SAE Aerospace
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AEROSPACE STANDARD

SAE AS4723

Issued 2007-07
Reaffirmed 2012-11

Insert, Screw Thread, Self-Locking, UNS S66286, Key Locked, Plastic Self Locking Device, Solid Film Lubricant Procurement Specification For

FSC 5340

RATIONALE

AS4723 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Type

This procurement specification covers inserts made from A286 alloy of the type identified under the Unified Numbering System as UNS S66286, solid film lubricated with a plastic self locking device, integrated locking keys to positively secure the insert against rotation when properly installed in threaded holes.

1.2 Application

Inserts covered by this specification are intended as general purpose fasteners up to 500 °F.

1.2.1 Inserts conforming to the design and dimensions of AS3502 and AS3503 shall be capable of developing a minimum tensile strength as follows: AS3502 = 160,000 psi : AS3503 = 200,000 psi.

1.3 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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http://www.sae.org/technical/standards/AS4723

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.

AMS 3644	Polyimide, Molded Rod, Bar, and Tube, Plaque, and Formed Parts
AMS 5662	Nickel Alloy, Corrosion and Heat Resistant, Bars, Forgings,and Rings 52.5Ni 19Cr 3.0Mo 5.1Cb (Nb) 0.90Ti 0.50Al 18Fe, Consumable Electrode or Vacuum Induction Melted 1775°F (968°C) Solution Heat Treated, Precipitation Hardenable
AMS 5663	Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings 52.5Ni 19Cr 3.0Mo 5.1Cb (Nb) 0.90Ti 0.50Al 19Fe Consumable Electrode or Vacuum Induction Melted 1775°F (968°C) Solution and Precipitation Heat Treated
AMS 5731	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
AMS 5734	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
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
AMS-QQ-A-225/6	Aluminum Alloy, 2024, Bar, Rod, and Wire; Rolled, Drawn, or Cold Finished
AMS-QQ-A-225/8	Aluminum Alloy 6061, Bar, Rod, Wire, and Special Shapes; Rolled, Drawn, or Cold Finished
AMS-QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet
AMS-QQ-A-250/11	Aluminum Alloy 6061, Plate and Sheet
AMS 2700	Passivation of Corrosion Resistant Steels
AS1310	Fastener Torque for Threaded Applications, Definitions of
AS1701	Lubricant, Solid Film
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/.

FED-STD-H28/2	Screw-Thread Standards for Federal Services, Section 2, Unified Inch Screw Threads-UN and UNR Thread Forms
FED-STD-H28/20	Screw-Thread Standards for Federal Services, Section 20, Inspection Methods for Acceptability of UN, UNR, UNJ, M and MJ Screw-Threads
MIL-HDBK-57	Listing of Fastener Manufacturers' Identification Symbols

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A 342	Test Methods for Permeability of Feebly Magnetic Materials
ASTM D 3951	Commercial Packaging
ASTM E 1417	Liquid Penetrant Examination
ASTM A 580/A 580M	Standard Specification for Stainless Steel Wire

2.1.4 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 B1.1	Unified Screw Threads, UN & UR Thread Form
ASME B46.1	Surface Texture (Surface Roughness, Waviness and Lay)
ASME Y14.5M-1994	Dimensions and Tolerances

2.1.5 NAS 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
NASM 1312-13	Fastener Test Methods, Method 13, Double Shear
NAS 4700	Testing - Metallurgical, Fasteners, External Threads

2.2 Definitions

Refer to AS1310 for definitions related to fastener torque.

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

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

PRODUCTION LOT: Shall consist of finished inserts fabricated by the same process from a single heat of alloy, heat treated at the same time to the same condition, produced as one continuous run and submitted for vendor's inspection at the same time.

2.3 Unit Symbols

% - percent (1% = 1/100)

in - inch

in² - square inch

lbf - pounds force

lbf·in - pound force per inch

ksi - kips (1000 pounds) per square inch

HRC - hardness, Rockwell C scale

3. TECHNICAL REQUIREMENTS

3.1 Material

3.1.1 Inserts

Shall be a corrosion and heat resistant steel, AMS 5731, AMS 5734, or AMS 5737 as specified on the part drawing.

