INCH-POUND

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SUPERCEDING
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(See 6.9 and 6.12)

DETAIL SPECIFICATION

# STUDS, BOLTS, SCREWS AND NUTS FOR APPLICATIONS WHERE A HIGH DEGREE OF RELIABILITY IS REQUIRED; GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

## 1 SCOPE

1.1 Scope. This specification covers standard studs, hex cap screws, and heavy hex bolts in nominal standard diameters of ¼ inch to 4 inches, nuts in nominal standard diameters of ¼ inch to 3 inches, and socket head cap screws in nominal standard diameters of ¼ inch to 1½ inches for submarine safety and other applications where a high degree of reliability is required (see 6.1).

1.2 Classification. The configurations, types, styles, material grades and conditions of fasteners are as listed below. Non-standard fasteners may be ordered using a drawing with the dimensional and material requirements of the fastener and tested to the requirements of this specification (see 6.2).

1.2.1 Configurations, types and styles

Studs

Type I - Full body
Type II - Reduced body
Type III - Constant strength body
Type IV - Continuous thread (bolt-stud)

Type III studs styles

| Style | Stud end thread | Nut end thread |
|---|---|---|
| a | Class 5 | Class 3A |
| b | Class 5 | Class 2A |
| c | Class 3A | Class 3A |
| d | Class 3A | Class 2A |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 05Q, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

Bolts
Type II – Heavy hex
Type III – Heavy hex structural

Screws
Type I - Hex cap
Type II - Socket head cap

Nuts
Type I - Hex
Type II - Hex jam
Type III - Heavy hex
Type IV - Heavy hex jam
Type V - Hex slotted

1.2.2 Material grades and conditions. The following military grades and conditions are covered in this specification:

| ALLOY TYPE | MATERIAL Grade | CONDITION |
|---|---|---|
| Alloy Steel | B7 | Hardened and Tempered |
| | B16 | Hardened and Tempered |
| | A574 | Hardened and Tempered |
| | 2H | Hardened and Tempered |
| | 4 | Hardened and Tempered |
| | 5 | Hardened and Tempered |
| | 7 | Hardened and Tempered |
| | 8 | Hardened and Tempered |
| | 4340 | Hardened and Tempered |
| Aluminum | 2024 | Solution Treated and Naturally Aged |
| | 6061 | Solution Treated and Artificially Aged |
| | 7075 | Solution Treated and Stabilized |
| Carbon Steel | 2 | As Formed or Stress Relieved |
| Copper Alloy | 462 | As Formed or Stress Relieved |
| | 464 | As Formed or Stress Relieved |
| | 482 | As Formed or Stress Relieved |
| | 510 | As Formed or Stress Relieved |
| | 544 | As Formed or Stress Relieved |
| | 632 | Quenched and Tempered |
| | 655 | As Formed or Stress Relieved |
| | 661 | As Formed or Stress Relieved |
| | 670 | As Formed or Stress Relieved |
| | 675 | As Formed or Stress Relieved |

| ALLOY TYPE | MATERIAL Grade | CONDITION |
|---|---|---|
| Corrosion Resistant Steel | 304 | Solution Annealed(A) |
| | 304 | Solution Annealed & Cold Worked(CW) |
| | 305 | Solution Annealed(A) |
| | 305 | Solution Annealed & Cold Worked(CW) |
| | 316 | Solution Annealed(A) |
| | 316 | Solution Annealed & Cold Worked(CW) |
| | 321 | Solution Annealed(A) |
| | 321 | Solution Annealed & Cold Worked(CW) |
| | 347 | Solution Annealed(A) |
| | 347 | Solution Annealed & Cold Worked(CW) |
| | 384 | Solution Annealed(A) |
| | 384 | Solution Annealed & Cold Worked(CW) |
| | 410 | Quenched and Tempered (H) |
| | 410 | Quenched and Tempered (I) |
| | 410 | Quenched and Tempered (T) |
| | 416 | Quenched and Tempered (H) |
| | 416Se | Quenched and Tempered (H) |
| | 416 | Quenched and Tempered (I) |
| | 416Se | Quenched and Tempered (I) |
| | 416 | Quenched and Tempered (T) |
| | 416Se | Quenched and Tempered (T) |
| | 431 | Quenched and Tempered (H) |
| | 431 | Quenched and Tempered (I) |
| | 431 | Quenched and Tempered (T) |
| | 630 | Annealed & Age Hardened |
| Nickel Alloy | 400 | As Formed or Stress Relieved |
| | 405 | As Formed or Stress Relieved |
| | 500 | Solution Annealed & Age Hardened |
| | 625 | Annealed |
| Titanium | T7 | Annealed |

1.2.3 Coatings for steel fasteners

Types of Coatings
A - Ion Vapor Deposited Aluminum
P - Phosphate
ZM - Zinc mechanically deposited
ZE - Zinc electrodeposited
ZS - Zinc Silicate

## 2 APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of the specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

QQ-N-281 - Nickel-Copper Alloy, Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections.

QQ-N-286 - Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500).

TT-C-490 - Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings.

DEPARTMENT OF DEFENSE

MIL-F-8961 - Fastener Element, Self-Locking, Externally Threaded, 450°F and 1200°F.

MIL-DTL-18240 - Fastener Element, Self-Locking, Threaded Fastener, 250°F Maximum.

DOD-PRF-24648 - Primer Coating, Zinc Dust Pigmented for Exterior Steel Surfaces (Metric).

MIL-DTL-25027 – Nut, Self-Locking, 250 Degree F, 450 Degree F, and 800 Degree F.

MIL-L-46010 - Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting.

MIL-H-81200 - Heat Treatment of Titanium and Titanium Alloys.

MIL-PRF-81329 - Lubricant, Solid Film, Extreme Environment, NATO Code No. S-1737.

MIL-DTL-83488 - Coating, Aluminum, High Purity.

STANDARDS

Department of Defense

MIL-STD-792 - Identification Marking Requirements for Special Purpose Components.

MIL-STD-1684 - CONTROL OF HEAT TREATMENT.

(Unless otherwise indicated, copies of the above specifications and standards are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

NAVSEA T9074-AS-GIB-010/271 - Requirements for Nondestructive Testing Methods.

(Copies of the above publication are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.3 Nongovernment publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues cited in the solicitation (see 6.2).

AEROSPACE MATERIAL SPECIFICATIONS (AMS)

2488 - Titanium and Titanium Alloys, Anodic Treatment.

2631 - Titanium and Titanium Alloy Bar And Billet, Ultrasonic Inspection.

2750 - Pyrometry.

(Available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B1.1 - Screw Threads, Unified, (UN and UNR Thread Form).

B1.2 - Gages and Gaging for Unified Inch Screw Threads.

B1.3M - Screw Thread Gaging Systems for Dimensional Acceptability- Inch and Metric Screw Threads (UN, UNR, UNJ, M and MJ).

B1.12 - Thread Class 5 Interference - Fit.

B18.2.1 - Bolts and Screws Inch Series, Square and Hex (with Addenda).

B18.2.2 - Nut, Hex and Square (Inch Series).

B18.2.6 - Fasteners for Use in Structural Applications.

B18.3 - Screws Set (Inch Series) Socket Cap, Shoulder and.

(Application for copies should be addressed to the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017 or the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY for TESTING AND MATERIALS (ASTM)

A 193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service. (DOD adopted)

A 194 - Standard Specification for Nuts, Carbon and Alloy Steel for Bolts for High-Pressure or High-Temperature Service or Both. (DOD adopted)

A 276 - Standard Specification for Steel Bars and Shapes, Stainless.

A 307 - Standard Specification for Carbon steel Bolts and Studs, 60,000 PSI Tensile Strength.

A 342 - Test Methods for Permeability of Materials, Feebly Magnetic.

A 354 - Specification for Bolts, Studs, and Other Externally Threaded Fasteners, Quenched and Tempered Alloy Steel.

A 380 - Standard Recommended Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems. (DOD adopted)

A 449 - Specification for Quenched and Tempered Steel Bolts and Studs.

A 574 - Standard Specification for Alloy Steel Socket Head Cap Screws.

B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes.

B 138 - Rod, Manganese Bronze, Bar, and Shapes

B 139 - Rod, Phosphor Bronze, Bar, and Shapes

B 150 - Standard Specification for Copper-Aluminum Bronze Rod, Bar, and Shapes.

B 348 - Standard Specification for Titanium and Titanium Bar and Billets.

B 446 - Standard Specification for Rod and Bar, Nickel-Chromium-Molybdenum-Columbium Alloy (UNS NO6625).

B 487 - Standard Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section. (DOD adopted)

B 504 - Standard Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method.

B 568 - Standard Test Method for Measurement of Coating Thickness by X-Ray Spectrometry.

B 580 - Standard Specification for Anodic Oxide Coatings on Aluminum. (DOD adopted)

B 597 - Standard Practice for Heat Treatment of Aluminum Alloys.

B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel. (DOD adopted)

B 695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

E 140 - Standard Hardness Conversion Tables for Metals.

F 467 - Standard Specification for Nonferrous Nuts for General Use.

F 468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws and Studs for General Use.

F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs. (DOD adopted)

F 594 - Standard Specification for Stainless Steel Nuts. (DOD adopted)

F 606 - Standard Method for Conducting Tests to Determine the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers and Rivets.

F 788 - Specification for Surface Discontinuities of Bolts, Screws and Studs, Inch and Metric Series.

F 812 - Specification for Surface Discontinuities of Nuts, Inch and Metric Series.

F 837 - Standard Specification for Stainless Steel Socket Head Cap Screws.

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Bar Harbor Drive, West Conshohocken, PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

J121 - Decarburization in Hardened and Tempered Threaded Fasteners, SAE Recommended Practice.

J122 - Surface Discontinuities on Nuts, SAE Recommended Practice.

J123 - Surface Discontinuities on Bolts, Screws and Studs in Fatigue Applications, SAE Recommended Practice.

J429 - Mechanical and Material Requirements for Externally Threaded Fasteners, SAE Standard.

J995 - Mechanical and Material Requirements for Steel Nuts, SAE Standard.

(Application for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.)

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA (AIA-NAS)

NASM-1312 - Fastener Test Methods

(Available from Aerospace Industries Association of America, 1250 I St. NW, Suite 1100, Washington, DC 20005)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersede applicable laws and regulations unless a specific exemption has been obtained.

## 3 REQUIREMENTS

3.1 General requirements. Fasteners shall meet the requirements of the applicable commercial standard cited in table I as modified herein.

3.2 Manufacturing process. Fasteners may be produced by any manufacturing process permitted by the specifications and standards cited in table I using any rod, bar or wire capable of meeting the requirements of this specification, including the material and fastener specifications cited in table I, except as specified below.

3.2.1 Grade 410, 416, 416Se, and 431 externally-threaded fasteners. When aluminum is used in the production of grade 410, 416, 416Se, and 431 fasteners, the maximum residual aluminum content shall be 0.05 percent. Grade 410, 416, 416Se, and 431 fasteners in condition I shall have a maximum sulfur content of 0.010 percent and a maximum phosphorus content of 0.020 percent.

3.2.2 Grade 625 fasteners. The metal used in the production of the bar, rod, or wire used to make grade 625 fasteners shall be refined using the electroslag remelting process (ESR) or the vacuum arc remelting process (VAR).

3.2.3 Titanium Alloys. The metal used in the production of the bar, rod, or wire used to make grade T7 fasteners shall be produced by multiple melting using consumable electrode practice. The last melting cycle shall be under vacuum. Barstock used to make titanium fasteners shall be ultrasonic inspected in accordance with AMS 2631. Barstock 2½ inches or smaller shall meet the requirements of acceptance class A1 and barstock over 2½ inches shall meet the requirements of acceptance class A.

3.3 Heat treatment. Unless otherwise approved (see 6.2), heat treatments shall be controlled in accordance with AMS 2750 or MIL-STD-1684. Fasteners shall be heat treated in accordance with the applicable commercial specification listed in table I and as specified below:

3.3.1 Martensitic stainless steel bolts, hex cap screws, and studs. When condition I is specified, the martensitic alloys 410, 416, 416Se, and 431 shall be hardened and tempered by heating to 1725 ± 25°F sufficient for austenitization, held for at least ½ hour, rapid air- or oil- quenched, reheated to 1125°F minimum, for at least 1 hour, and air cooled, to provide the specified properties.

3.3.2 Martensitic stainless steel socket head cap screws. When condition I is specified, the martensitic alloys 410, 416, 416Se, and 431 shall be hardened and tempered by heating to 1725 ± 25°F, held for at least ½ hour until the alloy is austenitized, rapid air- or oil- quenched, reheated to 1125°F minimum, for at least 1 hour, and air cooled, to provide the specified properties. When condition H is specified, the martensitic alloys 410, 416, 416Se, and 431 shall be hardened and tempered by heating to 1725 ± 50°F, held for at least 1 hour until the alloy is austenitized, rapid air- or oil- quenched, reheated to 1050°F minimum, for at least 1 hour, and air cooled, to provide the specified properties. When condition HT is specified, the martensitic alloys 410, 416, 416Se, and 431 shall be hardened and tempered by heating to 1725 ± 50°F, held for at least 1 hour until the alloy is austenitized, rapid air- or oil- quenched, reheated to 525°F minimum, for at least 1 hour, and air cooled, to provide the specified properties.

3.3.3 Externally threaded martensitic stainless steel fasteners. Externally threaded martensitic stainless steel fasteners produced by hot heading shall be quenched and tempered after heading.

3.3.4 Grade 500 (Nickel-Copper-Aluminum) externally-threaded fasteners. Grade 500 material that has been headed or threaded shall not be age hardened unless it has been solution annealed subsequent to the heading and threading operations. Threads formed after the final age hardening heat treatment shall be cut or ground only.

3.3.5 Grade 632 fasteners. Grade 632 fasteners produced by hot heading shall be heat treated in accordance with ASTM B 150 after the hot heading operation.

3.3.6 Aluminum alloys. Aluminum alloys shall be heat treated in accordance with ASTM B 597.

3.3.7 Titanium alloys. Barstock used to produce titanium alloy fasteners shall be given a recrystallization anneal in accordance with

3.3.8 MIL-H-81200.

3.4 Mechanical properties. Studs, bolts, screws and nuts shall conform to the mechanical property requirements in tables II, table III and table IV.

3.4.1 Wedge tensile tests. Headed fasteners shall support a load prior to fracture not less than the minimum tensile strength specified in in tables II and III for the applicable size, grade and thread series. Socket head cap screws, threaded within one diameter of the underside of the head, may be accepted if the fracture causing failure originates in the threaded area even if the fracture extends into the fillet or head before separation.

