Acoustic and Thermal Testing of an Integrated Multilayer Insulation and Broad Area Cooling Shield System

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Abstract:

A Multilayer Insulation (MLI) and Broad Area Cooling (BAC) shield thermal control system shows promise for long-duration storage of cryogenic propellant. The NASA Cryogenic Propellant Storage and Transfer (CPST) project is investigating the thermal and structural performance of this tank-applied integrated system. The MLI/BAC Shield Acoustic and Thermal Test was performed to evaluate the MLI/BAC shield's structural performance by subjecting it to worst-case launch acoustic loads. Identical thermal tests using Liquid Nitrogen (LN2) were performed before and after the acoustic test. The data from these tests was compared to determine if any degradation occurred in the thermal performance of the system as a result of exposure to the acoustic loads. The thermal test series consisted of two primary components: a passive boil-off test to evaluate the MLI performance and an active cooling test to evaluate the integrated MLI/BAC shield system with chilled vapor circulating through the BAC shield tubes. The acoustic test used loads closely matching the worst-case envelope of all launch vehicles currently under consideration for CPST. Acoustic test results yielded reasonable responses for the given load. The thermal test matrix was completed prior to the acoustic test and successfully repeated after the acoustic test. Data was compared and yielded near identical results, indicating that the MLI/BAC shield configuration tested in this series is an option for structurally implementing this thermal control system concept.

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