AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC
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1. SCOPE

1.1 Scope. This specification covers helical coil screw-thread inserts made from formed wire, the inner surfaces of which, after assembly, provide threads as specified.

1.2 Classification. Inserts shall be of the following types and classes, as specified (see 6.2).

a. Type I - Coarse thread

(1) Class 1 - Free running.

(2) Class 2 - Screw locking (self-locking).

b. Type II - Fine thread

(1) Class 1 - Free running.

(2) Class 2 - Screw locking (self-locking).

c. Type III - Taper pipe thread

(1) Class 5 - NPT pipe thread

(2) Class 6 - ANPT pipe thread

d. Type IV - Metric - spark plug thread

(1) Class 3 - Staking (spark plug thread)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

FEDERAL

FED-STD-H28/2	Screw Thread Standards for Federal Services, Section 2, Unified Inch
FED-STD-H28/7	Screw Thread Standards for Federal Services, Section 7, Pipe Threads, General Purpose

MILITARY

MS9018	Insert - 18-1.5MM Aviation Spark Plug Helical Coil
MS9071	Bosses, 18-1.50MM Spark Plug Thread Helical Insert, Standard Dimensions for (ASG)

(1) COMPLETELY REVISED

THE INITIAL RELEASE OF THIS DOCUMENT SUPERSEDES MIL-I-8846, REVISION D AMENDMENT 1, SUPPLEMENT 1.

THIRD ANGLE PROJECTION	CUSTODIAN	REVISION
	NATIONAL AEROSPACE STANDARDS COMMITTEE	1
PROCUREMENT SPECIFICATION: NONE	TITLE: INSERT, SCREW-THREAD, HELICAL COIL	CLASSIFICATION SPECIFICATION: NASM8846

Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks can be obtained from the Department of Defense Single Stock Point (DODSSP) http://dodssp.daps.dla.mil..

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

Copies can be obtained from ASME, Three Park Ave., New York, NY 10016-5990 www.asme.org

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 8/E 8M	Materials, Metallic, Tension Testing of
ASTM E290	Materials, Metallic, Semi-guided Bend Test for Ductility of
ASTM E1282	Standard Guide for Specifying the Chemical Compositions and Selecting Sampling Practices and Quantitive Analysis Methods for Metals and Alloys
ASTM D3951-90	Standard Practice for Commercial Packaging

Copies can be obtained from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA www.astm.org

NATIONAL AEROSPACE STANDARDS (NAS)

NAS1130	Insert Screw Thread, Helical Coil, Free Running and Self-Locking, Tangless
NAS6603 thru 6620	Bolt, Hex Head, Close Tolerance, Alloy Steel, Long Thread, Self-Locking and Nonlocking
NAS1352	Screw, Cap, Socket Head and Screw Cap Socket Head, Self-Locking, Alloy Steel, Cadmium Plated, UNC-3A
NASM21209	Insert, Screw Thread, Coarse and Fine, Screw Locking, Helical Coil, CRES
NASM33537	Insert - Screw-Thread, Helical Coil Coarse and Fine Thread, Standard Dimensions for
NASM122076 thru NASM122115	Insert - CRES Helical Coil Coarse Thread, 1 Dia Nominal Length
NASM122116 thru NASM122155	Insert - CRES Helical Coil Coarse Thread, 1-1/2 Dia Nominal Length
NASM122156 thru NASM122195	Insert - CRES Helical Coil Coarse Thread, 2 Dia Nominal Length
NASM122196 thru NASM122235	Insert - CRES Helical Coil Coarse Thread, 2-1/2 Dia Nominal Length
NASM122236 thru NASM122275	Insert-CRES Helical Coil Coarse Thread, 3 Dia Nominal Length
NASM124651 thru NASM124690	Insert CRES Helical Coil Fine Thread, 1 Dia Nominal Length
NASM124691 thru NASM124730	Insert CRES Helical Coil Fine Thread, 1-1/2 Dia Nominal Length
NASM124731 thru NASM124770	Insert CRES Helical Coil Fine Thread, 2 Dia Nominal Length
NASM124771 thru NASM124810	Insert CRES Helical Coil Fine Thread, 2-1/2 Dia Nominal Length
NASM124811 thru NASM124850	Insert CRES Helical Coil Fine Thread, 3 Dia Nominal Length

Copies can be obtained from the Aerospace Industries Association, 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209 www.aia-aerospace.org

SAE International

AS7245 Inserts, Screw Thread, Helical Coil 19Cr-9.2Ni, Corrosion Resistant Steel, Procurement for
AS71051 Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT, General Requirements for
AS8879 Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for

Copies can be obtained from SAE International, 400 Commonwealth Dr., Warrendale, PA 15096-0001 www.sae.org

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS and NAS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Associated specifications and standards. The individual item requirements shall be as specified herein and in accordance with the applicable standard. In the event of any conflict between the requirements of this specification and the MS sheets and NAS standard, the latter shall govern.

