

MIL-S-21472B
5 October 1971

SUPERSEDING
MIL-S-21472A
28 September 1965

MILITARY SPECIFICATION

SCREW, SHOULDER, HEXAGON SOCKET HEAD

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

1. SCOPE

1.1 This specification covers socket-head shoulder screws.

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 this specification to the extent specified herein.

SPECIFICATIONS

Federal

- 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-591 - Copper-Silicon, Copper-Zinc-Silicon and Copper-Nickel-Silicon Alloys: Rod, Wire, Strip, Sheet, Bar and Plate.
- QQ-N-281 - Nickel-Copper Alloy Bar, Plate, Rod, Sheet, Strip, Wire, Forgings and Structural and Special Shaped Sections.
- QQ-N-286 - Nickel-Copper-Aluminum Alloy, Wrought.
- QQ-P-416 - Plating, Cadmium (Electrodeposited).
- QQ-Z-325 - Zinc Coating, Electrodeposited, Requirements For.
- PPP-H-1581 - Hardware (Fasteners and Related Items), Packaging and Packing for Shipment and Storage of.

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Military

- MIL-I-6866 - Inspection, Penetrant Method of.
- MIL-I-6868 - Inspection Process, Magnetic Particle.
- MIL-H-6875 - Heat Treatment of Steels (Aircraft Practice) Process For.
- MIL-S-7742 - Screw Threads, Standard, Optimum Selected Series: General Specification For.
- MIL-B-24059 - Bronze, Nickel-Aluminum; Rod, Flat Products with Finished Edges, Shapes and Forgings.
- MIL-C-45662 - Calibration Systems Requirements.
- MIL-C-81562 - Coating, Cadmium and Zinc (Mechanically Deposited).

STANDARDS

Military

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-109 - Quality Assurance Terms and Definitions.
- MIL-STD-1312 - Fasteners, Test Methods.
- MS18116 - Bolt, Bolt-Stud, Stud, Stud-Bolt; Nickel-Copper-Aluminum Alloy (K-Monel); Special Requirements.
- MS51975 - Screw, Shoulder - Socket Head, Hexagon, Alloy Steel, Cadmium Plated, UNC-3A.

(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.)

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.

National Bureau of Standards (NBS) Handbook:

H28, Part I - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.)

American National Standards Institute (ANSI) Standards:

- ANSI B18.3 - Socket Cap, Shoulder and Set Screws.
- ANSI B46.1 - Surface Texture.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, N. Y. 10018.)

American Society for Testing and Materials (ASTM) Standards:

ASTM A370 - Mechanical Testing of Steel Products.
ASTM A574 - Alloy Steel Socket Head Cap Screws.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.)

3. REQUIREMENTS

3.1 Material. Socket-head shoulder screws shall be made from the following materials, unless otherwise specified (see 6.2).

3.1.1 Alloy steel. Alloy steel shoulder 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 3.3.1.

3.1.2 Non-ferrous material. Non-ferrous materials shall be as specified in Table IV.

3.2 Protective finish. Unless otherwise specified (see 6.2), screws shall be furnished uncoated. When specified (see 6.2), alloy steel screws shall have one of the following protective finishes.

3.2.1 Cadmium plating (Electrodeposited). Electrodeposited cadmium plating shall be Type II, Class 2 in accordance with QQ-P-416.

3.2.2 Cadmium coating (Mechanically deposited). Mechanically deposited cadmium coating shall be Type II, Class 2 in accordance with MIL-C-81562.

3.2.3 Zinc coating (Electrodeposited). Electrodeposited zinc coating shall be Type II, Class 3 in accordance with QQ-Z-325.

3.2.4 Zinc coating (Mechanically deposited). Mechanically deposited zinc coating shall be Type II, Class 3 in accordance with MIL-C-81562.

3.2.5 Other finishes. When protective finishes other than cadmium or zinc are required, they shall be as specified (see 6.2).

3.2.6 Hydrogen embrittlement. Electrodeposited alloy steel screws shall be subjected to a relief treatment in accordance with the applicable plating or coating specification, within 4 hours after plating or coating, to minimize the resulting embrittlement.

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3.3 Mechanical properties.

3.3.1 Alloy steel. Alloy steel screws shall meet the mechanical property requirements specified in Table I.

3.3.1.1 Hardness. Alloy steel screws shall have a Rockwell Hardness of C32-43 at the surface.

3.3.2 Non-ferrous material. Non-ferrous screws shall meet the mechanical property requirements specified in Table IV.

3.4 Metallographic requirements.

3.4.1 Carburization and decarburization. Alloy steel screws shall meet the carburization and decarburization limitations specified in ASTM A574.

3.4.2 Discontinuities. Alloy steel screws shall meet the discontinuities limitations specified in ASTM A574.

3.5 Design.

3.5.1 Dimensions and tolerances. Dimensions and tolerances shall be in accordance with ANSI B18.3 and MS51975. Dimensions shall apply after plating or coating.

