

(Tracking and Data Relay Satellite System) or another recipient. The link would be active during separation and post-separation to monitor spacecraft health, status, attitude, or other data inventories until attitude recovery and ground control can be re-established. An optical link would not interfere with the existing upper stage telemetry and beacon systems, thus meeting launch vehicle EMI environmental constraints.

*This work was done by K.B. Fielhauer and B.G. Boone for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-14832-1*

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### **Robust Thermal Control of Propulsion Lines for Space Missions**

A document discusses an approach to insulating propulsion lines for spacecraft. In spacecraft that have propulsion lines that are located externally

with open bus architecture, the lines are typically insulated by Multi Layer Insulation (MLI) blankets. MLI on propulsion lines tends to have large and somewhat random variances in its heat loss properties (effective emittance) from one location to the next, which makes it an un-robust approach to control propulsion line temperatures. The approach described here consists of a “clamshell” design in which the inner surface of the shell is coated with low-emissivity aluminized Kapton tape, and the outer surface is covered with black tape. This clamshell completely encloses the propulsion line. The line itself is covered with its heater, which in turn, is covered completely with black tape.

This approach would be low in heater power needs because even though the outer surface of the prop line (and its heater) is covered with black tape as well as the outer surface of the clamshell, the

inner surface of the clamshell is covered with low-emissivity aluminized Kapton tape. Hence, the heat loss from the line will be small and comparable to the MLI based one.

In terms of contamination changing the radiative properties of surfaces, since the clamshell’s inner surface is always protected during handling and is only installed after all the work on the prop line has been completed, the controlling surface, which is the clamshell’s inner surface, is always in pristine condition.

This proposed design allows for a much more deterministic and predictable design using a very simple and implementable approach for thermal control. It also uses low heater power and is robust to handling and contamination during and after implementation.

*This work was done by Pradeep Bhandari of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47441*