PFR-078 Title: FGM Boom Harness Discoloration

Assembly : FGM Boom	**SubAssembly :Inside Boom Harness**	
Component : Insulation	**Units Affected:**	**Units fixed:**
Originator: Ron Jackson	X X X X X X	- - - - - -
Organization: UCB-SSL	**Date: 6-28-05**	
Phone: (510) 643-2625	**Email : ronj@ssl.berkeley.edu**	

Failure Occurred During (Check one √) Functional test □ Qualification test □ S/C Integration □ Launch operations □ Other (Flight Assy)

Environment when failure occurred:

X 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.)

Harness contamination (Black spots along insulation).

Analyses Performed to Determine Cause

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

Sample shipped to GSFC for analysis.

Analysis complete by GSFC # Q50345FA - See attached report.

Corrective Action/ Resolution

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

No corrective action required to close PFR.

Acceptance:

MAM: Ron Jackson_____; MSE: Ellen Taylor_____

PM: Peter Harvey_____; Cognizant Engineer_____

Date of Closure_____

GODDARD SPACE FLIGHT CENTER

Parts Analysis Laboratory

Wire Failure Analysis

Project:	THEMIS	Part Type:	WIRE
Subsystem:	Instruments	Manufacturer:	Equator S
Requestor:	J. OSCHE 286-3306	Part Number:	GSC-05-80499-00
Investigator:	F. Felt 286-9634	Generic Number:	28-AWG 3-TSP
Date:	29 June 2005	Date Code:	UNKWN

Background

A half-meter length of insulated wire was submitted to the NASA GSFC Failure Analysis Laboratory for evaluation of several, small dark marks found on it.

Part Description

Information on the work order notes the wire manufacturer as Equator S. No further information was available at the time of this report.

Analysis and Results

The wire was inspected and small black marks were confirmed. The wire was cut into sections and mounted. Optical examination found that the marks were different in character. A tape-like material with black markings was partially adhered to the stripped end of the wire. The markings were not legible, but parallel edges suggested printing.

Optical examination of the other mark found that it exhibited a gray, scuff-like appearance, with white insulation of the wire visible in the background. The scuffmark followed the elevated edge of the wire wrapping, further indication that it was due to frictional abrasion with some object.

SEM and EDS examination confirmed that a tape-like material with hydrocarbon composition was partially adhered to the Telflon wire insulation near the stripped end of the wire. Black markings on the tape were not visible in the SEM. In the second location, EDS examination of the gray scuffmark indicated carbon and fluorine, most likely due to Teflon wire insulation. A small amount of oxygen was detected and may be evidence that the scuffmark has a hydrocarbon composition. However, it cannot be ruled out that the mark was due to carbon alone, such as a pencil mark. Carbon alone would be invisible against the carbon-rich background of the Teflon insulation.

Conclusion

Black markings, possibly printing, were found on tape partially adhered to the stripped end of the wire. The composition of this tape was

carbon and oxygen, likely a hydrocarbon material. Not metals were found.

The other mark appeared to be due to scuffing of some material against the elevated wrapping of the wire insulation. Oxygen found in this location may indicate the scuff was caused by frictional between the wire and a hydrocarbon material. However, it cannot be ruled out that the mark was carbon alone, such as a pencil marking.

Auger (AES) examination with depth profiling is recommended if further analysis of the scuffmark is desired.

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Part Type	WIRE	Part Number	GSC-05-80499-00
Manufacturer	Equator S	Lot Code	UNKWN

Appended Photographs:

