With the assumption of thermodynamic equilibrium behind a shock, the state variables of a nonreacting shocked fluid satisfy the following thermodynamic identities:

$$de = Tds - pdv \tag{6}$$

$$T(s,v) = \left(\frac{\partial e}{\partial s}\right)_v \tag{7}$$

$$p(s,v) = -\left(\frac{\partial e}{\partial v}\right)_s \tag{8}$$

For thermomechanical processes, a knowledge of e, s, T, p, and v provides a complete characterization of a thermodynamic state. Thus, the (e-s-v) equation of state is called complete because of the identities 7 and 8 that define the (T-s-v) and (p-s-v) equations of state, but all other equations of state among these variables are incomplete. The (e-p-v) equation of state is incomplete because it cannot be used to calculate temperature and entropy without additional data. Similarly, the (T-p-v) equation of state is incomplete because it cannot be used to calculate energy and entropy without additional data. However, a knowledge of any two incomplete equations of state provides a complete characterization because of the identities of thermodynamics.

The objective of the present work is to use shock wave and low pressure data to characterize completely the high pressure environment in the kilobar regime without additional thermodynamic assumptions. Since shock temperature cannot be measured directly with present-day techniques and cannot be calculated from knowledge of the energy along a Hugoniot curve, it is necessary to construct the (T-p-v) equation of state. Such a construction must be based on the mechanical properties of shocked states. At present the only feasible way to achieve this objective is to construct the (e-p-v) equation of state first, and then use it with the identities of thermodynamics to calculate the (T-p-v) relationship. Hugoniot curves form the basis of the experimental method of constructing the (e-p-v) equation of state using shock wave data; the relationship between the (T-p-v) and (e-p-v) equations of state forms the basis for calculating the temperature of shocked states.