3.5 Decarburization. The threaded portion of carbon and alloy steel studs, bolts and screws shall meet the requirements of SAE J121, class B.

3.6 Protective coating or treatment.

3.6.1 Carbon and alloy steels. When a protective coating is specified (see 6.2), carbon and alloy steel fasteners shall be coated using any one of the following methods:

Phosphate type:
Phosphate coated: TT-C-490, type I.
Metallic type coatings:
Ion vapor deposited aluminum coating:
MIL-DTL-83488, type II.
Electrodeposited zinc coating: ASTM B 633, type II.
Mechanically deposited zinc coating: ASTM B 695, type II.
Primer:
High zinc silicate:
DOD-PRF-24648, type 1, class 1, composition B.

3.6.1.1 Grades 8, 4340 and A574. Grades 8, 4340 and A574 fasteners shall not be coated with anodic zinc, metallic aluminum, zinc containing primer, or any other anodic coating, including all coatings in 3.6.1.

3.6.2 Class 3A and class 5 externally-threaded fasteners. Unless otherwise specified (see 6.2), externally-threaded fasteners with class 3A and class 5 threads shall not be coated.

3.6.3 Protective coating thickness. Unless otherwise specified (see 6.2), the thickness of coatings in the threaded areas of externally-threaded fasteners with class 2A threads shall be as specified in table V. The minumim coating thickness outside the threaded area shall be the same as the minimum thickness for the threaded area. There is no maximum thickness

for coatings outside the threaded area. When a coating is specified for internally-threaded fasteners or externally threaded fasteners with class 3A or class 5 threads, the minimum thickness in the threaded area shall be as specified (see 6.2).

3.6.4 Corrosion-resistant steels. Corrosion-resistant steel fasteners shall be descaled, cleaned and passivated in accordance with ASTM A 380.

3.6.5 Aluminum alloys. Aluminum alloy fasteners shall be supplied anodized in accordance with ASTM B 580, type D, unless immersion zinc flake/chromate dispersion coatingis specified (see 6.2).

3.6.6 Titanium alloys. Externally threaded titanium alloy fasteners shall be finished by anodizing in accordance with AMS 2488. Unless an inorganic coating is specified (see 6.2), a solid film lubricant to

3.6.7 MIL-L-46010 shall be applied. When an inorganic coating is specified, a solid film lubricant to

3.6.8 MIL-PRF-81329 shall be applied. The AMS 2488 anodizing procedure shall be modified as follows:

a) The anodizing bath need not be alkaline.

b) The final anodize coating shall be nonconductive.

c) The final anodize coating shall not cause any measurable dimensional change using standard fastener measuring equipment.

d) Coating thickness shall be verified by weight change and shall not be less than 400 milligrams per square foot.

e) Confirmatory preproduction tests of AMS 2488 are not required.

3.7 Hydrogen embrittlement relief. Externally-threaded fasteners of grades 410, 416, 416Se and 431 in the I and H conditions and grades 8, 4340, A574 and 630 in the final heat treated condition, which are electroplated or exposed to pickling acids or any other process that may introduce hydrogen, shall be given hydrogen embrittlement relief in accordance with ASTM B 633.

3.8 Magnetic permeability. For the annealed condition of 300 series austenitic corrosion-resistant steels, the relative magnetic permeability shall be determined and shall not exceed 2.0 (air = 1.0).

3.9 Dimensions.

3.9.1 Threads. Unless otherwise specified, threads shall be in accordance with the applicable commercial specification cited in table I and as modified herein (see 6.2). When specified (see 6.2), threads shall be rolled and shall not be cut or ground. External threads with rounded roots, identified as UNR in ASME B1.1, may be used in place of the UN series. When no coating will be applied, class 3A threads in accordance with ASME B1.1 may be used in place of class 2A threads (see 3.6.13). Thread dimensions of fasteners, with a specified minimum coating thickness (see 6.2), shall be modified in accordance with the requirements of 3.9.7.

3.9.1.1 Thread series on bolts, screws and nuts. Unless otherwise specified (see 6.2) the thread series shall be coarse for sizes 1 inch and less and constant 8 thread for sizes over 1 inch.

3.9.1.2 Threads series on studs. The threads on the stud end of type III fasteners (constant strength body) shall be class 5 (5HF or 5 CSF/ONF) in accordance with ASME B1.12 or class 3A in accordance with ASME B1.1 as

specified in 6.2. Unless otherwise specified (see 6.2) the thread series for class 2A and 3A threads shall be coarse for sizes 1 inch and less and constant 8 thread for sizes over 1 inch.

3.9.2 Studs.

3.9.2.1 Type I, II and III body diameter and thread length dimensions. Type I, II and III body diameter and thread length dimensions shall be as shown in table VI and table VII(see 6.2). The body diameters of type I, II, and III studs are defined as follows:

a) Full body. The body diameter (A) is not less than the minimum major diameter of the thread of the nut end, nor more than the nominal (basic) size plus 0.020 inch.
b) Reduced body. The body diameter (A) is not less than the minimum pitch diameter, nor more than the maximum major diameter of the nut and thread.
c) Constant strength body.
    (1) Cut or ground threads. The body diameter (A) is not less than the stress area diameter nor more than the stress area diameter plus the pitch diameter tolerance for the class fit of the nut end thread.
    (2) Rolled threads. The body diameter (A) is the same diameter as the blank before thread rolling. This blank diameter shall fall within the body diameter dimensions shown in table VI.

3.9.2.2 Type IV diameter and length. Diameter, length, and end configuration of continuous-thread studs shall be as specified (see 6.2).

3.9.2.3 Straightness. When rolled on a flat surface, the clearance as measured by a feeler gauge shall not exceed the value BT/5D, where B is the nominal length, D the nominal diameter, and T is the pitch diameter tolerance of the nut end thread.

3.9.2.4 Length tolerance. Length tolerance for studs shall be as follows:

| | Tolerance for nominal stud diameter | | | |
|---|---|---|---|---|
| Fastener length (B) | ¼ to ⅜ | 7/16 to ½ | 9/16 to 1¼ | Over 1¼ |
| Up to 6 inches | ±1/32 | ±1/16 | ±1/8 | ±¼ |
| Over 6 inches | ±1/16 | ±3/32 | ±3/16 | ±¼ |

3.9.3 Bolts. Dimensions of type II bolts shall conform to ASME B18.2.1. Dimensions of type III bolts shall conform to ASME B18.2.6. Unless otherwise specified, see 6.2, the bearing surface shall be either washer faced or chamfered.

3.9.4 Hex cap screws. Dimensions of type I hex cap screws in nominal diameters of ¼ through 3 inches shall conform to ASME B18.2.1. Dimensions of type I hex cap screws in nominal diameter of 3¼ through 4 inches shall be as shown in table VIII.

3.9.5 Socket head cap screws. Dimensions of hexagon socket head cap screws shall conform to ASME B18.3.

3.9.6 Nuts. Dimensions of nuts shall conform to ASME B18.2.2. Unless otherwise specified (see 6.2), the bearing surface shall be either washer faced or chamfered. Dimensions of type I hex nuts (large diameter) and type II hex jam nuts (large diameter) in nominal diameters of 1¾ through 3 inches

shall be as shown in table IX. Dimensions of type V hex slotted nuts (large diameter) in nominal diameters of 1¾ through 3 inches shall be as shown in table X.

3.9.7 Dimensions of Coated Fasteners.

3.9.7.1 Externally-threaded fasteners. For fasteners with coated external threads, class 2A minimum diameters shall apply before coating and 3A maximum diameters shall apply after coating.

3.9.7.2 Externally-threaded fasteners. Threaded fasteners that are to be coated to a specified minimum coating thickness (see 6.2), shall be made smaller to accommodate the coating.

a) The maximum pitch diameter shall be decreased by six times the coating thickness.
b) The minimum pitch diameter shall be decreased by four times the coating thickness.
c) The maximum major diameter shall be decreased by three times the coating thickness.
d) The minimum major diameter shall be decreased by two times the coating thickness.

3.9.7.3 Internally-threaded fasteners. Internally-threaded fasteners that are to be coated to a specified minimum coating thickness (see 6.2), shall be made thinner to accommodate the coating.

a) The minimum pitch diameter shall be increased by six times the minimum coating thickness.
b) The maximum pitch diameter shall be increased by four times the minimum coating thickness.
c) The minimum minor diameter shall be increased by three times the minimum coating thickness.
d) The maximum minor diameter shall be increased by two times the minimum coating thickness.

3.10 Self-locking elements. When specified (see 6.2), externally-threaded fasteners shall contain self-locking elements in accordance with MIL-F-8961 or

3.11 MIL-DTL-18240. When specified (see 6.2), internally-threaded fasteners shall contain self-locking elements in accordance with

3.12 MIL-DTL-25027.

3.13 Identification marking. Unless otherwise specified (see 6.2), fasteners shall be marked in accordance with table I and the following requirements.

3.13.1 Markings. The fastener shall be marked with the material symbol, the manufacturer’s symbol, and the lot number. For fasteners less than ½ inch, if all the marking on the item can not be applied due to space limitations, the marking shall be applied using the following order of precedence: material symbol, manufacturer's symbol, lot number. The material symbol is mandatory for all fasteners. Marking not included on small fasteners shall be placed on the container. Markings shall be permanent as defined in MIL-STD-792, clearly visible and remain clearly visible after the application of any required coatings (see 3.6.1). Markings on fasteners that are to be coated shall have a minimum depth of 4 mils.

3.13.2 Location. Marking shall be applied to the top surface of the head of bolts, hex cap screws and socket head cap screws, the nut end of

studs, and the top face of nuts. Studs with the same thread configuration on both ends may be marked on either end.

3.13.3 Marking after final heat treatment. Markings applied after the final heat treatment shall be applied in accordance with method I, II III, V, VIII or IX of MIL-STD-792, except grades 410, 416 and 431 in the H condition and grades 8, 630, A574, and 4340 shall be marked by method II.

3.14 Part identification. The part identification number (PIN) format is shown in appendix A and shall be used to obtain new National Stock Numbers (NSN's) as needed unless existing PIN formats (for example, from NAVSEA or shipbuilder drawings) can be used. The PIN shall also be marked on the packages for all fasteners meeting the requirements of this specifications.

3.15 Workmanship. Fasteners shall be uniform in quality and condition, and shall be free from rust, scale, seams, bursts, voids, nicks, gouges and burrs, to the extent required by the applicable inspection standards (see 4.3.2.1).

## 4 VERIFICATION

4.1 Conformance inspections. Conformance inspection shall include the examinations of 4.3 and the tests of 4.4.

4.2 Sampling.

4.2.1 Lot definition. A lot of fasteners shall consist of fasteners made from one heat of material that are of the same type, style, nominal size, thread series and have the same coating. All fasteners in a lot must be fabricated and heat treated in the same batch or by a continuous process under the same conditions as to time and temperature, and offered for inspection at one time. Fasteners of differing length that meet the above definition are permitted to be grouped into one lot.

4.2.2 Sampling for conformance inspection. Sampling shall be as shown in table XI. Fasteners selected for examination or testing shall be randomly selected from the lot shipped, in the quanitites identified in table XII.

4.3 Examinations.

4.3.1 Visual. Fasteners shall be visually inspected for correct configuration (see 1.2.1), presence of a self-locking element (see 3.11), presence of a coating (see 3.6), identification marking (see 3.13), and workmanship to 3.15 (see 6.2 and 6.3). Fasteners may be examined during production as part of a statistical process control program as long as the property measured is not changed by any subsequent operation. Wrong configuration, missing or unordered coatings, and improper workmanship or marking shall be cause for rejection of the lot. Unless otherwise specified, lots failing the visual examination may not be resubmitted for acceptance (see 6.2 and 6.7).

4.3.2 Inspection for defects. Nuts shall be inspected in accordance with SAE J122 or ASTM F 812 and bolts, screws and studs shall be inspected in accordance with SAE J123 or ASTM F 788, including supplementary requirement S1, unless an alternate method is specified (see 6.2 and 6.3). Head and socket discontinuities on cylindrical socket head cap screws shall be evaluated in accordance with ASTM A 574. Bolts, screws and studs, that have previously passed this inspection for defects, and are subsequently altered by reducing their length do need not be re-inspected for defects provided traceability to the original inspection results is maintained, no other dimensions are altered, the fastener has not been coated, the fastener is not heated to a temperature high enough to change its strength or microstructure,

and a random sample of fasteners selected in accordance with 4.2.2.are examined in accordance with SAE J123 or ASTM F 788 for defects within one diameter of the cut.

4.3.2.1 Nondestructive inspection. Fasteners selected for inspection in accordance with SAE J122, SAE J123, ASTM F 788, ASTM F 812, or ASTM A 574 shall be inspected by wet magnetic particle or liquid penetrant methods in accordance with NAVSEA T9074-AS-GIB-010/271. Nuts made from grade 400, 405, and 500 materials do not require liquid penetrant inspection unless required by 4.3.3. Unless otherwise specified, acceptance criteria shall be as required in SAE J122, SAE J123, ASTM F 788, ASTM F 812, or ASTM A 574 (see 6.2 and 6.3).

4.3.2.2 Determination of defect depth. Defects in fasteners that require measurement to determine acceptability shall be measured by one of the following methods: (a) macroscopic examination at not less than 25X, (b) micrometer measurement before and after defect removal or (c) microscopic examination of sections cut through the defects. A minimum of ten percent of the fasteners with seams shall be tested for depth determination.

4.3.3 Additional nondestructive testing of fasteners. When specified (see 6.2), fasteners shall be inspected by wet magnetic particle or liquid penetrant methods in accordance with NAVSEA T9074-AS-GIB-010/271 (see 6.2 and 6.3). Acceptance criteria and sampling shall be as specified (see 6.2). When required, this inspection is to be done in addition to the inspections required by 4.3.2.

4.4 Dimensional. Table XIV specifies the features to be dimensionally inspected (see 6.2 and 6.3). Acceptability of UN and UNR screw threads shall be determined based upon system 22S, ASME B1.3M, with the addition of control on the roundness of the pitch cylinder. Screw thread gages and gaging shall be in accordance with ASME B1.2 and capable of inspecting any out-of-round condition that affects fastener assembly and function.

4.5 Test methods.

4.5.1 Chemical analysis. Chemical analysis shall be performed as specified in the applicable commercial specification listed in table I. (see 6.2 and 6.3).

