ADOPTION NOTICE

SAE-AS4393, "NUT, SELF-LOCKING, UNS S66286, 1200 DEG. F, 160 000 PSI, UNJ THREAD", was adopted on 01-AUG-93 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Commander, Defense Supply Center Philadelphia, ATTN: DSCP-ITAA, 700 Robbins Avenue, Philadelphia, PA 19111-5096. Copies of this document may be purchased from the Society of Automotive Engineers 400 Commonwealth Drive Warrendale, Pennsylvania, United States, 15096-0001. http://www.sae.org/

Custodians:
Army - AR
Navy - AS
Air Force - 99
DLA - IS

Adopting Activity:
DLA - IS

FSC 5310

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE STANDARD

SAE AS4393 REV. A

Issued 1991-08
Revised 1997-10

Submitted for recognition as an American National Standard

Superseding AS4393

Nut, Self-Locking, UNS S66286, 1200 °F, 160 000 psi, UNJ Thread

FSC 5310

1. SCOPE:

1.1 Type:

This specification establishes the requirements for the following types of self-locking nuts:

a. Wrenching Nuts: i.e., hexagon and double hexagon nuts.
b. Anchor Nuts: i.e., plate nuts, gang channel nuts, and shank nuts.

The wrenching nuts, shank nuts, and nut elements of plate and gang channel nuts are made of corrosion and heat resistant precipitation hardenable iron base alloy of the type identified under the Unified Numbering System as UNS S66286 and of 160 000 psi axial tensile strength at room temperature, with maximum conditioning temperature of parts at 1200 °F prior to room temperature testing.

1.2 Application:

Primarily for use in aerospace propulsion systems up to approximately 1200 °F for tension height nuts made from bar, forging, or sheet. Nuts are designed for use with bolts capable of developing 160 000 psi tensile strength at room temperature and having UNJ profile threads.

2. REFERENCES:

2.1 Applicable Documents:

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

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-8510 FAX: (412) 776-0243
TO PLACE A DOCUMENT ORDER: (412) 776-4970 FAX: (412) 776-0790

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

AMS 2411	Silver Plating, High Temperature Application
AMS 2759/3	Heat Treatment of Precipitation Hardening Corrosion and Maraging Steel Parts
AMS 5525	Steel Sheet, Strip, and Plate, Corrosion and Heat Resistant, 15Cr-25.5Ni-1.2Mo-2.1Ti-0.006B-0.30V, 1800 °F (980 °C)
AMS 5731	Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 15Cr 25.5Ni 1.3Mo 2.1Ti 0.006B 0.30V, Consumable Electrode Melted, 1800 °F (980 °C) Solution Heat Treated
AMS 5732	Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 15Cr 25.5Ni 1.3Mo 2.1Ti 0.006B 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution and Precipitation Heat Treated
AMS 5734	Steel Bars, Forgings, and Tubing, Corrosion and Heat Resistant, 15Cr-25.5Ni-1.3Mo-2.1Ti-0.006B-0.30V, Consumable Electrode Melted, 1650 °F (900 °C) Solution Heat Treated
AMS 5737	Steel Corrosion and Heat Resistant, Bars, Wire, Forgings, and Tubing 15Cr 25.5Ni 1.2Mo 2.1Ti 0.006B 0.30V Consumable Electrode Melted 1650 °F (899 °C) Solution and Precipitation Heat Treated
AS870	Wrenching Configuration, Double Hexagon (12-Point), for Threaded Fasteners
AS954	Design Data and Standardization of Thin Wall 12-Point Sockets and Box Wrenches for Aerospace Engine Use
AS1310	Fastener Torque for Threaded Applications, Definitions of
AS3071	Acceptance Criteria - Magnetic Particle, Fluorescent Penetrant, and Contrast Dye Penetrant Inspection
AS7477	Bolts and Screws, Steel, Corrosion and Heat Resistant, Upset Headed, Heat Treated, Roll Threaded, 1800 °F Solution and Precipitation Heat Treated
AS7478	Bolts and Screws, Steel, Corrosion and Heat Resistant, 1800 °F Solution Heat Treated, Precipitation Heat Treated After Roll Threaded
AIR1471	Torque Tightening Fasteners

2.1.2 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

FED-STD-H28/2	Unified Inch Screw Threads - UN and UNR Thread Forms
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-S-8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter; General Specification for
MIL-STD-1312-6	Fastener Test Methods, Method 6, Hardness
MIL-STD-1312-7	Fastener Test Methods, Method 7, Vibration
MIL-STD-1312-8	Fastener Test Methods, Method 8, Tensile Strength

2.1.3 ASTM Publications: Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 112	Determining Average Grain Size
ASTM E 140	Standard Hardness Conversion Tables for Metals
ASTM E 1417	Liquid Penetrant Examination
ASTM D 3951	Commercial Packaging

2.1.4 ASME Publications: Available from ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900 or from ANSI, 11 West 42nd Street, 13th Floor, New York, NY 10036-8002.

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

2.1.5 NAS Publications: Available from National Standards Association, Inc., 1200 Quince Orchard Boulevard, Gaithersburg, MD 20878.

NAS3353 Fixture - Bearing Surface Squareness Test Self-Locking Nuts

2.2 Definitions:

Refer to AS1310 for definitions related to fastener torque.

BURR: A rough edge or ridge left on the metal due to a cutting, grinding, piercing or blanking operation.

DEFECT: Any nonconformance of the unit of product with specified requirements.

DEFECTIVE: A unit of product which contains one or more defects.

INSPECTION LOT: Shall consist of nuts from a single production lot, of the same part number.

PRODUCTION INSPECTION LOT: Shall be all furnished parts of the same part number, made from a single heat of alloy, heat treated at the same time to the same specified condition, produced as one continuous run, and submitted for vendor's inspection at the same time.

ROOM TEMPERATURE: Ambient temperature (68 °F approximately).

TIGHT BURR: A burr closely compacted and binding in the periphery of a part without any loose ends and is within the dimensional limits of the part.

