FF-S-86E
May 29, 1987
SUPERSEDING
FF-S-86D
June 15, 1971
(SEE SECTION 6)

FEDERAL SPECIFICATION

SCREW, CAP, SOCKET-HEAD

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers socket-head cap screws with optional hexagon and spline socket configurations.

1.2 Classification.

1.2.1 Types and sizes. Screws furnished under this specification shall be of the folowing types (see 6.2 and figure 8). Screws shall be classified according to size by the nominal body diameter as specified in ANSI/ASME B18.3.

1/ Type I -Hexagon socket, cylindrical head, 1936 series.
1/ Type III -Internal multiple spline socket, cylindrical head, 1936 series.
Type IV -Hexagon socket, flat countersunk head, 82° included angle.
Type V -Internal multiple spline socket, flat countersunk head, 82° included angle.
Type VI -Hexagon socket, cylindrical head, 1960 series.
Type VII -Internal multiple spline socket, cylindrical head, 1960 series.
Type VIII -Hexagon socket, button head.
Type IX -Internal multiple spline socket, button head.

1/ DO NOT USE FOR NEW DESIGN (See 6.3.1)

AMSC N/A FSC 5305

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

FEDERAL SPECIFICATIONS

QQ-B-637 -Brass, Naval: Rod, Wire, Shapes, Forgings and Flat Products with Finished Edges (Bar, Flat, Wire, and Strip).
QQ-B-728 -Bronze Manganese; Rod, Shapes, Forgings, and Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate).
QQ-B-750 -Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections.
QQ-C-00465 -Copper-Aluminum Alloys (Aluminum Bronze) (Copper Alloy Numbers 606, 614, 630, 632M, and 642); Rod, Flat Products with Finished Edges (Flat Wire, Strip, and Bar) Shapes, and Forgings.
QQ-C-591 -Copper-Silicon, Copper-Zinc-Silicon, and Copper-Nickel-Silicon Alloys: Rod, Wire, Shapes, Forgings, and Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate).
QQ-N-281 -Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections.
QQ-N-286 -Nickel-Copper-Aluminum Alloy, Wrought.
QQ-P-416 -Plating, Cadmium (Electrodeposited).

FEDERAL STANDARDS

FED-STD-H28/20 -Screw-Thread Standards for Federal Services, Section 20, Inspection Methods for Acceptability of UN, UNR, UNJ, M and MJ Screw-Threads
FED-STD-123 -Marking for Shipment (Civil Agencies).
FED TEST METHOD STD NO. 151 -Metals; Test Methods.
FED-STD-H28/2 -Screw-Thread Standards for Federal Services, Section 2, Unified Inch Screw threads- UN and UNR Thread Forms.

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402

(Single copies of this specification, and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.

(Federal Government activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards and Commercial Item Descriptions from established distribution points in their agencies.)

MILITARY SPECIFICATIONS

MIL-F-495	- Finish, Chemical, Black, for Copper Alloys.
MIL-H-6875	- Heat Treatment of Steel, Process for.
DOD-P-16232	- Phosphate Coatings, Heavy, Manganese or Zinc Base (for Ferrous Metals).
MIL-C-81562	- Coatings, Cadmium, Tin-Cadmium and Zinc (Mechanically Deposited).
MIL-C-13924	-Coating, Oxide, Black, for Ferrous Materials.

MILITARY STANDARDS

MIL-STD-105	-Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-6866	-Inspection, Liquid Penetrant
MIL-STD-1949	-Inspection, Magnetic Particle.

(Copies of military specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

ASTM

ASTM A 370 - Mechanical Testing of Steel Products.

ASTM A 380 - Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems

ASTM A 493 - Stainless and Heat-Resisting Steel for Cold Heading and Cold Forging - Bar and Wire

ASTM B 633 - Electrodeposited Coatings of Zinc on Iron and Steel

ASTM A 574 - Alloy Steel Socket-Head Cap Screws

ASTM F 606 - Conducting Tests to Determine the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets

ASTM D 3951 - Standard Practice for Commercial Packaging

ASTM F 835 - Alloy Steel Socket Button and Flat Countersunk Head Cap Screws

(Applications for copies should be addressed to the ASME, 1916 Race Street, Philadelphia, PA 19103.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)/AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ASME/ANSI B18.3 - Socket Cap, Shoulder and Set Screws - Inch Series

ANSI B1.1 -Unified Inch Screw Threads (UN and UNR Thread Form)

ANSI/ASME B46.1 -Surface Texture (Surface Roughness, Waviness, and Lay)

ANSI/ASME B1.3 -Screw Thread Gaging Systems for Dimensional Acceptability - Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)

(Applications for copies should be addressed to The American National Standards Institute, 1430 Broadway, New York, NY 10018 or The American Society of Mechanical Engineers, United Engineering Center, 345 E. 47th Street, New York, NY 10017.)

Society of Automotive Engineers (SAE)

AMS 5731 - Steel Bars, Forgings, Tubing and Rings, Corrosion and Heat Resistant

AMS 5737 - Steel Bars, Forgings and Tubing, Corrosion and Heat Resistant

(Applications for copies should be addressed to the Society or Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pa 15096)

3. REQUIREMENTS:

3.1 Material. The offeror/contractor is encouraged to use recovered materials in accordance with Public Law 94-580 to the maximum extent practicable. Screws shall be made of alloy steel in accordance with 3.1.1, corrosion-resistant steel in accordance with 3.1.2, corrosion and heat resistant steel in accordance with 3.1.3, or non-ferrous material in accordance with 3.1.4, as specified (see 6.2 and 6.3). Mechanical Properties shall be as specified in 3.2 and Tables IV, V, and VI as applicable.

3.1.1 Alloy Steel. Alloy steel screws shall be of a chemical composition which can be heat treated in accordance with MIL-H-6875, to meet the mechanical properties specified in 3.2.1 and 3.2.2. Alloy steel with a manganese content exceeding 2 percent shall not be used.

3.1.2 Corrosion-resistant steel (austenitic). Austenitic corrosion-resistant steel screws shall be manufactured from Type 302 (UNS S30200), Type 304 (UNS S30400), Type 305 (UNS S30500), Type 316 (UNS S31600), Type 384 (UNS S38400), or Type XM-7 (UNS S30430) in accordance with ASTM A 493 and the mechanical properties as specified in 3.2.3.

3.1.3 Heat and corrosion-resistant steel. Heat and corrosion-resistant steel screws shall be manufactured from A286 Iron Base Superalloy (UNS S66286) in accordance with AMS 5731 or AMS 5737, cold worked to meet the mechanical properties specified in 3.2.4.

3.1.4 Non-ferrous material. Non-ferrous screws shall be manufactured from an alloy conforming to the mechanical properties specified in Table VI.