4.5.2 Mechanical property tests. The tests marked as required in table XIII shall be performed on full sized fasteners using sampling per 4.2.2. The mechanical tests performed shall meet the requirements of table II, table III, and table IV (see 6.2 and 6.3). Unless otherwise specified, all mechanical tests shall be done after the final heat treatment (see 6.2). Unless otherwise specified, retesting is not allowed (see 6.2 and 6.6). Axial tensile strength, wedge tensile, and proof load tests are considered to be destructive tests. Subsequent to destructive testing, sample fasteners shall not be reworked nor offered for acceptance.

4.5.2.1 Testing of short externally-threaded fasteners. Production fasteners that have insufficient overall length or thread length to be tested in accordance with ASTM F 606 shall be evaluated using test fasteners that are at the minimum length requiring testing or up to ¼ inch longer. The test fasteners shall be made from the same heat of rod, bar, or wire as the production fasteners; have the same type, style, and diameter as the production fasteners; and shall be processed and heat treated with the production fasteners.

4.5.2.2 Testing of fasteners with reduced length. Fasteners that have passed all of the mechanical property tests of this specification may be reduced in length without repeating the mechanical property tests provided traceability to original lot and testing is maintained, the fasteners are not

heated to a temperature high enough to change their strength or microstructure, and no other dimensions are altered.

4.5.2.3 Wedge tensile testing of bolts and screws. Wedge tensile tests on headed fasteners shall be done in accordance with ASTM F 606. Bolts and screws that require a calculated test load greater than 150,000 pounds shall be tested on a machine with a test load limit of 150,000 pounds or greater and shall not fail at a load less than the calculated test load or the limit of the test machine, whichever is lesser. Fasteners may be tested with wedge angles greater than those specified. Because their head configuration will not permit wedge tensile testing, socket flat countersunk cap screws are exempt from wedge tensile testing.

4.5.2.3.1 Wedge angles for socket head cap screws. Wedge angles for socket head cap screws, other than titanium, shall be in accordance with ASTM A 574. Wedge angles for titanium socket head cap screws shall be 6° for fasteners under ½ inch in diameter and 4° for fasteners ½ inch or larger in diameter. Fasteners may be tested with wedge angles greater than those specified.

4.5.2.4 Proof load and axial tensile tests for bolts, screws and studs. Full sized axially tensile tests shall be done in accordance with ASTM F 606. Proof load tests on bolts, screws, and studs shall be done using method 1 in accordance with ASTM F 606. Full sized yield strength tests shall be done using method 2 or 2A in accordance with ASTM F 606. Studs selected in accordance with 4.2.2 shall be axial tensile tested in accordance with ASTM F 606. Full sized axial tensile tests on fully threaded rod that is too long shall be done on a cut specimen. Fasteners that can not be tested full size shall be tested using test specimens machined from the fastener in accordance with ASTM F 606.

4.5.2.5 Proof load test for nuts. Proof load tests on nuts shall be performed in accordance with ASTM F 606.

4.5.2.5.1 Nuts with required proof loads over 120,000 pounds. Hardness tests may not be substituted for proof tests on nuts that require a proof load of over 120,000 pounds.

4.5.2.6 Hardness. Hardness tests shall be performed in accordance with ASTM F 606. All copper, aluminum titanium, and grade 400 fasteners and grades 304, 305, 316, 321, 347, and 384 cold worked bolts,cold worked screws, cold worked studs, and socket head cap screws do not require hardness testing. Externally-threaded fasteners with hardness values below the minimum requirement may be accepted provided they pass all of the other required tests. Nuts with hardness values below the minimum requirement may be accepted provided they pass all of the other required tests. Hardness conversion of steels in accordance with ASTM E 140 is permitted.

4.5.2.7 Alternate mechanical testing. Mechanical test results on the rod, bar, or wire used to produce the fasteners, may be substituted for proof stress, yield strength and axial tensile tests of externally-threaded fasteners provided all of the following conditions and tests are met:

a) The tests were done on the same lot of rod, bar or wire used to produce the fasteners.

b) The fasteners were fabricated solely by machining without further heat treatment or cold work.

c) When quenched and tempered or solution annealed and aged rod, bar or wire is used to produce studs, bolts or screws ½ inch in diameter or less, its nominal diameter may be no more than four times the nominal diameter of the stud, bolt or screw.

d) When quenched and tempered or solution annealed and aged rod, bar or wire is used to produce studs, bolts or screws over ½" in diameter, its nominal diameter may be no more than twice the nominal diameter of the bolt or screw.

e) Headed fasteners are wedge tensile tested in accordance with 4.5.2.3 and meet the requirements of 3.4. Studs are axial tensile tested in accordance with 4.5.2.4 and meet the requirements of 3.4.

4.5.3 Decarburization. Decarburization examination shall be made in accordance with SAE J121, class B (see 6.2 and 6.3). All decarburization examinations shall be performed after the final heat treatment. Heading fasteners, without heating the threaded area, is not, for the purposes of decarburization examination, a heat treatment. Decarburization examination may be done on the fastener or the rod, bar or wire used to manufacture the fastener. Bar, rod or wire, decarburized to a greater extent than permitted by SAE J121, class B, may be used, without retesting, provided the depth of total decarburization is removed during a subsequent machining operation. Headed fasteners machined from heat-treated bar shall not require a decarburization test.

4.5.4 Magnetic permeability. Determination of magnetic permeability shall be conducted in accordance with ASTM A 342, method 3 to meet the requirements of 3.8.

4.5.5 Protective coating thickness. Protective coating thickness may be determined by one of the following methods: microscopic to ASTM B 487, coulometric method to ASTM B 504 or x-ray spectrometry to ASTM B 568. No less than two measurements shall be made on each sample to determine compliance with 3.6.3. The method used shall produce results that are precise within 0.4 mils or 10 percent of the specified coating thickness, whichever is greater. Failure of the coating thickness to meet the minimum coating thickness requirements shall be cause for rejection.

4.5.6 Hydrogen embrittlement relief. When hydrogen embrittlement relief is required by 3.7, a stress durability test shall be performed in accordance with NASM-1312, method 5. The test duration shall not be less than 48 hours. A wedge in accordance with 4.5.2.3 shall be used under the heads of bolts and screws or under nuts threaded on studs.

4.6 Invalid Tests. Tests required in 4.5.2 and 4.5.6 may be discarded and a replacement test done on a specimen selected from the same lot of fasteners when any one of the following conditions occur:

a) The test specimen was incorrectly machined

b) The test procedure was incorrect

c) There was a malfunction of the testing equipment

d) An external flaw, that is not indicative of an inferior or defective lot, develops during the test. Test specimens with internal flaws, such as cracks, ruptures and porosity, are not invalid.

## 5 PACKAGING

5.1 Packaging requirements. For acquisition purposes, the packaging requirements shall be specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Fasteners meeting this specification are intended for general, high temperature, high strength and corrosive environment applications where a high degree of reliability is required. It is designed to be used to acquire commercial off-the-shelf fasteners with added inspections to verify the high degree of reliability required. Fastener types and grades have been selected to meet diverse applications which include: elevated temperatures, immersion in sea water, salt air/marine environments, high preloads and high shock loadings.

6.1.1 Martensitic stainless steel fasteners. Condition "I" was developed for martensitic corrosion resisting steel fasteners requiring moderate strength and greater resistance to stress corrosion cracking in moist, halogenated, sulfur containing or wet environments.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a) Title, number, and date of this specification.

b) Part number (see 3.14), configuration, type, style, grade, condition (see 1.2), size, length (for studs, bolts and screws), (see 3.9.2.2), thread series, and class of fit (see 3.9.1, 3.9.1.1, 3.9.1.2) and, when needed, end configuration (see 3.9.2.2). When a nonstandard fastener is needed, it may be specified on a drawing. (See 1.2).

c) Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).

d) When heat treatments do not need to be controlled in accordance with AMS 2750 or MIL-STD-1684 (see 3.3).

e) Type of coating (see 3.6.1) and the minimum coating thickness for all internally-threaded fasteners, all externally-threaded fasteners with class 3A or 5 threads, and those externally-threaded fasteners with class 2A threads that need a thicker coating (see 3.6.3), when required.

f) When aluminum alloy fasteners are to be coated with an immersion zinc flake/chromate dispersion coating (see 3.6.5), the coating procedure and thickness requirements shall be provided.

g) When titanium alloy fasteners are to be coated with an inorganic coat (see 3.6.6).

h) When cut or ground threads are not permitted.

i) The thread series, when a nonstandard thread series is needed (see 3.9.1, 3.9.1.1, 3.9.1.2).

j) Bearing surface of the nut, when a specific bearing surface is needed (see 3.9.3 and 3.9.6).

k) Self-locking element, when required (see 3.10).

l) Identification markings, when a nonstandard identification marking is needed (see 3.13).

m) When required, the following are to be reported:
(1) examination test results (see 4.3.1, 4.3.2, 4.3.3, 4.4, and 6.3)
(2) chemical analysis(see 4.5.1 and 6.3),
(3) mechanical property test results (see 4.5.2 and 6.3),
(4) decarburization tests (see 4.5.3 and 6.3), and
(5) magnetic permeability tests (see 4.5.4 and 6.3).

n) When resubmittal of fastener lots that failed an examination is allowed (see 4.3.1 and 6.7).

o) When retesting of mechanical tests is allowed (see 4.5.2 and 6.5).

p) When rework and resubmittal of lots is allowed (see 4.5.2 and 6.6).

q) Procedure for inspecting defects in fasteners, when a nonstandard inspection procedure is needed. (See 4.3.2 and 4.3.2.1).

r) Acceptance criteria for accepting inspected defects, if a nonstandard inspection criteria is needed (see 4.3.2 and 4.3.2.1).

s) Nondestructive testing procedures and acceptance criteria, when additional nondestructive testing is needed (see 4.3.3).

t) When mechanical tests are to be done before the final heat treatment (see 4.5.2).

u) Packaging requirements (see 5.1)

v) When group 2 (316) may be furnished for group 1 (304) (see table I).

w) When group 6 (431) may be furnished for group 5 (416) (see table I).

x) When Grade 410 may be furnished for grade 416 or 416Se, 416 may be furnished for grade 410 or 416Se, or 416Se may be furnished for grade 410 or 416 (see table I).

y) When grade 462 may be furnished for grade 464 or 482, grade 464 may be furnished for grade 462 or 482, and grade 482 may be furnished for grade 462 or 464.(see table I).

z) When grade 510 may be furnished for grade 544 or grade 544 may be furnished for grade 510. (see table I).

aa) When grade 655 may be furnished for grade 661 and grade 661 may be furnished for grade 655(see table I).

bb) When grade 670 may be furnished for grade 675 and grade 675 may be furnished for grade 670(see table I).

6.3 Associated Data Item Descriptions (DIDs). This specification is cited in DoD 501.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) as the source document for the following DIDs. When it is necessary to obtain the data, the applicable DIDs must be listed on the Contract Data Requirements List (DD Form 1423), except where the DoD Federal Acquisition Regulation Supplement exempts the requirement for a DD Form 1423.

| DID Number | DID Title | Suggested Tailoring |
|---|---|---|
| DI-NDTI-80809 | Test/Inspection Report | 10.1, 10.2.1, 10.2.3.2, 10.2.6.4.2.a, 10.2.6.5.b, 10.2.7.1, 10.2.7.3 |

The above DIDs were current as of the date of this specification. The current issue of this AMSDL must be researched to ensure that only current and appropriate DIDs are cited on the DD Form 1423.

6.4 Part or identifying number. Part identifying numbers are constructed as shown in appendix A.

6.5 Retesting of mechanical property tests. If an axial tension test (see 4.5.2.4), a wedge tensile test (see 4.5.2.3), a proof load test (see 4.5.2.4 and 4.5.2.5), or a hardness test (see 4.5.2.6) does not meet the acceptance criteria specified it may be retested provided twice the number of specimens that were originally nonconforming are tested. If any of the retests fail, the lot shall be rejected and no further testing is permitted, unless the lot is reworked, retested, and resubmitted in accordance with 6.6.

6.6 Resubmittal of lots rejected for failing mechanical property tests. A rejected lot may be retested and resubmitted for acceptance provided that the rejected lot was reworked, as necessary, to correct the nonconforming condition. Reworking shall consist of any procedure required to correct physical or dimensional deficiencies in nonconforming material to meet specification requirements without adversely affecting its other required characteristics.

6.7 Resubmittal of lots rejected for failing inspections. A lot which failed an examination performed in accordance with 4.3 or 4.4 may have each remaining piece in the lot tested for the characteristic rejected during the initial examination and each piece that conforms to the specification may be offered for acceptance.

6.8 Coated fasteners. When a coating is specified for internally-threaded fasteners or externally-threaded fasteners with class 3A or class 5 threads, the minimum dimensions of the fastener must be decreased to accommodate the coating. This could reduce the strength of the fasteners. Class 2A externally-threaded fasteners can accommodate a standard coating without any reduction in its dimensions.

6.9 Supersession data. This specification supersedes MIL-S-1222H, dated 21 October 1986. A cross reference of type designations appears in table XV. Supersession of the material grades of the previous specifications are given in table XVI. Fasteners covered in previous revisions to MIL-S-1222 that are not covered in MIL-DTL-1222J may be reprocured using the previous requirements found in MIL-S-1222H.

6.10 Use of commercial fasteners. This specification is arranged to promote procurement of standard commercial fasteners with additional inspections to ensure their acceptability for use in applications where a high degree of reliability is required. Table I lists these additional requirements. For example, B16 alloy steel hex cap screws originally produced to ASTM A 193 can be used to meet this specification. To do so,

they must have additional inspections to show they meet the mechanical property, decarburization, dimensional and workmanship requirements of this specification when using the tighter sampling plan of MIL-DTL-1222. In addition, not all fasteners that pass the mechanical property tests of ASTM A 193 will pass the mechanical tests of MIL-DTL-1222. MIL-DTL-1222 has a maximum strength level that is not in ASTM A 193, a lower maximum hardness requirement, and requires that fasteners over 2½ inches in diameter have higher minimum tensile properties than ASTM A 193.