3.5.2 Threads. Unless otherwise specified (see 6.2), threads shall be Class 3A, UNC series in accordance with H28, Part I. Plated and coated Class 3A threads shall be as specified in the "Material Limits for Class 3A Coated Threads" in MIL-S-7742.

TABLE I

Mechanical Properties of Alloy Steel
Shoulder Screws

Nom. Size	Nom. Thread Size UNC-3A	Minimum Area Square Inches		Shear Strength Pounds-Min		Tensile Strength LBS-MIN <u>1/</u>
		Thread Neck	Shoulder	Single <u>2/</u>	Double <u>3/</u>	
.250	.190-24	.0139	.0475	1,170	7,980	1,950
.3125	.250-20	.0260	.0748	2,180	12,550	3,640
.375	.3125-18	.0441	.1081	3,700	18,150	6,170
.500	.375-16	.0665	.1932	5,580	32,450	9,310
.625	.500-13	.1238	.3029	10,400	50,900	17,300
.750	.625-11	.1979	.4371	16,600	73,400	27,700
1.000	.750-10	.2980	.7791	25,000	130,900	41,700
1.250	.875-9	.4140	1.2194	34,800	204,850	58,000

NOTES:

1. Ultimate tensile strength is based on a stress of 140,000 PSI Min and the minimum thread neck area.
2. Single shear strength is based on a stress of 84,000 PSI Min and the minimum thread neck area.
3. Double shear strength is based on a stress of 84,000 PSI Min and twice the minimum shoulder area.

3.6 Surface roughness. The surface roughness of the shoulder diameter of the screw shall not exceed 32 micro-inches RHA (Roughness Height Average). The surface roughness of all other surfaces of the screw, excluding the top and side of the head and flat point, shall not exceed 125 micro-inches RHA. The RHA values shall be interpreted in accordance with ANSI B46.1.

3.7 Workmanship. Screws shall be free from burrs, seams, laps, loose scale, irregular surfaces and any other defects which may affect their serviceability.

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

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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.

4.1.1 Definitions. Quality assurance terms and definitions are in accordance with MIL-STD-109.

4.1.2 Inspection Equipment and Facilities. Inspection equipment and facilities shall be established and maintained in accordance with MIL-C-45662.

4.2 Sampling for lot acceptance.

4.2.1 Lot. A lot shall consist of all shoulder screws of the same material, protective finish and size, produced by the same manufacturer under essentially the same conditions and offered for acceptance at any one 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.

4.2.3 Sampling for tests (except protective finish test). A random sample of screws shall be taken from each lot in accordance with Table II. Any one defective screw in a sample shall cause rejection of the lot represented by the sample.

TABLE II

<u>Lot Size</u>	<u>Sample Size</u>
2-50	2
51-500	3
501-35,000	5
Over 35,000	8

4.2.4 Sampling for protective finish. Sampling for tests of protective finish shall be in accordance with the applicable specification of 3.2.

4.2.5 Sampling of examination of packaging and packing. Sampling for examination and test of preservation, packaging, packing and marking shall be in accordance with PPP-H-1581.

4.3 Examination.

4.3.1 Visual and dimensional. 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. 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 sample, the lot represented by the sample shall be rejected.

TABLE III

Classification of Defects

<u>Categories</u>	<u>Defects</u>	<u>Inspection Method</u>
Critical	None defined	
Major	AQL = 2.5 percent defective	
101	Discontinuities (3.4.2)	Visual (see note)
102	Threads not as specified (3.5.2)	SIE*
103	Socket dimensions, not as specified (3.5.1)	SIE
104	Concentricity not as specified (3.5.1)	SIE
105	Shoulder diameter not as specified (3.5.1)	SIE
106	Shoulder length not as specified (3.5.1)	SIE
Minor	AQL = 4.0 percent defective	
201	Other dimensions not as specified (3.5.1)	SIE
202	Protective finish missing or incomplete (3.2)	Visual
203	Surface roughness not as specified (3.6)	SIE

* SIE = Standard Inspection Equipment

NOTE: If visual examination reveals cracks or seams, total lot examination shall be made by nondestructive testing in accordance with MIL-I-6866 or MIL-I-6868, as applicable. A referee sample of three screws shall be selected from the suspected parts, and metallurgical examination at 50X magnification shall be made to determine the extent and depth of the discontinuities. See 3.4.2 for limits.

4.3.2 Inspection of preparation for delivery. Preservation, packaging, packing and marking shall be inspected to determine conformance with the applicable requirements of Section 5 of this specification.

4.4 Test procedures.

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4.4.1 Hardness. Samples selected as specified in 4.2.3 shall be subjected to a hardness test to determine compliance with 3.3.1.1. The test shall be conducted in accordance with MIL-STD-1312, Test No. 6, on a clean, flat surface, capable of sustaining the load imposed by the hardness tester.