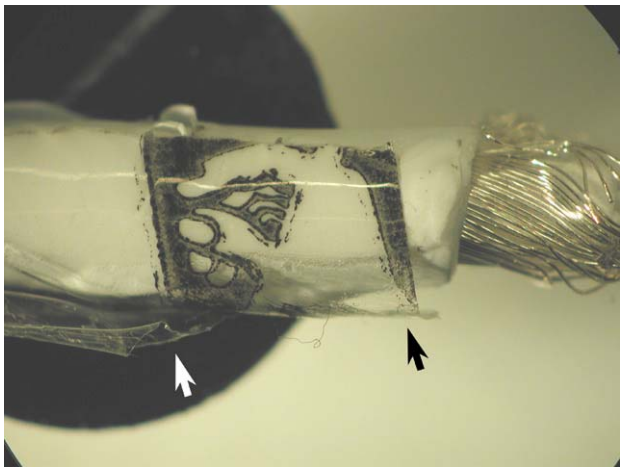

Figure 1. Optical examination of the dark mark near the wire end revealed a transparent, tape-like material with illegible markings. The parallel sides seen at arrows suggest printing.

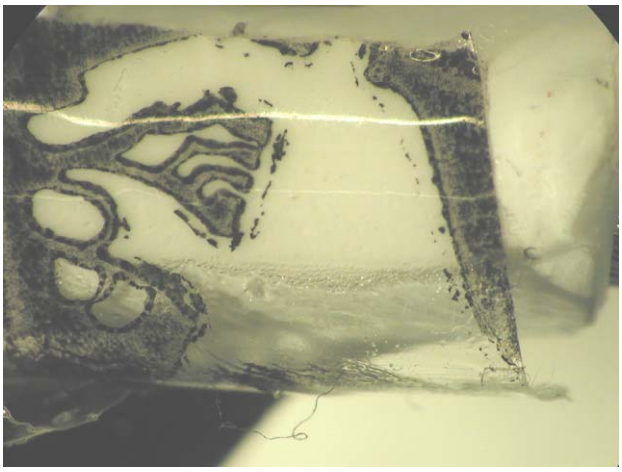

Figure 2. A close-up view of Figure 1 shows that tape and markings are detached from the wire at lower right in the image.

Figure 3. A scuff-like mark found on the wire. The straight, diagonal edge of the mark appears to follow an elevated edge of the wrapped wire insulation.

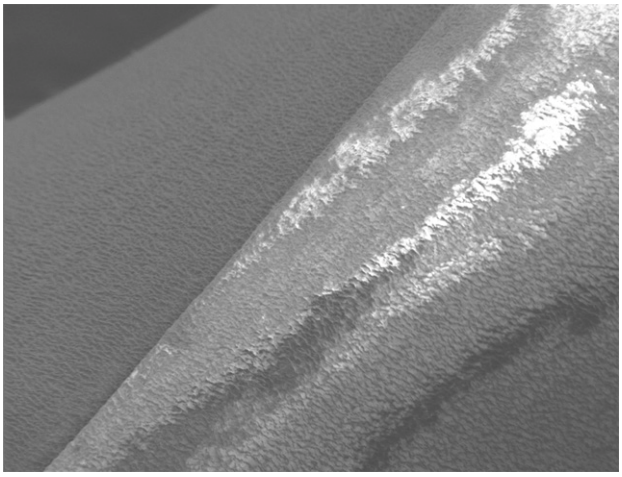

Figure 4. The straight edge of wrapped insulation is seen in this SEM photo. Material from the scuffmark was not discernible in the microscope.