3.1.2 Keys

Corrosion Resistant Steel Type 420 in accordance with ASTM A 580/A 580M [HRC 54-58].

3.1.3 Locking feature material, Polyimide Resin AMS 3644 Class 1 or Class 2.

3.2 Lubrication

Inserts shall be solid film lubricated in accordance with AS1701, Class VI.

3.3 Design

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

3.3.1 Dimensions

The dimensions of the finished parts, after all processing including surface treatment, shall conform to the part drawing, unless otherwise specified. Dimensions shall apply before coating with solid film lubricants.

3.3.2 Surface Texture

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

3.3.3 Threads

3.3.3.1 Internal Threads

Screw thread UNJ profile and dimensions shall be in accordance with AS8879, unless otherwise specified on the part drawing. Thread gauging shall be performed prior to the application of solid film lubricant and self locking feature.

3.3.3.2 External Threads

Screw thread UN profile and dimensions shall be in accordance with FED-STD-H28/2, unless otherwise specified on the part drawing. Minor diameters shall be as specified on the part drawing. Prior to producing key slots, the threads shall be inspected in conformance with FED-STD-H28/20, System 22. Assembled inserts (after key installation) shall be checked in a tapped hole prepared in accordance with AS4724.

3.3.3.3 Lead Threads

External lead threads shall not exceed two pitches, including chamfer.

3.3.3.4 Thread Forming

Threads may be produced either by machining, grinding, or fully formed by a single rolling process.

3.3.3.5 Self-Locking Feature

The thread locking feature shall contain a plastic locking collar. The installed insert shall provide locking torque within the limits of Table 1.

3.4 Heat Treatment

3.4.1 Shall conform to the technical requirements and other provisions specified in the material specification. In process solution treatment shall be carried out between 1650 °F and 1800 °F in a protective atmosphere.

3.4.2 The final product shall have been aged as per the material specification 1325 °F aging treatment.

3.5 Surface Treatment

3.5.1 Inserts, less the keys, shall be passivated in accordance with AMS 2700.

3.5.2 Keys shall be passivated in accordance with AMS 2700 prior to assembly.

3.6 Source Identification Mark

The insert shall be marked on the key tang or insert body. The source identification insignia for a manufacturer shall be in accordance with MIL-HDBK-57 or a private label distributor's insignia, as applicable. The source identification mark shall be legible and permanent.

3.7 Magnetic Permeability

Inserts shall have a magnetic permeability of 2.0 maximum (Air = 1.0) for a field of H = 200 oersteds, when tested in conformance with ASTM A 342.

3.8 Mechanical Properties

Parts shall conform to the requirements of 3.9.1, 3.9.3, 3.9.4, and 3.9.5.

3.8.1 Tensile Strength

Parts shall withstand a load not lower than that specified in Table 2 with or without the locking keys installed. Inserts shall be installed in test blocks (Figure 2) specified in 4.5.1, and tested with test bolts as specified in 4.5.3.1. The test bolt shall be assembled into the insert and shall be of sufficient length to extend through the insert a minimum of two pitches. The test shall be conducted in fixtures shown in Figure 1. The minimum proof load as specified in Table 2, as applicable, shall then be applied to the assembly without failure occurring. In the event of bolt failure below the applicable proof load, the test shall be repeated until the applicable proof rating of the insert is exceeded. The rate of loading shall not exceed 100 ksi per minute based on the shank area of the bolt.

