AEROSPACE STANDARD

AS7251™	REV. C

Issued 1991-01
Revised 2014-08
Reaffirmed 2020-02

Superseding AS7251B

Nuts, Self-Locking, Steel, Corrosion and Heat Resistant High Strength, All Metal 1200 °F Use, UNJ Thread Form

FSC 5310

RATIONALE

Introduction of sampling data including the updating of 4.2 and 4.3 and the addition of Tables 8 to 12, addition of new 3.2 headed design, addition of new 3.6 for NDT requirement, paragraphs renumbered and general updating.

1. SCOPE

1.1 Type

This document covers all metal, self-locking wrenching nuts, plate nuts, shank nuts, and gang channel nuts made from a corrosion and heat resistant steel of the type identified under the Unified Numbering System as UNS S66286 and of 160 ksi tensile strength at room temperature, with maximum test temperature of parts at 1200 °F.

1.2 Application

For use up to approximately 1200 °F where high strength nuts with UNJ thread form are required for use with standard AS8879 external threads.

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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http://standards.sae.org/AS7251C

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.

AMS2410 Plating, Silver, Nickel Strike, High Bake

AMS2411 Plating, Silver for High Temperature Applications

AMS5731 Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution Heat Treated

AMS5732 Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution and Precipitation Heat Treated

AMS5734 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 Heat Treated

AMS5737 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

AMS5853 Steel, Corrosion and Heat-Resistant, Bars and Wire, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution Treated and Work Strengthened, 160 ksi (1103 MPa) Tensile Strength

AS954 Wrenches, Hand, Twelve Point, High Strength, Thin Wall

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, UNS S66286, Tensile Strength 130 ksi, Procurement Specification

AS7478 Bolts and Screws, Steel, UNS S66286, Classification: 130 ksi/1200 °F, 1800 °F Solution Heat Treated, Aged After Roll Threaded, Procurement Specification for

AS7481 Studs, Steel, UNS S66286, Aged After Roll Threaded, Procurement Specification for

AS7482 Studs, Corrosion and Heat Resistant Steel, UNS S66286, Tensile Strength 130 ksi, 1800 °F Solution Heat Treated, Aged Before Roll Threading, Procurement Specification

AS8879 Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter

2.1.2 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

MIL-PRF-7808 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base

2.1.3 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

2.1.4 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 E140 Standard Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness

ASTM D3951 Commercial Packaging Standard Practice for

ASTM E1417/E1417M Standard Practice for Liquid Penetrant Testing

2.1.5 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NASM 1312-6 Fastener Test Methods, Method 6, Hardness

2.2 Definitions

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.

PRODUCTION INSPECTION LOT: Shall be all finished 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.

Refer to AS1310 for definitions related to fastener torque.

2.3 Unit Symbols

° degree, angle

°F degree, Fahrenheit

°C degree, Celsius

lbf pound-force

in^2 square inch

psi pound-force per square inch

µin Ra microinch, roughness average

lbf·in pound-force inch, torque

HRC hardness, Rockwell C scale

% percent (1% - 1/100)

cpm cycles per minute

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5731, AMS5734, or AMS5853.

3.2 Design

3.2.1 Dimensions

The dimensions of finished parts, after all processing, including plating, shall conform to the part drawing. Dimensions apply after plating.

3.2.2 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 squareness shall be measured as noted in 3.4.1.

3.2.3 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. Surface texture symbols per ASME Y14.36

3.3 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 3.9.3 when used with external threads that meet the requirements of 3.10. Tool marks resulting from producing the locking feature shall blend smoothly without abrupt change.

3.4 Threads

UNJ thread form and dimensions in accordance with AS8879.

3.4.1 Bearing Surface Squareness

The bearing surface shall be square (flat to concave) with the thread pitch cylinder axis within the limits specified on the part drawing. Bearing surface shall not be convex. Bearing surface squareness shall be tested using a table squareness gage and feeler gage. The squareness requirement shall apply to the complete bearing surface of the nut except that, for nonfloating plate nuts having a bearing surface exceeding 1.5 times the thread major diameter, the squareness requirement shall, unless otherwise specified on the part drawing, 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 squareness gage; plating or 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.

3.4.2 Plating

Internal thread plating or coating allowance shall be as specified in AS8879, unless otherwise specified on the part drawing.

3.5 Heat Treatment

The nuts shall be precipitation heat treated after forming to meet the performance requirements specified.

3.5.1 Hardness

Unless otherwise specified on the part drawing, the core hardness after heat treatment as in 3.5 shall be no greater than 46 HRC (see 8.1), determined in accordance with MIL-STD-1312-6 (in accordance with NASM 1312-6). The minimum limit is controlled by the axial tensile strength requirement in 3.9.1.

3.6 Fluorescent Penetrant Inspection

Prior to any required plating or coating and following all forming, deformation and heat treatment, parts shall be subject to fluorescent penetrant inspection in accordance with ASTM E1417/E1417M, Type I, Sensitivity Level 2 minimum. Acceptance criteria of surface discontinuities shall be in accordance with AS3071.

