NATIONAL AEROSPACE STANDARD

NASM25027
SPECIFICATION

NUT, SELF-LOCKING, 250°F, 450°F, AND 800°F

1. SCOPE

1.1 Scope. This specification covers self-locking nuts for use in temperatures of 250°F, 450° F, and 800° F (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements and documents cited in sections 3 and 4 of this specification, whether or not they are listed.

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-250/12 Aluminum Alloy 7075, Plate and Sheet

THE INITIAL RELEASE OF THIS DOCUMENT SUPERSEDES MIL-DTL-25027 REVISION H, AMENDMENT 1.

LIST OF CURRENT SHEETS

No.	Rev.	No.	Rev.	No.	Rev.
1	NEW	12	NEW	23	NEW
2	NEW	13	NEW	24	NEW
3	NEW	14	NEW	25	NEW
4	NEW	15	NEW	26	NEW
5	NEW	16	NEW	27	NEW
6	NEW	17	NEW	28	NEW
7	NEW	18	NEW	29	NEW
8	NEW	19	NEW		
9	NEW	20	NEW		
10	NEW	21	NEW		
11	NEW	22	NEW		

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REVISION

SPECIFICATIONS

FEDERAL (Continued)

GGG-W-636 Wrench (Box, Open End, and Combination)

GGG-W-641 Wrench, Socket (and Sockets, Handles, and Attachments for Socket Wrenches, Hand)

QQ-P-416 Plating, Cadmium (Electrodeposited)

TT-E-751 Ethyl Acetate, Technical

TT-I-735 Isopropyl Alcohol

TT-N-97 Naphtha, Aromatic

MILITARY

MIL-C-5541 Chemical Conversion Coatings on Aluminum and Aluminum Alloys

MIL-B-6812 Bolt, Aircraft

MIL-S-7742 Screw Threads, Standard, Optimum Selected Series: General Specification for

MIL-A-8625 Anodic Coatings, for Aluminum and Aluminum Alloys

MIL-S-8802 Sealing Compound, Temperature-Resistant Integral Fuel Tanks and Fuel Cavities, High-Adhesion

MIL-S-8879 Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for

MIL-P-23377 Primer Coating, Epoxy Polyamide, Chemical and Solvent Resistant

MIL-S-81733 Sealing and Coating Compound, Corrosion Inhibitive

STANDARDS

MILITARY

MIL-STD-129 Marking for Shipment and Storage

AN503 Screw and Machine, Drilled Fillister Head, Coarse Thread

MIL-STD-410 Qualification of Inspection, Personnel (Magnetic Particle and Penetrant)

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STANDARDS

MILITARY (continued)

MIL-STD-1312/1 Salt Spray

MIL-STD-1312/7 Vibration

MIL-STD-1312/8 Tensile Strength

MIL-STD-1312/9 Stress Corrosion

MIL-STD-1312/14 Stress Durability (Internally Threaded Fasteners)

MIL-STD-1312/31 Fastener Test Methods, Method 31, Torque

HANDBOOKS

MILITARY

MIL-HDBK-57 Fastener Manufacturers' Identification Symbols, Listing of

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

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 the DoD adopted are those listed in the issue of the DoDISS cited in the solicitation (see 6.2).

NATIONAL AEROSPACE STANDARD (NAS)

NAS 9703-9724 Bolt, Hex Head, Alloy Steel, Close Tolerance, Minimum Major, Long Threads.

NAS 9603-9624 Bolt, Hex Head, A286 Cres, Close Tolerance, Minimum Major, Long Threads.

NAS 1589 Fasteners, Threaded, Corrosion and Heat Resistant, 1200° F

(Application for copies of NAS publications should be addressed to the National Standards Association, 5161 River Road, Washington, DC 20016.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ASME B46.1 Surface Texture (Surface Roughness, Waviness and Lay)
ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes

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

AEROSPACE MATERIAL SPECIFICATIONS (AMS)

AMS2410 - Silver Plating, Nickel Strike - High Bake
AMS2411 - Plating, Silver, for High Temperature Applications
AMS2750 - Pyrometry

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AS 1310 Fastener Torque for Threaded Applications, Definitions of
AS 5272 Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting

(Application for copies of SAE publications should be addressed to Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A342 Permeability of Feebly Magnetic Materials, Test Methods For
ASTM A967 Chemical Passivation Treatments for Stainless Steel Parts
ASTM D740 Methyl Ethyl Ketone
ASTM D3951 Packaging, Commercial
ASTM E1417 Liquid Penetrant Examination, Standard Practice For
ASTM E1444 Magnetic Particle Examination, Standard Practice For

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

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 sheet, or MS sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Part Standards. The individual item requirements shall be as specified herein and in accordance with the applicable Part Standards. In the event of any conflict between requirements of this specification and the standard, the latter shall govern.

3.2 Qualification. The nut manufacturer shall be responsible for conducting qualification tests and furnishing part drawings, certified qualification test reports (if required by the purchaser) and test samples. The nuts furnished under this specification shall be produced using the same manufacturing methods as used to produce nuts that have passed qualification tests. The purchaser may apply any or all tests specified herein to any product represented as meeting this specification, at any time, to verify conformance.

3.2.1 Retention of qualification. To maintain product qualification status, manufacturers shall maintain on file, a certified qualification test report (See 4.3.2) available for inspection by the procuring activity. The retention of a certified qualification test

report by the manufacturer signifies that the manufacturer has demonstrated compliance to the qualification requirements of this specification. Products previously qualified through government-certified qualification tests and reports shall be considered qualified to this specification.

3.3 Materials.

3.3.1 250°F nuts. The threaded and load-carrying elements of the 250°F nuts shall be fabricated from noncorrosion resistant steel, corrosion-resistant steel, aluminum alloy, nickel-copper alloy or copper-base alloy in accordance with the applicable standard. The sulfur or phosphorus content of noncorrosion-resistant steel shall not be greater than .050 percent by weight for thread sizes .164-32 inch and above when the nut is heat treated to 36 HRc or greater.

3.3.2 450°F nuts. The threaded and load-carrying elements of the 450°F nuts shall be fabricated from noncorrosion-resistant steel or corrosion-resistant steel. The sulfur content or the phosphorus content of noncorrosion-resistant steel shall not be greater than .050 percent by weight for thread sizes .164-32 and above when the nut is heat treated to 36 HRc or greater.

3.3.3 800°F nuts. The 800°F nuts shall be fabricated from corrosion-resistant steel.

3.4 Design. Nut design shall conform to the applicable standard.

3.5 Construction. The self-locking nut or nut element shall be a self-contained unit, including the self-locking device. The locking device shall not operate by separate movement from the installation and shall not depend on pressure on the bearing surface for locking action. Tool marks resulting from producing the self-locking feature shall blend smoothly without abrupt change. For wrenchable nuts, dimensions across flats and corners shall be applicable prior to incorporation of the locking feature.

3.5.1 Bearing surface. The bearing surface shall be normal to the axis of the pitch diameter of the threads within the values shown in Figure 1. The bearing surface roughness average shall not be greater than 125 microinches in accordance with ASME B46.1 (see 4.5.1.1).

3.5.2 Threads. Unless otherwise specified, the threads shall be Class 3B in accordance with MIL-S-8879 prior to the incorporation of the locking feature. Threads used for the locking feature may be displaced or deformed in any manner which produces self-locking nuts conforming to this specification. The nut, after incorporation of the locking feature and prior to lubrication, shall allow the "go" gage to enter not less than a half turn. When the application of a lubricant prevents the use of standard gages, the nuts shall permit a minimum free rotation of three quarters of a turn (270 degrees) on the test bolt, having Class 3A threads.

3.5.3 Plate nut rivet-bolt hole spacing. Plate nut attaching rivet-bolt hole spacing shall be in accordance with the applicable standard (see 4.5.1.2).

3.6 Plating or surface treatment.

3.6.1 Noncorrosion-resistant steel nuts. Unless otherwise specified, nuts fabricated from noncorrosion-resistant steel shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2 except nuts that are heat treated to 39 HRc or higher and cadmium plated shall be baked for not less than 23 hours at 375° +/- 25° F starting within 2 hours after plating to provide hydrogen embrittlement relief. The baking process shall be controlled in accordance with AMS 2750.

3.6.1.1 Zinc plated nuts. Nuts that are heat treated to 39 HRc or higher and zinc plated shall be baked for not less than 3.5 hours at 375° F +/- 25° starting within 4 hours after plating to provide hydrogen embrittlement relief.

3.6.2 Corrosion-resistant steel nuts. Unplated nuts, parts or components fabricated from corrosion-resistant steel shall be passivated in accordance with ASTM A967. Staining requirements of ASTM A967 do not apply to parts that receive a supplementary coating or lubricant after passivation.

