



AEROSPACE STANDARD

AS4417**REV. A**

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Revised 2014-04

Superseding AS4417

(R) Nuts, Self-Locking, Alloy, Corrosion and Heat Resistant,
High Strength, All Metal, Solid Film Lubricated,
1400 °F, Procurement Specification

RATIONALE

Update thread specification to AS8879, add option for permanent set to test on bolt, revise coating allowance to AS8879 requirements, remove SI units throughout, update references throughout, general editorial update, redraw figures and re-format tables.

1. SCOPE

1.1 Type

This document covers all-metal, self-locking nuts, plate nuts, and gang channel nuts made of a corrosion and heat resistant nickel alloy.

1.2 Field of Application

For use in aerospace applications exposed to extreme environments where high strength nuts with unified "J" (AS8879) threads are required. The solid film used shall be capable of operating in a vacuum at a temperature elevated to 1400 °F.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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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.

AMS2518	Thread Compound, Anti-Seize, Graphite-Petrolatum
AMS5709	Nickel Alloy, Corrosion and Heat-Resistant, Bars and Forgings, 58Ni - 19.5Cr - 13.5Co - 4.3Mo - 3.0Ti - 1.4Al - 0.05Zr - 0.006B, Consumable Electrode or Vacuum Induction Melted, 1975 °F (1079 °C) Solution, Stabilization, and Precipitation Heat Treated
AS1310	Fastener Torque for Threaded Applications, Definitions of
AS1701	Lubricant, Solid Film
AS7471	Bolts and Screws, Nickel Alloy, UNS N07001 Tensile Strength 165 ksi, Corrosion and Heat Resistant, Procurement Specification
AS8879	Screw Threads - UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter

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 B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
ASME Y14.36M	Surface Texture Symbols

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 E1417/E1417M	Standard Practice for Liquid Penetrant Testing
ASTM D3174	Standard Test Method for Ash in the Analysis Sample of Coal and Coke from Coal

2.1.4 U.S. Government Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, <http://quicksearch.dla.mil/>.

MIL-STD-2073-1	Standard Practice for Military Packaging
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2.2 Definitions

Refer to AS1310 for definitions related to fastener torque.

ROOM TEMPERATURE: Ambient temperature (68 °F approximately)

3. TECHNICAL REQUIREMENTS

3.1 Nut Material

Shall be a corrosion and heat resistant nickel alloy, such as AMS5709 (UNS N07001), as specified.

3.2 Solid Film Lubricant

Shall meet the requirements of AS1701 Class IV.

3.3 Thread Compound

Shall meet the requirements of AMS2518 except it shall have no greater than 0.2% ash content as determined by ASTM D3174.

3.4 Construction

Each nut 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 the locking action.

3.5 Threads

Threads shall conform to AS8879 except that the finished product may have an antiseizure allowance that provides a clearance fit as specified on the drawing.

3.5.1 Thread Squareness

The bearing surface shall be square with the thread pitch diameter axis within the limits specified on the part drawing. Squareness shall be determined by a method agreed upon by purchaser and vendor. The squareness requirement shall apply to the complete bearing surface of the nut except that, for non-floating plate nuts having a bearing surface exceeding 1.5 times the thread major diameter, the squareness requirement shall, unless otherwise specified, apply only to the portion of the bearing surface of the nut contained within a diameter equal to 1.5 times the thread major diameter. The nuts to be inspected shall permit at least three complete turns of engagement on the thread arbor of the gage, coating may be stripped if necessary to meet this requirement. Multipiece floating plate nuts shall have the nut element removed from the retainer for checking thread squareness.

3.5.2 Coating Allowance

Internal AS8879 threads to be coated with solid film lubricant shall have the maximum pitch diameter increased in accordance with AS8879 coating allowance. The solid film lubricant may be removed for gaging. If the parts are to be returned to stock, they shall be recoated with solid film lubricant.

3.6 Finish

Nuts shall be coated with solid film lubricant in accordance with AS1701 Class IV. On nuts with thread sizes 0.2500 inch and larger, the coating thickness shall be not less than 0.0002 inch when measured on the thread pitch diameter. Microscopic measurement on a sectioned nut shall be used as a referee method. Nuts with thread sizes 0.1900 inch and smaller shall show complete coating coverage on the threads. Coating on other surfaces shall be 0.0003 to 0.0006 inch thick.

3.7 Performance

Nuts shall conform to the following requirements; all tests shall be conducted on representative nuts assembled on bolts of any convenient length and on which the nuts will assemble freely, with the fingers, a minimum of one complete turn.

3.7.1 Axial Strength

Not less than four nuts in the as-received condition and four nuts which have been heated to 1400 °F ± 15 °F, held at heat for 6 hours ± 0.25 hour, and cooled to room temperature shall be assembled on nickel alloy bolts conforming to AS7471, and having AS8879 threads. Each nut-bolt assembly shall be tested at room temperature in axial tension, using a bearing plate to grip the nut. The diameter of the hole in the bearing plate shall be 0.030 to 0.034 inch greater than the basic major diameter of the bolt thread and the bearing plate thickness shall be not less than the major diameter of the bolt thread. Edges of the hole in the bearing plate shall be broken 0.010 to 0.015 inch. Axial strength of the nut shall be not lower than the values specified in Table 1 and the nuts shall not crack during test; tests need not be run to destruction. The axial tensile load shall be applied to the nut slowly at a minimum of 1.5 minute to reach the axial tensile load values specified in Table 1.