6.11 Subject term (key word) listing.

Constant strength studs
Decarburization
Fasteners
Hex cap screws
Hydrogen embrittlement
Magnetic permeability
Nondestructive inspection
Protective coatings
Socket head cap screws
Threads

6.12 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification.

| | MIL-DTL-1222 | | | Commercial | | | Additional requirements | |
|---|---|---|---|---|---|---|---|---|
| | Grade | Form | Military Condition | Standard[1] | Material[2] | Fastener Condition[3] | Material symbol | Applicable Paragraphs[4] |
| Carbon and Alloy Steel | B7 | Bolt, Hex Cap Screw, or Stud | Hardened and Tempered | ASTM A 193 | Grade B7 | Quenched and Tempered | B7 | 3.3, 3.4, 3.5 |
| | B16 | Bolt, Hex Cap Screw, or Stud | Hardened and Tempered | ASTM A 193 | Grade B16 | Quenched and Tempered | B16 | 3.3, 3.4, 3.5 |
| | 2 | Bolt, Hex Cap Screw, or, Stud | As Formed or Stress Relieved | ASTM A 307 | Grade B | | "No mark" | 3.4, 3.5 |
| | 5 | Bolt, Hex Cap Screw, or Stud | Hardened and Tempered | ASTM A 449 | Type 1 | | 3 radial lines 120° apart | 3.3, 3.4, 3.5 |
| | 8 | Bolt, Hex Cap Screw, or Stud | Hardened and Tempered | ASTM A 354 | Grade BD | | 6 radial lines 60° apart | 3.3, 3.4, 3.5, 3.6.1.1, 3.7 |
| | 2H | Nut | Hardened and Tempered | ASTM A 194 | Grade 2H | | 2H | 3.3, 3.5 |
| | 2 | Nut | As Formed or Stress Relieved | SAE J995 | Grade 2 | | "No mark" | 3.4, 3.5 |
| | 4 | Nut | Hardened and Tempered | ASTM A 194 | Grade 4 | | 4 | 3.3, 3.5 |
| | 5 | Nut | Hardened and Tempered | SAE J995 | Grade 5 | | 3 circum-ferential marks 120° apart | 3.3, 3.5 |
| | 7 | Nut | Hardened and Tempered | ASTM A 194 | Grade 7 | | 7 | 3.3, 3.5 |
| Alloy Steel | 8 | Nut | Hardened and Tempered | SAE J995 | Grade 8 | | 6 circum-ferential marks 60° apart | 3.3, 3.5, 3.6.1.1 |
| | A574 | Socket Head Cap Screw | Hardened and Tempered | ASTM A 574 S1 | | | No mark | 3.3, 3.4, 3.5, 3.6.1.1, 3.7 |
| | 4340 | Socket Head Cap Screw | Hardened and Tempered | ASTM A 574 S1 | Grade 4340 | | 4340[5] | 3.3, 3.4, 3.5, 3.6.1.1, 3.7 |

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification. - Continued

| | MIL-DTL-1222 | | | Commercial | | | Additional requirements | |
|---|---|---|---|---|---|---|---|---|
| | Grade | Form | Military Condition | Standard[1] | Material[2] | Fastener Condition[3] | Material symbol | Applicable Paragraphs[4] |
| Corrosion Resistant Alloys | 304 | Bolt, Hex Cap Screw, or Stud | A | ASTM F 593 S5 | Group 1[6] | A | 304An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | | | CW | | | CW1 | 304[5] | 3.3, 3.4, 3.6.4 |
| | | | | | | CW2 | | |
| | 305 | Bolt, Hex Cap Screw, or Stud | A | ASTM F 593 S5 | Group 1[6] | A | 305An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | | | CW | | | CW1 | 305[5] | 3.3, 3.4, 3.6.4 |
| | | | | | | CW2 | | |
| | 316 | Bolt, Hex Cap Screw, or Stud | A | ASTM F 593 S5 | Group 2[7] | A | 316An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | | | CW | | | CW1 | 316[5] | 3.3, 3.4, 3.6.4 |
| | | | | | | CW2 | | |
| | 321 | Bolt, Hex Cap Screw, or Stud | A | ASTM F 593 S5 | Group 3[8] | A | 321An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | | | CW | | | CW1 | 321[5] | 3.3, 3.4, 3.6.4 |
| | | | | | | CW2 | | |
| | 347 | Bolt, Hex Cap Screw, or Stud | A | ASTM F 593 S5 | Group 3[8] | A | 347An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | | | CW | | | CW1 | 347[5] | 3.3, 3.4, 3.6.4 |
| | | | | | | CW2 | | |
| | 384 | Bolt, Hex Cap Screw, or Stud | A | ASTM F 593 S5 | Group 1[6] | A | 384An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | | | CW | | | CW1 | 384[5] | 3.3, 3.4, 3.6.4 |
| | | | | | | CW2 | | |
| | 410 | Bolt, Hex Cap Screw, or Stud | T | ASTM F 593 S5 | Group 5[9] | H | 410T[5] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | H | | | HT | 410H[5] | |
| | | | I | | | | 410I | |
| | 416 | Bolt, Hex Cap Screw, or Stud | T | ASTM F 593 S5 | Group 5[9] | H | 416T[5] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | H | | | HT | 416H[5] | |
| | | | I | | | | 416I | |
| | 416Se | Bolt, Hex Cap Screw, or Stud | T | ASTM F 593 S5 | Group 5[9] | H | 410SeT[5] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | H | | | HT | 410SeH[5] | |
| | | | I | | | | 416SeI | |
| | 431 | Bolt, Hex Cap Screw, or Stud | H | ASTM F 593 S5 | Group 6 | H | 431T[5] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | HT | | | HT | 431H[5] | |
| | | | I | | | | 431I | |
| | 630 | Bolt, Hex Cap Screw, or Stud | Annealed and Age Hardened | ASTM F 593 S5 | Group 7[6] | AH | 630[5] | 3.3, 3.6.4, 3.7 |
| | 304 | Nut | A | ASTM F 594 | Group 1[6] | A | 304An[5] | 3.3, 3.6.4, 3.8 |
| | | | CW | | | CW1 | 304[5] | 3.3, 3.6.4 |

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification. - Continued

| MIL-DTL-1222 | | | Commercial | | | Additional requirements | |
|---|---|---|---|---|---|---|---|
| Grade | Form | Military Condition | Standard[1] | Material[2] | Fastener Condition[3] | Material symbol | Applicable Paragraphs[4] |
| | | | S5 | | CW2 | | 3.3, 3.4, 3.6.4 |
| 305 | Nut | A | ASTM F 594 S5 | Group 1[6] | A | 305An[5] | 3.3, 3.6.4, 3.8 |
| | | CW | | | CW1 | 305[5] | 3.3, 3.6.4 |
| | | | | | CW2 | | 3.3, 3.6.4, 3.8 |
| 316 | Nut | A | ASTM F 594 S5 | Group 2[7] | A | 316An[5] | 3.3, 3.6.4, 3.8 |
| | | CW | | | CW1 | 316[5] | 3.3, 3.6.4 |
| | | | | | CW2 | | 3.3, 3.4, 3.6.4 |
| 321 | Nut | A | ASTM F 594 S5 | Group 3[8] | A | 321An[5] | 3.3, 3.6.4, 3.8 |
| | | CW | | | CW1 | 321[5] | 3.3, 3.6.4 |
| | | | | | CW2 | | 3.3, 3.4, 3.6.4 |
| 347 | Nut | A | ASTM F 594 | Group 3[8] | A | 347An[5] | 3.3, 3.6.4, 3.8 |
| | | CW | | | CW1 | 347[5] | 3.3, 3.6.4 |
| | | | | | CW2 | | 3.3, 3.4, 3.6.4 |
| 384 | Nut | A | ASTM F 594 | Group 1[6] | A | 384An[5] | 3.3, 3.6.4, 3.8 |
| | | CW | | | CW1 | 384[5] | 3.3, 3.6.4 |
| | | | | | CW2 | | 3.3, 3.4, 3.6.4 |
| 410 | Nut | T | ASTM F 594 | Group 5[9] | H | 410T[5] | 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4 |
| | | H | | | HT | 410H[5] | |
| 416 | Nut | T | ASTM F 594 | Group 5[9] | H | 416T[5] | 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4 |
| | | H | | | HT | 416H[5] | |
| 416Se | Nut | T | ASTM F 594 | Group 5[9] | H | 416SeT[5] | 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4 |
| | | H | | | HT | 416SeH[5] | |
| 431 | Nut | H | ASTM F 594 | Group 6 | H | 431T[5] | 3.3, 3.6.4 |
| | | HT | | | HT | 431H[5] | 3.3, 3.4, 3.6.4 |
| 630 | Nut | Annealed and Age Hardened | ASTM F 594 | Group 7[6] | AH | 630[5] | 3.3 |
| 304 | Socket Head Cap Screw | A | ASTM F 837 | Group 1[6] | CW | 304An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| 305 | Socket Head Cap Screw | A | ASTM F 837 | Group 1[6] | CW | 304An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| 384 | Socket Head Cap Screw | A | ASTM F 837 | Group 1[6] | CW | 304An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| 316 | Socket Head Cap Screw | A | ASTM F 837 S2, S4 | Alloy 316 or 316L | CW | 316An[5] | 3.3, 3.4, 3.6.4, 3.8 |

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification. - Continued

| | MIL-DTL-1222 | | | Commercial | | | Additional requirements | |
|---|---|---|---|---|---|---|---|---|
| | Grade | Form | Military Condition | Standard[1] | Material[2] | Fastener Condition[3] | Material symbol | Applicable Paragraphs[4] |
| Corrosion Resistant Alloys | 321 | Socket Head Cap Screw | A | ASTM F 837 S2, S4 | Alloy 321 or 347 | CW | 321An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | 347 | Socket Head Cap Screw | A | ASTM F 837 S2, S4 | Alloy 321 or 347 | CW | 347An[5] | 3.3, 3.4, 3.6.4, 3.8 |
| | 410 | Socket Head Cap Screw | T | ASME B18.3 | ASTM A493 Grade 410 | H | 410T[10] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | H | | | HT | 410H[10] | |
| | | | I | | | | 410I | |
| | 416 | Socket Head Cap Screw | T | ASME B18.3 | ASTM A493 Grade 416 | H | 416T[10] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | H | | | HT | 416H[10] | |
| | | | I | | | | 416I | |
| | 416Se | Socket Head Cap Screw | T | ASME B18.3 | ASTM A493 Grade 416Se | H | 416SeT[10] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | H | | | HT | 416SeH[10] | |
| | | | I | | | | 416ISe | |
| | 431 | Socket Head Cap Screw | H | ASME B18.3 | ASTM A493 Grade 431 | H | 431T[10] | 3.2.1, 3.3, 3.3.1, 3.3.3, 3.4, 3.6.4, 3.7 |
| | | | HT | | | HT | 431H[10] | |
| | | | I | | | I | 431I | |
| Copper | 462[11] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASTM F 468 | Cu 462 | As Formed or Stress Relieved | 462[5] | 3.4 |
| | 464[11] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASTM F 468 | Cu 464 | As Formed or Stress Relieved | 464[5] | 3.4 |
| | 482[11] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASME B18.2.1 | ASTM B 21 Alloy C48200 | As Formed or Stress Relieved | 482[10] | 3.4 |
| | | | | ASME B1.1 | | | | |
| | 510[12] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASTM F 468 | Cu 510 | As Formed or Stress Relieved | 510[5] | 3.4 |
| | 544[12] | Hex Cap Screw | As Formed or Stress Relieved | ASME B18.2.1 | ASTM B 139 Alloy C54400 Temper H04[13] | As Formed or Stress Relieved | 544[10] | 3.4 |
| | | Stud | | ASME B1.1 | | | | |
| | 632 | Hex Cap Screw | Quenched and Tempered | ASME B18.2.1 | ASTM B 150 Alloy C63200 | Quenched & Temper Annealed | 632[10] | 3.3, 3.3.5, 3.4 |
| | | Stud | | ASME B1.1 | | | | |

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification. - Continued

| MIL-DTL-1222 | | | Commercial | | | Additional requirements | |
|---|---|---|---|---|---|---|---|
| Grade | Form | Military Condition | Standard[1] | Material[2] | Fastener Condition[3] | Material symbol | Applicable Paragraphs[4] |
| 655[14] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASTM F 468 | Cu 655 | As Formed or Stress Relieved | 655[5] | 3.4 |
| 661[14] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASTM F 468 | Cu 661 | As Formed or Stress Relieved | 661[5] | |
| 670[15] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASME B18.2.1<br>ASME B1.1 | ASTM B 138 Alloy C67000 | As Formed or Stress Relieved | 670[10] | 3.4 |
| 675[15] | Bolt, Hex Cap Screw, or Stud | As Formed or Stress Relieved | ASTM F 468 | Cu 675 | As Formed or Stress Relieved | 675[5] | |
| 462[11] | Nut | As Formed or Stress Relieved | ASTM F 467 | Cu 462 | As Formed or Stress Relieved | 462[5] | 3.4 |
| 464[11] | Nut | As Formed or Stress Relieved | ASTM F 467 | Cu 464 | As Formed or Stress Relieved | 464[5] | 3.4 |
| 510[12] | Nut | As Formed or Stress Relieved | ASTM F 467 | Cu 510 | As Formed or Stress Relieved | 510[5] | |
| 544[12] | Nut | As Formed or Stress Relieved | ASME B18.2.2 | ASTM B 139 Alloy C54400 Temper H04[13] | As Formed or Stress Relieved | 544[10] | 3.4 |
| 632 | Nut | Quenched and Tempered | ASME B18.2.2 | ASTM B 150 Alloy C63200 Temper TQ30[16] | Quenched & Temper Annealed | 632[10] | 3.3, 3.3.5, 3.4 |
| 655[14] | Nut | As Formed or Stress Relieved | ASTM F 467 | Cu 655 | As Formed or Stress Relieved | 655[5] | 3.4 |
| 661[14] | Nut | As Formed or Stress Relieved | ASTM F 467 | Cu 661 | As Formed or Stress Relieved | 661[5] | |
| 670[15] | Nut | As Formed or Stress Relieved | ASME B18.2.1<br>ASME B1.1 | ASTM B 138 Alloy C67000 | As Formed or Stress Relieved | 670[10] | 3.4 |