2.3 Unit Symbols:

°	degree, angular
°C	degree Celsius
°F	degree Fahrenheit
%	percent (1% = 1/100)
HRC	hardness, Rockwell C scale
lbf	pound-force
lbf-in	pound-force inch, torque
psi	pound-force per square inch
cpm	cycles per minute
in^2	square inch
µin Ra	microinch, roughness average

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be a corrosion and heat resistant steel, AMS 5731 or AMS 5734 bars or forgings, as specified on the part drawing for wrenching nuts, shank nuts, and nut elements of plate and gang channel nuts. When specified on the part drawing, wrenching nuts and nut elements of plate or gang channel nuts may be formed from AMS 5525 sheet. Material for the retaining plate for plate nuts and channel for gang channel nuts shall be capable of meeting the requirements of this specification, and shall be as specified on the part drawing.

3.2 Design:

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

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

3.2.1.1 Bearing Surface Perpendicularity: Shall be as specified on the part drawing when tested in accordance with Appendix A.

3.2.1.2 Geometric Tolerances: Part features shall be within the geometric tolerance specified on the part drawing when tested by conventional measuring methods, except for bearing surface perpendicularity as in 3.2.1.1.

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

3.2.3 Threads: Screw thread UNJ profile in accordance with MIL-S-8879.

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

3.2.3.2 Plated Threads: Thread in plated nuts shall meet the material limits for coated or plated threads specified in MIL-S-8879.

3.2.3.3 After Forming Self-Locking Feature: The upper threaded portion shall be formed out of round in any manner which provides self-locking nuts meeting the locking torque requirements of this specification. The plated nut shall allow the GO thread plug gage to enter a minimum of three turns before engagement of the locking element for tension nuts having overall length of threaded portion not less than 1.2 times the nominal thread diameter; nuts having shorter threaded portion shall allow GO thread plug gage to enter a minimum of three quarters of a turn.

3.2.4 Construction: The nut shall be of the prevailing torque-type, self-contained, all metal unit, including the self-locking feature. The locking feature shall not operate by means of separate movement and shall not depend upon pressure on the bearing surface for the locking action. Tool marks resulting from producing the self-locking feature shall blend smoothly without abrupt change.

3.3 Heat Treatment:

The nuts shall be solution and precipitation heat treated in accordance with AMS 2759/3 requirements for UNS S66286.

3.4 Product Marking:

Each part shall be identification marked as specified on the part drawing. Depressed characters shall have a rounded root form, depressed 0.010 inch maximum.

3.5 Plating:

Unless otherwise specified on the part drawing, parts shall be silver plated in accordance with AMS 2411. On nuts with nominal thread diameter 0.250 inch and larger, the plating on the thread flanks shall be not less than 0.0002 inch thick when measured on the pitch diameter. Microscopic measurement of a sectioned nut shall be used as the referee method. Nuts with nominal thread diameter below 0.250 inch shall show complete coverage on the thread surfaces. Plating on the other surfaces shall be 0.0003 to 0.0006 inch thick, unless otherwise specified on the part drawing. No plating shall be applied to the retaining plate for floating plate nuts and channel for gang channel nuts, unless otherwise specified on the part drawing.

3.6 Lubrication:

The nuts may be provided a wax type coating (cetyl alcohol) which will prevent nut-bolt seizure at initial installation provided such treatment is applicable to all production nuts of the same part number.

3.7 Mechanical Properties:

3.7.1 Hardness: Unless otherwise specified on the part drawing, the core hardness after heat treatment as in 3.3 shall be no greater than 39 HRC (see 8.1), determined in accordance with MIL-STD-1312-6. The minimum limit is controlled by the axial tensile strength requirement in 3.10.1.

3.8 Metallurgical Properties:

3.8.1 Microstructure: Wrenching nuts and nut elements of anchor nuts shall have microstructure of completely recrystallized material, except for cold working effects of tapping and forming operation of locking feature.

3.8.2 Grain Size: Shall be an average of ASTM 5 or finer with grains as large as 2 in the base of the nut as determined by comparison of a polished and etched specimen with ASTM E 112 plate 2. In case of disagreement on grain size by the comparison method, the intercept (Heyn) procedure shall be used.

3.9 Quality:

Parts shall be uniform in quality and condition, free from loose burrs (tight burrs may be acceptable if part performance is not affected), foreign materials, and from imperfections detrimental to the usage of the part.

3.9.1 Fluorescent Penetrant Inspection: Parts shall be subject to fluorescent penetrant inspection, prior to plating or with plating removed, in accordance with ASTM E 1417, Type 1, Sensitivity Level 2. Acceptance criteria of surface discontinuities shall be in accordance with AS3071.

3.10 Product Performance Test:

Refer to Tables 7 and 8 for details of sample sizes for Acceptance Test Plan and Qualification Approval Test Plan.

3.10.1 Axial Tensile Strength: Nuts shall withstand the minimum tensile load as specified in Table 1 without rupture, stripping, or appearance of cracks when tested as follows:

3.10.1.1 As Received Condition at Room Temperature: Nuts in as received condition tested in accordance with MIL-STD-1312-8, using alloy steel test bolts hardened and tempered to 40 HRC minimum and having threads in accordance with 3.2.3, shall withstand the axial tensile load specified in Table 1, applied at room temperature at the rate specified in Note /2/.

3.10.1.2 After Bake, at Room Temperature: Prior to testing, the nut shall be assembled on a bolt as specified in 3.11 with at least two thread turns protruding through the nut and baked for 6 hours ± 0.25 hour at 1200 °F ± 15 °F, and then cooled to room temperature. A new test bolt shall be used for each axial tensile test. Nuts shall be tested, after baking, at room temperature in accordance with MIL-STD-1312-8 and shall withstand the axial tensile load in Table 1, applied at the rate specified in Note /2/.

