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THE HYPERVELOCITY IMPACT PERFORMANCE OF HONEYCOMB CORE SANDWICH PANELS

Abstract

Honeycomb cores are known to affect the shielding performance of dual-wall shields against hypervelocity impactors such as micrometeoroids and orbital debris (MMOD). At impact velocities sufficiently high to induce projectile fracture, expansion of the resulting cloud of projectile and front facesheet debris is restricted by the honeycomb cell walls (referred to as channelling). Generally, the presence of a honeycomb core is considered to be detrimental to shielding performance (e.g. [1]). However, this is not a uniform opinion. Jex et al. [2] and Sibeaud et al. [3] found that that shielding performance was actually enhanced, possibly due to secondary impacts between debris fragments and cell walls overcompensating for the detrimental effect of channelling. Although a significant number of publications have investigated the impact performance of honeycomb sandwich panels against MMOD projectiles at hypervelocity, there is still no clear consensus on a suitable ballistic limit equation (BLE) for mission risk assessment. A comparison of some performance equations for honeycomb sandwich panels with that of a standard Whipple shield is made in Figure 1, highlighting the variation between published BLEs. In this paper a review of leading BLEs will be presented, an assessment of their underlying assumptions will be made, and their relative strengths and weaknesses discussed. Their performance will be assessed against a database of over 100 impact experiments, from which recommendations about their application will be formulated.

References [1] Sennett, R. and B. Lathrop, Effects of Hypervelocity Impact on Honeycomb Structure. Journal of Spacecraft, 1968. 5(12): p. 1496-1497. [2] Jex, D.W., A. Miller, M., and C.A. MacKay, The Characteristics of Penetration for a Double-Sheet Structure with Honeycomb. 1970, NASA Marshall Space Flight Center. [3] Sibeaud, J.-M., C. Thamie, and C. Puillet, Hypevelocity Impact on Honeycomb Target Structures: Experiments and Modeling. International Journal of Impact Engineering, 2008. 35: p. 1799-1807.