3.2 Mechanical properties.

3.2.1 Alloy steel cylindrical head cap screws. Ultimate tensile strength and hardness of alloy steel cylindrical head cap screws shall conform to the following:

(a) Ultimate tensile strength
  (1) Sizes .060 through .500 inch .....180,000 PSI min
  (2) Sizes over .500 inch.....170,000 PSI min

(b) Hardness (after heat treatment)
  (1) Sizes .060 through .500 inch.....39 to 45HRC
  (2) Sizes over .500 inch.....37 to 45HRC
  (3) Screws electroplated in accordance with 3.3.2 or 3.3.3 shall have a maximum hardness of 43HRC. Minimum hardness to be as specified herein.

3.2.1.1 Specimens. Specimens machined from finished alloy steel cylindrical head screws shall have the following properties:

(a) Ultimate tensile strength
  (1) Sizes .060 through .500 inch.....180,000 PSI min
  (2) Sizes over .500 inch.....170,000 PSI min
(b) Yield strength (.2 percent offset)
  (1) Sizes .060 through .500 inch.....155,000 PSI min
  (2) Sizes over .500 inch.....150,000 PSI min
(c) Hardness (after heat treatment)
  (1) Sizes .060 through .500 inch.....39 to 45HRC
  (2) Sizes over .500 inch.....37 to 45HRC
  (3) Screws electroplated in accordance with 3.3.2 or 3.3.3 shall have maximum hardness of 43HRC. Minimum hardness to be as specified herein.
(d) Elongation in 4D.....12 percent min
  Screws electroplated in accordance with 3.3.2 or 3.3.3 shall have a minimum elongation of 12 percent.
(e) Reduction in area.....33 percent min

3.2.2 Alloy steel countersunk head and button head cap screws. The mechanical properties of these screws shall conform to ASTM F 835 except as follows: Screws electroplated in accordance with 3.3.2 or 3.3.3 shall have a hardness limitation of 42HRC.

3.2.3 Corrosion-resistant steel screws. Ultimate tensile strength and hardness of corrosion-resistant steel screws shall conform to the following:

(a) Ultimate tensile strength
  (1) Sizes through .625 inch.....80,000 PSI min
  (2) Sizes over .625 inch.....70,000 PSI min
(b) Hardness
  (1) Sizes through .625 inch.....80HRB min
  (2) Sizes over .625 inch.....74HRB min

3.2.3.1 Specimens. Specimens machined from corrosion resistant steel cylindrical head cap screws shall have the following properties:

(a) Ultimate tensile strength
  (1) Sizes through .625 inch.....80,000 PSI min
  (2) Sizes over .625 inch.....70,000 PSI min
(b) Yield strength (.2 percent offset)
  (1) Sizes through .625 inch.....30,000 PSI min
  (2) Sizes over .625 inch.....26,000 PSI min
(c) Hardness
  (1) Sizes through .625 inch.....80HRB min
  (2) Sizes over .625 inch.....74HRB min
(d) Elongation in 4D
  (1) Sizes through .625 inch.....10 percent min
  (2) Sizes over .625 inch.....20 percent min
(e) Reduction in area.....30 percent min

3.2.4 Heat and corrosion-resistant steel cylindrical head cap screws. Ultimate tensile strength and hardness of heat and corrosion-resistant steel screws shall conform to the following:

(a) Ultimate tensile strength (all sizes).....160,000 PSI min
(b) Hardness (after heat treatment).....33 to 42HRC

3.2.4.1 Specimens. Specimens machined from finished heat and corrosion-resistant steel cylindrical head cap screws shall have the following properties:

(a) Ultimate tensile strength (all sizes).....160,000 PSI min
(b) Yield strength (.2 percent offset)(all sizes)...120,000 PSI min
(c) Hardness (after heat treatment).....33 to 42HRC
(d) Elongation in 4D.....12 Percent min
(e) Reduction in area.....18 Percent min

3.2.5 Non-ferrous screws. The Properties of non-ferrous screws shall be as specified in Table VI.

3.3 Protective coating or surface treatment. Screws shall be furnished uncoated or with a protective coating or surface treatment as specified herein (see 6.2 and 6.3).

3.3.1 Cleaning, descaling and passivation. Corrosion-resistant steel cap screws shall be cleaned, descaled and passivated in accordance with ASTM A 380.

3.3.2 Cadmium Plating When specified, screws shall be cadmium plated by electrodeposition in accordance with QQ-P-416, Type II, Class 3 or by mechanical plating in accordance with MIL-C-81562, Type II, Class 3. When cadmium plating is specified for screws of 48 pitch of finer, plating thickness may be reduced below .0002 inch (5µm).

3.3.3 Zinc coating. When specified, screws shall be zinc coated by electrodeposition in accordance with ASTM B633, Type II, Class Fe/Zm 5 or by mechanical plating in accordance with MIL-C-81562, Type II, Class 6. When zinc coating is specified for screws of 48 pitch or finer, plating thickness may be reduced below .0002 inch (5µm)

3.3.4 Phosphate coating. When specified, screws shall be phosphate coated in accordance with DOD-P-16232, Type Z, Class 2.

3.3.5 Black chemical finish. When specified, copper alloy screws shall have a black chemical finish in accordance with MIL-F-495 and alloy steel or corrosion- resistant steel shall have a black chemical finish in accordance with MIL-C-13924.

3.4 Surface texture. For alloy steel cap screws of sizes up to and including .625 inch, and having nominal lengths equal to or less than 8 times the basic screw diameter, the surface roughness of the screws before plating shall not exceed 63 microinches (arithmetical average) on the fillet and head bearing surfaces, nor exceed 32 microinches on the threads. For larger sizes, longer lengths, and corrosion resistant steel screws, the surface roughness of the screws before plating shall not exceed 125 microinches (arithmetical average) on the body, fillet and head bearing surfaces. Normally, it will be sufficient to ascertain that these surfaces on screws have the equivalent of a smooth machined finish by visual comparison with known surface standards. However, when it is deemed necessary to measure these surfaces with commercially available equipment, roughness measurements shall be taken axially on the body and fillet surfaces, and circumferentially on the bearing surface in accordance with ANSI/ASME B46.1.

3.5 Design.

3.5.1 Dimensions. Unless otherwise specified, screws shall conform to the dimensions and tolerances specified in ANSI/ASME B18.3.

3.5.2 Cylindrical heads (drilled). When specified (see 6.2 and 6.3) screws shall be cross drilled in accordance with Table I. The alignment plug specified in Table I shall pass completely through the head without deflection. On nominal sizes . 164 inch and above, the drilled holes shall not break through the corners of the hexagon socket. Nominal sizes .112 inch and .138 inch shall have two drilled holes spaced 180°; sizes .164 inch and above shall have six drilled holes spaced 60°. Edges of holes in the sockets may contain burrs, however, the socket shall accept a key in accordance with ANSI/ASME B18.3.

3.5.3 Broaching chips. Broached sockets of screws nominal size .112 or larger shall have all loose chips removed. Remaining chips shall be firmly attached.