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3.6.2.1 800° F corrosion-resistant steel nuts. Unless otherwise specified, the threads of 800° F corrosion-resistant steel nuts shall be silver plated in accordance with AMS 2410 or AMS 2411. Application of such finish to the exterior surface of the nut or nut retaining cage may be omitted.

3.6.3 Plate nuts. No plating finish shall be applied in the area of the projection weld nibs of projection weld plate nuts.

3.6.4 Aluminum alloy nuts. Unless otherwise specified, nuts fabricated from aluminum alloy shall be anodized in accordance with MIL-A-8625 or chemically surface treated in accordance with MIL-C-5541. No protective finish need be applied to clad aluminum-plate nut retainers or gang channels. For identification, the threaded element of the high-strength aluminum alloy nuts, from .112-40 through .250-28 size of the regular type and from .112-40 through .190-32 size of the shear type, shall be dyed blue. When the threaded element of the nut assembly is not exposed, the exposed portion of the nut shall be dyed blue.

3.6.5 Copper-base alloy nuts. Unless otherwise specified, nuts fabricated from copper-base alloy shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2.

3.7 Lubrication. Nuts may be lubricated to prevent nut-bolt seizure, provided the lubricant has passed the applicable tests (see 4.5.2). The qualification test report shall identify the lubricant and shall classify it as either solid (dry) film or soluble film. The lubricant shall not be changed without requalification of the nut, except as noted in 3.7.1.

3.7.1 Solid (dry) film lubricant. When specified, the 250° F and 450° F nuts shall be coated with graphite-free solid (dry) film lubricant. If lubricant is in accordance with AS 5272, Type I, no testing of lubricant is required; if lubricant does not meet the requirements of AS 5272, Type I, then lubricant shall be subjected to and pass the applicable tests (see 4.5.2 through 4.5.2.5). Nickel and/or copper plate as a pretreatment for the application of solid (dry) film is optional.

3.7.2 Soluble lubricant. Soluble lubricant coated panels shall be composed of the same material and contain the same finish as the nut (see 4.5.2.1, 4.5.2.2, 4.5.2.5 and 4.5.2.6).

3.8 Mechanical properties.

3.8.1 Axial tensile strength. The nuts shall have a minimum axial tensile strength as specified in Table I (see 4.5.3.1).

3.8.2 Torque.

3.8.2.1 Wrench torque. Wrenchable nuts when tested in accordance with 4.5.3.2 shall withstand the wrench torque values specified in Table II. There shall be no permanent deformation that may interfere with the use of a box or open end wrench conforming to GGG-W-636.

3.8.2.2 Locking torque.

3.8.2.2.1 Maximum locking torque. The torque required for installation and/or removal shall not be greater than the values specified in Tables III and IV as applicable (see 4.5.3.3.2 and 6.1.2).

3.8.2.2.2 Minimum breakaway torque. The torque required to start the unseated nut in the removal direction shall be measured and shall not be less than the values specified in Table III for the minimum breakaway (see 4.5.3.3.3).

3.8.2.2.3 Permanent set. The nuts shall meet the minimum breakaway torque requirements on minimum material condition bolts or studs, subsequent to installation on maximum material condition bolts or studs, when tested in accordance with 4.5.3.3.4. The nuts shall not exceed the maximum locking torque nor be below the minimum breakaway torque values specified in Table III when subjected to this test.

3.8.2.3 Torque out. Torque out values for floating and retained nonfloating plate nuts, gang channel nuts, and Attached Retention Element (A.R.E.) nuts with no axial load on the bearing surface of the nut, shall not be less than the values listed in Table V (see 4.5.3.4). This test is not applicable to wrenchable nuts.

3.9 Push out. Push out values for the floating and nonfloating plate nuts, gang channel nuts, and (A.R.E.) nuts shall be not less than the values listed in Table VI when tested in accordance with 4.5.3.5.

3.10 Vibration. Self-locking nuts shall show no evidence of failure when tested in accordance with 4.5.3.6. Failure to meet this requirement will be cause for rejection of the lot represented by the test sample.

3.11 Discontinuities. Discontinuities shall not be greater than depths specified in Table VII (see 4.5.4 and Figures 2 and 2a). Care must be taken not to confuse cracks with discontinuities. Cracks as defined in 6.1.2 are not permitted in any location.

3.12 Stress embrittlement (durability). Noncorrosion-resistant steel cadmium or zinc plated nuts that are heat treated to 39 HRc or higher shall show no evidence of cracking or fracture when subjected to the applicable stress embrittlement tests (see 4.5.5.1 and 4.5.5.2). Stress embrittlement testing is not required for .138-inch and smaller size nuts.

3.13 Stress corrosion. Aluminum alloy nuts shall show no evidence of cracking when subjected to the stress corrosion tests (see 4.5.6 and 4.5.6.1).

3.14 Magnetic permeability. The magnetic permeability of the corrosion-resistant steel nuts shall be less than 2.0 (air = 1.0) for a field strength of H = 200 oersteds (see 4.5.7).

3.15 Manufacturer's identification. Nut thread sizes .190-inch diameter and larger manufactured after 30 June 1985 shall be permanently marked with the trademark or symbol of the manufacturer. The symbol or trademark must be listed in MIL-HDBK-57. On solid (dry) film lubricated parts, the marking shall be legible after solid (dry) film lubricant removal. However, the color of the nonmetallic locking element may be used if the color has been established as the manufacturer's trademark or symbol.

3.15.1 Copper-base alloy nuts. Unless otherwise specified, copper-base alloy nuts shall be identified as specified on the applicable standard.

3.16 Workmanship. Workmanship shall be consistent with the type of product, finish, and the class of thread fit specified. Sharp edges shall be broken; loose or hanging burrs and slivers which might become dislodged under usage shall be removed.

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4. VERIFICATION

4.1 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable test method documents or paragraphs in this specification.

4.2 Classification of inspection. The inspections specified herein are classified as follows:

a. Qualification inspection (4.3)

b. Quality conformance inspection (4.4)

4.3 Qualification inspection. Qualification inspection shall consist of the inspections listed in table XIII (see 6.4).

4.3.1 Sample. Test samples shall be of the same material and manufactured by the same method as production parts. The number of nuts to be subjected to qualification tests shall be as specified in table XIII. Complete identification (e.g. trade name) of the lubricant used on the nuts shall be included in the qualification test report.

4.3.2 Certified test report. The manufacturer shall maintain on file a certified test report showing that the manufacturer's product satisfactorily conforms to this specification. The test report shall include actual results of the tests specified herein. The manufacturer shall also maintain a dated drawing that completely describes the manufacturer's product. The drawing shall specify all dimensions. The test report shall include composition of material selected, coating or plating applied, forming process (machined, stamped, forged or drawn), and the Rockwell hardness and heat treatment. The drawing shall also specify the manufacturer's part number for each size.

4.3.3 Retention of qualification. Requalification will be required in the event any change is made in the product design, construction, materials, method of manufacture, heat treatment, finish, lubricant or manufacturer's part-number or designation.

4.4 Quality conformance inspection. Quality conformance inspections shall consist of the tests specified in table XIV. The purchaser may apply any or all tests specified herein to any product represented as meeting this specification, at any time, to verify conformance.

4.4.1 Selection of samples. Sample nuts shall be selected at random from each lot as specified herein.

4.4.1.1 Inspection lot. An inspection lot shall consist of finished nuts which are of the same type and diameter manufactured from one material heat using the same process, heat treated in the same manner and produced as one continuous run or part thereof.

4.4.1.2 Sampling plan A. Sample sizes for inspection of product characteristics delineated in paragraph 4.4.1.2.1 shall be in accordance with ANSI/ASQC Z1.4 as follows:

Major A - Inspection Level S-4
Major B - Inspection Level S-3
Minor - Inspection Level S-2

Acceptance = 0 Rejection = 1

4.4.1.2.1 Product Characteristics. The following characteristics shall be inspected.

Major A:
Self-locking feature missing

Major B:
101 Thread fit
102 Bearing surface squareness
103 Surface finish, plating or surface treatment
104 Rivet hole location and alignment (plate nuts only)
105 Height of nut

Minor:
201 Dimensions of wrenching element (wrenchable nuts only; see 3.5)
202 Loose or hanging burrs
203 All other dimensional characteristics not covered above

4.4.1.3 Sampling plan B. For the axial strength test (4.5.3.1), the sample shall be selected in accordance with Table VIII or IX, as specified herein. Samples for magnetic permeability will be selected in accordance with Table IX.

