Designation: A 449 – 07b

Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use[1]

This standard is issued under the fixed designation A 449; 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 specification[2] covers quenched and tempered steel hex cap screws, bolts, and studs having a minimum tensile strength of 120 ksi for diameters 1.0 in. and smaller; 105 ksi for diameters over 1.0 in. to 1½ in.; and 90 ksi for diameters 1¾ in. to 3.0 in. inclusive. The term ″fasteners″ in this specification denotes hex cap screws, bolts, and studs.

1.2 The fasteners are intended for general engineering use.

1.3 The fasteners are furnished in diameters ¼ to 3.0 in. inclusive. They are designated by type denoting chemical composition as follows:

Type	Description
Type I	Plain carbon steel, carbon boron steel, alloy steel, or alloy boron steel
Type 2	Withdrawn 2003
Type 3	Weathering steel

1.4 Terms used in this specification are defined in Terminology F 1789 unless otherwise defined in this specification.

1.5 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

1.6 *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]

A 563 Specification for Carbons and Alloy Steel Nuts

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 436 Specification for Hardened Steel Washers

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

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

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

F 1789 Terminology for F16 Mechanical Fasteners

F 2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

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

2.2 *ASME Standards:*[4]

B 1.1 Unified Screw Threads

B 18.2.1 Square and Hex Bolts and Screws

B 18.24 Part Identifying Number (PIN) Code System Standard for B 18 Fastener Products

3. Ordering Information

3.1 Orders for fasteners under this specification shall include the following:

3.1.1 Quantity (number of pieces),

3.1.2 Size, including nominal diameter and length,

3.1.3 Name of product,

3.1.4 Type, that is, Type 1, or Type 3 as required,

3.1.5 ASTM designation and year of issue, and

3.1.6 Other components such as nuts and washers if required.

3.1.7 *Hot-Dip or Mechanically Deposited Zinc Coatings*—For hot-dip or mechanically deposited zinc coatings covered by

[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 Dec. 1, 2007. Published January 2008. Originally approved in 1963. Last previous edition approved in 2007 as A 449 – 07a.

[2] For *ASME Boiler and Pressure Vessel Code* applications see related Specifications SA-449 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] 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.**

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

5.1 and requiring over-tapped nuts, specify the zinc coating process required, that is, hot-dip, mechanically deposited, or no preference (see 5.1).

3.1.8 *Other Coatings*—Specify other protective coating if required (see 5.2).

3.1.9 Specify if inspection at point of manufacture is required.

3.1.10 Test reports if required.

3.1.11 Supplementary or special requirements.

3.1.12 For establishment of a part identifying system, see ASME B 18.24.

NOTE 1—A typical ordering description follows: 1000 pieces ⅛ in. diameter × 4.0 in. long hex cap screw, Type 1, ASTM A 449–XX, each with one finished hex nut ASTM A 563, Grade DH. Each component mechanically zinc coated in accordance with B 695, Class 5, Type II.

3.2 *Suitable Nuts and Washers*:

3.2.1 Suitable nuts are covered in Specification A 563. Unless otherwise specified, the grade and style of nut shall be as follows:

Fastener Size and Surface Finish	Nut Grade and Style[A]
¼ to 1½ in., plain (or with a coating of insufficient thickness to require over-tapped nuts)	B, hex
Over 1½ to 3 in., plain (or with a coating of insufficient thickness to require over-tapped nuts)	A, heavy hex
¼ to 3 in., zinc-coated (or with a coating thickness requiring over-tapped nuts)	DH, heavy hex
¼ to 3 in., Type 3	C3, DH3, heavy hex

[A] Nuts of other grades and styles having specified proof load stresses (Specification A 563, Table 3) greater than the specified grade and style of nut are suitable.

3.2.2 Unless otherwise specified, washers ordered with fasteners shall be furnished to the requirements of Specification F 436, Type 1 or Specification F 436, Type 3. Washers for A 449 Type 3 fasteners shall conform to Specification F 436 Type 3.

