

**Nuts, Self-Locking, Corrosion Resistant Steel
High Strength, Prevailing Torque, All Metal
800°F (427°C) Use, UNJ Thread Form**

1. SCOPE:

1.1 Type:

This standard covers all-metal, self-locking, prevailing torque nuts made of corrosion resistant steel.

1.2 Application:

For use up to 800°F (427°C) where 220,000 psi (1,520 MPa) axial strength nuts with UNJ thread form are required.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this standard to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) and Aerospace Standards (AS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications:

Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pa. 15096.

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2.1.1 Aerospace Material Specifications:

- AMS 2350 Standard Test Methods
- AMS 2371 Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except Forgings
- AMS 5525 Plate, Sheet and Strip-15Cr 26Ni 1.3Mo 2.1Ti 0.3V
- AMS 5737 Steel Bars, Forgings and Mech. Tubing, Corrosion and Heat Resistant - 15Cr 26Ni 1.3 Mo 2.1Ti 0.30V Consumable Electrode Melted, 1650°F (900°C) Solution and Precipitation Heat Treated.
- AMS 7477 Bolts and Screws, Steel, Corrosion and Heat Resistant, Upset Headed, Heat Treated, Roll Threaded, 1800°F (982.2°C) Solution and Precipitation Heat Treated
- AMS 7478 Bolts and Screws, Steel, Corrosion and Heat Resistant, Heat Treated, Roll Threaded, 1800°F (982.2°C) Solution and Precipitation Heat Treated

2.1.2 Aerospace Standards:

- AS 954 Design Data and Standardization of Thin Wall 12-Point Sockets and Box Wrenches for Aerospace Engine Use

2.2 Government Publications:

Available from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

2.2.1 Federal Specifications:

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

2.2.2 Military Specifications:

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

2.2.3 Bureau of Standard Handbook: H28 - Screw Thread Standards for Federal Services.

2.3 ANSI Publications:

Available from American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

- ANSI B46.1 Surface Texture

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3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be a corrosion resistant steel such as AMS 5525 or AMS 5737, as specified on the drawing.

3.2 Construction:

Each nut shall be a self-contained unit including the self-locking device. The locking device shall not operate by means of separate movement from the installation and shall not depend on pressure on the bearing surface for the locking action. The locking device shall be set to meet the locking torque requirements of 3.8.3 when used with either Unified class 3A per MIL-S-7742 or MIL-S-8879 external threads.

3.3 Threads:

Nut threads shall conform to the latest issue of MIL-S-8879.

3.3.1 Thread Squareness: The bearing surface shall be square with the thread pitch diameter axis within the limits specified on the 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. The nuts to be inspected shall permit at least 3 complete turns of engagement on the thread arbor of the gage; plating or other coating may be stripped if necessary to meet this requirement.

3.3.2 Coating Allowance: Unless otherwise specified, internal thread coating allowance shall be as specified in MIL-S-8879.

3.4 Heat Treatment & Fabrication:

Nuts shall be fabricated and heat treated to meet the requirements of this standard and of the applicable part drawing.

3.5 Oxide Removal:

The parts shall have all surfaces free from surface oxide and oxide penetration. The removal process shall produce no intergranular attack or corrosion of the blanks.

3.6 Finish:

The nuts shall be coated with a dry film lubricant as specified on the applicable drawing.

3.7 Lubrication:

The nuts may be provided with or without additional lubrication coating over the specified coating of dry film lubricant.

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3.8 Performance:

Nuts shall conform to the following requirements. Unless otherwise specified, 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, up to the self-locking device. The completed assembly shall have bolts project through the nut at least 3 turns at start of test.

