THERMAL PROTECTION TRADEOFFS FOR BALLUTE VERSUS AEROSHELL ENTRY AND DESCENT AT MARS (PART II)

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The high mass required for human missions to Mars presents new challenges for thermal protection during entry, descent, and landing. Ballutes are typically considered for aerocapture missions, but previous analyses indicate that they can also be used for descent to the surface and may provide significant mass savings compared to entry with aeroshells. We will determine the thermal protection system mass required for descent to the surface of Mars employing traditional aeroshell techniques (albeit of much larger size than previously flown), as well as, combined aeroshell-ballute configurations. A one-dimensional heat-conduction code is employed to calculate the thermal protection mass for a range of vehicles with high- to low-ballistic coefficients and for a range of payloads (from 1 ton to 100 tons). In this study the thermal protection mass may include the ballute, heatshielding, or a combination of the two. Results show that ballutes with sufficiently low-ballistic coefficients require substantially lower thermal protection mass than traditional aeroshells. The thermal protection trades have important implications for human exploration of Mars.