3.7 Plating

Nuts shall be silver plated in accordance with AMS2411, unless otherwise specified on the part drawing. On nuts with thread sizes 0.250 inch and larger, the plating 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 0.190 inch and smaller shall show complete plate coverage on the thread. Plating on other surfaces shall be 0.0003 to 0.0006 inch thick.

3.8 Lubrication

The nuts may be provided with a wax type coating (such as 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.

3.9 Performance

Unless otherwise specified on the part drawing, nuts shall conform to the applicable requirements of Section 3. 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.

3.9.1 Axial Tensile Strength

Not less than four nuts in the as-received condition and four nuts which have been heated to 1200 °F ± 15 °F, held at heat for 6 hours ± 0.25 hours and cooled to room temperature, shall be assembled on alloy steel bolts hardened and tempered to not lower than 40 HRC, and having threads in accordance with 3.10. Each nut-bolt assembly shall be tested at room temperature in axial tension, using a bearing plate to grip the nut. The bearing plate hole diameter shall be 0.010 to 0.034 inch greater than the bolt thread basic major diameter. Bearing plate hole edges shall be broken 0.010 to 0.015 inch. Axial tensile strength of the nut shall be not lower than the load values specified in Table 1 and the nuts shall not crack during test; tests need not be run to failure. The axial tensile load shall be applied to the nut slowly at a maximum rate equivalent to:

$$\text{Load, lbf/minute} = 78\,000 \times D^2 \qquad \text{(Eq. 1)}$$

where:

D = Nominal major diameter of thread

3.9.1.1 Shank Nuts

Nuts with shanks designed to be flared at assembly (see Figure 1) shall be tested as in 3.9.1 except that the bearing plate hole 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.

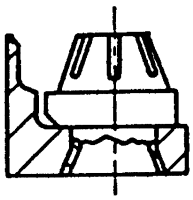


FIGURE 1 - FLANGE ASSEMBLY, FLARED SHANK NUT

3.9.2 Wrench Torque

This test is applicable to wrenching nuts with hexagon or double hexagon wrenching feature. For this test only, all nuts shall be cleaned to remove all traces of any supplemental lubricant (such as wax, cetyl alcohol, etc.). At least three nuts shall be tested at room temperature for wrench torque by assembling a nut on an alloy steel bolt having sufficient strength. The nut shall be tightened against a bushing with a hole diameter as in 3.9.1 and having hardness not lower than 40 HRC, and surface roughness of 63 microinches Ra. Nuts shall withstand 12 successive applications of the torque specified in Table 2 without destroying the wrenchability of the nut. Wrenches used for this test can be open ended type or socket type.

3.9.3 Locking Feature Torque

The locking feature torque-shall be measured and recorded for not less than 10 new nuts, selected at random from the lot, for each of the tests required in 3.9.5. Loading and conditioning for the five-cycle test of 3.9.5.2, shall be in accordance with 3.9.3.1. Test bolts shall conform to 3.10 or equivalent threaded parts. Test fixtures shall conform to 3.9.3.1.2. Tests shall be conducted at room temperature. The end of the bolt shall extend a minimum of 1.5 thread turns through the top of the nut at the start of the test. 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 the test shall not exceed 74 °F. The maximum prevailing and minimum breakaway torque (see AS1310) shall not exceed the values specified in Table 3 as required by the reusability tests in 3.9.5.

TABLE 1 - AXIAL TENSILE LOAD

Nut Thread Size	Axial Tensile Load at Room Temp. lbf minimum /1/
0.1120-40UNJC-3B	795
0.1120-48UNJF-3B	907
0.1380-32UNJC-3B	1190
0.1380-40UNJF-3B	1400
0.1640-32UNJC-3B	1914
0.1640-36UNJF-3B	2056
0.1900-32UNJF-3B	2805
0.2500-28UNJF-3B	5210
0.3125-24UNJF-3B	8389
0.3750-24UNJF-3B	12 940
0.4375-20UNJF-3B	17 440
0.5000-20UNJF-3B	23 780
0.5625-18UNJF-3B	30 210
0.6250-18UNJF-3B	38 410

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

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

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.

$$\text{Axial tensile load} = 160\,000 \text{ psi} \times A, \text{ lbf} \quad \text{(Eq. 3)}$$

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

TABLE 2 - WRENCH TORQUE

Nominal Dimension Across Flats inch	Double Hexagon Wrenching Feature Wrench Torque min lbf-in	Hexagon Wrenching Feature 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

TABLE 3 - LOCKING FEATURE TORQUES

Nominal Thread Size	Minimum Breakaway Torque lbf·in /1/	Minimum Breakaway Torque lbf·in /2/	Maximum Prevailing Torque lbf·in /3/	Maximum Prevailing Torque lbf·in /4/	Assembly Torque lbf-in /5/
0.1120-40	0.5	1	4	8	7
0.1120-48	0.5	1	4	8	7
0.1380-32	1	2	7	14	15
0.1380-40	1	2	7	14	16
0.1640-32	1.5	3	11	22	25
0.1640-36	1.5	3	11	22	26
0.1900-32	2	4	15	30	42
0.2500-28	3.5	7	30	60	95
0.3125-24	6.5	13	60	120	185
0.3750-24	9.5	19	80	160	330
0.4375-20	14	28	100	200	530
0.5000-20	18	36	150	300	800
0.5625-18	24	48	200	400	1150
0.6250-18	32	64	300	600	1580

/1/ Minimum breakaway torque for 12-cycle, room temperature, as received test; 5-cycle, loaded and conditioned test; permanent set test

/2/ Minimum breakaway torque for single-cycle, loaded, room temperature test

/3/ Maximum prevailing torque for 12-cycle, room temperature, as received test; single-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 single-cycle, loaded, room temperature test.