4.4.2 Tensile strength. When specified (see 6.2), samples selected as specified in 4.2.3 shall be subject to a tensile strength test to determine compliance with 3.3.1. The test shall be conducted in accordance with MIL-STD-1312, Test No. 8.

4.4.3 Double shear strength. Samples selected as specified in 4.2.3 shall be subjected to a double shear strength test to determine compliance with 3.3.1. The test shall be conducted in accordance with MIL-STD-1312, Test No. 13, with the following requirements. The shear plane shall be at least one screw diameter away from the end of the screw shoulder. Clearance between the loading and supporting members shall be 0.005 inch maximum. Hardness of the loading and supporting members shall be Rockwell C55 minimum. The holes for the screws shall have sharp edges and shall be the same size as the shoulder diameter of the screw.

4.4.4 Metallographic. When specified (see 6.2), samples taken as specified in 4.2.3 shall be tested to determine compliance with 3.4.1. The test shall be conducted in accordance with ASTM A574.

4.4.5 Ductility (Non-ferrous screws). Samples taken as specified in 4.2.3 shall be tested for elongation to determine compliance with 3.3.2. The test shall be conducted in accordance with ASTM A370 on a turned shank specimen having dimensions equal to the largest practical specimen which can be made from the screw.

4.4.6 Protective finish. Test of protective finishes shall be conducted in accordance with the applicable specification of 3.2.

4.4.7 Hydrogen embrittlement. The contractor shall furnish the Government certification that electrodeposited alloy steel screws have been subjected to the hydrogen embrittlement relief treatment specified in 3.2.6. When specified (see 6.2), electrodeposited alloy steel screws shall be subjected to a stress durability test in accordance with MIL-STD-1312, Test No. 5. The screws shall be held under load for 23 hours.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be level A or C, as specified (see 6.2), in accordance with PPP-H-1581.

5.2 Packing. Packing shall be level A, B or C, as specified (see 6.2), in accordance with PPP-H-1581.

5.3 Marking. Marking of unit packages and shipping containers shall be in accordance with PPP-H-1581.

6. NOTES

6.1 Intended use. Shoulder screws are intended for use in punch and die operations such as location and retention of spring strippers of press tools, and as fulcrums or pivots in machine design that involve links, levers or other oscillating parts.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification.
- b. Military Standard part number, if applicable.
- c. Material (3.1).
- d. Protective finish (3.2).
- e. Size, length and threads (3.5).
- f. Tests, when required (4.4.2, 4.4.4, 4.4.7).
- g. Selection of applicable level of preservation, packaging and packing (5.1, 5.2).

Custodians:

Army - WC
Navy - AS
Air Force - 82

Reviewer Interest

Army - ME, MU
Navy - OS
Air Force - None
DSA - IS
NSA

Preparing activity:

Army - WC

Project No. 5305-0818

User Interest

Army - AT, AV, GL
Navy - MC
Air Force - None

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Table IV
Mechanical Properties of Non-Ferrous
Shoulder Screws

Material	Applicable Document	Composition Or Class	Condition	Ultimate Tensile Strength Psi. Min	Yield Strength Psi. Min	Elongation ^{1/} Percent Min
Manganese Bronze	QQ-B-728	Class A	Soft	55,000	22,000 ^{3/}	20
Nickel-Aluminum Bronze	MIL-B-24059		Extruded and Annealed	90,000	37,000 ^{3/}	18
Phosphor Bronze	QQ-B-750	Comp. A	Hard	60,000	35,000 ^{2/}	15
Silicon Bronze	QQ-C-591	Copper Alloy No. 651	Hard	60,000	40,000 ^{3/}	10
Naval Brass	QQ-B-637	Comp. 1	Half Hard	60,000	27,000 ^{3/}	25
Nickel-Copper Alloy	QQ-N-281	Class A		80,000	40,000 ^{2/}	20
Nickel-Copper Aluminum Alloy	QQ-N-286 MS18116	Class A	Age Hardened MS18116	130,000	90,000 ^{2/}	20

^{1/} In 4D gage length.

^{2/} 0.2 percent offset.

^{3/} 0.5 percent extension under load.

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

1. TITLE

2. ORGANIZATION

3. CITY AND STATE

CONTRACT NUMBER

4. PROCUREMENT ORDER NUMBER

 GOVERNMENT CONTRACT SUBCONTRACT

5. WHICH PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT?

A. QUOTE PARAGRAPH NUMBER AND WORDING:

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES:

6. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

7. IS THE SPECIFICATION RESTRICTIVE?

 YES NO (If "yes", in what way?)

8. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

9. SIGNATURE (Printed or typed name and activity - Optional)

DATE

DD FORM 1426

REPLACES EDITION OF 1 OCT 54 WHICH MAY BE USED.

To detach this form, cut along this line.