SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

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TERMINAL BALLISTICS OF FLEXIBLE MICROMETEOROID AND SPACE DEBRIS PROTECTION SHIELDS

Abstract

A key element for paving the way for future manned exploration missions is to provide protected large-volume habitats for long-duration stays in Earth orbit and for long-distance journeys to celestial bodies. Currently, dimensions of rigid space modules, such as those presently constituting the International Space Station (ISS), are constrained by the volumetric capacity of today's launchers. This limitation can be overcome by using inflatable modules that allow for effective packaging for launch and in-orbit deployment. In that way, a significant increase in final volume is achieved compared to today's rigid habitat modules.

The protection of inflatables from micrometeoroids and space debris impact is challenging, since well-evolved techniques used in rigid manned-modules cannot be used. A flexible micrometeoroid and space debris protection shield (MDPS) is limited in the choice of materials to fabrics that are not yet well characterized or understood in terms of their behavior upon hypervelocity impact. Laboratory impact tests at Fraunhofer EMI's large light-gas gun (LLGG) were conducted to gain knowledge of the terminal ballistics of a fabrics-based MDPS. Physical processes are analyzed using high-speed video frames and specific damage parameters that quantify the interaction of the projectile with the shield. This gives valuable insights into the working principle of a flexible MDPS.