3.8.2 Resistance to Pull-out

Parts shall withstand a load not lower than that specified in Tables 3 or 4 with or without the locking keys installed. Inserts shall be installed in test blocks (Figure 2) specified in 4.5.1, and tested with test bolts as specified in 4.5.3.1. The test bolt shall be assembled into the insert and shall be of sufficient length to extend through the insert a minimum of two pitches. The test shall be conducted in fixtures shown in Figure 1. The minimum resistance to pull out strength specified in Tables 3 or 4 as applicable, shall be applied to the assembly. Failure of the insert to stay in the test block shall not occur below the loads specified in Tables 3 and 4. In the event of bolt failure below the applicable proof load, the test shall be repeated until the applicable proof rating of the insert is exceeded. The rate of loading shall not exceed 100 ksi per minute based on the shank area of the bolt.

3.8.3 Rotational Resistance (Proof)

Parts shall withstand a torque load not lower than that specified in Table 5. Inserts shall be installed in test blocks (Figure 2) as specified in 4.5.1, and tested with test bolts as specified in 4.5.3.1. The test shall be conducted as specified in Figure 3. The rotational force is to be applied with a torque wrench and the torque listed in Table 5, as applicable, shall be reached with no axial load exerted on the test block. Failure of the insert to remain in the test block shall be cause for rejection.

3.8.4 Self-locking Torque Test

Ten inserts shall be installed into test blocks (Figure 2) specified in 4.5.1, and tested with test bolts as specified in 4.5.3.2 with sufficient thread length to extend beyond the locking feature a minimum of two pitches. The bolt shall be engaged and disengaged from the assembled insert self-locking feature for a full 50 installation and removal cycles. The test shall be run at a rate slow enough to yield a dependable measure of torque, and to avoid overheating the assembly. The installation cycle shall be considered complete when two threads extend past the locking feature.

a. Measure and record bolt length

b. Install bolt through spacer defined in Figure 4

c. Install bolt observing the maximum installation torque

d. Record maximum installation torque

e. Record the maximum breakaway torque

f. Lubricate the bearing surface of the bolt with clean engine oil, seat the bolt until the specified elongation specified in Table 12 is obtained. Measure and record the loaded bolt length and the seating torque required to obtain elongation.

g. Heat the assembly for 6 h ± 15 min at a temperature of 500 °F ± 25 °F

h. Allow assembly to cool to room temperature; then measure and record the bolt length before unseating the bolt. Record the unseating torque.

i. Record the breakaway torque

j. Remove bolt from the insert recording both the maximum and minimum removal torque

k. Repeat Steps (a) through (j) for a total of 50 times

NOTE: If an insert exhibits varying torque characteristics [High or Low] this should be noted and the breakaway recorded at any low points.

Additional cycles may be performed to verify that the minimum breakaway torque values can be achieved by changing test bolts within the allowable limits.

Test bolts may be replaced when worn provided a minimum of five cycles have been performed on the bolt. The actual number of cycles performed by the bolt shall be indicated in the test report.

3.8.4.1 Torque Requirements

The minimum breakaway torque limits of Table 1 shall apply to the final cycle.

3.9 Quality

Parts shall be uniform in quality and condition, clean, sound, smooth, and free from burrs, foreign materials, and imperfections detrimental to the usage of the parts.

3.9.1 Discontinuities

See NAS 4007.

3.9.2 Microscopic Examination

NAS 4007.

3.9.3 Threads

See NAS4007.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of parts shall supply all samples and shall be responsible for performing all required tests. Purchaser reserves the right to perform such confirmatory testing as deemed necessary to ensure that the parts conform to the requirements of this specification.

4.2 Responsibility for Compliance

The manufacturer's system for parts production shall be based on preventing product defects, rather than detecting the defects at final inspection and then requiring corrective action to be invoked. An effective manufacturing in-process control system (e.g., Statistical Process Control - SPC) shall be established, subject to the approval of the purchaser, and used during production of inserts.

4.3 Classification of Tests

The inspection and testing of inserts shall be classified as either qualification tests or acceptance tests.

4.3.1 Qualification Tests

Qualification tests shall be performed on inserts selected from the first lot of each size produced by a manufacturer and shall be repeated whenever a significant change is made in the manufacturing process. The qualification tests shall consist of those tests and inspections defined in Table 7.

