

MIL-S-7839B
 21 December 1973
 SUPERSEDING
 MIL-S-7839A
 19 February 1965

MILITARY SPECIFICATION

SCREWS, STRUCTURAL, AIRCRAFT

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers aircraft structural screws.

1.2 Classification. Screws shall be of the types and sizes designated by the part numbers on the military standard (MS) as specified (see 6.2).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

QQ-A-225/6	Aluminum Alloy Bar, Rod, and Wire, Rolled, Drawn, Or Cold Finished, 2024
QQ-A-430	Aluminum Alloy Rod And Wire; For Rivets And Cold Heading
QQ-B-728	Bronze Manganese; Rod, Shapes, Forgings, And Flat Products (Flat Wire, Strip, Sheet, Bar, And Plate)
QQ-P-35	Passivation Treatments For Corrosion-Resisting Steel
QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-S-763	Steel Bars, Wire, Shapes, And Forgings, Corrosion-Resisting
FPP-H-1581	Hardware (Fasteners And Related Items), Packaging And Packing For Shipment And Storage Of

Military

MIL-S-6049	Steel, Chrome-Nickel-Molybdenum (8740) Bars And Reforging Stock (Aircraft Quality)
MIL-S-6050	Steel, Chrome-Nickel-Molybdenum (8630) Bars And Reforging Stock (Aircraft Quality)
MIL-H-6088	Heat Treatment Of Aluminum Alloys

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MIL-S-6098	Steel, Chrome-Nickel-Molybdenum (8735) Bars And Reforging Stock (Aircraft Quality)
MIL-S-6758	Steel, Chrome-Molybdenum (4130) Bars And Reforging Stock (Aircraft Quality)
MIL-I-6866	Inspection, Penetrant Method Of
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-H-6875	Heat Treatment Of Steels (Aerospace Practice, Process For)
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series. General Specification For
MIL-A-8625	Anodic Coatings, For Aluminum And Aluminum Alloys
MIL-S-8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter, General Specification For
MIL-S-18732	Steel Bars, Wire, Forging Stock, Forgings, Tubing (431), Special Quality

STANDARDS

Military

MIL-STD-105	Sampling Procedures And Tables For Inspection By Attributes
MIL-STD-410	Qualification Of Inspection Personnel (Magnetic Particle And Penetrant)
MIL-STD-1312	Fasteners, Test Methods
MS9006	Recesses-Cross, Low Torque Drive, Dimensions And Gage Dimensions For
MS24694	Screw, Machine, Flat Countersunk Head, 100°, Structural, Cross Recessed, UNC-3A And UNF-3A
MS27039	Screw, Machine - Pan Head, Structural, Cross Recessed
MS33750	Recess-Hi-Torque, Dimensions Of Recess, Gage, And Driver For

Air Force - Navy Aeronautical

AN502	Screw - Machine, Drilled Fillister Head, Fine Thread
AN503	Screw - Machine, Drilled Fillister Head, Coarse Thread
AN525	Screw - Washer Head

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

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

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.

AMS 6300 - Steel, .25 MO (.35-.40C)

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 485 Lexington Avenue, New York, NY 10017.)

3. REQUIREMENTS

3.1 Data. Unless otherwise specified in the contract or order, no data are required by this specification or any of the documents referenced in Section 2 (see 6.2).

3.2 Material.

3.2.1 Low-alloy steel. Low-alloy steel screws having .4375 inch body diameter and less shall be manufactured from steel conforming to AMS 6300 or MIL-S-6050. Low-alloy steel screws having a body diameter greater than .4375 inch shall be manufactured from steel conforming to MIL-S-6049, MIL-S-6050, MIL-S-6098, MIL-S-6758, or AMS6300.

3.2.2 Corrosion-resistant steel. Corrosion-resistant steel screws shall be manufactured from material conforming to QQ-S-763, class I, type C; QQ-S-763, class IV, or MIL-S-18732, or equal, or interchangeable with 16-18 chrome-nickel alloy steels.

3.2.3 Aluminum alloy. Aluminum-alloy screws shall be manufactured from material conforming to QQ-A-430, alloy 2024, or QQ-A-225/6 in the solution heat-treated T4 temper.

- 3.2.4 Manganese bronze. Manganese bronze screws shall be manufactured from material conforming to QQ-B-728.

3.3 Design and construction.

- 3.3.1 Threads. Threads of all screws shall conform to MIL-S-7742 or MIL-S-8879, as specified, and shall be of the sizes specified on the applicable MS. Unless otherwise specified, threads shall be right hand.

