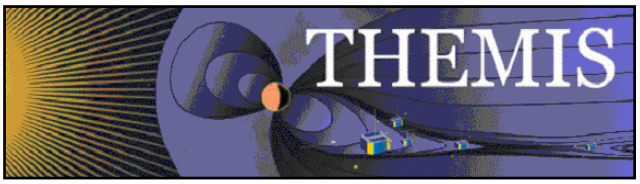

PFR-012 Title: EFI Ferrule Spring contact problem

Assembly : EFI Cable/Preamp Assy THM-SPB-MEC-840-009 in SPB unit S908	**SubAssembly : Preamp PWB #50**
Component : Ferrule spring	
Originator: Arthur Hull	**Organization: UCB/SSL THEMIS EFI**
Phone : (510)-643-0502	**Email : ahull@ssl.berkeley.edu**

Failure Occurred During (Check one √)

■ Functional test □ Qualification test □ S/C Integration □ Launch operations □ Other (Flight Assy)

Environment when failure occurred:

■ Ambient	□ Vibration	□ Shock	□ Acoustic
□ Thermal	□ Vacuum	□ Thermal-Vacuum	□ EMI/EMC

Problem Description

(In this section it is important to document the specific symptoms which exhibited the problem. In the event we see it happen again, we would like to know as much as possible.)

The electrical contact between ferrule spring and ferrule in the EFI SPB cable/preamp assembly was found to be problematic. The problem revealed itself during a LPT performed on the SPB mechanical assembly S908 prior to environmental testing. The resistance between the bias pin at the breakout box to the sphere input of the spin plane boom (SPB) unit was expected to be 75 MOhm. However a continuity check of the SPB mechanical unit revealed that the electrical path was open. Additional checks from the bias pin and the positive and negative supply line revealed that the open was not in the path from the breakout bias pin to the preamp and must be in the path from the preamp input to the sphere. The preamp was partially deployed to expose the sphere, fine wire and preamp. Subsequent measurements indicated that there was continuity between the fine wire and the sphere, however, the continuity between the preamp and bias line was intermittent depending on the tension on the fine wire. The path was open when the fine wire was pulled away from the preamp and 75 MOhm resistance value was measured when the tension was removed. This revealed a problem with electrical contact between the ferrule spring and the ferrule. All four of the F1 units and the three remaining F2 units were subsequently tested, and only one additional F2 unit was found to have an open electrical contact.

Analyses Performed to Determine Cause

(How do we know how the failure happened? Was it a bad part, bad handling, what?)

We unpacked the preamp assembly for further evaluation. We measured the length of the ferrule spring, its excursion from the sphere mount, the ferrule counterbore depth, and the dimensions of the usher top and found these measurements to be consistent with design. The uncompressed height of the spring on the PWB was measured and compared to springs worst case compressed height expected from design tolerance in the packaged configuration. We found that the uncompressed height was sufficient to provide electrical contact (e.g., 125 mil uncompressed versus 109 mil worst case expected height in packaged configuration). Using the ferrule spring soldering jig and viewing the engagement under a microscope, we discovered that the spring, which was found to fit loosely over the ferrule, was contacting the PEEK sphere mount. This prevented the spring from seating properly and making electrical contact on the designed ledge of the ferrule (see Figure 1). This seating problem exists in all of the SPB preamp units. However, an open circuit was probably not manifested in six of the eight SPB mechanical units tested because the springs in the other units probably fit sufficiently snug onto the ferrule to make contact laterally on the ferrule. A lateral contact point between the ferrule and the spring was not part of the original design and does not provide a consistent and reliable contact, owing to the differences in the spring diameters and differences in interference via the PEEK from unit to unit.

The detailed inspection of the ferrule and ferrule spring contact problem, revealed two other related issues with the current design and parts: 1) the contact force provided by the spring appears to be marginal in some units, and 2) the gold plating on all the ferrules in the batch was found to be of poor quality,

namely there was considerable amount of pitting visible on the ferrule surface and the finish was not a clear bright gold color, indicating that the plating thickness may not be up to specification. The ferrules were made out of tellurium copper, which is inherently more difficult to plate directly with gold than other materials and which is more susceptible to pitting unless a more stringent cleaning process is followed.

