# Experimental Study Of Supersonic Coanda Jet

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The Coanda effect is the tendency for a fluid jet to atach itself to an adjacent surface and follow its contour without causing an appreciable flow separation. The jet is pulled onto the surface by the low pressure region which develops as entrainment pumps fluid from the region between the jet and the surface. Then the jet is held to the wall surface by the resulting radial pressure gradient, which balance the inertial resistance of the jet to turning.

The jet may attach to the surface and may be deflected through more than 180 deg, when the radius of the Coanda surface is sufficiently large compared to the height of the exhaust nozzle. However, if the radius of curvature is small, the jet turns through a smaller angle, or may not attach to the surface at all. In general, the limitations in size and weight of a device will limit the radius of the deflection surface. Thus much effort has been paid to improve the jet deflection in a variety of engineering fields.

The Coanda effect has long been applied to improve aerodynamic characteristics, such as the drag/lift ratio of flight body, the engine exhaust plume thrust vectoring, and the aerofoil/ wing circulation control. During the energy crisis of the seventies, the Coanda jet was applied to reduce vehicle drag and led to drag reductions of as much as about 30% for a trailer configuration.

Recently a variety of industrial applications are exploiting another characteristics of the Coanda jets, mainly the enhanced turbulence levels and entrainment compared with conventional jet flows. Various industrial burners and combustors are based upon this principle. If the curvature of the Coanda surface is too great or the operating pressure too high, the jet flow will break away completely from the surface. This could have catastrophic consequences for a burner or combustor. Detailed understanding of the Coanda jet flow is essential to refine the design to maximize the enhanced entrainment in these applications.

Compared with a large number of the work on the incompressible Coanda jet, only a few work has been made to understand the flow physics of supersonic Coanda wall jet and to develop a suitable numerical prediction method. This is not surprising because the supersonic Coanda wall jet is subject to very complicated flow phenomena such as the shock/boundary layer interaction involving a multiple of shocks embedded inside the jet flow. The supersonic Coanda jet flow in the compressible regime deserves greater attention because of its large potential benefit in engineering applications. Recently renewed interest is concentrated on the purpose of making the wall jet flow attach further to a curved surface, resulting in augmentation of a life force. In this case, the jet flow attachment and/ or detachment from the curve surface is of practical importance. Some recent work investigated the effect of the geometry of the exhaust nozzle on the jet flow field and the resulting jet detachment could be delayed considerably employing a convergent-divergent nozzle.

The present study was performed to get a better understanding of the supersonic Coanda wall jet flow. An experiment was made using a small blow-down wind tunnel. The operating pressure ratio of the supersonic Coanda wall jet was varied to obtain moderately underexpanded supersonic jets at the exit of a convergent nozzle. The radius of curvature of the Coanda surface and the height of the exhaust nozzle throat were also changed to investigate their influence on the jet flow field. Static wall pressures along the Coanda wall surface were measured to characterize the jet flow. A schlieren optical system provided us a qualitative information to determine the attachment and detachments of the Coanda wall.