Standard Specification for
Alloy Steel Socket-Head Cap Screws

This standard is issued under the fixed designation A574; 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 (´) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This specification covers the requirements for quenched and tempered alloy steel hexagon socket-head cap screws, 0.060 through 4 in. in diameter where high strength is required.

1.2 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 A574 has been
developed—A574M; therefore no metric equivalents are presented in this
specification.

1.3 The following hazard caveat pertains only to the test
method portions, sections 5.1, 5.6, 8, and 12, of this specifi-
cation. This standard does not purport to address all of the
safety concerns, if any, associated with its use. It is the
responsibility of the user of this standard to establish appro-
priate safety and health practices and determine the applica-
bility of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:

A751 Test Methods, Practices, and Terminology for Chemi-
cal Analysis of Steel Products
E112 Test Methods for Determining Average Grain Size
F606 Test Methods for Determining the Mechanical Proper-
ties of Externally and Internally Threaded Fasteners,
Washers, Direct Tension Indicators, and Rivets
F788/F788M Specification for Surface Discontinuities of
Bolts, Screws, and Studs, Inch and Metric Series
F1470 Practice for Fastener Sampling for Specified Me-
chanical Properties and Performance Inspection
F1789 Terminology for F16 Mechanical Fasteners
F1940 Test Method for Process Control Verification to
Prevent Hydrogen Embrittlement in Plated or Coated
Fasteners
F2282 Specification for Quality Assurance Requirements for
Carbon and Alloy Steel Wire, Rods, and Bars for Me-
chanical Fasteners
F2328 Test Method for Determining Decarburization and
Carburization in Hardened and Tempered Threaded Steel
Bolts, Screws and Studs

2.2 ASME Standards:3

B18.3 Socket Cap, Shoulder, and Set Screws
B18.12 Glossary of Terms for Mechanical Fasteners
B18.24 Part Identifying Number (PIN) Code System Stan-
dard for B18 Fastener Products

3. Terminology

3.1 Definitions of Terms Specific to This Standard—The
definition of terms used in this specification shall be as specified in Terminology F1789, ASME B18.12, or the appli-
cable referenced standards, unless otherwise defined herein. In
the event that there are differences for a given term, ASTM
definitions shall be used.

4. Ordering Information

4.1 Orders for socket head cap screws under this specifica-
tion shall include the following information:

4.1.1 ASTM designation and year of issue.

4.1.2 Name of the screw (SHCS).

4.1.3 Quantity (number of pieces by size).

4.1.4 Dimensions, including nominal thread designation,
thread pitch, and nominal screw length.

4.2 Orders for socket head cap screws shall include the
following optional requirements if specified by the purchaser:

4.2.1 Inspection at point of manufacture.

4.2.2 Coating, if a protective finish other than those, which
are described in 5.5 is required, it must be specified (see
5.6).

4.2.3 Certified test reports, as required (see Section 15).

4.2.4 Additional testing (see 12.1).

4.2.5 Special packaging (see 18.1.2).

*1 This specification is under the jurisdiction of ASTM Committee F16 on
Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts,
Nuts, Rivets and Washers.

Current edition approved April 1, 2012. Published May 2012. Originally
approved in 1967. Last previous edition approved in 2011 as A574 – 11. DOI:
10.1520/A0574-12.

2 For referenced ASTM standards, visit the ASTM website, www.astm.org, or
contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM
Standards volume information, refer to the standard’s Document Summary page on
the ASTM website.

3 Available from American Society of Mechanical Engineers (ASME), ASME
www.asme.org.

*A Summary of Changes section appears at the end of this standard
5. Materials and Manufacture

5.1 The screws shall be fabricated from alloy steel made to a fine grain practice. In the event of controversy over grain size, referee tests on finished screws conducted in accordance with Test Methods E112 shall prevail.

5.2 Screws in sizes through 0.750 in. diameter, and with lengths through ten times the nominal product size or 6.0 inches, whichever is shorter, shall be cold headed, except that when specified by the purchaser the screws shall be hot headed. Larger sizes and longer lengths shall be cold or hot headed at the option of the manufacturer, unless otherwise specified by the purchaser. Screws larger than 1.500 in. nominal diameter shall be permitted to be machined. Sockets shall be forged or machined at the option of the manufacturer.

5.3 Screws in sizes through 0.625 in. diameter, and for product lengths through 4 in. shall be roll threaded, unless otherwise specified by the purchaser. Larger products shall be rolled, cut, or ground at the option of the manufacturer.