TABLE 1 - AXIAL TENSILE LOAD

Thread Size	Axial Tensile Load At Room Temperature lbf min /1/
0.1120-40 UNJC-3B	895
0.1120-48 UNJF-3B	1020
0.1380-32 UNJC-3B	1342
0.1380-40 UNJF-3B	1575
0.1640-32 UNJC-3B	2153
0.1640-36 UNJF-3B	2314
0.1900-32 UNJF-3B	3156
0.2500-28 UNJF-3B	5861
0.3125-24 UNJF-3B	9438
0.3750-24 UNJF-3B	14 556
0.4375-20 UNJF-3B	19 622
0.5000-20 UNJF-3B	26 758
0.5625-18 UNJF-3B	33 990
0.6250-18 UNJF-3B	43 207

/1/ The axial tensile load requirement is based on a stress of 180 000 psi x the tensile stress area

NOTE: The thread tensile stress area is based on the mating thread minor diameter and is calculated as follows:

$$A_s = .7854 [D - (1.2990 / n)]^2 \quad (\text{Eq. 1})$$

where:

A_s = thread tensile stress area in²

D = basic major diameter in

n = threads per inch

then,

The axial tensile load lbf = 180 000 psi × A_s

3.7.1.1 Shank Nuts

Nuts with shanks designed to be flared at assembly (see Figure 1) shall be tested as specified in 3.7.1 except that the hole in the bearing plate shall be 0.004 to 0.008 inch greater than the maximum allowable shank diameter. It is not necessary to flare the shank for this test. The bearing plate hole shall be chamfered sufficiently to clear the shank nut bearing surface-to-shank maximum fillet.

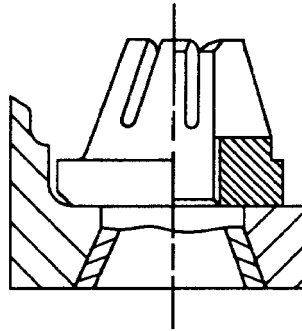


FIGURE 1 – SHANK NUTS

3.8 Qualification Tests

3.8.1 Completion of Testing

Self-locking nuts furnished to the requirements of this document shall be a product that meets the qualification tests specified herein. Completion within specified limits will establish conformance to the qualification tests requirements of this document. Successful completion of the qualification tests within the limits of this document does not relieve the supplier of responsibility for the design with respect to other requirements of this document.

3.8.2 Room Temperature Reusability

Nuts with lubricant applied shall demonstrate a minimum of five cycle reusability when tested in accordance with 3.8.4.1.

3.8.2.1 First Cycle Breakaway Torque

First cycle minimum breakaway torque shall meet the requirements of Table 2. The room temperature installation, removal, and breakaway torques on all subsequent cycles shall meet the requirements of Table 3.

3.8.3 Elevated Temperature Reusability

Lubricant which has been applied to nuts shall demonstrate a minimum of three cycle reusability when tested in accordance with 3.8.4.2.

3.8.3.1 Initial Installation Cycle

During the initial installation cycle, the minimum breakaway torque shall meet the requirements of Table 2 and the maximum installation torque shall meet the room temperature requirements of Table 3.

3.8.3.2 Elevated Temperature Exposure

The maximum installation or removal torque after elevated temperature exposure shall meet the requirements of Table 3.

3.8.4 Self-Locking Nut Qualification Bench Test

The qualification bench test specified in 3.8.4.1 through 3.8.4.8 shall be satisfactorily performed by the supplier prior to the initial shipment of the part.

TABLE 2 - FIRST CYCLE MINIMUM BREAKAWAY TORQUES

Thread Size	First Cycle Minimum Breakaway Torque lbf-in
0.1120-40 UNJC-3B	0.5
0.1120-48 UNJF-3B	0.5
0.1380-32 UNJC-3B	1
0.1380-40 UNJF-3B	1
0.1640-32 UNJC-3B	3
0.1640-36 UNJF-3B	3
0.1900-32 UNJF-3B	4
0.2500-28 UNJF-3B	7
0.3125-24 UNJF-3B	13
0.3750-24 UNJF-3B	19
0.4375-20 UNJF-3B	28
0.5000-20 UNJF-3B	36
0.5625-18 UNJF-3B	48
0.6250-18 UNJF-3B	64