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification. - Continued

| | MIL-DTL-1222 | | | Commercial | | | Additional requirements | |
|---|---|---|---|---|---|---|---|---|
| | Grade | Form | Military Condition | Standard[1] | Material[2] | Fastener Condition[3] | Material symbol | Applicable Paragraphs[4] |
| | 675[15] | Nut | As Formed or Stress Relieved | ASTM F 467 | Cu 675 | As Formed or Stress Relieved | 675[5] | |
| Nickel | 400 | Hex Cap Screw Stud | As Formed or Stress Relieved | ASTM F 468 | Ni 400 QQ-N-281, class a | As Formed or Stress Relieved | NC[5] | 3.4 |
| | 500 | Hex Cap Screw Stud | Solution Annealed and Aged | ASTM F 468 | Ni 500 QQ-N-286 | Annealed and Age Hardened | .K.[5] | 3.3, 3.3.4, 3.4 |
| | 625 | Hex Cap Screw | Annealed | ASME B18.2.1 | ASTM B 446 Grade 1 | Annealed | 625[10] | 3.2.2, 3.3, 3.4 |
| | | Stud | | ASME B1.1 | | | | |
| | 400 | Socket Head Cap Screw | As Formed or Stress Relieved | ASME B18.3 | Ni 400 QQ-N-281, class a | As Formed or Stress Relieved | NC[10] | 3.4 |
| | 500 | Socket Head Cap Screw | Solution Annealed and Aged | ASME B18.3 | QQ-N-286 | Annealed and Age Hardened | .K.[10] | 3.3, 3.3.4, 3.4 |
| | 625 | Socket Head Cap Screw | Annealed | ASME B18.3 | ASTM B 446 Grade 1 | Annealed | 625[10] | 3.2.2, 3.3, 3.4 |
| | 400[17] | Nut | As Formed or Stress Relieved | ASTM F 467 | Ni 400 QQ-N-281, class a | As Formed or Stress Relieved | NC[5] | 3.4 |
| | 405[17] | Nut | As Formed or Stress Relieved | ASTM F 467 | Ni 405 QQ-N-281. class b | As Formed or Stress Relieved | NCR or NC-R[5] | 3.4 |
| | 500 | Nut | Solution Annealed and Aged | ASTM F 467 | Ni 500 QQ-N-286 | Annealed and Age Hardened | .K.[5] | 3.3 |
| | 625 | Nut | Annealed | ASME B18.2.2 | ASTM B 446 Grade 1 | Annealed | 625[10] | 3.2.2, 3.3, 3.4 |

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification. - Continued

Notes: - Continued

1 The commercial fastener specification and any mandatory supplementary requirements.
2 The material alloy, grade, type, or group is cited as it is used in the commercial fastener standard. When a separate material specification is cited in the material column, the rod, bar or wire used to make the fasteners shall meet all of the requirements of the specification cited.
3 The fastener condition is cited as it is used in the commercial fastener specification.
4 Those requirements in paragraphs 3.2, 3.4, 3.5, 3.6, 3.7,and 3.8 that specifically apply to the specified fastener grade are cited. Paragraph 3.4 is only cited when the mechanical property requirements listed in table II, table III, or table IV are different than the property requirements in the applicable commercial specifications.
5 The material symbol is different than the symbol used in the commercial specification.
6 Any grade in group one, except 303, 303Se, or XM-1, may be supplied provided the fasteners are marked with the material symbol for the grade supplied. When approved, see 6.2, group 2 may be furnished for group 1. Only one grade may be furnished with each order.
7 Any grade in group two may be supplied provided the fasteners are marked with the material symbol for the grade supplied. Only one grade may be furnished with each order.
8 Any grade in group three may be supplied provided the fasteners are marked with the material symbol for the grade supplied. Only one grade may be furnished with each order.
9 When approved, see 6.2, group 6 may be furnished for gropup 5. When approved, see 6.2, Grade 410 may be furnished for grade 416 or 416Se, 416 may be furnished for grade 410 or 416Se, 416Se may be furnished for grade 410 or 416, or 431 may be furnished for 410, 416, or 416Se. Only one grade may be furnished with each order.
10 The commercial specifications do not have material symbols.
11 When approved, see 6.2, grade 462 may be furnished for grade 464 or 482, 464 may be furnished for grade 462 or 482, and 482 may be furnished for grade 462 or 464. Only one grade may be furnished with each order.
12 When approved, see 6.2, grade 510 may be furnished for grade 544 or grade 544 may be furnished for grade 510. Only one grade may be furnished with each order.
13 The temper of the rod or bar used to make the fasteners may be M20, or any other suitable temper.
14 When approved, see 6.2, grade 655 may be furnished for grade 661 and grade 661 may be furnished for grade 655. Only one grade may be furnished with each order.
15 When approved, see 6.2, grade 670 may be furnished for grade 675 and grade 675 may be furnished for grade 670. Only one grade may be furnished with each order.
16 The temper of the rod or bar used to make the fasteners may be M20, or any other suitable temper, if the fasteners are heat treated in accordance with ASTM B 150, Temper TQ30.
17 Grade 400 nuts may be furnished for grade 405 nuts and 405 nuts may be furnished for grade 400 nuts. Only one grade may be furnished with each order.

TABLE I. Commercial specification, grade, material symbol and additional requirements to certify items meeting commercial standards to this specification. - Continued

| | MIL-DTL-1222 | | | Commercial | | | Additional requirements | |
|---|---|---|---|---|---|---|---|---|
| | Grade | Form | Military Condition | Standard[1] | Material[2] | Fastener Condition[3] | Material symbol | Applicable Paragraphs[4] |
| Aluminum | 2024 | Bolt, Hex Cap Screw, or Stud | Solution Treated and Naturally Aged | ASTM F 468 | Al 2024 | T4 | 2024[5] | 3.3, 3.3.6. 3.4, 3.6.5 |
| | | Nuts | | ASTM F 467 | | | | 3.3, 3.3.6. 3.4, 3.6.5 |
| | 6061 | Bolt, Hex Cap Screw, or Stud | Solution Treated and Artificially Aged | ASTM F 468 | Al 6061 | T6 | 6061[5] | 3.3, 3.3.6. 3.4, 3.6.5 |
| | | Nuts | | ASTM F 467 | | | | 3.3, 3.3.6. 3.4, 3.6.5 |
| | 7075 | Bolt, Hex Cap Screw, or Stud | Solution Treated and Stabilized | ASTM F 468 | Al 7075 | T73 | 7075[5] | 3.3, 3.3.6. 3.4, 3.6.5 |
| | | Nuts | | ASTM F 467 | | | | 3.3, 3.3.6. 3.4, 3.6.5 |
| Titanium | T7 | Bolt, Hex Cap Screw, or Stud | Annealed | ASTM F 468 | ASTM B 348 Ti23 | As formed | T7[5] | 3.2.3, 3.3.7, 3.3, 3.4, 3.6.6 |
| | | Nut | | ASTM F 467 | | | | 3.3, 3.6.6 |

Notes:
1 The commercial fastener specification and any mandatory supplementary requirements.
2 The material alloy, grade, type, or group is cited as it is used in the commercial fastener standard. When a separate material specification is cited in the material column, the rod, bar or wire used to make the fasteners shall meet all of the requirements of the specification cited.
3 The fastener condition is cited as it is used in the commercial fastener specification.
4 Those requirements in paragraphs 3.2, 3.4, 3.5, 3.6, 3.7,and 3.8 that specifically apply to the specified fastener grade are cited. Paragraph 3.4 is only cited when the mechanical property requirements listed in table II, table III, or table IV are different than the property requirements in the applicable commercial specifications.

TABLE II. Mechanical property values for bolts, studs and hex cap screws.

| Material | | Heat treatment or condition | Nominal diameter (inches) | Full size fasteners | | | Rockwell hardness | Machined specimens from fasteners or on parent barstock | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Tensile strength, ksi | Yield strength, ksi min | Proof stress, ksi min | | Tensile strength ksi, min | Yield strength, ksi, min | Elongation in 4D percent, min | Reduction of area, percent, min |
| Carbon and alloy Steel | 2 | As formed or stress relieved | ¾ or less | 75[1]-100 | | 55[2] | B80 min[1] | 75[1] | 55[2] | 18 | 35[2] |
| | | | Over ¾ | 60-100 | | 35[2] | B70 min[1] | 60 | 35[2] | 18 | 35[2] |
| | 5 | Hardened and Tempered | 1 or less | 120-150[3] | | 85 | C23-34 | 120 | 92 | 14 | 35 |
| | | | Over 1-1½ | 105-150[3] | | 75[1] | B97[4]-C34[5] | 105 | 81 | 14 | 35 |
| | | | Over 1½ | 90-150[3] | | 55 | B90-99[6] | 90 | 58 | 14 | 35 |
| | B7 | Quenched and tempered | 2½ or less | 125-150[2,3] | | 95[2] | C25[7]-34[8] | 125 | 105 | 16 | 50 |
| | | | Over 2½ to 4 | 115-150[2] | | 85[2] | C22[7]-34[5] | 115 | 95 | 16 | 50 |
| | | | Over 4 | 115-150[2] | | 85[2] | C22[7]-34[5] | 115[1] | 95[1] | 16[9] | 50 |
| | B16 | Hardened and Tempered | 2½ or less | 125-150[2,3] | | 95[2] | C25[7]-C34[8] | 125 | 105 | 18 | 50 |
| | | | Over 2½ to 4 | 115-150[2] | | 85[2] | C22[7]-C34[5] | 115[1] | 95 | 17 | 45 |
| | | | Over 4 | 115-150[2] | | 85[2] | C22[7]-C34[5] | 115[1] | 95[1] | 17[1] | 45 |
| | 8 | Quenched and Tempered | 2½ or less | 150-175[3] | | 120 | C32[9]-C39 | 150 | 130 | 14 | 40 |
| | | | Over 2½ | 140-175[3] | | 105 | C30[9]-C39 | 140 | 115 | 14 | 40 |

TABLE II. Mechanical property values for bolts, studs and hex cap screws. - Continued

| Material | | Heat treatment or condition | Nominal diameter (inches) | Full size fasteners | | | Rockwell hardness | Machined specimens from fasteners or on parent barstock | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Tensile strength, ksi | Yield strength, ksi min | Proof stress, ksi min | | Tensile strength ksi, min | Yield strength, ksi, min | Elongation in 4D percent, min | Reduction of area, percent, min |
| Corrosion resistant steel | 316, 321, 347, 304, 305, 384 | Annealed | All sizes | 75-100 | 30 | | B95 max | 75[1] | 30 | 20[9] | |
| | | Cold Worked | ¾ or less | 105[1]-140[8] | 65 | | | 105[1] | 65[1] | 20 | |
| | | | Over ¾ | 90[1]-140 | 50[1] | | | 85[1] | 40 | 25 | |
| | 410, 416, 416Se | T[10] | All sizes | 125[1]-150[5] | 95[9] | | C25[1]-34[5] | 125[1] | 95[1] | 20[1] | |
| | | I[11] | All sizes | 110-140[11] | 90[11] | | C20-26[11] | 110[11] | 90[11] | 20[11] | |
| | | H[12] | All sizes | 180[1]-220[5] | 135[1] | | C38[1]-47[5] | 180[1] | 135[1] | 12 | |
| | 431 | H | All sizes | 125-150 | 95[9] | | C25-34[5] | 125 | 95[9] | 20[1] | |
| | | I[11] | All sizes | 110[11] | 90[11] | | C20-26[11] | 110[11] | 90[11] | 20[11] | |
| | | HT | All sizes | 180-220 | 135[9] | | C38[9]-47[8] | 180 | 135[9] | 12[1] | |
| | 630 | Annealed and age hardened | All sizes | 135-170 | 105 | | C28-C38 | 135 | 105 | 16 | |
| Copper | 462 | As formed or stress relieved | All sizes | 55[1]-90[5] | 25 | | | 55[1] | 20[9] | 25[1] | |
| | 464 | | All sizes | 55[1]-90[5] | 25[1] | | | 55[1] | 20[1] | 25 | |
| | 482[11] | | All sizes | 55-90[11] | 25[11] | | | 55[11] | 20[11] | 25[11] | |
| | 510 | | All sizes | 60-90 | 35 | | | 60[1] | 35[1] | 15 | |

TABLE II. Mechanical property values for bolts, studs and hex cap screws. - Continued

| Material | | Heat treatment or condition | Nominal diameter (inches) | Full size fasteners | | | Rockwell hardness | Machined specimens from fasteners or on parent barstock | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Tensile strength, ksi | Yield strength, ksi min | Proof stress, ksi min | | Tensile strength ksi, min | Yield strength, ksi, min | Elongation in 4D percent, min | Reduction of area, percent, min |
| Copper | 544[11] | | All sizes | 60-90[11] | 35[11] | | | 60[11] | 35[11] | 15[11] | |
| | 632[11] | As formed or stress relieved | All sizes | 90-120[11] | 35[11] | | | 90[11] | 35[11] | 18[11] | |
| | 655 | | All sizes | 65[1]-100[5] | 35[1] | | | 65[1] | 35[1] | 15[9] | |
| | 661 | | All sizes | 65[9]-100 | 35 | | | 65[9] | 35 | 15 | |
| | 670[11] | | All sizes | 55-90[11] | 20[11] | | | 55[11] | 20[11] | 20[11] | |
| | 675 | | All sizes | 55-90[5] | 20[9] | | | 55 | 20[9] | 20 | |
| Nickel | 400 | As formed or stress relieved | ¾ or less | 80-110[8] | 40 | | | 80 | 40 | 20 | |
| | | | Over ¾ | 80[1]-110[8] | 40[1] | | | 80[1] | 40[1] | 20 | |
| | 405 | | All sizes | 80[1]-110[8] | 40[1] | | | 80[1] | 40[1] | 20 | |
| | 500 | Annealed and Age Hardened | less than 1 | 130-180 | 90 | | C24-35[8] | 130 | 90 | 20 | |
| | | | 1 and over | 130-180 | 85 | | C24-35[8] | 130 | 85 | 20 | |
| | 625[11] | Annealed | 2¼ or less | 120 min[11] | 60[11] | | B85-C35[11] | 120[11] | 60[11] | 30[11] | |
| | | | Over 2¼ | 110 min[11] | 50[11] | | B85-C35[11] | 110[11] | 50[11] | 25[11] | |
| Aluminum | 2024 | T4 | All sizes | 62 min[1] | 40[1] | | | 62 | 40 | 10 | |
| | 6061 | T6 | All sizes | 42 min[1] | 35[1] | | | 42 | 35 | 10 | |
| | 7075 | T73 | All sizes | 68 min[1] | 50 | | | 68 | 56 | 10 | |
| Titanium | T7 | Annealed | Less than 1½ | 125[1]-165 | 115[1] | | | 125[1] | 115[1] | 12[1] | 20[2] |
| | | | 1½ to 2 | 120-165[11] | 110[11] | | | 120[11] | 110[11] | 12[11] | 20[11] |
| | | | Over 2 | 115-165[11] | 105[11] | | | 115[11] | 105[11] | 12[11] | 20[11] |

TABLE II. Mechanical property values for bolts, studs and hex cap screws. - Continued

Notes: - Continued
1 The commercial specification has a lower minimum requirement.
2 The commercial specification does not require this test for some or all of the fasteners.
3 There is no maximum requirement in the commercial specification.
4 HRB 97 was used instead of HRC 19 because the Rockwell C hardness range does not cover HRC 19.
5 The commercial specification has a lower maximum requirement.
6 The commercial specification has an equivalent hardness requirement.
7 There is no minimum in the commercial specification.
8 The commercial specification has a higher maximum requirement.
9 The commercial specification has a higher minimum requirement.
10 The equivalent commercial condition is “H.”
11 There is no commercial fastener specification for this fastener.
12 The equivalent commercial condition is “HT.”