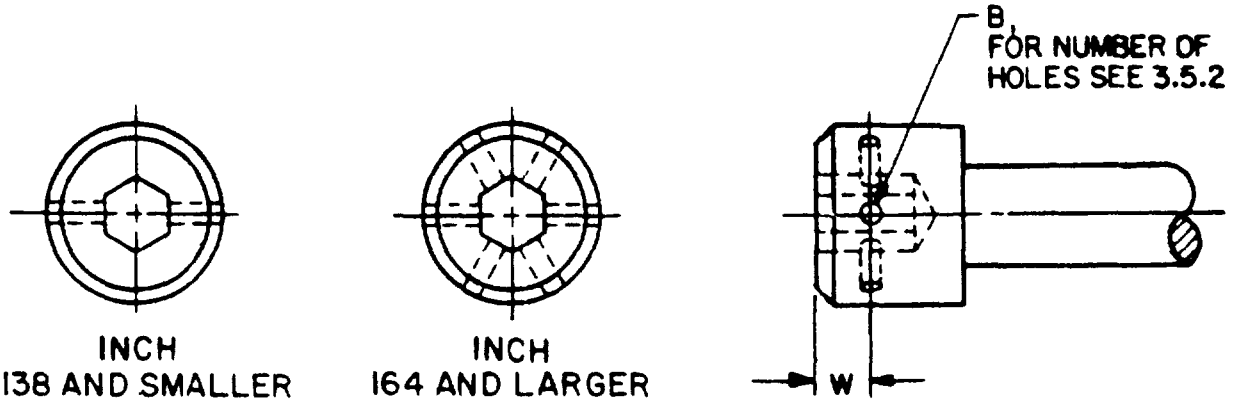


TABLE I. DIMENSIONS FOR DRILLED-HEAD SOCKET SCREWS

NOMINAL SIZE	W TOP OF HEAD TO CENTER OF HOLE		B DRILLED HOLE DIAMETER		HOLE ALIGNMENT PLUG DIAMETER
	MAX	MIN	MAX	MIN	
.1120	.040	.026	.039	.033	.025
.1380	.050	.035	.039	.033	.025
.1640	.060	.040	.050	.044	.030
.1900	.065	.045	.050	.044	.030
.2500	.085	.065	.050	.044	.030
.3125	.104	.084	.050	.044	.030
.3750	.123	.103	.067	.061	.051
.4375	.141	.121	.067	.061	.051
.5000	.160	.140	.067	.061	.051
.6250	.198	.178	.067	.061	.051
.7500	.235	.215	.097	.091	.081
.8750	.273	.253	.097	.091	.081
1.0000	.310	.290	.097	.091	.081
1.1250	.348	.328	.127	.119	.104
1.2500	.385	.365	.127	.119	.104
1.3750	.423	.403	.127	.119	.104
1.5000	.460	.440	.127	.119	.104

3.5.4 Threads.

3.5.4.1 Method of manufacture (threads). Screw threads shall be rolled for diameters through .625 inch and for screw lengths through 4.000 inch. For diameters and lengths other than this, threads may be rolled, cut or ground.

3.5.4.2 Thread series and class. Unless otherwise specified (see 6.2 and 6.3) threads shall be UNC, UNRC, UNF and UNRF series: Class 3A for nominal diameter sizes .060 through 1.000 inch inclusive and class 2A for nominal diameter sizes over 1.000 inch and larger in accordance with FED-STD-H28/2. Acceptability of screw threads shall be in accordance with FED-STD-H28/20, system 22.

3.6 Carburization and decarburization limits. The depth of carburization, total decarburization, and partial decarburization shall be in accordance with ASTM A 574 and ASTM F 835 as applicable. A carbon content throughout the threads equivalent to that of the core is desirable.

3.7 Discontinuities.

3.7.1 Threads. Threads shall have no laps at the root or on the flanks below the pitch diameter line as shown in Figure 1. Laps are permissible at the crest to a depth of 25 percent of the basic thread height and on the flanks above the pitch diameter line as shown in Figure 2. Slight deviation from the thread contour is permissible at the crest of the thread as shown in Figure 3.

3.7.2 Socket. The depth of discontinuities in the socket area shall be permissible within the limits of Table II, Note 1/, providing the discontinuities do not affect the usability and performance of the screw. Longitudinal discontinuities must not exceed 25 percent of the actual length of key engagement. Permissible and non-permissible discontinuities are shown in Figure 4.

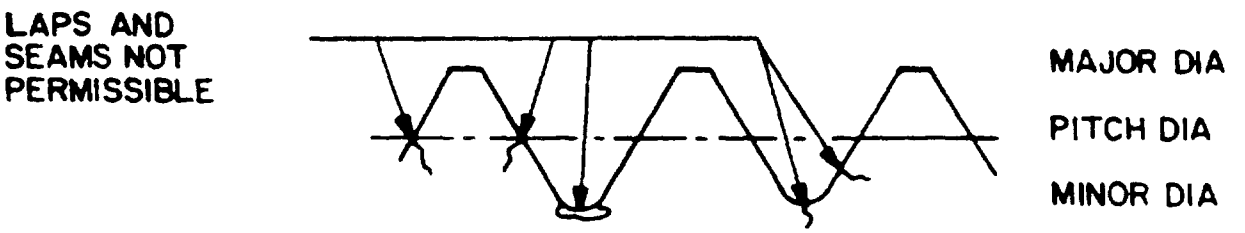


FIGURE 1. DISCONTINUITIES BELOW PITCH DIAMETER LINE.

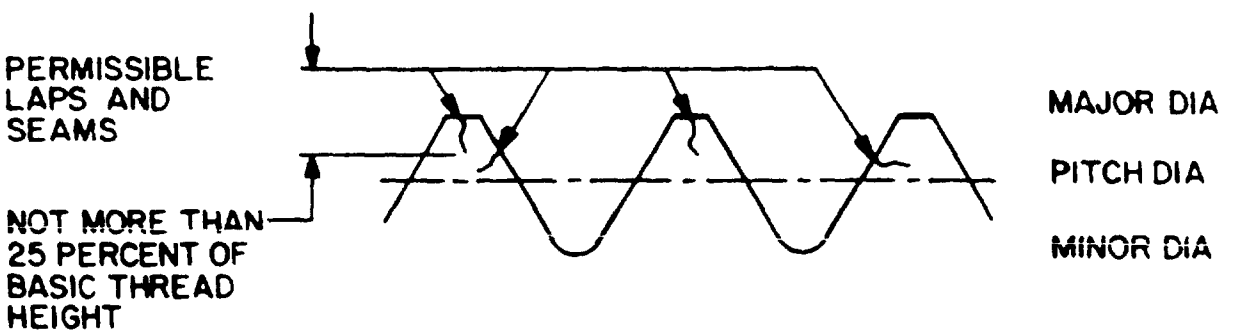


FIGURE 2. DISCONTINUITIES ABOVE PITCH DIAMETER.

