Designation: F835M – 04

Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws (Metric)[1]

This standard is issued under the fixed designation F835M; 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 hexagon socket button (SBHCS) and flat countersunk (SFHCS) head cap screws M3 through M20 thread sizes having material properties of ISO 898/1 Property Class 12.9.

1.2 Fasteners meeting this specification are intended for shear type applications and have tensile requirements equivalent to ISO 898/1 Property Class 10.9.

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 problems, 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:*[2]

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

D3951 Practice for Commercial Packaging

E3 Guide for Preparation of Metallographic Specimens

E18 Test Methods for Rockwell Hardness of Metallic Materials

E112 Test Methods for Determining Average Grain Size

E384 Test Method for Microindentation Hardness of Materials

F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric)

F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series

2.2 *ANSI/ASME Standards:*

B18.3.4M Hexagon Socket Button Head Cap Screws[3]

B18.3.5M Hexagon Socket Flat Countersunk Head Cap Screws[3]

B18.24.1 Part Identifying Number (PIN) Code System[4]

2.3 *ISO Standard:*

898/1 Mechanical Properties of Fasteners, Bolts, Screws and Studs[3]

3. Ordering Information

3.1 Orders for material under this specification shall include:

3.1.1 Quantity (number of screws).

3.1.2 Dimensions, including nominal thread designation, thread pitch and nominal screw length (millimetres). A standard part number may be used for this definition.

3.1.3 Name of the screw: SBHCS or SFHCS.

3.1.4 Coating, if required. If a protective finish other than black oxide is required, it must be specified on the order or product standard.

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, and

3.1.8 Any special requirements.

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

3.2 *Example*—1000 pieces M6 × 1 × 25 SBHCS lot tensile test, ASTM F835M – XX.

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

4.2 Screws shall be cold upset or extruded, or both.

4.3 Screws shall be roll threaded.

[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.

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

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

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

4.4 Screws shall be heat treated by quenching in oil from above the transformation temperature and then tempering by reheating to at least 380°C to be within the hardness range specified in Table 1.

4.4.1 The minimum tempering temperature may be verified by submitting screws to 370°C for 30 min at temperature. The average cross section hardness of three readings on the screw before and after retempering shall not differ by more than 20 DPH.

4.5 When protective or decorative coatings are applied to the screws, precautions as required by the coating, shall be taken to prevent embrittlement.

5. Chemical Composition

5.1 The chemical composition of the screw material shall conform to the heat analysis specified in Table 2.

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

5.4 Material analysis may be made by the purchaser from finished products and the chemical composition thus determined shall conform to the requirements specified for the product analysis in Table 2.

6. Mechanical Properties

6.1 The finished screws shall conform to the mechanical requirements specified in Table 1.

6.2 Screws having a nominal thread diameter-length combination equal to or greater than that in Table 1 of Test Methods F606M shall be tested full size and shall conform to the full size tensile requirements specified in Table 3. Tensile failures through the head are acceptable provided the load requirements are satisfied.

6.3 Screws having a nominal thread diameter-length combination as specified in 6.2 and a breaking load exceeding 535 kN preferably shall be tested full size and shall meet the full-size tensile properties in Table 3. When equipment of sufficient capacity for such tests is not available, or if excessive length of the screws makes full-size testing impractical, standard round machined specimens may be used which shall meet the "machined test specimen tensile properties" in Table 1. If discrepancy between full-size and machined specimen results, full-size tests shall be used as the referee method to determine acceptance.

6.4 Screws that are too short (lengths less than that specified in 6.2 (see also Test Methods F606M) or that have insufficient threads for tension testing shall not be subject to tension tests but shall conform to the hardness (minimum and maximum) requirements of Table 1.

6.5 All screws, regardless of size, shall conform to the hardness specified in Table 1. Hardness shall be met anywhere on the cross section through the threaded portion one diameter from the screw point.

TABLE 1 Mechanical Requirements

Full-size Screws:	
Tensile, min, MPa	980
Machined Test Specimen:	
Yield strength at 0.2 % offset, min, MPa	1100
Tensile strength, min, MPa	1220
Elongation in 5*D*, min, %	8
Reduction of area, min, %	35
Product Hardness:	
Rockwell	38 to 44 HRC
Vickers	372 to 434 DPH

TABLE 2 Chemical Requirements[A]

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

[A] See for alloy requirements.

TABLE 3 Minimum Ultimate Tensile Loads

NOTE 1—All values are rounded to 3 significant digits.

Thread Size	Stress Area, mm^2	Tensile Load, min, kN[A]
M3 × 0.5	5.03	4.93
M4 × 0.7	8.78	8.60
M5 × 0.8	14.2	13.9
M6 × 1	20.1	19.7
M8 × 1.25	36.6	35.9
M10 × 1.5	58.0	56.8
M12 × 1.75	84.3	82.6
M14 × 2	115	109
M16 × 2	157	155
M20 × 2.5	245	240

[A] Because of the head critical configuration of these parts, the full-size tensile loads are based on 80 % of the machined specimen tensile strength and the applicable stress areas. (Loads based on 980 MPa).

7. Other Requirements

7.1 *Decarburization*:

7.1.1 There shall be no evidence of carburization or gross decarburization on the surfaces of the heat-treated screws when measured in accordance with 11.5.

