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(R) Fastener Part Standard - Machine Screw Nuts (Metric and Inch)

RATIONALE

The ASME removed machine screw nuts from ASME B18.6.3 and added them to ASME B18.2.2. That change is now reflected in SAE J2485.

Section 1: Added statement about potential hazardous materials.

Section 2: Added new reference standards.

Section 3: Added a Definitions paragraph.

Section 4: Added caution on Black Oxide Coatings. Added requirements on phosphate coatings and zinc/aluminum inorganic coatings.

Figure 1: Field 3 Configuration added Designator F for hex flange nut.

Field 5 Platings and Coatings added Designators K = Manganese Phosphate Coating, P = Zinc Phosphate Coating, X = Zinc/Aluminum Inorganic Coating-No Chromium Permitted and ZA = Zinc with clear topcoat (Hexavalent chromium prohibited). Z = Zinc Electroplate allows ZA to be furnished. Designator C for cadmium coating is inactivated for new design. Designator A for Aluminum plating is deleted due to misidentification of the coating. Hexavalent chrome is now prohibited due to environmental and regulatory concerns.

Table 1: Reformatted to place Designators in alpha-numeric order. In accordance with industry practice, proof stress testing of machine screw nuts is no longer required.

Designator G steel expanded UNS compositions range to match standard production alloys.

Designators for CRES are reformatted. Designator S added alloy 302HQ and now identifies alloy XM7 as 18-9LW. New Designator S1 is added with 303 and 303Se free machining alloys. Designator S3 is added with 321 and 347 alloys. There is no change to current practice of allowing suppliers to choose the CRES alloy to be provided and this is noted. Hardness range of Designators in the S series is revised to align with ASTM F 594.

Designator C added copper alloys 260.

Designator C1 is added with naval brass alloys 462 and 464.

Designator T2 is added with titanium alloy 23, Ti-6Al-4V ELI.

Designator BN added "Grade 1" to alloy 686 and adjusted hardness and proof stress to match ASTM F 467.

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Section 5: Informational notes revised and added.

Minor editorial changes, clarifications and corrections made throughout.

1. SCOPE

This SAE Part Standard covers selected machine screw nuts manufactured in accordance with American Society for Mechanical Engineers (ASME) dimensional standards. This document covers material most often used in ship systems and equipment but its use may be applied wherever nuts of the covered materials are used. This document permits the nuts to be identified and ordered by a part identification number (PIN) as defined in this document.

1.1 Purpose

The purpose of this document is to assist the designer and other personnel in providing requirements and PINs for the most commonly used machine screw nuts. A PIN is normally required for all military applications and provides a useful means of communicating fastener requirements to suppliers and manufacturers in a very succinct manner.

1.2 Hazardous Materials

While the materials, methods, applications and processes described or referenced in this standard may involve the use of hazardous materials, this standard does not address the hazards that may be involved in such use. It is the responsibility of manufacturers and users to consult with officials on the applicable health and environmental regulations regarding the handling, use and disposal of hazardous materials. For nuts, some of the hazardous materials concerns are the application of the materials in platings (coatings), release of toxic vapors due to heat (for example, welding) and environmental regulations for disposal.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of all publications shall apply at date of purchase order.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE AMS2412	Plating, Silver, Copper Strike, Low Bake
SAE AMS2485	Coating, Black Oxide
SAE AMS2487	Anodic Treatment of Titanium and Titanium Alloys, Solution pH 12.4 Maximum
SAE AMS2488	Anodic Treatment - Titanium and Titanium Alloys, Solution pH 13 or Higher
SAE AS1701	Lubricant, Solid Film
SAE J2280	Ship Systems and Equipment - Fasteners - Selection and Identification Requirements
SAE J2295	Fastener Part Standard - Cap Screws, Structural Bolts, and Hex Nuts (Inch Dimensioned)
SAE J2295M	Fasteners-Part Standard - Cap Screws, Hex Bolts, and Hex Nuts (Metric)
SAE J2484	Fastener Part Standard - Machine Screws