3.3.1.1 Grip. The grip length shall be measured from the largest diameter of the bearing surface of the head, parallel with the screw axis, to the end of the unthreaded shank.

3.3.2 Head eccentricity. Machine screw heads shall not be eccentric with the screw bodies by more than 3 percent of the maximum head diameter. Eccentricity is defined as one-half of the total indicator reading (TIR).

3.3.2.1 Bearing surface. The bearing surface of protruding screw heads shall be at right angles to the body within 2 degrees.

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- 3.3.2.2 Slot drive. When a screw with a slot drive is required, the dimensions of the slot shall be as shown on the applicable screw standard.
- 3.3.2.3 Cross recess. Recess dimensions shall conform to MS9006 or MS33750 as specified on applicable standard or drawing.

3.3.3 Straightness of shank. The straightness of the shank shall be within the values specified in Table I when the screw is rolled on a surface plate and the point of greatest deviation is measured with a feeler gage of .250 inch width. The straightness of shank requirements shall apply to size .190 and larger screws, and screws smaller than size .190 that have a length greater than six times their diameter. For screws under size .190, the straightness of shank from Table I for size .190 shall be used.

TABLE I. Straightness of Shank

Screw Size	Deviation of screw shank from plate, maximum (inch per inch of screw length)
.190	0.0040
.250, .3125	.0030
.375, .4375	.0025
.500 and larger	.0020

3.4 Heat treatment

3.4.1 Steel. Low-alloy steel screws shall be heat treated in accordance with MIL-H-6875.

3.4.2 Aluminum alloy. Aluminum-alloy screws manufactured from material conforming to QQ-A-430, alloy 2024, shall be heat treated in accordance with MIL-H-6088.

3.5 Physical properties

3.5.1 Tensile strength. The tensile strength of the screws shall be as specified in Table II, when tested in accordance with 4.4

3.5.2 Hardness. All low-alloy steel screws shall be within the Rockwell hardness range C-26 to C-32, when tested in accordance with 4.5.

3.5.3 Cracks. Screws shall be free of cracks in any direction and location. A crack is defined as a clean crystalline break passing through the grain or grain boundary without the inclusion of foreign elements.

3.5.4 Discontinuities. All structural screws shall be acceptable, provided they do not contain discontinuities which equal or exceed the following limitations. Care must be taken not to confuse cracks (see 3.5.3) with discontinuities.

TABLE II. Strength Requirements

Size	Ultimate tensile strength (minimum) ¹ pounds			Ultimate double shear strength (minimum) ² pounds		
	Low-alloy steel	Corrosion- resistant steel	Aluminum alloy	Low-alloy steel	Corrosion- resistant steel	Aluminum alloy
Coarse Thread						
.138-32UNC-3	1,120	760	560	2,120	1,480	1,080
.164-32UNC-3	1,740	1,180	860	3,000	2,100	1,570
.190-24UNC-3	2,170	1,480	1,080	4,250	2,770	2,092
.250-20UNC-3	3,960	2,700	1,960	7,360	5,000	3,650
.3125-18UNC-3	6,520	4,440	3,230	11,500	7,820	5,700
Fine Thread						
.138-40UNF-3	1,260	860	630	2,120	1,480	1,080
.164-36UNF-3	1,820	1,240	900	3,000	2,100	1,570
.190-32UNF-3	2,490	1,690	1,230	4,250	2,770	2,092
.250-28UNF-3	4,520	3,080	2,240	7,360	5,000	3,650
.3125-24UNF-3	7,240	4,920	3,590	11,500	7,820	5,700
.375-24UNF-3	10,950	7,450	5,430	16,560	11,250	8,250
.4375-20UNF-3	14,800	10,070	7,350	22,500	15,300	11,200
.5000-20UNF-3	19,950	13,570	9,900	29,400	20,000	14,600
.5625-18UNF-3	25,300	17,200	12,560	37,400	25,300	18,500

¹ The values shown for the ultimate tensile strength are for minimum values and are based on:

- 125 KSI for low-alloy steel.
- 85 KSI for corrosion-resistant steel.
- 62 KSI for aluminum alloy.

The stress areas used for the calculation of the tensile strength values are based on the average of the mean pitch and minor diameters of the external thread.

² Ultimate shear strengths are computed on the basis of 60 percent of the ultimate tensile strengths.

