HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
Astronauts: Those Who Make It Happen (5)

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HIGH ALTITUDE FREE FALL: IMPLICATIONS FOR EMERGENCY ESCAPE IN NEAR EARTH SPACE OPERATIONS

Abstract

The deceleration forces acting on humans during free falls from high altitude were theoretically modeled and analyzed. Numerical estimates for total masses of 77-136 Kg (including 36 Kg of survival gear) and jump altitudes of 30-152 Km were done. The classic aerodynamic drag equation D = Cd A V2 was used for modeling and simulation; where D = Drag, Cd = Drag Coefficient, = air density, and A = Surface Area. The standard atmosphere profile was used for air density versus altitude. Falling velocity increases to a maximum and then decreases to terminal velocity asymptotically. Terminal velocity varies with falling body mass and cross sectional area. Decelerations are higher for jumps from higher altitudes and for higher body masses. For jumps from 30 km, decelerations peaked at about 1.2-1.8 G depending on attitude and body mass. For jumps from 152 km, decelerations peaked at about 7.3-15.4 G depending on configuration. Experience with short-duration (impact) decelerations suggests that these G levels are survivable. This analysis considered the special case of zero initial velocity during the free fall, for example, extreme skydiving or escape from a suborbital space vehicle. Extension to non-zero initial velocities may permit definition of potentially survivable atmospheric entry corridors for emergency escapes during operations in Near Earth Orbit (NEO). Future considerations have to include high altitude hypoxic effects and combined stresses from hypoxia and G-forces vs. falling body attitude.