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Experimental Investigation of the Base Flow and Base Pressure of Sudden Expansion Nozzle (Conference Paper) (Open Access)

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Abstract

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This paper presents an experimental investigation of an airflow from convergent- divergent axisymmetric nozzles expanded suddenly into circular duct of larger cross- sectional area than that of nozzle exit area, focusing attention on the base pressure and the flow development in the duct. To investigate the influence of area ratios and nozzle pressure ratios on the flow field developed in the duct, the micro jets of 1 mm orifice diameter located at 900 interval along a pitch circle diameter 1.3 times the nozzle exit diameter were employed as the controller of the base pressure. The Mach number investigated in the present study was 1.87, 2.2 and 2.58. The area ratios of the present study are 2.56, 3.24, 4.84 and 6.25. The nozzle pressure ratio (NPR) used were 3 and 5. The length-to-diameter ratio of the enlarged duct was varied from 10 to 1.The level of expansion at the nozzle exit (i.e. before sudden expansion) influences the wall pressure very strongly. From the results it is observed that for NPRs 3 there is no appreciable gain in the base pressure, and hence control employed in the form of micro jets is not effective for this NPR, however, at NPR 5, there is significant change in the base pressure values for all the area ratios. This clearly indicates that the level of expansion plays an important role to dictate the value of the base pressure and ultimately the control effectiveness by the micro jets.

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Engineering controlled terms: Aerodynamics, Ducts, Expansion, Rocket nozzles, Wall flow

Engineering uncontrolled terms: Axisymmetric nozzles, Control effectiveness, Cross sectional area, Experimental investigations, Length to diameter ratio, Nozzle pressure ratio, Orifice diameters, Pitch circle diameters

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