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Passive control of base pressure with static cylinder at supersonic flow (Conference Paper) (Open Access)

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Abstract

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An experimental investigation for over expanded, perfectly expanded and under expanded supersonic jets is presented to study the effectiveness of a static cylinder to reduce base drag at Mach 2 through a converging diverging nozzle for a cross-sectional duct nozzle area ratio of 9. A static cylinder of 2 mm diameter at 2 mm from the side wall of a square duct and 8 mm from the square nozzle exit in the base region is installed as a passive control device. Base pressures in the wake flow after sudden expansion of jets in to a square nozzle have been measured. The length width ratio of the duct is 10. The jets were operated at different nozzle pressure ratios in the range from 2 to 9. The flow field in the square duct was also observed for all cases. Static cylinder as a passive controller was found to reduce the base drag as high as 59 percent at NPR = 9 and 14 percent at NPR = 6. The base pressure depends on Mach number, area ratio, length to width ratio, and nozzle pressure ratio (NPR). When flow from the nozzle is over expanded, the static control is ineffective till NPR is 6. The level of expansion plays a vital role. The flow flux in the square duct remains almost identical with and without control for most of the cases. However, at higher NPRs namely 6, 7.8, and 9 the control results in an increase as well as a decrease in the wall pressure along the duct. Passive control of the base flow is effective for higher NPRs. The flow field for perfectly expanded nozzle is dominated by the shock waves. © Published under licence by IOP Publishing Ltd.

Author keywords

base pressure | nozzle pressure ratio | passive control | Wall pressure

Indexed keywords

Engineering controlled terms: Cylinders (shapes) | Drag | Ducts | Fighter aircraft | Flow fields | Rocket nozzles | Shock waves | Supersonic aerodynamics

Engineering uncontrolled terms: Base pressure | Converging-diverging nozzles | Experimental investigations | Length-to-width ratio | Nozzle pressure ratio | Passive control | Passive control devices | Wall pressure

Engineering main heading: Wall flow

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