

to  $E$  at constant  $V$

$$\Gamma/V = (\partial P / \partial E)_V \quad (25)$$

or

$$\Gamma = -\frac{V}{C_P} \left( \frac{\partial P}{\partial V} \right)_S \left( \frac{\partial V}{\partial T} \right)_P. \quad (26)$$

The bulk modulus at constant entropy is defined by

$$B_S = -V(\partial P / \partial V)_S \quad (27)$$

and the volume expansion coefficient by

$$\beta = (1/V)(\partial V / \partial T)_P. \quad (28)$$

Then Eq. (26) becomes

$$\Gamma = B_S \beta / \rho C_P. \quad (29)$$

Thus  $\Gamma$  at atmospheric pressure and low temperature can be determined from experimental data for the density, specific heat, bulk modulus, and thermal expansion coefficient.

The Mie-Gruneisen equation of state used with the approximation that

$$\rho \Gamma = \rho_0 \Gamma_0 \quad (30)$$

where  $\Gamma_0$  is the thermodynamic value determined from Eq. (24) and  $\rho_0$  is the initial density, provides a reasonable model for many solids subjected to shock compression.<sup>21, 28</sup> Due to this simplifying assumption facility is gained in calculating some thermodynamic properties off the Hugoniot and so this form for equation of state was adopted for the liquids studied. The model is probably inadequate for liquids because the theory was originally developed for solids. Other reasons for suggesting the model inadequate are the large compressibilities which give rise to high temperatures and changes in the specific heat at these elevated temperatures, but the method does provide a starting place for making calculations.