TABLE 3 - INSTALLATION, REMOVAL AND BREAKAWAY TORQUE LIMITS /1/

Thread Size	Maximum Installation or Removal Torque Room Temperature lbf-in	Maximum Installation or Removal Torque After High Temperature Exposure lbf-in	Minimum Breakaway Torque lbf-in
0.1120-40 UNJC-3B	5	10	0.5
0.1120-48 UNJF-3B	5	10	0.5
0.1380-32 UNJC-3B	10	20	1
0.1380-40 UNJF-3B	10	20	1
0.1640-32 UNJC-3B	15	30	1.5
0.1640-36 UNJF-3B	15	30	1.5
0.1900-32 UNJF-3B	18	36	2
0.2500-28 UNJF-3B	30	60	3.5
0.3125-24 UNJF-3B	60	120	6.5
0.3750-24 UNJF-3B	80	160	9.5
0.4375-20 UNJF-3B	100	200	14
0.5000-20 UNJF-3B	150	300	18
0.5625-18 UNJF-3B	200	400	24
0.6250-18 UNJF-3B	300	600	32

/1/ Installation, Removal, and Breakaway Torque. The first cycle breakaway torque shall be within the limits of Table 2. The installation, removal, and breakaway torques on all subsequent cycles shall be within the limits of Table 3.

3.8.4.1 Room Temperature Reusability Test

A room temperature reusability test shall be run on not less than five nuts as specified below. The bolt used shall be as specified in Table 4. The bolt shall be replaced for each nut tested.

- a. Insert the bolt through a spacer as shown in Figure 2. The material for the spacer-type fixture shall be made of AMS5709 nickel alloy. Spacer may be counter-bored 0.004 to 0.008 inch greater than the maximum allowable shank diameter of shank nuts, so the spacer can seat onto the bearing surface of the nut. The spacer length shall be as specified in Table 4.
- b. Apply a thin coating of lubricant meeting the requirements of AMS2518 and 3.3 to the threaded surface of a test bolt as specified in Table 4 and to the bearing surface of the nut to which solid film lubricant has been applied.
- c. Install the nut and record the maximum installation torque.
- d. Record the breakaway torque.
- e. Seat the nut using the torque specified in Table 5.
- f. Unseat the nut and record the unseating torque.
- g. Record the breakaway torque.
- h. Remove the nut and record the maximum removal torque.
- i. Steps (b) through (h) shall be repeated a total of twelve times; except the minimum prevailing torque is also to be measured and recorded on the fifth cycle.

NOTE: Test shall be run slowly enough to limit the temperature rise of the nut to 75 °F above room temperature. If a nut exhibits a varying (high-low) torque, this shall be noted and breakaway torque recorded at low points.

TABLE 4 - TEST BOLT

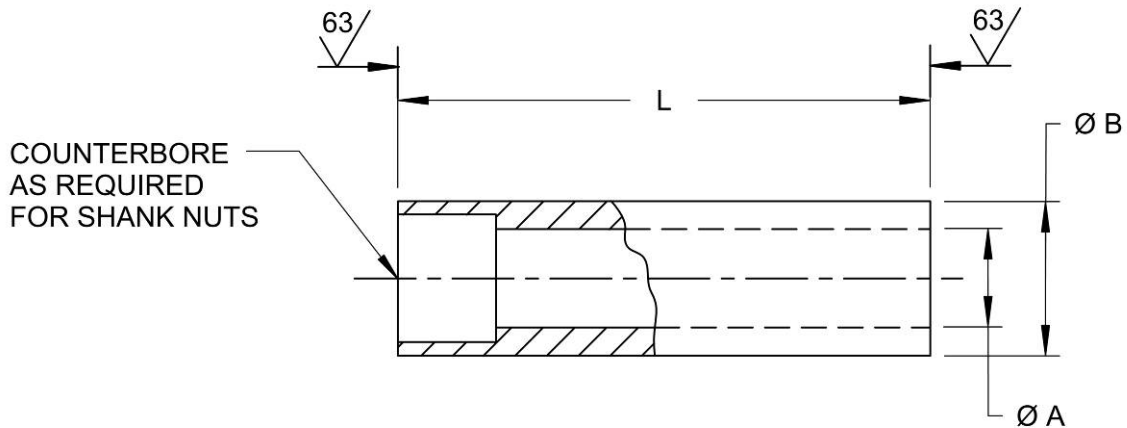
Test Bolt /1/	Nominal Thread Size in	Nominal Bolt Length in	Fixture Length in	Minimum Bolt Elongation in /2/
---	0.1120	1.000	0.735-0.765	0.0021
MS9694-22	0.1380	1.500	1.109-1.139	0.0031
MS9695-29	0.1640	2.000	1.569-1.599	0.0043
MS9696-33	0.1900	2.500	2.010-2.040	0.0056
MS9697-33	0.2500	2.500	1.941-1.971	0.0054
MS9698-31	0.3125	2.500	1.845-1.875	0.0051
MS9699-29	0.3750	2.500	1.823-1.853	0.0050
MS9700-28	0.4375	2.500	1.718-1.748	0.0048
MS9701-26	0.5000	2.500	1.621-1.651	0.0045
MS9702-25	0.5625	2.500	1.518-1.548	0.0042
---	0.6250	2.500	1.433-1.463	0.0040

/1/ Test bolts used shall conform to AS7471 and shall have AS8879 threads. The parts shown have UNJF threads and are for reference only.