TABLE 1 - Axial Tensile Load

Nut Thread Size	Axial Tensile Load at Room Temp. lbf minimum /1/
0.138 -32UNJC-3B	1 190
0.138 -40UNJF-3B	1 400
0.164 -32UNJC-3B	1 914
0.164 -36UNJF-3B	2 056
0.190 -32UNJF-3B	2 805
0.250 -28UNJF-3B	5 210
0.3125-24UNJF-3B	8 389
0.375 -24UNJF-3B	12 940
0.4375-20UNJF-3B	17 440
0.500 -20UNJF-3B	23 780
0.5625-18UNJF-3B	30 210
0.625 -18UNJF-3B	38 410

TABLE 1 - Axial Tensile Load (Continued)

NOTES:

/1/ Requirements above apply to companion bolts with UNJ threads to Class 3A tolerance. Area upon which stress for axial strength load requirements is based on the area at 0.75H thread depth and calculated from equation:

$$A = 0.7854\,[D-(1.5H)]^2 = 0.7854\,[D-(1.2990/n)]^2 \qquad \text{(Eq. 1)}$$

where:

A = area at 0.75H thread depth, in^2
H = height of sharp V-thread = (cos 30°)/n, inch
n = number of thread pitches per inch
D = major diameter, maximum, inch

Load requirements for axial strength load is based on 160 000 psi stress induced on area A. Axial tensile load is calculated from equation:

$$\text{Axial Tensile Load} = 160\,000 \times A, \text{ for load in lbf} \qquad \text{(Eq. 2)}$$

For sizes not shown, axial tensile strength load for nuts shall be based upon the respective bolt stress area using above equations and 160 000 psi stress.

/2/

$$\text{Maximum Load, lbf/minute} = 78\,000 \times D^2 \qquad \text{(Eq. 3)}$$

where:

D = nominal major diameter of thread

3.10.1.3 Shank Nuts: Nuts with shanks designed to be flared at assembly (see Figure 1) shall be tested as in 3.10.1 except that the bearing plate hole shall be 0.004 to 0.008 inch greater than the maximum 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.

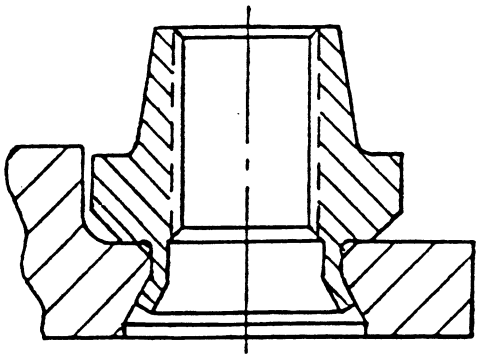


FIGURE 1 - Flange Assembly, Flared Shank Nut

3.10.2 Wrench Torque: Wrenching nuts with hexagon or double hexagon wrenching feature conforming to AS870 shall be tested as specified in Appendix B and shall withstand the wrench torques specified in Table 2 applied through 15 engagement cycles without any permanent deformation which can interfere with the use of socket wrenches conforming to AS954.

TABLE 2 - Wrench Torque

Nominal Dimension Across Flats inch	Nut Wrenching Feature Double Hexagon Wrench Torque min, lbf-in	Nut Wrenching Feature Hexagon Wrench Torque min, lbf-in
0.188	--	30
0.218	40	40
0.250	82	60
0.281	145	90
0.312	205	125
0.375	450	250
0.438	730	370
0.500	930	495
0.562	1130	690
0.625	1565	990
0.688	2000	1235
0.750	2375	1485
0.781	2750	1730
0.812	3180	1980

3.10.3 Push Out Load: Anchor nuts shall be tested as specified in Appendix C and shall withstand the push out load specified in Table 3 without separating from the plate or channel. Nuts shall be serviceable after this test.

TABLE 3 - Push-Out Load

Nominal Thread Diameter inch	Push Out Load minimum lbf
0.138	60
0.164	80
0.190	100
0.250	125
0.3125	125
0.375	125
0.4375	125
0.500	125
0.5625	125
0.625	125

3.10.3.1 The push out test in 3.10.3 is applicable to gang channel nuts, plate nuts (floating and nonfloating except side by side, corner and side mounted types). See Appendix A for definition of types.

3.10.4 Torque Out: Anchor nuts of the types in 3.10.3.1 shall be tested as specified in Appendix D and shall withstand the torque out loads in Table 4 without cracking, rupture, or being deformed to a degree which will prevent normal use. This test shall be performed with no axial load on the bearing surface of the nut retainer plate or channel.

TABLE 4 - Torque-Out Load

Nominal Thread Diameter inch	Torque-Out Load minimum lbf-in
0.138	30
0.164	45
0.190	60
0.250	100
0.3125	160
0.375	240
0.4375	350
0.500	450
0.5625	600
0.625	900

3.10.5 Permanent Set: Nuts shall be tested as specified in Appendix E and shall not exceed the maximum permissible prevailing torque or be less than the minimum breakaway torque values specified in Table 5. The bolt or mandrel shall protrude through the nut a minimum of three full thread turns.

3.10.6 Reusability Test at Room Temperature, After Bake: Nuts shall be tested for five consecutive cycles as specified in Appendix F, loading initially to 75 000 psi in accordance with 3.10.6.3. The assembly shall be heated in a furnace to 1200 °F ± 15 °F and held at heat for 6 hours ± 0.25 hour, removed from the furnace and cooled to room temperature.

3.10.6.1 Wrenching and Reference Recording: Wrenchable nuts shall be wrenched by turning the nut relative to the fixture. The wrenchability of the tested nuts shall permit assembly of standard wrench. For reference information, the installation and unseating torques shall be recorded for each heat cycle.

3.10.6.2 Locking Feature Torque Requirements: Nuts tested as in 3.10.6 shall conform to the minimum breakaway torque in Table 5, Column (1), for each cycle. The prevailing torque shall be measured on installation and removal, and shall not exceed the torque in Table 5, Column (4), nor shall be less than the breakaway torque in Table 5, Column (1).

3.10.6.3 Loading by Elongation: Loading shall be determined by measurement of elongation of the bolt at room temperature using bolts having a shank diameter equal to the thread pitch diameter. The bolt elongation used to load the nut-bolt assembly to induce 75 000 psi axial tensile stress in the bolted assembly is based on a modulus of elasticity of 29 500 000 psi and the following equations:

$$e = s/E, \text{ unit elongation, inch/inch} \quad \text{(Eq. 4)}$$

$$eL = \text{bolt elongation, inch} \quad \text{(Eq. 5)}$$

where:

e = unit strain of bolt loaded shank, inch/inch
s = 75 000 psi bolt stress at area of max minor (root) dia
E = 29 500 000 psi modulus of elasticity
L = bushing length (see Appendix F) in loaded nut-bolt assembly

The elongation of bolts for nut sizes not listed herein shall be 0.0025424L, where L = bushing length as in Appendix F.