4. Materials and Manufacture

4.1 *Heat Treatment*:

4.1.1 Type 1 fasteners produced from medium carbon steel shall be quenched in a liquid medium from the austenitizing temperature.

4.1.2 Type 1 fasteners produced from medium carbon steel to which chromium, nickel, molybdenum, or boron were intentionally added, and Type 3 fasteners, shall be quenched in oil from the austenitizing temperature.

4.1.3 Type 1 and Type 3 fasteners, regardless of the steel used, shall be tempered by reheating to not less than 800°F.

4.2 *Threading*—Threads shall be rolled, cut, or ground.

4.3 *Secondary Processing*—If any processing which can affect the mechanical properties of the fasteners is performed after the initial testing, the fasteners shall be retested for all specified mechanical properties affected by the reprocessing.

5. Protective Coatings

5.1 *Zinc, Hot Dip, and Mechanically Deposited Requiring Over-tapped Nuts*:

5.1.1 When zinc-coated fasteners are required, the purchaser shall specify the zinc-coating process, such as, hot-dip, mechanically deposited, or no preference.

5.1.2 When hot dip is specified, the fasteners shall be zinc coated by the hot-dip process in accordance with the requirements of Specification F 2329.

5.1.3 When mechanically deposited is specified, the fasteners shall be zinc coated by the mechanical deposition process in accordance with the requirements of Class 55 of Specification B 695.

5.1.4 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification F 2329, or a mechanically deposited zinc coating in accordance with Specification B 695, Class 55. Threaded components (bolts and nuts) shall be coated by the same zinc coating process, and the suppliers' option shall be limited to one process per item with no mixed processes in a lot.

NOTE 2—When the intended application requires that assembled tension exceeds 50 % of minimum bolt or stud proof load, an anti-galling lubricant may be needed. Application of such a lubricant to nuts and a test of the lubricant efficiency are provided in Supplementary Requirement S1 of Specification A 563 and should be specified when required.

5.2 *Other Coatings*:

5.2.1 When other coatings are required, the purchaser shall specify the coating specification, including the classification codes or grade numbers to identify the coating material, thickness, supplemental treatments, or other requirements to define the coating. The fasteners shall be coated in accordance with and conform to the specified coating specification.

5.2.2 When a specification does not apply, the purchaser shall specify the desired coating, coating thickness, supplemental treatments, or other requirements to define the coating.

6. Chemical Composition

6.1 Type 1 fasteners shall be plain carbon steel, carbon boron steel, alloy steel, or alloy boron steels, at the manufacturers option, conforming to the requirements in Table 1.

6.2 Type 3 fasteners 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 a the option of the manufacturer. See Guide G 101 for methods of estimating the atmospheric corrosion resistance of low alloy steel.

6.3 Product analyses made on finished fasteners representing each lot shall conform to the product analysis requirements specified in Table 1 or Table 2, as applicable.

6.4 Heats of steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted for bolts. Compliance shall be based on certification that heats of steel having any of the listed elements intentionally added were not used to produce the bolts.

6.5 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology A 751.

7. Mechanical Properties

7.1 *Hardness*—The fasteners shall conform to the hardness specified in Table 3. See Table 3, Note A.

7.2 *Tensile Properties*:

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 1 Chemical Requirements for Type 1 Fasteners

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	0.015–0.30	0.13–0.32

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	0.10–0.30	0.08–0.32
Boron	0.0005–0.003	0.0005–0.003

Element	Carbon Steel	
	Heat Analysis	Product Analysis
Carbon	0.30–0.52	0.28–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Silicon	0.15–0.35	0.13–0.37
Alloying Elements	[A]	[A]

Element	Carbon Steel	
	Heat Analysis	Product Analysis
Carbon	0.30–0.52	0.28–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.035	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.

