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Burst Pressure Failure of Titanium Tanks Damaged by Secondary Plumes from Hypervelocity Impacts on Aluminum Shields HENRY NAHRA, LOUIS GHOSN, NASA-Glenn Research Center, ERIC CHRIS-TIANSEN, NASA-Johnson Space Center, B. ALAN DAVIS, CHRISTOPHER KEDDY, KAREN RODRIGUEZ, White Sands Test Facility, JOSHUA MILLER, WILLIAM BOHL, Lockheed Martin Space Systems Company — Metallic pressure tanks used in space missions are inherently vulnerable to hypervelocity impacts from micrometeoroids and orbital debris; thereby knowledge of impact damage and its effect on the tank integrity is crucial to a spacecraft risk assessment. This paper describes tests that have been performed to assess the effects of hypervelocity impact (HVI) damage on Titanium (Ti) pressure vessels burst pressure and characteristics. The series consists of a pair of HVI impact tests on water-filled Ti tanks (water as a surrogate to the propellant) and subsequent burst tests of these tanks and an undamaged control tank. The tanks were placed behind Aluminum (Al) shields and then each was impacted with a 7 km/s projectile. The resulting impact debris plumes partially penetrated the Ti tank surfaces resulting in a distribution of craters. During the burst tests, the tank that failed at a lower burst pressure did appear to have the failure initiating at a crater site with observed spall cracks. A fracture mechanics analysis that provides insight into how the cracks associated with a spall site initiate a failure cascade is discussed.

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