- 3.8.1 Axial Strength: Not less than 4 nuts in the as-received condition and 4 nuts which have been heated to $800^{\circ}\text{F} \pm 15$ ($427^{\circ}\text{C} \pm 8^{\circ}$), held at heat for 6 hr, ± 15 min., and cooled to room temperature shall be assembled on steel bolts hardened and tempered to not lower than 44 HRC or equivalent and having threads in accordance with 3.9. Each nut-bolt assembly shall be pulled, at room temperature, in tension, axially, using a bearing plate to grip the nut. The diameter of the hole in the bearing plate shall be 0.030 - 0.034 inch (0.76 - 0.86 mm) greater than the basic major diameter of the bolt threads 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 - 0.015 inch (0.25 - 0.38 mm). Axial strength of the nut shall be not lower than the values specified in Table I and the nuts may exhibit yield but shall not fracture during test; test need not be run to destruction:

TABLE I

Thread Size	Axial Strength	
	lbf	(N)
0.164 -32	2,630	(11700)
0.164 -36	2,830	(12590)
0.190 -32	3,860	(17170)
0.250 -28	7,160	(31850)
0.3125-24	11,540	(51330)
0.375 -24	17,790	(79130)
0.4375-20	23,980	(106660)
0.500 -20	32,700	(145460)
0.5625-18	41,540	(184780)
0.625 -18	52,810	(234900)

- 3.8.1.1 The axial strength requirement for thread sizes not shown may be calculated from the following formula:

- 3.8.1.1.1 In U.S. Customary Units:

$$S = 0.7854 (D-2h_b)^2 \times 220,000$$

Where:

S = Axial strength requirement in lb.

D = Max major diameter of external thread in inches.

h_b = Twice the external thread addendum in inches.

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3.8.1.1.2 In SI Units:

$$S = 0.7854 (D - 2h_b)^2 \times 1,520$$

Where:

S = Axial strength requirement in N

D = Max major diameter of external thread in mm.

h_b = Twice the external thread addendum in mm.

3.8.2 Wrench Torque: At least 3 nuts shall be tested at room temperature for wrench torque by assembling a nut on a bolt having sufficient strength. The nut shall be tightened against a bushing with a hole diameter as in 3.8.1 and having hardness not lower than 46HRC or equivalent and surface roughness on the bearing surface of 63 microinches (1.6 μ m) or less. Nuts shall withstand 12 successive applications of the torque specified in Table II without destroying the wrenchability of the nut. Wrenches used for this test shall be open end type conforming to Federal Specification GGG-W-636, Type IV for hexagon nuts and a socket type conforming to AS 954 for double hexagon nuts. For this test only, all nuts shall be cleaned to remove all trace of any lubricant, except the specified coating of dry film lubricant. In order to reduce the loads imposed on the test bolts, it is permissible to increase the friction between the nut and bolt threads and abutting faces by stripping the dry film lubricant from these surfaces or by utilizing mechanical means to prevent nut rotation. The nut wrench pads and the dry film lubricant thereon must not be deformed to the extent that wrenchability is affected.

TABLE II

Nom. Thread Dia.	Wrench Torque lbf-in.	(N.m)
0.164	40	(4.52)
0.190	82	(9.27)
0.250	205	(23.16)
0.3125	450	(50.84)
0.375	730	(82.49)
0.4375	1,130	(127.69)
0.500	1,650	(186.45)
0.5625	2,000	(226.00)
0.625	2,750	(310.75)

