



METRIC
Designation: **F 912M – 9900**

Standard Specification for Alloy Steel Socket Set Screws [Metric]¹

This standard is issued under the fixed designation F 912M; 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 specification covers the requirements for quenched and tempered alloy steel socket set screws (SSS) M1.6 through M24 sizes having hardnesses 45 to 53 HRC, ISO 898/5 property class 45H.

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 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.*

NOTE 1—This specification is the metric companion of Specification F 912.

2. Referenced Documents

2.1 ASTM Standards:

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products²

¹ This specification is under the jurisdiction of ASTM Committee F-16 on Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets, and Washers.

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

D 3951 Practice for Commercial Packaging³

E 3 Methods of Preparation of Metallographic Specimens⁴

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁴

E 112 Test Methods for Determining Average Grain Size⁴

E 384 Test Method for Microhardness of Materials⁴

F 788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series⁵

2.2 *ANSI/ASME Standards:*

B18.3.6M Hexagon Socket Set Screws Metric Series⁶

B18.24.1 Part Identifying Number (PIN) Code System⁷

2.3 *ISO Standard:*

898/5 Mechanical Properties of Fasteners—Set Screws and Similar Threaded Fasteners Not Under Tensile Stress⁶

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, thread pitch, nominal screw length (millimetres) 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 Lot testing, if required. See 10.3.

3.1.6 Certification, if required. See 14.1.

3.1.7 ASTM designation and year of issue.

3.1.8 Any special or supplemental requirements.

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

3.2 *Example*—50 000 pieces M6x1x8 cone point SSS—certification per 14.1—ASTM F 912M—__ (state issue date), or 25000 pcs B1836A 060008K SSS—certification per 14.1—ASTM F 912M—__ (state issue date).

4. Material and Manufacture

4.1 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 Method E 112 shall prevail.

4.2 The screw 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 alloying elements chromium, nickel, molybdenum, or vanadium shall be present in the steel in sufficient quantity to assure that 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 thus determined shall confirm to the requirements specified for the product analysis in Table 1.

² *Annual Book of ASTM Standards*, Vol 01.03.

³ *Annual Book of ASTM Standards*, Vol 15.09.

⁴ *Annual Book of ASTM Standards*, Vol 03.01.

⁵ *Annual Book of ASTM Standards*, Vol 01.08.

⁶ Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.

⁷ Available from American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

TABLE 1 Chemical Requirements

NOTE 1—Plus alloys per 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

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 point end hardness within 0.04 mm distance from the surface shall be equal to or greater than the measured core hardness but shall not exceed 53 HRC (560 DPH).

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 Table 3 when measured as shown in Fig. 1. and in accordance with 11.4.

8. Dimensions

8.1 Unless otherwise specified, the product shall conform to the requirements of ANSI/ASME B18.3.6M.

9. Workmanship, Finish, and Appearance

9.1 Surface Discontinuities:

9.1.1 The surface discontinuities for these products shall conform to Specification F 788/F 788M 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 Threads shall have no laps at the root or on the flanks, as shown in Fig. 2(a). Laps are permitted at the crest (Fig. 2(c)) that do not exceed 25 % of the basic thread depth and on the flanks outside the pitch cylinder. Longitudinal seams rolled beneath the root of the thread and across the crests of cut threads are acceptable within the limits of 0.03 D or 0.2 mm, whichever is greater.

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

10. Number of Tests

10.1 The requirements of this specification shall be met in continuous mass production for stock, and the manufacturer shall

TABLE 2 Torsional Strength Requirements

Nominal Screw Size	Shortest Nominal Screw Lengths Subject to Torque Testing for			Test Torque N-m, min
	Cup and Flat Points	Cone and Oval Points	Half Dog Points	
1.6	3	3	3	0.1
2	4	4	4	0.2
2.5	4	4	4	0.6
3	4	5	5	1.0
4	5	6	6	2.1
5	5	8	8	4.7
6	6	8	8	7.7
8	8	10	10	17.8
10	10	12	12	35
12	12	16	16	57
16	16	20	20	126
20	25	25	25	252
24	25	30	30	420

TABLE 3 Decarburization Limits for Threads^A

Thread Pitch, P, mm	Basic Thread Height, $h = 0.6135P$ mm	$N = 3/4 h$ min, mm	Root, 0.1 h, mm
0.7	0.429	0.322	0.043
0.8	0.491	0.368	0.049
1	0.613	0.460	0.061
1.25	0.767	0.575	0.077
1.5	0.920	0.690	0.092
1.75	1.074	0.806	0.107
2	1.227	0.920	0.123
2.5	1.534	1.151	0.153
3	1.840	1.380	0.184
3.5	2.147	1.610	0.215
4	2.454	1.841	0.245
4.5	2.761	2.071	0.276
5	3.068	2.301	0.307

^A See Fig. 2.

