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A Rate-Dependent Viscoelastic Damage Model for Simulation of Solid Propellant Impacts ERIK MATHESON, Lockheed Martin — A viscoelastic deformation and damage model (VED) for solid rocket propellants has been developed based on an extensive set of mechanical properties experiments. Monotonic tensile tests performed at several strain rates showed rate and dilatation effects. During cyclic tensile tests, hysteresis and a rate-dependent shear modulus were observed. A tensile relaxation experiment showed significant stress decay in the sample. Taylor impact tests exhibited large dilatations without significant crack growth. Extensive modifications to a viscoelastic-viscoplastic model (VEP) necessary to capture these experimental results have led to development of the VED model. In particular, plasticity has been eliminated in the model, and the multiple Maxwell viscoelastic formulation has been replaced with a time-dependent shear modulus. Furthermore, the loading and unloading behaviors of the material are modeled independently. To characterize the damage and dilatation behavior, the Tensile Damage and Distention (TDD) model is run in conjunction with VED. The VED model is connected to a single-cell driver as well as to the CTH shock physics code. Simulations of tests show good comparisons with tensile tests and some aspects of the Taylor tests.

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