1 *Hardness*: The bolts shall conform to the hardness specified in Table 3.

8.2 *Tensile Properties*:

8.2.1 Except as permitted in 8.2.2 for long bolts, and 8.2.3 for short bolts, sizes 1.0 in. and smaller having a nominal length of 2¼ in. D and longer, and sizes larger than 1.0 in. having a nominal length of 3D and longer, shall be wedge tested full size and shall conform to the minimum and maximum 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.

8.2.2 When the nominal 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 test shall take precedence.

8.2.3 Sizes 1.0 in. and smaller having a nominal length shorter than 2¼ 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 1.0 in. and smaller having a nominal length shorter than 2D, which cannot axially tensile tested shall be qualified on the basis of hardness.

8.2.4 Size 1⅝ in. having a nominal length shorter than 3D shall be qualified on the basis of hardness.

8.2.5 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.

8.3 *Nuts and Washers*—Mechanical properties for nuts and washers shall be in accordance with the applicable specification in 6.5.3.

9. Assembly Lot Tension Test

9.1 *Purpose*—The assembly lot tension test shall be performed on fastener assemblies to determine the ability of the assembly to provide the required minimum tension.

9.2 *Requirement*—Full size completed assemblies tested in accordance with 14.4 shall develop a bolt tension when the spline end is separated from the bolt conforming to the requirements in Table 5, Column 1.

10. Carburization/Decarburization

10.1 This test is intended to evaluate the presence or absence of carburization and decarburization as determined by the difference in microhardness near the surface and core.

10.2 *Requirements*:

10.2.1 *Carburization*—The assemblies shall show no evidence of a carburized surface when evaluated in accordance with 15.5.

TABLE 3 Hardness Requirements for Tension Control Bolts

Bolt Size in.	Bolt Length, in.	Brinell		Rockwell C	
		Min	Max.	Min	Max.
½ to 1 in., incl	Less than 2D ^A	311	352	33	38 [†]
	2D and over	...	352	...	38 [†]
1⅝ in.	Less than 3D ^A	311	352	33	38 [†]
	3D and over	...	352	...	38 [†]

^A Tension control bolts 1.00 in. nominal diameter and smaller and shorter than 2D are subject only to minimum and maximum hardness. Tension control bolts 1⅝ inch nominal diameter and shorter than 3D are subject only to minimum and maximum hardness.

[†] Editorially corrected in March 2012.

TABLE 4 Tensile Requirements for Full Size Tension Control Bolts

Bolt Size, Threads per in. and Series Designation	Stress Area ^A in. ²	Tensile Load ^B lbf		Proof Load Length Measurement Method, lbs	Alternative Proof Load ^B Yield Strength Method min lbs
		Min	Max.		
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
½ in. — 13 UNC	0.142	21 300	24 600	17 050	18 500
⅝ in. — 11 UNC	0.226	33 900	39 100	27 100	29 400
¾ in. — 10 UNC	0.334	50 100	57 800	40 100	43 400
7/8 in. — 9 UNC	0.462	69 300	79 950	55 450	60 100
1 in. — 8 UNC	0.606	90 900	104 800	72 700	78 800
1½ in. — 7 UNC	0.763	114 450	132 000	91 550	99 200

^A The stress area is calculated as follows:

$$A_s = 0.7854 [D - (0.9743/n)]^2$$

where:

- A_s = stress area, in.²,
- D = nominal bolt size, and
- n = threads per inch.

^B Loads tabulated are based on the following:

Bolt Size, in.	Column 3	Column 4	Column 5	Column 6
½ to 1½	150 000 psi	173 000 psi	120 000 psi	130 000 psi

TABLE 5 Assembly Lot Tension Test Requirements

Bolt Size, in. Threads per in. and Series Designation	Manufacturers Acceptance Test Tension, lbs, min ^A		Tension lbs, min (for information only) ^B
	Column 1	Column 2	
½ —13 UNC	16 000	15 000	
⅝ —11 UNC	25 000	24 000	
¾ —10 UNC	37 000	35 000	
7/8 —9 UNC	51 000	49 000	
1—8 UNC	67 000	64 000	
1½ —7 UNC	84 000	80 000	

^A The manufacturer's acceptance test tension values are 5 % higher than the tension in Column 2 and are rounded to the nearest 1000 lbs.