3.10.7 Reusability Test at Room Temperature, As Received Condition: Nuts shall be tested for 15 cycles as specified in Appendix G, loading to installation torque specified in Table 5, Column (5). Wrenchable nuts shall be turned relative to the fixture. For nonwrenchable nuts, the bolt head shall be turned. Locking feature torque shall conform to the minimum breakaway torque and maximum prevailing torque in Table 5, Column (1) and (3), respectively, for each cycle. The prevailing torque shall be measured on installation and removal, and shall not exceed the torque in Table 5, Column (3), nor shall be less than the breakaway torque in Table 5, Column (1). After testing, the nut shall assemble freely, with the fingers, up to the self-locking feature. Bolt threads shall remain serviceable and permit assembly of a new nut freely, with the fingers, up to the self-locking feature.

3.10.8 3-Cycle Test at Room Temperature: Nuts shall be tested as specified in Appendix H, loading to assembly torque specified in Table 5, Column (5). Wrenchable nuts shall be turned relative to the fixture. For nonwrenchable nuts, the bolt head shall be turned. Nuts shall conform to the minimum breakaway torque in Table 5, Column (2a) for the first cycle, and Column (2b) for the subsequent 2nd and 3rd cycles. The prevailing torque shall be measured on installation and removal, and shall not exceed the torque in Table 5, Column (3), nor shall be less than the breakaway torque in Table 5, Column (2b).

TABLE 5 - Locking Feature Torques and Installation Torque

Nominal Thread Size	Minimum Breakaway torque lbf-in (1)	Minimum Breakaway Torque lbf-in (2a)	Minimum Breakaway Torque lbf-in (2b)	Maximum Prevailing Torque lbf-in (3)	Maximum Prevailing Torque lbf-in (4)	Installation torque lbf-in (5)
0.138 -32	1	2	1.2	7	14	15
0.138 -40	1	2	1.2	7	14	16
0.164 -32	1.5	3	1.8	11	22	25
0.164 -36	1.5	3	1.8	11	22	26
0.190 -32	2	4	2.4	15	30	42
0.250 -28	3.5	7	4.2	30	60	95
0.3125-24	6.5	13	7.8	60	120	185
0.375 -24	9.5	19	11.4	80	160	330
0.4375-20	14	28	16.8	100	200	530
0.500 -20	18	36	21.6	150	300	800
0.5625-18	24	48	28.8	200	400	1 150
0.625 -18	32	64	38.4	300	600	1 580

(1) Minimum breakaway torque for 15-cycle, room temperature, as received test; 5-cycle, loaded and conditioned test; permanent set test.

(2a) Minimum breakaway torque for first-cycle, of 3-cycle, loaded, room temperature test.

(2b) Minimum breakaway torque for second and third cycles of 3-cycle, loaded, room temperature test.

(3) Maximum prevailing torque for 15-cycle, room temperature, as received test; 3-cycle, loaded, room temperature test; permanent set test.

NOTE: At initial installation, values may be exceeded when bolt first enters locking feature, provided all parts are within the specified limits after a minimum of 1.5 thread pitches, including chamfer, protrudes through the top of nut.

(4) Maximum prevailing torque at removal for 5-cycle, loaded and conditioned test.

(5) Assembly torque for 15-cycle and 3-cycle tests. Values equal torque to induce 60 000 psi in companion bolt mean stress area (see AIR1471) when one member is silver plated and where threads and bearingn surfaces are lubricated with MIL-L-7808 aircraft engine oil.

3.10.9 Accelerated Vibration Test: Nuts shall be tested in accordance with MIL-STD-1312-7 and shall be loaded to assembly torques specified in Table 6. The loaded nut assembly shall withstand 30 000 cycles continuous vibration at 30 cycles per second and an amplitude (total travel) of 0.435 to 0.465 inch without relative rotation exceeding 360°, without cracking of the nut, and without being capable of turning nut by hand. Nut sizes to be tested shall be as shown in Table 6; testing of other nuts sizes shall be as agreed upon by purchaser and vendor.

3.10.9.1 At Room Temperature, As Received Condition: Nut shall be loaded as specified in 3.10.9 on spacer then removed and reinstalled four additional times on the same bolt to the assembly torques in Table 6. The final assembly shall be with the block ready for the vibration test. The loaded nut assembly shall then be vibrated at room temperature in accordance with 3.10.9 requirements, and nuts shall conform to the requirements of 3.10.9 after the vibration test.

3.10.9.2 At Room Temperature After Baking: Nuts shall be loaded as specified in 3.10.9 on spacer as specified in Appendix F, and the loaded nut assembly shall be heated in a furnace to 1200 °F ± 15 °F and held at heat for 6 hours ± 0.25 hour, and cooled to room temperature. Nut shall then be removed from the assembly and reinstalled four additional times on the same bolt to the assembly torques in Table 6. The final assembly shall be on the test fixture in the block ready for the vibration test. The loaded nut assembly shall then be vibrated at room temperature in accordance with 3.10.9 requirements, and nuts shall conform to the requirements of 3.10.9 after the vibration test.

3.10.10 Flareability: Unless otherwise specified on the part drawing, the shank of shank nuts shall be capable of being flared with a 60° included angle conical tool to a diameter equal to 120% of the maximum shank diameter without cracking.

TABLE 6 - Assembly Torque for Accelerated Vibration Test

Nominal Thread Size	Assembly Torque lbf-in
0.164 -32	22
0.164 -36	22
0.190 -32	30
0.250 -28	60
0.3125-24	120
0.375 -24	160
0.4375-20	200
0.500 -20	300
0.5625-18	400
0.625 -18	600

3.11 Test Bolts:

Except as specified in 3.10.1.1 and 3.10.2, test bolts shall be unplated and conform to AS7477 or AS7478 with threads in accordance with MIL-S-8879.

