Abstract Submitted
for the SHOCK15 Meeting of
The American Physical Society

The effect of shear strength on isentropic compression experiments STUART THOMSON, PETER HOWELL, JOHN OCKENDON, HILARY OCKENDON, University of Oxford — Isentropic compression experiments (ICE) are a novel way of obtaining equation of state information for metals undergoing violent plastic deformation. In a typical experiment, millimetre thick metal samples are subjected to pressures on the order of $10 - 10^2$GPa, while the yield strength of the material can be as low as 10^{-1}GPa. The analysis of such experiments has so far neglected the effect of shear strength, instead treating the highly plasticised metal as an inviscid compressible fluid. However making this approximation belies the basic elastic nature of a solid object. A more accurate method should strive to incorporate the small but measurable effects of shear strength. Here we present a one-dimensional mathematical model for elastoplasticity at high stress which allows for both compressibility and the shear strength of the material. In the limit of zero yield stress this model reproduces the hydrodynamic models currently used to analyse ICEs. We will also show using a systematic asymptotic analysis that entropy changes are universally negligible in the absence of shocks. Numerical solutions of the governing equations will then be presented for problems relevant to ICEs in order to investigate the effects of shear strength over a model based purely on hydrodynamics.

Stuart Thomson
University of Oxford

Date submitted: 30 Jan 2015 Electronic form version 1.4