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Plasticity analysis from shockwave velocimetry BRYAN REED, JAMES STOLKEN, REED PATTERSON, JEFF NGUYEN, MUKUL KUMAR, Lawrence Livermore National Laboratory — Using shocks in tantalum as a test case, we are developing methods to extract plasticity information from shock velocimetry in the absence of impedance-matched windows. We have revisited literature data analysis approaches, combining them into a single formalism while generalizing the physics. Finding the deviatoric stress and plastic strain in a one-dimensional wave is reduced to the problem of determining (1) the material's equation of state and pressure-dependent shear modulus and (2) the particle velocity as a function of position and time. The results provide plastic stress-strain data while clarifying the links between rate-dependent plasticity and shock wave propagation. Plastic relaxation acts a distributed source of elastic rarefaction waves that superpose very nearly in step with the shocks. This mechanism is known to produce elastic precursor decay, but we also find that it may account for an unexpected slowing of the plastic shock speed at intermediate pressures. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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