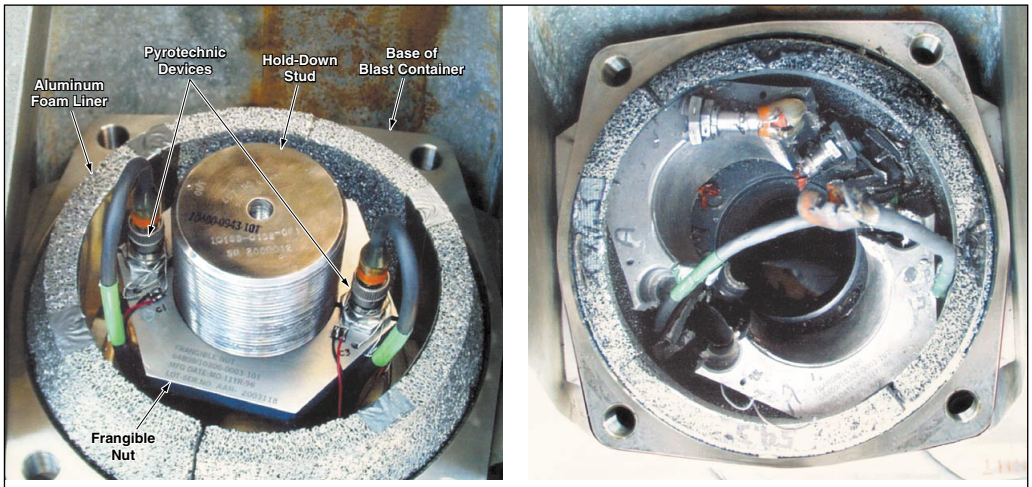
Lightweight Energy Absorbers for Blast Containers

Aluminum foam liners tested for possible replacement of solid lead liners.

Marshall Space Flight Center, Alabama

Kinetic-energy-absorbing liners made of aluminum foam have been developed to replace solid lead liners in blast containers on the aft skirt of the solid rocket booster of the space shuttle. The blast containers are used to safely trap the debris from small explosions that are initiated at liftoff to sever frangible nuts on hold-down studs that secure the spacecraft to a mobile launch platform until liftoff.

The desire to replace the lead liners arose from the large mass density of lead and its poor energy-absorption performance in the specific application, along with the toxicity of lead and its susceptibility to corrosion in the seacoast launch environment. The aluminum foam liners are products of a program of design and testing in which the mechanical properties of the foam were tailored for the specific application. Factors considered in the program included mass density, degree of porosity, sizes of pores, resistance to corrosion, strength-to-weight ratio, responses to loads, and variable stress-vs.-strain characteristics.



An **Aluminum Foam Liner** dissipated the kinetic energy of the debris of a frangible nut and pyrotechnic devices in a test firing in a blast container.

Static drop tests were performed on foams of various thicknesses and densities to optimize the design. On the basis of the results of these tests, aluminum foam liners with densities of 16 and 24 percent were selected. Sample foam liners were tested in a simulated launch configuration (see figure). The results of the tests showed that suitably designed and fabricated aluminum foam liners absorb energy more effectively than the solid lead liners do.

This work was done by Donald L. Balles, Thomas M. Ingram, Howard L. Novak, and Albert F. Schricker of USBI Co. for **Marshall Space Flight Center**. *Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (256) 544-0021. Refer to MFS-31563.

Brush-Wheel Samplers for Planetary Exploration

NASA's Jet Propulsion Laboratory, Pasadena, California

A report proposes brush-wheel mechanisms for acquiring samples of soils from remote planets. In simplest terms, such a mechanism would contain brush wheels that would be counter-rotated at relatively high speed. The mechanism would be lowered to the ground from a spacecraft or other exploratory vehicle. Upon contact with the ground, the counterrotating brush wheels would kick soil up into a collection chamber. Thus, in form and function, the mechanism would partly resemble traditional street and carpet sweepers. The main advantage of using of brush wheels (in contradistinction to cutting wheels or other, more complex mechanisms) is that upon encountering soil harder than expected, the brushes could simply deflect and the motor(s) could continue to turn. That is, sufficiently flexible brushes would afford resistance to jamming and to overloading of the motors used to rotate the brushes, and so the motors could be made correspondingly lighter and less power hungry. Of course, one could select the brush stiffnesses and motor torques and speeds for greatest effectiveness in sampling soil of a specific anticipated degree of hardness.

This work was done by Tommaso Rivellini of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

NPO-30665