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- 3.8.3 Self-Locking Torque and Reuseability: The self-locking torque shall be measured for not less than 10 nuts as-received and 10 nuts after conditioning as in 3.8.3.1. Test bolts as in 3.9 shall be used. New bolts shall be used for each nut tested. Test shall be conducted at room temperature with no axial stress and with nuts assembled on bolts so that the bolts project through the nuts not less than 3 turns at start of each test cycle. Test shall be run in such a manner that a dependable measure of torque will be obtained. The increase in temperature of the nuts during test shall not exceed 75°F (42°C). After testing, nut threads shall show no distortion, galling, or scratches of such depth as to prevent reassembly of nut freely, with the fingers, up to the self-locking device. Bolt threads shall remain serviceable and permit assembly of a new nut freely, with the fingers, up to the self-locking device. The maximum locking torque reading and the minimum breakaway torque reading shall not exceed the value in Table III. The maximum locking torque is the highest self-locking torque encountered in any installation or removal cycle with the nut in motion and with no load on the base of the nut. The breakaway torque is that torque required to start nut or bolt rotation from a fixed position during a removal cycle with no load on the base of the nut.
- 3.8.3.1 Conditioning: Nut-bolt assemblies shall be axially loaded initially to 110,000 psi (758 MPa) at room temperature in a spacer-type fixture in accordance with 3.8.3.1.2. Loading shall be determined by elongation measurement of the bolt at room temperature. Bolt and fixture lengths conforming to 3.9 shall be used. Allow assembly to remain stressed at room temperature for at least 1 hr, remeasure, and adjust loading to agree with the required stress. The assemblies shall then be heated in a furnace at 800°F ± 15 (427°C ± 8°) for 6 hr, ± 15 min., removed, cooled to room temperature, and unloaded by backing off nut 1/2 turn. Breakaway torque shall be measured at this point. The nut shall be turned relative to the fixture. The wrenchability of the tested nuts shall not be destroyed by the test.
- 3.8.3.1.1 Loading: The correct elongation for bolts to load the nuts to 110,000 psi (758 MPa) shall be determined by using a modulus of elasticity of 29,500,000 psi (203.4 GPa). The elongation of bolts for nut sizes not listed herein shall be $0.0037288L$, where L = fixture length as in Table V.
- 3.8.3.1.2 Fixture: The spacer-type fixture shall be made of AMS 5735. The diameter of the bolt hole in the fixture shall be 0.030 - 0.034 in. (0.76 - 0.86 mm) greater than the basic major diameter of the bolt thread (See Fig. 1).
- 3.8.3.2 Test Procedure:
- 3.8.3.2.1 As Received: Nuts shall be installed and completely removed from the bolt 12 consecutive times. Except for the first installation, the nuts shall not exceed the maximum locking torque of Table III during the installation or removal cycle and shall not show less than the minimum breakaway torque of Table III at the start of the removal cycle.

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TABLE III - (Inch)

Thread Size	Min. Breakaway Torque	Max. Locking Torque	
		(1)	(2)
0.164 -32	24 ozf-in.	11 lbf-in.	22 lbf-in.
0.164 -36	24 ozf-in.	11 lbf-in.	22 lbf-in.
0.190 -32	32 ozf-in.	15 lbf-in.	30 lbf-in.
0.250 -28	3.5 lbf-in.	30 lbf-in.	60 lbf-in.
0.3125-24	6.5 lbf-in.	60 lbf-in.	120 lbf-in.
0.375 -24	9.5 lbf-in.	80 lbf-in.	160 lbf-in.
0.4375-20	14.0 lbf-in.	100 lbf-in.	200 lbf-in.
0.500 -20	18.0 lbf-in.	150 lbf-in.	300 lbf-in.
0.5625-18	24.0 lbf-in.	200 lbf-in.	400 lbf-in.
0.625 -18	32.0 lbf-in.	300 lbf-in.	600 lbf-in.

TABLE III - (SI)

Thread Size	Min. Breakaway Torque	Max. Locking Torque	
		(1)	(2)
0.164 -32	169.46 mN.m	1.24 N.m	2.49 N.m
0.164 -36	169.46 mN.m	1.24 N.m	2.49 N.m
0.190 -32	225.95 mN.m	1.70 N.m	3.39 N.m
0.250 -28	395.41 mN.m	3.39 N.m	6.78 N.m
0.3125-24	734.34 mN.m	6.78 N.m	13.56 N.m
0.375 -24	1.07 N.m	9.04 N.m	18.08 N.m
0.4375-20	1.58 N.m	11.30 N.m	22.60 N.m
0.500 -20	2.03 N.m	16.95 N.m	33.90 N.m
0.5625-18	2.71 N.m	22.60 N.m	45.19 N.m
0.625 -18	3.62 N.m	33.90 N.m	67.79 N.m

(1) At initial installation, values may be exceeded for 20% of the parts tested when bolt first enters locking feature provided all parts are within the specified limits after a minimum length of two pitches, including chamfer, protrudes through the nut.

(2) Maximum for removal after conditioning only.

