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Compressible axisymmetric swirling flow states in chambers with various geometries YUXIN ZHANG, Washington State Univ, ZVI RUSAK, Rensselaer Polytechnic Institute, SHIXIAO WANG, The University of Auckland — The stability and breakdown of compressible swirling flows is an important problem for a variety of technological applications such as the aerodynamics of slender wings operating at high angles of incidence, flows in jet engine nozzles and in combustion chambers. We investigate the structure of inviscid, compressible, subsonic and axisymmetric swirling flow of a perfect gas in chambers with varying geometries. The inlet flow is described by profiles of circumferential and axial velocity and temperature together with a fixed azimuthal vorticity. The outlet flow is assumed to be a zero radial velocity state. The nonlinear interaction among flow compressibility, flow swirl and chamber geometry are investigated numerically. We solve the unsteady and axisymmetric Euler equations using the Steger and Warming flux vector splitting method. The solver provides the natural evolution of flows including the dynamics to states with low-speed recirculation zones along the chamber centerline or attached to the wall. Results of the time-asymptotic states show agreement with theoretical predictions of steady compressible swirling flows in chambers. Results also shed light on the stability of various steady states and the nature of flow evolution.

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