

knowledge of the recentered Hugoniot in the Lucite. To obtain this recentered Hugoniot, a Mie-Grüneisen equation of state was assumed in the Lucite.<sup>58</sup> When referenced from the foot of the initial Hugoniot, this takes the form

$$\begin{aligned} P(V,E) &= P(S_0,V) + \frac{\Gamma}{V} (E - E(S_0,V)) \\ &= \frac{\Gamma}{V} (E - E(S_0,V_0)) + P(S_0,V) + \frac{\Gamma}{V} \int_{V_0}^V P(S_0,V) dV. \end{aligned}$$

Collecting the volume-dependent-only terms into an arbitrary function gives

$$P(V,E) = \frac{\Gamma}{V} (E - E(S_0,V_0)) + f(V). \quad (4.5)$$

The energy jump condition on the initial Hugoniot is

$$E - E(S_0,V_0) = \frac{1}{2} P_H^0(V_0 - V). \quad (4.6)$$

Equation (4.5) must hold in particular on the initial Hugoniot. Therefore, by eliminating the energy expression between Equation (4.5) and Equation (4.6), one obtains

$$P_H^0(V) = \frac{\Gamma}{2V} P_H^0(V)(V_0 - V) + f(V).$$

Solving this for  $f(V)$  and substituting back into Equation (4.5) gives the required Mie-Grüneisen equation of state,

$$P(V,E) = \frac{\Gamma}{V} (E - E(S_0,V_0)) + P_H^0(V) \left( 1 - \frac{\Gamma}{2V} (V_0 - V) \right).$$

The energy jump condition on the recentered Hugoniot is

$$E - E' = \frac{1}{2} (P_H - P')(V' - V),$$

where  $P' = P_H^0(V')$  and  $(P', V')$  represent the reference state for the recentered Hugoniot. When combined with the energy jump condition on the initial Hugoniot, this gives

$$E - E(S_0, V_0) = \frac{1}{2} P'(V_0 - V') + \frac{1}{2} (P_H + P')(V' - V).$$

Combining this with the Mie-Grüneisen equation of state gives the required pressure on the recentered Hugoniot.

$$P_H(V) = \frac{P_H^0(V) \left[ 1 - \frac{\Gamma}{2} \frac{V_0}{V} \left( 1 - \frac{V}{V_0} \right) \right] + P' \frac{\Gamma}{2} \frac{V_0}{V} \left( 1 - \frac{V}{V_0} \right)}{1 - \frac{\Gamma}{2} \frac{V_0}{V} \left( \frac{V'}{V_0} - \frac{V}{V_0} \right)} \quad (4.7)$$

To facilitate the calculation, a quadratic  $P - \eta$  relation,  $\eta = 1 - V/V_0$ , was fit to the initial Hugoniot data in the range 10 to 60 kilobars. The result,

$$P_H^0(\eta) = 0.0197 - 0.223\eta + 1.51\eta^2, \quad (4.8)$$

was not forced through the origin. This allowed a better fit to the data in the region of interest. The quantity  $\Gamma/V$  was assumed constant. The value of  $\Gamma_0$  is difficult to assess from the literature. Acoustical data<sup>59</sup> give  $\Gamma_0 = 5.13$  while thermodynamic data<sup>60</sup> predict  $\Gamma_0$  approximately equal to 0.9. A gross linear fit to  $D - u$  data, using the relation<sup>61</sup>

$$\Gamma_0 = 2 \frac{dD}{du} - 1,$$

yields a value of  $\Gamma_0 \approx 0.8$ . For this work, strains using a value of  $\Gamma_0 = 1.0$  are quoted. In practice, pressures of about 22 kilobars and 44 kilobars were obtained in the Lucite. Predictions of strain for  $\Gamma_0 = 5.13$  are 1% and 4% lower, respectively.