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- 3.8.3.2.2 Conditioned: Conditioning cycles shall be performed in accordance with 3.8.3.1. The nuts shall be completely removed from the bolt after each cycle of conditioning. The conditioning test shall be run for 5 consecutive cycles, using the same nut, bolt, and spacer. The maximum locking torque and the minimum breakaway torque for each cycle shall not exceed the limits specified in Table III.
- 3.8.4 Permanent Set: At least three nuts shall be assembled on a maximum mandrel (See Fig. 2) so that the mandrel projects through the nuts not less than three turns. Nuts shall then be removed from the maximum mandrel and assembled on a minimum mandrel (See Fig. 3) in the same manner. The nuts shall not exceed the maximum locking torque of Table III during the installation or removal cycle on the maximum mandrel and shall not show less than the minimum breakaway torque of Table III at the start of the removal cycle on the minimum mandrel.
- 3.8.5 Vibration: Ten nuts of the type to be tested for the sizes listed in Table IV shall be installed on a test bolt as in 3.9 on a test fixture as in 3.8.3.1.2. The assembly torque values shall be as specified in Table IV. For sizes not shown, the torque shall be as agreed upon by vendor and purchaser. Testing of nuts other than hexagon or double hexagon wrenching types shall be as agreed upon by purchaser and vendor.

TABLE IV

Nom. Thread Size	Assembly Torque	
	lbf-in.	(N m)
0.164 -32	22	(2.49)
0.164 -36	22	(2.49)
0.190 -32	30	(3.39)
0.250 -28	60	(6.78)
0.3125-24	120	(13.56)
0.375 -24	160	(18.08)
0.4375-20	200	(22.60)
0.500 -20	300	(33.90)
0.5625-18	400	(45.20)
0.625 -18	600	(67.80)

Five nuts shall be removed from the test bolts and reinstalled four additional times to the torque values in Table IV. The other five assembled nuts shall be baked at 800°F ± 15 (427°C ± 8°) for 6 hr ± 15 min. and air cooled; these nuts shall then be removed and reinstalled four additional times to the torque values specified in Table IV. The five baked nuts and the five unbaked nuts shall be assembled on the vibration test fixture (see Fig. 4) on test bolts and vibration tested at room temperature. The assemblies shall be vibrated 15,000 cycles at a frequency of 1750 - 1800 cpm (29.2 - 30.0 Hz) and an amplitude of 0.435 - 0.465 in. (11.05 - 11.81 mm). 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 be not greater than 360 degrees. The nuts shall not have developed any cracks or broken segments, as shown by examination at 10X magnification.

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3.9 Test Bolts:

All test bolts shall have a P.D. shank and shall have threads conforming to the requirements of MIL-S-8879. Cres bolts shall conform to AMS 7477 or AMS 7478, except for heat treatment, tensile and stress rupture properties, and shall have a minimum ultimate tensile strength of 180,000 psi (1,240 MPa) at room temperature. Test bolts shall have lengths as shown in Table V.

TABLE V - (Inch)

Nominal Thread Size	Nominal Bolt Length Inches	Fixture Length (L) Inches	Required Bolt Elongation Inch
0.164 -32	2.000	1.569-1.599	.0059
0.164 -36	2.000	1.569-1.599	.0059
0.190 -32	2.500	2.010-2.040	.0076
0.250 -28	2.500	1.941-1.971	.0073
0.3125-24	2.500	1.845-1.875	.0069
0.375 -24	2.500	1.823-1.853	.0068
0.4375-20	2.500	1.718-1.748	.0065
0.500 -20	2.500	1.621-1.651	.0061
0.5625-18	2.500	1.518-1.548	.0057
0.625 -18	2.500	1.433-1.463	.0054

TABLE V - (SI)

Nominal Thread Size	Nominal Bolt Length (mm)	Fixture Length (L) (mm)	Required Bolt Elongation (mm)
0.164 -32	50.8	39.85-40.61	0.150
0.164 -36	50.8	39.85-40.61	0.150
0.190 -32	63.5	51.05-51.82	0.193
0.250 -28	63.5	49.30-50.06	0.185
0.3125-24	63.5	46.86-47.62	0.175
0.375 -24	63.5	46.30-47.07	0.173
0.4375-20	63.5	43.64-44.40	0.165
0.500 -20	63.5	41.18-41.94	0.155
0.5625-18	63.5	38.56-39.32	0.145
0.625 -18	63.5	36.40-37.16	0.137

3.10 Test Lubrication:

Before each installation of the nut, bolt threads shall be lubricated with a coating of the dry film lubricant specified for the nut threads. The bolt lubricant shall not be baked.