5.4 Screws shall be heat treated by quenching in oil from above the transformation temperature and then tempered by reheating to at least 700°F to achieve the mechanical properties specified in Section 7 and Table 1.

5.4.1 When specified by the purchaser, the minimum tempering temperature shall be verified by subjecting screws to 680°F for 30 minutes at temperature. The mean cross section hardness of three readings on the screw before and after retempering shall not differ by more than 2 points hardness Rockwell C (HRC).

5.5 Standard Finishes—Unless otherwise specified, the screws shall be furnished with one of the following “standard surfaces as manufactured” at the option of the manufacturer:

(1) bright uncoated,
(2) thermal black oxide, or
(3) chemical black oxide.

Hydrogen embrittlement tests shall not be required for screws furnished in these conditions.

5.6 Protective Coatings:

5.6.1 When a protective finish other than as specified in 5.5 is required, it shall be specified on the purchase order with the applicable finish specification.

5.6.2 When protective or decorative coatings are applied to the screws, precautions specified by the coating requirements to minimize internal hydrogen embrittlement shall be exercised. Additional precautions such as the requirements in Test Method F1940 and Test Methods F606 shall be by agreement with the purchaser.

6. Chemical Composition

6.1 The screws shall be alloy steel conforming to the chemical composition specified in Table 2 and the requirements in Specification F2282. See Supplementary Requirement S1 when additional alloy steel grades are required.

6.2 One or more of the following alloying elements: chromium, nickel, molybdenum, or vanadium shall be present in sufficient quantity to ensure that the specified strength properties are met after oil quenching and tempering. As a guide for selecting material, an alloy steel should be capable of meeting the specified mechanical requirements if the “as oil quenched” core hardness one diameter from the point is equal to or exceeds 25 HRC + (55 × carbon content).

6.3 When product analyses are made by the purchaser from finished screws representing each lot, the chemical composition, thus determined, shall conform to the requirements prescribed for product analysis in Table 2.

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

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

7. Mechanical Properties

7.1 Socket head cap screws shall be tested in accordance with the mechanical testing requirements specified in Table 3, and shall meet the mechanical requirements in Table 1, and either Table 4 or Table 5.

7.2 The screws that are tested for wedge tensile strength shall utilize a wedge of the angle specified in Table 6 under the head. To meet the requirements of the wedge test, there must be a tensile failure in the body or thread section. For the purpose of this test, failure means separation into two pieces. Screws threaded to the head shall pass the requirements for this test if the fracture that caused failure originated in the thread area, even though it may have propagated into the fillet area or the head before separation.

8. Metallurgical Requirement

8.1 Carburization or Decarburization:

| TABLE 2 Chemical Requirements |
|-------------------------------|------------------|--------------|
| Element                        | Composition, %   |              |
|                                | Heat Analysis    | Product Analysis |
| Carbon, min                    | 0.33             | 0.31         |
| Phosphorus, max                | 0.035            | 0.040        |
| Sulfur, max                    | 0.040            | 0.045        |
| Alloying elements              | See S2           |              |