/2/ Bolt elongation is determined using 85 000 psi axial load on the nut-bolt assembly and a modulus of elasticity of 31×10^6 psi. Stress area of the bolt shall be based on the maximum minor diameter of the bolt thread. The elongation of the bolts for nut sizes not listed herein shall be $0.002742L$ min, where L = nominal spacer length as shown in Figure 2.

TABLE 5 - SEATING TORQUE

Nominal Thread Size in	Seating Torque lbf-in
0.1120	13
0.1380	16
0.1640	20
0.1900	40
0.2500	100
0.3125	225
0.3750	390
0.4375	840
0.5000	1100
0.5625	1600
0.6250	2400



A = BASIC MAJOR DIAMETER OF BOLT THREAD PLUS .030 -.034 IN

B = NUT WASHER FACE DIAMETER PLUS .115 - .135 IN. SPACER MAY BE MADE FROM HEX STOCK WITH B EQUALING THE DIMENSION ACROSS THE FLATS.

NOTES:

/1/ ENDS SHALL BE PARALLEL WITH .0015 FIM

/2/ ENDS SHALL BE SQUARE WITH CENTERLINE WITHIN .002 FIM

FIGURE 2 - SPACER

3.8.4.2 Elevated Temperature Reusability Test

An elevated temperature reusability test shall be run on not less than five nuts as specified below. The bolt used shall be as specified in Table 4. The bolt shall be replaced for each nut tested and for each cycle of the test.

- a. Measure and record the original bolt length.
- b. Insert the bolt through a spacer shown in Figure 2. The material for the spacer-type fixture shall be made of AMS5709 nickel alloy. Spacer may be counterbored 0.004 to 0.008 inch greater than the maximum allowable shank diameter of shank nuts, so the spacer can seat onto the bearing surface of the nut. The spacer length shall be specified in Table 4.
- c. Apply a thin coating of lubricant meeting the requirements of AMS2518 and 3.3 to the threaded surface of a test bolt as specified in Table 4 and to the bearing surface of the nut to which solid film lubricant has been applied.
- d. Install the nut and record the maximum installation torque.
- e. Record the breakaway torque.
- f. Seat the nut until the bolt elongation as specified in Table 4 is obtained, record the seating torque. Measure and record the loaded bolt length.
- g. The bolt/nut/spacer assembly shall be soaked at $1400^{\circ}\text{F} \pm 25^{\circ}\text{F}$ for $100 \text{ hours} \pm 8 \text{ hours}$.
- h. Allow the assembly to cool to room temperature; then measure and record the bolt length before unseating the nut.
- i. Unseat the nut and record the unseating torque.

- j. Record the breakaway torque.
- k. Remove the nut and record the maximum removal torque.
- l. Measure and record the bolt length.
- m. Steps (b) through (l) shall be repeated a total of three times except the minimum prevailing torque shall be measured and recorded on the third removal cycle.

NOTE: If a nut exhibits varying (high-low) torque, it shall be noted and the breakaway torque recorded at low points.

3.8.4.3 Permanent Set

At least three nuts shall be assembled on a maximum mandrel or bolt in accordance with Figure 3 so that the mandrel or bolt projects through the nut not less than three turns. Nuts shall then be removed from the maximum mandrel or bolt and assembled on a minimum mandrel or bolt in accordance with Figure 4 in the same manner. Tests shall be conducted at room temperature with no axial stress. The nuts shall not exceed the maximum locking torque of Table 3 during the installation or removal cycle on the maximum mandrel or bolt and shall not show less than the minimum breakaway torque of Table 3 at the start of the removal cycle on the minimum mandrel or bolt.

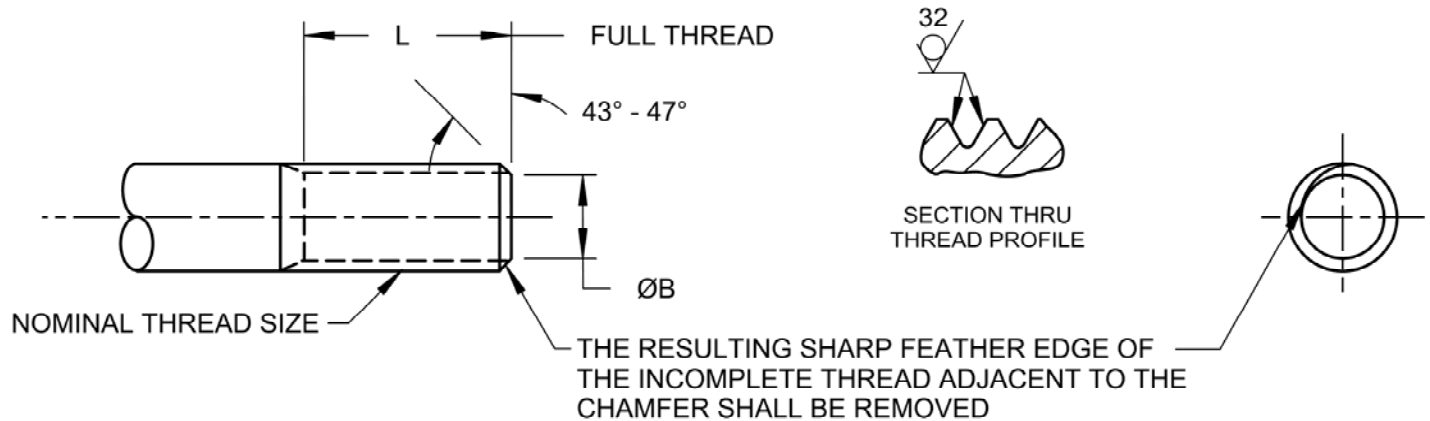
3.8.4.4 Torque Test

Parts from each manufacturing lot shall be subjected to a first cycle room temperature breakaway torque test as follows:

