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Near critical swirling flow of a viscoelastic fluid NGUYEN LY, ZVI RUSAK, JOHN TICHY, Rensselaer Polytechnic Institute, SHIXIAO WANG, U. Auckland, New Zealand — The interaction between flow inertia and elasticity in high Re, axisymmetric, and near-critical swirling flows of a viscoelastic fluid in a finite-length straight circular pipe is studied. The viscous stresses are described by the Giesekus constitutive model. The application of this model to columnar streamwise vortices is first investigated. Then, a nonlinear small-disturbance analysis is developed from the governing equations of motion. It explores the complicated interactions between flow inertia, swirl, and fluid viscosity and elasticity. An effective Re that links between steady states of swirling flows of a viscoelastic fluid and those of a Newtonian fluid is revealed. The effects of the fluid viscosity, relaxation time, retardation time and mobility parameter on the flow development and on the critical swirl for the appearance of vortex breakdown are explored. Decreasing the ratio of the viscoelastic characteristic times from one increases the critical swirl for breakdown. Increasing the Weissenberg number from zero or increasing the fluid mobility parameter from zero cause a similar effect. Results may explain changes in the appearance of breakdown zones as a function of swirl level that were observed in Stokes *et al.* (2001) experiments, where Boger fluids were used.

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