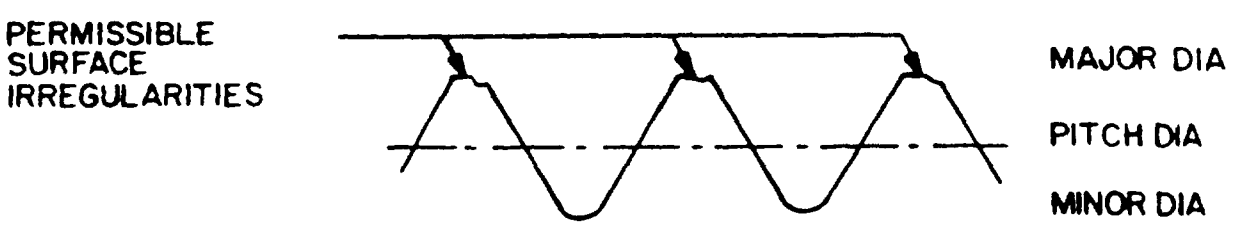


FIGURE 3. DISCONTINUITIES IN CREST CONTOUR.

TABLE II. DISCONTINUITY LIMITS

NOMINAL SIZE	PERMISSIBLE DISCONTINUITY DEPTH (MAX) BEARING, FILLET AND BODY SURFACES 1/	PERMISSIBLE DISCONTINUITY DEPTH (MAX) HEAD SURFACES 2/
.0600	.005	.007
.0730	.005	.007
.0860	.005	.007
.0990	.005	.007
.1120	.005	.007
.1380	.005	.008
.1640	.005	.010
.1900	.006	.011
.2500	.008	.015
.3125	.009	.018
.3750	.011	.023
.4375	.013	.026
.5000	.015	.030
.5625	.017	.034
.6250	.019	.038
.7500	.023	.045
.8750	.026	.053
1.0000	.030	.060
1.1250	.034	.064
1.2500	.038	.064
1.3750	.041	.064
1.5000	.045	.064

NOTE: Formulas for permissible discontinuity depths:
1/ Formula 1: Bearing, area, fillet, and other surfaces - max depth = .03D or .005 inch (whichever is greater).
2/ Formula 2: Peripheral discontinuities - max depth = .06D, but not to exceed .064 inch.
NOTE: D = nominal diameter of screw.

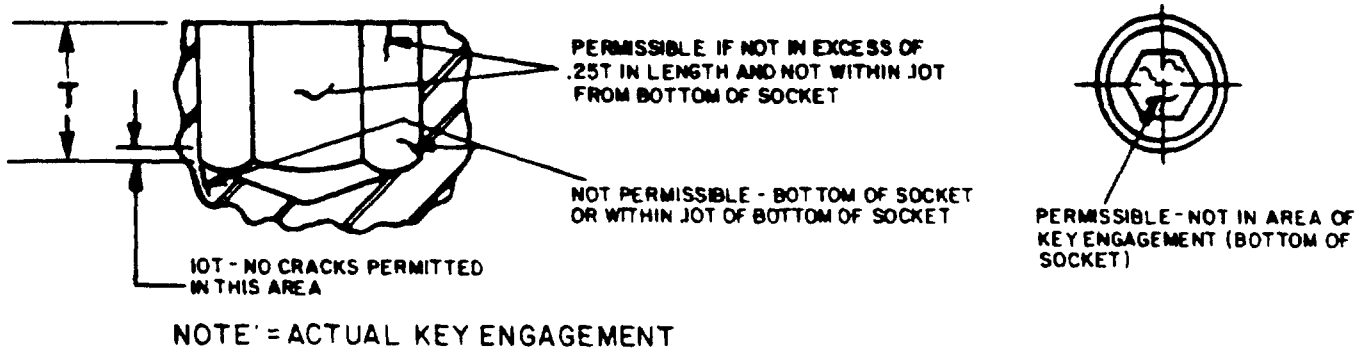


FIGURE 4. DISCONTINUITIES IN SOCKET.

3.7.3 Cylindrical head screws. The limits of acceptable discontinuities for cylindrical head screws shall be in accordance with Figure 5, and Table II, on all surfaces except threads and fillets. Discontinuities as defined in 6.4, are permitted in the locations illustrated in Figure 5 to the depths shown. All discontinuities are to be measured perpendicular to the indicated surfaces. The socket area shall conform to the limitations in Figure 4.

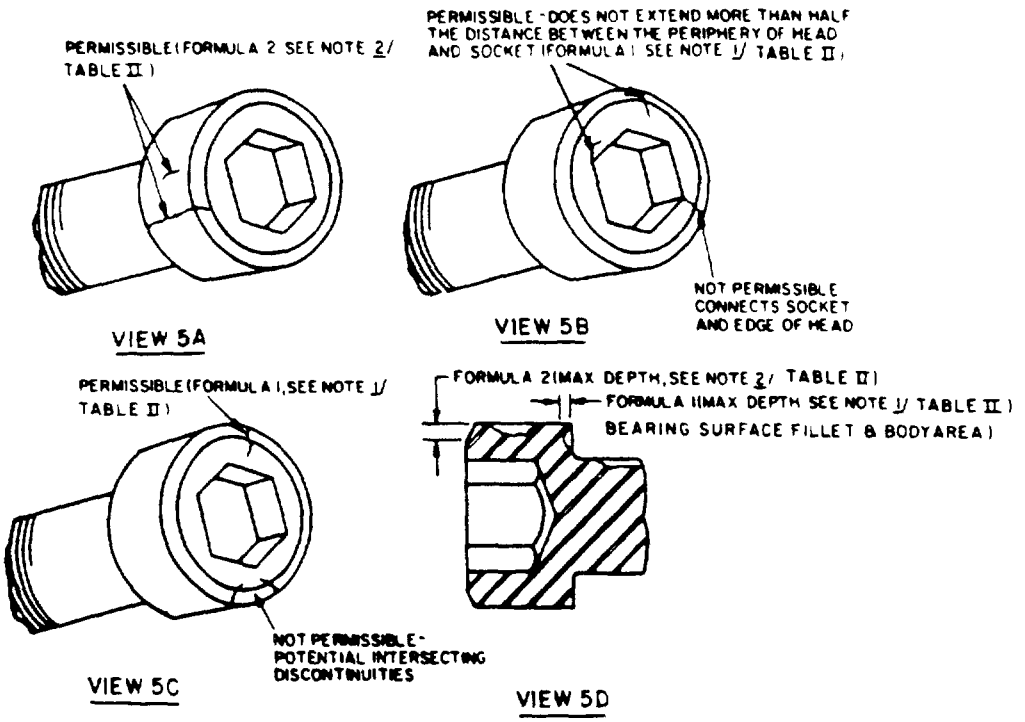


FIGURE 5. DISCONTINUITIES IN CYLINDRICAL HEADS.

3.7.4 Flat countersunk head screws. The limits of acceptable discontinuities for flat countersunk head screws shall be in accordance with Figure 6 on all surfaces except threads and fillets. The socket area shall conform to the limitations in Figure 4.

