The fits for $f(v)$ and $g(v)$ define the (e-p-v) equation of state and allow calculation of Hugoniots centered on, and isentropes passing through points on the $p=0$ isobar in the (p-v) plane. The discontinuous change in slope of the $g(v)$ function at $v = 1.01316$ cc/g is manifest in the shape of these curves in the neighborhood of this volume.

V. CALCULATIONS

Construction of Hugoniot Curves and Isentropes

The Hugoniot curves centered on $p = 0$ at -20^{o}C, 25^{o}C, 158.5^{o}C, and 256^{o}C were calculated directly with Eq. 14. The isentropes passing through $p = 0$ at 25^{o}C, 158.5^{o}C, 256^{o}C, and 296^{o}C were constructed by integrating Eq. 15 numerically with a Runge-Kutta technique. The -20^{o}C, 158.5^{o}C, and 256^{o}C Hugoniots and the 296^{o}C isentrope are shown in Fig. 4. The 25^{o}C Hugoniot and the 25^{o}C and 296^{o}C isentropes are shown in Fig. 5.

Calculation of Temperature

Equation 9 was used to calculate the temperature along the isentropes passing through 25^{o}C and 296^{o}C on the atmospheric isobar. The values of temperature along these isentropes are listed in Table II. Calculation of temperature at points where isentropes intersect the 25^{o}C Hugoniot defines values of shock temperature along this Hugoniot curve. The point of intersection ($T_c = 522.1^{o}$C, $p_c = 58$ kbar, $v_c = 0.661$ cc/g) of the 296^{o}C isentrope and the 25^{o}C Hugoniot is the highest point on the 25^{o}C Hugoniot where shock temperature can be calculated with the present data. The temperature on the 25^{o}C Hugoniot below 58 kbar can be calculated with the isentropes lying to the left of the 296^{o}C isentrope. The temperature where the 256^{o}C isentrope intersects the Hugoniot is 456.7^{o}C, and the temperature where the 158.5^{o}C isentrope intersects the Hugoniot is 291.5^{o}C.

It is not possible to calculate temperature on the 25^{o}C Hugoniot above 58 kbar without making further assumptions. The temperature along the Hugoniot above 58 kbar was calculated with constant C_v rather than by extrapolating the low pressure data further. The equation for shock temperature[2] above a point (T_c, v_c) on a Hugoniot centered at $(p_o = 0,\ v_o)$,

$$TI = T_c + \frac{1}{2C_v}\int_{v_c}^{v} I[p + (v_o - v)\ \frac{dp}{dv_H}\ ]\ dv \qquad (17)$$

with

$$I = \exp\int_{v_c}^{v} dv/f(v)$$

was used to calculate temperature on the 25°C Hugoniot above (T_c = 522.1°C, v_c = 0.661 cc/g). The integral term in Eq. 17 was evaluated numerically with a constant value of $C_v = 1.3735 \times 10^{-2}$ kbar cm^3/g°C equal to the constant value along the 296°C isentrope. Since C_v is constant along an isentrope, the significance of temperatures calculated with Eq. 17 depends on the variation of C_v with volume along the atmospheric isobar above v = 1.35 cc/g. In the case that C_v increases with increasing volume above v = 1.35 cc/g, it also increases with the increasing pressure along the Hugoniot curve, and the values of temperature calculated with Eq. 17 under the assumption of constant C_v would be upper estimates for shock temperature above 58 kbar. The values of temperature calculated with Eq. 17 are listed in Table III.

For comparison the method of Walsh and Christian[2] was also used to calculate temperature along the 25°C Hugoniot curve with Eq. 17. The integral was evaluated under the assumption that C_v and f(v) were constant along the Hugoniot curve and that the values of these constants were the values of C_v and f(v) evaluated at 25°C. The calculated temperatures where the 158.5°C, 256°C, and 296°C isentropes intersect the 25°C Hugoniot are 296.8°C, 507.1°C, and 561.5°C. The values of temperature above 58 kbar calculated by this method are also listed in Table III.

VI. SUMMARY AND CONCLUSIONS

Because of the scarcity and inaccuracy of experimental data, it was necessary to assume a simple form of the (e-p-v) equation of state to calculate the thermodynamic properties of silicone fluid. The particular form of the (e-p-v) relationship, e = pf(v) + g(v) with f(v) and g(v) arbitrary functions of volume, was suggested from the shock wave data and also from the variation of $(\partial e/\partial p)_v$ along the atmospheric isobar. Values of f(v) calculated from the shock wave data and values of f(v) calculated from atmospheric static data with the identity $(\partial e/\partial p)_v = -C_p(\partial v/\partial p)_s(\partial T/\partial v)_p$