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Ballistic Performance of Porous-Ceramic, Thermal Protection Systems JOSHUA MILLER, WILLIAM BOHL, Lockheed Martin Space Systems Company, ERIC CHRISTIANSEN, B. ALAN DAVIS, NASA Johnson Space Center, CORY FOREMAN, Lockheed Martin Exploration & Science — Porous-ceramic, thermal protection systems are used heavily in current reentry vehicles like the Orbiter, and they are currently being proposed for the next generation of US manned spacecraft, Orion. These systems insulate reentry critical components of a spacecraft against the intense thermal environments of atmospheric reentry. Additionally, these materials are also highly exposed to space environment hazards like solid particle impacts. This paper discusses impact testing up to 9.65 km/s on one of these systems. The materials considered are 8 lb/ft^3 alumina-fiber-enhanced-thermal-barrier (AETB8) tiles coated with a toughened-unipiece-fibrous-insulation/reaction-cured-glass layer (TUFI/RCG). A semi-empirical, first principals impact model that describes projectile dispersion is described that provides excellent agreement with observations over a broad range of impact velocities, obliquities and projectile materials. A model extension to look at the implications of greater than 10 GPa equation of state measurements is also discussed. Predicted penetration probabilities for a vehicle visiting the International Space Station is 60% lower for orbital debris and 95% lower for meteoroids with this model compared to an energy scaled approach.

Joshua Miller
Lockheed Martin Space Systems Company

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