4.4.1.4 Sampling plan C. For the locking torque, the torque out, and push out tests (4.5.3.3, 4.5.3.4 and 4.5.3.5, respectively), sampling shall be in accordance with the attribute plan shown in Table IX. The acceptance or rejection numbers shall apply to all of the individual inspections for the locking torque, torque out, and push out tests taken separately; i.e., a nut shall be classified defective if it fails any of these inspections.

4.4.1.5 Sampling plan D. For the discontinuities test (4.5.4), sampling shall be at random in accordance with ANSI/ASQC Z1.4, Level S-3. Failure of any nut sample to meet the requirements of Figure 2a and Table VII after micro-examination in accordance with 4.5.4 shall be cause for rejection of the lot.

4.5 Inspection methods.

4.5.1 Examination of product. The nuts shall be examined for conformance to this specification and applicable standards with respect to material, workmanship, dimensions, design and construction, and finish.

4.5.1.1 Bearing surface. Prior to incorporation of the locking feature the nut shall be assembled on a Class 3A threaded member having a minimum thread length equal to the nut height. The bearing surface values shall be measured with a feeler gage after contact when the nut is turned finger tight on a table squareness gage having a seating surface diameter equal to "W" (see Figure 1).

4.5.1.2 Plate nut rivet-bolt hole spacing. Plate nut rivet-bolt hole spacing may be determined by suitable variable gages or by means of a functional alignment gage specified in Figure 3.

4.5.2 Lubricant coatings.

4.5.2.1 Effect of the coating on the ability of cadmium plating to prevent galvanic corrosion Four panels made of the same material as the finished fastener shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2. Two of the panels shall be coated with the candidate lubricant and two with any product in accordance with AS5272, Type I. The panels shall then be scribed with an "X" extending to .250-inch from each corner, and subjected to a 96-hour salt spray test in accordance with MIL-STD-1312/1. After exposure, there shall be no significant difference in corrosion when a comparison is made between the panels with the candidate lubricant and those panels coated with a lubricant in accordance with AS 5272, Type I.

4.5.2.2 Effect of the coating on structural materials in contact with the fastener. Corrosion test specimens shall be panels with four test fasteners per panel. The four fasteners shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2. Two fasteners shall be overcoated with the candidate lubricant and two with any product in accordance with AS5272, Type I. Duplicate specimen sets of the following alloys and finishes shall be subjected to a 96-hour salt spray test in accordance with MIL-STD-1312/1.

a. Bare 7075-T6 aluminum alloy and bare 2024-T6 aluminum alloy treated in accordance with MIL-C-5541, Class 1A.

b. Bare 7075-T6 aluminum alloy and bare 2024-T6 aluminum alloy anodized in accordance with MIL-A-8625, Type II, Class 1.

c. Clad 7075-T6 aluminum alloy and clad 2024-T6 aluminum alloy treated in accordance with MIL-C-5541.

d. Untreated titanium alloy.

e. Untreated 300 series corrosion resistant steel.

After exposure, the specimens shall be disassembled and there shall be no significant difference in corrosion on either the fasteners or panel faying surface when a comparison is made between the fasteners coated with the candidate lubricant and fasteners coated with a lubricant in accordance with AS 5272, Type I.

4.5.2.3 Behavior of coating with paint. Corrosion test specimens shall be of the same aluminum alloys and treatments as specified in 4.5.2.2b and c, and painted with two coats of primer in accordance with MIL-P-23377, Class 2. The specimens shall be subjected to a 96-hour salt spray test in accordance with MIL-STD-1312/1. After exposure, there shall be no significant difference in corrosion, blistering, or loss of adhesion of the paint when a comparison is made between the fasteners coated with the candidate lubricant and fasteners coated with a lubricant in accordance with AS 5272, Type I.

4.5.2.4 Effect of coating on sealing materials. Corrosion test specimens shall be of the same aluminum alloys and treatments as specified in 4.5.2.2b and c, except that sealant materials in accordance with MIL-S-8802 and MIL-S-81733 shall be applied to the fasteners. A specimen panel shall be prepared for each sealant material. Before the application of the sealant material, the fasteners and panels shall be cleaned by scrubbing and rinsing with solvent formulated in accordance with Table XII. After rinsing, and while still wet, the specimens shall be wiped dry with a clean, non-oily wiping cloth. The specimen shall be subjected to a 96-hour salt spray test in accordance with MIL-STD-1312/1. After exposure, there shall be no significant difference in loss of adhesion or degradation of sealant material when a comparison is made between the fasteners coated with the candidate lubricant and fasteners coated with lubricant in accordance with AS 5272, Type I.

4.5.2.5 Effect of lubricant on stress corrosion resistance of aluminum fasteners. The lubricated threaded fastener shall be scratched through to the basis metal. Torque shall be applied against the aluminum alloy panels to induce 90,000 psi in mating bolt. The assembly shall be salt-spray tested for 96 hours in accordance with MIL-STD-1312/1. After exposure, the lubricated fastener shall not have any cracks which can be determined under 10X magnification.

4.5.2.6 Soluble lubricant removability. Soluble lubricant coated panels, made of the same material and containing the same finish as the fastener, shall be submerged for 10 minutes +/-1 minute in the cleaner specified in Table XII. The panel shall then be wiped dry with a clean cloth. Failure of all lubricants to be removed from the panel by the above process shall be cause for rejection.

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4.5.3 Mechanical properties.

4.5.3.1 Axial strength. The axial strength test shall be conducted in accordance with MIL-STD-1312/8. Steel bolts or studs heat treated to 160-180 KSI with threads per MIL-S-8879 modified per Table XV shall be used for this test. For nuts with tensile requirements other than those specified in this document, bolts or mandrels with MIL-S-8879 threads and sufficient strength to meet or exceed the tensile value requirements shall be used.

4.5.3.1.1 Qualification Testing. Prior to testing, three nuts of the 450° F shall be baked on a bolt for 6 hours at 450° F. Three of the 800° F (corrosion-resistant steel) nuts shall be baked on the bolt for 6 hours at 800° F. The 250° F nuts need not be baked prior to the test. The nuts shall be tested to destruction at room temperature.

4.5.3.1.2 Quality Conformance Testing. The nuts shall be assembled on the bolts or studs and subjected to axial strength test at room temperature. Nuts will not be tested to destruction if attribute plans are used.

4.5.3.2 Wrench torque (wrenchable nuts only). Steel bolts, with Class 3A threads in accordance with MIL-S-7742 or MIL-S-8879, shall be used for this test. The nut submitted shall be finger tightened on the bolt up to the self-locking element. The regular nut shall be tightened against a steel bushing with a socket wrench per GGG-W-641 to the torque value specified in Table II. The regular nuts shall also be tightened against a steel bushing with an open end wrench to the torque values specified in Table II for shear nuts up to .625-inch. Shear nuts shall be tightened with a socket or box wrench to the values specified in Table II. The open end wrench and box wrench shall be in accordance with GGG-W-636, Type I, Class 1, and Type IV. Deformation that interferes with the proper installation and removal of the nut with the wrench is sufficient cause for rejection.

4.5.3.3 Locking torque. The locking torque tests shall be conducted with no axial load on the nut at a rate such that the temperature rise of the nut under test shall not be greater than 75° F above room ambient temperature. Throughout the test the same nut and bolt combination shall be used unless the bolt or mandrel threads do not remain in serviceable condition during testing, then, a new bolt or mandrel shall be used and so noted in the test report. No more than one additional bolt or mandrel shall be used per test sample.

4.5.3.3.1 Bolts, screws or studs for maximum locking torque, minimum breakaway torque, and permanent set tests. For the maximum locking torque, minimum breakaway torque, and permanent set tests, screws, bolts or studs with Class 3A fit threads conforming to MIL-S-7742 or MIL-S-8879, with the major thread diameters per NAS 9600 and NAS 9700 series, as defined in Table XV, shall be used on nuts with mating threads conforming to MIL-S-7742 or MIL-S-8879, as applicable. The pitch diameter after plating shall be class 3A. The nut shall be capable of being assembled with the fingers on the screws, bolts or studs up to the locking element. Cadmium-plated, noncorrosion-resistant steel screws, bolts or studs shall be used for testing noncorrosion-resistant steel nuts, copper-based alloy nuts, and aluminum alloy nuts. Corrosion resistant steel screws, bolts or studs shall be used for testing corrosion resistant steel and nickel-copper alloy nuts. (See Table XV for test bolts).

4.5.3.3.2 Maximum locking torque. - Room Temperature. (For these tests, installation shall be considered completed when one (1) to two (2) bolt threads, excluding the bolt end chamfer, protrude through the top of the nut.). For configurations where the end of the nut is not visible, such as closed end blind or domed fasteners, and where the locking mechanism is not at the end of the nut, the bolt threads shall extend a minimum of one and a maximum of two pitches beyond the locking device.