TABLE 1 Mechanical Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>&lt;=0.500 in. Nom. Dia.</th>
<th>&gt;0.500 in. Nom. Dia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-size screws:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile or wedge tensile strength, min, ksi</td>
<td>180</td>
<td>170</td>
</tr>
<tr>
<td>Proof load (stress), ksi</td>
<td>140</td>
<td>135</td>
</tr>
<tr>
<td>Product hardness:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rockwell (HRC)</td>
<td>39–45</td>
<td>37–45</td>
</tr>
<tr>
<td>Machined test specimen:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield strength at 0.2% offset, min., ksi</td>
<td>153</td>
<td>153</td>
</tr>
<tr>
<td>Tensile strength, min., ksi</td>
<td>180</td>
<td>170</td>
</tr>
<tr>
<td>Elongation in 5D, min.</td>
<td>10 %</td>
<td>10 %</td>
</tr>
<tr>
<td>Reduction of area, min.</td>
<td>35 %</td>
<td>35 %</td>
</tr>
</tbody>
</table>
TABLE 3 Mechanical Testing Requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Tensile Load, min, lb</th>
<th>Product Length</th>
<th>Hardness, max</th>
<th>Hardness, min</th>
<th>Decarb/ Carburization</th>
<th>Test Conducted Using Full Size Product</th>
<th>Test Conducted Using Machined Test Specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Proof Load</td>
<td>Wedge Tensile Strength</td>
</tr>
<tr>
<td>1</td>
<td>All short lengths</td>
<td>...</td>
<td>Less than 3D (A)</td>
<td>... (b)</td>
<td>... (b)</td>
<td>(C)</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>2</td>
<td>(0.5 \leq D \leq 270,000)</td>
<td>...</td>
<td>3D to 1.5 in.</td>
<td>... (b)</td>
<td>... (b)</td>
<td>(C)</td>
<td>...</td>
<td>(X) (C)</td>
</tr>
<tr>
<td>3</td>
<td>(0.5 \leq D \leq 270,000)</td>
<td>...</td>
<td>Over 3D</td>
<td>... (b)</td>
<td>... (b)</td>
<td>(C)</td>
<td>...</td>
<td>(X) (C)</td>
</tr>
<tr>
<td>4</td>
<td>(0.5 \leq D \leq 270,000)</td>
<td>...</td>
<td>Over 3D</td>
<td>... (b)</td>
<td>... (b)</td>
<td>(C)</td>
<td>...</td>
<td>(X) (C)</td>
</tr>
<tr>
<td>5</td>
<td>(0.5 \leq D \leq 270,000)</td>
<td>...</td>
<td>Over 3D</td>
<td>... (b)</td>
<td>... (b)</td>
<td>Z (C)</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

\(A\) \(D\) denotes nominal diameter of product.
\(b\) Denotes mandatory test.
\(C\) Either all tests denoted by \(X\) or all tests denoted by \(Y\) shall be performed. In case of arbitration full-size tests, denoted \(X\), shall be decisive. Proof load test denoted \(Z\) shall be conducted when purchaser requests the test in inquiry and order.

TABLE 4 Tensile Requirements for Coarse Thread Screws

<table>
<thead>
<tr>
<th>Screw Dia ((D)), in.</th>
<th>Threads/ in.</th>
<th>Tensile Load, min, lbf (A)</th>
<th>Stress Area, in. (B)</th>
<th>Proof Load (Length Measurement Method), min, lbf (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.073</td>
<td>64</td>
<td>473</td>
<td>0.00263</td>
<td>368</td>
</tr>
<tr>
<td>0.086</td>
<td>56</td>
<td>666</td>
<td>0.00370</td>
<td>518</td>
</tr>
<tr>
<td>0.099</td>
<td>48</td>
<td>877</td>
<td>0.00487</td>
<td>682</td>
</tr>
<tr>
<td>0.112</td>
<td>40</td>
<td>1 090</td>
<td>0.00604</td>
<td>846</td>
</tr>
<tr>
<td>0.125</td>
<td>40</td>
<td>1 430</td>
<td>0.00796</td>
<td>1 110</td>
</tr>
<tr>
<td>0.138</td>
<td>32</td>
<td>1 640</td>
<td>0.00909</td>
<td>1 270</td>
</tr>
<tr>
<td>0.164</td>
<td>32</td>
<td>2 520</td>
<td>0.01140</td>
<td>1 960</td>
</tr>
<tr>
<td>0.190</td>
<td>24</td>
<td>3 150</td>
<td>0.0175</td>
<td>2 450</td>
</tr>
<tr>
<td>0.250</td>
<td>20</td>
<td>5 730</td>
<td>0.0318</td>
<td>4 450</td>
</tr>
<tr>
<td>0.3125</td>
<td>18</td>
<td>9 440</td>
<td>0.0524</td>
<td>7 340</td>
</tr>
<tr>
<td>0.375</td>
<td>16</td>
<td>13 900</td>
<td>0.0775</td>
<td>10 800</td>
</tr>
<tr>
<td>0.4375</td>
<td>14</td>
<td>19 100</td>
<td>0.1063</td>
<td>14 900</td>
</tr>
<tr>
<td>0.500</td>
<td>13</td>
<td>25 500</td>
<td>0.1419</td>
<td>19 900</td>
</tr>
<tr>
<td>0.625</td>
<td>11</td>
<td>38 400</td>
<td>0.226</td>
<td>30 500</td>
</tr>
<tr>
<td>0.750</td>
<td>10</td>
<td>56 800</td>
<td>0.334</td>
<td>45 100</td>
</tr>
<tr>
<td>0.875</td>
<td>9</td>
<td>78 500</td>
<td>0.462</td>
<td>62 400</td>
</tr>
<tr>
<td>1.000</td>
<td>8</td>
<td>103 000</td>
<td>0.606</td>
<td>81 800</td>
</tr>
<tr>
<td>1.125</td>
<td>7</td>
<td>129 000</td>
<td>0.763</td>
<td>103 000</td>
</tr>
<tr>
<td>1.250</td>
<td>7</td>
<td>165 000</td>
<td>0.969</td>
<td>131 000</td>
</tr>
<tr>
<td>1.375</td>
<td>6</td>
<td>196 000</td>
<td>1.155</td>
<td>156 000</td>
</tr>
<tr>
<td>1.500</td>
<td>6</td>
<td>239 000</td>
<td>1.405</td>
<td>190 000</td>
</tr>
<tr>
<td>1.750</td>
<td>5</td>
<td>323 000</td>
<td>1.90</td>
<td>256 000</td>
</tr>
<tr>
<td>2.000</td>
<td>4½</td>
<td>425 000</td>
<td>2.50</td>
<td>338 000</td>
</tr>
<tr>
<td>2.250</td>
<td>4½</td>
<td>552 000</td>
<td>3.25</td>
<td>439 000</td>
</tr>
<tr>
<td>2.500</td>
<td>4</td>
<td>680 000</td>
<td>4.00</td>
<td>540 000</td>
</tr>
<tr>
<td>2.750</td>
<td>4</td>
<td>838 000</td>
<td>4.93</td>
<td>666 000</td>
</tr>
<tr>
<td>3.000</td>
<td>4</td>
<td>1 010 000</td>
<td>5.97</td>
<td>806 000</td>
</tr>
<tr>
<td>3.250</td>
<td>4</td>
<td>1 210 000</td>
<td>7.10</td>
<td>958 000</td>
</tr>
<tr>
<td>3.500</td>
<td>4</td>
<td>1 420 000</td>
<td>8.33</td>
<td>1 120 000</td>
</tr>
<tr>
<td>3.750</td>
<td>4</td>
<td>1 640 000</td>
<td>9.66</td>
<td>1 300 000</td>
</tr>
<tr>
<td>4.000</td>
<td>4</td>
<td>1 880 000</td>
<td>11.08</td>
<td>1 500 000</td>
</tr>
</tbody>
</table>