3.2 Material. Unless otherwise specified on the drawing, the wire shall be manufactured from induction furnace or electric arc furnace steel, cold drawn, and shaped by rolling to conform to this specification and the applicable MS and NAS standards.

3.2.1 Chemical composition. The chemical composition of the wire shall conform to Table I (AS7245).

TABLE I – Chemical Composition

Element	Analysis (Percent)
Carbon	0.15 Max
Manganese	2.00 Max
Silicon	1.00 Max
Phosphorus	0.045 Max
Sulfur	0.035 Max
Chromium	17.00 to 20.00
Nickel	8.00 to 10.50
Molybdenum	0.75 Max
Copper	0.75 Max
Iron	Remainder

3.2.2 Tensile Strength. Before coiling into parts, the wire shall have a tensile strength not lower than 150,000 pounds per square inch (psi) (see 4.4.2).

3.2.3 Cold-bending. Wire from which the inserts are made shall withstand, without cracking, bending at room temperature through an angle of 180 degrees around a diameter equal to twice the cross-sectional dimension of the wire in the plane of bend (see 4.4.3).

3.3 Design. The detail design and dimensions of the inserts shall conform to the applicable MS sheets and NAS standards (see 3.1).

3.3.1 Surface texture. The surface roughness of thread flanks shall be 32 microinches Ra or as specified in the detail specification or the product drawing. Roughness shall be specified in accordance with the method outlined ASME B46.1.

3.4 Threads. Class 1 inserts, (NAS1130, NASM122076 thru NASM122275, and NAS1130, NASM124651 thru NASM124850) and Class 2 inserts (NAS1130, NASM21209), when assembled in accordance with NASM33537, shall produce a finished thread meeting the requirements of FED-STD-H28/2 and accept external threads which conform to AS8879. After assembly, Class 1 and Class 2 inserts shall conform to the minimum and maximum lengths specified on NASM33537. Class 3 inserts (MS9018), when assembled, shall form threads in accordance with MS9071. Class 5 and Class 6 inserts, when assembled in accordance with the applicable design standard or drawing, shall form threads conforming to FED-STD-H28/7 and AS71051, respectively.

3.5 Screw-locking-torque. The class 2 insert, when assembled in accordance with NASM33537 and tested in accordance with 4.4.5 shall produce torque in accordance with the values specified in Table II.

Table II – Pound-Inches Torque at Room Temperature

Fine Thread Series			Coarse Thread Series		
Bolt Size	Maximum Locking Torque, Installation Or Removal	Minimum Breakaway Torque	Bolt Size	Maximum Locking Torque, Installation or Removal	Minimum Breakaway Torque
.0990-56	2	7 /1/	.0860-56	1.25	3 /1/
.1120-48	3	10 /1/	.0990-48	2	7 /1/
.1380-40	6	1.0	.1120-40	3	10 /1/
.1640-36	9	1.5	.1250-40	4.7	13 /1/
.1900-32	13	2.0	.1380-32	6	1.0
.2500-28	30	3.5	.1640-32	9	1.5
.3125-24	60	6.5	.1900-24	13	2.0
.3750-24	80	9.5	.2500-20	30	4.5
.4375-20	100	14.0	.3125-18	60	7.5
.5000-20	150	18.0	.3750-16	80	12.0
.5625-18	200	24.0	.4375-14	100	16.5
.6250-18	300	32.0	.5000-13	150	24.0
.7500-16	400	50.0	.5625-12	200	30.0
.8750-14	600	70.0	.6250-11	300	40.0
1.0000-12	800	90.0	.7500-10	400	60.0
1.1250-12	900	117.0	.8750-9	600	82.0
1.2500-12	1,000	143.0	1.0000-8	800	110.0
1.3750-12	1,150	165.0	1.1250-7	900	137.0
1.5000-12	1,350	190.0	1.2500-7	1,000	165.0
			1.3750-6	1,150	185.0
			1.5000-6	1,350	210.0

/1/ Ounce-inches.