- a. Apply a thin coating of lubricant meeting the requirements of AMS2518 and 3.3 to the threaded surface of a bolt as specified in Table 4.
- b. Install a nut on the bolt and record the maximum installation torque.
- c. Record the breakaway torque.
- d. Remove the nut and record the maximum removal torque.

3.8.4.4.1 Installation and Removal Torque

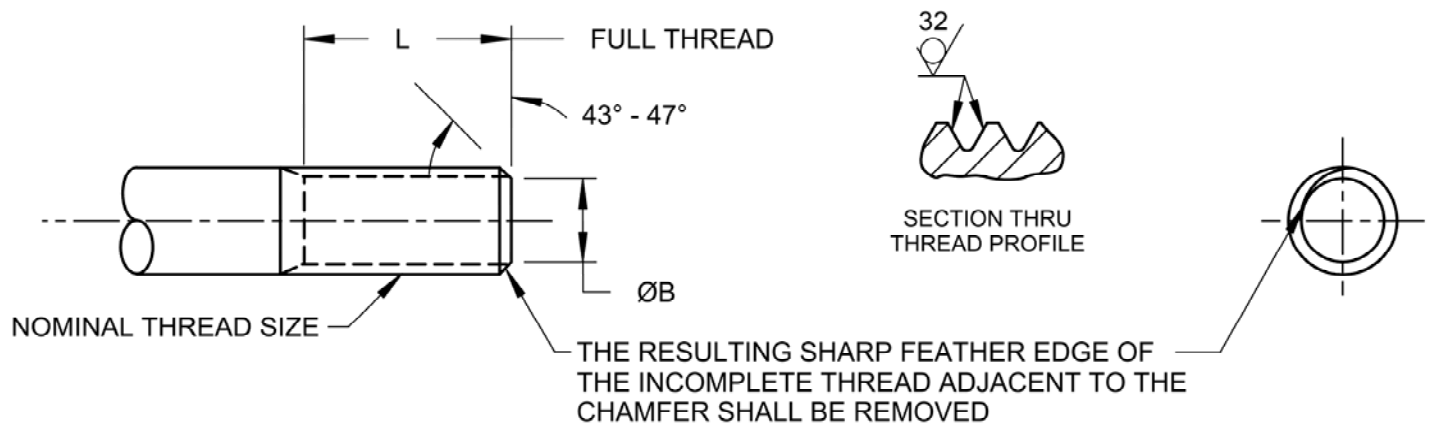
The room temperature installation and removal torques shall be within the limits of Table 3 and the first cycle breakaway torque shall be within the limits of Table 2.



Nominal Thread Size /3/	Major Ø in	Pitch Ø in	Minor Ø Max in	Helix Tolerance in /4/	Half Angle Tolerance Plus/Minus	B Ø in	L in min
0.1120-40	0.1069-0.1094	0.0949-0.0953	0.0832	0.0002	0 degree 20 minutes	0.063-0.083	0.224
0.1120-48	0.1075-0.1098	0.0977-0.0981	0.0880	0.0002	0 degree 30 minutes	0.068-0.088	0.224
0.1380-32	0.1320-0.1350	0.1167-0.1171	0.1019	0.0003	0 degree 15 minutes	0.082-0.102	0.276
0.1380-40	0.1329-0.1354	0.1209-0.1213	0.1092	0.0002	0 degree 15 minutes	0.089-0.109	0.276
0.1640-32	0.1580-0.1610	0.1427-0.1431	0.1279	0.0003	0 degree 15 minutes	0.108-0.128	0.328
0.1640-36	0.1585-0.1612	0.1451-0.1455	0.1320	0.0002	0 degree 15 minutes	0.112-0.132	0.328
0.1900-32	0.1840-0.1870	0.1687-0.1691	0.1539	0.0003	0 degree 15 minutes	0.134-0.154	0.380
0.2500-28	0.2435-0.2468	0.2257-0.2261	0.2088	0.0003	0 degree 15 minutes	0.189-0.209	0.500
0.3125-24	0.3053-0.3089	0.2843-0.2847	0.2644	0.0003	0 degree 15 minutes	0.244-0.264	0.625
0.3750-24	0.3678-0.3714	0.3467-0.3471	0.3268	0.0003	0 degree 15 minutes	0.307-0.327	0.750
0.4375-20	0.4294-0.4334	0.4038-0.4042	0.3797	0.0003	0 degree 15 minutes	0.360-0.380	0.875
0.5000-20	0.4919-0.4960	0.4663-0.4667	0.4422	0.0003	0 degree 15 minutes	0.422-0.442	1.000
0.5625-18	0.5538-0.5582	0.5251-0.5255	0.4983	0.0003	0 degree 10 minutes	0.478-0.498	1.125
0.6250-18	0.6163-0.6206	0.5876-0.5880	0.5608	0.0003	0 degree 10 minutes	0.541-0.561	1.250