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3.5.4.1 Longitudinal discontinuities. Longitudinal discontinuities extending through fillets or threads as shown on Figure 1 that exceed the limits shown in Table III shall not be acceptable. Seams up to the depth indicated which have been rolled beneath root of thread shall be acceptable.

3.5.4.2 Transverse discontinuities. Transverse discontinuities in the shank of the screw as shown on Figure 2 that exceed the limits shown in Table III shall not be acceptable. Transverse discontinuities shall not be confused with tool marks.

TABLE III. Limits for Seam Depth and Tool Marks or Undercuts

Screw size in inches	.3125 and under	.3750	.4375	.5000 and over
Depth in shank in inches	0.005	0.006	0.007	0.008

3.5.4.3 Screw head shank junction. Only longitudinal seams of the depths permitted in Table III shall be permitted. Slight tool marks or undercuts of depth not to exceed the limits in Table III will be permitted, provided they fair into the shank with no sharp scratches, gouges, or corners.

3.5.5 Decarburization. Decarburization of low-alloy steel screws shall not exceed the limits shown in Table IV, when tested in accordance with 4.6.

TABLE IV. Decarburization Limits

Size	Complete decarburization (inch)	Complete plus partial decarburization (inch) ¹
Up to .375, incl	0.004	0.010
Over .375 to .5000, incl	.005	.012
Over .5000	.006	.014

¹ The permissible values shown are based on measurements of the entire periphery of the cross section and the average depth determined.

3.5.6 Head structure. A section of the head shall show no detrimental defects when tested in accordance with 4.7.

3.6 Finish. Screws shall be finished as specified in Table V unless otherwise noted on the applicable MS.

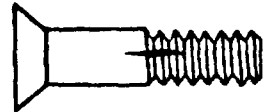
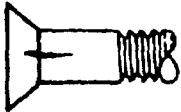
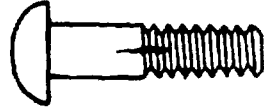
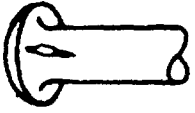


FIGURE 1. LONGITUDINAL DISCONTINUITIES EXTENDING THROUGH FILLETS OR THREADS.

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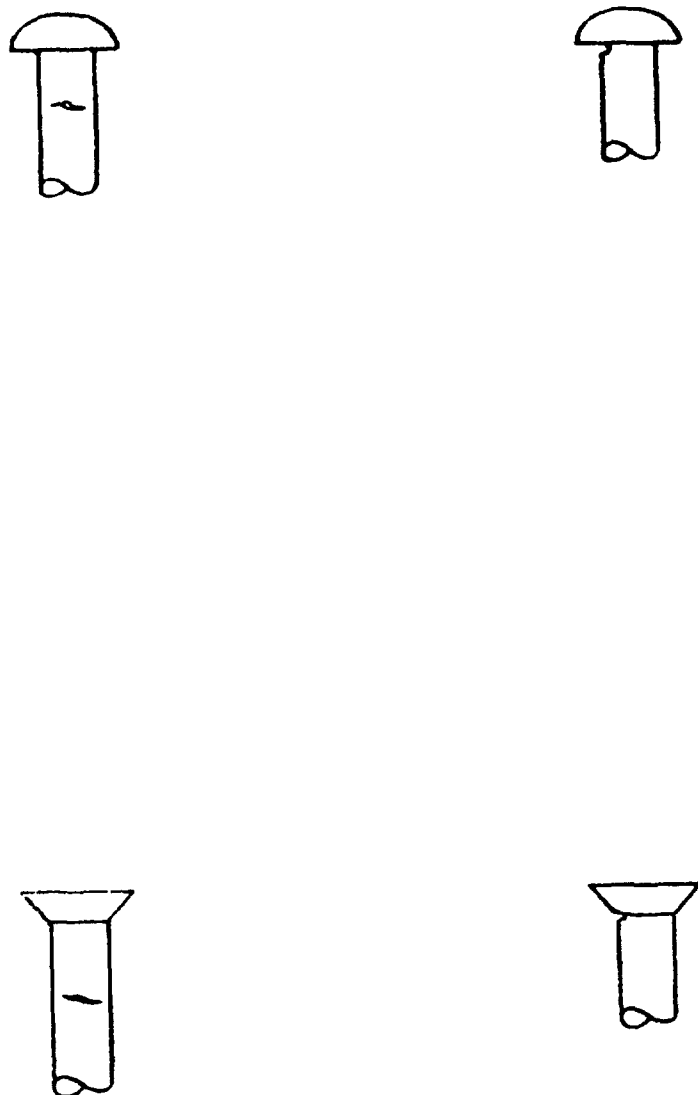


