



Designation: ~~A 574-00~~ Designation: A 574 - 04

Standard Specification for Alloy Steel Socket-Head Cap Screws¹

This standard is issued under the fixed designation A 574; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This specification² 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.

NOTE 1—A complete metric companion to Specification A 574 has been developed—A 574M; therefore no metric equivalents are presented in this specification.

1.2 The following hazard caveat pertains only to the test method portion, Section 12, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:³

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

D 3951 Practice for Commercial Packaging

E 3 Methods Practice of Preparation of Metallographic Specimens

E 112 Test Methods for Determining the Average Grain Size

E 384 Test Method for Microhardness Hardness of Materials

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

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

2.2 ANSI/ASME Standards:

B1.1 Unified Screw Threads⁴

B18.3 Socket Cap, Shoulder, and Set Screws⁴

B18.24.1 Part Identifying Number (PIN) Code System⁵

2.3 Federal Standard:

H-28 Handbook of Thread Dimensions⁶

3. Terminology

3.1 Definitions:

3.1.1 Definitions of discontinuities covered by 10.2 follow:

3.1.2 ~~crack~~—clean crystalline break passing through the grain or grain boundary without inclusion of foreign elements.

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

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² For ASME Boiler and Pressure Vessel Code applications see related Specification SA-574 in Section II of that code.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards*, Vol 01.03, volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ Annual Book of ASTM Standards, Vol 15.09.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁵ Annual Book of ASTM Standards, Vol 03.01.

⁵ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

⁶ Annual Book of ASTM Standards, Vol 01.08.

⁶ Available from General Services Administration, Specification and Consumer Information Distribution Branch, Bldg. 197, Washington Navy Yard, Washington, DC 20407.

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

3.1.3 *inclusions*—particles of nonmetallic impurities, usually oxides, sulfides, silicates, and such, which are mechanically held in the steel during solidification.

3.1.4 *nicks or pits*—depressions or indentations in the surface of the metal.

3.1.5 *seam or lap*—anocrystalline break through the metal which is inherently in the raw material.

4. Ordering Information

4.1 Orders for socket head cap screws under this specification shall include the following:

4.1.1 ASTM designation and year of issue.

4.1.2 Quantities (number of pieces by size).

4.1.3 Size and length.

4.2 Orders for socket head cap screws may include the following optional requirements:

4.2.1 Inspection at point of manufacture.

4.2.2 Coating, if a protective finish other than black oxide (thermal or chemical) is required, it must be specified.

4.2.3 Certified test reports (see 11.2).

4.2.4 Additional testing (see 11.3).

4.2.5 Special packaging (see 16.1.2).

4.2.6 Supplementary requirements (see S1).

4.2.7 Special requirements.

4.2.8 For establishment of a part identifying system, see ASME B18.24.1.

5. Materials and Manufacture

5.1 The screws shall be fabricated from a steel which has been made by the open-hearth, basic-oxygen, or electric-furnace process.

5.2 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 Method E 112 shall prevail.

5.3 Unless otherwise specified, the heads of screws through 1.500-in. diameter shall be fabricated by hot or cold forging. Over 1.500-in. diameter, the heads may be fabricated by hot or cold forging or by machining. Sockets may be forged or machined.

5.4 Unless otherwise specified, threads of screws shall be rolled for diameters through 0.625 in. and for screw lengths through 4 in. For diameters and lengths other than this, threads may be rolled, cut, or ground.

5.5 The screws shall be heat treated by oil quenching from above the transformation temperature and then tempering at a temperature not lower than 650°F.

5.6 *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.

5.7 *Protective Coatings*: <http://www.astm.org/catalog/standards/sist/4e0cfe4d-3826-4e0c-bfed-6646068c7aaf/astm-a574-04>

5.7.1 When a protective finish other than as specified in 5.6 is required, it shall be specified on the purchase order with the applicable finish specification.

5.7.2 When protective or decorative coatings are applied to the screws, precautions specified by the coating requirements to minimize embrittlement shall be exercised.

6. Chemical Composition

6.1 The screws shall be alloy steel conforming to the chemical composition specified in Table 1. See Supplementary Requirement S1 when specific chemistry 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 Product analyses may be 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 1.

TABLE 1 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 6.2	

6.4 Application of heats of 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 A 751.

7. Mechanical Properties

7.1 The hardness of finished screws shall be 39 to 45 HRC for 0.500 in. and smaller and 37 to 45 HRC for 0.625 in. and larger. This shall be only the mechanical requirements for screws that are shorter than three times the diameter or that have insufficient threads for tension testing.