3.6 Identification of product. Unplated class 1 inserts shall be furnished in bright stainless steel finish. Cadmium plated class 1 inserts shall be gold to yellow iridescent in color. Unplated class 2 inserts shall be coated with a red dye which may completely or partially cover insert. Cadmium plated class 2 inserts shall be olive drab to dark brown in color. Class 1 and 2 inserts coated with a dry film lubricant shall be dark gray to black in color. On inserts that are cadmium plated the cadmium shall be 0.0001 inch nominal thickness. Plating shall be in accordance with the applicable MS and NAS standards.

3.7 Workmanship. The formed wire shall be of uniform quality and temper; smooth; clean; and free from kinks, waviness, splits, cracks, laps, seams, scale, segregation, and other imperfections which may impair the serviceability of the insert.

(1) COMPLETELY REVISED

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the procuring activity. The procuring activity reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.2 Responsibility for compliance. The manufacturer's system for parts production should be based on preventing product imperfections, rather than detecting the imperfections at final inspection and then requiring corrective action to be invoked. An effective manufacturing in-process control system shall be established, subject to the approval of the purchaser, and used during production of parts.

4.1.3 Inspection requirements. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the procuring activity for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations is an acceptable practice to ascertain conformance to requirements. However, this does not authorize submission of known imperfect material, either indicated or actual, nor does it commit the procuring activity to accept imperfect material.

4.2 Classification of inspection. The examination and testing of inserts shall be classified as quality conformance inspection.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of the sampling tests and examinations.

4.3.1 Inspection lot. An inspection lot shall consist of inserts which are of the same type, class, thread size and length, fabricated by the same process, from the same heat of material, and produced as one continuous run or order, or part thereof, and submitted for acceptance inspection at the same time.

4.3.2 Sampling tests and examinations.

4.3.2.1 Sampling for tests. Sampling for the material composition test (4.4.1), tensile strength test (4.4.2) and cold-bending test (4.4.3) shall be in accordance with the applicable test paragraph. Any one failure shall be cause for rejection of the represented lot.

4.3.2.2 Nondestructive tests - visual and dimensional. A random sample shall be selected from each production inspection lot; the size for the sample to be as specified in Table III. All dimensional characteristics are considered imperfect when out of tolerance.

4.3.2.3 Destructive tests - screw locking torque. A random sample shall be selected from each production sample lot as per Table III. Normal sample size inspection shall be in effect until conditions for adjusting from normal to reduced sampling size are satisfied. Normal sampling size inspection shall resume when the conditions for switching from reduced to normal sample size occur.

4.3.2.3.1 Normal to reduced sample size switching. Switching from normal to reduced sample shall be instituted providing the following conditions are satisfied.

a. The preceding 10 lots have been on normal inspection (Note 6.5) and all have been accepted; and

c. Production of a sample item or items using similar processes has been continuous under normal size sampling without a break longer than 90 days; and

d. Reduced inspection is considered desirable.

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4.3.2.3.2 Reduced to normal sample size switching. When reduced sample size inspection is in effect, normal sample size inspection shall be instituted if any of the following conditions occur on original inspection:

a. A lot is rejected; or

b. Production of a sample item or items using similar processes ceases or is delayed for a period greater than 90 days; or

c. Other conditions warrant that normal sample size inspection be resumed.

4.3.2.4 Acceptance Quality. Of random samples tested, acceptance quality shall be based on zero imperfections.

4.3.2.5 Disposition of sample units. Sample units which have been subjected to test 4.4.5 shall not be delivered on the contract or order.

4.4 Methods of inspection.

4.4.1 Material composition. It shall be ascertained that the material complies with 3.2.1. The manufacturer's certificate of chemical composition may be accepted. At the discretion of the procuring activity, the material shall be tested in accordance with ASTM E1282. If the material does not pass these tests the entire lot shall be rejected.

4.4.2 Tensile strength. Two samples of each lot representative of the insert material shall be tested in accordance with test method ASTM E 8/E 8M for compliance with 3.2.2.

4.4.3 Cold-bending. Two samples of each lot representative of the insert material shall be tested in accordance with test method ASTM E290 for compliance with 3.2.3.

4.4.4 Visual and mechanical examination. Samples of all insert lots shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements.