4.3.2 Acceptance Tests

Acceptance tests shall be performed on each inspection lot. The acceptance tests shall consist of those tests and inspections defined in Table 8.

4.4 Test Sampling

4.4.1 Material

Raw material chemical analysis certification may be accepted in lieu of test data.

4.4.2 Destructive Tests

A random sample shall be selected from each inspection lot; the size of the sample to be as specified in Table 9. The sample units inspected may be selected from those that have been subjected to and passed the non-destructive tests and the fluorescent penetrant and magnetic particle inspection, with additional units selected from the manufacturing lot.

4.4.3 Fluorescent Penetrant Inspection

A random sample shall be selected from each inspection lot; the size of the sample to be as specified in Table 10 and classified as in Table 11. The sample units inspected may be selected from those that have been subjected to and passed the visual and dimensional inspection, with additional units selected at random from the manufacturing lot as necessary.

4.4.4 Non-Destructive Tests - Visual and Dimensional

A random sample of parts shall be taken from each inspection lot; the size of the sample to be as specified in Table 10 and classified as in Table 11. All dimensional characteristics are considered defective when out of tolerance.

4.4.5 Acceptance Quality

Of random samples tested, acceptance quality shall be based on zero defectives.

4.5 Test Materials

4.5.1 Test Blocks

Test blocks shall be fabricated in accordance with Figure 2 as applicable. The aluminum alloy used to prepare the test blocks shall be tested (by heat lot) to determine the ultimate shear strength. The 6061 (UNS A96061) T6 and T651 tempers, in accordance with AMS-QQ-A-225/8 and AMS-QQ-A-250/11 respectively, shall have a minimum shear strength of 27 ksi. Three shear test specimens, per heat lot, of aluminum material shall be made and tested in conformance with NASM 1312, test method 13. Raw material shear test certification may be accepted in lieu of test data.

4.5.2 Test Specimens

Test specimens shall consist of inserts installed in conformance with AS4724 in test blocks specified in 4.5.1 (see Figure 2).

4.5.3 Test Bolts

Bolts for use in all tests shall have Class 3A threads in conformance with AS8879.

4.5.3.1 Ultimate Tensile Strength of Test Bolts

Bolts used for tests specified in 3.9.1 and 3.9.3 shall have a minimum ultimate tensile strength of 200 ksi. No specific finish or material is required.

4.5.3.2 Self-locking Torque Test Bolts

Bolts used for the test specified in 3.9.4 shall be made of corrosion-resistant steel with a minimum tensile strength of 140 ksi. Test bolts shall be selected within the lower 50% of the Class 3A pitch diameter tolerance range.

4.6 Reports

The vendor of parts shall furnish with each shipment, a report stating that the chemical composition of the parts conforms to the applicable material specification, showing the tensile strength, and stating that the parts conform to the other technical requirements. This report shall include the purchase order number, lot number, contractor or other direct supplier of material, part number, nominal size, and quantity.

4.7 Rejected Lots

If a manufacturing lot is rejected, the vendor of parts may perform corrective action to screen out or rework the defective parts, and resubmit for acceptance tests inspection as in Table 8. Resubmitted lots shall be clearly identified as re-inspected lots.

5. PACKAGING

5.1 Packaging shall be in accordance with ASTM D 3951.

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

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

FASTENERS, INSERT, SCREW THREAD, PLASTIC LOCKING DEVICE, KEY-LOCKED, SOLID FILM LUBRICATED
PART NUMBER
LOT NUMBER
PURCHASE ORDER NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