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3.11 Quality:

Nuts shall be uniform in quality and condition, clean, sound, and free from fins, burrs, cracks, tool marks, and other imperfections detrimental to their performance except that nut out of round formation to produce self-locking feature may produce tool markings providing they blend smoothly without abrupt change.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor shall supply all samples and shall be responsible for performing all required tests. Results of tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that parts conform to the requirements of this standard.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to material (3.1) and locking torque and reuseability as-received (3.8.3) are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to all other technical requirements of this standard are classified as qualification or periodic control tests.

4.3 Sampling:

4.3.1 Acceptance Tests:

4.3.1.1 Material: In accordance with AMS 2371.

4.3.1.2 Performance: As specified herein.

4.3.2 Qualification Tests: As specified herein or as agreed upon by purchaser and vendor.

4.4 Reports:

4.4.1 The vendor shall furnish with, or prior to, the first shipment of parts of each type and material three copies of a report of test data showing that the parts conform to all requirements of this standard.

4.4.2 The vendor of parts shall furnish with each shipment three copies of a report stating that the composition of the parts conforms to the requirements of the applicable material specification and showing the results of tests to determine conformance to the locking torque and reuseability as-received requirements of this standard. This report shall include the purchase order number, material specification number and its revision letter if any, this standard number and revision letter, contractor or other direct supplier of material, part number, and quantity.

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4.5 Resampling and Retesting:

If any specimen used in the above tests fails to meet the specified requirements, acceptance of the parts may be based on the results of testing three additional specimens for each original nonconforming specimen, all additional specimens shall conform to specified requirements. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Nuts of each different part number shall be packed in separate containers. Each container shall be marked to give the following information:

NUTS, SELF-LOCKING, CORROSION AND HEAT RESISTANT

AS 1371

PART NUMBER

PURCHASE ORDER NUMBER

QUANTITY

MANUFACTURER'S IDENTIFICATION

5.2 Packaging:

Containers of parts shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

6. ACKNOWLEDGEMENT:

A vendor shall mention this standard number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS:

Parts not conforming to this standard or to authorized modifications will be subject to rejection.

PREPARED BY
SAE COMMITTEE E-25, ENGINE & PROPELLER STANDARD UTILITY PARTS

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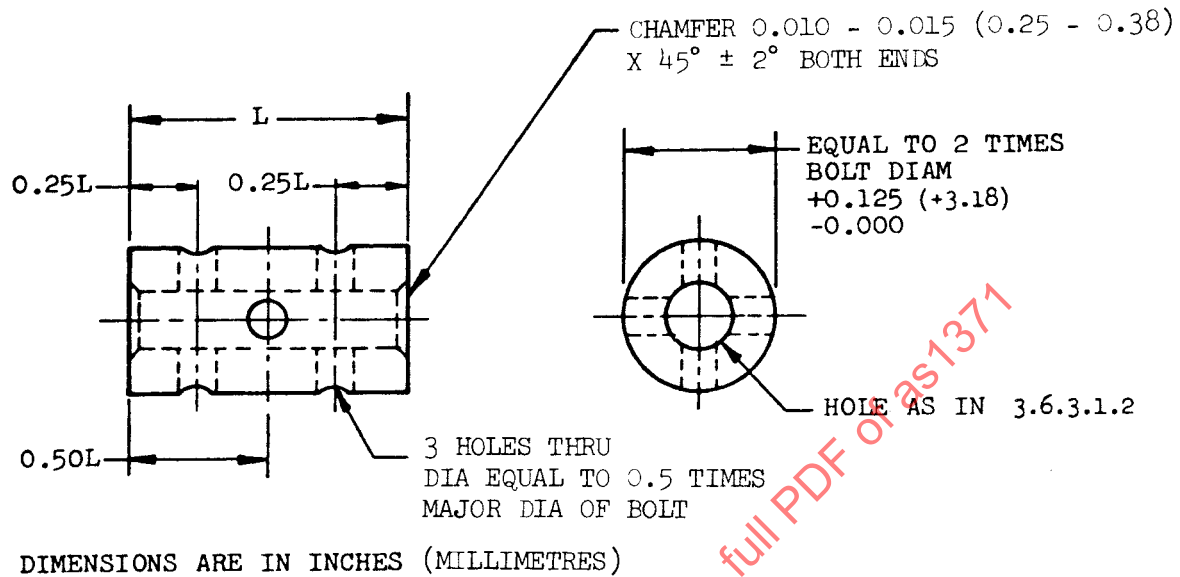


