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The Breakdown of Compressible Vortex Flows ZVI RUSAK, Rensselaer Polytechnic Institute, JUNG J. CHOI, Georgia Institute of Technology — The theoretical foundation for the global analysis of the dynamics of vortex flows is extended to the case of subsonic compressible swirling flows in a finite-length, straight, circular pipe. A novel nonlinear partial differential equation for the solution of the flow stream function is developed in terms of the incoming specific total enthalpy, specific entropy, and circulation functions. Solutions of the resulting nonlinear ordinary differential equation for the columnar case together with a newly derived flow-force condition describe the flow outlet state. These solutions are used to form the bifurcation diagrams of steady, compressible flows with swirl as the swirl level is increased. These provide theoretical predictions of the critical swirl ratio for the first appearance of vortex breakdown as function of Mach number.

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