FIGURE 2. TRANSVERSE DISCONTINUITIES IN THE HEAD OR SHANK

TABLE V. Finish

Material	Type of finish	Finish in accordance with
Steel, low-alloy	Cadmium plate	QQ-P-416, Type II, class 2
Steel, corrosion-resistant	Passivate	QQ-P-35
Aluminum alloy	Anodize	MIL-A-8625

3.6.1 Passivating process for corrosion-resistant steel screws. Corrosion-resistant steel screws shall be passivated in accordance with QQ-P-35.

3.7 Identification of product. When required, screws shall be marked for identification purposes as shown on the applicable MS. It is permissible for the screw manufacturer to include his identification marking on the screws.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection. The examination and tests of screws are classified as quality conformance inspection (see 4.3 through 4.10).

- 4.3 Examination of product. Sampling for visual and dimensional attributes shall be at random in accordance with MIL-STD-105. Acceptable quality levels (AQL's) for major A, minor A, and minor B classes of characteristics shall be as follows

Major A - 4.0 percent.

Minor A - 6.5 percent.

Minor B - 10 percent.

The total defective items for all characteristics of a given class (e.g., major A, minor A, minor B) shall be combined in order to apply the acceptance and rejection provisions of MIL-STD-105.

4.3.1 Method. Finished screws shall be checked for conformance with the following requirements.

4.3.1.1 Dimensions. Dimensions shall be measured by suitable gages or measuring instruments. In case of controversy, gages and instruments certified by Government laboratories shall be employed. Screw threads shall be checked as specified in MIL-S-7742.

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4.3.1.1.1 Definition of defects. All dimensional characteristics are considered defective when out of tolerance.

* 4.3.1.2 Classification of defects.

Critical

Classification	AN502, AN503 screw, fillister head	MS24694 screw machine, flat hd 100° structural	AN525 MS27039 screw
None	X	X	X

Major A

Thread size and form	X	X	X
Unthreaded shank diameter (A)	X	X	X
More than two imperfect threads	X	X	X
Grip length (G)	X	X	X
Slot or recess in head missing	X	X	X
Straightness of shank	X	X	X
Surface finish, plating	X	X	X
Identification	X	X	X
Radius under head	X	-	-
Hole in head missing	X	-	-
Squareness between head and shank	X	-	X
Head diameter (D)	-	X	-
Head angle	-	Y	-
Eccentricity of head to shank	-	X	-

Minor A

Overall length	X	X	X
Burrs and tool marks	X	X	X
Slot or recess dimensions	X	X	X
Head diameter (A or B)	X	-	X
head height (D)	X	-	-
Crown height (C)	X	-	-
Washer diameter and location	X	-	-
Eccentricity of head and shank	-	-	X
Radius between head and shank	-	Y	-
Head thickness (H)	-	-	X
Washer thickness (E)	-	-	X
Washer diameter (A)	-	-	X
Fillet under head	-	-	X

Minor B

Chamfer on thread end	X	X	X
Flat on OD of head (F)	-	X	-
Head crown radius (F)	-	-	X

4.4 Tension.

- 4.4.1 Sampling. Samples for the tension test shall be in accordance with MIL-STD-105, AQL of 4.0 percent, Special Inspection Level S-3.
- 4.4.2 Method. The screws shall be tested in accordance with MIL-STD-1312, Test No. 8.
 - 4.4.2.1 When the screw is too short for application of the tension test, the number of tension test specimens may be selected from the wire or rod from which the screws are to be made. Such wire or rod should receive the same heat treatment and other processes as the production lots represented so that strength will be the same for both.

4.5 Hardness.

- 4.5.1 Sampling. Sampling for the hardness test shall be in accordance with MIL-STD-105, AQL of 4.0 percent, Special Inspection Level S-3.
- 4.5.2 Method. Hardness test shall be in accordance with MIL-STD-1312, Test No. 6.

- 4.6 Decarburization. Decarburization shall be determined by microexamination. Specimens shall be taken from a transverse section of the shank of the finished screw. The etchant shall be 5 percent nital. Microscopic examination shall be made at a magnification of 100 diameters. Sampling shall be in accordance with MIL-STD-105, AQL of 4.0 percent, Special Inspection Level S-3.

