Abstract Submitted
for the SHOCK19 Meeting of
The American Physical Society

Diffusion Effects near Discontinuities in Explosions DAVID GROTE, ALLEN KUHL, Lawrence Livermore Natl Lab — We study the problem of diffusion effects near contact surfaces CS in TNT explosions. The flow is modeled by the compressible Navier-Stokes equations in 1-D spherical coordinates. The hyperbolic terms of the conservation laws are integrated with a 2-order Godunov scheme, while the viscous terms are advanced by a 2-order Runge-Kutta method. A tabular EOS, based on equilibrium thermodynamics, is used. Two numerically-converged solutions were found: the inviscid and viscous solutions. The blast wave solution scaled gas-dynamically i.e., with the cube-root of the charge mass . However, species concentrations and peak temperatures near the DP-air contact surface: CS were smeared by molecular diffusion effects. Similarity solutions in a Lagrangian frame of the CS were derived and found to agree with the numerical solution. Species diffusion near CS scales according to an erfc function which depends on the mass Pclet function and diffusivity D. Thermal diffusion near CS scales according to the exponential function which depends on the heat Pclet functions. Thermal diffusion drops the peak air temperature from 10,500 K (inviscid) to 4,000 K (viscous).

Allen Kuhl
Lawrence Livermore Natl Lab

Date submitted: 29 Mar 2019 Electronic form version 1.4