Assurance of COTS Fiber Optic Cable Assemblies for Space Flight

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Technology in the field of fiber optics has been mainly driven by the telecommunications industry. In order for the available technology to be useful for space flight applications, certain assurance procedures are necessary. Results from investigating how to choose a COTs cable that can withstand space flight have been published and presented previously as well as the issues, yet unresolved during recent studies. In order to resolve the issues associated with the usage of COTS fiber optic cable assemblies it was necessary to determine what assurance techniques were the most successful at simulating the long term effects of the space flight environment on a cable assembly.

The technology validation approach used, is a method of performance assessment and testing that intensifies many known failure mechanisms of fiber optic cable assemblies. In particular, the results of thermal and vibration testing can be very indicative of long term reliability. The shrinkage of materials in a typical cable assembly configuration has presented problems in the past for space flight projects that wished to use available fiber optic cable assemblies in harsh environments. Presented here are results of thermal cycling testing of commercially available fiber optic cable assemblies in order to determine the adequate preconditioning procedure necessary to produce a system ready for space flight.

Also presented here is the assurance process by which a ribbon cable and array connector assembly was upgraded and tested for performance under harsh conditions to confirm its ability to withstand the space environment. Technology validation techniques were used to determine the functionality of this

connector/cable assembly for space flight. As part of that validation, an evaluation was conducted to determine whether all components of the connector assembly would pass space flight outgassing criteria. A study conducted on the radiation effects of the commercial fiber proposed for this application proved the commercial optical fiber to be adequate for an EO-1 application. As a result of a high vibration environment, a larger core optical fiber (100/140 micron) was chosen to help in performance of the array connector under conditions that were not in the original commercial specification. Using the larger core fiber required the fabrication of connector ferrules of 140 micron outer diameter for the array connector, that were previously not available. Vibration and thermal tests, were conducted to determine if the commercially available 125 micron diameter connector ferrules would meet the requirements of space flight. The results and conclusions from this assurance study and qualification testing of a commercial ribbon connector/cable assembly are presented here.

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