1. Surface Texture: Symbols per ASME Y14.36M. Requirements per ASME B46.1.
2. Test fixture may be a mandrel made of steel with hardness of 50 HRC minimum or a bolt conforming to AS7471.
- /3/ Screw threads per AS8879 except as otherwise specified in table.
- /4/ Helix tolerance is the allowable axial variation in helix between any two thread pitches not farther apart than the basic length of engagement and is the total width of the tolerance zone, parallel to thread axis, within which the actual helical path (positive and negative) must lie.

FIGURE 3 - MAXIMUM MANDREL TEST FIXTURE



Nominal Thread Size /3/	Major $\varnothing$ in	Pitch $\varnothing$ in	Minor $\varnothing$ Max in	Helix Tolerance in /4/	Half Angle Tolerance Plus/Minus	$\varnothing B$ in	L in min
0.1120-40	0.1065-0.1069	0.0935-0.0939	0.0813	0.0002	0 degree 20 minutes	0.061-0.081	0.224
0.1120-48	0.1071-0.1075	0.0963-0.0967	0.0864	0.0002	0 degree 30 minutes	0.066-0.086	0.224
0.1380-32	0.1316-0.1320	0.1152-0.1156	0.0997	0.0003	0 degree 15 minutes	0.080-0.100	0.276
0.1380-40	0.1325-0.1329	0.1194-0.1198	0.1073	0.0002	0 degree 15 minutes	0.087-0.107	0.276
0.1640-32	0.1576-0.1580	0.1411-0.1415	0.1257	0.0003	0 degree 15 minutes	0.106-0.126	0.328
0.1640-36	0.1581-0.1585	0.1435-0.1439	0.1299	0.0002	0 degree 15 minutes	0.110-0.130	0.328
0.1900-32	0.1836-0.1840	0.1670-0.1674	0.1517	0.0003	0 degree 15 minutes	0.132-0.152	0.380
0.2500-28	0.2431-0.2435	0.2239-0.2243	0.2062	0.0003	0 degree 15 minutes	0.186-0.206	0.500
0.3125-24	0.3049-0.3053	0.2823-0.2827	0.2614	0.0003	0 degree 15 minutes	0.241-0.261	0.625
0.3750-24	0.3674-0.3678	0.3446-0.3450	0.3239	0.0003	0 degree 15 minutes	0.304-0.324	0.750
0.4375-20	0.4290-0.4294	0.4015-0.4019	0.3762	0.0003	0 degree 15 minutes	0.356-0.376	0.875
0.5000-20	0.4915-0.4919	0.4639-0.4643	0.4387	0.0003	0 degree 15 minutes	0.419-0.439	1.000
0.5625-18	0.5534-0.5538	0.5226-0.5230	0.4943	0.0003	0 degree 10 minutes	0.474-0.494	1.125
0.6250-18	0.6159-0.6163	0.5850-0.5854	0.5568	0.0003	0 degree 10 minutes	0.537-0.557	1.250

1. Surface Texture: Symbols per ASME Y14.36M. Requirements per ASME B46.1.
2. Test fixture may be a mandrel made of steel with hardness of 50 HRC minimum or a bolt conforming to AS7471.
- /3/ Screw threads per AS8879 except as otherwise specified in table.
- /4/ Helix tolerance is the allowable axial variation in helix between any two thread pitches not farther apart than the basic length of engagement and is the total width of the tolerance zone, parallel to thread axis, within which the actual helical path (positive and negative) must lie.

FIGURE 4 - MINIMUM MANDREL TEST FIXTURE

3.8.4.5 Vibration

Ten nuts of the type to be tested for the sizes listed below shall be installed on a test bolt as specified in Table 4 on a test fixture as shown in Figure 2. The assembly torque values shall be as specified in Table 6. For sizes not shown, the torque shall be as agreed upon by purchaser and vendor. Testing of nuts other than hexagon or double hexagon wrenching types shall be as agreed upon by purchaser and vendor.

