Process Specification for the Installation of Key-retained Screw Thread Inserts

Engineering Directorate

Structural Engineering Division

June 2020

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

Process Specification for the Installation of Key-retained Screw Thread Inserts

Prepared by:	Signature on File Jay Bennett Materials and Processes Branch/ES4	04/30/2020 Date
Reviewed by:	Signature on File Brittany Kerr Quality Engineering Branch/NT4	04/30/2020 Date
Approved by:	Signature on File Brian Mayeaux Materials and Processes Branch/ES4	05/29/2020 Date

REVISIONS		
VERSION	CHANGES	DATE
--	Original version	5/31/96
A	Included reference to sealing specification, improved the verification section, and reordered the sections.	7/29/99
B	Added three new paragraphs to section 3. In the tables in appendix A, created a separate column for NAS part numbers, corrected two typos in part number designations, and rounded off tap drill depths to nearest .005".	10/18/99
C	Changed Division name. Revised Section 6.1 (Work Instructions), and revised Section 9.0 (Training).	10/2004
D	Updated document numbers and names in Section 4.0 (References)	2/2007
E	Changed Approver, added PRC-4004, added Removal and Replacement section (6.9), and changed qualification to include removal and replacement	5/2020

1.0 SCOPE

This process specification establishes requirements for the installation of key- retained inserts and studs.

2.0 APPLICABILITY

This specification shall be applicable whenever the installation of key-retained inserts and studs is invoked per section 3.0, “Usage”.

3.0 USAGE

This process specification shall be called out on the engineering drawing by using a drawing note. For example:

INSTALL KEY-RETAINED INSERTS PER NASA/JSC PRC-9006.

Most hole preparation details do not need to be specified on the engineering drawing because the requirements are covered in this PRC. Through-holes are preferred but must be specified on the engineering drawing. Use of a plug tap is standard for blind holes. When use of a bottom tap is necessary, it shall be specified on the engineering drawing as follows:

USE BOTTOM TAP.

The depth of the drill hole for plug taps is the sum of the maximum insert length, the maximum insert depth below the surface, and the length of five incomplete threads. The depth of the drill hole for bottom taps is the sum of the maximum insert length, the maximum insert depth below the surface, and the length of three incomplete threads. Standard drill hole depths are found in Tables 1, 2, 3, and 4 (see Appendix A). Alternate drill hole depths may be used, as long as minimum full thread depth is maintained, but the alternate drill hole depth must be specified on the engineering drawing.

The depth of the drilled hole does not include the material removed by point of the drill. The standard drill point has an included angle of 60°. A 135° or flat bottom drill bit can be utilized if necessary but must be called out on the engineering drawing.

The hole preparation for self-locking and non-self-locking inserts is identical except for the larger sizes. Separate hole preparation dimensions are given for these sizes.

This specification may be used to install non-standard key-retained screw thread inserts. Hole preparation dimensions for these inserts shall be called out on the engineering drawing.

Wet installation of inserts with corrosion preventative primer is standard for aluminum and for dissimilar metal joints. Use the following callout:

SEAL INSERT PER NASA/JSC PRC-4004.

In some design cases, sealant may not be necessary, but the decision not to use sealant should be reviewed in advance with Materials and Processes Branch (ES4) personnel.

4.0 REFERENCES

The following references were used to develop this process

specification: SOP-007.1 *Preparation and Revision of Process*

Specifications

JPR 8500.4 *Engineering Drawing System Manual*

The following documents are called out as an extension of the requirements given in this specification:

NASA/JSC PRC-4004 *Process Specification for the Sealing of Joints and Faying Surfaces*

FED-STD-H28/2B *Screw-Thread Standards for Federal Services, Section 2, Unified Inch Threads -- UN And UNR Thread Forms*

MS51830 *Insert, Screw-Thread, Locked In, Key-Locked, Miniature and Lightweight*

MS51831 *Insert, Screw-Thread, Locked In, Key-Locked, Heavy Duty*

MS51832 *Insert, Screw-Thread, Locked In, Key-Locked, Extra Heavy Duty*

MS51833 *Stud, Locked In, Key-Locked, Regular Duty*

MS51834 *Stud, Locked In, Key-Locked, Heavy Duty*

MS51835	*Inserts and Studs, Locked in, Key Locked, Hole Dimensions for and Assembly of*
NAS1394	*Insert-Threaded Metal, Lightweight, Self-Locking, and Non Self-Locking*
NAS1395	*Insert-Threaded Metal, Heavy Duty, Self-Locking, and Non Self-Locking*

5.0 MATERIAL REQUIREMENTS

None identified.

6.0 PROCESS REQUIREMENTS

6.1 WORK INSTRUCTIONS

All work shall be performed to written procedures. The work instructions shall contain sufficient detail to ensure that the manufacturing process produces consistent, repeatable products that comply with this specification.

