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SOFI/Substrate Integrity Testing for Cryogenic Propellant Tanks

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Liquid propellant tank insulation for space flight requires low weight as well as high insulation factors. Use of Spray-On Foam Insulation (SOFI) is an accepted, cost effective technique for insulating a single wall cryogenic propellant tank and has been used extensively throughout the aerospace industry. Determining the bond integrity and the SOFI's ability to withstand the strains, both physical and thermal, applied during fill and drain cycles is critical to the longevity of the insulation. This determination has previously been performed using highly volatile, explosive cryogens, which increases the test costs enormously, as well as greatly increasing the risk to both equipment and personnel.

CTD has developed a new test system, based on previous NASA testing, that enables a relatively small SOFI/substrate test sample to be monitored for any deformations, delaminations, or disjunctures within during the cooling and mechanical straining process of the substrate, as well as enabling the concurrent application of thermal and physical strains to two specimens at the same time. The thermal strains are applied by cooling the substrate to the desired temperature (from 4 K to 250 K) while maintaining exposure to ambient conditions at the surface of the SOFI foam.

Multiple temperature gaging points are exercised to ensure even cooling across the substrate, while surface temperatures of the SOFI can be monitored to determine the heat flow through the SOFI. The system also allows for direct measurement of the strains in the substrate during the test.

The test system as well as test data from testing at 20 K for liquid Oxygen simulation testing will be discussed.

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