



Designation: F912 – 11 (Reapproved 2017)

Standard Specification for Alloy Steel Socket Set Screws¹

This standard is issued under the fixed designation F912; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers the requirements for quenched and tempered alloy steel socket-set screws (SSS) in nominal diameters 0.060 through 2 in. having hardnesses 45 to 53 HRC.

1.2 These set screws are intended for compression applications only and are not customarily subjected to embrittlement tests. For tensile applications, consult with the manufacturer for proper alloy and hardness.

1.3 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 F912 has been developed—F912M; therefore, no metric equivalents are shown in this Specification.

1.4 The hazard statement pertains only to the test method section, Section 11 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.*

1.5 *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:²

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

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 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.

E3 Guide for Preparation of Metallographic Specimens

E112 Test Methods for Determining Average Grain Size

E384 Test Method for Microindentation Hardness of Materials

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, and Studs, Inch and Metric Series

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

F2328 Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws, Studs, and Nuts

2.2 ASME Standards:³

B18.3 Socket Cap, Shoulder and Set Screw, Inch Series⁴

B18.24 Part Identifying Number (PIN) Code System Standard for B18 Fastener Products

3. Ordering Information

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

3.1.1 Quantity (number of screws).

3.1.2 Dimensions, including nominal thread designation, threads per inch, nominal screw length (inches) and point configuration. A standard part number may be used for this definition.

3.1.3 Name of the screw (SSS).

3.1.4 Coating, if required. See 4.4.

3.1.5 Certification, if required. See 14.1.

3.1.6 ASTM designation and year of issue.

3.1.7 Any special or supplemental requirements.

3.1.8 For establishment of a part identifying system, see ASME B18.24.

4. Materials and Manufacture

4.1 The screws shall be fabricated from alloy steel made to fine grain practice. In the event of controversy over grain size,

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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

referee tests on finished screws conducted in accordance with Test Methods **E112** shall prevail.

4.2 The screws may be forged, formed, extruded, machined, or ground to meet the dimensional characteristics and performance requirements.

4.3 Set screws shall be heat treated by quenching in oil from above the transformation temperature and then tempered by reheating to meet the hardness range specified in **6.2**.

4.4 *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.

4.5 *Protective Coatings:*

4.5.1 When a protective finish other than as specified in **4.4** is required, it shall be specified on the purchase order with the applicable finish specification.

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

5. Chemical Composition

5.1 The chemical composition of the screw material shall conform to the heat analysis specified in **Table 1**.

5.2 One or more of the following alloying elements: chromium, nickel, molybdenum, or vanadium shall be present in the steel in sufficient quantity to assure the specific strength properties are met after oil quenching and tempering. The steel shall meet the AISI definition of alloy steel, that is, maximum and minimum element content requirement or minimum element limits specified.

5.3 Alloy steel to which bismuth, selenium, tellurium, or lead has been intentionally added to improve machinability shall be permitted.

5.4 Material analysis may be made by the purchaser from finished products and the chemical composition shall conform to the requirements specified for the product analysis in **Table 1**.

6. Mechanical Properties

6.1 Socket set screws when subjected to a torque test in accordance with **11.2** shall withstand application of the test tightening torque specified in **Table 2** without evidence of the socket reaming or the screw bursting.

6.2 Socket set screws shall have a hardness of 45 to 53 HRC. The hardness limits shall apply throughout the screw from core to surface.

7. Other Requirements

7.1 *Decarburization:*

7.1.1 There shall be no evidence of gross decarburization of the surfaces of the heat-treated screws when measured in accordance with **11.4**.

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

8. Dimensions

8.1 Unless otherwise specified, the product shall conform to the requirements of ASME B 18.3.

9. Workmanship, Finish, and Appearance

9.1 *Surface Discontinuities:*

9.1.1 The surface discontinuities for these products shall conform to Specification **F788** and the additional limitations specified herein.

9.1.2 Processing defects that connect the socket to the periphery of the screw are not permissible. Defects originating on the periphery and with a traverse indicating a potential to intersect are not permissible.

9.1.3 Quench cracks of any depth, any length, or in any location are not permitted.

10. Number of Tests

10.1 Practice **F1470** shall be used to determine the necessary sampling plan and the number of tests that must be performed to demonstrate all the requirements of this specification are met for each lot.

11. Test Methods

11.1 Chemical analysis shall be conducted in accordance with Test Methods, Practices, and Terminology **A751**.

11.2 For socket strength torque test, the test screw shall be assembled into a tapped hole of 2B tolerance class in a steel block (see **Fig. 1**) until the face of the screw is flush with the top surface of the test block and the set screw bears against a firm base, such as a hardened screw installed from the opposite side of the block. The applicable hexagon key bit in accordance with ASME B 18.3 shall be inserted to the full depth of the set screw socket and the test torque listed in **Table 2** applied by means of a torque wrench. The screw shall be disassembled from the block and examined for compliance to the requirements of **6.1**.