2.1.2 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

- ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)
- ASME B1.3 Screw Thread Gaging Systems for Dimensional Acceptability - Inch and Metric Screw Threads (UN, UNR, UNJ, M and MJ)
- ASME B1.13M Metric Screw Threads - M Profile
- ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
- ASME B18.2.4.1 Metric Hex Nuts, Style 1
- ASME B18.12 Glossary of Terms for Mechanical Fasteners
- ASME B18.18 Quality Assurance for Fasteners

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

- ASTM A 29/A 29M Steel Bars, Carbon and Alloy, Hot Wrought, General Requirements for
- ASTM A 342/A 342M Standard Test Methods for Permeability of Feebly Magnetic Materials
- ASTM A 380 Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment, and Systems
- ASTM A 453/A453M High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels
- ASTM A 563 Carbon and Alloy Steel Nuts
- ASTM A 563M Carbon and Alloy Steel Nuts [Metric]
- ASTM B 580 Anodic Oxide Coatings on Aluminum
- ASTM F 467 Nonferrous Nuts for General Use
- ASTM F 467M Nonferrous Nuts for General Use [Metric]
- ASTM F 594 Stainless Steel Nuts
- ASTM F 812/F 812M Surface Discontinuities of Nuts, Inch and Metric Series
- ASTM F 836M Style 1 Stainless Steel Metric Nuts
- ASTM F 1136 Zinc/Aluminum Corrosion Protective Coatings for Fasteners
- ASTM F 1137 Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners

Field 3 – Configuration As defined in ASME B18.2.2 (inch products) and ASME B18.2.4.1M (metric products)

H = Hex

S = Square (Inch UNC threads only, Not recommended for new design)

F = Hex Flange

Field 4 - Nominal Diameter (The type thread in Field 2 determines whether diameter is in inch or metric units).

Inch - Indicate nominal size with one or two characters as required for sizes 0 through 12.

<u>Dia PIN</u>	<u>UNC</u>	<u>UNF</u>	<u>Diameter</u>	<u>Dia PIN</u>	<u>UNC</u>	<u>UNF</u>	<u>Diameter</u>
0	-----	0-80	0.0600	F4	1/4-20	1/4-28	0.2500
1	1-64	1-72	0.0730	F5	5/16-18	5/16-24	0.3125
2	2-56	2-64	0.0860	F6	3/8-16	3/8-24	0.3750
3	3-48	3-56	0.0990	F7	7/16-14	7/16-20	0.4375
4	4-40	4-48	0.1120	F8	1/2-13	1/2-20	0.5000
5	5-40	5-44	0.1250	F9	9/16-12	9/16-18	0.5625
6	6-32	6-40	0.1380	G5	5/8-11	5/8-18	0.6250
8	8-32	8-36	0.1640	G6	3/4-10	3/4-16	0.7500
10	10-24	10-32	0.1900				
12	12-24	12-28	0.2160				

Notes:

These diameters are often not available and are not recommended for new design: 0, 1, 3, 5, 12, F7, & F9

For ¼ inch and larger diameters, use of nuts per SAE J2295 is recommended. (See 4.3.2 Note)

Metric - Multiply nominal screw size in mm by 10 (Diameters limited to those In ASME B18.2.4.1M for applicable configurations)

<u>Dia PIN</u>	<u>Diameter & Pitch</u>	<u>Nom. Size</u>	<u>Dia PIN</u>	<u>Diameter & Pitch</u>	<u>Nom. Size</u>
20	M2 x 0.4	2 mm	50	M5 x 0.8	5 mm
25	M2.5 x 0.45	2.5 mm	60	M6 x 1	6 mm
30	M3 x 0.5	3 mm	80	M8 x 1.25	8 mm
35	M3.5 x 0.6	3.5 mm	100	M10 x 1.5	10 mm
40	M4 x 0.7	4 mm	120	M12 x 1.75	12 mm

Note: For M6 and larger diameters, use of nuts per SAE J2295M is recommended (See 4.3.2 Note).