Corrective Action/ Resolution

(How do we fix the unit? And how do we make sure it doesn't happen again?)

Make following design changes to all preamp SPB mechanical assemblies (F1-F6):

- Sphere mount: Add a counterbore 20 mil deep in the sphere mount so that the spring is clear of the sphere mount (see Figure 2).
- Ferrule: 1) Change material to beryllium copper or copper, 2) increase the ferrule shaft length by 20 mil to clear spring from sphere mount and to increase the contact force at the ledge, 3) reduce the tip diameter of the ferrule by 5 mil to allow spring to engage ferrule at the ferrule ledge, as opposed to the sides of the ferrule, and 4) shorten the ferrule tip by 10 mil to guarantee enough clearance between the ferrule and the PWB.

For F1 SPB assembled units: Open the packaged preamp units and replace affected parts. Perform CPT and workmanship vibration tests and proceed with subsequent testing.

For F2 SPB assembled units: Open the packaged preamp units and replace affected parts. Perform CPT and proceed as planned with vibration, thermal vacuum and subsequent testing.

No changes will be made to the AXB mechanical design: Our plan is to either 1) select PWBs which have springs that provide appropriate contact force on AXB tip-piece adaptor/threaded insert contact from group or 2) adjust spring height to provide appropriate contact force.

For F1 AXB assembled units: Open the packaged preamp units, measure height of spring and verify contact. If the PWB present in unit is found to have marginal spring contact force, then either 1) replace with PWB with spring having proper contact force from group or 2) adjust spring height to provide appropriate contact force. Perform CPT and workmanship vibration tests and proceed with subsequent testing.

Additional checks:

- Check each preamp PWB using a jig for proper seating and contact of the ferrule spring with the ledge of the ferrule (or in AXB case with the tip-piece adaptor/threaded insert contact surface)
- Inspect the gold plating on each ferrule.
- Perform a continuity check of each assembled flight SPB preamp unit with sphere/fine wire under 3-lb tension to simulate load on orbit.

Acceptance:
MAM: Ron Jackson_____; MSE: Ellen Taylor_____

PM: Peter Harvey_____; Cognizant Engineer_____

Date of Closure_____

PFR-012 Title: EFI Ferrule Spring contact problem

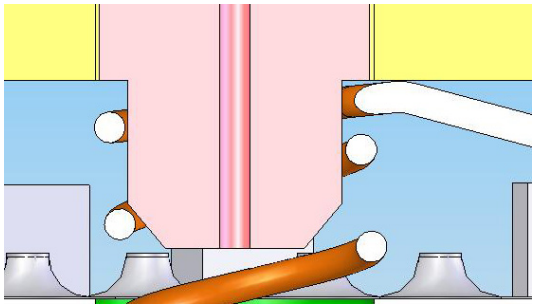

Figure1 Illustration of spring contact problem

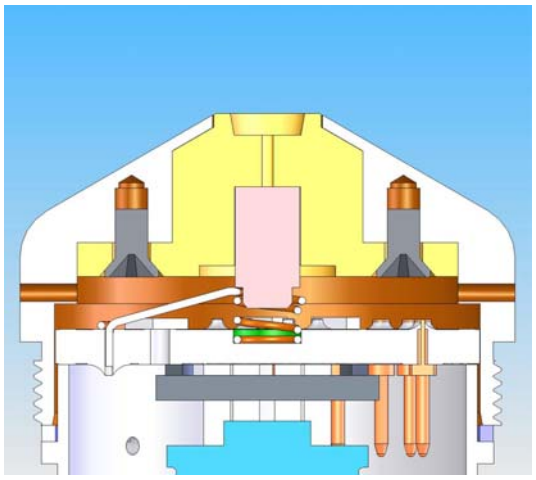

Figure 2 New Design to Fix problem