^B The values in Column 2 are excerpts from the Research Council Specification for Structural Joints Using ASTM A 325 and A490 Bolts. They are equal to 70 % of the specified minimum tensile strength for tests of full size A490 bolts with UNC threads tested in axial tension and are rounded to the nearest 1000 lbs (kips).

10.2.2 *Decarburization*—Hardness value differences shall not exceed the requirements set forth for decarburization in Test Method F2328 for class 2/3H materials when evaluated in accordance with 15.5.

11. Dimensions

11.1 Tension Control Bolts:

11.1.1 Tension control bolts shall be furnished with either round (button or dome), heavy hex structural or alternate design heads as specified by the purchaser.

11.1.2 The head, body and spline dimensions shall conform to the requirements in ASME B18.2.6 for tension control bolts.

11.1.3 Head designs as specified in 11.1.1 shall have a bearing surface area and head height equal to or larger than required for heavy hex structural bolts in ASME B18.2.6.

11.1.4 The thread length shall be as specified in ASME B18.2.6 for heavy hex structural bolts.

11.2 *Nuts and Washers*—The dimensions for nuts and washers shall be in accordance with the applicable specification specified in 6.5.3.

11.3 Threads:

11.3.1 Threads on tension control bolts shall be the Unified Coarse Thread Series as specified in ASME B1.1, and shall have Class 2A tolerances.

11.3.2 The gauging limit for bolts shall be verified during manufacture. In case of purchaser/supplier controversy over thread compliance, System 21 of ASME B1.3M shall be used for referee purposes.

12. Workmanship, Finish, and Appearance

12.1 For tension control bolts, 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.

12.2 For the nut component, surface discontinuity limits shall be in accordance with the applicable specification in 6.5.3.

13. Magnetic Particle Inspection for Bolt Longitudinal Discontinuities and Transverse Cracks

13.1 Requirements:

13.1.1 Each sample representative of the bolt lot shall be magnetic particle inspected for longitudinal discontinuities and transverse cracks.

13.1.2 The lot, as represented by the sample, shall be free from nonconforming bolts, as defined in Specification F788/F788M, when inspected in accordance with Sections 13.2 – 13.2.4.

13.2 Inspection Procedure:

13.2.1 The inspection sample shall be selected at random from each bolt lot in accordance with 14.4.5 and examined for longitudinal discontinuities and transverse cracks in the threads, body, fillet, and underside of the head.

13.2.2 Magnetic particle inspection shall be conducted in accordance with Guide E709 or Practice E1444. Guide E709

shall be used for referee purposes. If any nonconforming bolt is found during the manufacturer's examination of the lot selected in 13.2.1, the lot shall be 100 % magnetic particle tested and all nonconforming bolts shall be removed and scrapped or destroyed.

13.2.3 Eddy current or liquid penetrant inspection may be substituted for the 100 % magnetic particle inspection when nonconforming bolts are found and 100 % inspection is required. On completion of the eddy current or liquid penetrant inspection, a random sample selected from each bolt lot in accordance with Guide F1470, shall be reexamined by the magnetic particle method. In case of controversy, the magnetic particle test shall take precedence.

13.2.4 Magnetic particle indications of themselves shall not be cause for rejection. If in the opinion of the quality assurance representative the indications may be cause for rejection, a sample taken in accordance with Guide F1470 shall be examined by microscopic examination or removal by surface grinding to determine if the indicated discontinuities are within Specification F788/F788M limits.

14. Testing

14.1 Testing Responsibility:

14.1.1 Each component lot and assembly lot shall be tested by the manufacturer prior to shipment in accordance with the lot identification control quality assurance plan in 14.2 – 14.4.