For work performed at JSC facilities, these work procedures consist of Detailed Process Instructions (DPI's).

For contracted work, the contractor shall be responsible for preparing and maintaining, and certifying written work procedures that meet the requirements of this specification.

6.2 HOLE PREPARATION AND DRILLING

Hole preparation shall be in accordance with Tables 1,2, 3, and 4 in Appendix A. In addition, tapped holes shall be drilled to the diameter and depth specified in the Appendix A tables.

6.3 COUNTERSINK

The edge of the recess shall be countersunk. The angle of countersink shall be 100 degrees inclusive.

6.4 TAPPING

Threads in the parent material shall meet FED-STD-H28/2B, UN thread form, with a modified minor diameter, tolerance class 2B, except when noted as NS. Minimum full thread depth requirements shall be as noted in

the Appendix A tables.

6.5 HOLE FINISH

The hole protective finish shall be completed as-specified on the engineering drawing.

6.0 FLUSHNESS

Miniature inserts shall be 0.005 to 0.015 in. below the surface of the parent material after installation. Lightweight, heavy-duty, and extra heavy-duty inserts shall be
0.010 to 0.030 inch below the surface of the parent material after installation. The driven keys shall be flush or below the surface of the parent material.

6.1 BROACHING

When key inserts are installed into materials where the minimum ultimate tensile strength is greater than 80,000 pounds per square inch, the key slots shall be broached. The slots shall also be broached for aluminum alloys that are defined as non-corrosion resistant by MSFC-SPEC-250.

6.2 KEY INSTALLATION

The key shall be installed using the manufacturers tooling only. If the manufacturers' tool does not set the key to the proper depth, a punch may be used to set the key slightly below the surface.

6.3 REMOVAL AND REPLACEMENT

The key insert shall be removed by using a standard drill to remove the material between the keys. A punch shall then be used to deflect the keys inward and break them off. Remove the insert with an E-Z Out type tool.

The hole and the threads shall be inspected to assure they still meet requirements.

The keys may be placed in the same location if the key slots are still in good condition. If new key slot is required, the key locations shall be located approximately 90 degrees from the original location for two key inserts, or approximately 45 degrees for four key inserts.

7.0 <u>PROCESS QUALIFICATION</u>

The key insert installation, removal, and replacement process shall be qualified and approved by M&P prior to assembly of production parts. This

qualification shall provide documented evidence that the installation procedures are capable of meeting the requirements of this process specification and the engineering drawing. Any change to the procedure or insert type shall require re-qualification.

8.0 PROCESS VERIFICATION

The requirements in sections 6.2 (Hole Preparation and Drilling), 6.3 (Counter- sink), 6.4 (Tapping), and 6.6 (Flushness) shall be verified by inspection.

9.0 TRAINING AND CERTIFICATION OF PERSONNEL

This process shall be performed by personnel qualified through training or experience and certified by their supervision to conduct the process.

10.0 DEFINITIONS

None.

APPENDIX A – INSERT INSTALLATION DATA

Table 1: Miniature Insert Installation Data

Insert	Hole Preparation					
Part Number	Internal Thread (Modified Minor Diameter)	Tap Drill Diameter	Plug Tap Drill Depth ±0.010	Bottom Tap Drill Depth ± 0.010	CSK Dia +0.010 -0.000	Minimum Full Thread Depth
MS51830XX101	0.164-32	.137 .133	.305	.245	.166	.140
MS51830XX102	0.190-32	.164 .160	.355	.295	.194	.160
MS51830XX103	0.216-28	.191 .186	.380	.305	.220	.160
MS51830XX104	0.250-28	.231 .227	.430	.355	.255	.210

Table 2: Lightweight Insert Installation Data

Insert Part Number		Hole Preparation					
NAS Series	MS Series	Internal Thread (Modified Minor Diameter)	Tap Drill Diameter	Plug Tap Drill Depth ±0.010	Bottom Tap Drill Depth ± 0.010	CSK Dia +0.010 -0.000	Minimum Full Thread Depth
NAS1394XX3	MS51830XX105 MS51830XX201 MS51833XX101 MS51833XX201	0.3125-18	.276 .271	.635	.525	.323	.370
NAS1394XX4	MS51830XX106 MS51830XX202 MS51833XX102 MS51833XX202	0.3750-16	.336 .331	.735	.610	.385	.430
NAS1394XX5	MS51830XX107 MS51830XX203 MS51833XX103 MS51833XX203	0.4375-14	.401 .396	.840	.695	.447	.500
NAS1394XX6	MS51830XX108 MS51830XX204 MS51833XX104 MS51833XX204	0.5000-13	.457 .452	.930	.775	.510	.560
NAS1394XX7	MS51830XX109 MS51830XX205 MS51833XX105 MS51833XX205	0.5625-12	.521 .515	1.025	.855	.572	.620
NAS1394XX8	MS51830XX110 MS51830XX206 MS51833XX106 MS51833XX206	0.6250-11	.583 .577	1.125	.945	.635	.680