TABLE III. Mechanical property values for socket head cap screws.

| Material | Heat treatment or condition | Nominal diameter (inches) | Full-sized fasteners | | Rockwell hardness | Machined specimens from fasteners or parent barstock | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Tensile strength ksi min | Yield strength ksi min | | Tensile strength ksi min | Yield strength ksi min | Elongation in 4D percent min | Reduction of area percent min |
| A574, 4340 | Hardened and Tempered | ½ or less | 180 | 155[1] | C39-45 | 180 | 155 | 10 | 33 |
| | | Over ½ | 170 | 153[1] | C37-45 | 170 | 153 | 10 | 33 |
| 384, 316, 321, 347, 304, 305 | Annealed[2] | ⅝ or less | 80[3] | 30[4] | | 80[3] | 30 | 10 | 30 |
| | | Over ⅝ | 70 | 26[4] | | 70 | 26 | 20 | 30 |
| 410[5],416[5], 416Se[5] | T[5] | All sizes | 125-150[5] | 95[5] | C25-43[5] | 125[5] | 95[5] | 20[5] | |
| | H[5] | All sizes | 180-220[5] | 135[5] | C36-43[5] | 180[5] | 125[5] | 12[5] | |
| | I[5] | All sizes | 110 MIN[5] | 90[5] | C20-26[5] | 110[5] | 90[5] | 20[5] | |
| 431[5] | H[5] | All sizes | 125-150[5] | 95[5] | C25-43[5] | 125[5] | 95[5] | 20[5] | |
| | HT[5] | All sizes | 180-220[5] | 135[5] | C36-43[5] | 180[5] | 125[5] | 12[5] | |
| | I[5] | All sizes | 110 MIN[5] | 90[5] | C20-26[5] | 110[5] | 90[5] | 20[5] | |
| 400[5] | As Formed or Stress Relieved | All sizes | 80[5] | 40[5] | | 80[5] | 40[5] | 20[5] | |
| 500[5] | Annealed and age hardened | Less than 1 | 130[5] | 90[5] | C24-35[5] | 130[5] | 90[5] | 20[5] | |
| | | 1 and over | 130[5] | 85[5] | C24-35[5] | 130[5] | 85[5] | 20[5] | |
| 625[5] | Annealed | 2¼ or less | 120[5] | 60[5] | B85-C35[5] | 120[5] | 60[5] | 30[5] | |
| | | Over 2¼ | 110[5] | 50[5] | B85-C35[5] | 110[5] | 50[5] | 25[5] | |

Notes:
1 The commercial specification requires a proof test instead of a full size yield strength test.
2 The equivalent commercial condition is “CW.”
3 The commercial specification has a higher minimum requirement.
4 The commercial specification does not require this test for some or all of the fasteners.
5 There is no commercial fastener specification for this fastener.

TABLE IV. Mechanical property values for nuts.

| Material | | Heat treatment or condition | Nominal size (inches) | Proof stress for hex nut (ksi min)[1] | Rockwell hardness |
|---|---|---|---|---|---|
| Carbon and alloy steels | 2 | As Formed or Stress Relieved | All sizes | 90 | B80[2] – C32 |
| | 2H | Hardened and tempered | All sizes | 150 | C24 - C38 |
| | 4,7 | Hardened and tempered | All sizes | 150 | C24 - C38 |
| | 5 | Hardened and tempered | Up to 1″ | 120 | C23 – C32 |
| | | | Over 1″ | 105 | B97[3] – C32 |
| | 8 | Hardened and tempered | Up to 5/8″ | 150 | C24 – C32 |
| | | | Over 5/8″ | 150 | C24[4] – C32[5] |
| Corrosion resistant steels | 384, 316, 321, 347, 304, 305 | Annealed | All | 75 | B65 – B95 |
| | | Cold Worked (CW1) | Up to 5/8″ | 90 | B95 |
| | | Cold worked (CW2) | ¾ and over | 90[6] | B90[6] - C32 |
| | 410, 416, 416Se | T | All sizes | 125[6] | C25[6] – 34[7] |
| | | H | All sizes | 180[6] | C38[6] – 47[7] |
| | 431 | H | All sizes | 125 | C25 – C34[7] |
| | | HT | All sizes | 180 | C38[8] – 47[5] |
| | 630 | Annealed and age hardened | All sizes | 135 | C28 – C38 |
| Copper | 462, 464 | As formed or stress relieved | All sizes | 55[6] | |
| | 510, 544 | As formed or stress relieved | All sizes | 60 | |
| | 632[9] | Quenched and tempered | All sizes | 90[9] | |
| | 655 | As formed or stress relieved | All sizes | 65[6] | |
| | 661 | As formed or stress relieved | All sizes | 65[8] | |
| | 670[9] | As formed or stress relieved | All sizes | 55[9] | |
| | 675 | As formed or stress relieved | All sizes | 55 | |

TABLE IV. Mechanical property values for nuts. - Continued

| Material | | Heat treatment or condition | Nominal size (inches) | Proof stress for hex nut (ksi min)[1] | Rockwell hardness |
|---|---|---|---|---|---|
| Nickel | 400 | As formed or stress relieved | All sizes | 80 | |
| | 405 | As formed or stress relieved | All sizes | 80[6] | |
| | 500 | Annealed and age hardened | All sizes | 130 | C24 min |
| | 625[9] | Annealed | 2¼ or less | 120[9] | B85-C35[9] |
| | | | Over 2¼ | 110[9] | B85-C35[9] |
| Aluminum | 2024 | T4 | All sizes | 55 | |
| | 6061 | T6 | All sizes | 40 | |
| | 7075 | T73 | All sizes | 52 | |
| Titanium | T7 | Annealed | All sizes | 120[8] | |

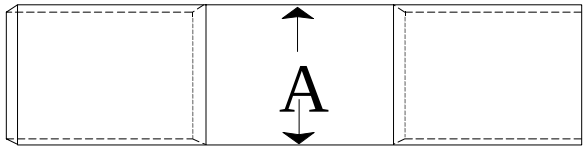
Notes:
1 To determine minimum proof stress for nuts other than hex nuts use the following:
   (a) Proof stress for jam nuts (all materials) = 0.60F.
   (b) Proof stress for heavy hex nuts (ferrous) = 1.10F.
   (c) Proof stress for heavy hex nuts (nonferrous) = 1.08F.
   (d) Proof stress for slotted nuts (all materials) = 0.80F.
   (where F = proof stress for hex nut.)
2 There is no minimum in the commercial specification.
3 HRB 97 was used instead of HRC 19 because the Rockwell C hardness range does not cover HRC 19.
4 The commercial specification has a higher minimum.
5 The commercial specification has a higher maximum.
6 The commercial specification has a lower minimum.
7 The commercial specification has a lower maximum.
8 The commercial specification has a higher minimum.
9 There is no commercial fastener specification for this fastener

TABLE V. Coating thicknesses on externally-threaded fasteners with thread class 2A.

| Diameter | Minimum thickness (inches) | | Maximum thickness (inches) | |
|---|---|---|---|---|
| | UNC Thread[1] | 8UN Thread[2] | UNC Thread[3] | 8UN Thread[4] |
| ¼ | 0.000183 | --- | 0.000275 | --- |
| 5/16 | 0.000200 | --- | 0.000300 | --- |
| 3/8 | 0.000217 | --- | 0.000325 | --- |
| 7/16 | 0.000233 | --- | 0.000350 | --- |
| ½ | 0.000250 | --- | 0.000375 | --- |
| 9/16 | 0.000267 | --- | 0.000400 | --- |
| 5/8 | 0.000267 | --- | 0.000400 | --- |
| ¾ | 0.000300 | --- | 0.000450 | --- |
| 7/8 | 0.000317 | --- | 0.000475 | --- |
| 1 | 0.000333 | 0.000333 | 0.000500 | 0.000500 |
| 1 1/8 | 0.000367 | 0.000350 | 0.000550 | 0.000525 |
| 1¼ | 0.000367 | 0.000350 | 0.000550 | 0.000525 |
| 1 3/8 | 0.000400 | 0.000367 | 0.000600 | 0.000550 |
| 1½ | 0.000400 | 0.000367 | 0.000600 | 0.000550 |
| 1¾ | 0.000450 | 0.000383 | 0.000675 | 0.000575 |
| 2 | 0.000483 | 0.000383 | 0.000725 | 0.000575 |
| 2¼ | 0.000483 | 0.000400 | 0.000725 | 0.000600 |
| 2½ | 0.000517 | 0.000400 | 0.000775 | 0.000600 |
| 2¾ | 0.000533 | 0.000417 | 0.000800 | 0.000625 |
| 3 | 0.000533 | 0.000433 | 0.000800 | 0.000650 |
| 3¼ | 0.000550 | 0.000433 | 0.000825 | 0.000650 |
| 3½ | 0.000550 | 0.000433 | 0.000825 | 0.000650 |
| 3¾ | 0.000567 | 0.000450 | 0.000850 | 0.000675 |
| 3 7/8 | 0.000567 | 0.000450 | 0.000850 | 0.000675 |
| 4 | 0.000567 | 0.000450 | 0.000850 | 0.000675 |

Notes:
1 One sixth of the thread allowance in table 20 of ASME B1.1.
2 One sixth of the thread allowance in table 25 of ASME B1.1.
3 One fourth of the thread allowance in table 20 of ASME B1.1.
4 One fourth of the thread allowance in table 25 of ASME B1.1.

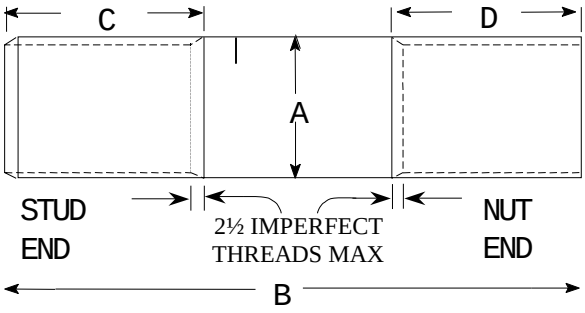
TABLE VI. Body diameter - studs, type I, II, III.




| Size | Body diameter (inches)(A) | | | | | | | | | | | | Nut end thread |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Full Body | | | | Reduced Body | | | | Constant strength body | | | | |
| | Type I Styles a & c | | Type I Styles b & d | | Type II Styles a & c | | Type II Styles b & d | | Cut thread[1] Styles b & d | | Rolled thread Styles a, b, c, d | | |
| | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| ¼ | 0.270 | 0.241 | 0.270 | 0.240 | 0.250 | 0.214 | 0.248 | 0.212 | 0.205 | 0.201 | 0.220 | 0.212 | UNC |
| 5/16 | 0.332 | 0.303 | 0.332 | 0.302 | 0.312 | 0.273 | 0.311 | 0.271 | 0.262 | 0.258 | 0.278 | 0.271 | UNC |
| 3/8 | 0.395 | 0.365 | 0.395 | 0.364 | 0.375 | 0.331 | 0.373 | 0.328 | 0.318 | 0.314 | 0.336 | 0.328 | UNC |
| 7/16 | 0.457 | 0.427 | 0.457 | 0.425 | 0.437 | 0.387 | 0.436 | 0.385 | 0.373 | 0.368 | 0.393 | 0.385 | UNC |
| ½ | 0.520 | 0.489 | 0.520 | 0.487 | 0.500 | 0.446 | 0.498 | 0.443 | 0.430 | 0.425 | 0.452 | 0.443 | UNC |
| 9/16 | 0.582 | 0.551 | 0.582 | 0.549 | 0.562 | 0.504 | 0.560 | 0.501 | 0.487 | 0.481 | 0.510 | 0.501 | UNC |
| 5/8 | 0.645 | 0.612 | 0.645 | 0.611 | 0.625 | 0.561 | 0.623 | 0.558 | 0.542 | 0.536 | 0.568 | 0.558 | UNC |
| ¾ | 0.770 | 0.737 | 0.770 | 0.735 | 0.750 | 0.680 | 0.748 | 0.677 | 0.658 | 0.652 | 0.687 | 0.677 | UNC |
| 7/8 | 0.895 | 0.861 | 0.895 | 0.859 | 0.875 | 0.798 | 0.873 | 0.794 | 0.773 | 0.767 | 0.804 | 0.794 | UNC |
| 1 | 1.020 | 0.985 | 1.020 | 0.983 | 1.000 | 0.913 | 0.998 | 0.910 | 0.885 | 0.878 | 0.920 | 0.910 | UNC |
| 1 1/8 | 1.145 | 1.108 | 1.145 | 1.106 | 1.125 | 1.026 | 1.122 | 1.022 | 0.993 | 0.986 | 1.034 | 1.022 | UNC |
| 1 1/8 | 1.145 | 1.110 | 1.145 | 1.108 | 1.125 | 1.039 | 1.122 | 1.035 | 1.010 | 1.003 | 1.046 | 1.034 | UNC |
| 1¼ | 1.270 | 1.233 | 1.270 | 1.231 | 1.250 | 1.151 | 1.247 | 1.147 | 1.118 | 1.111 | 1.159 | 1.147 | UNC |
| 1¼ | 1.270 | 1.235 | 1.270 | 1.233 | 1.250 | 1.164 | 1.247 | 1.160 | 1.135 | 1.129 | 1.171 | 1.159 | 8UN |
| 1 3/8 | 1.395 | 1.356 | 1.395 | 1.354 | 1.375 | 1.260 | 1.372 | 1.256 | 1.221 | 1.213 | 1.269 | 1.256 | UNC |
| 1 3/8 | 1.295 | 1.360 | 1.295 | 1.358 | 1.375 | 1.288 | 1.372 | 1.284 | 1.260 | 1.253 | 1.296 | 1.284 | 8UN |
| 1½ | 1.520 | 1.481 | 1.520 | 1.479 | 1.500 | 1.385 | 1.497 | 1.381 | 1.346 | 1.338 | 1.394 | 1.381 | UNC |
| 1½ | 1.520 | 1.485 | 1.520 | 1.483 | 1.500 | 1.413 | 1.497 | 1.409 | 1.386 | 1.378 | 1.421 | 1.409 | 8UN |

