

FED. SUPPLY CLASS

5307

1. SCOPE

- 1.1 Scope. This specification covers the requirements for locked-in studs. The method of locking in the stud is by means of a serrated collar and an accessory locking with matching serrations installed within the parent material to prevent rotation.

2. APPLICABLE DOCUMENTS

2.1 Government documents

- 2.1.1 Specifications, standards and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

Federal

QQ-A-225/6 ~~Aluminum Alloy Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, 2024.~~
QQ-A-250/6 ~~Aluminum Alloy 5083, Plate and Sheet.~~

Military

MIL-STD-2073/1 Standard Practice for Military Packaging.
MIL-S-6049 ~~Steel, Chrome Nickel Molybdenum (8740) Bars, Rods, and Forging Stock (For Aircraft Applications).~~
MIL-S-6758 ~~Steel, Chrome Molybdenum (4130) Bars and Reforging stock (Aircraft Quality).~~
MIL-S-7742 Screw Threads, Standard, Optimum Selected Series: General Specification for.
MIL-A-8625 Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-T-9047 ~~Titanium and Titanium Alloy Bars (Rolled or Forged) and Reforging Stock, Aircraft Quality.~~
MS51995 Fasteners, Ring Locked Inserts and Studs, Installation and Replacement of.
MS51999 Stud, Locked In - Ring Locked, Serrated, Design and Usage Limitations for.

STANDARDS

Federal

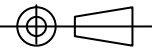
FED-STD-H28/2 Screw-Thread Standards for Federal Services, Section 2, Unified Inch Screw Threads UN and UNR Thread Forms.
FED-STD-H28/20 Screw Threads Standards for Federal Services, Section 20, Inspection Methods for Acceptability of UN, UNR, UNJ, M and MJ Screw-Threads.

(Copies can be obtained from the Department of Defense Single Stock Point (DODSSP) <http://dodssp.daps.dla.mil>.)

- 2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

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THE INITIAL RELEASE OF THIS DOCUMENT SUPERSEDES MIL-S-45909, REVISION C. PART NUMBERS REMAIN M45909.

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FORM 09-01

REVISION DATE: AUGUST 26, 2011

ISSUE DATE: NOVEMBER 1999

ASTM International

ASTM E1742	Inspection, Radiographic
ASTM E1444	Inspection, Magnetic Particle
ASTM E1417	Inspection, Liquid Penetrant
ASTM D3951	Standard Practice for Commercial Packaging
ASTM E8/E8M	Tension Testing of Metallic Materials

(Copies can be obtained from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA www.astm.org)

Aerospace Industries Association (AIA)

NASM1312	Fastener Test Methods
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(Copies can be obtained from the Aerospace Industries Association, 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209 www.aia-aerospace.org)

SAE International

AMS2801	Heat Treatment of Titanium Alloy Parts
AMS6930	Titanium Alloy Bars, Forgings and Forging Stock 6.0Al - 4.0V Solution Heat Treated and Aged (UNS R56400)
AMS6931	Titanium Alloy Bars, Forgings and Forging Stock 6.0Al - 4.0V Annealed (UNS R56400)
AMS-S-6758	Steel, Chrome-Molybdenum (4130) Bars and Reforging stock (Aircraft Quality)
AMS6322	Steel Bars, Forgings, and Rings .50Cr-.55Cr-.55 Ni-.25Mo (.38-.43C) (SAE 8740)
AMS6325	Steel Bars and Forgings .50Cr-.55Ni-.25Mo (.28-.43C) (SAE 8740) Heat Treated, 105 KSI (724 MPa) Tensile Strength
AMS6327	Steel Bars and Forgings, .50Cr-.55Ni-.25Mo (.38-.43C) (SAE 8740) Heat Treated, 125 KSI (862 MPa) Tensile Strength
AS8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification for
AMS-H-81200	Heat Treatment of Titanium and Titanium Alloys
AMS-QQ-P-416	Plating, Cadmium (Electrodeposited)
AMS2700	Passivation Treatments for CRES
AMS2759	Heat Treatment of Steel Parts
AMS2401	Cadmium Plating, Low Hydrogen Content Deposit
AMS2488	Anodic Treatment of Titanium and Titanium Alloys
AMS4967	Titanium Alloy Bars, Forgings, and Rings
AMS5622	Alloy Bars, Forgings, and Rings, Corrosion and Heat Resistant
AMS5731	Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant
AMS5734	Steel Bars, Forgings, and Tubing, Corrosion and Heat Resistant
AMS6322	Steel Bars, Forgings, and Rings
AMS-QQ-A-225/6	Aluminum Alloy Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, 2024
AMS-QQ-A-250/6	Aluminum Alloy 5083, Plate and Sheet

