Analytical Equations of State for use in Hydro-Codes JOHN MAW, AWE — Hydro-code users often need to decide whether to use a tabular or analytical equation of state (EOS) in simulations. Many good, wide range, tabular forms have been generated, particularly for metals, often based on ab-initio electronic structure calculations. For other materials, including alloys and organics, tables either do not exist or are of limited accuracy. Analytical EOS forms can be generated quickly for novel materials where tabular forms are not available but are only as good as the experimental data used to generate them. However, they do have the advantage that they can be easily modified to assess the sensitivity of simulations to EOS uncertainties. A tabular form can only be modified by re-generating the EOS from scratch. This paper considers a number of analytical EOS forms with particular emphasis on those that give realistic descriptions of low density and off-Hugoniot states far from the regimes where they have been validated. The issues of robustness, an essential requirement of EOS for hydro-code simulations are addressed. Temperatures are not explicitly calculated in EOS of the form P(V,E) but may be required for use in material strength models. Simple methods are discussed for calculating temperatures that are thermodynamically consistent with an analytical EOS.

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