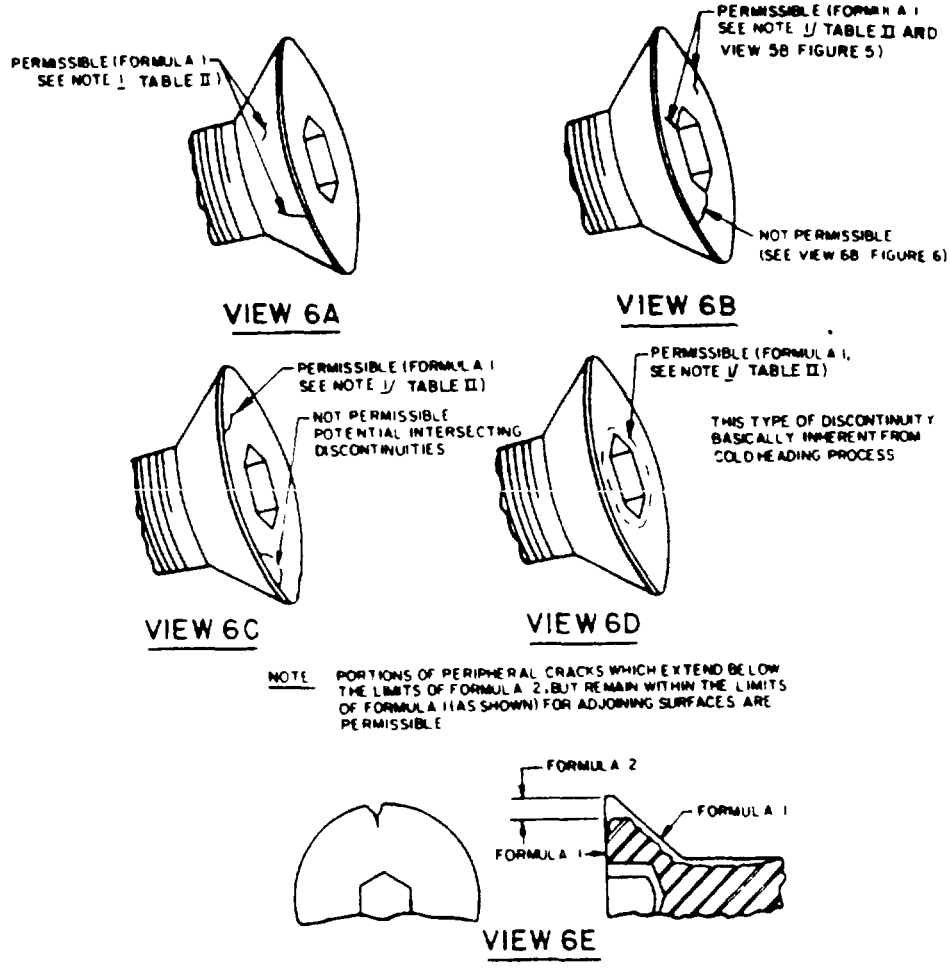


FIGURE 6. DISCONTINUITIES IN FLAT COUNTERSUNK HEADS.

3.7.5 Button head screws. The limits of acceptable discontinuities for button head screws shall be in accordance with Figure 7 on all surfaces except threads and fillets. The socket area shall conform to the limitations in Figure 4.

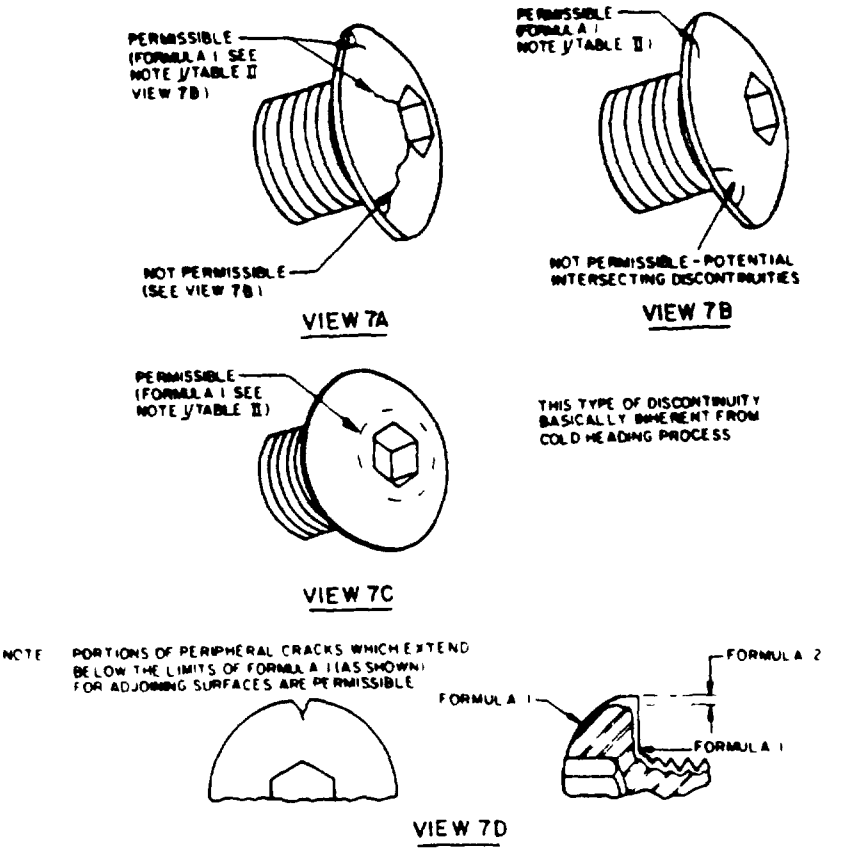


FIGURE 7. DISCONTINUITIES IN BUTTON HEADS.

3.8 Workmanship Screws shall be free from burrs, cracks, seams, laps, nicks, pits, loose scale, irregular surfaces, chips and other defects that will adversely affect life or serviceability.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection.

4.2.1 Lot. A lot shall consist of all screws of the same type, made from the same heat of material, heat treatment, protective coating, surface finish, size, length, and threads produced by the same suppliers facility and offered for acceptance at the same time.

4.2.2 Sampling for examination. A random sample of screws shall be taken from each lot in accordance with MIL-STD-105, Inspection Level II. The acceptable Quality Level (AQL) shall be as specified in Table III. For small lot procurement, see 4.2.7.

4.2.3 Sampling for mechanical properties and metallographic tests. A random sample of screws shall be taken from each lot in accordance with MIL-STD-105, Inspection level S-1 for destructive testing. The AQL shall be 4.0 percent defective. For small lot procurement, see 4.2.7.

4.2.4 Sampling for protective coating or surface treatment tests. Sampling for tests of protective coating or surface treatment shall be in accordance with the applicable specification as specified in 3.3.1, 3.3.2, 3.3.3, 3.3.4 and 3.3.5.