7.1.2 The depth of partial decarburization shall be limited to the values in Table 4 when measured as shown in Fig. 1, and in accordance with 11.5.

TABLE 4 Decarburization Limits for Threads[A]

Thread-Pitch, *P*, mm	Basic Thread Height, h_s = 0.6135P mm	$N = \frac{3}{4}\ h_s$, min, mm	Root = $0.1h_s$, 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

[A] See Fig. 1.

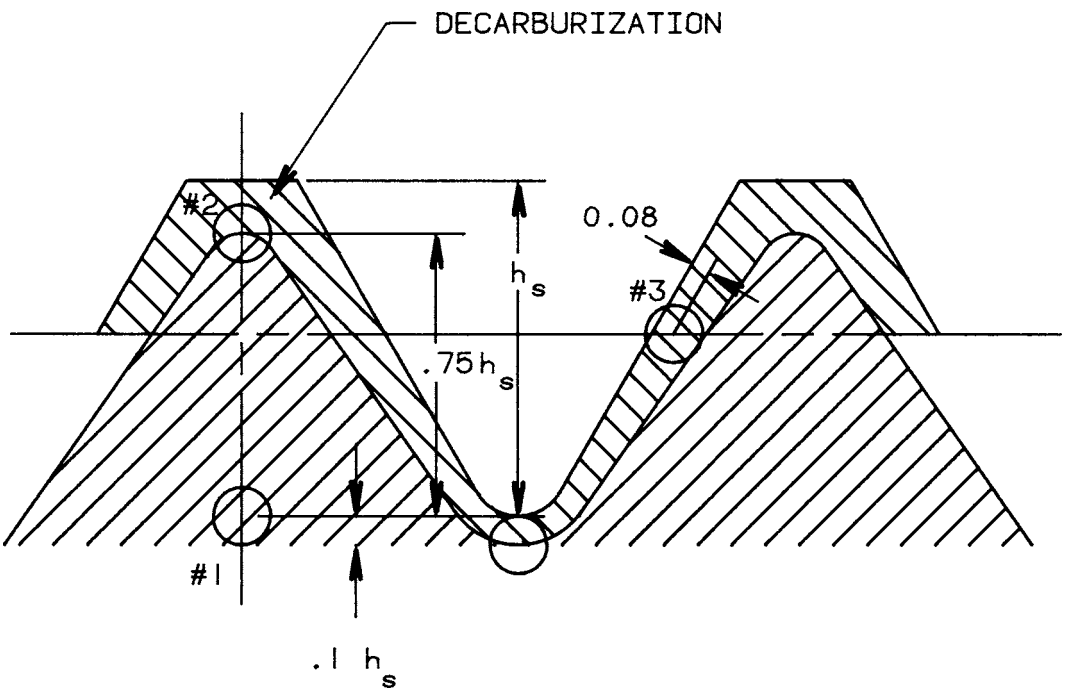

FIG. 1 Decarburization Limits

7.2 *Embrittlement*—Coated screws shall withstand the embrittlement test in accordance with 11.4 without showing indications of discontinuities. The loading shall be calculated with minimum screw tensile requirements.

8. Dimensions

8.1 Unless otherwise specified, the dimensions shall conform to the requirements of ANSI/ASME B18.3.4M or B18.3.5M as specified.

9. Workmanship, Finish and Appearance

9.1 *Surface Finish*—The screws shall have a black (thermal or chemical) oxide finish, unless otherwise specified.

9.2 *Surface Discontinuities*:

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

9.2.2 Forging defects that connect the socket to the periphery of the head are not permissible. Defects originating on the periphery and with a traverse indicating a potential to intersect are not permissible. Other forging defects are permissible provided those located in the bearing area, fillet, and top surfaces shall not have a depth exceeding 0.03 *D* or 0.13 m, whichever is greater. For peripheral discontinuities, the maximum depth may be 0.06 *D* not to exceed 1 mm (see Fig. 2).

9.2.3 Forging defects 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 0.25 *T*, or a maximum depth of 0.03 *D* not to exceed 0.13 mm (see Fig. 3).

9.2.4 Seams in the shank shall not exceed a depth of 0.03 *D* or 0.2 mm, whichever is greater.

9.2.5 No transverse discontinuities shall be permitted in the head-to-shank fillet area.

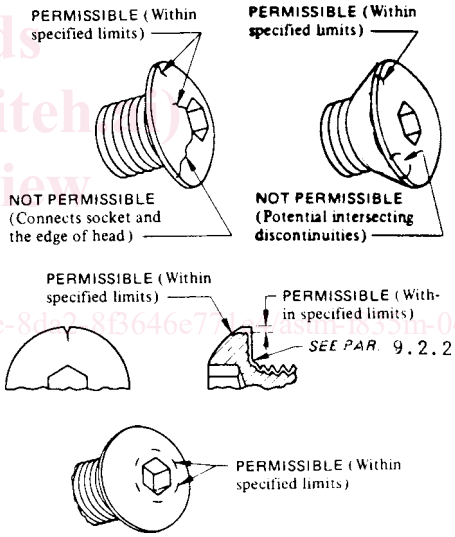

FIG. 2 Head Discontinuities

9.2.6 Threads shall have no laps at the root or on the flanks, as shown in Fig. 4. Laps are permitted at the crest (Fig. 4*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 9.2.4.

9.2.7 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 make sample inspections to ensure that the product conforms to the specified requirements. Additional tests of