3.12 Test Lubrication:

Stud-mandrel or bolt threads and nut bearing surface, and for nonwrenchable nut tests, the bolt bearing surface shall be lubricated with aircraft engine oil MIL-L-7808 or equivalent before each installation of the nut.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of parts shall supply all parts for vendor tests and shall be responsible for performing all required tests. Subsequent to qualification, there shall be no changes in the manufacturing method and operations sequence without requalification of the parts. Results of such tests shall be reported to the purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that parts conform to the requirements of this specification.

4.2 Classification of Tests:

The inspection and testing of parts shall be classified as follows:

a. Acceptance Tests
b. Qualification Tests

4.2.1 Acceptance Tests: Tests classified as acceptance or routine control tests are listed in Table 7.

4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification and part drawing are listed in Table 8.

4.3 Sampling:

4.3.1 Acceptance Tests: Acceptance tests shall be performed on each inspection lot.

4.3.1.1 Nondestructive Tests, Visual and Dimensional: A random sample shall be selected from each inspection lot, the size of the sample to be as specified in Table 10. The classification of defects for nuts will be as specified in Table 9. Defects not classified in Table 9 shall be classified as Minor B defects. All dimensional characteristics are considered defective when out of tolerance.

4.3.1.2 Destructive Tests: A random sample shall be selected from each inspection lot, the size of the sample shall be as specified in Table 11, Column B. The sample nuts may be selected from those that have been subjected to and passed the nondestructive tests.

4.3.2 Qualification Tests: The qualification test samples shall consist of the applicable number of nuts for each thread size to be tested as specified in Table 8.

TABLE 7 - Summary of Acceptance Tests

Characteristic	Req. Para.	Sample Size	Test Method
Non-Destructive Tests			
Dimensions	3.2.1	Tables 9 & 10	Conventional measuring methods
Bearing Surface Perpendicularity	3.2.1.1	Tables 9 & 10	Appendix A
Geometric tolerances	3.2.1.2	Tables 9 & 10	Conventional measuring methods
Surface Texture	3.2.2	Tables 9 & 10	Per ASME B46.1
Thread Size	3.2.3	Tables 9 & 10	Inspection per MIL-S-8879
Product Marking	3.4	Tables 9 & 10	Visual examination
Quality	3.9	Tables 9 & 10	Visual examination
Fluorescent Penetrant Inspection	3.9.1	Tables 9 & 10	Inspection per ASTM E 1417 Criteria per AS3071
Packaging & Identification	5.1	100%	Visual examination
Destructive Tests			
Material	3.1	4.3.1.1	Certify composition
Axial Tensile Strength as received condition	3.10.1.1	Table 11	MIL-STD-1312-8
Plating	3.5	Table 11	Per AMS 2411
Microstructure	3.8.1	Table 11	Microscopic examination 100X
Grain Size	3.8.2	Table 11	Microscopic examination with chart in ASTM E 112
3-Cycle Test	3.10.8	Table 11	Appendix H
Flareability	3.10.10	Table 11	Conventional flaring tool

TABLE 8 - Summary of Qualification Tests

Characteristic	Req. Para.	Sample Size	Test Method
Destructive tests 1/			
Material	3.1	3	Certify composition
Plating	3.5	5	Per AMS 2411
Hardness	3.7.1	5	MIL-STD-1312-6
Microstructure	3.8.1	5	Microscopic examination 100X
Grain Size	3.8.2	5	Microscopic examination with chart in ASTM E 112
Axial Tensile Strength	3.10.1		
As Received	3.10.1.1	4	MIL-STD-1312-8
After 1200 °F Bake	3.10.1.2	4	MIL-STD-1312-8
Wrench Torque	3.10.2	3	Appendix B
Push Out Load	3.10.3	5	Appendix C
Torque Out	3.10.4	5	Appendix D
Permanent Set Test	3.10.5	3	Appendix E
Reusability Test			
After 1200 °F Bake	3.10.6	10	Appendix F
As Received	3.10.7	10	Appendix G
Accelerated Vibration Test	3.10.9		
As Received	3.10.9.1	5	MIL-STD-1312-7
After 1200 °F Bake	3.10.9.2	5	MIL-STD-1312-7
Flareability	3.10.10	3	Conventional flaring tool
Non-Destructive Tests 2/			
Dimensions	3.2.1	All	Conventional measuring method
Bearing Surface Squareness	3.2.1.1	All	Appendix A
Geometric Tolerances	3.2.1.2	All	Conventional measuring method
Surface Texture	3.2.2	All	Per ASME B46.1
Thread Size	3.2.3	All	Inspection per MIL-S-8879
Construction	3.2.4	All	Visual examination
Product Marking	3.4	All	Visual examination
Quality	3.9	All	Visual examination
Fluorescent Penetrant	3.9.1	All	Inspection per ASTM E 1417, criteria per AS3071

1/ Total number of samples for destructive tests equals 80; all samples shall be subjected to the non-destructive tests prior to being subjected to the destructive tests. The same test sample may be used for more than one test provided that none of the characteristics of the samples are altered during the test procedure.

2/ Sample size includes all samples for destructive tests.

TABLE 9 - Classification of Visual and Dimensional Characteristics

Class	Characteristic
Major A	
101	Presence of locking element
102	Surface discontinuities revealed by fluorescent penetrant inspection
Major B	
201	Thread size
202	Perpendicularity of bearing surface
203	Product marking
204	Shank diameter
205	Shank length
206	Rivet hole size
207	Rivet hole location
208	Surface texture
209	3-cycle test
Minor A	
301	Wrenching size and configuration
302	Nut height
303	Bearing surface diameter
304	Float of nut element
305	Burrs and tool marks
306	Depth of counterbore
307	Flange thickness
Minor B	
401	Runout of wrenching form to thread
402	Runout of shank OD to thread
403	Runout of flange OD to thread
404	Countersink on thread end
404	Other dimensional characteristics not listed

NOTE: The characteristic and its class determines the size of the sample to be selected from Table 10.