Field 5 - Platings and Coatings

- = No special platings or coatings

B = Black oxide (see 4.4.2)

C = Cadmium electroplate (See 4.4.1) (Not Recommended for New Design, See 4.4.1.2 and 5.7.2)

D = Dry Film Lubricant (See 4.4.6)

K = Manganese Phosphate Coating (See 4.4.8)

N = Zinc Nickel Coating (See 4.4.1)

P = Zinc Phosphate Coating (See 4.4.8)

S = Silver Coating (see 4.4.5)

X = Zinc/Aluminum Inorganic Coating-No Chromium Permitted (See 4.4.7 and 4.4.9)

Z = Zinc Electroplate - Supplier may furnish designation **ZA** (See 4.4.1)

ZA = Zinc with clear topcoat (Hexavalent chromium prohibited) (See 4.4.1, 4.4.1.1 and 4.4.9)

Note: If dry film lubricant is used over another coating, list the other coating first, then the dry film lubricant. Example: ZD for dry film lubricant over zinc plating.

Field 6 - Material (See Table 1 for designator and mechanical property requirements)

FIGURE 1 - PINs FOR MACHINE SCREW NUTS (CONTINUED)

TABLE 1 - MACHINE SCREW NUT MATERIALS AND PIN DESIGNATORS

Field 6 Designator	UNS Designation	Name/ Material Specification ⁽¹⁾	Proof Stress ⁽²⁾ Min, ksi	Proof Stress ⁽²⁾ Min, MPa	Hardness, Rockwell	Permitted Coatings (Field 5)
A1	UNS A96061	Aluminum 6061-T6	40	275	B40 min. ³	Anodize (required, see 4.4.3), D
A3	UNS A96262	Aluminum 6262-T9	52	360	B60 min. ³	Anodize (required, see 4.4.3), D
BN	UNS N06686	Ni-Cr-Mo-W Alloy 686 Grade 1 (see 5.11)	120	825	C21 min.	D
C	UNS C26000 UNS C27000 UNS C27400	Brass – Cu 260 Cu 270 Cu 274 (see 5.9)	60	415	F55 min.	D, S
C1	UNS C46200 UNS C46400	Naval Brass – Cu 462, Cu 464 (see 5.10)	50	345	B65 min B55 min	D, S
G	UNS G10080- UNS G10300 UNS G11160- UNS G11320	Carbon Steel- ASTM A 29/A 29M	68	470	B55-C32	B, C, D, K, P, X, Y, Z, ZA, ZC
H	UNS N10276	Ni-Mo-Cr Ni276	110	760	C20 min.	D
HR	UNS S66286	Alloy A 286 ASTM A 453/ A453M	130	895	B99 min.	D
N	UNS N04400	Ni-Cu Alloy 400	70	485	B60 min.	D
S	UNS S30400 UNS S30403 UNS S30433 UNS S30500 UNS S38400 UNS S30430	Austenitic Stainless Steel Alloy 304 Alloy 304L Alloy 302HQ Alloy 305 Alloy 384 Alloy 18-9LW (XM7) (No Free Machining CRES)	70	500	B65 – C32 (inch) B81 – C32 (metric)	Passivation (required, see 4.4.4), D, S
The more corrosion resistant alloys covered by S2 and S3 may be provided at the supplier's option without purchaser's preapproval.						
S1	UNS S30300 UNS S30423	Austenitic Stainless Steel Alloy 303 or Alloy 303Se	See Above	See Above	See Above	See above
The more corrosion resistant alloys covered by S, S2, and S3 may be provided at the supplier's option without purchaser's preapproval.						
S2	UNS S31600 UNS S31603	Austenitic Stainless Steel Alloy 316 Alloy 316L	See above	See above	See above	See above
S3	UNS S32100 UNS S34700	Austenitic Stainless Steel Alloy 321 Alloy 347	See above	See above	See above	See above
T1	UNS R55111	Titanium Alloy Ti-5-1-1-1 (see 5.8)	105	725	C24 min. ³	Anodize (required, see 4.4.3), D
T2	UNS R56401	Titanium Alloy Ti-6Al-4V ELI (see 5.8)	125	860	C25 min. ³	Anodize (required, see 4.4.3), D

1. Unless otherwise indicated the chemical requirements of the following specifications apply:
Inch - (Austenitic steel - ASTM F 594) (Non ferrous materials - ASTM F 467)
(Carbon steel - ASTM A 563)
Metric (Austenitic steel - ASTM F 836M) (Non ferrous materials - ASTM F 467M)
(Carbon steel - ASTM A 563M)
2. ksi units apply to inch size fasteners and MPa units apply to metric size fasteners. Proof stress values are for informational use in selecting fasteners except when specific requirements in this document are referenced.
3. Aluminum and Titanium alloys hardness values are for information only as noted in ASTM F 467 and ASTM F 467M.