4.5.3.3.2.1 Tests for 250° 450° and 800° F nuts. Install and remove nut for 15 cycles. Measure and record the maximum installation and removal torque values for the first, seventh and fifteenth cycles, to determine compliance with 3.8.2.2.1. For all metal aluminum nuts 250° application install and remove nut for one cycle only. Record the maximum installation and removal torque values.

4.5.3.3.3 Minimum breakaway torque - Room Temperature. Minimum breakaway torque for the tests specified in 4.5.3.3.3.1 shall be measured between the limits of one and maximum of two (2) threads of the bolt or screw, as applicable, extending beyond the nut. For configurations where the end of the nut is not visible, such as closed end blind or domed fasteners, and where the locking mechanism is not at the end of the nut, the bolt threads shall extend a minimum of one and a maximum of two pitches beyond the locking device.

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4.5.3.3.3.1 Tests for 250° 450° and 800° F nuts. While performing the maximum locking torque test measure and record the minimum breakaway torque during the first, seventh and fifteenth removal cycles to determine compliance with 3.8.2.2.2. For all metal aluminum nuts 250° application record the minimum breakaway torque during the single cycle test.

4.5.3.3.4 Permanent set. Permanent set shall be evaluated by subjecting three of the nuts, at room ambient temperature, to installation on a maximum material condition bolt or stud, followed by removal from a minimum material condition bolt or stud as described herein and in 4.5.3.3.4.1 and 4.5.3.3.4.2. For all-metal aluminum nuts that specify one-cycle use, three nuts shall be tested on the maximum material condition bolt or stud, and three other nuts, representative of the same production lot, shall be tested on the minimum material condition bolt or stud.

4.5.3.3.4.1 Maximum material condition bolts and studs. Three nuts from the same lot shall be assembled on maximum material condition bolts or studs (as defined below) so that at least three threads protrude through the top of the nut. The maximum prevailing locking torque shall be measured and recorded during the third complete turn of the nut and after the top of the nut is flush with the end of the bolt or stud. The nut shall then be removed completely from the bolt or stud. The locking torque shall not exceed the maximum values specified in Table III. Thread pitch diameter size for the maximum material condition test bolts or studs shall be as specified in Table X, and shall be inspected with a single element pitch diameter gage. Test bolt or stud threads shall also meet functional ring gage requirements of MIL-S-8879.

4.5.3.3.4.2 Minimum material condition bolts and studs. The same three nuts shall then be assembled on minimum material condition bolts or studs (as defined below) so that at least three threads protrude through the top of the nut. Breakaway torque required to start the nut in the removal direction shall be measured and recorded. The breakaway torque shall not be less than the minimum values specified in Table III. Thread pitch diameter size for the minimum material condition test bolts or studs shall be as specified in Table X, and shall be inspected with a single element pitch diameter gage. Test bolt or stud threads shall also meet functional ring gage requirements of MIL-S-8879.

4.5.3.3.5 Conditioning tests - (At temperature).

4.5.3.3.5.1 Locking Torque.

4.5.3.3.5.1.1 Tests for 450° and 800° F nuts. Install nut on bolt, record the maximum locking torque, bake at test temperature for 6 hours, cool to room ambient temperature. Record the maximum removal torque. Install and remove nut an additional 14 cycles recording the maximum installation and removal torques at the seventh cycle and fifteenth cycles. Take the test nuts and install on a brand new bolt or screw, bake at test temperature for one hour and remove nut at this temperature. Record the maximum installation and removal torques.

4.5.3.3.5.1.2 Tests for 250° F nuts. Install nut on bolt or screw and record maximum installation torque, bake at test temperature for 3 hours, cool to room ambient temperature. Record the maximum removal torque. Take test nuts and install on a brand new bolt or screw, record the maximum installation torque, bake at test temperature for one hour and remove nut at this temperature. Record the maximum removal torque.

4.5.3.3.5.2 Minimum breakaway torque - Conditioning tests (At temperature).

4.5.3.3.5.2.1 Tests for 450° and 800° F nuts. Minimum breakaway shall be measured and recorded at the first, seventh, fifteenth and last removal cycles.

4.5.3.3.5.2.2 Tests for 250° F nuts. Minimum breakaway shall be measured and recorded for the first and the last removal cycle.

4.5.3.4 Torque out. Nuts when tested in accordance with MIL-STD-1312/31 shall meet the torque out values specified in Table V with no axial load on the bearing surface of the nut. Torque applied by wrenching an ease-out tool inserted from the top or bottom of the nut is optional.

Gang channel and plate nuts shall be attached to a .250-inch thick steel plate. Gang channel shall be attached to the test plate at locations equal to the rivet hole locations of standard two lug plate nuts or half the distance between 2 consecutive nuts whichever is smaller. A hole in the plate shall be located concentric with the nominal position of the threads in the nut and shall have a diameter equal to the nominal thread size plus twice the minimum radial float specified on the applicable specification sheet or standard.

A.R.E. nuts shall be installed into 2024-T3 aluminum alloy panels having a thickness as specified on the applicable specification sheet or standard.

The nuts shall not crack the retainer. The nuts shall not become malformed enough to preclude the application of the same torque in the opposite direction.

4.5.3.5 Push out. The minimum load required to push out the nut from the retainer of any plate nut and gang channel nut, or from the installation material of A.R.E. nuts shall not be less than the values specified in Table VI. For the plate nut and gang channel nuts, the minimum load required to affect a permanent deformation axial with a threaded element of .030-inch, measured at the thread centerline between the test plate and the base of the nut, shall not be less than the values specified in Table VI. The nuts shall be prepared for this test in the manner specified in 4.5.3.4, except that the push-out stud or device shall be provided with a hemispherical end of a diameter equal to the thread diameter plus .030-inch minimum.

4.5.3.6 Vibration. Sample nuts with bolts of the size and quantities specified in Table XI shall be vibrated in accordance with MIL-STD-1312/7. There shall be no failures at less than 30,000 cycles. Vibration tests on nuts larger than .500-inch are waived, provided that .500-inch nuts and smaller, of the same type and design of locking device, have passed the vibration test.

4.5.3.6.1 Preparation for vibration test.

4.5.3.6.2 Nut assembly. Five (5) nuts shall be assembled at room temperature in accordance with Figure 1 of MIL-STD-1312/7, with bolts and torque values as specified in Table XI. The nuts shall then be removed and reinstalled to the torque values four additional times before being vibrated.

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4.5.3.6.2.1 Baking of test specimens. Five (5) additional pieces of the 450° F and 800° F nuts shall be assembled on the appropriate bolts and baked for six hours at 450° F and 800° F, respectively. The baked specimens shall be allowed to cool in air to room temperature. The nuts shall then be removed and reinstalled to torque values specified in Table XI for four additional times before being vibrated. It is not necessary to bake the 250° F nuts for this test. Different spacers may be used for baking and vibration.

4.5.3.6.2.2 Anchor nuts and A.R.E. nuts. One piece anchor nuts may have their lugs trimmed equal to the width of the nut base to provide symmetry about the thread axis. Only the trimmed portion of one piece anchor nuts and the nut element from A.R.E. nuts and multi-piece anchor nuts shall be tested.

4.5.3.6.3 Vibration test method. The assembly shall traverse the entire length of the slots in the test fixture throughout the test. The test shall be run for 30,000 cycles. The test shall be stopped if a nut becomes disassembled from the bolt. The nut samples shall be examined under 10X magnification for cracks. The nuts shall be considered to have failed the vibration test under the following conditions:

a. When any structural failure (such as broken segments, locking inserts falling out) or cracks occur in the nuts during the test (not including failure of the bolt).

b. When any nut comes completely off the bolt or can be turned completely on or off the bolt with the fingers during or after completion of 30,000 cycles.

c. When relative rotation between any nut and bolt is greater than 360°.

4.5.4 Discontinuities. Discontinuities in nuts, such as laps, seams, and inclusions shall be determined by one of the following methods of inspection, unless visual inspection discloses discontinuities which would preclude the necessity for these inspections. The presence of cracks in nuts shall be cause for rejection (see Figures 2 and 2A). If, in the opinion of the inspector, the discontinuities are cause for rejection, representative samples shall be taken from those nuts showing discontinuities. The nuts shall be further examined by micro-examination to determine if the discontinuities are in accordance with the limits specified herein. Discontinuities within the acceptable limits of Table VII shall not be cause for rejection. Multi-piece nuts such as gang channel and floating anchor nuts shall be inspected prior to assembly. If the multi-piece nut is heat treated after assembly, the unit may, at manufacturers discretion be inspected as an assembly. The presence of cracks in nuts, channel and/or retainers shall be cause for rejection.