\(A\) Values based on 180 ksi for 0.500 and smaller and 170 ksi for sizes larger than 0.500 in. and stress area in accordance with Footnote \(B\).
\(B\) Stress areas based on H-28 as follows:

\[ A_s = 0.7854 \left[ D - (0.9743/n) \right]^2 \]

where:

\(A_s\) = stress area,
\(D\) = nominal screw size, and
\(n\) = threads/in.

\(C\) Values based on 140 ksi for 0.500 and smaller and 135 ksi for sizes larger than 0.500 in. and stress area in accordance with Footnote \(B\).

8.1.1 There shall be no evidence of carburization or total decarburization on the surfaces of the heat-treated screws when measured in accordance with Test Method \(F2328\) (Class 3 Product).

8.1.2 The depth of partial decarburization shall be limited to the values in Test Method \(F2328\) (Class 3 Product) when measured as described therein.
9. Dimensions

9.1 Unless otherwise specified, the product shall conform to the requirements of ASME B18.3.

10. Workmanship, Finish, and Appearance

10.1 Surface Discontinuities—The surface discontinuities for these products shall conform to Specification F788/F788M and the additional limitations specified herein.

10.2 Forging Cracks:
10.2.1 Forging cracks that connect the socket to the periphery of the head as shown in Fig. 1 are not permissible.

10.2.2 Forging cracks originating on the periphery of the head and with a traverse indicating a potential to intersect on the top of the socket head as shown in Fig. 1 are not permissible.

10.2.3 Other forging cracks are permissible provided those that are located in the bearing area, fillet, and top surfaces do not have a depth exceeding 0.03D or 0.005 in., whichever is greater. For peripheral discontinuities, the maximum depth shall be 0.06D or 0.064 in., whichever is greater (see Fig. 1).

10.2.4 Forging cracks located in the socket wall within 0.1 times the actual key engagement (T) from the bottom of the socket are not permissible. Discontinuities located elsewhere in the socket shall not have a length exceeding 0.25T, or a maximum depth of 0.03D or 0.005 in., whichever is greater (see Fig. 2).