TABLE III – Sample Sites

Nondestructive Tests Visual and Dimensional Characteristics		Destructive Tests Screw-Locking Torque		
Production Inspection Lot Size	Sample Size	Production Inspection Size	Normal Sample Size	Reduced Sample Size
90 & under	8	50 & under	2	2
91 to 150	12	51 to 500	3	2
151 to 280	19	501 to 35000	5	2
281 to 500	21	35001 & over	8	5
501 to 1200	27			
1201 to 3200	35			
3201 to 10000	38			
10001 to 35000	46			
35001 to 150000	56			
150001 & over	64			

4.4.5 Screw-locking torque (Class 2 inserts).The torque test shall consist of a 15-cycle, room-temperature torque test, using cadmium-plated bolts or screws in accordance with Table IV, and with thread lengths greater than the nut thicknesses of Table IV. The bolt or screw pitch diameter, after plating, shall be class 3A. The bolts selected for this test shall be of sufficient length so the thread runout does not enter the insert and that a minimum of one full thread extends past the end of the insert. A new bolt or screw and a new tapped hole shall be used for each complete 15-cycle test. The insert shall be assembled in a nut in accordance with Table IV. Bolts and screws must assemble freely, with the fingers, up to the locking coil or coils. The bolt or screw shall be engaged and disengaged from the assembled insert for 15 full installation and removal cycles without axial load on the insert. The test shall be run at a rate slow enough to yield a dependable measure of torque and avoid heating of the bolt. A bolt shall be considered fully installed when three threads extend past the end of the locking coils of the insert; the removal cycle shall be considered complete when the locking coils are disengaged.

4.4.5.1 Maximum locking torque. Maximum locking torque shall be the maximum torque value encountered on any installation or removal cycle and shall not exceed the values specified in Table II. Maximum locking torque readings shall be taken on the first and seventh installation cycles and on the fifteenth removal cycle.

4.4.5.2 Minimum breakaway torque. Minimum breakaway torque shall be the minimum torque required to start removal of the screw or bolt from the installed position and shall be recorded at the start of the fifteenth removal cycle. The torque value for any cycle shall not be less than the applicable value shown on Table II.

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Table IV – Dimensions of Insert Nuts and Bolts Required for Torque Test

Bolt Size		Test Nuts /1/ /4/ Across Flats (Maximum)	Test Nuts /1/ /4/ Thickness /2/ +0.010 -0.000	Bolts for Torque Tests Basic NAS Part Number /3/
FINE THREADS	.0990-56 UNF-3B	0.250	0.170	
	.1120-48 UNF-3B	0.312	0.190	
	.1380-40 UNF-3B	0.344	0.240	
	.1640-36 UNF-3B	0.375	0.280	
	.1900-32 UNJF-3B	0.437	0.320	NAS6603
	.2500-28 UNJF-3B	0.500	0.410	NAS6604
	.3125-24 UNJF-3B	0.562	0.510	NAS6605
	.3750-24 UNJF-3B	0.688	0.600	NAS6606
	.4375-20 UNJF-3B	0.750	0.710	NAS6607
	.5000-20 UNJF-3B	0.875	0.800	NAS6608
	.5625-18 UNJF-3B	0.937	0.900	NAS6609
	.6250-18 UNJF-3B	1.062	0.990	NAS6610
	.7500-16 UNJF-3B	1.250	1.190	NAS6612
	.8750-14 UNJF-3B	1.437	1.380	NAS6614
	1.0000-12 UNJF-3B	1.625	1.625	NAS6616
	1.1250-12 UNJF-3B	1.812	1.770	NAS6618
	1.2500-12 UNJF-3B	2.000	1.960	NAS6620
	1.3750-12 UNJF-3B	2.187	2.150	------
	1.5000-12 UNJF-3B	2.187	2.330	------
COARSE THREADS	.0860-56 UNC-3B	0.188	0.150	NAS1352
	.0990-48 UNC-3B	0.250	0.170	
	.1120-40 UNC-3B	0.312	0.190	NAS1352
	.1250-40 UNC-3B	0.344	0.210	
	.1380-32 UNC-3B	0.344	0.240	NAS1352
	.1640-32 UNC-3B	0.375	0.280	NAS1352
	.1900-24 UNC-3B	0.437	0.320	NAS1352
	.2500-20 UNC-3B	0.500	0.410	NAS1352
	.3125-18 UNC-3B	0.562	0.510	NAS1352
	.3750-16 UNC-3B	0.688	0.600	NAS1352
	.4375-14 UNC-3B	0.750	0.710	NAS1352
	.5000-13 UNC-3B	0.875	0.800	NAS1352
	.5625-12 UNC-3B	0.937	0.900	NAS1352
	.6250-11 UNC-3B	1.062	0.990	NAS1352
	.7500-10 UNC-3B	1.250	1.190	NAS1352
	.8750-9 UNC-3B	1.437	1.380	NAS1352
	1.0000-8 UNC-3B	1.625	1.625	
	1.1250-7 UNC-3B	1.812	1.770	
	1.2500-7 UNC-3B	2.000	1.960	
	1.3750-6 UNC-3B	2.187	2.150	
	1.5000-6 UNC-3B	2.187	2.330	