4.5.4.1 Inspection method for noncorrosion-resistant steel nuts. Magnetic particle inspection shall be performed in accordance with ASTM E1444. Such inspection shall be performed on finished nuts of thread sizes .190-inch and larger subsequent to any processing operations which would adversely affect the ability of the part to be inspected. The nuts shall be magnetically inspected in a circular manner. The magnetized field shall be normal to the longitudinal axis of the nut. Nuts shall not be dyed as an indication of magnetic particle inspection specified by the sampling requirements of this specification. Personnel conducting magnetic particle inspection shall be qualified in accordance with MIL-STD-410.

4.5.4.2 Inspection method for corrosion-resistant steel nickel-copper alloy and aluminum nuts. Fluorescent penetrant inspection shall be performed in accordance with ASTM E1417. This inspection shall be performed on finished nuts of thread sizes .190 and larger and prior to coating and subsequent to any processing operations which would adversely affect the ability of the part to be inspected. Nuts shall not be dyed as an indication of fluorescent penetrant inspection specified by the sampling requirement of this specification. Personnel conducting fluorescent penetrant inspection shall be qualified in accordance with MIL-STD-410.

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4.5.5 Stress embrittlement.

4.5.5.1 23-hour stress embrittlement test. Ten nuts or 10 percent, whichever is less, shall be selected from each lot and tested in accordance with MIL-STD-1312/14. The test load shall be 75-80 percent of the axial strength specified on the applicable standard. The duration of the test shall be 23 hours.

4.5.5.2 168-hour stress embrittlement test. Five nuts shall be tested in accordance with MIL-STD-1312/14. The test load shall be 75-80 percent of the axial strength specified on the applicable standard. The duration of the test shall be 168 hours.

4.5.6 Stress corrosion. Samples of the sizes .086-56 through and including .2500-28 aluminum alloy nuts shall be subjected to the following test. Five of the nuts of the size being qualified shall be assembled on cadmium plated steel bolts or screws, as applicable, against cadmium plated steel bushings. The torque used in assembly shall be:

a. 4 inch-pounds for the .086-56 size.

b. 8 inch-pounds for the .112-40 size.

c. 15 inch-pounds for the .138-32 size.

d. 20 inch-pounds for the .164-32 size.

e. 40 inch-pounds for the .190-32 size.

f. 100 inch-pounds for the .250-28 size.

The assembly shall then be submerged in a solution consisting of 53 grams of sodium chloride and 50 grams of sodium chromate per liter of solution for 2 weeks at room temperature (75° F). After 2 weeks, the nut shall be examined and any cracks visible to the unaided eye shall be cause for rejection. If no cracks are visible, one sample of each size shall be sectioned, polished, and subjected to metallurgical examination. Any cracks shown by this examination shall cause rejection of the lot.

4.5.6.1 Stress corrosion test for aluminum plate nuts. Stress corrosion testing shall conform to MIL-STD-1312/9. Nuts shall be installed into test panels conforming to Figure 1. Aluminum alloy 7075-T6 nuts shall be installed into test panels conforming to QQ-A-250/12. The test bolt shall be in accordance with NAS 1589. The test duration shall be 96 hours. Following exposure, torque out resistance shall be evaluated in accordance with 4.5.3.4 herein. No failures are permitted.

4.5.7 Magnetic permeability. The magnetic permeability shall be determined by the use of an indicator in accordance with ASTM A342 Method 6.

4.6 Inspection of packaging. The sampling and inspection of preservation, packing and container marking shall be in accordance with ASTM D3951.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity

6. NOTES

6.1 Intended use. The nuts conforming to this specification are intended for use in applications where the temperature is not greater than the following values:

Copper-base alloy nuts - 250° F
Aluminum-alloy nuts - 250° F
Corrosion-resistant steel - 250° F, 450° F, or 800° F
Noncorrosion-resistant steel - 250° F or 450° F
Nickel-copper alloy nuts - 250° F

NOTE: Temperature limits below those listed may occur due to coatings, lubricants and/or non-metallic locking elements. Certain limitations in reusability (less than 15 cycles) occur for certain material and lubricant combinations.

6.1.1 Cadmium Plating interchangeability. For all applications, nuts plated in accordance with QQ-P-416, Class 2, Type II can be used to replace nuts plated with QQ-P-416, Class 2, Type I. Nuts with Type I plating cannot be used in place of nuts with Type II plating. In applications for solid (dry) film lubricated nuts, the type and class are optional providing the nuts meet the salt spray requirements of QQ-P-416, Class 2, Type II.

6.1.2 Definitions. For the purpose of clarification and interpretation, the following definitions are applicable to this specification.

Maximum Locking Torque. The maximum torque encountered during the installation or removal with no load on the base of the nut. On the first installation cycle, maximum locking torque is defined as the highest reading measured during the third complete turn of the nut after the top of the nut is flush with the end of the bolt.

Maximum Installation Torque. (See "Maximum Locking Torque".)

Maximum Removal Torque. This is the highest torque value obtained when the nut (or bolt) is rotated from its installed position in the removal direction. This torque is measured when the nut (or bolt) is in motion and until the bolt disengages the nut locking device. There should be no axial load on the base of the nut when the torque is measured.

Minimum Breakaway Torque. The torque required to start nut (or bolt) rotation from its installed position during the removal cycle with no load on the base of the nut. Also: "Breakaway torque."

Installed. A nut is considered installed when one (1) or two (2) bolt threads, excluding the bolt end chamfer, protrude through the top of the nut.

Removal Cycle. The removal cycle should be considered complete when the locking device is disengaged.

Regular (reg) nuts. Nuts identified as "Regular Height", "Low Height", or "125 KSI Ftu" in the title block of the part standard.

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Shear Nuts. Nuts identified as "Thin", or "Shear Type" in the title block.

Crack. A clean crystalline break passing through the grain or grain boundary without the inclusion of foreign elements.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. MS or NAS part numbers.

c. Applicable levels of packaging and packing (see 5.1).

6.2.2 Acquisition of Nuts Not Previously Qualified. Nuts which have not been previously qualified via Government-certified qualification tests and reports may be acquired, provided that certified qualification test reports for these nuts are retained on file by the manufacturer along with the quality conformance inspection data and they are made available to the buyer upon request.

6.2.3 Acquisition of nuts manufactured prior to issuance of Revision H. Unless otherwise specified, Revision H is applicable to nuts manufactured after 15 August 1997.

6.2.4 Certification. When requested each shipment of parts will include a Certification Report. That contains the following:

a. Customer's name (and Division, if applicable)
b. Purchase Order number and date
c. Part number
d. Part name
e. Procurement specification number
f. Thread specification and gaging system used (if applicable)
g. Inspection lot size
h. Production lot number
i. Quantity shipped
j. Shipper number
k. Material producer
l. Material type and heat number
m. Material composition (Mill heat test report, independent laboratory report)
n. Mechanical property test reports, include, hardness, tensile strength, stress embrittlement, locking torque tests, push-out, torque-out, etc., as applicable
o. Magnetic particle inspection results
p. Fluorescent penetrant inspection results
q. Magnetic permeability test results
r. Other data as specified in the part standard

6.3 References to this Specification. Any use or reference to this specification is the responsibility of the design activity or procuring agency. When referencing this specification, or any portion herein, the design activity or procuring agency must indicate specific sections applicable and assume responsibility for performance of the product.

6.4 Qualification. This paragraph intentionally blank.

6.5 Subject term (key word) listing.

a. Nut self-locking hexagon
b. Nut, self-locking heavy hex

TABLE I. Axial tensile load (pounds).

