



Designation: F468 – 22

# Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use<sup>1</sup>

This standard is issued under the fixed designation F468; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification covers the requirements for commercial wrought nonferrous bolts, hex cap screws, and studs 0.250 to 1.500 in. and socket head cap screws (including socket head cap, button head and flat countersunk head configurations) with nominal thread 0.06 (size 0) through 1.500 in. inclusive in diameter manufactured from a number of alloys in common use and intended for general service applications.

1.2 Applicable nuts for use with bolts, cap screws, and studs covered by this specification are covered by Specification F467.

1.2.1 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

NOTE 1—A complete metric companion to Specification F468 has been developed—F468M; therefore no metric equivalents are presented in this specification.

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

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[B154 Test Method for Mercurous Nitrate Test for Copper Alloys](#)

[B193 Test Method for Resistivity of Electrical Conductor Materials](#)

[B211/B211M Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire](#)

[B565 Test Method for Shear Testing of Aluminum and Aluminum-Alloy Rivets and Cold-Heading Wire and Rods](#)

[B574 Specification for Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Molybdenum-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod](#)

[D3951 Practice for Commercial Packaging](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E18 Test Methods for Rockwell Hardness of Metallic Materials](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

[E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys \(Withdrawn 2017\)<sup>3</sup>](#)

[E38 Methods for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys \(Withdrawn 1989\)<sup>3</sup>](#)

[E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry \(Withdrawn 2022\)<sup>3</sup>](#)

[E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes \(Withdrawn 2002\)<sup>3</sup>](#)

[E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition](#)

[E62 Test Methods for Chemical Analysis of Copper and Copper Alloys \(Photometric Methods\) \(Withdrawn 2010\)<sup>3</sup>](#)

[E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys \(Withdrawn 2010\)<sup>3</sup>](#)

[E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys \(Withdrawn 2003\)<sup>3</sup>](#)

[E92 Test Methods for Vickers Hardness and Knoop Hardness of Metallic Materials](#)

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.04 on Nonferrous Fasteners.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

- E101** Test Method for Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique (Withdrawn 1996)<sup>3</sup>
- E120** Test Methods for Chemical Analysis of Titanium and Titanium Alloys (Withdrawn 2003)<sup>3</sup>
- E165/E165M** Practice for Liquid Penetrant Testing for General Industry
- E227** Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique (Withdrawn 2002)<sup>3</sup>
- E354** Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys
- E478** Test Methods for Chemical Analysis of Copper Alloys
- E1409** Test Method for Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by Inert Gas Fusion
- F467** Specification for Nonferrous Nuts for General Use
- F606/F606M** Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
- F788** Specification for Surface Discontinuities of Bolts, Screws, Studs, and Rivets, Inch and Metric Series
- F1470** Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

#### 2.2 ASME Standards:<sup>4</sup>

- ASME B1.1** Unified Inch Screw Threads (UN and UNR Thread Form)
- ASME B1.3** Screw Thread Gaging System for Dimensional Acceptability – Inch Screw Threads (IN, UNR, and UNJ)
- ASME B18.2.1** Square and Hex Bolts and Screws, Including Hex Cap Screws
- ASME B18.3** Socket Head Cap, Shoulder, and Set Screws – Inch Series
- ASME H35.1** Alloy and Temper Designation Systems for Aluminum

#### 2.3 Federal Specifications:<sup>5</sup>

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

### 3. Ordering Information

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

- 3.1.1 Quantity (number of pieces of each item and size),
- 3.1.2 Name of item. For silicon bronze alloy 651, state if hex cap screw dimensions or roll thread body diameter are required (see 7.1.2);
- 3.1.3 Size (nominal diameter, threads per inch, thread pitch, thread class, and length);
- 3.1.4 Alloy number (Table 1). For Ti5, state Class A or Class B (Table 1, 6.5, and 6.5.1);
- 3.1.5 Stress relieving, if required (see 4.2.3);
- 3.1.6 Source inspection, if required (see Section 13);

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

<sup>5</sup> DLA Document Services Building 4/D 700 Robbins Avenue Philadelphia, PA 19111-5094 <http://quicksearch.dla.mil/>

3.1.7 Certificate of compliance, conformance, or test reports, if required (see Section 15);

3.1.8 Additional requirements, if any, to be specified on the purchase order (see 4.2.1, 4.2.4, 7.3.1, 8.2, 10.1, and 11.1);

3.1.9 Supplementary Requirements, if any; and

3.1.10 ASTM designation and date of issue.

#### NOTE 2—Example

10 000 pieces, Hex Cap Screw, 0.250 in.-20 × 3.00 in., Alloy 270. Furnish Certificate of Compliance, Supplementary Requirement S1, ASTM F 468-XX.

### 4. Materials and Manufacture

#### 4.1 Materials:

4.1.1 The bolts, cap screws, socket head cap screws and studs shall be manufactured from material having a chemical composition conforming to the requirements in Table 1, except as provided in Supplementary Requirement S5, and capable of developing the required mechanical properties for the specified alloy in the finished fastener. See Specification B574 for nickel alloys.

4.1.2 The starting condition of the raw material shall be at the discretion of the fastener manufacturer except as provided in 4.1.3 and Supplementary Requirement S5, but shall be such that the finished products conform to all of the specified requirements.

4.1.3 Alloy 625 material shall be refined using the electroslag remelting process (ESR), or the vacuum arc remelting process (VAR).

