SAE Aerospace
An SAE International Group

METRIC AEROSPACE STANDARD

SAE MA4368

Issued 1990-08
Reaffirmed 2012-12

Nut, Plain, Round - Spanner Wrenching, Shaft Mounted, UNS S66286, Procurement Specification For, Metric

FSC 5310

RATIONALE

MA4368 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 Type:

This procurement specification covers aircraft quality metric spanner nuts for retaining shaft mounted parts. Nuts are made from a corrosion and heat resistant age hardenable iron base alloy of the type identified under the Unified Numbering System as UNS S66286, and silver plated. Thread shear proof strength at room temperature is 450 MPa.

1.2 Application:

Primarily for aerospace propulsion system applications to retain parts on shafts where a good resistance to relaxation is required.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other documents shall be the issue in effect on the date of the purchase order.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1.1 Aerospace Material Specifications:

AMS-2410	Plating, Silver, Nickel Strike, High Bake
AMS-2411	Plating, Silver, For High Temperature Applications
AMS-2645	Fluorescent Penetrant Inspection
AMS-2759/3	Heat Treatment of Precipitation Hardening Corrosion Resistant and Maraging Steel Parts

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/MA4368

2.1.1.1 (Continued):

AMS-5731	Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 980°C (1800°F) Solution Heat Treated
AMS-5732	Steel Bars, Wire, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 980°C (1800°F) Solution and Precipitation Heat Treated
AMS-5734	Steel Bars, Forgings, and Tubing, Corrosion and Heat Resistant, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 900°C (1650°F) Solution Heat Treated
AMS-5737	Steel Bars, Wire, Forgings, and Tubing, Corrosion and Heat Resistant, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 900°C (1650°F) Solution and Precipitation Heat Treated

2.1.1.2 Aerospace Standards:

MA1370	Screw Threads - MJ Profile, Metric
MA1566	Gaging Practice and Gage Requirements

2.1.2 ASTM Publication: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 112 - Determining Average Grain Size

2.1.3 ANSI Publication: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

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

2.1.4 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.1.4.1 Military Standards:

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-1312	Fasteners, Test Methods
MIL-STD-2073-1	DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be AMS-5731 or AMS-5734 solution heat treated stock or AMS-5732 or AMS-5737 steel, as specified on the part drawing.

3.2 Design:

Finished (completely manufactured) parts shall conform to the following requirements:

3.2.1 Dimensions: The dimensions of finished parts, after all processing including plating, shall conform to the part drawing. Dimensions apply after plating but before coating with dry film lubricants.

3.2.1.1 Bearing Surface Perpendicularity: Shall be as specified on the part drawing relative to the thread pitch cylinder axis.

3.2.1.2 Geometric Tolerances: Part features shall be within the geometric tolerance specified on the part drawing when tested by conventional measuring methods.

3.2.2 Surface Texture: Surface texture of finished parts, prior to plating, shall conform to the requirements as specified on the part drawing, determined in accordance with ANSI/ASME B46.1.

3.2.3 Threads: Metric screw thread MJ profile and dimensions in accordance with MA1370.

3.2.3.1 Countersink: The entering end of the thread at the bearing surface and the opposite end of the thread shall be countersunk as specified on the part drawing.

3.2.3.2 Plated Threads: Unless otherwise specified on the part drawing, thread dimensions prior to plating shall meet the before coating thread limits for the standard G coating allowance. After coating, the material limits for standard MJ threads with H allowance shall apply.

3.3 Fabrication:

3.3.1 Blanks: Blanks shall be machined sufficiently to remove surface defects.

3.3.2 Heat Treatment: Threaded blanks made from AMS-5731 or AMS-5734 solution heat treated stock shall, before finishing the bearing surface, be heat treated as follows:

3.3.2.1 Heating Equipment: Shall be in accordance with AMS-2759/3.

3.3.2.2 Solution Heat Treatment: Formed blanks of AMS-5731 or AMS-5734, before threading and finishing the bearing surface, shall be solution heat treated at 980°C for AMS-5731 or 900°C for AMS-5734 in accordance with AMS-2759/3.

3.3.2.3 Precipitation Heat Treatment: All blanks, before finishing the bearing surface except those of AMS-5732 and AMS-5737, shall be precipitation heat treated in accordance with AMS-2759/3.

3.3.3 Bearing Surface: Bearing surface shall be finish machined on the heat treated and threaded blanks to produce the perpendicularity and surface texture requirements as in 3.2.1.1 and 3.2.2.

