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

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DEBRIS SHIELDING FOR INFLATABLE STRUCTURES DEVELOPMENT AND CHARACTERIZATION AT HYPERVELOCITY IMPACTS

Abstract

Large habitable volumes will be required to extend the human presence in space in the near future and to support the human space exploration in the long term. In order to protect habitats with large surface areas exposed to the potential threat induced by micro-meteoroids and space debris, proper high resistance debris shielding suitable for integration in an inflatable multi-layer shell need to be developed.

Thales Alenia Space (TAS) has been involved for several years in the definition and design of inflatable structures in the frame of ASI and ESA programs, which have mostly addressed technologies relevant to air and pressure containment for pressurized volumes, regenerative systems for life support and crew support systems. Flexible Micro-Meteoroids and Orbital Debris (MMOD) shielding systems were considered in few studies and extensively analyzed in internal RD activities focusing on missions of brief/medium duration and to configurations with minimum envelope and mass.

Micro Meteoroids and Orbital Debris (MMOD) shielding systems for future long-duration manned missions in Earth orbit and beyond have been investigated and characterized as part of the Hypervelocity Impacts on Expandable Protection for Space Vehicles research program founded by the European Space Agency, with TAS-I as prime contractor.

The present paper aims at describing the MMOD shielding systems investigated in the frame of the HVI-Expand study. In particular, proper multi-layer configurations (made from multi layer insulation, air and pressure containment layers, MMOD shields) have been investigated and the best option selected with respect to a reference mission scenario. An extensive testing activity has been performed to characterize the selected multi-layer configuration with hypervelocity tests, simulating debris impacts. Test data evaluation has led to the definition of ballistic limit equations for a flexible configuration with an areal density of about 10 kg / m2 tested at velocities up to 7 km/s, at 0, 45 and 60 impact angles.