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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Mars Exploration (2)

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AEROTHERMODYNAMIC FEASIBILITY OF A SPHERE-CONE WITH A FORWARD FACING CAVITY FOR MANNED MARS MISSIONS

Abstract

The manned missions to mars require design other than an Aeroshell to limit the g values within human tolerance. The non-ballistic designs however, are vulnerable to aerodynamic heating in hostile entry conditions of an alien planet. This paper attempt to investigate the effect a forward facing cylindrical cavity placed at the nose of a Martian entry vehicle as a passive heat reduction mechanism. The hypothetical manned Martian entry vehicle chosen for the study is a 9o sphere cone with nose radius of 15.24 cm and an overall length of 29 cm. Cylindrical cavities inserted axisymmetrically at the nose of the vehicle have a diameter of 4, 5 and 6 cm with length of cavity to diameter of cavity ratio (l/d) varying between 2 to 4. The effectiveness of various cavity configurations in reducing aerodynamic heating is established by the time marching numerical solutions of two dimensional axisymmetric Navier-Stokes equations using a commercially available Navier-Stokes Solver. All simulations are done at a freestream Mach, pressure and temperature of 10, 1400 N/m2 and 560 K respectively assuming the Martian atmosphere to be a chemically reacting mixture of 9 species with 95.7% carbon dioxide, 1.6% argon, and 2.7% nitrogen in the freestream. The results show that deep cylindrical cavities can substantially reduce the aerodynamic heating of the Martian vehicle