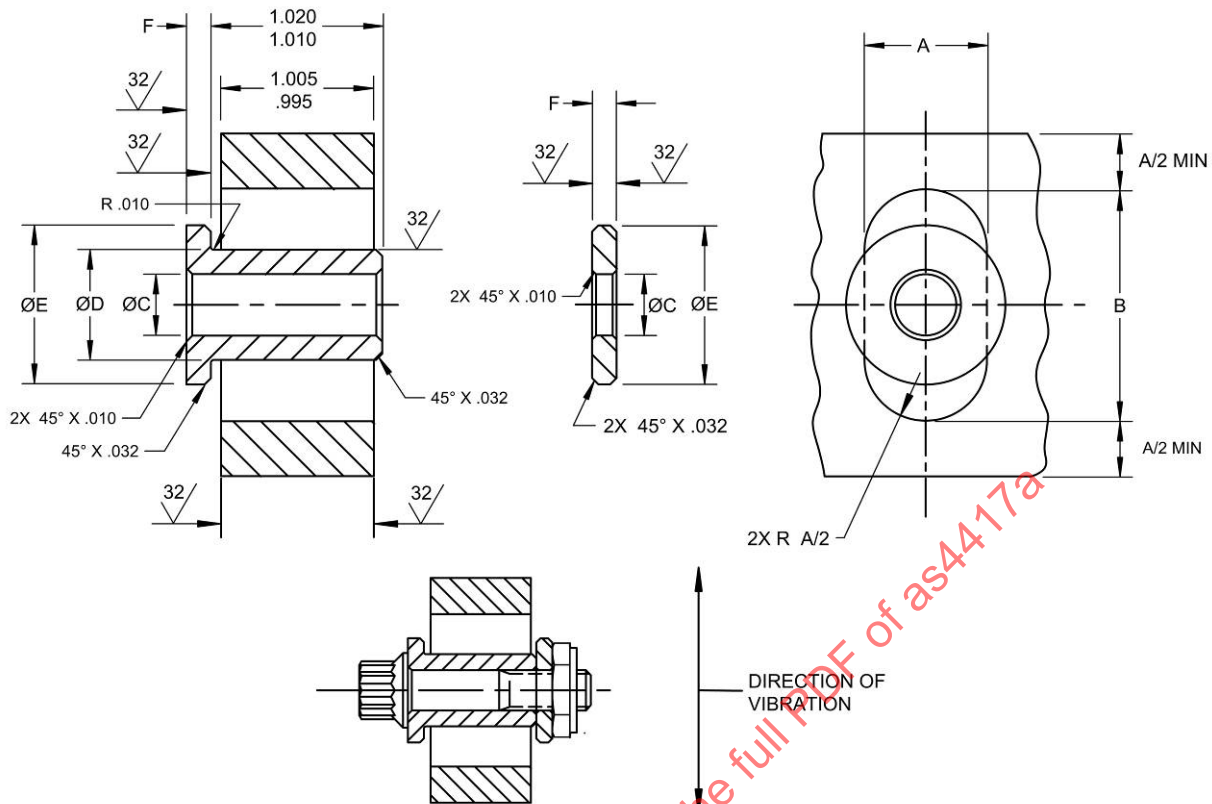
TABLE 6 - VIBRATION TEST, ASSEMBLY TORQUE

Nominal Thread Size in	Assembly Torque lbf-in min
0.1640-32	20
0.1640-36	20
0.1900-32	30
0.2500-28	60
0.3125-24	120
0.3750-24	160
0.4375-20	200
0.5000-20	300
0.5625-18	400
0.6250-18	600

Five nuts shall be removed from the test bolts and reinstalled four additional times to the torque values specified for the thread size. The other five assembled nuts shall be baked at $1400^{\circ}\text{F} \pm 15^{\circ}\text{F}$ for 6 hours ± 0.25 hour and air cooled; these nuts shall then be removed and reinstalled four additional times to the torque values specified for the thread size. The five baked nuts and the five unbaked nuts shall be assembled on the vibration test fixture (see Figure 5) on test bolts and vibration tested at room temperature. Assemblies of nuts having Class 3B threads shall be vibrated 30 000 cycles at a frequency of 29.2 to 30.0 Hz and an amplitude of 0.435 to 0.465 inch. The assembly shall traverse the entire length of the slots in the test fixture. Reference lines shall be scribed, or other suitable markings made, to determine the amount the nut turns on the test bolt during vibration test. The relative rotation between any nut and bolt shall not be greater than 360 degrees. The nuts shall not have developed any cracks or broken segments, as shown by examination at 10X magnification. Multi-piece floating plate nuts shall have the nut element removed from the retainer for this test. Fixed anchor nuts may have the lugs removed.

3.8.4.6 Flarability

At least three shank nuts shall be tested for flarability. The shank of shank nuts shall not crack when flared with a 60 degree included angle conical tool to a diameter equal to 120% of the maximum allowable shank diameter, unless otherwise specified on the part drawing.



TYPICAL ASSEMBLY

Nominal Thread Size in	A in	B in	ØC in	ØD in	ØE in	F in	Bolt (Typical)
0.1640	0.301-0.308	1.044-1.048	0.172-0.176	0.294-0.298	0.520-0.530	0.121-0.125	MS9555-26
0.1900	0.326-0.333	1.069-1.073	0.198-0.202	0.320-0.324	0.545-0.555	0.121-0.125	MS9556-27
0.2500	0.498-0.505	1.243-1.247	0.263-0.267	0.493-0.497	0.745-0.755	0.161-0.165	MS9557-28
0.3125	0.623-0.630	1.368-1.372	0.326-0.330	0.618-0.622	0.870-0.880	0.161-0.165	MS9558-27
0.3750	0.748-0.755	1.493-1.497	0.388-0.392	0.743-0.747	0.995-1.005	0.161-0.165	MS9559-26
0.4375	0.873-0.880	1.618-1.622	0.450-0.454	0.868-0.872	1.195-1.205	0.186-0.190	MS9560-27
0.5000	0.998-1.005	1.743-1.747	0.513-0.517	0.988-0.992	1.370-1.380	0.186-0.190	MS9561-26
0.5625	1.123-1.130	1.868-1.872	0.576-0.580	1.113-1.117	1.545-1.555	0.211-0.215	MS9562-27
0.6250	1.248-1.255	1.993-1.997	0.638-0.642	1.238-1.242	1.695-1.705	0.211-0.215	----