- 4.7 Head structure. A longitudinal macrosection of the head and not less than .250 inch of the upper portion of the shank, after the head forming and heat treating process, shall be examined for internal structure. Sampling shall be in accordance with MIL-STD-105, AQL of 4.0 percent, Special Inspection Level S-3.

- 4.7.1 Steel screws. Steel screws shall be etched in an aqueous solution containing 50 percent (by volume) of hydrochloric acid held at 70° to 82° Centigrade (C) (160° to 180° Fahrenheit (F)) for a time sufficient to reveal the macrostructure properly.

4.7.2 Aluminum-alloy screws. Aluminum-alloy screws shall be etched in a 5- to 15-percent (by weight) aqueous caustic soda (NaOH) solution at approximately 82°C (180°F) for a time sufficient to reveal the macrostructure properly. This shall be followed by washing in water and dipping in a 10-percent (by weight) nitric acid solution to remove black stains. Water washing and drying shall follow.

4.8 Magnetic particle inspection. The indicated discontinuities, cracks, seams, and inclusions in low-alloy steel screws shall be determined by magnetic particle inspection unless visual inspection discloses discontinuities which would preclude the necessity for magnetic particle inspection. Magnetic particle indications of themselves shall not be cause for rejection. If in the opinion of the inspector, the indications are cause for rejection, representative samples shall be taken from those screws showing indications which shall be further examined by microexamination to determine whether the indicated discontinuities are in accordance with the limits specified herein.

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4.8.1 Sampling. Sampling for magnetic particle inspection shall be at random in accordance with MIL-STD-105, with an AQL of 1.5 percent. The acceptance and rejection numbers of this sampling plan shall apply to those screws which are judged defective or in nonconformance with the requirements contained herein after microexamination has been performed on those samples revealing magnetic particle indications. Magnetic particle inspection shall not be required for screws less than .250 inch in diameter.

4.8.2 Method. Magnetic particle inspection shall be performed in accordance with MIL-I-6868. Such inspection shall, in general, be performed on finished screws, but in any case, subsequent to any processing operations which could adversely affect the part. The magnetizing field shall be parallel to the longitudinal axis of the screw, primarily for the indication of transverse defects. Screws shall not be dyed as an indication of magnetic particle inspection in accordance with sampling requirements of this specification. Personnel conducting magnetic particle inspection shall be certified in accordance with MIL-STD-410.

4.9 Fluorescent penetrant inspection. The indicated discontinuities, cracks, seams, and inclusions in aluminum-alloy screws shall be determined by fluorescent penetrant inspection. Fluorescent penetrant indications of themselves shall not be cause for rejection. If in the opinion of the inspector the indications are cause for rejection, representative samples shall be taken from those screws showing indications which shall be further examined by microexamination to determine whether the indicated discontinuities are in accordance with the limits specified herein.

4.9.1 Sampling. Sampling for fluorescent penetrant inspection shall be at random in accordance with MIL-STD-105, with an AQL of 1.5 percent. The acceptance and rejection numbers of this sampling plan shall apply to those screws which are judged defective or in nonconformance with the requirements contained herein after microexamination has been performed on those samples revealing fluorescent penetrant indications. Fluorescent penetrant inspection shall not be required for screws less than .250 inch in diameter.

4.9.2 Method. Fluorescent penetrant inspection shall be performed in accordance with MIL-I-6866. Such inspection shall, in general, be performed on finished screws, but in any case subsequent to any processing operations which could adversely affect the part. Screws shall not be dyed as an indication of fluorescent penetrant inspection in accordance with the sampling requirements of this specification. Personnel conducting fluorescent penetrant inspection shall be certified in accordance with MIL-STD-410.

4.10 Packaging, packing, and marking. Preparation for delivery shall be examined for conformance to Section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing, and marking. Unless otherwise stipulated by the procuring activity, preservation, packaging, packing, and marking shall be in accordance with the applicable requirements of PPP-H-1581 as specified (see 6.2).

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6. NOTES

- 6.1 Intended use. The screws are intended for aircraft structural applications, airframe mechanical subsystems, airborne mechanical equipment, and air special mission mechanical systems.
- 6.2 Ordering data. Procurement documents should specify:
 - a. Title, number, and date of this specification.
 - b. Data requirements (see 3.1).
 - c. IS part No. of the screw desired (see 1.2).
 - d. Levels of packaging and packing required (see 5.1).
- 6.3 Asterisks. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assures no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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User Activities.

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