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Group Invariance Properties of the Inviscid Compressible Flow Equations for a Modified Tait Equation of State SCOTT RAMSEY, ROY BATY, Los Alamos National Laboratory — This work considers the group invariance properties of the inviscid compressible flow equations (Euler equations) under the assumptions of one-dimensional symmetry and a modified Tait equation of state (EOS) closure model. When written in terms of an adiabatic bulk modulus, a transformed version of these equations is found to be identical to that for an ideal gas EOS. As a result, the Lie group invariance structure of these equations and their subsequent reduction to a lower-order system is identical to the published results for the ideal gas case. Following the reduction of the Euler equations to a system of ordinary differential equations, a variety of elementary closed-form solutions are derived. These solutions are then used in conjunction with the Rankine-Hugoniot conditions to construct discontinuous shock wave and free surface solutions that are analogous to the classical Noh, Sedov, Guderley, and Hunter similarity solutions of the Euler equations for an ideal gas EOS. The versions of these problems for the modified Tait EOS are found to be semi-analytic in that a transcendental root extraction (and in some cases numerical integration of ordinary differential equations) enables solution of the relevant equations.

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