Abstract Submitted
for the SHOCK11 Meeting of
The American Physical Society

An Equation of State for Solids DENNIS GRADY, Applied Research Associates — A number of equations of state have been proposed over the years that have attempted to achieve a level of universality such that high-pressure compressibility of a solid can be reasonably predicted. Further, these proposed, and in some cases demonstrated, universal equations of state are formulated with constants that can be calculated from ambient properties of the material; usually the ambient density and bulk elastic constants. Most of these efforts preface the work with acknowledgment of the seminal equation of state (EOS) of Murnaghan followed by noting the limitations of the Murnaghan EOS to perhaps 10-15% compression volume strain. In spite of these obvious limitations, because of analytic convenience, and the needs of the high-pressure community for a convenient equation of state, the Murnaghan EOS continues to be frequently, and in most cases effectively, use. In this paper the fundamental observations of Murnaghan are examined relating to the pressure dependence of the compression modulus. An alternative implementation of the Murnaghan assumption of a linear pressure dependence of the compression modulus is introduced that leads to a modified EOS with equal analytic convenience and with applicability to markedly larger volume strains. This alternative EOS is compared with reference isothermal high-pressure compression data for copper and aluminum, and contrasted with other universal equations of state including the Murnaghan EOS, the Birch third-order EOS, equations of state resulting from the Mie and the Morse potentials, and the Rose-Vinet EOS.

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Date submitted: 09 Feb 2011 Electronic form version 1.4