(Copies can be obtained from SAE International, 400 Commonwealth Dr., Warrendale, PA 15096-0001 www.sae.org)

ASME

ASME B46.1	Surface Texture (Surface Roughness, Waviness and Lay)
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(Copies can be obtained from ASME, Three Park Ave., New York, NY 10016-5990 www.asme.org)

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Document Sharing Hub

American Society for Quality

ANSI/ASQ Z1.4 Sampling Procedures And Tables For Inspection By Attributes

(Copies can be obtained from the American Society for Quality, 600 North Plankinton Ave., Milwaukee, WI 53203
www.asq.org)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other information services.)

- 2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS/AS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained in which case the exception will be identified in the text and cited in the solicitation.

3. REQUIREMENTS

- 3.1 MS/AS sheets. The individual item requirements shall be as specified herein and in accordance with the applicable MS/AS sheet. In the event of any conflict between the requirements of this specification and the MS/AS sheet, the latter shall govern.
- 3.2 Material. Recycled and reclaimed materials (see 3.1) shall be used to the maximum extent practicable. The stud shall be a one piece, all metal unit, made from the following materials as specified in the applicable MS/AS sheet (see 3.1) when inspected in conformance with 4.6.2.
- 3.2.1 Alloy steel. Alloy steel shall be Grade 4130 (UNS G41300) in accordance with AMS-S-6758 or Grade 8740 (UNS G87400) in accordance with ~~MIL-S-6049~~ AMS6322, AMS6325, or AMS6327.
- 3.2.2 CRES. Corrosion and heat resistant steel shall be type A286 (UNS S66286) in accordance with AMS5731 or AMS5734.
- 3.2.2.1 Nickel base alloy. Nickel base alloy shall be corrosion and heat resistant type 718 (UNS N07718) in accordance with AMS5662.
- 3.2.3 Titanium alloy. Titanium alloy shall be type Ti-6Al-4V (UNS R56400) in accordance with ~~MIL-T-9047~~ AMS6930, AMS6931, or AMS4967.
- 3.3 Heat treatment. The stud shall be heat treated in accordance with AMS2759 or AMS-H-81200 as applicable and shall develop the mechanical properties specified herein when inspected in conformance with 4.10.
- 3.4 Protective finish or surface treatment. The stud shall be furnished with a protective plating or surface treatment as specified in the applicable MS/AS sheet (see 3.1) when inspected in conformance with 4.6.3.
- 3.4.1 Alloy steel. Alloy steel studs heat treated below 180 KSI Ft_u shall be cadmium plated in accordance with AMS-QQ-P-416, Type II, Class 3. Alloy steel studs heat treated 180 KSI Ft_u or greater shall be cadmium plated in accordance with AMS2401.
- 3.4.2 CRES. CRES studs shall be passivated in accordance with AMS2700, Method 1, Class 4.
- 3.4.3 Titanium alloy. None required. Anodic treatment per AMS2488, Type 2 when specified on applicable MS/AS sheet (see 3.1).
- 3.5 Design, dimensions and tolerance. Design, dimensions and tolerances shall conform to the requirements of the applicable MS/AS sheet (see 3.1) and shall apply after application of the protective finish and surface treatment specified in 3.4.

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- 3.5.1 **Threads.** Threads shall be right hand in accordance with the applicable MS/AS sheet (see 3.1).
- 3.5.1.1 **Nut end threads.** Nut end threads shall conform to MIL-S-7742 or AS8879 as specified in the applicable MS/AS sheet (see 3.1). Acceptability of threads shall be in accordance with FED-STD-H28/20, system 21.
- 3.5.1.2 **Stud end threads.** Stud end threads shall conform to FED-STD-H28/2. Pitch diameter and minor diameter shall be as specified in the applicable MS/AS sheet (see 3.1). Acceptability of threads shall be in accordance with FED-STD-H28/20, system 21.
- 3.5.1.3 **Thread forming.** Threads for nut end shall be fully formed by a single rolling process. Threads for stud end may be produced either by machining, grinding, or fully formed by a single rolling process.
- 3.5.1.4 **Incomplete threads.** The runout threads shall be faired into the shank within a minimum of one and a maximum of two pitches without an abrupt change in cross sectional area. Lead thread shall not exceed two pitches. The root and flanks of the runout thread may deviate from true thread form but shall be smooth and free of tool marks.
- 3.5.1.5 **Grain flow.** The grain flow in rolled threads shall follow the general thread contour with the maximum density at the bottom of the root radius as shown in Figure 1.