14.1.2 When components or assemblies are furnished by a source other than the manufacturer, the responsible party as defined in Section 19 shall be responsible for assuring all tests have been performed and the components and assemblies comply with the requirements of this specification.

14.2 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 distributors and purchasers maintain the identification and integrity of each lot until the assemblies are installed.

14.3 Lot Control—All components shall be manufactured, processed, and tested in accordance with a lot control plan that provides lot purity and lot identification. The manufacturer and distributors shall identify and maintain the integrity of each lot of components and finished assemblies from raw material selection through all processing operations and treatments to final packing and shipment. Each component lot shall be assigned its own component lot number and each assembly lots its own assembly lot number.

14.4 Number of Tests:

14.4.1 Tensile strength, proof load, hardness and carburization/decarburization sampling shall be in accordance with Guide F1470.

14.4.2 Chemical composition sampling shall be one test per heat conducted by the steel producer.

14.4.3 Assembly lot tension test sample size shall be in accordance with Guide F1470, Sample Level C, Table 3, as a minimum.

14.4.4 Sampling for dimensional and thread fit compliance shall be in accordance with the quality assurance provisions of ASME B18.2.6.

14.4.5 Sampling for workmanship, surface discontinuities, including head bursts, and magnetic particle inspection shall be in accordance with Guide F1470.

14.4.6 Sampling for the nut and washer components shall be in accordance with the applicable nut and washer specification referenced in 6.5.3.

14.4.7 When tested in accordance with the required sampling plan, a component lot shall be rejected if any of the test specimens fail to meet the applicable requirements.

15. Test Methods

15.1 Chemical analyses, when required, shall be conducted in accordance with Test Methods, Practices, and Terminology A751.

15.2 Tensile and Hardness—Conduct tensile and hardness tests in accordance with Test Methods F606 using the wedge or axial tension testing of full size product method (depending on size and nominal length as specified in 8.2), except that fractures shall occur only in the bolt threads and no fracture shall occur at the junction of the head and body.

15.3 Proof Load—Conduct proof load tests in accordance with Test Methods F606 Method 1, Length Measurement, or Method 2, Yield Strength, at the option of the manufacturer.

15.4 Assembly Installation Tension Test:

15.4.1 Test Conditions—Conduct tests at an ambient temperature between 50 and 90° F (10 and 32°C).

15.4.2 Test Device:

15.4.2.1 The tension measuring device shall be capable of measuring the assembly tension after torquing.

15.4.2.2 The tension measuring device shall be calibrated in 1000 lb increments.

15.4.2.3 Calibrate the tension measuring device (and any other equipment) based on the frequency of use and the equipment manufacturer's recommendation, but not less than one time per year.

15.4.3 Installation and Tension Test:

15.4.3.1 Install the tension control bolt, nut, washer, and appropriate spacer washer(s) in the tension measuring device. The device shall not restrain the head from turning.

15.4.3.2 Install the washer(s) under the nut such that three to five threads of the bolt are located between the bearing face of the nut and the underside of the bolt head using the washer furnished with the assembly in contact with the nut.

15.4.3.3 Initially tighten the assembly using a hand wrench by turning the nut to produce the setting tension specified below.

Bolt Diameter, in.	Setting Tension	Tension, 1000 lb
1/2		1 to 3
5/8		2 to 4
3/4		3 to 5
7/8		4 to 6
1		5 to 7
1 1/8		6 to 8

15.4.3.4 Complete tightening the assembly nut using a spline drive installation tool capable of engaging the nut and spline end simultaneously during this process. Tighten continuously until the spline shears from the bolt.

15.4.3.5 The bolt component, regardless of head style, shall not be restrained during the assembly tightening.

15.4.3.6 In order to pass, shearing of the spline end shall occur in the shear groove. Failure in the threaded region shall be considered nonconforming.

15.4.3.7 Record the tension after shearing of the spline end as the assembly installation tension.

15.5 Carburization/decarburization tests shall be conducted in accordance with Test Method **F2328** using the Micro-indentation Hardness Method.