3.9.3.1 Loading and Conditioning

Nut-bolt assemblies shall be lubricated in accordance with 3.12 and loaded in axial tension to 75 ksi at room temperature on a spacer-type fixture in accordance with 3.9.3.1.2, measuring and recording maximum prevailing torque. Loading shall be determined by elongation measurement of the bolt at room temperature. For reference, minimum bolt lengths are given in Table 7. Allow assembly to remain stressed at room temperature for not less than 1 hour, remeasured, and loading adjusted to 75 ksi. The loaded assemblies shall then be heated in a furnace to 1200 °F ± 15 °F, held at heat for 6 hours ± 0.25 hours, removed from furnace, cooled to room temperature, and unloaded by loosening nut one-half turn and record unseating torque. Breakaway and prevailing torques shall be measured and recorded as the nut is removed from the bolt. In case of wrenchable nuts, the nut shall be turned relative to the fixture; in the case of anchor or channel nuts, the bolt head shall be turned. The wrenchability of the tested nuts shall not be destroyed by the test.

3.9.3.1.1 Loading

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:

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

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

where:

e = unit strain of bolt loaded shank, inch/inch

s = 75 000 psi bolt stress at area of max (root) diameter

E = 29 500 000 psi modulus of elasticity

L = bushing length (see Figure 2) in loaded nut-bolt assembly, inch

The elongation of bolts for nut sizes not listed herein shall be 0.0025425L,

where:

L = bushing length as in Figure 2

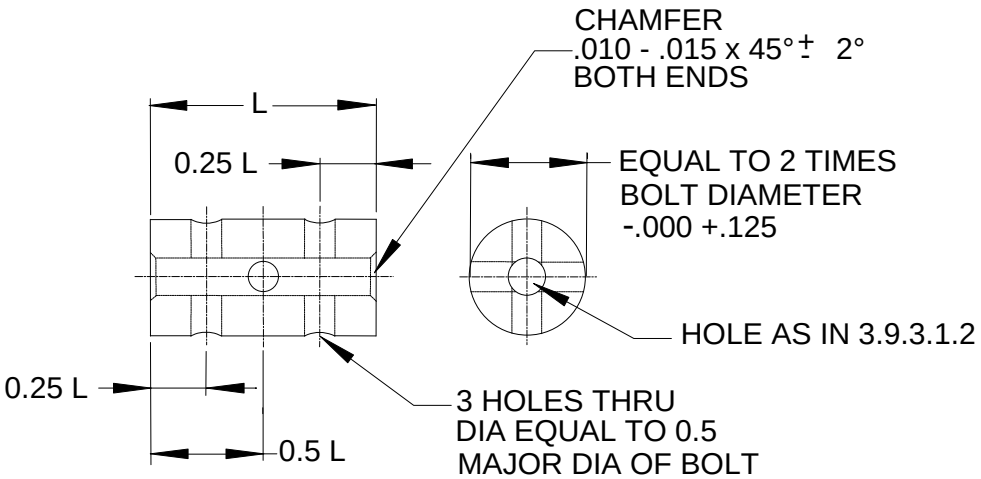


FIGURE 2 - SPACER-TYPE FIXTURE

3.9.3.1.2 Fixture

The spacer-type fixture shall be made of AMS5732 or AMS5737 steel. The diameter of the bolt hole in the fixture shall be 0.030 to 0.034 inch greater than the maximum major diameter of the bolt thread (see Figure 2). Fixture may be counter-bored 0.004 to 0.008 inch greater than the maximum allowable shank diameter of shank nuts to permit the spacer to seat onto the bearing surface of the nut. Alternative bolts lengths and elongations may be used provided they meet the requirements of 3.9.3.1.1