TABLE III. CLASSIFICATION OF DEFECTS

CATEGORIES	DEFECTS	INSPECTION METHOD
Critical	AQL = 1.0	
1	Discontinuities (see 3.7)	CIE 1/
Major	AQL = 2.5	
101	Socket dimensions (see 3.5.1)	CIE 1/
102	Threads (see 3.5.4)	CIE 1/
Minor	AQL = 4.0	
201	Protective coating or surface treatment (see 3.3)	Visual/CIE 1/
202	Surface roughness (see 3.4)	Visual/CIE 1/
203	Body diameter (cylindrical and flat countersunk heads) (see 3.5.1)	CIE 1/
204	Head diameter (see 3.5.1)	CIE 1/
205	Head height (see 3.5.1)	CIE 1/
206	Head chamfer (see 3.5.1)	CIE 1/
207	Bearing surface (see 3.5.1)	CIE 1/
208	Edge of head radius or chamfer (cylindrical heads) (see 3.5.1)	CIE 1/
209	Concentricity (see 3.5.1)	CIE 1/
210	Underhead fillet (see 3.5.1)	CIE 1/
211	Screw length (see 3.5.1)	CIE 1/
212	Thread length (see 3 5.1)	CIE 1/
213	Grip gaging length (cylindrical and flat contersunk heads) (see 3.5.1)	CIE 1/
214	Screw point chamfer (see 3.5.1)	CIE 1/
215	Flushness tolerance (flat countersunk heads) (see 3.5.1)	CIE 1/
216	Drilled hole dimensions (cylindrical heads) (see 3.5.2)	CIE 1/
217	Broaching chips (see 3.5.3)	Visual/CIE 1/

NOTE: 1/ Commercial Inspection Equipment

4.2.5 Sampling for chemical analysis. A random sample of screws shall be taken from each lot in accordance with MIL-STD-105, Inspection level S-1 for destructive testing. The acceptable quality level (AQL) shall be 4.0 percent defective. Sample previously selected for examination or for mechanical properties or metallographic tests may be used. For small lot procurement, see 4.2.7.

4.2.6 Sampling for discontinuities. A random sample of screws shall be taken from each lot in accordance with MIL-STD-105, Inspection level II for non-destructive testing. The AQL shall be 1.0 percent defective. For small lot procurement see 4.2.7.

4.2.7 Sampling for small lots. For small lot procurement of less than 51 screws, sampling and acceptance/rejection criteria for mechanical properties, metallographic, chemical analysis, and discontinuity tests shall be as follows:

Lot size	Sample size	Number of Defectives	
		Accept	Reject
2 to 10	1	0	1
11 to 50	2	0	1

4.2.8 Inspection of packaging. the sampling and inspection of the preservation, packing and container marking shall be as specified in 5.

4.2.9 Examination

4.2.9.1 Visual and dimensional examination Each screw taken as specified in 4.2.2 shall be examined to verify conformance with this specification. Examination shall be conducted in accordance with Table III and ASME/ANSI B18.3. Any screw in the sample containing one or more defects shall be rejected, and if the number of defective screws in any sample exceeds the acceptance number for that category, the lot represented by the sample shall be rejected.

4.3 Test methods.

4.3.1 Mechanical property test. The hardness test as specified in 4.3.1.1, axial tension test as specified in 4.3.1.2 or wedge tension test as specified in 4.3.1.3 shall be mandatory tests of finished screws and specimens as applicable to determine compliance to meet the mechanical property requirements as specified in 3.2.

4.3.1.1 Hardness test. Samples selected as specified in 4.2.3 shall be subjected to a hardness test conducted in accordance with ASTM F 606 at room temperature on a clean, flat surface, capable of sustaining the load imposed by the hardness tester. Non-ferrous screws shall be excluded from this test.

4.3.1.2 Axial tension test. Samples selected as specified in 4.2.3 shall be subjected to a full size tension test conducted in accordance with ASTM F 606. The minimum required length for tension testing shall be 3D. the speed of testing, as determined with a free running crosshead shall be a maximum of 1 in/min.

4.3.1.2.1 Full-size test specimens. Screws shall be tension tested full-size, when practical.

4.3.1.2.2 Tension testing of machined test specimen. For testing screws having tensile properties greater than can be measured on available test equipment, the body shall be turned down, concentric to the axis of the screw, to the largest practical gage dimension specified in ASTM F 606. These specimens shall be tested for tensile strength, yield strength, elongation and reduction in area in accordance with ASTM F 606. Non-ferrous screws shall be excluded from the reduction in area test.

4.3.1.3 Wedge tension test. Samples selected as specified in 4.2.3 shall be subjected to tension testing of full-size screws with a wedge in accordance with ASTM F 606. The purpose of this test is to obtain the tensile strength and to demonstrate the head quality and ductility of a screw by subjecting it to eccentric loading. Flat countersunk head screws shall be excluded from this test.

4.3.2 Metallographic test. Samples selected as specifed in 4.2.3 shall be subjected to a metallographic test conducted in accordance with ASTM A 574 and ASTM F 835 to determine conformance with 3.6.

4.3.3 Protective coating or surface treatment tests. Protective coating of surface treatment tests shall be conducted in accordance with the applicable specification , as specified in 3.3.1, 3.3.2, 3.3.3, 3.3.4 and 3.3.5.

4.3.4 Chemical Analysis. Samples selected as specified in 4.2.5 shall be subjected to a chemical analysis in accordance with Federal Test Method Standard No. 151, Method 111.2 or Method 112.2. In case of dispute Method 111.2 shall be the basis for acceptance. When a mill certificate covering chemical requirements can be furnished, it will be acceptable in lieu of the chemical analysis required by 4.2.5 (see 6.2)

4.3.5 Discontinuity inspection test. For sizes .250 and smaller, samples selected as specified in 4.2.6 shall be subjected to the method of inspection in accordance with ASTM F 788 to meet the requirements of 3.7. Marking of inspected parts shall be optional. For sizes .3125 and larger, samples selected as specified in 4.2.6 shall be subjected to MIL-STD-6866 or MIL-STD-1949 inspection methods as applicable to meet the requirements of 3.7.

5. Packaging.

5.1 Packaging requirements. Packaging requirements shall be in accordance with ASTM D 3951.

5.2 Marking for civil agencies. Marking for all containers shall be in accordance with FED-STD-123.

6. NOTES

6.1 Intended use. This specification covers externally threaded fasteners, which are designed to be driven into tapped holes with a hexagon or spline key or setter, in applications which require high strength precision products, compactness of design of the assembled parts, used in confined spaces or sinking of heads below surfaces into holes which fit the head.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

a. Title, number and date of this specification.
b. Type, size and length or standard part number (see 1.2).
c. Title, number and date including part number specified in accordance with military document (see 6.3).
d. Material certification, if required (see 3.1 and 4.3.4).
e. Protective coating or surface treatment, if required (see 3.3)
f. Cross drilling of cylindrical heads, if required (see 3.5.2).
g. Thread series and class (see 3.5.4.3).