4.3 Dimensional Requirements for Nuts

The dimensional requirements for a particular configuration machine screw nut are to be as shown in ASME B18.2.2 for inch machine screw nuts and ASME B18.2.4.1M for metric machine screw nuts.

4.3.1 Thickness of Nuts

The thickness of metric machine screw nuts shall be in accordance with ASME B18.2.4.1M and the thickness of inch machine screw nuts shall be in accordance with ASME B18.2.2.

4.3.2 Diameters of Nut Threads

Diameters shall be restricted to those identified in the applicable dimensional standards, ASME B18.2.4.1M and ASME B18.2.2. For new design, diameters should be restricted to the following sizes when possible:

- a. Metric - M2, M2.5, M3, M3.5, M4, M5, M6, M8, M10, M12
- b. Inch - No. 2, No. 4, No. 6, No. 8, No. 10, 1/4, 5/16, 3/8

NOTE: To minimize configurations, it is recommended that standard nuts as identified in SAE J2295M and SAE J2295 be used for diameters of M6 and 1/4 inch and larger when available. Unlike machine screw nuts, nuts to SAE J2295M and SAE J2295 carry material identification marking.

4.3.3 Thread Types and Fits

Thread types and fits shall be restricted to those identified herein and permitted in the applicable dimensional standard. Threads, tolerances, allowances for plating and gauging shall be in accordance with ASME B18.2.2 for inch machine screw nuts and ASME B18.2.4.1M for metric machine screw nuts. The threads on inch size nuts shall be Unified Standard Class 2B in accordance with ASME B1.1 for both plain and coated threads. For metric nuts, threads shall be metric coarse series Class 6H conforming to ASME B1.13M for both plain and coated threads.

Thread acceptance shall be based on ASME B1.3M System 21.

4.4 Coating Requirements

Coatings shall be limited to those identified herein. Coatings are recommended for the medium carbon steels for corrosion protection. The applicable coating shall be designated in the PIN as indicated in Figure 1. While not normally recommended, the black oxide coating can be specified for materials other than carbon steels where a shiny natural appearance must be avoided.

4.4.1 Electro-deposited Coatings

Electro-deposited coatings of zinc, zinc-nickel or cadmium shall be in accordance with ASTM F 1941 for inch dimensioned nuts and ASTM F 1941M for metric nuts as provided herein. Coating thickness is applicable to significant surfaces only. The following minimum plating thickness is required:

Less than 1/4 inch nominal diameter or 7mm nominal diameter – 1/6 the allowance as identified in ASME B1.1.

NOTE: Low coating thickness impairs chromate adhesion and performance. Use of these coatings is not recommended when the thickness will be less than 0.00015 inches or 3.8 µm.

1/4 to 1/2 inch nominal diameter or 7mm to 12mm nominal diameter – ASTM F 1941 for inch and ASTM F 1941M for metric shall be Thickness Designation 5 (5 µm or 0.0002 in.) or 1/6 the allowance identified in ASME B1.1, whichever is less.

4.4.1.1 Hexavalent chromium is prohibited in the chromate finishes for these coatings. A ZA designator is available to allow the selection of a clear topcoat.

4.4.1.2 Cadmium coated fasteners are not recommended for new design, see 5.7.2.

4.4.2 Black Oxide Coatings

Black oxide coatings shall be in accordance with SAE AMS2485. A caution regarding the use of black oxide coated fasteners is contained in 5.7.3.

4.4.3 Coatings for Titanium and Aluminum Nuts

Nuts of titanium alloy shall be anodized in accordance with SAE AMS2487 or AMS2488, Type 2 (except testing requirements may be negotiated between manufacturer and coating supplier). See 4.4.6 for an additional coating often used for titanium nuts. Aluminum nuts shall be anodized in accordance with ASTM B 580. There is no Field 5 Designator in the PIN for anodizing of titanium or aluminum nuts since the treatment is required.