3.9.4 Permanent Set

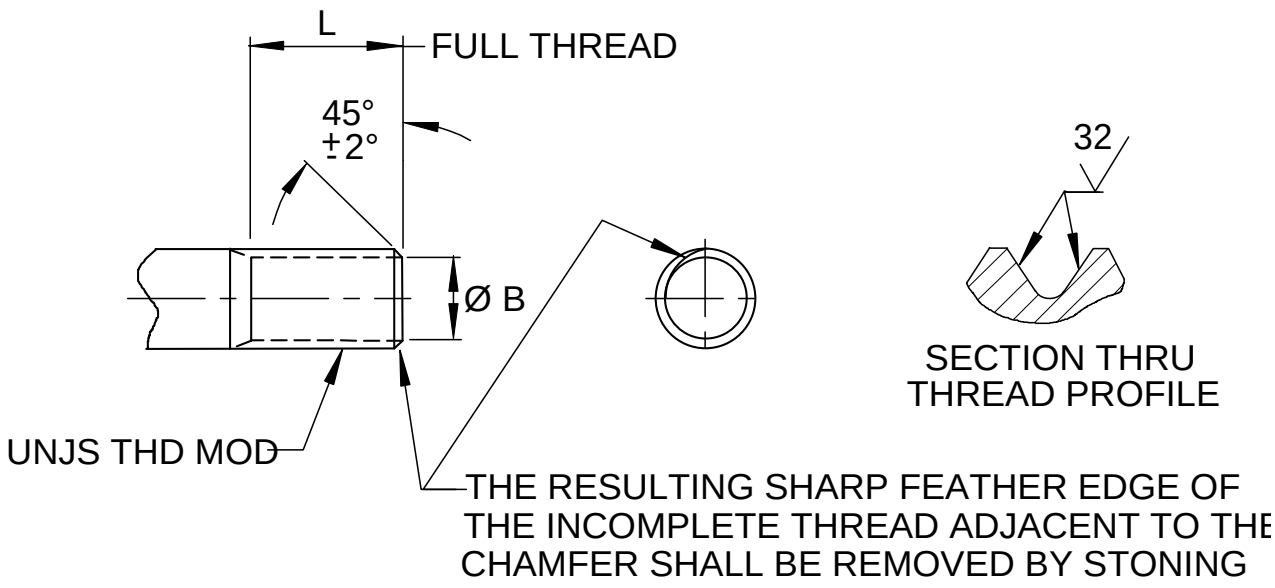
At least three nuts shall be assembled on a maximum material bolt or stud (see Figure 3) so that the bolt or stud protrudes through the nut not less than three thread turns. Nuts shall then be removed from the maximum material bolt or stud and assembled on a minimum material bolt or stud (see Figure 4) in the same manner. Tests shall be conducted at room temperature with no axial stress; breakaway and prevailing torques shall be measured and recorded. The nuts shall not exceed the maximum prevailing torque of Table 3, Column /3/, during the installation or removal cycle on the maximum material bolt or stud and shall not be less than the minimum breakaway torque of Table 3, Column /1/, at the start of the removal cycle on the minimum material bolt or stud.

3.9.5 Reusability

Nuts shall be assembled on test bolts conforming to 3.10 and tested in accordance with 3.9.3 as modified in 3.9.5.1, 3.9.5.2, and 3.9.5.3. After testing, bolt threads to remain serviceable and permit a new nut to assemble freely with the fingers, up to the self-locking device.

3.9.5.1 Twelve-Cycle, Room Temperature, As Received Test

Ten nuts shall be installed and removed from the bolts 12 consecutive times, using the same nut and bolt; breakaway and prevailing torques shall be measured and recorded. The nuts shall not exceed the maximum prevailing torque of Table 3, Column /3/, during the installation or removal cycle and shall not be less than the minimum breakaway torque of Table 3, Column /1/.



Nominal Thread Size	Major Diameter Modified	Pitch Diameter	Minor Diameter Max	Helix Tolerance	Half Angle Tolerance ±	B	L Min
0.1120-40	0.1069 - 0.1094	0.0949 - 0.0958	0.0827	0.0002	0º 20’	0.063 - 0.083	0.224
0.1120-48	0.1075 - 0.1098	0.0978 - 0.0985	0.0876	0.0002	0º 30’	0.068 - 0.088	0.224
0.1380-32	0.1320 - 0.1350	0.1167 - 0.1177	0.1013	0.0003	0º 15’	0.082 - 0.102	0.276
0.1380-40	0.1329 - 0.1354	0.1210 - 0.1218	0.1087	0.0002	0º 15’	0.089 - 0.109	0.276
0.1640-32	0.1580 - 0.1610	0.1427 - 0.1437	0.1273	0.0003	0º 15’	0.108 - 0.128	0.328
0.1640-36	0.1585 - 0.1612	0.1452 - 0.1460	0.1315	0.0002	0º 15’	0.112 - 0.132	0.328
0.1900-32	0.1840 - 0.1870	0.1687 - 0.1697	0.1533	0.0003	0º 15’	0.134 - 0.154	0.380
0.2500-28	0.2435 - 0.2468	0.2257 - 0.2268	0.2081	0.0003	0º 15’	0.189 - 0.209	0.500
0.3125-24	0.3053 - 0.3089	0.2843 - 0.2854	0.2636	0.0003	0º 15’	0.244 - 0.264	0.625
0.3750-24	0.3678 - 0.3714	0.3467 - 0.3479	0.3260	0.0003	0º 15’	0.307 - 0.327	0.750
0.4375-20	0.4294 - 0.4334	0.4038 - 0.4050	0.3789	0.0003	0º 15’	0.360 - 0.380	0.875
0.5000-20	0.4919 - 0.4960	0.4662 - 0.4675	0.4414	0.0003	0º 15’	0.422 - 0.442	1.000
0.5625-18	0.5538 - 0.5582	0.5250 - 0.5264	0.4974	0.0003	0º 10’	0.478 - 0.498	1.125
0.6250-18	0.6163 - 0.6206	0.5875 - 0.5889	0.5599	0.0003	0º 10’	0.541 - 0.561	1.250

Dimensions in inches.