7.2.1 Except as permitted in 7.2.2 for long fasteners and 7.2.3 for short fasteners, hex cap screws and hex and square head bolts in sizes 1.00 in. and smaller having a length of 2¼ D and longer and sizes 1⅛ to 1½ in. inclusive having a length of 3D and longer shall be wedge tested full size. Bolts with heads other than hex or square shall be axially tested. Both wedge and axially tested hex cap screws and bolts shall conform to the proof load or alternative proof load, and minimum wedge tensile load in Tables 4 and 5, as applicable. The load applied during proof load testing shall be equal to or greater than the proof load in Table 4 or Table 5 as applicable.

7.2.2 Hex cap screws and square head bolts larger than 1½ in. diameter, other than those excepted in 7.2.3, shall preferably be tested full size and when so tested shall conform to the tensile strength and either the specified proof load or yield strength requirements in Tables 4 and 5, as applicable. When equipment of sufficient capacity for full size testing is not available, or when the length of the bolt makes full size testing impractical, machined specimens shall be tested and shall conform to the requirements of Table 6.

7.2.3 Sizes 1.00 in. and smaller having a 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 Tables 4 and 5. Sizes 1.00 in. and smaller having a length shorter than 2D which cannot be axially tensile tested shall be qualified on the basis of hardness.

7.2.4 Studs 3D and longer shall be axially tension tested full size and shall conform to the tensile and proof load or alternate proof load specified in Table 4 and Table 5, as applicable. When equipment for full size testing is not available, or when the studs are too long for full size testing, machined specimens shall be tested and shall conform to the tensile requirements in Table 6.

7.2.5 If fasteners are subjected to both hardness and tensile tests, the tensile test results shall take precedence in the event of low hardness test results.

7.2.6 If fasteners are subjected to both full size and machined specimen tests, the full size test results shall take precedence if the results of the two methods differ.

8. Dimensions

8.1 *Head and Body*:

8.1.1 *Hex Cap Screws*—Unless otherwise specified, hex cap screws shall be furnished with dimensions conforming to ASME B 18.2.1.

8.1.2 *Bolts*—When styles other than specified in 8.1.1 are required, they shall have dimensions conforming to those specified by the purchaser.

8.1.3 *Studs*—Studs shall have dimensions conforming to those specified by the purchaser.

8.2 *Threads*:

8.2.1 *Uncoated*—Unless otherwise specified, uncoated threads shall be the Unified Coarse Thread Series as specified in the latest issue of ASME B 1.1, and shall have Class 2A tolerances.

8.2.2 *Coated*—Unless otherwise specified, zinc-coated bolts, to be used with zinc-coated nuts or tapped holes, which are tapped oversize in accordance with Specification A 563, shall have UNC Class 2A threads before hot-dip or mechanically deposited zinc-coating. After zinc coating, the pitch diameter and major diameter shall not exceed the Class 2A limits by more than the following amounts:

Nominal Diameter, in.	Oversize Limit, in.[A]	
	Hot-Dip Zinc	Mechanical Zinc
¼	0.016	0.012
5⁄16 , ⅜	0.017	0.012
7⁄16 , ½	0.018	0.012
9⁄16 , ⅝ ,¾	0.020	0.013
⅞	0.022	0.015
1.0 to 1¼	0.024	0.016
1⅜ , 1½	0.027	0.018
1¾ to 3.0, incl	0.050	0.033

[A] Hot-dip zinc nuts are tapped oversize after coating and mechanical zinc coated nuts are tapped oversize before coating.

8.2.3 Unless otherwise specified, fasteners electroplated or mechanically coated to 0.0005 in. or less, threads prior to plating shall conform to ASME B 1.1 Class 2A and after

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 2 Chemical Requirements for Type 3 Fasteners[A]

Element	Composition, %					
	Type 3 Fasteners[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	0.14–0.25	0.14–0.25	0.18–0.27	0.19–0.25
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
Phosphrous:						
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
Silicone:						
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	0.27–0.53	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 fasteners. Selection of a class shall be at the option of the bolt manufacturer.
[B] These elements are not specified or required.