6.3 Military Procurement Items procured under this specification for military use are to be limited to the variety shown on the applicable Military Standards as specified herein:

NAS 1351 -Screw, Cap, Socket Head - Undrilled and Drilled, Plain and Self-Locking, Alloy Steel and Corrosion-Resisting Steel, UNRF-3A.

NAS 1352 -Screw, Cap, Socket Head- Undrilled and Drilled, Plain and Self-Locking, Alloy Steel and Corrosion-Resisting, Steel UNRC-3A.

MS16995 -Screw, Cap, Socket Head and Hexagon, Corrosion Resisting Steel, UNC-3A

MS16996 -Screw, Cap, Socket Head and Hexagon, Corrosion Resisting Steel, UNF-3A

MS16997 -Screw, Cap, Socket Head and Screw Cap, Socket Head, Self-Locking, Alloy Steel, Cadmium Plated, UNC-3A

MS16998- Screw, Cap, Socket Head and Screw Cap, Socket Head, Self-Locking, Alloy Steel, Cadmium Plated, UNF-3A

MS21262- Screw, Self-Locking, 250°F, Cylindrical Head Hexagon Wrenching Socket, Alloy Steel, 160 KSI FTU (Socket Head Cap Screw) (ASG)

MS21295- Screw, Self-Locking, 250°F, Cylindrical Head, Hexagonal Wrenching Socket, Corrosion Resisting Steel, 80 KSI FTU (Socket Head Cap Screw) (ASG)

MS24667- Screw, Cap-Socket Head, Flat Countersunk, 82 deg., Alloy Steel, Cadmium Plated, UNC-3A

MS24671- Screw, Cap-Socket Head, Flat Countersunk, 82 deg., Corrosion Resisting Steel, UNC-3A

MS24673- Screw, Cap, Socket Head, Hexagon, Drilled, Corrosion Resisting Steel (UNF-3A)

MS24674- Screw, Cap, Socket Head, Hexagon, Drilled, Corrosion Resisting Steel (UNC-3A)

MS24677- Screw, Cap, Socket Head, Drilled, Alloy Steel, Cadmium Coated (UNC-3A)

MS24678- Screw, Cap, Socket Head, Drilled, Alloy Steel, Cadmium Coated (UNF-3A)

MS35455- Screw, Cap, Socket Head, Hexagon, Alloy Steel, Uncoated, UNC-3A

MS35456- Screw, Cap, Socket Head, Hexagon, Alloy Steel, Uncoated, UNF-3A

MS35457- Screw, Cap, Socket Head, Hexagon, Alloy Steel, Cadmium or Zinc, UNC-3A

MS35458- Screw, Cap, Socket Head, Hexagon, Alloy Steel, Cadmium or Zinc, UNF-3A

MS35459- Screw, Cap, Socket Head, Hexagon, Alloy Steel, Phosphate, UNC-3A

MS35460- Screw, Cap, Socket Head, Hexagon, Alloy Steel, Phosphate, UNF-3A

MS35461- Screw, Cap, Socket Head, Hexagon, Steel, Corrosion-Resisting, Passivated, UNC-3A

6.3.1 Types I and III screws (1936 series). Types I and III screws (1936 series) are obsolete for new design.

6.4 Definitions of discontinuities.

6.4.1 Crack. A crack is a clean crystalline break passing through the grain or grain boundary without inclusion of foreign elements.

6.4.2 Seam. A seam is an elongated discontinuity in the metal caused by a defect which has been closed by rolling or forging mechanically, but not united.

6.4.3 Inclusion. An inclusion is particles of non-metallic impurities, usually oxides, sulfides, silicates and such, which are mechanically held in steel during solidification.

6.4.4 Lap. A lap is a surface defect appearing as a seam caused by folding over metal, fins or sharp corners, and then rolling or forging, but not welding them into the surface.

6.4.5 Nicks, Pits. Nicks and pits are a depression or indentation in the surface of the metal.

6.5 Subject term (key word) listing.

Button head cap screw
Cylindrical head cap screw
Flat countersunk cap screw
Socket head cap screw

6.6 Supersession data. This specification includes the requirements of FF-S-86D dated 15 December 1971 and Amendment -1 dated 6 November 1972. Cross reference data between the types of screws covered by this specification and the types and styles of the preceding specifications, FF-S-86 dated 4 November 1953, FF-S-86A dated 16 May 1961, FF-S-86B dated 23 April 1964, FF-S-86C dated 17 October 1967, and FF-S-86D dated 15 December 1971, are as follows:

FF-S-86	FF-S-86A	FF-S-86B, FF-S-86C FF-S-86D AND FF-S-86E
Type I, Style 11	Type I, 1936 Series	Type I, 1936 Series
Type I, Style 12	Type III, 1936 Series	Type III, 1936 Series
Type I, Style 13	Type IV	Type IV
Type II, Style 11	None 1/	None 1/
None	Type V	Type V
None	Type VI, 1960 Series	Type VI, 1960 Series
None	Type VII, 1960 Series	Type VII, 1960 Series
None	None	Type VIII
None	None	Type IX

1/ These specifications do not cover Type II, Style 11 of FF-S-86 since that type of fastener is an internal wrenching bolt.

TABLE IV. TENSILE LOADS OF CORROSION-RESISTANT AND HEAT AND CORROSION-RESISTANT STEEL CYLINDRICAL HEAD SCREWS - COARSE THREADS

NOMINAL SIZE	THREADS PER INCH	TENSILE STRESS AREA 2/	TENSILE LOAD LBS-MIN (CORROSION-RESISTANT STEEL)	TENSILE LOAD LBS-MIN (HEAT AND CORROSION-RESISTANT STEEL)
.0730 1/	64	.00263	210	420
.0860	56	.00370	295	590
.0990 1/	48	.00487	390	780
.1120	40	.00604	480	960
.1380	32	.00909	730	1,460
.1640	32	.01400	1,120	2,240
.1900	24	.01750	1,400	2,800
.2500	20	.03180	2,545	5,090
.3125	18	.05240	4,190	8,380
.3750	16	.07750	6,200	12,400
.4375	14	.10630	8,505	17,010
.5000	13	.14190	11,350	22,700
.5625 1/	12	.18200	14,560	29,120
.6250	11	.22600	18,080	36,160
.7500	10	.33400	23,380	53,440
.8750	9	.46200	32,340	73,920
1.0000	8	.60600	42,420	96,960
1.1250	7	.76300	53,410	122,080
1.2500	7	.96900	67,830	155,040
1.3750	6	1.15500	80,850	184,800
1.5000	6	1.40500	98,350	224,800

1/ Do not use for new design.

