NUMERICAL SIMULATIONS OF SUPERSONIC EXHAUST DIFFUSER AT VARIOUS OPERATING CONDITIONS

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Abstract

A numerical study was carried out to determine starting characteristics of a straight cylindrical supersonic exhaust diffuser of a high altitude simulation of high expansion rocket nozzle. The starting conditions of the supersonic exhaust diffuser are numerically simulated for contour nozzle of exit-to-throat area ratio of 21.77, diffuser diameter-to-nozzle throat area ratio of23.36, and diffuser length-to-diameter ratio of 15. The evacuation performances of supersonic exhaust diffuser at various operating conditions are investigated with help of the Mach contour plots. The Mach variations along the centre line and wall of the diffuser indicate the location of the shock and flow characteristics. Validation of numerical simulation is carried out with experimental data and shows a good agreement between them. Flowfield inside the straight cylinder supersonic exhaust diffuser is presented out for stagnation to ambient pressure ratio of 5.5 - 28. The nozzle is started at the stagnation to ambient pressure ratio of about 17. The straight cylindrical supersonic exhaust diffuser is started at the stagnation pressure to ambient pressure ratio of about 21. The numerical simulations of the flowfield are able to capture the flows filled in the diffuser and the shock system is fully established in the duct.

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