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Gas dynamics of heat-release-induced waves in supercritical fluids: revisiting the Piston Effect MARIO TINDARO MIGLIORINO, CARLO SCALO, Purdue University — We investigate a gasdynamic approach to the modeling of heat-release-induced compression waves in supercritical fluids. We rely on highly resolved one-dimensional fully compressible Navier-Stokes simulations of CO_2 at pseudo-boiling conditions in a closed duct inspired by the experiments of Miura *et al.*, *Phys. Rev. E*, vol. 74, 2006. Near-critical fluids exhibit anomalous variations of thermodynamic variables taken into account by adopting the Peng-Robinson equation of state and Chung's Method. An idealized heat source is applied, away from the boundaries, resulting in the generation of compression waves followed by contact discontinuities bounding a region of hot expanding fluid. For higher heat-release rates such compressions are coalescent with distinct shock-like features (i.e. non-isentropicity and propagation Mach numbers measurably greater than unity) and a non-uniform post-shock state, not present in ideal gas simulations, caused by the highly nonlinear equation of state. Thermoacoustic effects are limited to: (1) a one-way/one-time thermal-to-acoustic energy conversion, and (2) cumulative non-isentropic bulk heating due to the resonating compression waves, resulting in what is commonly referred to as the Piston Effect.

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