NASA Technology Summary

National Aeronautics and
Space Administration

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Lightweight Foam Core Systems for In-Space Applications

As NASA looks to travel faster and farther into our solar system, the agency must safely reduce the mass of propulsion systems and still provide sufficient protection from space hazards, such as damage from meteoric debris. NASA scientists hope to achieve these goals by investigating in improvements in shield and insulation technology.

Protection for propellant tanks, propellant and pressurant lines, and other feed system components could come in the form of new lightweight foam core systems — providing optimum shielding and sufficient insulation to potentially replace heavier and less space efficient multi-layer insulation blankets (MLI) currently used.

Technologists in the In-Space Propulsion Technology Office at NASA's Marshall Space Flight Center in Huntsville, Ala., and Jet Propulsion Laboratory in Pasadena, Calif., are developing lightweight foam core systems technologies, with subsystem testing underway in 2005. The work could lead to lighter propulsion systems that are easily integrated into the spacecraft and offer more reliable protection and a low-risk of failure from meteoroid impact.

Lightweight component technology could translate into significant spacecraft propulsion system dry mass savings (not including propellant). The technology could reduce the mass of propulsion thermal control systems — which insulate spacecraft systems from the wide range of temperatures experienced during travel to and in space.

Conventional multi-layered insulation, or MLI, is universally applied for component thermal control. This covering incorporates cloth and varies the spacing between the insulation and underlying components to use the MLI as a shield against thermal damage. Such protection is incomplete, adds mass and bulk to the feed system, and makes integration with the spacecraft difficult.

NASA scientists are developing potentially superior technology that will reduce dependence on and possibly replace state-of-art MLI used to cover tanks and other components. The new foam core technology will provide better meteoroid protection with higher-reliability; easier installation and rework; and equivalent thermal control — all at lower mass (up to 75 percent mass reduction) and with less bulk (up to 90 percent thickness reduction).

Plans are to demonstrate this technology in a relevant environment to Technology Readiness Level (TRL) 6 — ground or space demonstration of a system prototype or model. It is likely that advances in lightweight foam insulation also will provide cross-cutting benefits that enable some robotic science exploration missions to utilize Earth-gravity assist — or the Earth's gravitational pull as a sort of speed boost — for optimized mission trajectories, which could save hundreds of kilograms of weight on some deep space missions.

The In-Space Propulsion Technology Office at the Marshall Center is partnering with NASA's Jet

Propulsion Laboratory to develop lightweight foam core systems for protection of propellant tanks and propulsion components for in-space applications.

Research in this technology is sponsored by the In-Space Propulsion Technology Program, which is managed by NASA's Science Mission Directorate in Washington and implemented by the In-Space Propulsion Technology Office at the Marshall Space Flight Center in Huntsville, Ala. The program's objective is to develop in-space propulsion technologies that can enable or benefit near and mid-term NASA space science missions by significantly reducing cost, mass and travel times.

For more information, visit:
http://www.inspacepropulsion.com
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