

SPIRE BSM Declared Process List

Procedure ID SPI-BSM-PRJ-708 ITEM #16

Preparation and Torque Tightening of fasteners

Version Control

ID	Change	Initial	Date
v.1.0	first release and use of procedure on DM-1 prior to vibration shake	IP	23.Apr.02
v.1.1	Amended torque values after problems on STM and DM-1 (see SPI-BSM-NCR-0012 and 0013).	IP	27.Aug.02

Note this document has been issued without full formatting - further work by A.Toni in hand on this and minor notes (marked xxx or yyy).

Contents

Version Control	1
Contents	1
Ref Docs	1
Applicable Docs.....	1
Scope	1
Introduction	1
Preparation.....	2
Threaded component.....	2
Clamped component	2
Screw	2
Equipment.....	2
Tightening torque.....	3
Standard Cases.....	3
Special Cases	4

Ref Docs

DML list xxx
MSSL or RAL preparation notes xxx.
ESA PSS on threaded fasteners ESA-PSS-03-208
NCR's SPI-BSM-NCR-0012 and -0013

Applicable Docs

DPL list xxx
QA plan xxx
Calc sheet for torques xxx

Scope

This procedure outlines the required preparation of stainless steel screw type fasteners for use with the SPIRE BSM, and the torque settings to be used.

Introduction

Space flight components require a high degree of cleanliness, low outgassing and contamination and a joint which is secure against vibration. Product assurance requirements are rigorous and the correct application of procedures must be verifiable.

For the BSM, fasteners generally consist of a stainless steel screw fitted into an aluminium or G-10 component.

To prevent damage to the screw thread in the weaker material, a threaded insert is used.

A locking insert is generally specified to prevent loosening under vibration or thermal cycling, and a high pre-load applied to the fastener to stretch the shank of the screw and provide a firm clamping force even in the worst case of low temperatures and heavy vibration.

A vacuum safe lubricant is applied to prevent the high cleanliness surfaces from seizing. Generally MoS₂ is used (see DML ID~xxx). This also provides for a much reduced scatter in the pre-load forces produced.

Thread lock of any kind is expressly forbidden. In special cases where specified on drawings a bead of approved adhesive is specified to be applied visibly around the fastener head (this is only used when a locking insert is unavailable, e.g. with very small screw threads <M2.5).

A spring washer (Belleville type) is often used when required to prevent the joint from loosening when cooled down. In exceptional cases an Invar washer may be used instead where specified on drawings.

Preparation

Threaded component

1. Validate that a locking insert is present. Component assembly records will indicate that these have been fitted, and a check using a clean screw should indicate that one is present (resistance to finger tightening will be felt)
2. Ensure component is clean. If the part it does not have a valid cleanliness certificate then flow wash in clean IPA or ultrasonic bath where practical.
3. Final check bore and mating surfaces are free of damage or burrs.

Clamped component

1. Check that bore is clean. If the part it does not have a valid cleanliness certificate then flow wash in clean IPA or ultrasonic bath where practical.
2. Final check bore and mating surfaces are free of damage or burrs.

Screw

Usually, a batch of fasteners will be prepared before use:

1. Ensure component is clean. If the part it does not have a valid cleanliness certificate then flow wash in clean IPA or ultrasonic bath where practical.
2. In a separate, semi-clean, area apply a coating of MoS₂ to the screw threads and the contact area under the screw head.

Note: alternative methods may include tumbling of batches in MoS₂ powder or applying lubricant with a suitable small non-metallic brush.

3. Where possible, prevent excess lubricant getting into hex sockets as this encourages rounding or slip out when tightening.
4. Wipe excess lubricant from the fastener.

Equipment

1. Check calibration of torque wrenches/screwdriver and that correct settings are applied.

2. If more than one setting is in use at a time make sure separate torque wrenches are clearly labeled.
3. When setting up tools (which is often not a fine art for these small torque levels) err on the side of a lower torque (don't risk breaking the screws!)
4. A calibrated inspection tool (torque watch) should be available.

Tightening torque

In the case of locking inserts (a.k.a. 'prevailing torque locking systems') an additional torque is required to overcome the resistance of the insert before applying enough torque to stretch the bolt

Standard Cases

Threaded part	Aluminium / Brass (with insert)	MoS ₂ Lubricant on thread and under fastener head:	M2.5	M4	
Clamped part	Aluminium				
prevailing torque from insert ¹			20	50	Nmm
torque on screw or nut			465	2309	Nmm
TOTAL torque setting			485	2359	Nmm
conversion ² to Lbf-in			4.30	20.88	Lbf-in

Threaded part	Aluminium (NO insert)	MoS ₂ Lubricant on thread and under fastener head:	M2.5	M4	
Clamped part	Aluminium				
prevailing torque from insert			0	0	Nmm
torque on screw or nut			465	2309	Nmm
TOTAL torque setting			465	2309	Nmm
conversion to Lbf-in			4.12	20.44	Lbf-in

Threaded part	G-10 (with insert)	MoS ₂ Lubricant on thread and under fastener head:	M2.5	M4	
Clamped part	Aluminium				
prevailing torque from insert			20	Not used	Nmm
torque on screw or nut			432		Nmm
TOTAL torque setting			452		Nmm
conversion to Lbf-in			4.00		Lbf-in

¹ Note that by experiment this varied from 20 to 100 Nmm. Values below 20Nmm may indicate a non-locking insert.

² For use with equipment in US or Imperial units, note : 1Nm = 8.8507 lbf-in

Special Cases

Some special cases are known at this time. Drawings will be modified to show these (CTD in progress).

1. Screws on the **Chop Axis Mirror**, drg xxxx item yyyy (M2.5 hex socket screws x 2 places) .
 - it is important not to over compress the flex pivots
 - Torque to 280Nmm
2. Screws on the jiggle Frame, **mounting the Chop axis position sensors**. drg xxxx item yyyy (M2.5 flat head countersunk screws x 6 places).
 - These are inaccessible with a torque screwdriver.
 - Experienced technician to assemble to as strong finger tight setting without stripping threads.
3. Screws on **Jiggle axis motor mounts** drg xxxx item yyyy (M2.5 hex socket screws x 6 places).
 - these are inaccessible with a torque screwdriver as a long extension is required. (additional tooling shall be requested)
 - Experienced technician to assemble to as strong finger tight setting without stripping threads.
4. Screws on **BSM structure to interface shoe** drg xxxx item yyyy (M4 x 3places)
 - One or more of these are inaccessible with a torque wrench or screwdriver as a long slim extension is required. (additional tooling shall be requested)
 - Experienced technician to assemble to as strong hand tight setting without stripping threads.