Surface roughness: in microinches Ra per ASME B46.1.

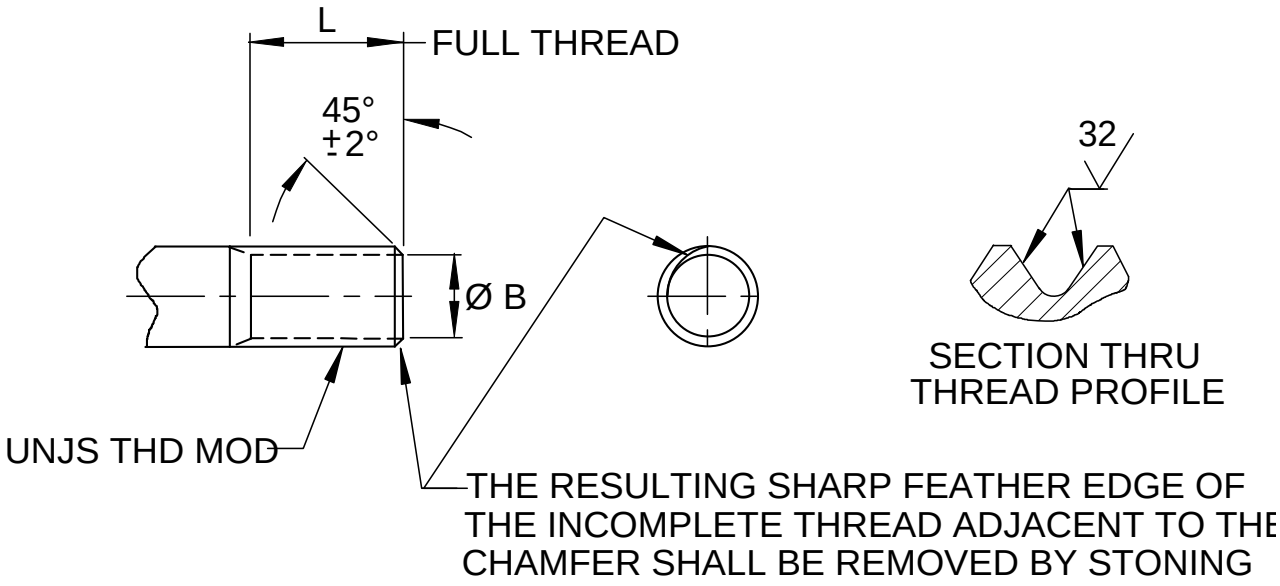
Bolts or Studs shall conform to AS7477, AS7478, AS7481, or AS7482, except threads may be formed by any method provided above dimensional and surface finish requirements are met.

Screw Threads: AS8879 except as otherwise specified in the above table.

Surface texture symbols per ASME Y14.36M.

Helix Tolerance is 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 tolerance zone, parallel to thread axis, within which the actual helical path (positive and negative) must lie.

FIGURE 3 - MAXIMUM MATERIAL BOLT OR STUD



Nominal Thread Size	Major Diameter Modified	Pitch Diameter	Minor Diameter Max	Helix Tolerance	Half Angle Tolerance ±	B	L Min
0.1120-40	0.1065 - 0.1069	0.0939 - 0.0943	0.0813	0.0002	0º 20’	0.061 - 0.081	0.224
0.1120-48	0.1071 - 0.1075	0.0967 - 0.0971	0.0864	0.0002	0º 30’	0.066 - 0.086	0.224
0.1380-32	0.1316 - 0.1320	0.1156 - 0.1161	0.0997	0.0003	0º 15’	0.080 - 0.100	0.276
0.1380-40	0.1325 - 0.1329	0.1198 - 0.1203	0.1073	0.0002	0º 15’	0.087 - 0.107	0.276
0.1640-32	0.1576 - 0.1580	0.1415 - 0.1421	0.1257	0.0003	0º 15’	0.106 - 0.126	0.328
0.1640-36	0.1581 - 0.1585	0.1439 - 0.1444	0.1299	0.0002	0º 15’	0.110 - 0.130	0.328
0.1900-32	0.1836 - 0.1840	0.1674 - 0.1680	0.1517	0.0003	0º 15’	0.132 - 0.152	0.380
0.2500-28	0.2431 - 0.2435	0.2243 - 0.2249	0.2062	0.0003	0º 15’	0.186 - 0.206	0.500
0.3125-25	0.3049 - 0.3053	0.2827 - 0.2834	0.2614	0.0003	0º 15’	0.241 - 0.261	0.625
0.3750-24	0.3674 - 0.3678	0.3450 - 0.3457	0.3239	0.0003	0º 15’	0.304 - 0.324	0.750
0.4375-20	0.4290 - 0.4294	0.4019 - 0.4027	0.3762	0.0003	0º 15’	0.356 - 0.376	0.875
0.5000-20	0.4915 - 0.4919	0.4643 - 0.4651	0.4387	0.0003	0º 15’	0.419 - 0.439	1.000
0.5625-18	0.5534 - 0.5538	0.5230 - 0.5239	0.4943	0.0003	0º 10’	0.474 - 0.494	1.125
0.6250-18	0.6159 - 0.6163	0.5854 - 0.5863	0.5568	0.0003	0º 10’	0.537 - 0.557	1.250

Dimensions in inches.