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

5.1.4 Containers of parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT

A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

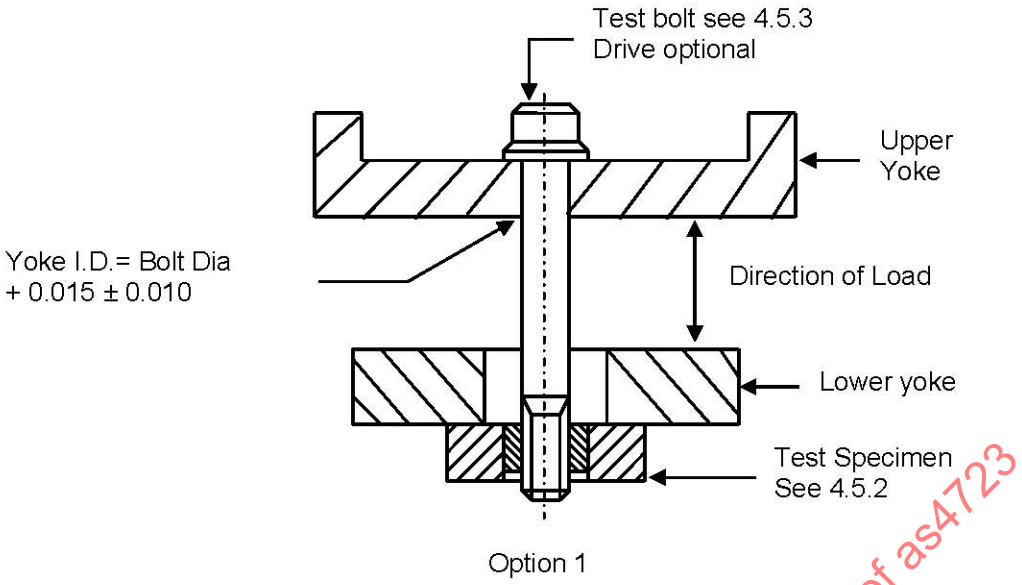
7. REJECTIONS

Parts not conforming to this specification, will be subject to rejection.

8. NOTES

8.1 Key Words

Key locked insert, self locking, plastic locking device, key locked insert, solid film lubricated



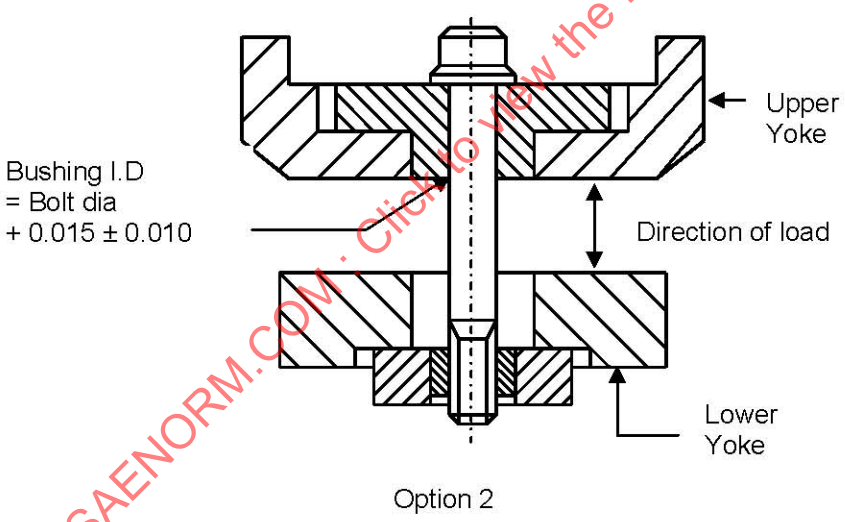
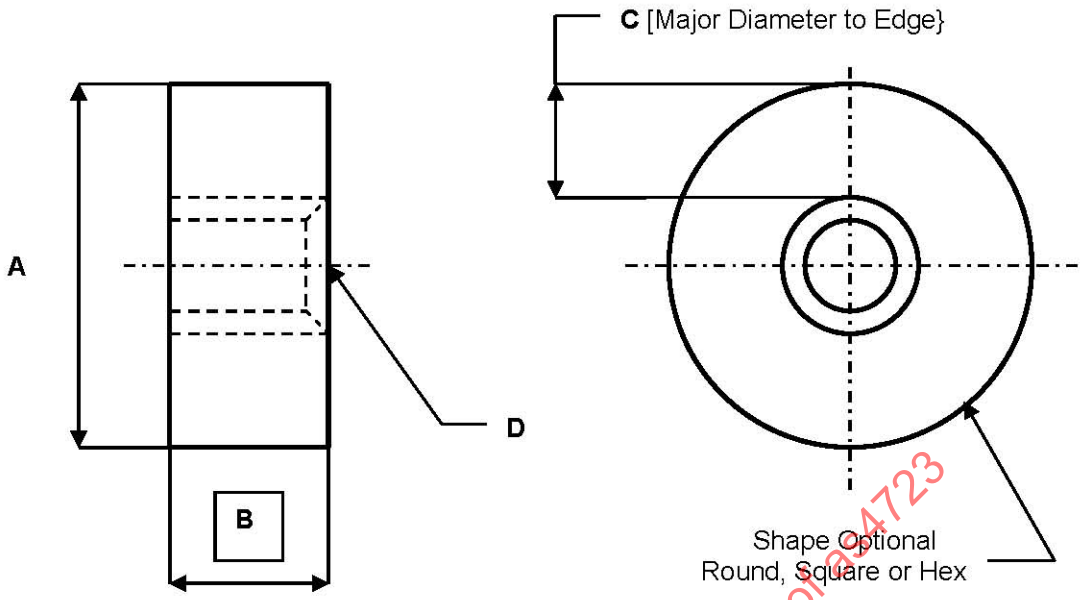