1. Material to be steel . Hardness 40-45 HRC.
2. Tolerances: Linear dimensions ± 0.010 , angular dimensions ± 5 degrees
3. Surface Texture: Symbols per ASME Y14.36M. Requirements per ASME B46.1.

FIGURE 5 - VIBRATION TEST FIXTURE

3.8.4.7 Push Out

This requirement is applicable only to gang channel nuts, floating plate nuts, and nonfloating plate nuts. At least five nuts shall be screwed or clamped to a steel plate or plates of a thickness equal to or greater than the basic major diameter of the nut thread. The bolt hole in the plate shall be located within 0.010 inch radius of true position in relation to the nut minor diameter when the nut is at basic position. The screw or clamping head diameter shall not exceed 1.5 times the rivet hole diameter and shall employ the rivet holes or be centered over same. The rivet hole size and its location from the thread axis of the nut in gang channel nut assemblies shall be shown in Table 7, unless otherwise specified. With the push out stud or device hemispherical end inserted against the base of the nut thread, the push out load specified in Table 7 shall be applied evenly to the nut on a line perpendicular to the mounting plane of the nut. When subjected to the push out load, the nut shall not be pushed out of the retainer of any type of plate nut or gang channel nut or effect a permanent deformation axial with the threaded element of more than 0.030 inch when measured at the thread centerline between the steel plate and the base of the nut retainer. Any deformation that will prevent a bolt from being assembled freely with the fingers is not permitted.

TABLE 7 - PUSH-OUT

Nominal Thread Diameter in	Rivet Hole Diameter in	Hole Location in /1/	Push-Out Load lbf-in min
0.1120	0.093-0.103	0.334-0.354	40
0.1380	0.093-0.103	0.334-0.354	60
0.1640	0.093-0.103	0.334-0.354	80
0.1900	0.093-0.103	0.334-0.354	100
0.2500	0.093-0.103	0.490-0.510	125
0.3125	0.125-0.135	0.490-0.510	125
0.3750	0.125-0.135	0.490-0.510	125
0.4375	0.125-0.135	0.522-0.572	125
0.5000	0.125-0.135	0.615-0.635	125
0.5625	0.125-0.135	0.678-0.698	125
0.6250	0.125-0.135	0.740-0.760	125

/1/ Distance from nut thread axis.

3.8.4.8 Torque-Out

The requirement is applicable only to gang channel nut assemblies, floating plate nuts, and nonfloating plate nuts. At least five nuts shall be prepared as in 3.8.4.7 and subjected to the torque out values in Table 8, first in the clockwise direction and then in the counterclockwise direction. The diameter of the torque stud shall have a maximum diametral clearance of 0.010 inch in the test plate. The torque stud shall be provided with a shoulder to seat against the base of the nut element and may incorporate a suitable bushing. Reverse loading may be accomplished by use of a check nut assembled onto the stud threads that protrude through the top of the nut. This test shall be performed with no axial load on the bearing surface of the nut. The nut assembly shall withstand the applied torque without cracking, rupture, or being deformed sufficiently to prevent normal use of the nut. Nuts used in push out test shall be used for this test.

TABLE 8 - TORQUE-OUT

Nominal Thread Diameter in	Torque-Out Load lbf-in min
0.1120	20
0.1380	30
0.1640	45
0.1900	60
0.2500	100
0.3125	160
0.3750	240
0.4375	350
0.5000	450
0.5625	600
0.6250	900

3.8.5 Testing Requirements

3.8.5.1 Reusability Tests

All recorded torque values for these tests shall meet the requirements of room temperature reusability (3.8.2) or elevated temperature reusability (3.8.3).

3.8.5.2 Distortion

During any testing, nut threads shall not show excessive distortion galling or scratches. Bolt threads shall remain serviceable and permit free assembly of a new nut with the fingers up to the locking device.

3.8.5.3 Deformation

During any testing, nut wrenching surfaces shall not show deformation that may interfere with the use of a box or socket wrench.

3.8.5.4 Bolt Reuse

Bolts and mandrels may be reused provided they meet the specified dimensions when checked before each test with a functional and pitch diameter tri-roll gage.

3.8.5.5 Qualification

The nuts furnished to the requirements of this specification shall be a product that meets the qualification tests specified herein.

3.8.5.6 Records

The supplier shall maintain records of all tests and inspections necessary to substantiate compliance with applicable standards and specifications.

3.8.5.7 Retention of Specimens

The supplier shall retain the bolts and nuts which were used in performing nut qualification bench test (3.8.4).