TABLE 10 - Sampling Data

Non-Destructive Tests
Visual and Dimensional Characteristics
For Classes Major A, Major B, Minor A, and Minor B

Production Inspection Lot Size	Major A Sample Size	Major B Sample Size	Minor A Sample Size	Minor B Sample Size
2 to 8	All	All	5	3
9 to 15	All	13	5	3
16 to 25	All	13	5	3
26 to 50	32	13	5	5
51 to 90	32	13	7	6
91 to 150	32	13	11	7
151 to 280	32	20	13	10
281 to 500	48	29	16	11
501 to 1200	73	34	19	15
1201 to 3200	73	42	23	18
3201 to 10000	86	50	29	22
10001 to 35000	188	60	35	29
35000 to 150000	123	74	40	29
150001 to 500000	156	90	40	29
500001 & over	189	102	40	29

The acceptance number of defectives is ZERO in all cases.
For classification of characteristics, refer to Table 9.

TABLE 11 - Sampling Data

Destructive Tests
Mechanical and Metallurgical Characteristics

Production Inspection Lot	Sample Size
Up to 500	3
501 to 3200	5
3201 to 35000	8
35001 & over	13

The acceptance number of defectives is ZERO in all cases.

4.4 Reports:

4.4.1 The vendor shall furnish with, or prior to, the first shipment of parts of each part number a report of test data showing that the parts conform to all technical requirements of this specification and the part drawing.

4.4.2 The vendor of parts shall furnish with each production lot shipment a report stating that the chemical composition of the parts conform to the applicable material specification, and showing the results of tests to determine conformance to the acceptance tests, and where applicable, the flareability requirements of this specification. This report shall include the purchase order number, production lot number, AS4393, contractor or direct supplier of material, part number, nominal size, and quantity.

4.5 Rejected Lots:

If a production inspection lot is rejected, the vendor of parts shall perform corrective action to screen out or rework the defective parts, resubmit for acceptance tests inspection as in Table 3 or scrap the entire lot. Resubmitted lots shall be clearly identified as reinspected lots.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 Packaging shall be in accordance with ASTM D 3951.

5.1.2 Parts having different part numbers shall be packed in separate containers.

5.1.3 Each container of parts shall be marked to show not less than the following information:

NUTS, SELF-LOCKING STEEL, CORROSION AND HEAT RESISTANT
AS4393
PART NUMBER
LOT NUMBER
PURCHASE ORDER NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

5.1.4 Threaded fasteners shall be protected from abrasion and chafing during handling, transportation, and storage.

6. ACKNOWLEDGMENT:

A vendor shall mention AS4393 in all quotations and when acknowledging purchase orders.

7. REJECTIONS:

Parts not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES:

8.1 Hardness conversion tables for metals are presented in ASTM E 140.

8.2 Key Words:

Nuts, Self-Locking, Procurement Specification

8.3 The change bar (**l**) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document.

PREPARED BY SAE COMMITTEE E-25,
GENERAL STANDARDS FOR AEROSPACE PROPULSION SYSTEMS

APPENDIX A
MEASUREMENT OF PERPENDICULARITY VARIATION OF THE BEARING SURFACE

A.1 SCOPE:

This appendix is a mandatory part of this specification.

A.1.1 Purpose of Test:

To measure the variation from perpendicularity of the nut bearing surface "A" (see Figure A1) relative to the thread. This inspection is applicable to all nuts.

A.1.2 Floating Nuts:

This measurement applies only to the nut element of floating nuts, when the retaining plate or channel has been removed.

A.2 APPLICABLE DOCUMENTS:

MIL-S-8879	Screw Threads, UNJ Profile
NAS3353	Fixture - Bearing Surface Squareness Test, Self-Locking Nuts

A.3 APPARATUS:

A.3.1 Particulars:

Particulars of the fixture are given in NAS3353; the mandrel shall be in accordance with the maximum mandrel in Appendix E, Figure E1.

A.4 PROCEDURE:

A.4.1 The perpendicularity of the bearing surface relative to the thread shall be measured within the basic area "A" as defined in Figure A1.

A.4.2 Nuts may be checked for perpendicularity before or after forming the self-locking feature.

A.4.3 The maximum threaded mandrel is manually assembled into the nut a minimum of three turns if checked before forming the locking feature, or until the end of the mandrel is through the locking feature if checked after forming. The variation from perpendicularity is evaluated with a shim of the required thickness.