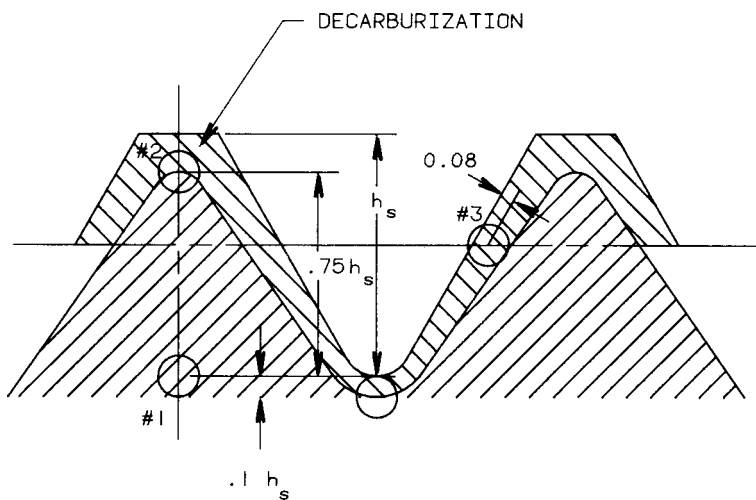


FIG. 1 Decarburization Limits

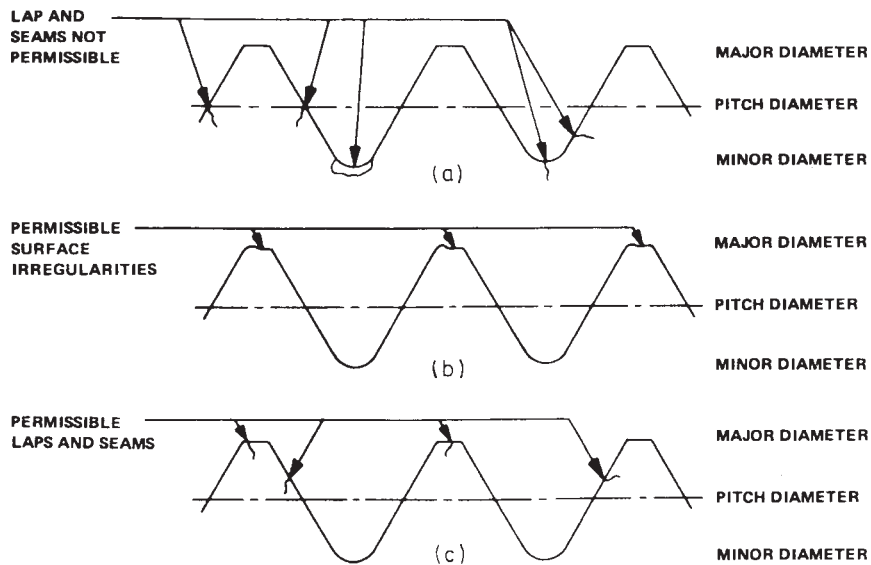


FIG. 2 Thread Discontinuities

make sample inspections to ensure that the product conforms to the specified requirements. Additional tests of individual shipments of material are not ordinarily contemplated. A record of individual heats of steel in each test lot shall be maintained. The container shall be coded to permit identification of the lot.

10.2 When specified in the order, the manufacturer shall furnish a test report certified to be the last complete set of mechanical tests for each stock size in each shipment.

10.3 When additional tests are specified on the purchase order, a lot, for purposes of selecting test samples, shall consist of all screws offered for inspection at one time of one diameter and length. From each lot, the number of samples for each requirement shall be as follows:

Number of Pieces in Lot	Number of Samples
800 and less	1
Over 800 to 8000, incl	2
Over 8000 to 22 000, incl	3
Over 22 000	5

10.4 Should any sample fail to meet the requirements of a specified test, double the number of samples from the same lot shall be retested for the requirement(s) in which it failed. All of the additional samples shall conform to the specification or the lot shall be rejected.

11. Test Methods

11.1 Chemical analysis shall be conducted in accordance with Test Methods A 751.

11.2 For socket strength torque test, the test screw shall be assembled into a tapped hole of 5H tolerance class in a steel block (see Fig. 3) 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 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 E 18.