Surface roughness: in microinches Ra per ASME B46.1.

Bolts or Studs shall conform to AS7477, AS7478, AS7481, or AS7482, except threads may be formed by any method provided above dimensional and surface finish requirements are met.

Screw Threads: AS8879 except as otherwise specified in the above table.

Surface texture symbols per ASME Y14.36M.

Helix Tolerance is 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 tolerance zone, parallel to thread axis, within which the actual helical path (positive and negative) must lie.

FIGURE 4 - MINIMUM MATERIAL BOLT OR STUD

3.9.5.2 Five-Cycle, Loaded and Conditioned Test

Conditioning cycles shall be performed in accordance with 3.9.3.1. The nuts shall be completely removed from the bolt after each cycle of conditioning. The conditioning test shall be run five consecutive cycles, using the same nut, bolt and spacer; breakaway and prevailing torques shall be measured and recorded. The maximum prevailing torque and the minimum breakaway torque for each cycle shall not exceed the limits specified in Table 3, Columns /4/ and /1/, respectively.

3.9.5.3 Single-Cycle, Loaded, Room Temperature Test

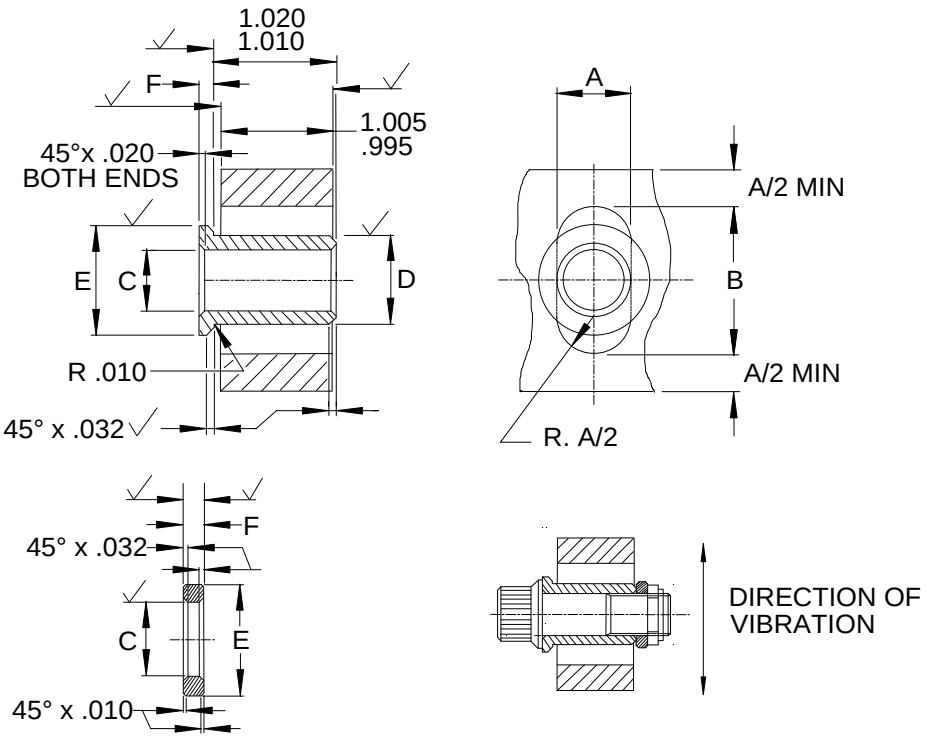
Nuts shall be assembled and loaded to the assembly torque specified in Table 3, Column /5/. The nut shall be completely removed from the bolt; breakaway and prevailing torques shall be measured and recorded; and the nuts shall not exceed the maximum prevailing torque of Table 3, Column /3/, during the installation or removal cycle and shall not be less than the minimum breakaway torque of Table 3, Column /2/.

3.9.6 Vibration Test

Ten nuts of the type to be tested, for the sizes listed in Table 4, shall be installed on a test bolt conforming to 3.10 and on a test fixture as in 3.9.3.1.2. The assembly torque values shall be as specified in Table 4. 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. 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 1200 °F ± 15 °F for 6 hours ± 0.25 hours and cooled to room temperature; 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 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 1750 to 1800 cpm 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 be not greater than 360 degrees. The nuts shall not have developed any cracks or broken segments, as shown by examination at 10X magnification. Multipiece floating plate nuts shall have the nut element removed from the retainer for this test. Fixed anchor nuts may have the lugs removed. Vibration testing is not required for nuts of nominal thread diameter less than 0.164 inch.