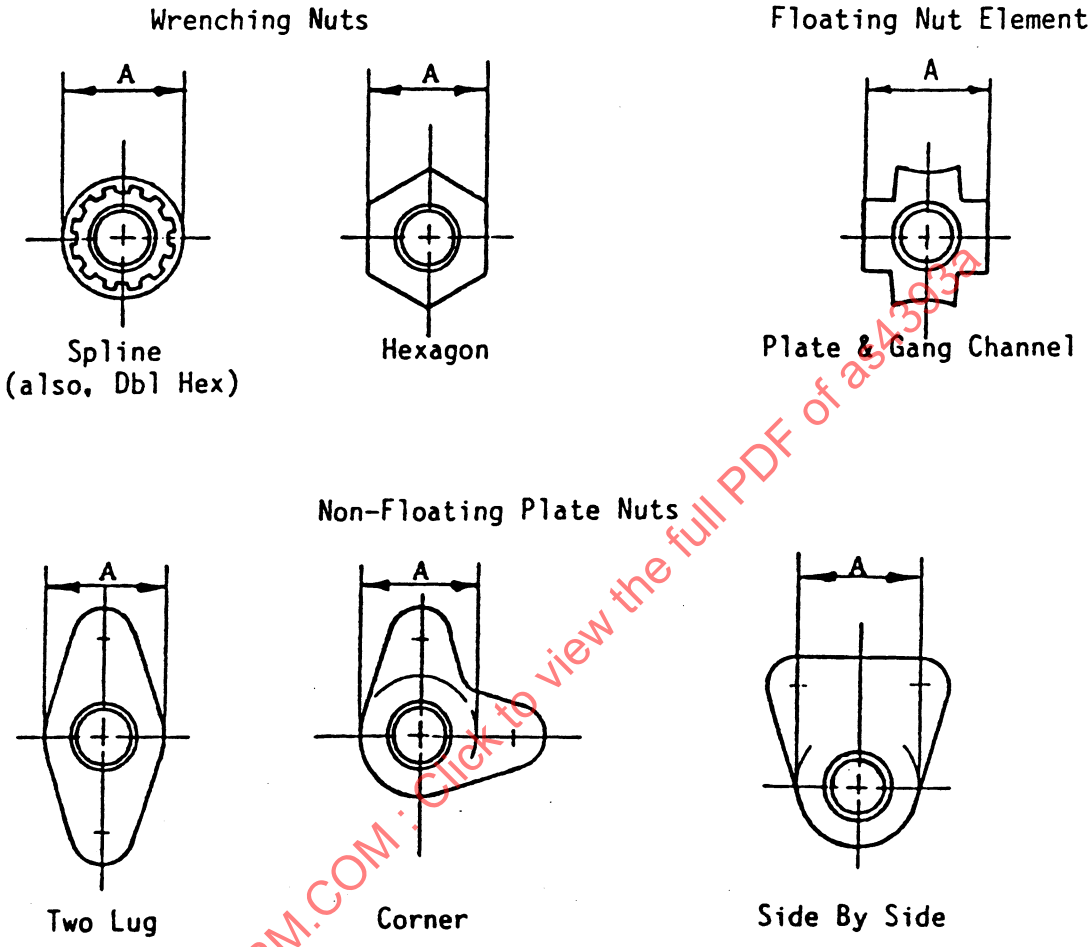


FIGURE A1 - Bearing Surface Area “A” Under Perpendicularity Control for Various Types of Nuts

APPENDIX B
WRENCH TORQUE TEST

B.1 SCOPE:

This appendix is a mandatory part of this specification.

B.1.1 Purpose of Test:

To test that the wrenching configuration is capable of withstanding the high unseating torques encountered with nuts in hot areas of aerospace propulsion systems.

B.1.2 Nut Types to be Tested:

This test is applied to externally wrenched nuts of spline, double hexagon, and hexagon wrenching configuration.

B.2 APPLICABLE DOCUMENTS:

MIL-S-8879	Screw Thread, UNJ Profile
FED-STD-H28/2	Screw Thread, UN Profile
AS954	Thin Wall 12-Point Sockets for Aerospace Engine Use

B.3 APPARATUS:

B.3.1 Typical Apparatus:

The typical test apparatus is shown in Figure B1 comprises the following:

a. Alloy steel stud with threads conforming to MIL-S-8879 or FED-STD-H28/2, tolerance Class 3A.

b. Two wrenches conforming to AS954; double hexagon sockets for hexagon and double hexagon drive nuts.

c. Square drive adapter for socket wrenches.

B.4 PROCEDURE:

B.4.1 Method Using Stud and Wrenches:

B.4.1.1 Place adapter in vise. For hexagon nuts, bottom hexagon nut is gripped in vise.

B.4.1.2 Locate first wrench socket on adapter.

B.4.1.3 Assemble nuts to be tested onto stud until bearing surfaces contact at mid length of stud. Ensure stud engages full length of nut thread but protrusion must not prevent full location of nut wrenching configuration into wrench socket.

B.4.1.4 Locate assembly into first wrench.

B.4.1.5 Engage second wrench onto upper nut and test to the requirement of this specification.

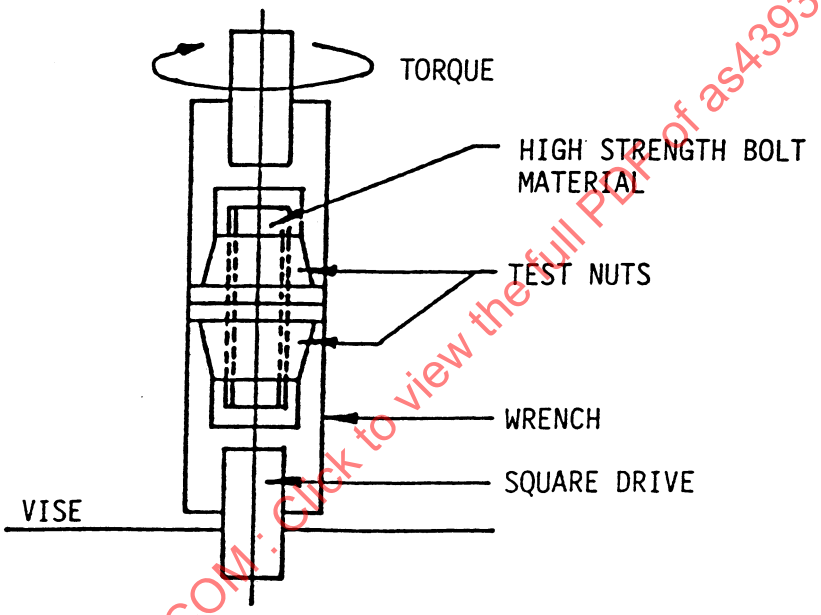


FIGURE B1 - Wrench Torque Test Apparatus

APPENDIX C
PUSH OUT TEST

C.1 SCOPE:

This appendix is a mandatory part of this specification.

C.1.1 Purpose of Test:

This test is to determine whether the nut retainer plate or channel is capable of withstanding the axial push out load specified in this specification after the nut is installed.

C.1.2 Types of Nuts to be Tested:

This test is applicable to floating plate nuts and gang channel nuts. It is not applicable to nonfloating plate nuts that are side by side mounting, and also, to floating angle plate nuts (see Figure C1).