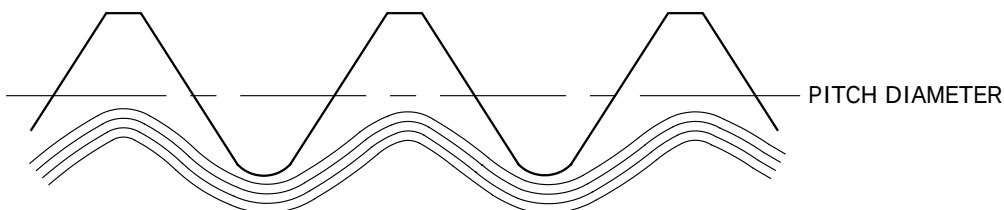


FIGURE 1 – THREAD GRAIN FLOW

- 3.5.2 **Locking serrations.** Locking serration dimensions shall conform in size to the applicable MS/AS sheet part number (see 3.1) and shall be of full form.
- 3.5.3 **Surface texture.** The surface texture of the stud prior to plating shall not exceed the values specified in the applicable MS/AS sheet (see 3.1) and shall be in accordance with ASME B46.1 when tested in accordance with 4.6.6.
- 3.5.4 **Straightness.** The straightness of the stud shall be within the values specified in Table I when tested in accordance with 4.6.5.

TABLE I – STRAIGHTNESS

STUD SIZE NUT END	DEVIATION OF STUD FROM PLATE, MAX (INCHES PER INCH OF STUD NUT END LENGTH)
.1900 and smaller	.0040
.2500 thru .3125	.0030
.3750 thru .4375	.0025
.5000 and larger	.0020

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- 3.6 Mechanical properties. Studs conforming to the design and dimensions specified in the applicable MS/AS sheet (see 3.1) and having load ratings as specified in Table II shall be capable of developing a minimum tensile strength, a minimum proof strength, and have a minimum shear engagement areas in accordance with Table II.

TABLE II – MECHANICAL PROPERTIES

LOAD RATINGS KSI	MINIMUM TENSILE STRENGTH KSI	MINIMUM PROOF STRENGTH KSI	MINIMUM SHEAR ENGAGEMENT AREA (STUD END)		
			MS51497		
			500 NUMBERS	640 NUMBERS	800 NUMBERS
140	140	95	TABLE V COL 1	TABLE V COL 2	TABLE V COL 3
160	160	130			
180	180	145			

LOAD RATINGS KSI	MINIMUM TENSILE STRENGTH KSI	MINIMUM PROOF STRENGTH KSI	MINIMUM SHEAR ENGAGEMENT AREA (STUD END)					
			MS51551					
			100 NUMBERS	100A NUMBERS	100B NUMBERS	200 NUMBERS	200A NUMBERS	200B NUMBERS
125	125	75	TABLE V COL 4	TABLE V COL 5	TABLE V COL 6	TABLE V COL 7	TABLE V COL 8	TABLE V COL 9
140	140	95						
160	160	130						

LOAD RATINGS KSI	MINIMUM TENSILE STRENGTH KSI	MINIMUM PROOF STRENGTH KSI	MINIMUM SHEAR ENGAGEMENT AREA (STUD END)	
			MS51989	
			100 & 300 NUMBERS	200 & 400 NUMBERS
125	125	75	TABLE V COL 10	TABLE V COL 11

LOAD RATINGS KSI	MINIMUM TENSILE STRENGTH KSI	MINIMUM PROOF STRENGTH KSI	MINIMUM SHEAR ENGAGEMENT AREA (STUD END)		
			MS51992		
			500 NUMBERS	640 NUMBERS	800 NUMBERS
140	140	95	TABLE V COL 12	TABLE V COL 13	TABLE V COL 14
160	160	130			
180	180	145			

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3.6.1 **Tensile strength.** The stud shall develop the minimum axial load listed in Table III when tested as specified in 4.7.1.

