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Enlarge duct length optimization for suddenly expanded flows (Article)

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Abstract

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In many applications like the aircraft or the rockets/missiles, the flow from a nozzle needs to be expanded suddenly in an enlarged duct of larger diameter. The enlarged duct is provided after the nozzle to maximize the thrust created by the flow from the nozzle. When the fluid is suddenly expanded in an enlarged duct, the base pressure is generally lower than the atmospheric pressure, which results in base drag. The objective of this research work is to optimize the length to diameter (L/D) ratio of the enlarged duct using the CFD analysis in the flow field from the supersonic nozzle. The flow from the nozzle drained in an enlarged duct, the thrust, and the base pressure are studied. The Mach numbers for the study were 1.5, 2.0 and 2.5. The nozzle pressure ratios (NPR) of the study were 2, 5 and 8. The L/D ratios of the study were 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10. Based on the results, it is concluded that the L/D ratio should be increased to an optimum value to reattach the flow to an enlarged duct and to increase the thrust. The supersonic suddenly expanded flow field is wave dominant, and the results cannot be generalized. The optimized L/D ratios for various combinations of flow and geometrical parameters are given in the conclusion section. © 2020.

SciVal Topic Prominence

Topic: Base Pressure | Mach Number | Convergent-Divergent Nozzle

Prominence percentile: 85.885

Author keywords

Base pressure | Length to diameter ratio | Mach number | Nozzle pressure ratio | Thrust

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