Notes:
1 Maximum values are for class 2A fit only. 3A fit should use 3A pitch diameter tolerance limits as found in ASME B1.1

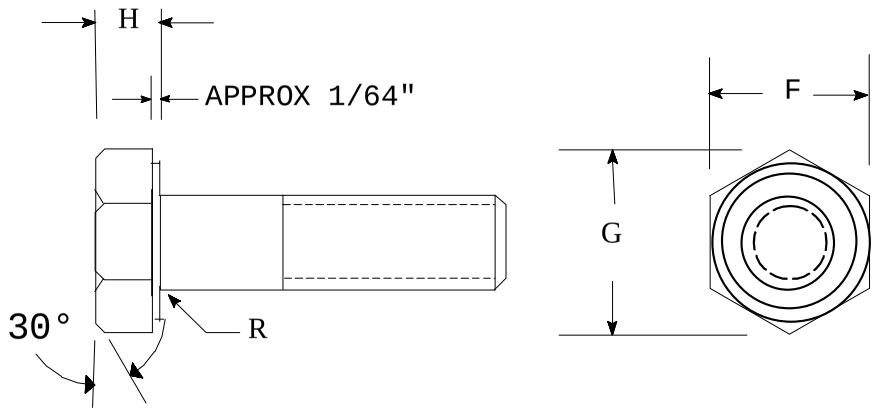
TABLE VII. Thread length dimensions for studs, type I, II, III.




| Inch | Nominal Size | | Minimum Thread Length (inches)[1,2] | | |
|---|---|---|---|---|---|
| | Threads Per Inch[3] | | Nut end (D) | | |
| | Coarse thread series | Fine Thread Series | Up to 6 inches long (B) | Over 6 inches long (B) | Stud end (C)[4] |
| ¼ | 20 | 28 | 0.750 | 1.000 | 0.375 |
| 5/16 | 18 | 24 | 0.875 | 1.125 | 0.460 |
| 3/8 | 16 | 24 | 1.000 | 1.250 | 0.562 |
| 7/16 | 14 | 20 | 1.125 | 1.375 | 0.656 |
| ½ | 13 | 20 | 1.250 | 1.500 | 0.750 |
| 9/16 | 12 | 18 | 1.375 | 1.625 | 0.844 |
| 5/8 | 11 | 18 | 1.500 | 1.750 | 0.937 |
| ¾ | 10 | 16 | 1.750 | 2.000 | 1.125 |
| 7/8 | 9 | 14 | 2.000 | 2.250 | 1.312 |
| 1 | 8 | 12 | 2.250 | 2.500 | 1.500 |
| 1 1/8 | 7 | 12 | 2.500 | 2.750 | 1.687 |
| 1¼ | 7 | 12 | 2.750 | 3.000 | 1.875 |
| 1 3/8 | 6 | 12 | 3.000 | 3.250 | 2.062 |
| 1½ | 6 | 12 | 3.250 | 3.500 | 2.500 |

Notes:
1 When studs are too short to be threaded as specified, the threading shall be of equal length from each end to the center and the ends shall be rounded or chamfered. Imperfect or incomplete threads at the junction of the two thread classes shall not exceed 2½ threads and shall occur in the nut end.
2 The maximum thread length shall be the specified minimum length plus 3/16 inch or 2½ threads, whichever is greater.
3 Thread taper variations shall fall within the applicable pitch diameter tolerances.
4 The stud end of studs shall be chamfered 45 to 50 degrees from a point 1/64 to 1/32 inches below the root diameter of the thread.

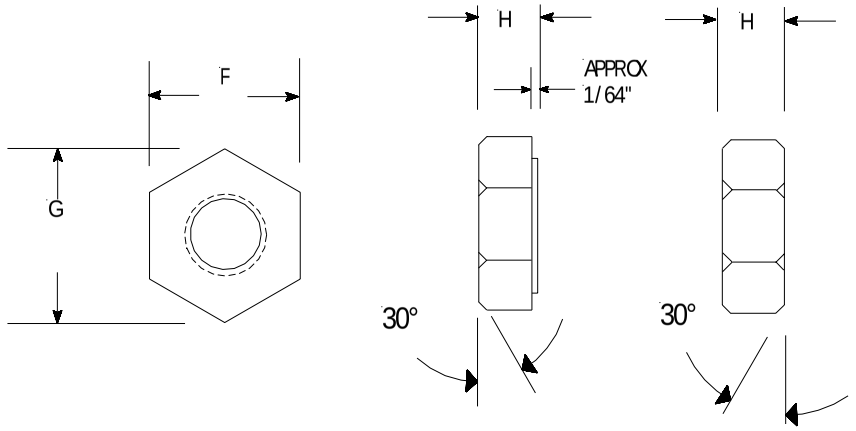
TABLE VIII. Type I Hex Cap Screws not covered in ASME B18.2.1.[1,2]




| Nominal size or basic major diameter of thread | Body diameter[3] | Width across flats F | | Width across corners G | | Height H | | | Radius of fillet R | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Max | Max (basic) | Min | Max | Min | Nominal | Max | Min | Min | Max |
| 3¼ | 3.335 | 4.8750 | 4.712 | 5.629 | 5.372 | 2 | 2.064 | 1.936 | 0.125 | 0.188 |
| 3½ | 3.589 | 5.2500 | 5.075 | 6.062 | 5.786 | 2 1/8 | 2.193 | 2.057 | 0.125 | 0.188 |
| 3¾ | 3.858 | 5.6250 | 5.437 | 6.495 | 6.198 | 2 5/16 | 2.385 | 2.241 | 0.125 | 0.188 |
| 4 | 4.111 | 6.0000 | 5.800 | 6.928 | 6.612 | 2½ | 2.576 | 2.424 | 0.125 | 0.188 |

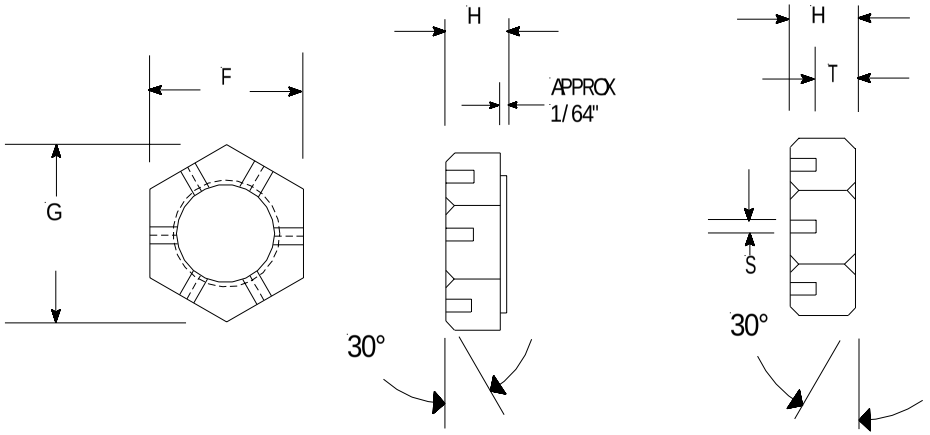
Notes:
1 Dimensions given in inches.
2 Notes pertaining to hex cap screws contained in ASME B18.2.1 shall apply.
3 There may be a reasonable swell or fin under the head or die seam on the body not to exceed the nominal body diameter by 0.183 for sizes over 3 inches

TABLE IX. Type I hex nut and type II hex jam nuts not covered in ASME B18.2.2.




| Nominal size or basic major diameter of thread | Width across flats F | | Width across Corners G | | Thickness nuts H | | | Thickness jam nuts H | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Max (basic) | Min | Max | Min | Nominal | Max | Min | Nominal | Max | Min |
| 1 3/4 | 2.6250 | 2.538 | 3.031 | 2.893 | 1½ | 1.540 | 1.460 | 31/32 | 1.009 | 0.929 |
| 2 | 3.0000 | 2.900 | 3.464 | 3.306 | 1 23/32 | 1.763 | 1.675 | 1 3/32 | 1.138 | 1.050 |
| 2¼ | 3.3750 | 3.262 | 3.897 | 3.719 | 1 59/64 | 1.970 | 1.874 | 1 13/64 | 1.251 | 1.155 |
| 2½ | 3.7500 | 3.625 | 4.330 | 4.133 | 2 9/64 | 2.193 | 2.089 | 1 29/64 | 1.505 | 1.401 |
| 2 3/4 | 4.1250 | 3.988 | 4.763 | 4.546 | 2 23/64 | 2.415 | 2.303 | 1 37/64 | 1.634 | 1.522 |
| 3 | 4.5000 | 4.350 | 5.196 | 4.959 | 2 37/64 | 2.638 | 2.518 | 1 45/64 | 1.763 | 1.643 |

TABLE X. Type V hex slotted nuts not covered in ASME B18.2.2.




| Nominal Size or Basic Major Diameter of Thread | Width Across Flats F | | Width Across Corners G | | | Thickness Nuts H | | Slot | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Width S | | Unslotted Thickness T | |
| | Max (Basic) | Min | Max | Min | Nominal | Max | Min | Max | Min | Max | Min |
| 1¾ | 2.6250 | 2.538 | 3.031 | 2.893 | 1½ | 1.540 | 1.460 | 0.52 | 0.43 | 1.24 | 1.20 |
| 2 | 3.0000 | 2.900 | 3.464 | 3.306 | $1\frac{23}{32}$ | 1.763 | 1.675 | 0.52 | 0.43 | 1.43 | 1.38 |
| 2¼ | 3.3750 | 3.262 | 3.897 | 3.719 | $1\frac{59}{64}$ | 1.970 | 1.874 | 0.52 | 0.43 | 1.67 | 1.62 |
| 2½ | 3.7500 | 3.625 | 4.330 | 4.133 | $2\frac{9}{64}$ | 2.193 | 2.089 | 0.64 | 0.55 | 1.79 | 1.74 |
| 2¾ | 4.1250 | 3.988 | 4.763 | 4.546 | $2\frac{23}{64}$ | 2.415 | 2.303 | 0.64 | 0.55 | 2.05 | 1.99 |
| 3 | 4.5000 | 4.350 | 5.196 | 4.959 | $2\frac{37}{64}$ | 2.638 | 2.518 | 0.71 | 0.62 | 2.23 | 2.17 |

TABLE XI. Conformance inspection and tests.

| Inspection/Tests | Requirement Paragraph | Test Paragraph | Sampling Requirements |
|---|---|---|---|
| Visual | 1.2.1, 3.6, 3.10, 3.13 & 3.15 | 4.3.1 | Plan A in table XII |
| Inspection for defects | 3.15 | 4.3.2 | Titanium: 100 per cent<br>All other alloys: Plan B in table XII |
| Dimensional | 3.9 | 4.4 | Plan A in table XII |
| Dimensional after coating | 3.9 | 4.4 | Plan A in table XII |
| Magnetic permeability | 3.8 | 4.5.4 | Plan A in table XII |
| Coating thickness | 3.6.3 | 4.5.5 | Plan C in table XII |
| Chemical analysis | 3.1 | 4.5.1 | One test |
| Mechanical properties | 3.4 | 4.5.2 | Plan C in table XII |
| Hydrogen embrittlement | 3.7 | 4.5.6 | Plan C in table XII |
| Decarburization | 3.5 | 4.5.3 | One test |

TABLE XII. Sample size for inspections and tests.

| Lot size | Sample Size | | |
|---|---|---|---|
| | Sampling Plan A | Sampling Plan B | Sampling Plan C |
| 2 to 3 | All | All | 1 |
| 4 to 15 | 3 | 3 | 2 |
| 16 to 90 | 5 | 5 | 2 |
| 91 to 150 | 8 | 8 | 3 |
| 151 to 500 | 9 | 13 | 3 |
| 501 to 1,200 | 9 | 20 | 5 |
| 1,201 to 10,000 | 9 | 32 | 5 |
| 10,001 to 35,000 | 10 | 50 | 5 |
| 35,001 to 250,000 | 10 | 80 | 8 |

TABLE XIII. Mechanical Property Test Requirements.

| Test | Bolts and Screws | Studs | Nuts |
|---|---|---|---|
| Hardness | Required | Required | Required |
| Proof stress or yield stress | Required | Required | Required |
| Axial tensile strength | | Required | |
| Wedge tensile | Required | | |

TABLE XIV. Dimensional examination requirements.

| Type Fastener | Dimension to be examined |
|---|---|
| Bolts and Screws (Except: Socket head cap screws) | Major diameter<br>Go maximum material (Functional size)<br>Minimum material (Pitch diameter)<br>Head height<br>Width across flats<br>Width across corners<br>Shank diameter<br>Overall length<br>Thread length<br>Fillet radius<br>Straightness |
| Studs | Major diameter<br>Go maximum material (Functional size)<br>Minimum material (Pitch diameter)<br>Shank diameter<br>Overall length<br>Thread length<br>Straightness |
| Socket head cap screws | Major diameter<br>Go maximum material (Functional size)<br>Minimum material (Pitch diameter)<br>Head height<br>Head diameter<br>Hex socket size<br>Key Engagement<br>Width across flats<br>Width across corners<br>Shank diameter<br>Overall length<br>Thread length<br>Fillet radius<br>Straightness |
| Nuts | Minor diameter<br>Go maximum material (Functional size)<br>Minimum material (Pitch diameter)<br>Thickness<br>Width across flats<br>Width across corners |

TABLE XV. Cross-reference of type designations.

| Type and Description | | Commercial Specifications | MIL-DTL-1222J | MIL-S-1222H | MIL-S-001222G |
|---|---|---|---|---|---|
| Stud | Full body | No commercial standard[1] | Type I, Class a | Type I, Class a | Type I, Class a |
| | | | Type I, Class b | Type I, Class b | Type I, Class b |
| | | | Type I, Class c | Type I, Class c | Type I, Class c |
| | | | Type I, Class d | Type I, Class d | Type I, Class d |
| | Reduced body | | Type II, Class a | Type II, Class a | Type II, Class a |
| | | | Type II, Class b | Type II, Class b | Type II, Class b |
| | | | Type II, Class c | Type II, Class c | Type II, Class c |
| | | | Type II, Class d | Type II, Class d | Type II, Class d |
| | Constant strength body | | Type III, Class a | Type III, Class a | Type III, Class a |
| | | | Type III, Class b | Type III, Class b | Type III, Class b |
| | | | Type III, Class c | Type III, Class c | Type III, Class c |
| | | | Type III, Class d | Type III, Class d | Type III, Class d |
| | Continuous thread | | Type IV | Type IV | Type IV |
| Bolt | Hex | ASME B18.2.1 | Type I screw | Type I | Type I |
| | Heavy hex | ASME B18.2.1 | Type II | Type II | Type II |
| | Heavy hex structural | ASME B18.2.6 | Type III | Type III | Type III |
| | Round head | ASME B18.5 | | Type IV | |
| | Round head square neck | ASME B18.5 | | Type V | |
| Screw | Hex cap | ASME B18.2.1 | Type I | Type I | Type I |
| | Hex socket head cap | ASME B18.3 | Type II | Type II | |
| Nut | Hex | ASME B18.2.2 | Type I | Type I | Type I |
| | Hex jam | ASME B18.2.2 | Type II | Type II | Type II |
| | Heavy hex | ASME B18.2.2 | Type III | Type III (Semi-finished) | Type III |
| | Heavy hex jam | ASME B18.2.2 | Type IV | Type IV | Type IV |
| | Hex slotted | ASME B18.2.2 | Type V | Type V | |

Notes:
1 Dimensions to MIL-DTL-1222.

