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Passive control of base drag employing dimple in subsonic suddenly expanded flow (Article)

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Abstract

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This paper presents an experimental and computational investigation to study the effectiveness of dimples to control the base pressure in Backward facing step (BFS) for various Nozzle pressure ratio (NPR) having Compressible flow to minimize the base drag. Two dimples of 3 mm diameter located at 1800 interval along pitch circle diameter of 23 mm in the base region was employed as passive controls. The test was conducted for NPR 1.27, 1.38, 1.52 and 1.69. The model is designed in such a way so as to provide four BFS with angle of incidence as 150 from which the flow suddenly expands to a square duct of 25 mm. The experimental investigation is carried out for different length of duct $4D \leq L \leq 10D$ to see the influence of geometric parameter on base pressure. From the present investigation, it was found that dimples as passive control is very effective at higher NPR and the wall pressure distribution too was quite stable at higher NPR. Also the geometric parameter was found to influence the base pressure for a particular NPR. Computational investigation using commercial CFD tool shows pressure and velocity distribution profile for both dimple and non-dimple control. Tests are carried out by using Navier-stokes equation, Turbulence model as SST, Reynolds number $(Re) = 122.56 \times 10^3$. From this investigation it is clear that for a given nozzle pressure ratio one can find optimum L/D ratio which will result in maximum increase/decrease of base pressure and dimples can be effective passive controller for reducing base drag without disturbing the flow field. © June 2018 IJENS.

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