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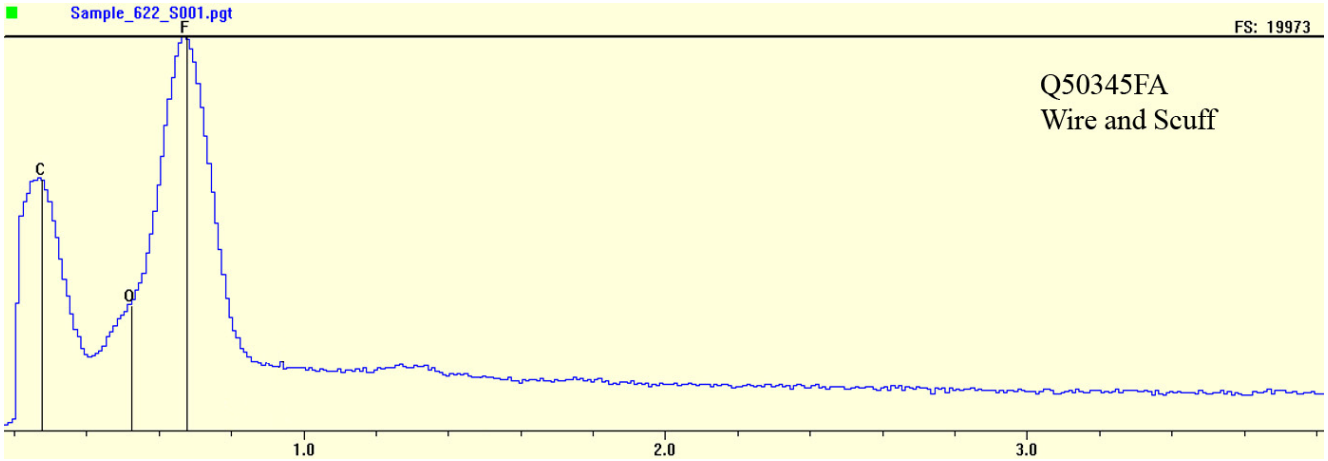

Figure 5. An EDS spectrum taken of the scuffmark exhibits mostly fluorine and carbon, likely due to the Teflon (C2F4) wire insulation. Note that a small amount of oxygen may also be present--a possible indication that the scuffmark is composed of some hydrocarbon material. However, if the scuffmark were due to carbon, such as a pencil mark, penciling would be essentially invisible against the carbon-rich background of the Teflon. No metals are present. The small unmarked bump at approximately 1.35keV is a fluorine sum peak, not an additional element.

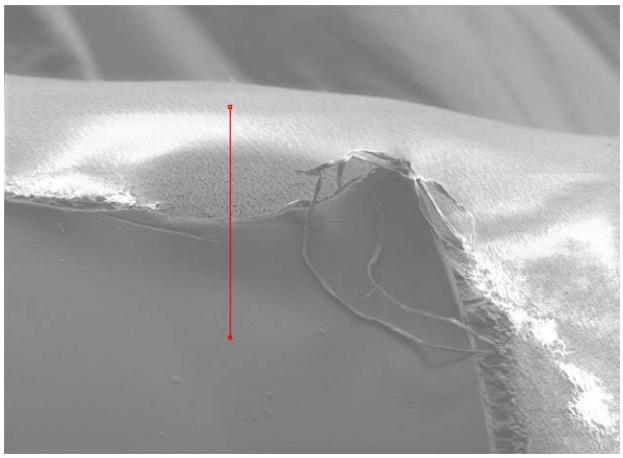

Figure 6. A SEM view of the tape (with black markings) near the stripped end of the wire. The red line marks the path of the EDS line-scan seen in Figure 7.

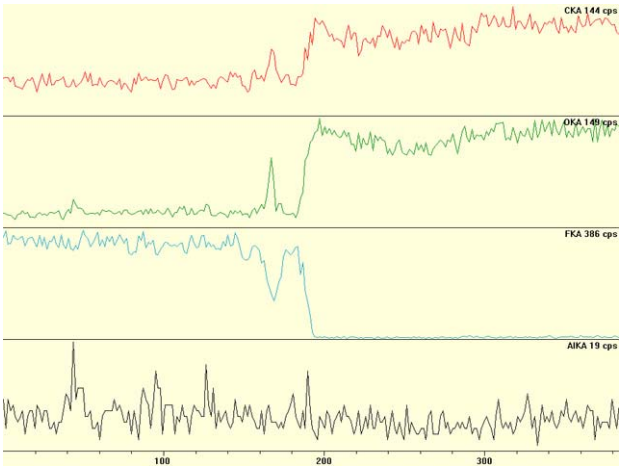

Figure 7. The left side of this line-scan matches the top of the red line in Figure 6. The blue line shows a drop in fluorine when the scan hits the tape, and an increase in carbon and oxygen, respectively red and green. The aluminum count rate at bottom is negligible and likely due to noise. The line-scan spectra are consistent with a hydrocarbon composition of the tape.