Effect of Nozzle Pressure Ratio and Control Jets Location to Control Base Pressure in Suddenly Expanded Flows

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Abstract

In this paper, computational fluid dynamic (CFD) analysis and experiments have been carried out to study the effect of nozzle pressure ratio, i.e. the ratio of inlet pressure to atmospheric pressure, and the pitch circle diameter of the control jets to regulate the base pressure. The variables considered for the analysis as well as the experiments are the nozzle pressure ratio (NPR), the Mach number (M) and the pitch circle diameter (PCD) of the control jets. The area ratio considered for the study is kept constant at 4.84 while the length to diameter (L/D) ratio of an enlarged duct is set constant at 5. The inertia parameter considered for the study is Mach number. The Mach numbers considered for study are 1.5, 2.0, and 2.5. The nozzle pressure ratio considered for study are 2, 5 and 8. Three different pitch circle diameters of control jets considered for study are 13.1 mm, 16.2 mm and 19.3 mm. From the numerical simulations and the results of the experimental tests, it is found that the control jets are very beneficial to increase the base pressure at higher NPR when the jets issuing from the nozzles are under-expanded. The control jets were able to increase the base pressure value from 160% to 400% at nozzle pressure ratio 8. It is concluded that the parameter D(3)is the most effective pitch circle diameter of the control jets to increase the base pressure.

Keywords

Author Keywords: Base pressure; Mach number; PCD of control jets; Nozzle pressure ratio
KeyWords Plus: ACTIVE CONTROL

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