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Complete Equation of State for Shocked Liquid Nitrogen: Analytical Developments[1] J. M. WINEY, Y. M. GUPTA, Washington State University — The thermodynamic response of liquid nitrogen has been studied extensively, in part, due to the long-standing interest in the high pressure and high temperature dissociation of shocked molecular nitrogen. Previous equation of state (EOS) developments regarding shocked liquid nitrogen have focused mainly on the use of intermolecular pair potentials in atomistic calculations. We present EOS developments for undissociated liquid nitrogen, incorporating analytical models, for use in shock wave continuum calculations. The analytical models, together with Hugoniot data, were used to extrapolate a low pressure reference EOS for nitrogen [Span, et al., J. Phys. Chem. Ref. Data 29, 1361 (2000)] to high pressures and high temperatures. Using our EOS, the calculated pressures and temperatures for single shock, double shock, and multiple shock compression of liquid nitrogen provide a good match to the measured results over a broad range of P-T space. These calculations provide the first comparison of EOS developments with recently-measured P-T states under multiple shock compression [Lacina and Gupta, J. Chem. Phys. 141, 084503 (2014)]. The present EOS developments are general and are expected to be useful for other liquids that have low pressure EOS information available.

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