FINE THD SERIES					COARSE THD SERIES				
THD SIZE	REG NUTS 1/		SHEAR NUTS 2/			REG NUTS 1/		SHEAR NUTS 2/	
	STEEL	AL ALLOY	STEEL	AL ALLOY	THD SIZE	STEEL	AL ALLOY	STEEL	AL ALLOY
					.086-56	440	440 3/	230	230 3/
					.112-40	750	750 3/	370	370 3/
					.138-32	1,130	1,130 3/	560	560 3/
					.164-32	1,720	1,720 3/	860	860 3/
.190-32	2,460	2,460 3/	1,230	1,230 3/	.190-24 4/	2,010	1,000		
.250-28	4,580	4,580 3/	2,290	1,140	.250-20 4/	3,760	1,860		
.312-24	7,390	3,670	3,700	1,830	.312-18 4/	6,360	3,150		
.375-24	11,450	5,680	5,720	2,840	.375-16 4/	9,540	4,730		
.437-20	15,450	7,660	7,720	3,830	.437-14 4/	13,140	6,520		
.500-20	21,110	10,470	10,550	5,240	.500-13 4/	17,730	8,800		
.562-18	26,810	13,300	13,400	6,650	.562-12 4/	22,890	11,360		
.625-18	34,130	16,930	17,060	8,460	.625-11 4/	28,530	14,150		
.750-16	50,020	24,810	25,010	12,400	.750-10 4/	42,770	21,200		
.875-14	68,440	33,950	34,220	16,970	.875-9 4/	60,330	29,920		
1.000-12	90,000	44,640	45,000	22,320	1.000-8 4/	79,280	39,330		
1.125-12	116,700	57,880	58,350	28,940	1.125-7 4/	99,500	49,350		
1.250-12	147,940	73,380	73,970	36,690	1.250-7 4/	125,000	62,000		
1.375-12	171,000	84,800	85,500	42,400	1.375-6 4/	150,000	74,400		
1.500-12	205,000	101,700	102,500	50,800	1.500-6 4/	181,000	89,800		
					1.750-5 4/	245,000	121,500		
					2.000-4.5 4/	322,000	160,000		
					2.250-4.5 4/	414,000	205,000		
					2.500-4 4/	510,000	253,000		

NOTES:
1/ There are no axial tensile strength requirements on copper-base alloy nuts.
2/ The regular nut values shall be used unless the standard specifies that the values for shear nuts are applicable.
3/ These are the axial tensile strength values for the aluminum alloy nuts identified by a blue dye.
4/ Inactive for design for military aircraft. For applicability other than military aircraft, see 6.1.

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TABLE II. WRENCH TORQUE (INCH-POUND).

FINE THD SERIES							COARSE THD SERIES						
THREAD SIZE	REG NUTS			SHEAR NUTS			THREAD SIZE	REG NUTS			SHEAR NUTS		
	STEEL	AL ALLOY	COPPER -BASE ALLOY	STEEL	AL ALLOY	COPPER-BASE ALLOY		STEEL	AL ALLOY	COPPER -BASE ALLOY	STEEL	AL ALLOY	COPPER-BASE ALLOY
							.086-56	4	4	2			
							.112-40	8	8	4			
							.138-32	15	15	8			
							.164-32	23	23	12	14	14	7
.190-32	46	46	23	29	29	15	.190-24 1/	40	20	20	22	22	11
250-28	115	115	58	69	35	35	.250-20 1/	86	43	43			
.312-24	260	130	130	160	80	80	.312-18 1/	185	93	93			
.375-24	450	225	225	270	138	138	.375-16 1/	315	158	158			
.437-20	965	483	483	575	288	288	.437-14 1/	550	225	225			
.500-20	1,265	633	633	760	380	380	.500-13 1/	1,000	500	500			
562-18	1,840	920	920	1,110	550	550	.562-12 1/	1,265	633	633			
.625-18	2,760	1,380	1,380	1,600	800	800	.625-11 1/	1,725	863	863			
750-16	5,750	2,875	2,875	3,450	1,725	1,725	.750-10 1/	2,875	1,438	1,438			
.875-14	8,050	4,025	4,025	4,830	2,415	2,415	.875-9 1/	5,300	2,650	2,650			
1.000-12	10,990	5,495	5,495	6,822	3,441	3,441	1.000-8 1/	8,750	4,375	4,375			
1 125-12	14,850	7,425	7,425	10,350	5,175	5,175	1.125-7 1/	13,100	6,550	6,550			
1.250-12	22,500	11,250	11,250	17,250	8,625	8,625	1.250-7 1/	17,600	8,800	8,800			
1.375-12	22,500	11,250	11,250	17,250	8,625	8,625	1.375-6 1/	20,000	10,000	10,000			
1 500-12	22,500	11,250	11,250	17,250	8,625	8,625	1.500-6 1/	20,000	10,000	10,000			
							1.750-5 1/	20,000	10,000	10,000			
							2.000-4.5 1/	20,000	10,000	10,000			
							2.250-4.5 1/	20,000	10,000	10,000			
							2.500-4 1/	20,000	10,000	10,000			

NOTES:
1/ Inactive for design for military aircraft.

Table III. Maximum Locking and Minimum Breakaway Torque Values (inch-pounds).

FINE THD SERIES			COARSE THD SERIES		
THD SIZE	MAX LKG TRQ INSTL OR REMOVAL	MIN BREAKAWAY TORQUE	THD SIZE	MAX LKG TRQ INSTL OR REMOVAL	MIN BREAKAWAY TORQUE
			.086-56	2.5	.2
			.112-40	5	.5
			.138-32	10	1.0
			.164-32	15	1.5
.190-32	18	2.0	.190-24 1/	18	2.0
.250-28	30	3.5	.250-20 1/	30	4.5
.312-24	60	6.5	.312-18 1/	60	7.5
.375-24	80	9.5	.375-16 1/	80	12.0
.437-20	100	14.0	.437-14 1/	100	16.5
.500-20	150	18.0	.500-13 1/	150	24.0
.562-18	200	24.0	.562-12 1/	200	30.0
.625-18	300	32.0	.625-11 1/	300	40.0
.750-16	400	50.0	.750-10 1/	400	60.0
.875-14	600	70.0	.875-9 1/	600	82.0
1.000-12	800	90.0	1.000-8 1/	800	110.0
1.125-12	900	117.0	1.125-7 1/	900	137.0
1.250-12	1,000	143.0	1.250-7 1/	1,000	165.0
1.375-12	1,200	180.0	1.375-6 1/	1,200	200.0
1.500-12	1,400	210.0	1.500-6 1/	1,400	230.0
			1.750-5 1/	1,800	300.0
			2.000-4.5 1/	2,200	360.0
			2.250-4.5 1/	2,600	430.0
			2.500-4 1/	3,000	500.0

1/ Inactive for design of military aircraft.

TABLE IV. Locking torque tests.

Nut types 1/	Test Temperature	Test Paragraph	Percent allowable maximum 2/ of Table III
250° F	Room ambient	4.5.3.3.2 4.5.3.3.3.1	100
250° F	250° F	4.5.3.3.5.1.2 4.5.3.3.5.2.2	150
450° F	Room ambient	4.5.3.3.2.1 4.5.3.3.3.1	100
450° F	450° F	4.5.3.3.5.1.1 4.5.3.3.5.2.1	200 3/ 150 4/
800° F	Room ambient	4.5.3.3.2.1 4.5.3.3.3.1	100
800° F	800° F	4.5.3.3.5.1.1 4.5.3.3.5.2.1	200 3/ 150 4/

1/ Maximum usage temperature
2/ Installation and/or removal torque
3/ First, seventh and fifteenth cycles
4/ Last cycle only

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TABLE V. Torque out.

Thread Size	Torque (minimum inch-pounds)
.086	10
.112	20
.138	30
.164	45
.190	60
.250	100
.312	160
.375	240
.437	350
.500	400
.562	450
.625	500

TABLE VI. Push out.

Thread Size	Pounds
.086	20
.112	40
.138	60
.164	80
.190	100
.250 and over	125

TABLE VII. Limits of Depths (inches) on Laps, Seams and Inclusion

Thread size of nut	.312 and under	.375	.437	.500	.562	.625	.750	.875
Nuts made from sheet metal	.005	.006	.007	.009	.011	.012	.014	.017
Nuts made from bar or wire	.010	.011	.012	.014	.016	.017	.019	.022

TABLE VII. Limits of Depths (inches) on Laps, Seams and Inclusion (CONTINUED)

Thread size of nut	1.000	1.125	1.250	1.375	1.500	1.750	2.000	2.250	2.500
Nuts made from sheet metal	—	—	—	—	—	—	—	—	—
Nuts made from bar or wire	.025	.028	.031	.048	.052	.066	.075	.084	.096

TABLE VIII. Variables plan.

Lot size	Sample size
Under 10,000	5
10,000 to 50,000	7
50,001 to 100,000	10
Over 100,000	15

TABLE IX. Attribute plan.

Lot size	Sample Size	Acceptance Number
Under 10,000	5	0
10,000 to 50,000	10	0
50,001 to 100,000	15	0
Over 100,000	27	0

TABLE X. Pitch Diameter dimensions for permanent set test.