11.4 *Decarburization Tests Shall be Conducted as Follows:*

11.4.1 Section the thread area of the screw longitudinally through the axis, mount, and polish it in accordance with Methods E 3. Take measurements (1) at the minor diameter in the center of the thread ridge, (2) 0.75 h toward the thread crest on the perpendicular bisector of the thread ridge, (3) on the thread flank approximately at the pitch line at a depth of 0.08 mm, and (4) in the thread root at a depth of 0.1 h. Use one of the two methods for decarburization evaluation, either optical or microhardness measurements. The microhardness measurement shall constitute a referee method in case of dispute.

11.4.2 For optical measurement, etch the section in 2– 4 % nital. Examine the surface of the etched samples under a microscope at 100× using a measuring eyepiece graduated in 0.03-mm increments. The width of any light etching band normally defines the decarburization depth. A dark etching band indicates the possibility of carburization.

11.4.3 Measure microhardness in accordance with Test Method E 384 on unetched specimens using a DPH 136° indenter or a Knoop indenter using the following load application:

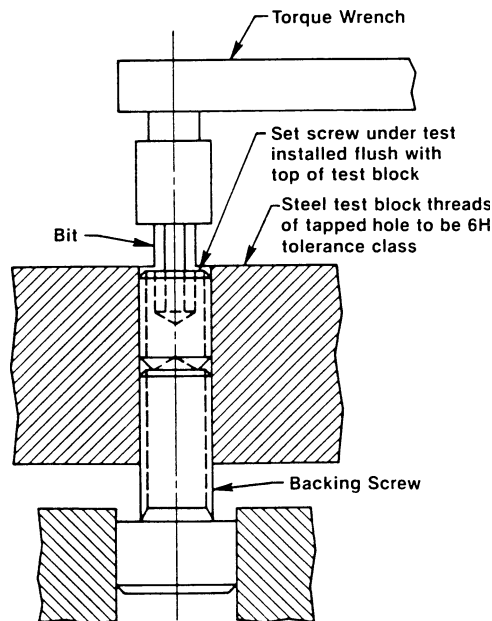


FIG. 3 Typical Torque Test Fixture

Thread Pitch, P, min.	Load
Over 0.6	500 gf
0.6	200 gf
Less than 0.6	Use optical evaluation in 11.4.2

11.4.3.1 Screw threads greater than 48 threads per inch, optical evaluation as described in paragraph 11.4.2 shall determine conformance to specification requirements. Take measurements at minor diameter (Reading No. 1) on the thread crest bisector to determine base material hardness. Take measurements (Reading No. 2) on the bisector 0.75 h, from the minor measurement toward the thread crest. Also take measurements (Reading No. 3) on the thread flank at the pitch line at a depth within 0.08 mm from the surface. Reading No. 3 may be taken on the same or an adjacent thread.

11.4.4 *Interpret Microhardness Readings as Follows:*

11.4.4.1 A decrease of more than 30 hardness points from Reading No. 1 to Reading No. 2 shall be regarded as decarburization and indicates the screw does not conform to specification requirements.

11.4.4.2 An increase of more than 30 hardness points from Reading No. 1 to Reading No. 3 shall be regarded as carburization and indicates that the screw does not conform to specification requirements.

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 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

14. Certification

14.1 Upon request for the purchaser in the contract or order, a manufacturer’s certification that the material was manufactured and tested in accordance with this specification, together with a report of the latest mechanical tests of each stock size in each shipment, shall be furnished at the time of shipment.

15. Responsibility

15.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser and certifies that the fastener was manufactured, sampled, tested and inspected in accordance with this specification and meets all of its requirements.

16. Packaging and Package Marking

16.1 *Packaging:*

16.1.1 Unless otherwise specified, packaging shall be in accordance with Practice D 3951.

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 Name and brand or trademark of the manufacturer,

16.2.1.3 Number of pieces,

16.2.1.4 Purchase order number, and

16.2.1.5 Country of origin.

17. Keywords

17.1 alloy; metric; screws; set; socket; steel



SUMMARY OF CHANGES

This section identifies the location of selected changes to this standard that have been incorporated since the -97a -99 issue. For the convenience of the user, Committee F-16 has highlighted those changes that impact the use of this standard. This section may also include descriptions of the changes or reasons for the changes, or both.

- ~~(1) Revised 3.1.4 to delete information regarding coatings other than black oxide.~~
- ~~(2) Added a new 1.2 indicating screws are intended~~
- ~~(1) Added 3.1.9, providing for compression applications only.~~
- ~~(3) Added 4.4 through 4.5.2, covering protective coatings.~~
- ~~(4) Added 4.4 defining the standard finishes as bright uncoated, thermal black oxide, or chemical black oxide.~~
- ~~(5) Deleted 9.1, Surface Finish. Covered in 4.4.~~
- ~~(6) Added Section 17, Keywords: optional use of ASME B18.24.1, Part Identifying Number (PIN) Code System.~~

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