7.2 Screws, other than those exempted in 7.1 and 7.3, shall meet the proof load and tensile requirements in Table 2 and Table 3. The screws shall be tension tested with a wedge of the angle specified in Table 4 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.

7.3 Screws having a diameter larger than 1.500 in. shall be preferably tested in full size and shall meet the requirements of Table 2 and Table 3. When equipment of sufficient capacity is not readily available, screws shall meet 170 ksi, min, tensile strength, 153 ksi, min, yield strength at 0.2 % offset, and 10 % elongation on specimens machined in accordance with Test Methods F 606.

TABLE 2 Tensile Requirements for Coarse Thread Screws

Screw Dia (<i>D</i>), in.	Threads/in.	Tensile Load, min, lbf ^A	Stress Area, in. ² ^B	Proof Load (Length Measurement Method), min, lbf ^C
0.073	64	473	0.00263	368
0.086	56	666	0.00370	518
0.099	48	877	0.00487	682
0.112	40	1 090	0.00604	846
0.125	40	1 430	0.00796	1 110
0.138	32	1 640	0.00909	1 270
0.164	32	2 520	0.0140	1 960
0.190	24	3 150	0.0175	2 450
0.250	20	5 730	0.0318	4 450
0.3125	18	9 440	0.0524	7 340
0.375	16	13 900	0.0775	10 800
0.4375	14	19 100	0.1063	14 900
0.500	13	25 500	0.1419	19 900
0.625	11	38 400	0.226	30 500
0.750	10	56 800	0.334	45 100
0.875	9	78 500	0.462	62 400
1.000	8	103 000	0.606	81 800
1.125	7	129 000	0.763	103 000
1.250	7	165 000	0.969	131 000
1.375	6	196 000	1.155	156 000
1.500	6	239 000	1.405	190 000
1.750	5	323 000	1.90	256 000
2.000	4½	425 000	2.50	338 000
2.250	4½	552 000	3.25	439 000
2.500	4	680 000	4.00	540 000
2.750	4	838 000	4.93	666 000
3.000	4	1 010 000	5.97	806 000
3.250	4	1 210 000	7.10	958 000
3.500	4	1 420 000	8.33	1 120 000
3.750	4	1 640 000	9.66	1 300 000
4.000	4	1 880 000	11.08	1 500 000

^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 Handbook H-28 (U.S. Department of Commerce) as follows:

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

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*.

TABLE 3 Tensile Requirements for Fine Thread Screws

Screw Dia (<i>D</i>), in.	Threads/in.	Tensile Load, min, lbf ^A	Stress Area, in. ² ^B	Proof Load (Length Measurement Method) min, lbf ^C
0.060	80	324	0.00180	252
0.073	72	500	0.00278	389
0.086	64	709	0.00394	552
0.099	56	941	0.00523	732
0.112	48	1 190	0.00661	925
0.125	44	1 490	0.00830	1 160
0.138	40	1 830	0.01015	1 420
0.164	36	2 650	0.01474	2 060
0.190	32	3 600	0.0200	2 800
0.250	28	6 500	0.0364	5 100
0.3125	24	10 400	0.0580	8 120
0.375	24	15 800	0.0878	12 300
0.4375	20	21 400	0.1187	16 600
0.500	20	28 800	0.1599	22 400
0.625	18	43 500	0.256	34 600
0.750	16	63 400	0.373	50 400
0.875	14	86 500	0.509	68 700
1.000	12	113 000	0.663	89 500
1.125	12	146 000	0.856	116 000
1.250	12	182 000	1.073	145 000
1.375	12	224 000	1.315	178 000
1.500	12	269 000	1.581	213 000

^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:

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

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*.

TABLE 4 Wedge Test Angles

Screw Size, <i>D</i> , in.	Wedge Angle, Deg	
	Body Lengths 2 <i>D</i> or Less or Threaded to the Head	Body Lengths Greater than 2 <i>D</i>
0.112 – 0.500, incl	6	10
0.625 – 0.750, incl	6	8
0.875 to 1.500, incl	4	6

8. Metallurgical Requirement

8.1 Carburization or Decarburization :

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 12.3.

8.1.2 The depth of partial decarburization shall be limited to the values in Table 5 when measured as shown in Fig. 1 and in accordance with 12.3.

9. Dimensions

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

9.2 Unless otherwise specified, threads shall be Unified standard: Class 3A, UNRC and UNRF series for screw sizes 0.060 through 1 in. inclusive; Class 2A, UNRC and UNRF series for sizes over 1 in. to 1.500 in. inclusive; and Class 2A UNRC series for sizes larger than 1.500 in. in accordance with ANSI B1.1.