10.3 Seams in the shank shall not exceed a depth of 0.03D or 0.005 in., whichever is greater.

10.4 Thread Discontinuities—Threads shall have no laps at the root or on the flanks located below the pitch line, as shown in Fig. 3, when inspected in accordance with Specification F788/F788M, S1.2. Laps are permissible at the thread crest.

\[ \text{TABLE 6 Wedge Test Angles} \]

<table>
<thead>
<tr>
<th>Screw Size, ( D ), in.</th>
<th>Body Lengths 2D or Less to the Head</th>
<th>Body Lengths Greater than 2D</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.112 – 0.500, incl</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>0.625 – 0.750, incl</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>0.875 to 1.500, incl</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

\[ \text{FIG. 1 Head and Body Discontinuity Location and Limits} \]
11. Sampling and Number of Tests

11.1 Guide F1470 shall be used to determine the necessary sampling plan and the number of tests that must be performed to demonstrate that all of the requirements of this standard are met for each lot.

12. Test Methods

12.1 Testing, to demonstrate that the requirements in 5.4.1, Section 7, or any additional mechanical tests that are required by the purchaser have been met, shall be in accordance with Test Methods F606 at room temperature.

12.2 The inspection and evaluation of surface discontinuities shall be in accordance with the requirements in Specification F788/F788M.

12.3 Decarburization and carburization tests shall be conducted in accordance with Test Method F2328, Class 3.
13. Inspection

13.1 If the inspection described in 13.2 is required by the purchaser, it shall be specified in the inquiry and contract or order.

13.2 The purchaser’s representative, upon reasonable notice, shall have free entry to all parts of the manufacturer’s works, or supplier’s place of business, that concern the manufacture or supply of the material ordered. The manufacturer or supplier shall afford the purchaser’s representative all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspections required by the specification that are requested by the purchaser’s representative shall be made before shipment, and shall be conducted so as not to interfere unnecessarily with the operation of the manufacturer’s works or supplier’s place of business.

14. Rejection and Rehearing

14.1 The disposition of nonconforming lots shall be in accordance with the provisions found in Guide F1470.

15. Certification

15.1 When specified on the Purchase Order, the manufacturer or supplier, as applicable, shall furnish a test report or certificate of conformance as specified by the purchaser.

15.2 When a test report is specified, it shall include the heat number and the results of the chemical composition, mechanical properties, metallurgical requirements, dimensional tests, and workmanship requirements.

15.3 When a certificate of conformance is specified, it shall include a statement certifying the fasteners have been manufactured, tested and inspected, and that they either conform or do not conform to the requirements of this specification.

16. Responsibility

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

17. Product Marking

17.1 All screws with nominal diameters of ¼ in. and larger manufactured to this revision shall be permanently marked to identify the manufacturer’s or private label distributor’s identification symbol. Marking for “Socket Head Cap Screws” shall be on the side of the head or on top.

17.2 Manufacturer’s or private label distributor’s identification shall be distinct.

NOTE 2—Manufacturing head markings should be unique and traceable directly to the manufacturer, and comply with governmental regulations where applicable.

18. Packaging and Package Marking

18.1 Packaging:

18.1.1 Unless otherwise specified, product shall be packaged according to the manufacturer’s practice to prevent damage before and during shipment.

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

18.2 Package Marking:

18.2.1 The container shall be marked to permit identification of the lot. Each shipping unit shall also include or be plainly marked with the following information:

18.2.1.1 ASTM designation,

18.2.1.2 Size,

18.2.1.3 Name and brand or trademark of the manufacturer,

18.2.1.4 Number of pieces,

18.2.1.5 Purchase order number, and

18.2.1.6 Country of origin.

19. Keywords

19.1 alloy steel; cap screws; socket head

SUPPLEMENTARY REQUIREMENTS

The following Supplementary Requirement shall apply only when specified by the purchaser in the contract or purchase order. Supplementary requirements shall in no way negate any requirement of the specification itself.

S1. Specific Grade Chemical Compositions

S1.1 When Supplementary Requirement S1 is specified on the order, the chemical composition shall conform to one of the compositions in Table S1.1 at the option of the supplier, unless a specific composition (Grade) has been specified on the purchase order.
SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A574 – 11 that may impact the use of this standard. (Approved April 1, 2012.)

(1) Revised Table 3 to include mechanical test requirements for nominal diameters over 0.5 in. and <270,000 lb minimum tensile load.

Committee F16 has identified the location of selected changes to this standard since the last issue (A574 – 08 that may impact the use of this standard.

(1) Added purchaser’s option to request proof load test in Table 3, item 3.