16. Inspection

16.1 If the inspection described in **16.2** is required by the purchaser, it shall be specified in the inquiry and contract or order.

16.2 The purchaser's representative shall have free entry to all parts of the manufacturer's works or suppliers place of business that concern the manufacture or supply of the assemblies. The manufacturer or supplier shall afford the purchaser's representative all reasonable facilities to satisfy him that the assemblies are 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 so as not to interfere unnecessarily with the operation of the manufacturers or suppliers operations.

17. Rejection and Rehearing

17.1 Disposition of nonconforming sets shall be in accordance with the section on Disposition of Nonconforming Lots of Guide **F1470**.

18. Certification

18.1 The manufacturer or supplier, whichever is the responsible party as defined in Section **19**, shall furnish the purchaser a test report for each lot that includes the following:

18.1.1 Heat analysis and heat number of each component (bolt, nut, and washer), and a statement certifying that heats having the elements listed in **7.1.4** and **7.1.5** intentionally added were not used to produce the tension control bolts.

18.1.2 Results of hardness, tensile and proof load tests of each component (bolt, nut, and washer), when applicable.

18.1.3 *Results of Assembly Lot Installation Tension Tests*—At the manufacturer's option, the mean and standard deviations may be reported.

18.1.4 Results of magnetic particle inspection tests.

18.1.5 Results of visual inspection for bursts.

18.1.6 Statement of compliance with dimensional and thread fit requirements.

18.1.7 Assembly lot number, individual component lot numbers for bolt-nut-washer, and purchase order number.

18.1.8 ASTM specification number, type, and issue date.

18.1.9 Complete mailing address of responsible party.

18.1.10 Title and signature of the individual assigned certification responsibility by the company officers.

18.2 Failure to include all the required information on the test report shall be cause for rejection.

19. Responsibility

19.1 The party responsible for the assemblies shall be the organization that supplies the assemblies to the purchaser and certifies that the assemblies have been manufactured, sampled, tested, and inspected in accordance with this specification and meets all of its requirements.

20. Product Marking

20.1 *Manufacturers Identification*—All components of each assembly shall be marked by the manufacturer with a unique identifier to identify the manufacturer.

20.2 *Grade Identification:*

20.2.1 Type 1 tension control bolts shall be marked "A490TC".

20.2.2 Type 3 tension control bolts shall be marked "A490TC" with all characters underlined. Manufacturers shall be permitted to use additional marks indicating the bolt is a weathering type.

20.3 *Marking Location and Methods*—All markings shall be located on the top of the bolt head and shall be raised or depressed at the manufacturer's option. The nut and washer marking shall be depressed.

20.4 *Acceptance Criteria*—Tension control bolts which are not marked in accordance with these provisions shall be considered nonconforming and subject to rejection.

21. Packaging and Package Marking

21.1 *Packaging:*

21.1.1 Unless otherwise specified, the assemblies shall be properly packed to prevent loss and damage during shipment.

21.1.2 All products shall be assembled. (See **6.5.2**.)

21.1.3 Special packaging requirements shall be defined at the time of the inquiry and order, but shall not void the requirements in **21.1.2** and **6.5.2**.

21.2 *Package Marking:*

21.2.1 Each shipping unit shall include or be plainly marked with the following information:

21.2.1.1 ASTM designation and type,

21.2.1.2 Size, nominal diameter, and length,

21.2.1.3 Name of the manufacturer and the supplier, if furnished by an entity other than the manufacturer,

21.2.1.4 Number of assemblies,

21.2.1.5 Assembly lot number(s),

21.2.1.6 Purchase order number(s), and

21.2.1.7 Country of origin.

22. Keywords

22.1 alternate design fasteners; bolts; alloy steel; fasteners; spline end; structural; tension control bolt; tension control bolt assembly; twist-off bolt; weathering steel

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (F2280-12) that may impact the use of this standard. (Approved September 1, 2014)

(1) Revised—15.2 to limit acceptable fractures to threads only.

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