Thread Size	Pitch Dia Total Tol.	Min Material Condition			Max Material Condition	
		MIN PD	MAX PD		MIN PD	MAX PD
1	2	3	4		5	6
.086-56	0.0016	0.0728	0.0732		0.0736	0.0744
.112-40	0.0019	0.0939	0.0943		0.0949	0.0958
.138-32	0.0021	0.1156	0.1161		0.1167	0.1177
.164-32	0.0022	0.1415	0.1421		0.1427	0.1437
.190-24 *	0.0025	0.1604	0.1610		0.1619	0.1629
.190-32	0.0023	0.1674	0.1680		0.1687	0.1697
.250-20 *	0.0028	0.2147	0.2154		0.2164	0.2175
.250-28	0.0025	0.2243	0.2249		0.2257	0.2268
.312-18 *	0.0030	0.2734	0.2742		0.2752	0.2764
.312-24	0.0027	0.2827	0.2834		0.2843	0.2854
.375-16 *	0.0033	0.3311	0.3319		0.3331	0.3344
.375-24	0.0029	0.3450	0.3457		0.3467	0.3479
.437-14 *	0.0035	0.3876	0.3885		0.3897	0.3911
.437-20	0.0031	0.4019	0.4027		0.4038	0.4050
.500-13 *	0.0037	0.4463	0.4472		0.4485	0.4500
.500-20	0.0032	0.4643	0.4651		0.4662	0.4675
.562-12 *	0.0039	0.5045	0.5055		0.5068	0.5084
.562-18	0.0034	0.5230	0.5238		0.5250	0.5264
.625-11 *	0.0041	0.5619	0.5629		0.5644	0.5660
.625-18	0.0035	0.5854	0.5863		0.5875	0.5889
.750-10 *	0.0044	0.6806	0.6817		0.6832	0.6850
.750-16	0.0038	0.7056	0.7065		0.7079	0.7094
.875-9 *	0.0047	0.7981	0.7993		0.8009	0.8028
.875-14	0.0041	0.8245	0.8255		0.8270	0.8286
1.000-8 *	0.0051	0.9137	0.9150		0.9168	0.9188
1.000-12	0.0044	0.9415	0.9426		0.9441	0.9459
1.125-7 *	0.0054	1.0268	1.0282		1.0300	1.0322
1.125-12	0.0045	1.0664	1.0675		1.0691	1.0709
1.250-7 *	0.0055	1.1517	1.1531		1.1550	1.1572
1.250-12	0.0046	1.1913	1.1925		1.1940	1.1959
1.375-6 *	0.0060	1.2607	1.2622		1.2643	1.2667
1.375-12	0.0047	1.3162	1.3174		1.3190	1.3209
1.500-6 *	0.0061	1.3856	1.3871		1.3893	1.3917
1.500-12	0.0048	1.4411	1.4423		1.4440	1.4459
1.750-5 *	0.0067	1.6134	1.6151		1.6174	1.6201
2.000-4.5 *	0.0071	1.8486	1.8504		1.8529	1.8557
2.250-4.5 *	0.0073	2.0984	2.1002		2.1028	2.1057
2.500-4 *	0.0078	2.3298	2.3318		2.3345	2.3376

NOTES: Asterisk (*) indicates coarse threads, Inactive for design for military aircraft.
Column 3 is the minimum pitch diameter per MIL-S-8879.
Column 4 is the minimum PD plus one-quarter (0.25) of the total PD tolerance.
Column 5 is the maximum pitch diameter (Col 6) minus 0.4 of the total PD tolerance.
Column 6 is the maximum pitch diameter per MIL-S-8879.

TABLE XI. Vibration requirements.

MIL-STD-1312/7

Nut size	Bolt 1/ size	250° F Number of Samples Required	450° F and 800° F Number of Samples Required	Assembly torque (inch-pound) +5%-0
.190-32	NAS9603/9703-20	5	10	36
.250-28	NAS9604/9704-21	5	10	60
.312-24	NAS9605/9705-21	5	10	120
.375-24	NAS9606/9706-21	5	10	160
.437-20	NAS9607/9707-22	5	10	200
.500-20	NAS9608/9708-22	5	10	300

1/ For CRES nuts use NAS 96XX series of bolts. Equivalent bolts of different configurations may be substituted.

TABLE XII. Formulation of cleaner.

Ingredient	Specification	Percent by volume
Aromatic petroleum naphtha	TT-N-97 type I grade B	50
Ethyl acetate	TT-E-751	20
Methyl-ethyl-ketone	ASTM D740	20
Isopropyl alcohol	TT-I-735	10

TABLE XIII. Qualification inspections.

Test	Requirement paragraph	Test method paragraph	Sample Size
Examination of product	3.3 - 3.5	4.5.1 - 4.5.1.2	All
Suitability of lubricant coating	3.7 - 3.7.2	4.5.2 - 4.5.2.6	3
Axial tensile strength	3.8.1	4.5.3.1	10
Wrench torque	3.8.2.1	4.5.3.2	3
Locking torque	3.8.2.2 - 3.8.2.2.2	4.5.3.3 - 4.5.3.3.5	20 1/
Permanent set	3.8.2.2.3	4.5.3.3.4	3
Torque out	3.8.2.3	4.5.3.4	5
Push out	3.9	4.5.3.5	5
Vibration	3.10	4.5.3.6 - 4.5.3.6.3	10
Discontinuities	3.11	4.5.4 - 4.5.4.2	All
168-hour stress embrittlement	3.12	4.5.5.2	10
Stress corrosion	3.13	4.5.6	5
Magnetic permeability	3.14	4.5.7	All

1/ For locking torque (10) of the (20) samples shall be used for tests at room temperature and (10) for conditioning tests.
2/ Torque out and push out are not applicable to right angle plate nut and wrenchable nuts.

TABLE XIV. Quality conformance inspections.

Test	Requirement paragraph	Test method paragraph
Examination of product	3.4 - 3.5.2	4.5.1 - 4.5.1.2
Axial tensile strength	3.8.1	4.5.3.1
Locking torque 1/	3.8.2.2 - 3.8.2.2.3	4.5.3.3 thru 4.5.3.3.4.1
Torque out (not applicable to right angle plate and wrenchable nuts)	3.8.2.3	4.5.3.4
Push out (not applicable to right-angle plate wrenchable nuts)	3.9	4.5.3.5
Discontinuities	3.11	4.5.4
23-hour stress embrittlement	3.12	4.5.5.1
Magnetic Permeability	3.14	4.5.7

1/ Except paragraphs 3.8.2.2.3 and 4.5.3.3.4.

TABLE XV. TEST BOLTS 3/ 4/

FINE THREAD SERIES			COARSE THREAD SERIES			EXTERNAL THREAD MAJOR DIAMETER 1/
NUT SIZE	NUT MATERIAL		NUT SIZE	NUT MATERIAL		
	NONCRES STEEL	CRES		NONCRES STEEL	CRES	
	ALUMINUM			ALUMINUM		
	Ni-Cu ALLOY			Ni-Cu ALLOY		
	Cu BASE ALLOY			Cu BASE ALLOY		
			.086-56	MS16997	MS16995	-
			.112-40	MS16997	MS16995	-
			.138-32	MS16997	MS16995	-
			.164-32	MS16997	MS16995	-
190-32	NAS9703	NAS9603	.190-24	2/	2/	-
.250-28	NAS9704	NAS9604	.250-20	2/	2/	-
312-24	NAS9705	NAS9605	.312-18	2/	2/	-
.375-24	NAS9706	NAS9606	.375-16	2/	2/	-
.437-20	NAS9707	NAS9607	.437-14	2/	2/	-
.500-20	NAS9708	NAS9608	.500-13	2/	2/	-
.562-18	NAS9709	NAS9609	.562-12	1/	1/	-
.625-18	NAS9710	NAS9610	.625-11	2/	2/	-
.750-16	NAS9712	NAS9612	.750-10	2/	2/	-
.875-14	NAS9714	NAS9614	.875-9	2/	2/	-
1.000-12	NAS9716	NAS9616	1.000-8	2/	2/	-
1.125-12	NAS9718	NAS9618	1.125-7	2/	2/	-
1.250-12	NAS9720	NAS9620	1.250-7	2/	2/	-
1.375-12	NAS9722	NAS9622	1.375-6	2/	2/	
1.500-12	NAS9724	NAS9624	1.500-6	2/	2/	
			1.750-5	1/	1/	1.723/1.750
			2.000-4.5	1/	1/	1.978/2.000
			2.250-4.5	1/	1/	2.228/2.250
			2.500-4	1/	1/	2.476/2.500

Threads per MIL-S-7742 or MIL-S-8879 except as follows:

1/ External thread major diameter modified as tabulated.

2/ External thread major diameter per NAS9600 or NAS9700 series

3/ Screws, bolts, studs or threaded mandrels having like characteristics such as, material, dimensions, heat treat, finish and lubricant may be used.

4/ Cadmium plated, non-corrosion resistant steel screws, bolts or studs. Unplated, corrosion resistant steel screws, bolts or studs.