TABLE 3 Hardness Requirements for Hex Cap Screws, Bolts, and Studs

Nominal Diameter, in.	Length, in.	Brinell		Rockwell C	
		Min	Max	Min	Max
¼ to 1, inclusive	Less than 2D[A]	253	319	25	34
	2D and over	. . .	319	. . .	34
Over 1 to 1½ , inclusive	Less than 3D[A]	223	286	19	30
	3D and over	. . .	286	. . .	30
Over 1½ to 3, inclusive	Less than 3D[A]	183	235	. . .	. . .
	3D and over	. . .	235	. . .	. . .

[A] Hex cap screws and bolts larger than 1.00 in. diameter and shorter than 3D and all studs shorter than 3D are subject only to minimum and maximum hardness.
D = Nominal diameter or thread size

plating shall not exceed the Class 3A maximum limits, that is, Class 2A plus the allowance.

9. Workmanship, Finish, and Appearance

9.1 Surface discontinuity limits, inspection, and evaluation shall be in accordance with Specification F 788/F 788M.

10. Number of Tests and Retests

10.1 *Testing Responsibility*:

10.1.1 Each lot shall be tested by the manufacturer prior to shipment in accordance with the lot identification control quality assurance plan in 10.2-10.5.

10.1.2 When fasteners are furnished by a source other than the manufacturer, the responsible party as defined in 15.1 shall be responsible for assuring all tests have been performed and the fasteners comply with the requirements of this specification (see 4.3).

10.2 *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 secondary processors, distributors, and purchasers maintain the identification and integrity of each lot until the product is installed.

10.3 *Lot Processing*—All fasteners shall be processed in accordance with a lot identification-control quality assurance plan. The manufacturer, secondary processors, and distributors shall identify and maintain the integrity of each lot from raw material selection through all operations and treatments to final

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 4 Tensile Load Requirements for Coarse-Thread Full-Size Hex Cap Screws, Bolts and Studs

Bolt or Stud Diameter, in.	Threads per in.[A]	Stress Area,[B] in.[2]	Tensile Load, min, lbf[C]	Proof Load, Length Measurement Method, lbf[C]	Alternative Proof Load, Yield Strength Method (0.2 % Offset), lbf[C]
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
¼	20	0.0318	3 800	2 700	2 900
5/16	18	0.0524	6 300	4 450	4 800
⅜	16	0.0775	9 300	6 600	7 100
7/16	14	0.1063	12 750	9 050	9 800
½	13	0.1419	17 050	12 050	13 050
9/16	12	0.182	21 850	15 450	16 750
⅝	11	0.226	27 100	19 200	20 800
¾	10	0.334	40 100	28 400	30 700
⅞	9	0.462	55 450	39 250	42 500
1	8	0.606	72 700	51 500	55 750
1⅛	7	0.763	80 100	56 450	61 800
1¼	7	0.969	101 700	71 700	78 500
1⅜	6	1.155	121 300	85 450	93 550
1½	6	1.405	147 500	104 000	113 800
1¾	5	1.90	171 000	104 500	110 200
2	4½	2.50	225 000	137 500	145 000
2¼	4½	3.25	292 500	178 750	188 500
2½	4	4.00	360 000	220 000	232 000
2¾	4	4.93	443 700	271 150	286 000
3	4	5.97	537 300	328 350	346 200

[A] For 8 threads per in., sizes 1⅛ to 1½ in., inclusive, stresses of 105 000 psi, 74 000 psi, and 81 000 psi shall be used for calculating the values in columns 4, 5, and 6 respectively.

[B] The stress area is taken from ASME B1.1 which uses the equation below to calculate the values:

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

where:

A_s = stress area,
D = nominal diameter, and
n = threads per in.

[C] Values tabulated are based on the following:

Bolt Size, in.	Column 4, psi	Column 5, psi	Column 6, psi
¼ to 1, incl.	120 000	85 000	92 000
1⅛ to 1½ , incl.	105 000	74 000	81 000
1¾ to 3, incl.	90 000	55 000	58 000

packing and shipment. Each lot shall be assigned its own lot-identification number, each lot shall be tested, and the inspection test reports for each lot shall be retained.