/1/ Material: Aluminum alloy 2024-T4 or T351.
/2/ Nut thickness is equal to dimension "H" minimum of NASM33537.
/3/ Equivalent class 3A cadmium plated socket head cap screws may be substituted for the NAS and MS bolts.
/4/ For locking torque testing a plate or block of the same material and hole dimensions may be used in lieu of the nut configurations.

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4.4.6 Inspection of Packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of ASTM D 3951-90, Standard Practice for Commercial Packaging.

5. PACKAGING

5.1 Packaging requirements. Preservation, packaging, packing, and marking shall conform to ASTM D3951-90, Standard Practice for Commercial Packaging.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The inserts covered by this specification are intended for use in an original design application, especially in soft materials, to provide protection against thread failures caused by stripping, fatigue, wear, corrosion, and seizing. They are also intended for use in the repair of damaged or worn threads not originally protected. The class 2 insert which has prevailing torque capabilities provides protection to the joint against loosening caused by vibration and impact loading, thus obviating the use of lock washers, lock wires, or other means of locking.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification

b. Part number in accordance with the applicable MS sheet or NAS standard (see 3.1).

c. Type, class, nominal length, thread size, and series (see 1.2).

d. Applicable levels of preservation, packaging, and packing (see 5.1).

e. Package quantities, if other than standard.

6.3 Design and installation guidance.

6.3.1 Design. Tanged inserts and tangless inserts require different installation tooling and shall not be supplied interchangeably. The decision to select tanged inserts or tangless inserts shall be made by the design activity.

6.3.2 Inserts lengths. Type I and type II inserts are available in five standard lengths, 1, 1-1/2, 2, 2-1/2 and 3 times the nominal thread diameter. For specific sizes and part numbers see section 2.

6.3.3 Installation. Inserts are installed in accordance with the dimensional requirements contained in NASM33537.

6.3.4 Insert length selection. The standard engineering practice of balancing the tensile strength of the bolt material against the shear strength of the parent or boss material also applies to helical coil inserts. Table V will aid the designer in developing the full load value of the bolt rather than stripping the parent or tapped material.

In using this table these factors must be considered:

6.3.4.1 Actual bolt tensile strength, particularly in the lower bolt tensile ranges may be significantly higher than the nominal values. This should be considered in insert length selection.

6.3.4.2 The parent material shear strengths are for room temperature. Elevated temperatures call for significant shear value reductions; compensation should be made when required. Shear values are appropriate because the parent material is subject to shearing stress at the major diameter of the tapped threads.

6.3.4.3 When parent material shear strength falls between two tabulated values, use the lower of the two.

6.3.4.4 Bolt thread length, overall length, insert length, and full tapped thread depth must be adequate to insure full thread engagement when assembled in order to comply with its design function. Refer to NASM33537.

Table V – Length of Thread Engagement in Bolt Nominal Diameters

Shear Strength of Parent Material (psi Fsu)	Bolt Tensile Strength Rating (psi Ftu)					
	80,000	100,000	125,000	160,0000	180,000	220,000
10,000	2-1/2	3	-	-	-	-
15,000	1-1/2	2	2-1/2	3	-	-
20,000	1-1/2	1-1/2	2	2-1/2	3	3
25,000	1	1-1/2	1-1/2	2	2-1/2	2-1/2
30,000	1	1	1-1/2	2	2	2-1/2
40,000	1	1	1	1-1/2	1-1/2	2
50,000	1	1	1	1	1-1/2	1-1/2

6.4 Tools. Helical coil wire screw thread taps and plug gages are defined in A-A-59158. Included in A-A-59158 are tools for inserting and extracting helical coil wire screw thread inserts with tangs only. Tools for tangless inserts are specified by the manufacturer.

6.5 Sampling. Only tests conducted after 8 March, 1994 are to be considered for satisfying normal to reduced sample size switching conditions.

6.6 Subject term (Keyword) listing:

Free Running
Screw Locking
Tanged Inserts
Tangless Inserts