Calibration Procedure for Wescott-Stewart-Davis Equation of State with PBX-9502

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1 Poster Abstract

The major objective of this research is to calibrate the Wescott-Stewart-Davis (WSD) equation of state (EOS) with current shock data for PBX-9501 and then apply the same method to other explosive materials in order to characterize their respective EOS. The calibration procedure consists of first, calibrating the products from overdriven hugoniot experiements and then, calibrating the reactants based on the products EOS and reactant hugoniot data. The products EOS is calibrated by solving highly non-linear equations for adiabatic gamma, Chapman-Jougeut (CJ) pressure, total chemical energy, Gurney energy, and the partitioning pressure to obtain the calibration constants for the WSD functional form. This is done while also performing a constrained least squares minimization against experiemental isentrope data to determine an optimized fit for the CJ pressure, energy released during detonation, energy of the gaseous products, and partitioning pressure. Lastly for the products, a least squares minimization is performed against overdriven hugoniot data to determine slope of the EOS at high particle velocities. For the reactants, an unconstrained least squares minimization is performed against hugoniot data to determine the fitting parameters for the reactants EOS. Then, after the CJ detonation speed, energy at the Von-Neumann point, and volume at the Von-Neumann point have been determined from the EOS, the calibration constant for the temperature to move off the reference isentrope is solved from the non-linear equation for energy as a function of temperature and volume at the Von-Neumann point. This research provides a fundamental understanding of the calibration procedures for the WSD EOS, which can be used to calibrate the WSD EOS for other explosive materials.

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