10.4 *Lot Definition*:

10.4.1 *Standard Lot*—A lot shall be a quantity of uniquely identified fasteners of the same nominal size and length produced consecutively at the initial operation from a single mill heat of material and processed at one time, by the same processor in the same manner so that statistical sampling is valid. The identity of the lot and lot integrity shall be maintained throughout all subsequent operations and packaging.

10.5 *Number of Tests*— The minimum number of tests from each lot for the tests specified below shall be as follows:

Tests	Number of Tests in Accordance With
Hardness, tensile strength, proof load	Guide F 1470
Coating weight/thickness	The referenced coating specification[A]
Surface discontinuities	Specification F 788/F 788M
Dimensions and thread fit	ASME B 18.2.1

[A] Guide F 1470 if the coating specification does not specify a testing frequency.

11. Test Methods

11.1 Tensile, proof load, and hardness tests shall be conducted in accordance with Test Methods F 606.

11.2 Tensile strength for hex cap screws and hex and square bolts shall be determined using the wedge or axial tension testing method of full size product method or the machined test specimens method depending on size and length as specified in 7.2.2-7.2.6. Bolts with heads other than hex or square shall be axially tested. Fracture on full size tests shall be in the body or threads of the fastener without a fracture at the junction of the head and body.

11.3 Studs shall be tested by the axial tension method as described in the second paragraph of axial tension testing of full size products in the Test Methods section of Test Methods F 606.

11.4 Proof load shall be determined using Method 1, length measurement, or Method 2, yield strength, at the option of the manufacturer.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 5 Tensile Load Requirements for Fine-Thread Full-Size Hex Cap Screws, Bolts, and Studs

Bolt or Stud Diameter, in.	Threads per in.	Stress Area,[A] in.^{2}	Tensile Load, min, lbf[B]	Proof Load, Length Measurement Method, lbf[B]	Alternative Proof Load, Yield Strength Method (0.2 % Offset), min, lbf[B]
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
¼	28	0.0364	4 350	3 100	3 500
5⁄16	24	0.0580	6 950	4 950	5 350
⅜	24	0.0878	10 550	7 450	8 100
7⁄16	20	0.1187	14 250	10 100	10 900
½	20	0.1599	19 200	13 600	14 700
9⁄16	18	0.203	24 350	17 250	18 700
⅝	18	0.256	30 700	21 750	23 500
¾	16	0.373	44 750	31 700	34 300
⅞	14	0.509	61 100	43 250	46 800
1	12	0.663	79 550	56 350	61 000
1⅛	12	0.856	89 900	63 350	69 350
1¼	12	1.073	112 650	79 400	86 900
1⅜	12	1.315	138 100	97 300	106 500
1½	12	1.581	166 000	117 000	128 000

[A] See footnote *B* in Table 4.
[B] See footnote *C* in Table 4.

TABLE 6 Tensile Strength Requirements for Specimens Machined from Hex Cap Screws, Bolts, and Studs

Nominal Diameter, in.	Tensile Strength, min, psi	Yield Strength, min, psi	Elongation in 4*D*, min, %	Reduction of Area, min, %
¼ to 1, incl.	120 000	92 000	14	35
Over 1 to 1½ , incl.	105 000	81 000	14	35
Over 1½ to 3, incl.	90 000	58 000	14	35

12. Inspection

12.1 If the inspection described in 12.2 is required by the purchaser, it shall be specified in the inquiry and contract or order.

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

13. Rejection and Rehearing

13.1 Disposition of nonconforming fasteners shall be in accordance with the section on Disposition of Nonconforming Lots of Guide F 1470.