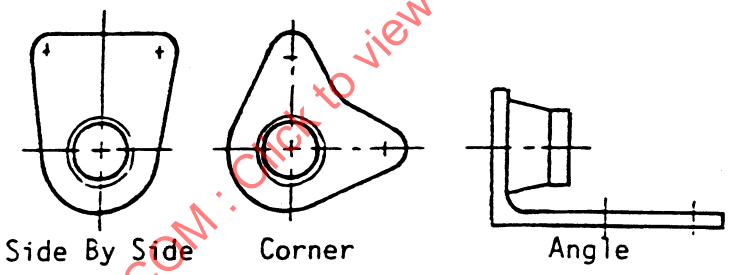


FIGURE C1 - Types of Nuts Not Applicable to Push Out Test

C.2 APPLICABLE DOCUMENTS:

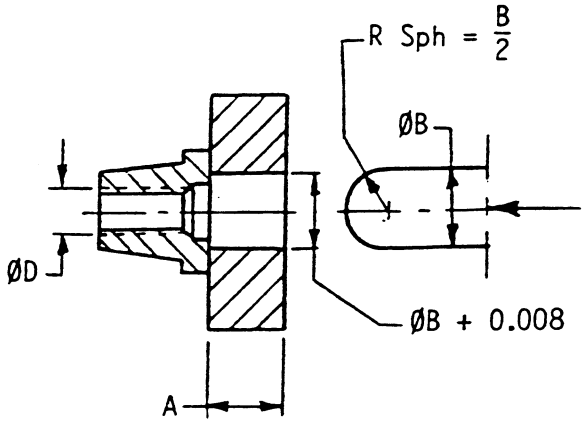
MIL-S-8879 Screw Threads, UNJ Profile

C.3 APPARATUS:

C.3.1 Parts Contained:

The test apparatus is shown in Figure C2 and comprises the following:

a. The retention plate.
b. Rivets or bolts to attach test nut to plate.
c. A push-out mandrel with spherical end.
d. A bolt with threads conforming to MIL-S-8879, tolerance Class 3A.



Dimensions in inch

A = 0.312 for D ≤ 0.190
A = 0.438 for D > 0.190
B = D + 0.020
D = nom major dia of thread

FIGURE C2 - Push Out Test Apparatus

C.4 PROCEDURE:

C.4.1 Attach the plate nut or section of gang channel to be tested to the plate by riveting or with bolts.

C.4.2 Apply the push-out load given in this specification to the spherically ended mandrel as shown in Figure C2.

C.4.3 Install a standard bolt with the fingers up to the locking feature using no supporting pressure on the nut.

C.4.4 Remove bolt and detach nut from retention plate or channel.

C.4.5 Submit the nut for visual examination and, if necessary, to an examination at low magnification after sectioning.

APPENDIX D
TORQUE OUT TEST

D.1 SCOPE:

This appendix is a mandatory part of this specification.

D.1.1 Purpose of Test:

This test is to determine that the retention device is capable of holding the nut element against rotation when tightening or untightening the mating bolt.

D.1.2 Types of Nuts to be Tested:

This test is applicable to the following types of nuts produced as multi-piece nuts:

a. Floating plate nuts or gang channel nuts.
b. Fixed plate nuts which have the nut body assembled on a plate by brazing or swaging.

D.2 APPLICABLE DOCUMENTS:

MIL-S-8879	Screw Threads, UNJ Profile
FED-STD-H28/2	Screw Threads, UN Profile

D.3 APPARATUS:

D.3.1 Typical Apparatus:

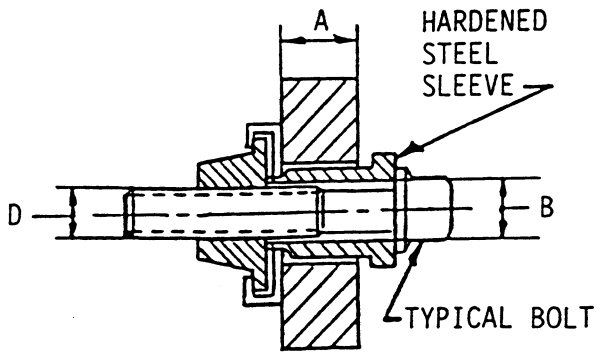
A typical test apparatus is shown in Figure D1 and comprises the following:

a. A retention plate.

b. Rivets or bolts to attach test nut to plate.

c. A bolt with threads conforming to MIL-S-8879 or FED-STD-H28/2 tolerance Class 3A.

d. A hardened steel sleeve that bears the axial load against the base of nut element and bolt bearing surface, with no axial load on the retention plate during the test.



Dimensions in inch

A = 0.312 for D ≤ 0.190
A = 0.438 for D > 0.190
B = D + 0.008
D = nom major dia of thread

FIGURE D1 - Torque Out Test Apparatus

D.4 PROCEDURE:

D.4.1 Attach the nut or section of gang channel to be tested to the plate by riveting or with bolts.

D.4.2 Apply the torque-out torque given in this specification in a clockwise direction.

D.4.3 Remove the bolt and detach nut from retention plate or channel.

D.4.4 Submit the nut for visual examination and, if necessary, to an examination at low magnification after sectioning.

APPENDIX E
PERMANENT SET TEST

E.1 SCOPE:

This appendix is a mandatory part of this specification.

E.1.1 Purpose of Test:

This test is applicable to all self-locking nuts (wrenching nuts and anchor nuts) and is to verify the ability of the nut locking feature to perform within the locking torques of this specification when assembled on a minimum threaded mandrel (or bolt) after having first been assembled onto a maximum threaded mandrel (or bolt).

E.2 APPLICABLE DOCUMENTS:

MIL-S-8879	Screw Threads, UNJ Profile
ASME B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)

E.3 APPARATUS:

E.3.1 Test Mandrels:

The apparatus shown in Figures E1 and E2 comprises the following:

a. Maximum mandrel (Figure E1).
b. Minimum mandrel (Figure E2).

TABLE E1 - Maximum Mandrel Pitch Diameter

Nominal Thread Size	Pitch Diameter inch	Nominal Thread Size	Pitch Diameter inch
0.138-32	0.1167-0.1171	0.3125-24	0.2843-0.2847
0.138-40	0.1209-0.1213	0.375 -24	0.3467-0.3471
0.164-32	0.1427-0.1431	0.4375-20	0.4038-0.4042
0.164-32	0.1451-0.1455	0.500 -20	0.4663-0.4667
0.190-32	0.1687-0.1691	0.5625-18	0.5251-0.5255
0.250-28	0.2257-0.2261	0.625 -18	0.5876-0.5880

NOTES:
1. Maximum Mandrel:
2. Material: Steel heat treated to 39 HRC minimum.
3. Surface Roughness: Thread flanks to be 32 µin Ra in accordance with ASME B46.1.
4. Threads: MIL-S-8879 except pitch diameter shall be as specified in Table E1.