



Contribution ID: 108

Type: **Contributed Oral Presentation**

Quantifying MLI Thermal Conduction in Cryogenic Applications from Experimental Data

Monday, June 29, 2015 5:30 PM (15 minutes)

Multilayer Insulation (MLI) uses stacks of low-emittance metalized sheets combined with low-conduction spacer features to greatly reduce the heat transfer to cryogenic applications from higher temperature surrounds. However, as the hot-side temperature decreases from room temperature to cryogenic temperatures, the level of radiant heat transfer drops as the fourth power of the temperature, while the heat transfer by conduction only falls off linearly. This results in cryogenic MLI being dominated by conduction, a quantity that is extremely sensitive to MLI blanket construction and very poorly quantified in the literature.

To develop useful quantitative data on cryogenic blanket conduction, multilayer nonlinear heat transfer models were used to analyze extensive heat transfer data measured by Lockheed Palo Alto on their cryogenic dewar MLI and measured by JPL on their spacecraft MLI. The data-fitting aspect of the modeling allows the radiative and conductive thermal properties of the tested blankets to be explicitly quantified. Results are presented showing that MLI conductance varies by a factor of 1000 between spacecraft MLI and Lockheed's best cryogenic MLI.

It is clear from the three-order-of-magnitude range of values that MLI conductance is a high-uncertainty parameter in MLI performance. The analysis also demonstrates that conductance governs the thermal performance of both high-temperature spacecraft MLI as well as low-temperature cryogenic MLI. For both of these temperature extremes, MLI emittance is found to play a secondary role to spacer conductance in establishing MLI thermal effectiveness. Thus, MLI performance is critically dependent on the achieved MLI conductance.

Primary author: Dr ROSS, Ronald (Jet Propulsion Laboratory)

Presenter: Dr ROSS, Ronald (Jet Propulsion Laboratory)

Session Classification: C1OrF - Thermal Insulation Applications and Measurements

Track Classification: CEC-14 - Thermal Insulation Systems