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Experimental and Computational Investigation of the Shearing Resistance of an Elastomer at Pressures Up to 18 GPa and Strain Rates of $10^5 - 10^6 s^{-1}$ TONG JIAO, RODNEY CLIFTON, Brown University — Pressure-shear plate impact (PSPI) experiments have been conducted to study the mechanical response of an elastomer (polyurea) at high pressures and high strain rates. The previously determined isentrope has been extended to 18 *GPa*. At this pressure, the high-strain-rate shearing resistance of polyurea is approximately 1 *GPa*–comparable to, or greater than, that of high strength steels and at much lower weight. From the PSPI experiments it is evident that the shearing resistance of polyurea increases essentially proportionately with increasing pressure. Polyurea's response to volumetric changes is largely reversible whereas its response to distortional changes is largely dissipative. These effects are modeled by introducing a constitutive model that incorporates a finite deformation isotropic elasticity model for the instantaneous response and a quasilinear viscoelasticity model–with distributed relaxation times–to model relaxation from the instantaneous elastic response. In order to model a dependence of shear wave speed on pressure, the strain energy function for the instantaneous elastic response is comprised of a distortion-dependent term multiplied by a factor that depends only on the change in volume. This model has been implemented into Abaqus^{TM}to simulate the response of polyurea P1000 under the impact conditions of a variety of PSPI experiments. Results of these simulations suggest that the main features of the experimental results can be explained by such a model.

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