Books & Reports

Lightweight Thermal Insulation for a Liquid-Oxygen Tank

A proposed lightweight, reusable thermal-insulation blanket has been designed for application to a tank containing liquid oxygen, in place of a non-reusable spray-on insulating foam. The blanket would be of the multilayer-insulation (MLI) type and equipped with a pressure-regulated nitrogen purge system. The blanket would contain 16 layers in two 8-layer sub-blankets. Double-aluminized polyimide 0.3 mil (≈0.008 mm) thick was selected as a reflective shield material because of its compatibility with oxygen and its ability to withstand ionizing radiation and high temperature. The inner and outer sub-blanket layers, 1 mil (≈0.025 mm) and 3 mils (≈0.076 mm) thick, respectively, would be made of the double-aluminized polyimide reinforced with aramid. The inner and outer layers would provide structural support for the more fragile layers between them and would bear the insulation-to-tank attachment loads. The layers would be spaced apart by lightweight, low-thermal-conductance netting made from polyethylene terephthalate.

This work was done by G. Scott Willen, Jennifer Lock, and Steve Nieczkoski of Technology Applications, Inc. for **Johnson Space Center**. *For further information, contact:*

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Refer to MSC-23099.

Stellar Gyroscope for Determining Attitude of a Spacecraft

A paper introduces the concept of a stellar gyroscope, currently at an early stage of development, for determining the attitude or spin axis, and spin rate of a spacecraft. Like star trackers, which are commercially available, a stellar gyroscope would capture and process images of stars to determine the orientation of a spacecraft in celestial coordinates. Star trackers utilize charge-coupled devices as image detectors and are capable of tracking attitudes at spin rates of no more than a few degrees per second and update rates typically <5 Hz. In contrast, a stellar gyroscope would utilize an active-pixel sensor as an image detector and would be capable of tracking attitude at a slew rate as high as 50°/s, with an update rate as high as 200 Hz. Moreover, a stellar gyroscope would be capable of measuring a slew rate up to 420°/s. Whereas a Sun sensor and a three-axis mechanical gyroscope are typically needed to complement a star tracker, a stellar gyroscope would function without them; consequently, the mass, power consumption, and mechanical complexity of an attitude-determination system could be reduced considerably.

This work was done by Bedabrata Pain, Bruce Hancock, Carl Liebe, and Jeffrey Mellstrom of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

NPO-30481

Lifting Mechanism for the Mars Explorer Rover

A report discusses the design of a rover lift mechanism (RLM) — a major subsystem of each of the Mars Exploration Rover vehicles, which were landed on Mars in January 2004. The RLM had to satisfy requirements to (1) be foldable as part of an extremely dense packing arrangement and (2) be capable of unfolding itself in a complex, multistep process for disengaging the rover from its restraints in the lander, lifting the main body of the rover off its landing platform, and placing the rover wheels on the platform in preparation for driving the rover off the platform. There was also an overriding requirement to minimize the overall mass of the rover and lander. To satisfy the combination of these and other requirements, it was necessary to formulate an extremely complex design that integrated components and functions of the RLM with those of a rocker-bogie suspension system, the aspects of which have been described in several prior *NASA Tech Briefs* articles. In this design, suspension components also serve as parts of a 4-bar linkage in the RLM.

This work was done by Joseph Melko, Theodore Iskenderian, Brian Harrington, and Christopher Voorhees of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

NPO-40875