TABLE 4 - ASSEMBLY TORQUE FOR 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



Nut Size	A +0.004 -0.000	B +0.004 -0.000	C +0.004 -0.000	D +0.004 -0.000	E +0.010 -0.000	F +0.004 -0.000	Min Bolt Length Ref /1/
0.1640	0.301	1.044	0.172	0.294	0.520	0.121	1.625
0.1900	0.326	1.069	0.198	0.320	0.545	0.121	1.625
0.2500	0.498	1.243	0.263	0.493	0.745	0.161	1.781
0.3125	0.623	1.368	0.326	0.618	0.870	0.161	1.844
0.3750	0.748	1.493	0.388	0.743	0.995	0.161	1.938
0.4375	0.873	1.618	0.450	0.868	1.195	0.186	2.031
0.5000	0.998	1.743	0.513	0.988	1.370	0.186	2.125
0.5625	1.123	1.868	0.576	1.113	1.545	0.211	2.250
0.6250	1.248	1.993	0.638	1.238	1.695	0.211	2.312

Material: Steel. Hardness: 40 – 45 HRC.

Surface Roughness: Surfaces marked √ to be 32 microinches Ra per ASME B46.1

Dimensions in inches, unless otherwise specified.

Tolerances linear dimensions: ±0.010. Angular dimensions: ±5°.

/1/ Min bolt length calculated to provide 3 pitches protruding through AS3067 or AS3477 Nut, for Max grip of test fixture bushing and spacer and then rounded to 0.031 increment .

FIGURE 5 - VIBRATION TEST FIXTURE

3.9.7 Flarability

At least three shank nuts shall be tested for flareability. 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.

3.9.8 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 nominal major diameter of the nut thread. The plate bolt hole at maximum material condition (MMC) shall be positioned within 0.010 inch radius relative to the nut thread minor diameter at MMC. 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 as shown in Table 5, unless otherwise specified on the part drawing. With the push-out stud or device hemispherical end inserted against the base of the nut thread, the push-out load specified in Table 5 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 axially 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 5 - PUSH-OUT LOAD AND RIVET HOLE SIZE AND LOCATION

Nominal Thread Diameter Inch	Rivet Hole Diameter Inch	Hole Location (Distance From Nut Thread Axis) Inch	Push-Out Load, Minimum lbf
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	0.552 - 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

3.9.9 Torque-Out

This requirement is applicable only to gang channel nut assemblies, floating plate nuts, and nonfloating nuts. At least five nuts shall be prepared as in 3.9.8 and subjected to the torque-out loads in Table 6, first in the clockwise direction and then in the counterclockwise direction. The diameter of the torque stud shall have 0.010 inch maximum diametral clearance 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 retainer plate. 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 6 - TORQUE-OUT LOAD

Nominal Thread Diameter Inch	Torque-Out Load, Minimum lbf·in
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

3.10 Test Bolts

Except as specified in 3.9.1 and 3.9.2, bolts shall conform to AS7477 or AS7478 and shall have threads conforming to AS8879. For reference information, table in Figure 5 and Table 7 provides minimum bolt lengths.

TABLE 7 - SUGGESTED TEST BOLTS AND FIXTURE LENGTHS

Nominal Thread Diameter Inch	Fixture Length Inch	Bolt Elongation Inch	Reference Bolt Length /1/ Inch
0.1120	0.735 - 0.765	0.0021	1.000
0.1380	1.109 - 1.139	0.0031	1.438
0.1640	1.252 - 1.270	0.0035	1.625
0.1900	1.252 - 1.270	0.0035	1.625
0.2500	1.332 - 1.350	0.0037	1.781
0.3125	1.332 - 1.350	0.0037	1.844
0.3750	1.332 - 1.350	0.0037	1.938
0.4375	1.382 - 1.400	0.0038	2.031
0.5000	1.382 - 1.400	0.0038	2.125
0.5625	1.432 - 1.450	0.0040	2.250
0.6250	1.432 - 1.450	0.0040	2.312

/1/ Minimum bolt length calculated to provide 3 pitches protruding through AS3067 or AS3477, for maximum grip of fixture length and then rounded to 0.031 increment.

3.11 Uncoated Nuts

Uncoated nuts that have threads with an allowance for coating at assembly shall be plated for test purposes as in 3.7, uncoated nuts permanently attached to brackets or other similar parts shall be tested with bolts plated in accordance with AMS2410 or AMS2411 to a thickness of 0.0003 to 0.0006 inch. Plated bolts shall meet the requirements of 3.10 before plating.

3.12 Test Lubrication

Bolt threads shall be lubricated with MIL-PRF-7808 oil before each installation of the nut.

3.13 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.

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. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that parts conform to the requirements of this document.

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 9.

4.2.2 Qualification Tests

Tests to determine conformance to all technical requirements of this specification 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 Material

Sampling for material composition on each heat shall be in accordance with AMS5731, AMS5734, or AMS5853.