14. Certification

14.1 When specified on the purchase order, the manufacturer or supplier, whichever is the responsible party as defined in Section 15, shall furnish the purchaser test reports which include the following:

14.1.1 Heat analysis, heat number, and a statement certifying that heats having the elements listed in 6.4 intentionally added were not used to produce the fasteners,

14.1.2 Results of hardness, tensile, and proof load tests,

14.1.3 Zinc coating measured coating weight/thickness for coated fasteners,

14.1.4 Statement of compliance with dimensional and thread fit requirements,

14.1.5 Lot number and purchase order number,

14.1.6 Complete mailing address of responsible party, and

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

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

15. Responsibility

15.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

16. Product Marking

16.1 *Manufacturers Identification*—All hex cap screws and bolts and one end of studs ⅜ in. and larger, and whenever feasible studs smaller than ⅜ in., shall be marked by the manufacturer with a unique identifier to identify the manufacturer or private label distributor, as appropriate.

16.2 *Type Identification*:

16.2.1 Type 1 hex cap screws and bolts and one end of Type 1 studs ⅜ in. and larger, and whenever feasible studs smaller than ⅜ in., shall be marked "A 449."

16.2.2 All Type 3 hex cap screws, blots, and studs shall be marked to indicate that they are produced from weathering steel. Heads of type 3 hex cap screws and bolts shall be marked "A 449" underlined. Type 3 studs ⅜ in. and larger, and whenever feasible studs smaller than ⅜ in., shall be marked "A 449" underlined on at least one end. Studs under ⅜ in. not

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

marked "A 449" underlined, shall be marked with the use of additional marks to indicate that they are produced from weathering steel.

16.3 *Marking Location and Methods*:

16.3.1 All markings shall be located on the top of a hex cap screw and bolt heads and on one end of studs and shall be either raised or depressed at the manufacturer's option.

16.3.2 Type and manufacturer's or private label distributor's identification shall be separate and distinct. The two identifications shall preferably be in different locations and, when on the same level, shall be separated by at least two spaces.

16.4 *Acceptance Criteria*—Fasteners which are not marked in accordance with these provisions shall be considered nonconforming and subject to rejection.

17. Packaging and Package Marking

17.1 *Packaging*:

17.1.1 Unless otherwise specified, packaging shall be in accordance with Practice D 3951.

17.1.2 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

17.2 *Package Marking*:

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

17.2.1.1 ASTM designation and type,
17.2.1.2 Size,
17.2.1.3 Name and brand or trademark of the manufacturer,
17.2.1.4 Number of pieces,
17.2.1.5 Lot number,
17.2.1.6 Purchase order number, and
17.2.1.7 Country of origin.

18. Keywords

18.1 bolts; carbon steel; hex cap screws; steel; studs

SUPPLEMENTARY REQUIREMENTS

S1. Marking

S1.1 Studs that are continuously threaded with the same class of thread shall be marked on each end with the marking required by Section 16.

S1.2 Marking small sizes (customarily less than 0.375 in.) may not be practical. Consult the producer for the minimum size that can be marked.

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A 449–07a) that may impact the use of this standard. (Approved December 1, 2007.)

(*1*) Sections 5.1.3 and 5.1.4 were revised.

Committee F16 has identified the location of selected changes to this standard since the last issue, A 449 – 07, that may impact the use of this standard. (Approved Aug. 1, 2007.)

(*1*) Changed the reference hot dip zinc coating specification from Specification A 153/A 153M Gr. C, to Specification F 2329.

Committee F16 has identified the location of selected changes to this standard since the last issue, A 449 – 04b$^{\epsilon 1}$, that may impact the use of this standard. (Approved May 15, 2007.)

(*1*) Revised or added sections below to cover addition of Type 3 weathering steel:
1.3 Scope,
2 Reference Documents,
3.1.4 Ordering Information,
3.2.1 Suitable Nuts,
3.2.2 Suitable Washers,
4.1.2 and 4.1.3Heat Treatment,
6.2 and Table 2 Chemical Composition, and
16.2 Product Marking
(*2*) Renumbered sections 6.2, 6.3 and 6.4.
(*3*) Section 10.5, number of Tests, removed reference to "Rotational Capacity" tests. These tests not required by this specification.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

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.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale