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Response of active control on flow field of the duct pressure at supersonic Mach numbers
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Abstract
In this study, experiments were conducted to control the base pressure and wall pressure in the wake at considerably high Mach numbers for a duct diameter of 25 mm. Tests were done at Mach 1.87 and 2.2. The Nozzle Pressure Ratios considered are 3 to 11 at different expansion levels. These experiments were conducted to evaluate the flow mechanism's efficacy while the nozzle is under the impact of favorable and adverse pressure. The control mechanism was positioned at 6.5 mm from the central axis of the main jet. Results reveal that the minimum pipe length required for the flow to remain attached with the duct is L = 2D. When the duct is L = 2D or 3D, the flow pattern is erratic due to the incident's excessive interaction of the reflected shock waves, and the impact of the ambient pressure. Because of the high duct diameter, the control is not efficient even though nozzles are under-expanded. For a larger area ratio, the reattachment length will be large, hence control becomes marginally effective. For over-expanded jets, the control results to reduce the pressure inside the duct. When nozzles encounter high-intensity adverse pressure results in high wall pressure compared to the lower nozzle pressure ratio due to the decline in the strength of the wave. When nozzles are under-expanded, the control effectiveness is optimum. The control mechanism is employed is able to suppress oscillations for large ducts compared to the short duct, where the flow is oscillatory. The control mechanism also results in the reduction of jet noise for some selected cases. © 2022

Author Keywords
Active control; Confined flow; Jet state; Microjets; Sudden expansion; Wall pressure

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