FIGURE 1 - Conditioning Test Spacer - Type Fixture

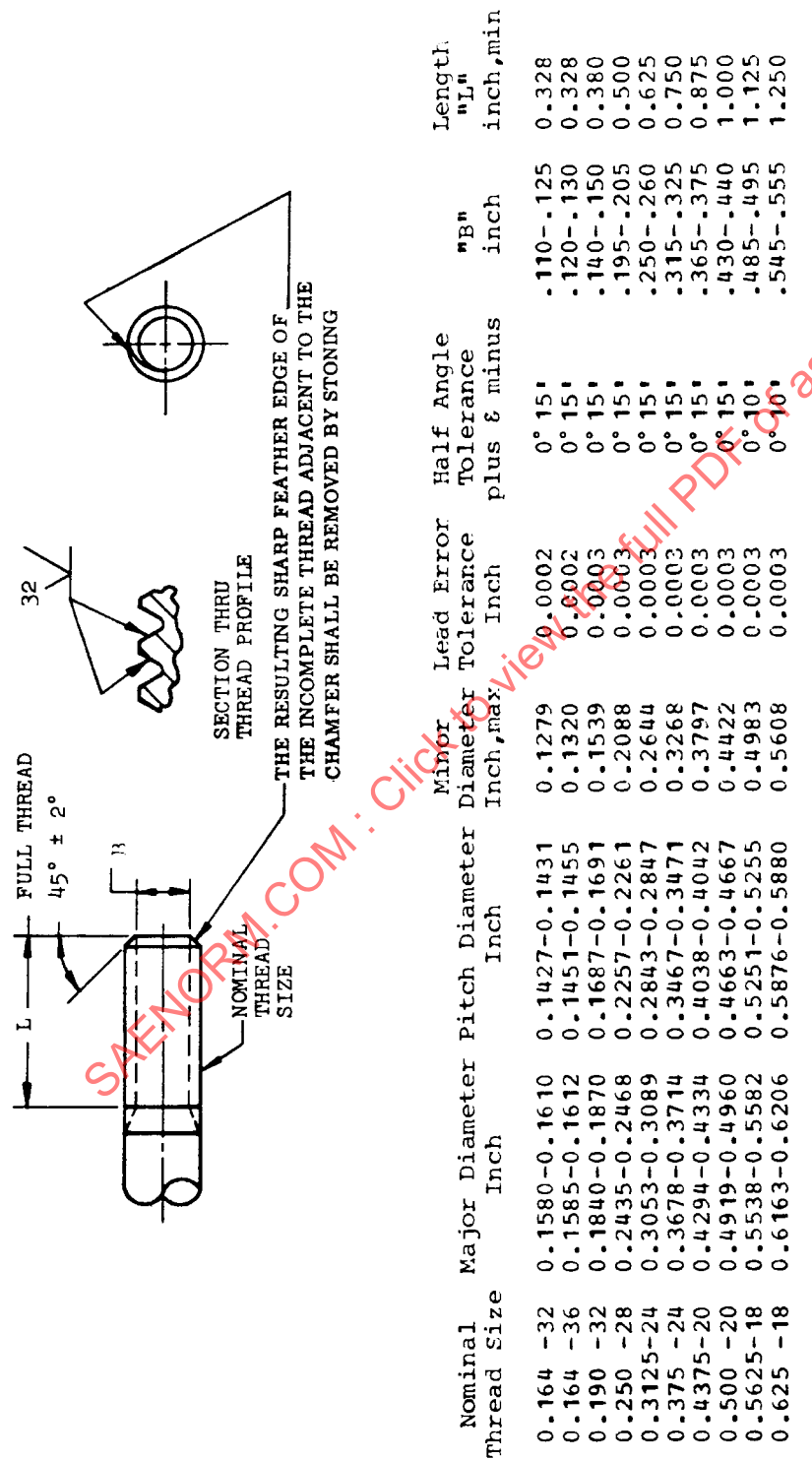
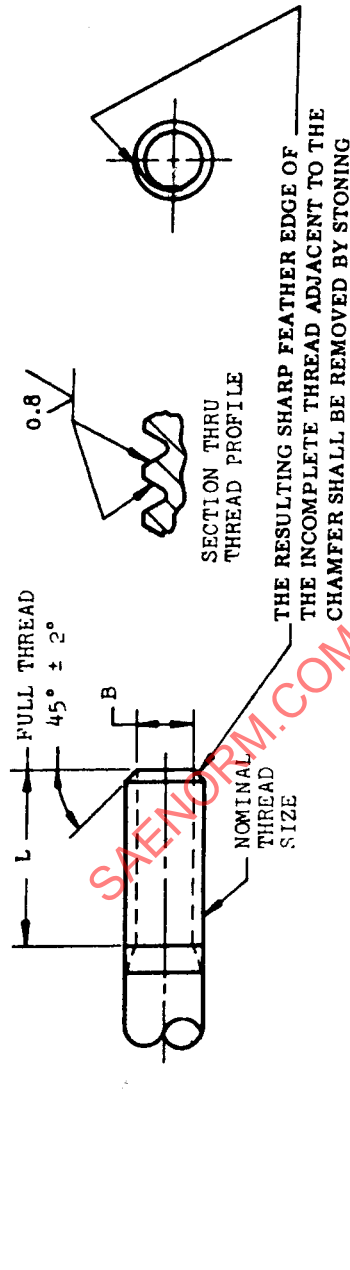


