Thus to calculate the (T-p-v) from the (e-p-v) equation of state, it is necessary first to construct a family of isentropes in the (p-v) plane and then to calculate temperature along them with Eq. 9. It is important to note that temperature cannot be calculated with Eq. 9 unless the temperatures T_i at particular points (p_i, v_i) on the isentropes are known. Measurement of the temperature along any curve which intersects the entire family of isentropes permits a value of T_i to be assigned to each isentrope. Thus the (T-p-v) equation of state is determined in the domain of the (p-v) plane covered by a family of isentropes. For a given (e-p-v) equation of state, there is a thermodynamically consistent (T-p-v) equation of state for each assignment of temperature along a nonisentropic curve.

Measurements of temperature and energy along the atmospheric isobar are sufficient to calculate the (T-p-v) and (e-p-v) equations of state from a family of Hugoniot curves centered on this isobar. However, the (e-p-v) and (T-p-v) equations of state will necessarily be specified over different but overlapping domains of the (p-v) plane. The family of Hugoniot curves defines the domain where the (e-p-v) equation of state is known, but the family of isentropes constructed from the (e-p-v) relationship defines the subdomain where the (T-p-v) equation of state is known.

III. EXPERIMENTS

Dow Corning silicone 210 fluid (100 centistokes) was chosen because of its good thermal stability and its large coefficient of expansion. Static experiments were performed to measure the variation of density and specific enthalpy h", along the atmospheric isobar. Shock wave experiments were performed to determine a family of Hugoniot curves centered on the atmospheric isobar.

Static Measurements

The variation of volume with temperature at atmospheric pressure between $-30^{\circ}C$ and $150^{\circ}C$ was measured with a density balance. A least squares fit for the data, with T in degrees Kelvin,

$$v^{-1} = 1.2566 + 1.0577 \times 10^{-3} T + 2.604 \times 10^{-7} T^2$$