TABLE XVI. Cross reference of material grades.

| | MIL-DTL-1222J | MIL-S-1222H[1] | | | | MIL-S-001222G and MIL-B-857[1,2] |
|---|---|---|---|---|---|---|
| | Grade and Condition[3] | Amendment | | | | |
| | | 3 | 2 | 1 | Base | |
| Carbon and Alloy Steel | 2 | 2 | | | | 2[4] |
| | 2H | 2H | | | | 2H |
| | 4 | 4 | | | | 4 |
| | 4340 | 4340 | | | | |
| | 5 | 5 | | | | 5[4] |
| | 7 | 7 | | | | |
| | 8 | 8 | | | | 8[4] |
| | A574 | A574 | | | | |
| | B7 | B7 | | | | B7 |
| | B16 | B16 | | | | B16, B14[5] |
| | Not Covered[6] | L7 | | | | |
| | Not Covered[6] | L43 | | | | |
| Corrosion Resistant Steel | 304-A | 303-A | | | | 303[4]-A |
| | 304-CW | 303-CW | | | 303–CW | 303[4]-SH |
| | Not Covered[7] | | 303-SH | | | |
| | 304-A | 303Se-A | | | | |
| | 304-CW | 303Se-CW | | | 303Se–CW | |
| | Not Covered[7] | | 303-SH | | | |
| | 304-A | 304-A | | | | 304-A |
| | 304-CW | 304-CW | | | 304–CW | 304-SH |
| | Not Covered[7] | | 304-SH | | | |
| | 305-A | 305-A | | | | 305[4]-A |
| | 305-CW | 305-CW | | | 305-CW | 305[4]-SH |
| | Not Covered[7] | | 305-SH | | | |
| | 316-A | 316-A | | | | 316[4]-A |
| | 316-CW | 316-CW | | | 316-CW | 316[4]-SH |
| | Not Covered[7] | | 316-SH | | | |
| | 321-A | 321-A | | | | 321-A |
| | 321-CW | 321-CW | | | 321-CW | 321-SH |
| | Not Covered[7] | | 321-SH | | | |
| | 347-A | 347-A | | | | 347-A |
| | 347-CW | 347-CW | | | 347-CW | 347-SH |
| | Not Covered[7] | | 347-SH | | | |
| | 384-A | 384-A | | | | 384-A |
| | 384-CW | 384-CW | | | 384-CW | 384-SH |
| | Not Covered[7] | | 384-SH | | | |
| | 410-T | 410-T | | 410-H[8] | | 410-T |
| | 410-H | 410-H[8] | | 410-HT | | 410-H |
| | 416-T | 416-T | | 416-H[8] | | 416-T |
| | 416-H | 416-H[8] | | 416-HT | | 416-H |

1 The following abbreviations are used for MIL-S-1222 revisions G and H: A – Annealed; CW - Cold Worked; SH - Strain Hardened; AH - Annealed and Age Hardened
2 Those grades cited in MIL-B-857 have been identified by a footnote.
3 The alloy grade and condition listed in MIL-DTL-1222J.
4 This designation is also used in MIL-B-857.
5 Use Grade B16 to replace Grade B14 in MIL-S-1222F
6 Use MIL-S-1222.
7 Use amendment 2 to MIL-S-1222H
8 CAUTION: Condition H of MIL-S-1222H and amendment 1 to MIL-S-1222H have a higher strength than condition H of MIL-S-1222G and amendments 2 and 3 to MIL-S-1222H and have the same marking.

| | MIL-DTL-1222J | MIL-S-1222H[1] | | | | MIL-S-001222G and MIL-B-857[1,2] |
|---|---|---|---|---|---|---|
| | Grade and Condition[3] | Amendment | | | | |
| | | 3 | 2 | 1 | Base | |
| | 416 Se-T | 416 Se-T | | 416 Se-H[8] | | |
| | 416 Se-H | 416 Se–H[8] | | 416 Se-HT | | |
| | 431-H | 431-H | | | | |
| | 431-HT | 431-HT | | | | |
| | 630 | 630 | | | | |
| Copper | 462 | 462 | | | | 462, Naval brass[4] |
| | 464 | 464 | | | | 464, Naval brass[4] |
| | Use 462 or 464 | 482 | | | | 482, Naval brass[4] |
| | 510 | 510 | | | | 510 Phosphor bronze[4] |
| | 544 | 544 | | | | 544 Phosphor bronze[4] |
| | 632 | 632 | | | | 632, Ni-Al bronze[4] |
| | Use 655 or 661 | | | | | 651 Silicon bronze[4] |
| | 655 | 655 | | | | 655, Silicon bronze[4] |
| | 661 | 661 | | | | 661, Silicon bronze[4] |
| | 670 | 670 | | | | 670Manganese bronze[4] |
| | 675 | 675 | | | | 675 Manganese bronze[4] |
| Nickel | 400 | 400 | | | | 400, Ni-Cu, Cl A[4] |
| | Studs, Screws and Bolts – 400 Nuts – 405 | 405 | | | | 405, Ni-Cu, Cl B[4] |
| | 500 | 500 | | | | 500, Ni-Cu-Al[4] |
| | 625 | 625 | | | | |
| Aluminum | 2024 | 2024 | | | | 2024 |
| | 6061 | 6061 | | | | 6061 |
| | 7075 | 7075 | | | | |
| Titanium | T7 | T7 | | | | T7 |

# APPENDIX

## Part Identification Numbering System

A.1.1 Scope The appendix details a procedure for assigning part numbers to the fasteners procured to MIL-DTL-1222. This appendix is not a mandatory part of this specification. The information contained herein is intended for guidance only.

A.1.2 Format. the part number shall consist of nine fields. Each field describes a different aspect of the fastener.

A.1.2.1 Field 1. Field 1 shall be M1222. This indicates that the fastener was made in accordance with MIL-DTL-1222.

A.1.2.2 Field 2 Field 2 represents the fastener type.

a) B2 signifies a heavy hex bolt.
b) B3 signifies a heavy hex structural bolt.
c) R signifies a hex cap screw.
d) S signifies a socket head cap screw.
e) ST1 signifies a full-body stud
f) ST2 signifies a reduced-body stud
g) ST3 signifies a constant-strength body stud (type III).
h) ST4 signifies a continuous-thread stud (type IV).
i) N1 signifies a hex nut.
j) N2 signifies a hex jam nut.
k) N3 signifies a heavy hex nut.
l) N4 signifies heavy hex jam nut.
m) N5 signifies a hex slotted nut.

A.1.2.3 Field 3 Field 3 represents the bearing surface of the or nut.

a) W signifies washer faced.
b) C signifies chamfered.
c) X signifies either washer faced or chamfered.
d) N signifies that this field does not apply.

A.1.2.4 Field 4 Field 4 represents the nominal diameter in $^{1}/_{16}$ths of an inch. Use one digit for fasteners $^{9}/_{16}$ and smaller and 2 digits for fasteners $^{5}/_{8}$ inch and larger.

A.1.2.5 Field 5. Field 5 represents the thread type.

a) C signifies a coarse (UNC or UNRC to ASME B1.1) thread type.
b) F signifies a fine (UNF or UNRF to ASME B1.1) thread type.
c) M signifies metric threads in accordance with ASME B.13M.

A.1.2.6 Field 6. Field 6 represents the thread class.

a) 2 signifies a class 2A thread to ASME B1.1.
b) 3 signifies a class 3A thread to ASME B1.1 (includes style C studs).
c) 4 signifies a class 4G6G thread to ASME B1.3M.
d) 6 signifies a class 6G thread to ASME B1.3M.
e) D signifies a class 3A thread and a class 2A thread to ASME B1.1 (style D studs).
f) B signifies a class 5HF thread to ASME B1.12 and a class 2A thread to ASME B1.1 (style B studs).
g) A signifies a class 5HF thread to ASME B1.12 and a class 3A thread to ASME B1.1 (style A studs).

A.1.2.7 Field 7 Field 7 represents the nominal length of ‘fasteners in 1/16ths of an inch. Use one digit for fasteners 9/16 and smaller and 2 digits for fasteners 5/8 inch and larger. Use “0” to represent a nut.

A.1.2.8 Field 8. Field 8 represents the material type and, when there is more than one condition, the condition.

a) GA signifies grade B7.
b) GB signifies grade B16.
c) GC signifies grade 2.
d) GD signifies grade 2H.
e) GE signifies grade 4.
f) GF signifies grade 5.
g) GG signifies grade 7.
h) GH signifies grade 8.
i) GI signifies grade A574.
j) GJ signifies grade 4340.
k) SA signifies annealed grade 304, 305, or 384.
l) SB signifies cold worked grade 304, 305, or 384.
m) SC signifies annealed grade 316.
n) SD signifies cold worked grade 316.
o) SE signifies annealed grade 321 or 347.
p) SF signifies cold worked grade 321 or 347.
q) SH signifies condition T grade 410, 416, or 416Se.
r) SI signifies condition H grade 410, 416, or 416Se.
s) SJ signifies condition I grade 410, 416, or 416Se.
t) SK signifies condition T grade 431.
u) SL signifies condition H grade 431.
v) SM signifies condition I grade 431.
w) SN signifies grade 630.
x) CA signifies grade 462.
y) CB signifies grade 464.
z) CC signifies grade 482.
aa) CD signifies grade 510.
bb) CE signifies grade 544.
cc) CF signifies grade 632.
dd) CG signifies grade 655.
ee) CH signifies grade 661.
ff) CI signifies grade 670.
gg) CJ signifies grade 675.
hh) NA signifies alloy 400.
ii) NB signifies alloy 405.
jj) NC signifies grade 500.
kk) ND signifies grade 625.
ll) AA signifies grade 2024.
mm) AB signifies grade 6061.
nn) AC signifies grade 7075.
oo) TA signifies grade T7.

A.1.2.9 Field 9. Field 9 represents *option of locking element*.

a) “N” signifies *no locking element*.
b) L signifies a locking element.

A.1.2.10 Field 10. Field 10 represents the coating used on the steel fasteners:

a) X signifies any coating listed in 3.6.1.
b) A signifies ion vapor deposited aluminum.
c) P signifies phosphate.
d) ZX signifies any zinc coating listed in 3.6.1.
e) ZM signifies zinc mechanically deposited.
f) ZE signifies zinc electrodeposited.
g) ZS signifies zinc silicate.
h) N signifies no coating.

A.1.3 Examples.

A.1.3.1 Screw. A ½ inch nominal diameter 2 inch long grade B16 hex cap screw with coarse class 3A threads and an aluminium ion vapor deposited coating would have a part number of "M1222RN8C332GBNA".

a) Field 1 is "M1222".
b) Field 2 is "R" for hex cap screw.
c) Field 3 is "N" for not applicable.
d) Field 4 is "8" for ½ inch, or 8 x 1/16th inches, nominal diameter.
e) Field 5 is "C" for UNC threads.
f) Field 6 is "3" for class 3A threads.
g) Field 7 is "32" for a 2 inch or 32 x 1/16th inches, length.
h) Field 8 is "GB" for a B16 material grade.
i) Field 9 is "N" for no locking element.
j) Field 10 is "A" for an ion vapor deposited aluminum coating.

A.1.3.2 Socket head cap screw. A 1 inch nominal diameter 6" long K-Monel socket head cap screw with fine, class 2A threads and no coating would have a part number of "M1222SN16F296NCNN".

a) Field 1 is "M1222".
b) Field 2 is "S" for socket hex cap screw.
c) Field 3 is "N" for not applicable.
d) Field 4 is "16" for 1 inch, or 16 x 1/16th inches, nominal diameter.
e) Field 5 is "F" for UNF threads.
f) Field 6 is "2" for class 2A threads.
g) Field 7 is "96" for A 2 inch or 96 x 1/16th inches, length.
h) Field 8 is "NC" for a K-Monel (500) material grade.
i) Field 9 is "N" for no locking element.
j) Field 10 is "N" for no coating.

A.1.3.3 STUD. A 1½ inch nominal diameter 5" long annealed 316 constant-strength body stud with fine class 5hf threads on the stud end and fine class 3A threads on the nut end and no coating would have a part number of "M1222ST3N24FDH80SCNN".

a) Field 1 is "M1222".
b) Field 2 is "ST3" for constant-strength body stud.
c) Field 3 is "N" for not applicable.
d) Field 4 is "24" for 1½ inch, or 24 x 1/16th inches, nominal diameter.
e) Field 5 is "F" for UNF threads.
f) Field 6 is "DH" for class 5HF threads on the stud end and class 3A on the nut end.
g) Field 7 is "80" for a 5 inch or 80 x 1/16th inches, length.

h) Field 8 is “SC” for an annealed 316 material grade.
i) Field 9 is “N” for no locking element.
j) Field 10 is “N” for no coating.

A.1.3.4 NUT. A ¾ inch nominal diameter nickel-aluminum-bronze (632) nut with a locking mechanism and fine class 2A threads and a phosphate coating would have a part number of “M1222N1X12F20CFLP”.

a) Field 1 is “M1222”.
b) Field 2 is “N1” for hex nut.
c) Field 3 is “X” washer faced or chamfered.
d) Field 4 is “12” for ¾ inch or 12 x 1/16th inches, nominal diameter.
e) Field 5 is ”F” for UNF threads.
f) Field 6 is “2” for class 2A threads.
g) Field 7 is “0" for nuts.
h) Field 8 is “CF” for a nickel-aluminum-bronze material grade.
i) Field 9 is “L” because there is a locking element.
j) Field 10 is “P” for a phosphate coating.

Custodian:
Air Force – 99
Navy – SH

Preparing Activity:
Navy – SH
(Project 53GP-0315)

Review activities:
Navy - MC
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