4.4.4 Passivation

All corrosion-resistant steel nuts shall be passivated in accordance with ASTM A 380. There is no Field 5 Designator in the PIN since the treatment is required. Nuts which are silver plated are not required to be passivated.

4.4.5 Silver Plating

Silver plating shall be in accordance with SAE AMS2412. Plating of threads shall be 5 μm (0.0002 inches) thick minimum. Threads shall show complete coverage. Silver plating on all other surfaces is optional. Tarnishing or discoloration of silver is not cause for rejection. Guidance on the selection of silver plating is contained in 5.7.1.

4.4.6 Solid Dry Film Lubricants

Dry or solid film lubricants are used on nuts to prevent corrosion and to reduce installation friction. These coatings are recommended for use on titanium and corrosion resisting steel nuts to reduce friction and galling. Solid or dry film lubricants shall be in accordance with SAE AS1701 Class 1 except that the dry film lubricant used for heat and corrosion resistant (HR) nuts shall be of a class rated for 399 °C (750 °F) or higher.

4.4.7 Zinc/Aluminum Inorganic Coating

These coatings shall meet the requirements of ASTM F 1136 as identified below:

X = Zinc/Aluminum Inorganic Coating-No Chromium Permitted-Must pass 500 hour salt spray test.

4.4.8 Phosphate Coatings

Manganese Phosphate coatings should not be exposed to temperature in excess of 121 °C (250 °F). Zinc Phosphate coatings should not be used if contact with alkaline materials or exposure to temperatures above 93 °C (200 °F) is expected. A supplementary coating shall be provided for improved corrosion resistance and shall be selected from one of the applicable coatings below:

K = Manganese Phosphate with chemically converted supplemental treatment in accordance with MIL-DTL-16232, Type M, Class 2.

P = Zinc Phosphate Coating with supplementary zinc rich epoxy resin coating. (Coating shall be in accordance with ASTM F 1137 Grade II or Grade III and shall meet 240 hour salt spray test.)

4.4.9 Prohibited Coatings

Coatings containing hexavalent chromium other than as trace element (an extremely small but detectable quantity of a substance) of naturally occurring metals production are prohibited. Hexavalent chromium shall not be added.

4.5 Quality Assurance

The ordering document must address quality assurance requirements. Many of the ASTM standards have supplementary requirements that apply only when specified by the purchaser in the contract or order. If the fastener standards referenced herein do not address quality control requirements, the following inspections shall apply:

4.6 Surface Discontinuities

When visual inspection determines there are surface discontinuities a nondestructive inspection shall be performed in accordance with ASTM F 812/F 812M MT or PT inspection. This requirement applies only to metric nuts 5 mm diameter and larger and inch nuts of 1/4 in and larger diameter.

4.7 Dimensions

Dimensional inspections shall be in accordance with the referenced ASME dimensional standard and Inspections shall be in accordance with ASME B18.18 Category 2.

4.8 Strength and Material Tests and Inspections

The machine screw nuts must be in compliance with the chemical requirements of the specified material specification as identified in Table 1. Proof load testing is not required unless specified by the purchasing activity. Hardness testing shall be conducted in accordance with ASTM F 606. The minimum sample size shall be in accordance with ASTM F 1470 Size C.

4.8.1 Coating Thickness

For coated nuts, the coating thickness shall be verified by one of the methods identified in ASTM F 1941 or F 1941M as applicable. The number of samples shall be as specified ASTM F 1941 or F 1941M as applicable.

5. NOTES

This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.

5.1 Intended Use

This document establishes requirements and PINs for selected materials. While this document was developed specifically for ship systems and equipment, its use is not restricted to these applications.

5.2 Identification of Part Numbering System on Drawings

On drawings where a column exists for identifying the manufacturer or his Commercial and Government Entity (CAGE) Code, indicate the CAGE Code "81343/ J2485" or "SAE J2485" as required by the drawing standard. If no column exists or there is space only for the 5-digit CAGE Code, then a note must indicate that the part numbers are defined in SAE J2485.