11.3 Hardness shall be determined in accordance with Test Methods **F606/F606M**.

11.4 Decarburization and carburization tests shall be conducted in accordance with Test Method **F2328**, Class 3.

11.4.1 Screw threads greater than 48 threads per in., evaluation by the optical method as described Test Method **F2328** shall determine conformance to specification requirements.

TABLE 1 Chemical Requirements

NOTE 1—Plus alloys in accordance with **5.2**.

Element	Composition, %	
	Heat Analysis	Product Analysis
Carbon	0.30 to 0.48	0.28 to 0.50
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045

TABLE 2 Torsional Strength Requirements

Nominal Size	Shortest Nominal Screw Lengths Subject to Torque Testing for			Test Torque
	Cup and Flat Points	Cone and Oval Points	Half Dog Points	in.-lb, min
0	0.060	0.109	0.125	1.1
1	0.073	0.125	0.141	2.1
2	0.086	0.125	0.141	2.1
3	0.099	0.141	0.156	6.0
4	0.112	0.141	0.172	6.0
5	0.125	0.156	0.188	11
6	0.138	0.172	0.203	11
8	0.164	0.188	0.219	23
10	0.190	0.188	0.250	40
1/4	0.250	0.250	0.312	94
5/16	0.312	0.312	0.391	183
3/8	0.375	0.375	0.438	317
7/16	0.437	0.438	0.547	502
1/2	0.500	0.500	0.609	750
5/8	0.625	0.625	0.766	1460
3/4	0.750	0.750	0.906	2520
7/8	0.875	0.875	1.125	5750
1	1.000	1.000	1.266	8000
1 1/8	1.125	1.125	1.391	8000
1 1/4	1.250	1.250	1.500	11 000
1 3/8	1.375	1.375	1.656	11 000
1 1/2	1.500	1.500	1.797	18 100
1 3/4	1.750	1.750	2.219	38 000
2	2.000	2.000	2.391	38 000

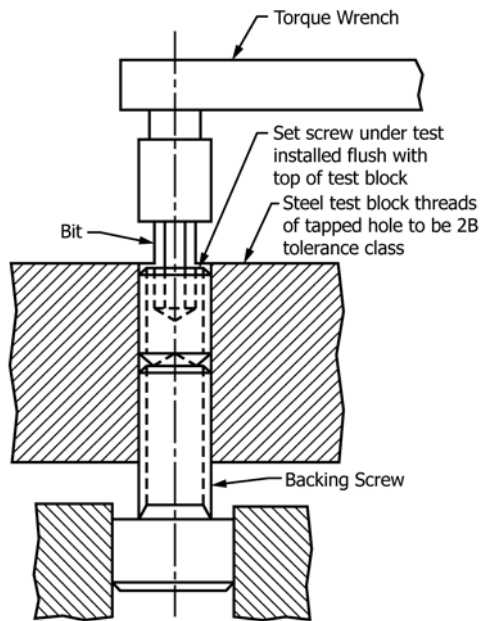


FIG. 1 Typical Torque Test Fixture

12. Inspection

12.1 The inspector representing the purchaser, upon reasonable notice, shall have free entry to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector 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 so conducted as not to interfere unnecessarily with the operation of the works.

13. Rejection and Rehearing

13.1 The disposition of nonconforming lots shall be in accordance with Practice F1470.

14. Certification

14.1 Upon request of the purchaser in the contract or order, the manufacturer or supplier, as applicable, shall furnish a test report or certificate of conformance as specified by the purchaser.

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

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

15. Responsibility

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

16. Packaging and Package Marking

16.1 Packaging:

16.1.1 Unless otherwise specified, packaging shall be in accordance with the manufacturers practice to prevent damage before and during shipment.

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

16.2 Package Marking:

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

16.2.1.1 ASTM designation,



- 16.2.1.2 Size,
- 16.2.1.3 Name and brand or trademark of the manufacturer,
- 16.2.1.4 Number of pieces,
- 16.2.1.5 Purchase order number (when specified in the order), and

- 16.2.1.6 Country of origin.

17. Keywords

- 17.1 alloy; set; socket; steel

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (F912–04 ^{e1}) that may impact the use of this standard.

- (1) Revised- Section 1, Scope, to clarify “nominal” diameter and remove .000 from 2 in. size.
- (2) Revised-sections 2.1 and 5.4, to clean up grammar and correct names of standards. Removed section 3.1.5 (lot testing is now always required and not an option).
- (3) Revised section 7.1.2.
- (4) Complete revision of Section 10 (referred to F1470).
- (5) Revised section 11.3 to Test Methods F606/F606M and added Test Methods F606/F606M to 2.1.
- (6) Revised section 11.4 decarburization test methods (referred to F2328) and added F2328 to 2.1.
- (7) Revised 11.4.1.
- (8) Removed sections 11.4.2 to 11.4.4.2.
- (9) Section 13, revised to refer to F1470 and added F1470 to 2.1.
- (10) Revised section 14.1; added sections 14.2 and 14.3.
- (11) Revised section 16.1.1 and 16.2.1.5.
- (12) Removed existing Figure 1 and Table 3.
- (13) Renumbered existing Figure 2 to Figure 1.
- (14) Renumbered figure in section 11.2.

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