The conservation of energy across the shock front may be expressed by equating the network done per unit area per unit time by the pressure forces to the change in kinetic and internal energy of a mass element. The work done at A (see Fig. 1) is $P_0 U_{p0} \delta t$ and at B the work required to bring a mass element to a velocity U_p in time δt is $PU_p \delta t$. Hence, the net work done is $(PU_p - P_0 U_{p0})\delta t$. The increase in kinetic energy across the shock is $\rho_0(U_s - U_{p0})\delta t(U_p^2 - U_{p0}^2)/2$ and in the internal energy is $\rho(U_s - U_{p0})\delta t(E-E_0)$. Equating the net work done to the increase in specific energy,

$$PU_p - P_0 U_{p0} = \rho_0(U_s - U_{p0})\left[(U_p - U_{p0})^2 + (E-E_0)\right]/2. \tag{5}$$

The velocities in Eq. (5) can be eliminated by using Eqs. (1) and (4) to obtain the more usual form for the Hugoniot equation

$$E - E_0 = (P+P_0)(V_0 - V)/2. \tag{6}$$

If the material ahead of an advancing shock wave is stationary, then U_{p0} is zero; also in a single shock process, P_0 represents atmospheric pressure and can be neglected since this pressure is very much less than the dynamic pressures available from explosives. The conservation relations become with these simplifications

$$V/V_0 = (U_s - U_p)/U_s \tag{7}$$

$$P = \rho_0 U_s U_p \tag{8}$$

$$E - E_0 = P(V_0 - V)/2. \tag{9}$$

All the quantities P, V, E, U_s, and U_p are defined for a given steady state shock front and the locus of any pair refers to a Hugoniot curve in the corresponding space.