#### 4.2 Manufacture:

4.2.1 *Forming*—Unless otherwise specified, the fasteners shall be cold formed, hot formed, or machined from suitable material, at the option of the manufacturer.

4.2.2 *Condition*—Except as provided in 4.2.3 and Supplementary Requirement S5, the fasteners shall be furnished in the following conditions:

Alloy	Condition
Copper (all alloys)	As formed or stress relieved at manufacturer's option
Nickel alloys: 400 and 405	As formed or stress relieved at manufacturer's option
500 625	Solution annealed and aged Annealed
Aluminum alloys: 2024-T4 6061-T6	Solution treated and naturally aged Solution treated and artificially aged
7075-T73 Titanium	Solution treated and stabilized As formed

4.2.3 *Stress Relieving*—When required, stress relieving shall be specified by the purchaser for nickel alloys 400 and 405 and all copper alloys.

4.2.4 *Threads*—Unless otherwise specified, the threads shall be rolled or cut at the option of the manufacturer.

4.2.4.1 Bolts, cap screws and studs shall be rolled or cut at the option of the manufacturer.

4.2.4.2 Socket head cap screws and flat countersunk head cap screws in sizes up to 1.00 in. inclusive and product lengths up to 6.00 in. inclusive shall have threads formed by rolling, except by special arrangement with the purchaser. Larger products may be rolled or cut at the option of the manufacturer.

**TABLE 1 Chemical Requirements**

Composition, % maximum except as shown, ellipses indicate no requirement for listed element													
UNS Designation Number	Copper and Copper-Base Alloys <sup>A</sup>												
	Alloy	General Name	Aluminum	Copper	Iron	Manganese	Nickel <sup>B</sup>	Phosphorus	Silicon	Zinc	Lead	Tin	Arsenic
C11000	110	ETP copper	...	99.9 min <sup>C</sup>	...	...	...	...	...	...	...	...	...
C26000	260	cartridge brass 70 %	...	68.5–71.5 <sup>D</sup>	0.05	...	...	...	...	balance	0.07	...	...
C27000	270	yellow brass 65 %	...	63.0–68.5 <sup>D</sup>	0.07	...	...	...	...	balance	0.09	...	...
C46200	462	naval brass 63 – 1/2 %	...	62.0–65.0 <sup>E</sup>	0.10	...	...	...	...	balance	0.20	0.5–1.0	...
C46400	464	naval brass	...	59.0–62.0 <sup>E</sup>	0.10	...	...	...	...	balance	0.20	0.5–1.0	...
C51000	510	phosphor bronze 5 % <sup>A</sup>	...	balance <sup>F</sup>	0.10	...	...	0.03–0.35	...	0.30	0.05	4.2–5.8	...
C61300	613	aluminum bronze	6.0–7.5	balance <sup>G</sup>	2.00–3.00	0.20	0.15	0.015	0.10	0.10	0.01	0.20–0.50	...
C61400	614	aluminum bronze <sup>D</sup>	6.0–8.0	balance <sup>C,F</sup>	1.50–3.50	1.00	...	0.015	...	0.20	0.01	...	...
C63000	630	aluminum bronze	9.0–11.0	balance <sup>C,F</sup>	2.00–4.00	1.50	4.0–5.5	...	0.25	0.30	...	0.20	...
C64200	642	aluminum bronze	6.3–7.6	balance <sup>C,F</sup>	0.30	0.10	0.25	...	1.5–2.2 <sup>H</sup>	0.50	0.05	0.20	0.09
C65100	651	silicon bronze low <sup>B</sup>	...	balance <sup>C,F</sup>	0.80	0.70	...	...	0.8–2.0	1.5	0.05	...	...
C65500	655	silicon bronze high <sup>A</sup>	...	balance <sup>C,F</sup>	0.80	0.05–1.30	0.6	...	2.8–3.8	1.5	0.05	...	...
C66100	661	silicon bronze	...	balance <sup>C,F</sup>	0.25	1.50	...	...	2.8–3.5	1.5	0.20–0.8	...	...
C67500	675	manganese bronze <sup>A</sup>	0.25 max	57.0–60.0 <sup>C,F</sup>	0.80–2.0	0.05–0.50	...	...	...	balance	0.20	0.5–1.5	...
C71000	710	copper-nickel 20 %	...	balance <sup>C,F</sup>	1.0	1.00	19.0–23.0	...	...	1.00	0.05	...	...
C71500	715	copper-nickel 30 %	...	balance <sup>C,F</sup>	0.40–1.0	1.00	29.0–33.0	...	...	1.00	0.05	...	...

<sup>A</sup>Elements shown as balance shall be arithmetically computed by deducting the sum of the other named elements from 100.

<sup>B</sup>Cobalt is to be counted as nickel.

<sup>C</sup>Silver is to be counted as copper

<sup>D</sup>Minimum content of copper plus all other elements with specified limits shall be 99.7%.

<sup>E</sup>Minimum content of copper plus all other elements with specified limits shall be 99.6%

<sup>F</sup>Minimum content of copper plus all other elements with specified limits shall be 99.5 %

<sup>G</sup>Per UNS C61300: copper (including silver) plus specified elements = 99.8 min; this standard requires copper plus silver = 88.5–91.5

<sup>H</sup>This standard allows for an alloy with max 2.6 % silicon provided the sum of all the elements other than copper, silicon, and iron does not exceed 0.30 %.