PFR-95 Title: Thermal Radiator Tape Adhesive Failure

Assembly : Instrument Suite	**SubAssembly :** SST, ESA, FGB, SCB, AXB	
Component : Thermal Control Tape	**Units Affected:**	**Units fixed:**
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Organization: UCB	**Date: 09/16/05**	
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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

The ITO coated silver Teflon tape samples with 3M 9703 adhesive failed to remain adhered to its substrate in its third thermal vacuum test, Test #3.

First a testing history is required to understand the development of this problem. Before deciding to use this tape and adhesive for THEMIS we tested a sample of similar tape that was being used for the STEREO project. The tape used on THEMIS differs from the STEREO sample by manufacture date, perforation pattern, and method of adhesive application. The STEREO tape sample was thermal cycled 5 times from –135 to +80 ºC and examined. All tape samples remained adhered to their substrate and the tape's surface conductivity remained within specification. We then ordered the THEMIS specific tape from Dunmore Corp. The STEREO tape was also ordered from Dunmore but came without the adhesive. APL personnel applied the 9703 adhesive manually on site. For THEMIS we had Dunmore apply the adhesive in their factory.

When the adhesive arrived it was attached to the same sample of aluminum and thermal cycled 6 times from –60 to +65 ºC. In this test all five tape samples failed to remain adhered to their substrate.

After consultation with 3M we modified our application method. The tape was applied as it was in the first test and then warmed to 50 ºC. While still warm it was re-rolled and placed back in the oven for 12 Hours @ +50 ºC. These samples were then thermal cycled 6 times from –65 to +75 ºC and all tape samples remained adhered to the substrate so the test was considered a success. However, after the tape sample sat on my desk for 21 days at room temperature, it was noticed that three of the tape edges, out of 24 edges on 6 tape samples, had pulled up.

This tape is used on the AXB, FGB and SCB Hinge, ESA, and SST. Three flight AXB units have been delivered for spacecraft integration but they all used the STEREO tape, which passed qualification. We have enough excess STEREO tape to complete the remaining AXBs and FGB/SCB hinges.

Analyses Performed to Determine Cause

A Second test was done using more flight like hardware. The test samples consisted of two SST shells with flight alodine, one cylindrical support piece from the ETU ESA with flight alodine, and the same bare aluminum u-channel used in all previous tests. For all samples, various sized pieces of ITO coated Silver Teflon tape with 9703 adhesive was applied using the same method used in Test #3 above. Tape was applied with finger pressure and a Brayer roller at room temperature. It was then warmed to 60 deg Celsius in an oven. After this initial warm up, it was removed and the tape was re-applied using finger pressure and a brayer roller while hot. The samples were then placed back in the oven for 24 hours at 60 degrees Celsius.

In Test #3 this is all of the preparation done to the samples. In Test #4 we took the additional step of applying conductive silver epoxy to the edges and corners of the tape pieces. This epoxy was then cured in the oven at 60Deg C for another 24 hours. One of the SST shells received no epoxy for comparison.

All samples were then thermal cycled in a thermal vac chamber from –75 to 75 Deg C. Upon removal all tape was adhered well to the aluminum. All samples were examined under a microscope. All of the epoxy sites were intact except one. One failed due to an error during application that caused the epoxy at that site to be too thin. All other epoxy sites were intact and adhered to both the tape and aluminum.

The edge of each tape piece was examined under the scope and mechanically tested for adhesion. All edges, including those on the SST without epoxy, were well adhered.

The samples were then cycled again as ride-a-longs for another test. As before, they received 6 cycles from –75 to +75. They were inspected under the scope and all tape remained well adhered.

Corrective Action/ Resolution

Tape was retested using flight aluminum alodine treated samples and with silver epoxy holding down corners and long edges. This technique has resulted in a well-adhered tape that satisfies THEMIS requirements.

Acceptance:
MAM: Ron Jackson_____; MSE: Ellen Taylor_____

PM: Peter Harvey_____; Cognizant Engineer: C. Smith _____

Date of Closure_____