3.4 Product Marking:

Each part shall be identification marked as specified on the part drawing. Depressed characters shall have a rounded root form, depressed 0.25 mm maximum.

3.5 Plating:

Unless otherwise specified on the part drawing, parts shall be silver plated in accordance with AMS-2410 or AMS-2411 on the bearing surface and thread, on other surfaces plating is optional. The plating on the thread shall be not less than 5 μm thick when measured on the pitch diameter. Microscopic measurement of a sectioned nut shall be used as the referee method. Plating on the bearing surface shall be 8 to 15 μm thick, unless otherwise specified on the part drawing.

3.6 Mechanical Properties:

3.6.1 Thread Axial Shear Strength: Parts, assembled on an externally threaded alloy steel fixture, hardened and tempered not lower than 40 HRC, 371 HB, or 392 HV, shall withstand at room temperature an axial tensile load, tested in accordance with DOD-STD-1312-108, that induces an axial shear stress in the nut thread not less than 450 MPa without rupture, stripping or appearance of cracks. Area upon which stress for axial shear strength load requirements is based is the area of the minimum pitch cylinder of the nut thread for a length (Le) equal to one-half the nut threaded length (excluding the depth of face wrenching slots, if applicable), calculated from Equation 1:

$$A = 3.1416 D_2 (Le/2) \quad \text{(Eq. 1)}$$

where:

A = nut thread shear area, mm^2
D_2 = nut thread minimum pitch diameter, mm
Le = nut threaded length minus depth of face wrenching slots, if applicable, mm

Tensile test load requirements is based on 450 MPa shear stress induced in nut thread shear area, calculated from Equation 2:

$$L = (A \times 450\ MPa)/1000 \quad \text{(Eq. 2)}$$

where:

L = tensile test load in kN
A = nut thread shear area, mm^2

3.6.2 Hardness: Unless otherwise specified on the part drawing, the hardness after heat treatment as in 3.3.2 shall be uniform and within the range of 24 to 39 HRC, 247 to 362 HB, or 260 to 382 HV when tested in accordance with MIL-STD-1312-6.

3.7 Metallurgical Properties:

3.7.1 Microstructure: Shall have microstructure of completely recrystallized material.

3.7.2 Grain Size: Shall be predominantly five or finer with occasional grains as large as two as determined by comparison of a polished and etched specimen with ASTM E 112 plate 2. In case of disagreement on grain size by the comparison method, the intercept (Heyn) procedure shall be used.

3.8 Quality:

Parts shall be uniform in quality and condition, clean, sound, and free from burrs and foreign materials and imperfections detrimental to their performance.

3.8.1 Fluorescent Penetrant Inspection: Parts shall be subject to fluorescent penetrant inspection in accordance with AMS-2645. Parts shall be free of cracks, seams, inclusions, and flaws.

3.8.2 Internal Defects: Etched specimens of transverse sections of parts or section of parts examined at approximately 20X magnification shall reveal no cracks, laps, or porosity.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of parts shall supply all samples and shall be responsible for performing all required tests. Purchaser reserves the right to perform such confirmatory testing as deemed necessary to ensure that the parts conform to the requirements of this specification.

4.2 Classification of Tests:

Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each production inspection lot.

4.3 Production Inspection Lot:

A production inspection lot shall be all finished parts of the same part number, made from a single heat of alloy, heat treated at the same time to the same specified condition, produced as one continuous run, and submitted for vendor's inspection at the same time.