FIGURE 1 - TENSILE AND PULLOUT FIXTURE [OPTIONS]



NOTE 1. DIMENSIONS:
A = TO BE 1.000, 2.000, 3.000 OR LARGER AS REQUIRED
B = LENGTH OF APPLICABLE INSERT PLUS 0.063 MINIMUM
C = TO BE A MINIMUM OF 0.500 **D**
D = NOMINAL EXTERNAL THREAD DIAMETER OR APPLICABLE INSERT TAPPED PER AS4724

NOTE 2. MATERIAL:
ALUMINIUM ALLOY 2024 -T4 OR 2024 - T351 PER AMS-QQ-A-225/6 OR AMS-QQ-A-250/4 [3.8.1]
ALUMINIUM ALLOY 6061 -T6 OR 6061 - T651 PER AMS-QQ-A-225/8 OR AMS-QQ-A-250/11 [3.8.3 AND 3.8.4]

FIGURE 2 - TEST BLOCK (COUPON)

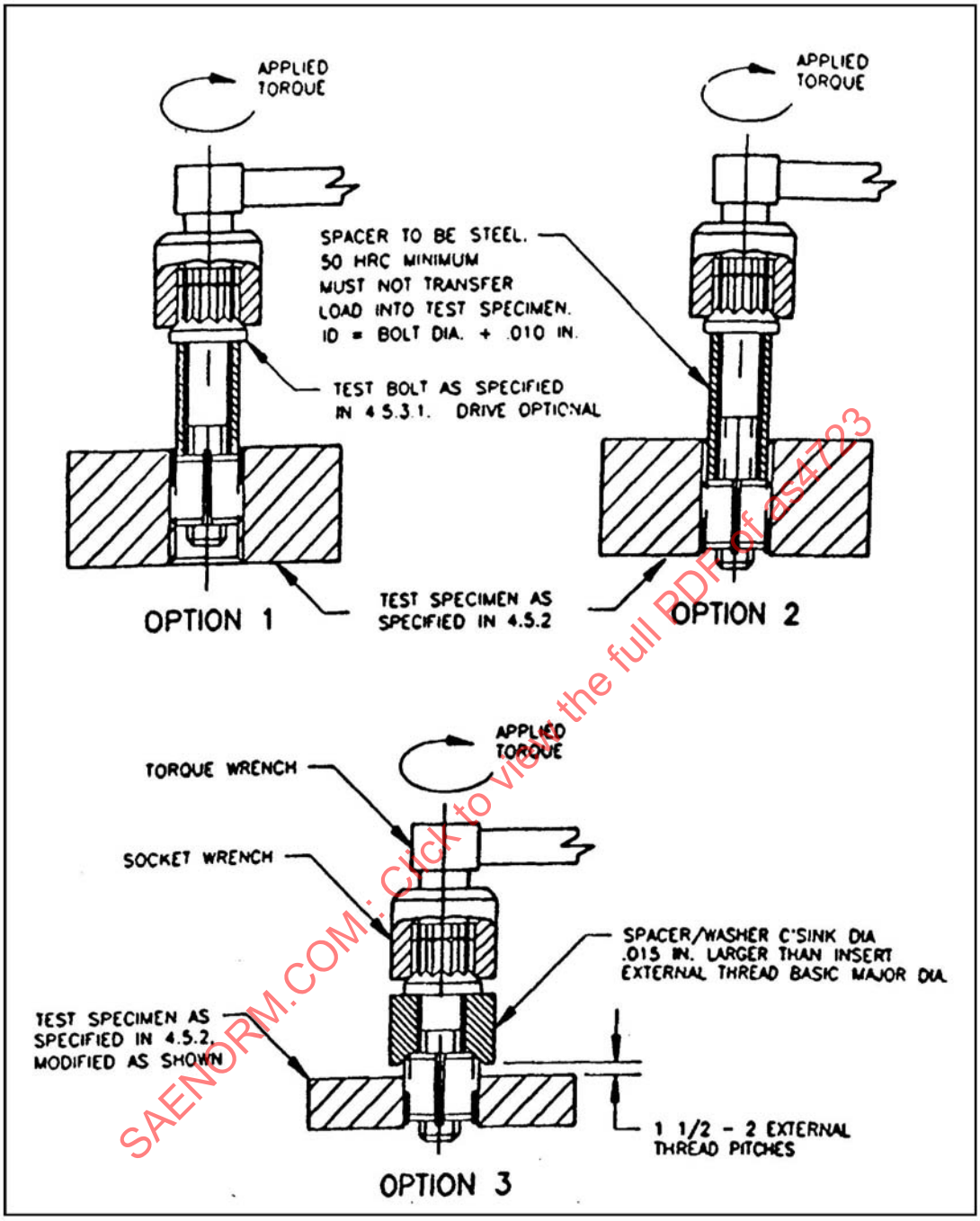
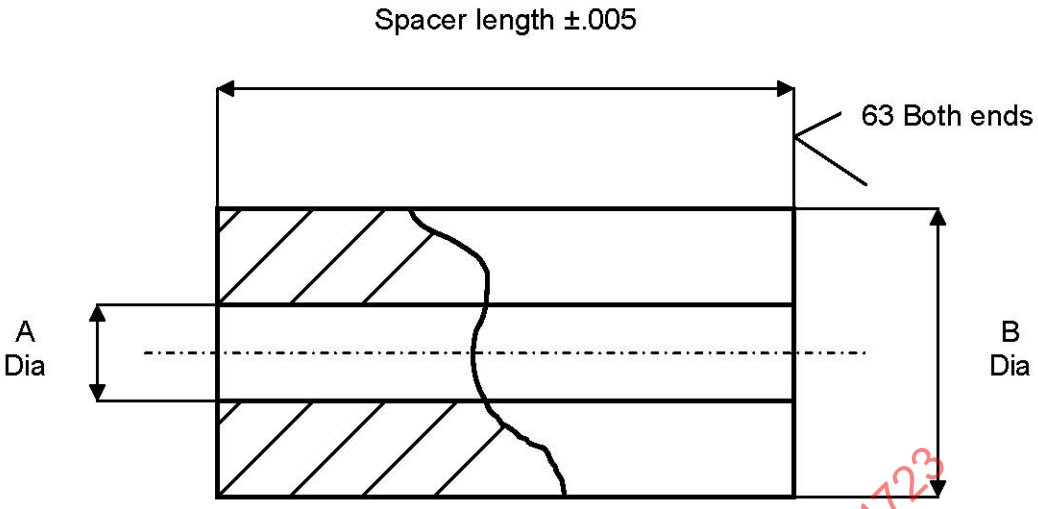