FIGURE 2 - Maximum Mandrel Test Fixture (Inch)

Material of mandrel to be steel of hardness not lower than 50 HRC.
Surface texture is in microinches per ANSI B46.1.
Use of bolt or stud meeting requirements of this figure is optional.
Screw threads per MIL-S-8879 except as otherwise specified in table.
Tolerance on lead error is the allowable variation between any two threads (see Handbook H28) .



Nominal Thread Size	Major Diameter Millimetres	Pitch Diameter Millimetres	Minor Diameter mm, max	Lead Error Tolerance mm	Half Angle Tolerance plus & minus	"B" mm	Length "L" mm, min
0.164 -32	4.014-4.089	3.625-3.634	3.248	0.005	0° 15'	2.80-3.17	8.332
0.164 -36	4.026-4.094	3.686-3.695	3.352	0.005	0° 15'	3.05-3.30	8.332
0.190 -32	4.674-4.749	4.285-4.295	3.909	0.008	0° 15'	3.56-3.81	9.652
0.250 -28	6.185-6.268	5.733-5.742	5.303	0.008	0° 15'	4.96-5.20	12.700
0.3125-24	7.755-7.846	7.222-7.231	6.715	0.008	0° 15'	6.35-6.60	15.875
0.375 -24	9.343-9.443	8.807-8.816	8.300	0.008	0° 15'	8.01-8.25	19.050
0.4375-20	10.907-11.008	10.257-10.266	9.644	0.008	0° 15'	9.28-9.52	22.225
0.500 -20	12.495-12.598	11.884-11.854	11.231	0.008	0° 15'	10.93-11.17	25.400
0.5625-18	14.067-14.178	13.338-13.347	12.656	0.008	0° 10'	12.32-12.57	28.575
0.625 -18	15.654-15.763	14.925-14.935	14.244	0.008	0° 10'	13.85-14.09	31.750

Material of mandrel to be steel of hardness not lower than 50 HRC.

Surface texture is in μm per ANSI B46.1.

Use of bolt or stud meeting requirements of this figure is optional.

Screw threads per MIL-S-8879 except as otherwise specified in table.

Tolerance on lead error is the allowable variation between any two threads (see Handbook H28).

FIGURE 2 - Maximum Mandrel Test Fixture (SI)