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Aerodynamic Control and Mixing with Ramp Injection PAUL DIMOTAKIS, MICHAEL JOHNSON, MICHAEL SLESSOR, JEFFREY BERGTHORSON, California Institute of Technology — Experiments were conducted to investigate the behavior of a flow and geometry with many features that are potentially useful for a Supersonic Combustion Ramjet (SCRAMJET) engine: a recirculation zone for flameholding, enhanced mixing between fuel and air, and low total-pressure losses. In subsonic flow with no mass injection, the exit velocity and guidewall static-pressure profiles are found to collapse over a large range of inlet Reynolds numbers. Significant control of exit velocity and guidewall pressure profiles is possible via injection through a perforated ramp into the freestream. The control authority on the overall pressure coefficient increases with increasing inlet Reynolds number. Simple control volume analysis bounds the expected overall pressure coefficient for the device. In transonic/low-supersonic flow, the area ratio calculated from measured pressures agrees well with the visual shear-layer thickness, confirming low total-pressure losses. Further flow control is possible through variable heat release from a fast- chemical reaction between reactants carried in the two streams. At the highest heat release studied, mass injection requirements are lowered by, roughly, a factor of two. Measurements of mixing inferred from the temperature rise in reacting flow indicate higher mixing levels vs. classical free shear layers. As in free shear layers, however, mixing levels decrease with increasing heat release.

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