Paper ID: 13060
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SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

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SPACECRAFT COMPOSITE SHIELDING SYSTEM: COMBINATION OF NORMAL AND OBLIQUE BUMPERS

Abstract

Spacecraft protection from hypervelocity impacts of micrometeoroids and space debris is one of the main concerns for structural engineers to deal with. Till date only 6% of the population is operational spacecraft while rest more or less lies in the category of space junk. Whipple shield and other different concepts have already been matured for shielding and protecting spacecrafts from space debris impacts. In this research, advance Composite materials is employed for shielding system in a combination of normal and inclined impacts on front and rear wall bumpers of Spacecraft Composite shielding system. Initially Carbon-Epoxy laminate was prepared by using CU125NS with 16 layers in [(0/45/90)2]s arrangement. Afterwards the composite bumpers were exposed to LEO environment with 14 thermal cycling, UV, Atomic Oxygen and high vacuum to get the real time scenario of shielding system. During that TML (TotalMassLoss) was found to be around 0.40% along with degradation in surface properties due to synergistic effects of UV and AO. Afterwards the specimen was attacked by space debris Al2017-T4, 2.85mm radius by using light gas gun (LGG) working on Helium and Argon. The arrangement of shielding was done with pre-defined standoff distance between the front and rear bumpers in normal and oblique configuration with respect t o angle of attack. The obliquity was kept variable with respect to the risk of spacecraft exposed to space debris attack. The specimens were tested in the velocity range of 1_1.5km/s due to the limitation of two stage LGG. The comparison was done with normal bumpers, inclined bumpers and combination of normal and inclined bumpers independently with Whipple shield concept and found that the energy profile for the normal and oblique combination of bumpers towards spacecraft shielding concept is the best towards energy absorption of space debris and protecting the spacecraft. In the end the analysis was done by using LS-DYNA software for the validation of experimental profile. The module used was Smooth Particle Hydrodynamics (SPH) because of high strain rate involvement, SPH is the best for such high velocity impacts. The modelling methodology adopted was combination of SPH and FE to properly encounter the energy absorption profile. The average difference among experimental and analytical results was found within the range of 10_15%. C-Scan images showed the real time impacted damaged specimen being attacked at different angles with respect to specimen orientation.