2/ $A_s = 3.1416 \left(\frac{E}{2} - \frac{3H}{16} \right)^2$ as specified in ANSI B1.1

TABLE V. TENSILE LOADS OF CORROSION-RESISTANT AND HEAT AND CORROSION-RESISTANT STEEL CYLINDRICAL HEAD SCREWS - FINE THREADS

NOMINAL SIZE	THREADS PER INCH	TENSILE STRESS AREA 2/	TENSILE LOAD LBS-MIN (CORROSION-RESISTANT STEEL)	TENSILE LOAD LBS-MIN (HEAT AND CORROSION-RESISTANT STEEL)
.0600	80	.00180	145	290
.0730 1/	72	.00278	220	440
.0860	64	.00394	315	630
.0990 1/	56	.00523	420	840
.1120	48	.00661	530	1,060
.1380	40	.01015	810	1,620
.1640	36	.01474	1,180	2,360
.1900	32	.02000	1,600	3,200
.2500	28	.03640	2,910	5,820
.3125	24	.05800	4,640	9,280
.3750	24	.08780	7,025	14,050
.4375	20	.11870	9,495	18,990
.5000	20	.15990	12,790	25,580
.5625 1/	18	.20300	16,240	32,480
.6250	18	.25600	20,480	40,960
.7500	16	.37300	26,110	59,680
.8750	14	.50900	35,630	81,440
1.0000	12	.66300	46,410	106,080
1.1250	12	.85600	59,920	136,960
1.2500	12	1.07300	75,110	171,680
1.3750	12	1.31500	92,050	210,400
1.5000	12	1.58100	110,670	252,960
1.0000 1/	14 NS	.67900	47,500	108,570

1/ Do not use for new design.

2/ $A_s = 3.1416 \left(\frac{E}{2} - \frac{3H}{16} \right)^2$ as specified in ANSI B1.1

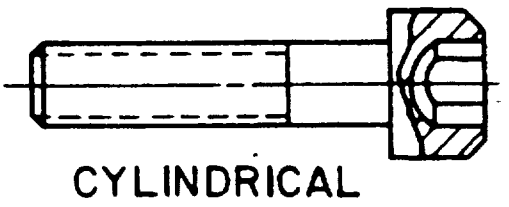
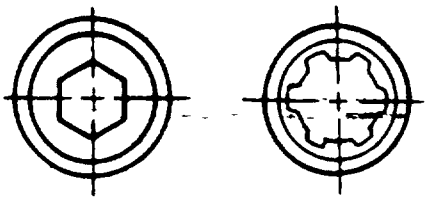
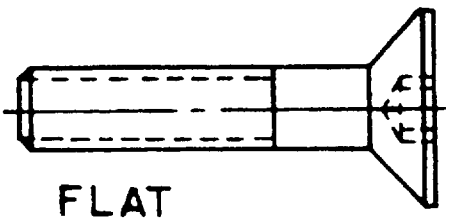
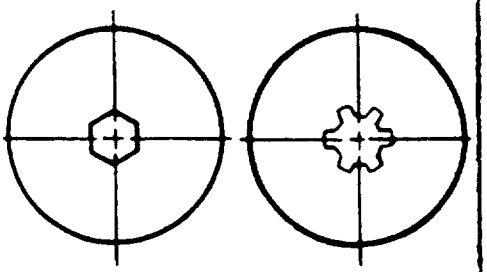
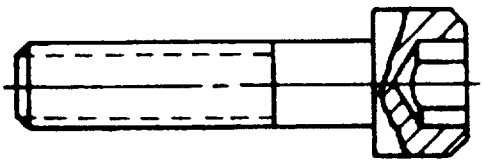
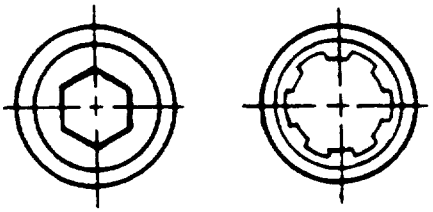
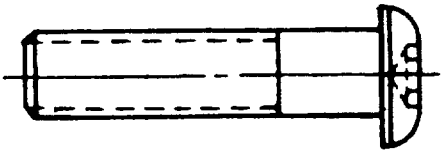
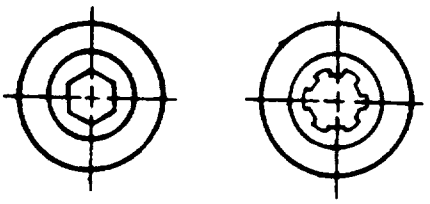
TABLE VI. MECHANICAL PROPERTIES OF NON-FERROUS SCREWS

MATERIAL	APPLICABLE DOCUMENT	COMPOSITION CLASS OR ALLOY NUMBER	CONDITION OR TEMPER	ULTIMATE TENSILE STRENGTH PSI MIN	YIELD STRENGTH PSI MIN	ELONGATION 1/ PERCENT MIN
Manganese Bronze	QQ-B-728	Class A	Soft	65,000	22,000 3/	20
Nickel-Aluminum Bronze	QQ-C-00465	Copper Alloy No 632M	Quench and Temper, Heat Treatment	90,000	50,000 3/	15
Phosphor Bronze	QQ-B-750	Composition A	Hard	80,000 (Dia under .250) 70,000 (Dia = .250 to .500) 60,000 (Dia = over .500 to 1.000) 55,000 (Dia = 1.000 to 3.000) 50,000 (Dia = over 3.000)	Not Specified	Not Specified 13 15 18 18
Silicon Bronze	QQ-C-591	Copper Alloy No. 651	Hard	60,000	40,000 3/	10
Naval Brass	QQ-B-637	Copper Alloy No. 464	Half-Hard or Light Annealed	60,000	27,000 3	22 (Dia = .500 & under) 25 (Dia = over .500)
Nickel-Copper Alloy	QQ-N-281	Class A	Hot Finished (As Hot Finished or Stress Relieved)	80,000	40,000 2/	30
Nickel-Copper Aluminum Alloy	QQ-N-286	Class A	Annealed and Age Hardened	130,000	90,000 2/	20

1/ In 4D gage length.

2/ .2 percent offset.

3/ .5 percent extension under load.

TYPES	DRIVES	HEADS
Type I 1/ and Type III, 1/ 1936 Series	 CYLINDRICAL	
Type IV and Type V	 FLAT	
Type VI and Type VIII, 1960 Series	 CYLINDRICAL	
Type VIII and Type IX 1960 Series	 BUTTON	

1/ Obsolete for new design (see 6.3.1)

FIGURE 8. SOCKET-HEAD SCREW TYPES

Military Interest:

Custodians:

Army- AR
Navy- OS
Air Force- 99

Review Activities:

Army- AV, EA, MI
Navy- SH
Air Force- 82
DLA- IS
NSA- NS

User Activities:

Army- AT, ME
Navy- AS, MC, YD
Air Force

Civil Agency Coordinating Activities

GSA
NASA

Preparing Activity:

Army- AR

Agent:

DLA- IS

(Project 5305-1532)

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1. DOCUMENT NUMBER	2. DOCUMENT TITLE
FF-S-86E	Screw, Cap. Socket-Head

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)* _____

5 PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6 REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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