Table 3: Heavy Duty Insert Installation Data

Insert Part Number		Hole Preparation					
NAS Series	MS Series	Internal Thread (Modified Minor Diameter)	Tap Drill Diameter	Plug Tap Drill Depth ±0.010	Bottom Tap Drill Depth ± 0.010	CSK Dia. +0.010 -0.000	Minimum Full Thread Depth
NAS1395XX08	MS51834XX101 MS51834XX201	0.3125-18	.276 .271	.635	.525	.323	.370
NAS1395XX3	MS51831XX101 MS51831XX201 MS51834XX102 MS51834XX202	0.3750-16	.336 .331	.670	.545	.385	.370
NAS1395XX4	MS51831XX102 MS51831XX202 MS51834XX103 MS51834XX203	0.4375-14	.401 .396	.775	.635	.447	.430
NAS1395XX5	MS51831XX103 MS51831XX203 MS51834XX104 MS51834XX204	0.5000-13	.457 .452	.865	.715	.510	.500
NAS1395XX6	MS51831XX104 MS51831XX204 MS51834XX105 MS51834XX205	0.5625-12	.521 .515	.960	.795	.572	.560
NAS1395XX7	MS51831XX105 MS51831XX205 MS51834XX106 MS51834XX206	0.6250-11	.583 .577	1.125	.945	.635	.680
NAS1395XX8	MS51831XX106 MS51831XX206 MS51834XX107 MS51834XX207	0.6875-11NS	.646 .640	1.185	1.005	.700	.750
NAS1395XX9	MS51831XX107 MS51831XX207 MS51834XX108 MS51834XX208	0.8125-16	.771 .765	1.170	1.045	.822	.940
NAS1395XX10	MS51831XX108 MS51831XX208 MS51834XX109 MS51834XX209	0.875-14	.833 .827	1.275	1.135	.885	1.000
	MS51831XX109 MS51831XX209 MS51834XX110 MS51834XX201	1.125-12	1.067 1.061	1.585	1.420	1.145	1.310
	MS51831XX109L MS51831XX209L MS51834XX110L MS51834XX201L	1.125-12	1.067 1.061	1.710	1.545	1.145	1.440
	MS51831XX110 MS51831XX210 MS51834XX111 MS51834XX211	1.25-12	1.192 1.186	1.710	1.545	1.270	1.440
	MS51831XX110L MS51831XX210L MS51834XX111L MS51834XX211L	1.25-12	1.192 1.186	1.835	1.670	1.270	1.560
	MS51831XX111 MS51831XX211 MS51834XX112 MS51834XX212	1.375-12	1.317 1.311	1.835	1.670	1.395	1.560
	MS51831XX111L MS51831XX211L MS51834XX112L MS51834XX212L	1.375-12	1.317 1.311	1.960	1.795	1.395	1.680

Table 4: Extra Heavy Duty Insert Installation Data

Insert	Hole preparation					
Part Number	Internal Thread (Modified Minor Diameter)	Tap Drill Diameter	Plug Tap Drill Depth ±0.010	Bottom Tap Drill Depth ± 0.010	CSK Dia. +0.010 -0.000	Minimum Full Thread Depth
MS51832XX101 MS51832XX201	.4375-14	.401 .396	.715	.570	.447	.370
MS51832XX102 MS51832XX202	.500-13	.457 .452	.805	.650	.510	.440
MS51832XX103 MS51832XX203	.5625-12	.521 .515	.900	.730	.572	.500
MS51832XX104 MS51832XX204	.625-11	.583 .577	1.000	.820	.635	.560
MS51832XX105 MS51832XX205	.6875-11NS	.646 .640	1.125	.945	.700	.680
MS51832XX106 MS51832XX206	.8125-16	.771 .765	1.045	.920	.822	.750
MS51832XX107 MS51832XX207	.875-14	.833 .827	1.215	1.070	.885	.940
MS51832XX108 MS51832XX208	1.000-12	.942 .936	1.335	1.170	1.020	1.000
MS51832XX109 MS51832XX209	1.250-12	1.192 1.186	1.587	1.420	1.270	1.310
MS51832XX109L MS51832XX209L	1.250-12	1.192 1.186	1.712	1.545	1.270	1.440
MS51832XX110 MS51832XX210	1.375-12	1.317 1.311	1.712	1.545	1.395	1.440
MS51832XX110L MS51832XX210L	1.375-12	1.317 1.311	1.837	1.670	1.395	1.560
MS51832XX111 MS51832XX211	1.500-12	1.442 1.437	1.837	1.670	1.520	1.560
MS51832XX111L MS51832XX211L	1.500-12	1.442 1.437	1.962	1.795	1.520	1.680