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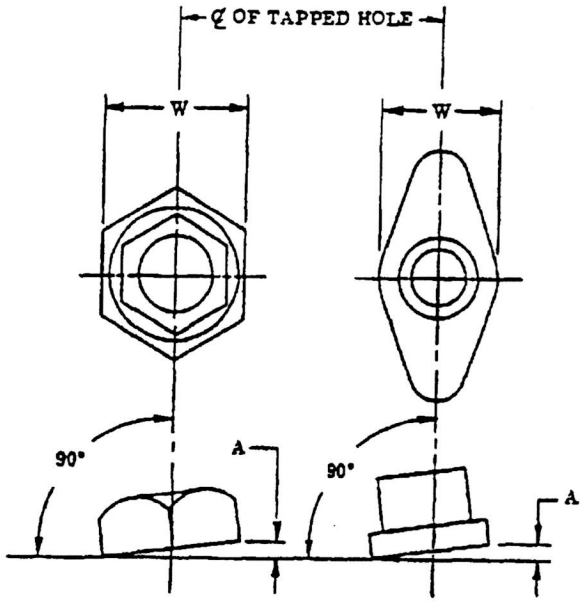

W Width or Base Ring Bearing (to Nearest .0625-inch)	A Maximum (Inch)	W Width or Base Ring Bearing (to Nearest .0625-inch)	A Maximum (Inch)
Less Than .188	.004	2.063, 2.125	0.020
.188, .250	.005	2.188, 2.250	.021
.313, .375	.006	2.313, 2.375	.022
.438, .500	.007	2.438, 2.500	.023
.563, .625	.008	2.563, 2.625	.024
.688, .750	.009	2.688, 2.750	.025
.813, .875	.010	2.813, 2.875	.026
.938, 1.000	.011	2.938, 3.000	.027
1.063, 1.125	.012	3.063, 3.125	.028
1.188, 1.250	.013	3.188, 3.250	.029
1.313, 1.375	.014	3.313, 3.375	.030
1.438, 1.500	.015	3.438, 3.500	.031
1.563, 1.625	.016	3.563, 3.625	.032
1.688, 1.750	.017	3.688, 3.750	.033
1.813, 1.875	.018	3.813, 3.875	.034
1.938, 2.000	.019	3.938, 4.000	.035

FIGURE 1. Dimensions for measuring relationship of bearing surface with respect to the axis of the pitch diameter of the threads.

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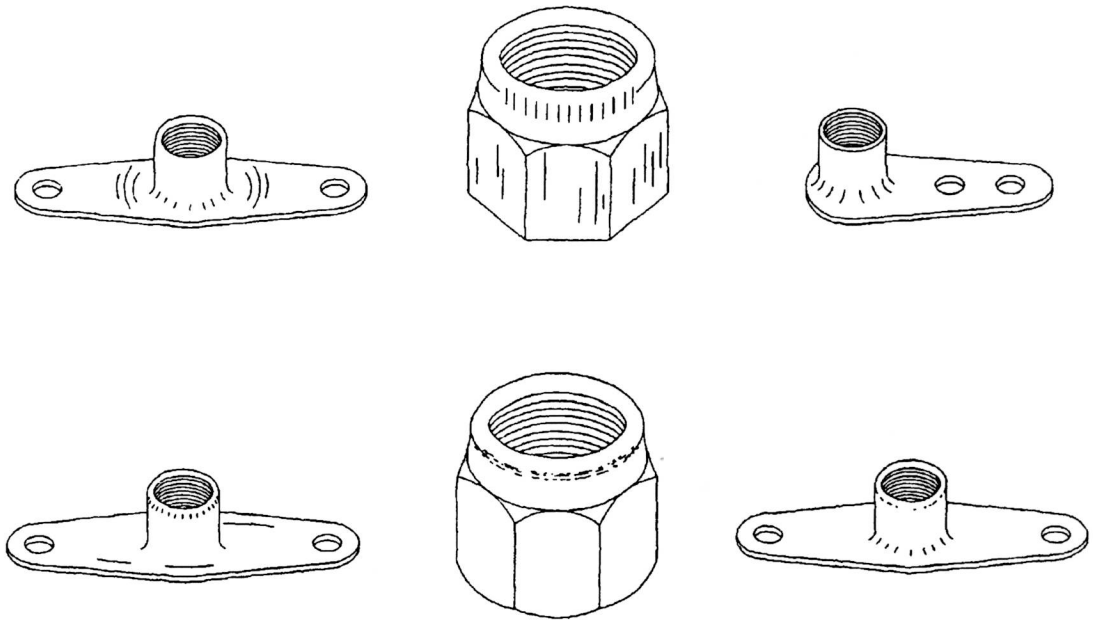
ACCEPTABLE



Tool marks and draw marks on self-locking nuts as a result of normal machining or heading operations shall not be cause for rejection, provided discontinuities are within the limits of Table VII.

FIGURE 2. Acceptable indications of self-locking nuts as revealed by magnetic particle or fluorescent penetrant inspection.

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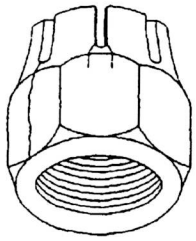
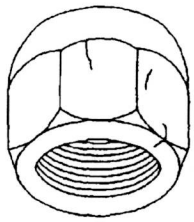
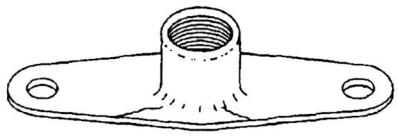
REJECTABLE

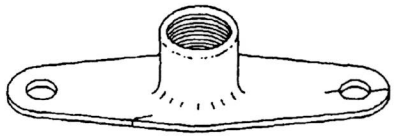


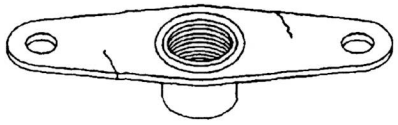
Nut having seams, laps, or inclusions which intersect an edge in line with beam slots passing through the center of the hex flats.

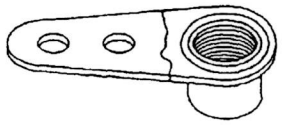


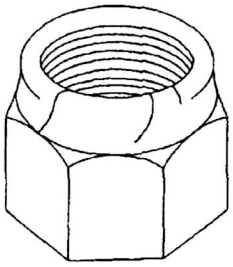
Nut fabricated from bar stock which has seams, laps, or inclusions which intersect an edge.

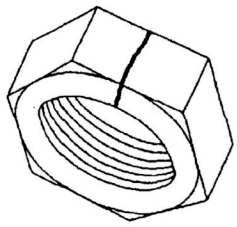


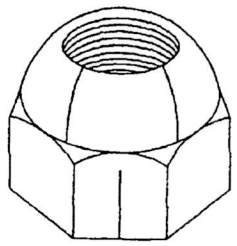












Nuts having laps or seams due to the forming of the metal in excess of the limits specified in Table VII.

FIGURE 2a Rejectable indications of self-locking nuts as revealed by magnetic particle or fluorescent penetrant inspection.

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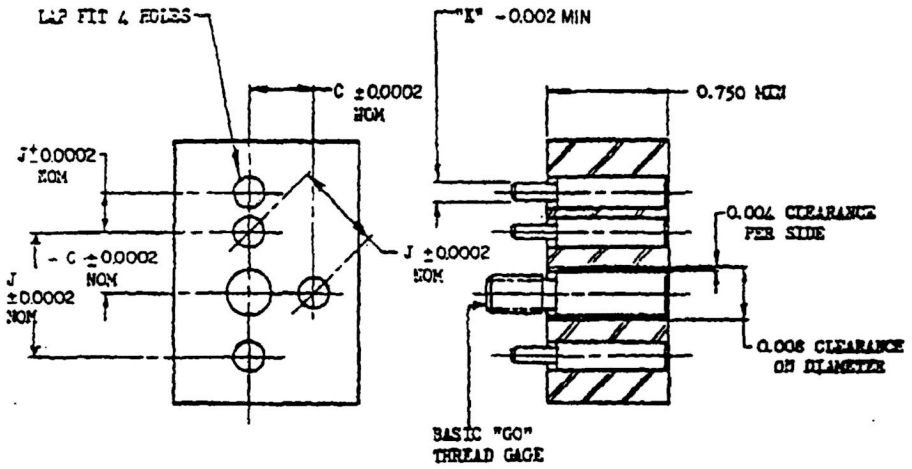

NOTES:
1. Dimensions in inches.
2. MS or AN tolerance on dimension "J" between rivet holes ± ±0.002, gage pins being 0.002 below min "K" dia check parts to 0.002 functionally.
3. MS tolerance on dimension "C" between rivet and tapped hole equal the center of tapped hole shall not deviate in any direction from the center of plate nut as determined by the rivet holes by more than 0.005.
4. The center hole in the gage having 0.004 clearance per side and the rivet hole pins having 0.001 clearance per side checks the relationship to a total of 0.005 per side functionally.

FIGURE 3. Plate nut functional alignment gage.

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