4.3.1 Acceptance Tests: The acceptance tests consist of all the tests specified in Table 1.

TABLE 1 - Summary of Acceptance Tests

Characteristic	Req. Para.	Sample Size	Test Method
Destructive Tests			
Thd Axial Shear Strength	3.6.1	Table IV, Col B	DOD-STD-1312-108
Hardness	3.6.2	Table IV, Col B	MIL-STD-1312-6
Microstructure	3.7.1	Table IV, Col B	Microscopic exam. 100X
Grain Size	3.7.2	Table IV, Col B	Microscopic exam. with chart in ASTM E 112
Plating	3.5	Table IV, Col B	Microscopic measurement of sectioned nut
Internal Defects	3.8.2	Table IV, Col B	Macroscopic exam. per 3.8.2
Non-Destructive Tests			
Dimensions	3.2.1	Tables II & III	Conventional measuring methods
Bearing Surface Squareness	3.2.1.1	Tables II & III	Conventional measuring methods
Geometric Tolerances	3.2.1.2	Tables II & III	Conventional measuring methods
Surface Texture	3.2.2	Tables II & III	Per ANSI/ASME B46.1 by visual or fingernail comparison with std texture specimens. In case of conflict, stylus instrument may be used if surface is accessible.
Thread Size	3.2.3	Tables II & III	Gaging methods per MA1566
Product Marking	3.4	Tables II & III	Visual examination
Workmanship	3.8	Tables II & III	Visual examination
Fluorescent Penetrant Inspection	3.8.1	Tables II & III	Inspection per AMS-2645 Criteria per 3.8.1
Packaging & Identification	5.1	100 %	Visual examination

Note: The same test sample may be used for more than one test provided that none of the characteristics of the samples are altered during the test procedure.

4.3.2 Acceptance Test Sampling:

4.3.2.1 Nondestructive Test - Visual and Dimensional: A random sample will be selected from each production inspection lot; the size of the sample to be as specified in Table 2. The classification of defects for parts shall be as specified in Table 3. Defects not classified in Table 3 shall be classified as Minor B defects. All dimensional characteristics are considered defective when out of tolerance.

4.3.2.2 Hardness Test (see 3.6.2): A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table 4, Column B. The sample units may be selected from those that have been subjected to and passed the visual and dimensional inspection, with additional units selected at random from the production inspection lot as necessary.

4.3.2.3 Fluorescent Penetrant Inspection: A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table 2. The classification of defects for parts shall be as specified in Table 3.

4.3.2.4 Destructive Tests: A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table 4, Column B. The sample units may be selected from those that have been subjected to and passed the nondestructive tests with additional units selected at random from the production inspection lot as necessary.

4.3.3 Acceptance Quality: The acceptance quality level and acceptance number of defectives for the acceptance tests shall be as specified in Tables 2 and 4.

4.4 Reports:

The vendor of parts shall furnish with each shipment a copy of a report stating that the chemical composition of the parts conforms to the applicable material specification, showing the results of tests to determine conformance to the room temperature thread axial shear strength, hardness, and stating that the parts conform to the other technical requirements of this specification. This report shall include the purchase order number, lot number, MA4368, contractor or other direct supplier of material, part number, nominal size, and quantity.

4.5 Resampling and Retesting:

If any part or specimen used in the above tests fails to meet the specified requirements for mechanical properties, metallurgical properties, and quality as in 3.6, 3.7, and 3.8, disposition of the parts may be based on the results of testing three additional parts or specimens for each original nonconforming part or specimen. Failure of any retest part or specimen to meet the specified requirement shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

TABLE 2 - Sampling Data

Visual and Dimensional Characteristics
Sample Size, Acceptance Number (Ac) and Rejection Number (Re) for
AQL 0.15%, 1.0%, 2.5%, and 4.0%

Production Inspection Lot	0.15 % AQL			1.0 % AQL			2.5 % AQL			4.0 % AQL		
	Sample Size	Ac	Re	Sample Size	Ac	Re	Sample Size	Ac	Re	Sample Size	Ac	Re
25 & under	All	0	1	13	0	1	5	0	1	3	0	1
26 to 50	All	0	1	13	0	1	5	0	1	13	1	2
51 to 90	80	0	1	13	0	1	20	1	2	13	1	2
91 to 150	80	0	1	13	0	1	20	1	2	20	2	3
151 to 280	80	0	1	50	1	2	32	2	3	32	3	4
281 to 500	80	0	1	50	1	2	50	3	4	50	5	6
501 to 1200	80	0	1	80	2	3	80	5	6	80	7	8
1201 to 3200	80	0	1	125	3	4	125	7	8	125	10	11
3201 to 10000	315	1	2	200	5	6	200	10	11	200	14	15
10001 to 35000	315	1	2	315	7	8	315	14	15	315	21	22
35001 to 150000	500	2	3	500	10	11	500	21	22	315	21	22
150001 to 500000	800	3	4	800	14	15	500	21	22	315	21	22
500001 & over	1250	5	6	1250	21	22	500	21	22	315	21	22

Sample sizes listed above are based on single sampling plans for normal inspection per MIL-STD-105. It is permissible to use other sampling plans per MIL-STD-105 which provide the same quality protection. When sample size equals or exceeds the lot size, 100 % inspection is required.