4.3.1.2 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 11. The classification of defects for nuts will be as specified in Table 10. Defects not classified in Table 10 shall be classified as Minor B defects. All dimensional characteristics are considered defective when out of tolerance.

4.3.1.3 Destructive Tests

A random sample shall be selected from each inspection lot, the size of the sample shall be as specified in Table 12. 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.

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 document and the part drawing.

4.4.2 The vendor of parts shall furnish with each production inspection 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 document. This report shall include the purchase order number, production lot number, AS7251C, 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 4.2.1, 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 D3951.

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
AS7251C
PART NUMBER
PURCHASE ORDER NUMBER
LOT NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

6. ACKNOWLEDGMENT

A vendor shall mention AS7251 in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Parts not conforming to this document will be subject to rejection.

8. NOTES

8.1 Hardness Conversion Tables

Hardness conversion tables for metals are presented in ASTM E140.

8.2 A 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, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

TABLE 8 - SUMMARY OF QUALIFICATION TESTS

Characteristic	Required Paragraph	Sample Size	Test Method
DESTRUCTIVE TESTS 1/			
Material	3.1	4.3.1.1	Certify Composition
Plating	3.7	5	AMS2411
Hardness	3.5.1	5	NASM 1312-6
Axial Tensile Strength	3.9.1	8	3.9.1
WrenchTorque	3.9.2	3	3.9.2
Permanent Set Test	3.9.4	3	3.9.4
12 Cycle Room Temp Test	3.9.5.1	10	3.9.5.1
5 Cycle loaded and conditioned test	3.9.5.2	10	3.9.5.2
Single cycle loaded room temp test	3.9.5.3	10	3.9.5.3
Vibration Test	3.9.6	10	3.9.6
Flarability	3.9.7	3	3.9.7
Pushout	3.9.8	5	3.9.8
Torque Out	3.9.9	5	3.9.9
NONDESTRUCTIVE TESTS 2/			
Construction	3.3	All	Visual examination
Dimensions	3.2.1	All	Conventional measuring method
Geometric Tolerances	3.2.2	All	Conventional measuring method
Surface Texture	3.2.3	All	ASME B46.1
Thread Size	3.4	All	AS8879
Bearing Surface Squareness	3.4.1	All	3.4.1
Fluorescent Penetrant Inspection	3.6	All	3.6 Criteria per AS3071
Quality	3.13	All	Visual examination
Packaging and identification	5.1	All	Visual examination

1/ Total number of samples for destructive tests equals 75; all samples shall be subjected to the nondestructive 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 - SUMMARY OF ACCEPTANCE TESTS

Characteristic	Required Paragraph	Sample Size	Test Method
NONDESTRUCTIVE TESTS			
Dimensions	3.2.1	Tables 10 and 11	Conventional measuring methods
Bearing Surface Squareness	3.4.1	Tables 10 and 11	3.3.1
Geometric Tolerances	3.2.2	Tables 10 and 11	Conventional measuring methods
Surface Texture	3.2.3	Tables 10 and 11	Per ASME B46.1
Thread Size	3.4	Tables 10 and 11	Inspection per AS8879
Product Marking	5.1	Tables 10 and 11	Visual examination
Quality	3.13	Tables 10 and 11	Visual examination
Fluorescent Penetrant Inspection	3.6	100%	Inspection per ASTM E1417 Criteria per AS3071
Packaging and Identification	5.1	100%	Visual examination
Product marking	Requirement on standard	100%	Visual examination
DESTRUCTIVE TESTS			
Material	3.1	4.3.1.1	Certify composition
Axial Tensile Strength as received condition	3.9.1	Table 12	NASM 1312-8
Plating	3.7	Table 12	Per AMS2411
Single cycle loaded room temp test	3.9.5.3	Table 12	3.9.5.3
Flareability	3.9.7	Table 12	Visual examination

TABLE 10 - CLASSIFICATION OF VISUAL AND DIMENSIONAL CHARACTERISTICS

Class	Characteristic
Major A	
101	Presence of locking element
Major B	
201	Thread size
202	Squareness of bearing surface
203	Shank diameter
204	Shank length
205	Rivet hole size
206	Rivet hole location
207	Surface texture
208	5 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
405	Other dimensional characteristics not listed

Note the characteristic and its class determines the size of the sample to be selected from Table 11.

TABLE 11 - SAMPLING DATA
Nondestructive 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	7	7
51 to 90	32	13	11	8
91 to 150	32	13	11	7
151 to 280	32	29	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 10 000	86	50	29	22
10 001 to 35 000	108	60	35	29
35 001 to 150 000	123	74	40	29
150 001 to 500 000	156	90	40	29
500 001 and over	189	102	40	29

The acceptance number of defects is ZERO in all cases.
For classification of characteristics refer to Table 10.

TABLE 12 - SAMPLING DATA
Destructive Tests
Mechanical and Metallurgical Characteristics

Production Inspection Lot	Sample Size
Up to 500	3
501 to 3200	5
3201 to 35 000	8
35 001 and over	13

The acceptance number of defectives is ZERO in all cases.

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