TABLE III – MINIMUM TENSILE STRENGTH OF STUDS (NUT END)

NOMINAL SIZE (NUT END)	TENSILE STRESS AREA (IN ²) /a/		MINIMUM AXIAL LOAD (LBF) /b/							
			MS51551			MS51989		MS51497 & MS51992		
	COARSE THREAD	FINE THREAD	125 KSI UNJF	140 KSI UNJF	160 KSI UNJF	125 KSI		140 KSI UNJF	160 KSI UNJF	180 KSI UNJF
.1380	.0091	.0101	—	—	—	1,140	1,260	—	—	—
.1640	.0140	.0147	1,840	2,060	2,350	1,750	1,840	—	—	—
.1900	.0175	.0200	2,500	2,800	3,200	2,190	2,500	2,800	3,200	3,600
.2500	.0318	.0364	4,550	5,100	5,800	4,000	4,550	5,100	5,800	6,550
.3125	.0524	.0580	7,300	8,100	9,200	6,600	7,300	8,100	9,200	10,400
.3750	.0775	.0878	11,000	12,300	14,000	9,700	11,000	12,300	14,000	15,800
.4375	.1063	.1187	14,800	16,600	19,000	13,300	14,800	16,600	19,000	21,400
.5000	.1419	.1599	20,000	22,400	25,600	17,700	20,000	22,400	25,600	28,800
.5625	.182	.203	—	—	—	22,700	25,400	—	—	—
.6250	.226	.256	—	—	—	28,200	32,000	35,800	41,000	46,100
.7500	.334	.373	—	—	—	41,700	46,600	—	—	—

/a/ The tensile stress areas used for the calculation of the axial load values are based on the stress area per formula specified in FED-STD-H28/2.

/b/ The minimum axial loads shown are the applicable tensile stress areas multiplied by the appropriate load rating.

3.6.2 **Proof load.** The stud shall be capable of withstanding proof loads as specified in Table IV when tested in accordance with 4.7.1.

TABLE IV – PROOF LOAD FOR STUDS (NUT END)

NOMINAL SIZE (NUT END)	TENSILE STRESS AREA (IN ²) /c/		MINIMUM PROOF LOAD (LBF) /d/							
			MS51551			MS51989		MS51497 & MS51992		
	COARSE THREAD	FINE THREAD	75 KSI UNJF	95 KSI UNJF	130 KSI UNJF	75 KSI		95 KSI UNJF	130 KSI UNJF	145 KSI UNJF
.1380	.0091	.0101	—	—	—	680	760	—	—	—
.1640	.0140	.0147	1,100	1,400	1,911	1,050	1,100	—	—	—
.1900	.0175	.0200	1,500	1,900	2,600	1,310	1,500	1,900	2,600	2,900
.2500	.0318	.0364	2,750	3,450	4,700	2,400	2,750	3,450	4,700	5,250
.3125	.0524	.0580	4,400	5,500	7,500	3,900	4,400	5,500	7,500	8,400
.3750	.0775	.0878	6,600	8,300	11,400	5,800	6,600	8,300	11,400	12,700
.4375	.1063	.1187	8,900	11,300	15,400	8,000	8,900	11,300	15,400	17,200
.5000	.1419	.1599	12,000	15,200	20,800	10,600	12,000	15,200	20,800	23,200
.5625	.182	.203	—	—	—	13,600	15,200	—	—	—
.6250	.226	.256	—	—	—	16,900	19,200	24,300	33,300	37,100
.7500	.334	.373	—	—	—	25,000	28,000	—	—	—

/c/ The tensile stress areas used for the calculation of the axial load values are based on the stress area per formula specified in FED-STD-H28/2.

/d/ The minimum proof loads shown are the applicable tensile stress areas multiplied by the appropriate load rating.

3.6.3 **Resistance to pullout.** the stud shall demonstrate minimum shear engagement areas as specified in Table V. The installed stud with locking in place as specified in 4.1.3 shall have a minimum resistance to pullout in accordance with Table VI. Values specified in Table VI are based on the minimum shear engagement areas of the stud (Table V) when installed in a test block of 25 KSI shear strength and tested in accordance with 4.7.2.