FIGURE 3 - ROTATIONAL RESISTANCE FIXTURE [OPTIONS]



A = Nominal thread Size plus 0.031 in ± 0.005 in

B = Bolt washer face dimension plus 0.125 in ± 0.010 in. Spacer may be made from hex stock with **B** equalling the dimension across the flats

Ends shall be parallel within 0.0015 FIM.
Ends shall be square with the centreline within 0.002 FIM.
Spacer material shall be AMS 5663 or AMS 5662 heat treated to the requirements of AMS 5663
Dimensions and tolerancing per ASME Y14.5M-1994

FIGURE 4 - TEST SPACER

TABLE 1 - INSTALLATION, REMOVAL AND BREAKAWAY TORQUE LIMITS

	Maximum Installation or Removal torques lbf.in (1)		
Basic Internal Thread Size UNJF	Room Temperature Installation	Removal After High Temperature Exposure	Minimum Breakaway Torque lbf-in
0.1640	15	30	1.5
0.1900	18	36	2.0
0.2500	30	60	3.5
0.3125	60	120	6.5
0.3750	80	160	9.5
0.4375	100	200	14.0
0.5000	150	300	18.0
(1) Installation torques listed above may be exceeded during the initial installation [as the bolt sizes the insert locking feature] on 20% of the parts tested provided all parts are within limits after one and one half [1-1/2] threads protrude through the insert.			

TABLE 2 - MINIMUM TENSILE STRENGTH

Basic Internal Thread Size UNJF	Tensile Stress Area in^2	Inserts Per AS3502 Tensile Load-lbf (2)	Inserts Per AS3503 Tensile Load-lbf (2)
0.1640	0.0147	2,350	2,940
0.1900	0.0200	3,200	4,000
0.2500	0.0364	5,820	7,280
0.3125	0.0580	9,280	11,600
0.3750	0.0878	14,050	17,560
0.4375	0.1187	19,000	23,740
0.5000	0.1599	25,600	31,980
NOTE 1. Stress area per ANSI B1.1-1982, Section 11 NOTE 2. Tensile load for AS3502 inserts = Tensile stress area x 160 ksi Tensile load for AS3503 inserts = Tensile stress area x 200 ksi			

TABLE 3 - RESISTANCE TO PULLOUT FOR AS3502 INSERTS

Basic Internal Thread Size	Minimum Shear Engagement Area External Thread in^2 (1)	Minimum Pullout Load lbf (2)
0.1640	0.1025	8,710
0.1900	0.1615	13,720
0.2500	0.2274	19,320
0.3125	0.2956	25,120
0.3750	0.3980	33,830
0.4375	0.5164	43,890
0.5000	0.7619	64,760

NOTE 1. Shear engagement area is an assembled dimensional value measured parallel to the axis of the fastener for the overall engaged area of the mating thread member. It does not represent a dimension of either of the members in an unassembled condition.

NOTE 2. Pull-out load = Shear engagement area x Ultimate Shear strength of the material

To compute minimum pullout load in other materials, multiply shear engagement area by the applicable minimum ultimate shear strength of the material.

TABLE 4 - RESISTANCE TO PULLOUT FOR AS3503 INSERTS

Basic Internal Thread Size	Minimum Shear Engagement Area External Thread in^2 (1)	Minimum Pullout Load lbf (2)
0.1640	0.1283	10,990
0.1900	0.1953	16,600
0.2500	0.2398	20,380
0.3125	0.3144	26,720
0.3750	0.4356	37,020
0.4375	0.5760	44,960
0.5000	0.7880	66,980

NOTE 1. Shear engagement area is an assembled dimensional value measured parallel to the axis of the fastener for the overall engaged area of the mating thread members. It does not represent a dimension of either of the members in an unassembled condition.

NOTE 2. Pull-out load = Shear engagement area x Ultimate Shear strength of the material

To compute minimum pullout load in other materials, multiply shear engagement area by the applicable minimum ultimate shear strength of the material.