was used above 150°C to calculate initial conditions for the shock wave experiments. The standard deviation from the least squares fit is less than 0.1% of the largest volume measured.

The variation of specific enthalpy with temperature at atmospheric pressure between -26°C and 318°C was determined with a drop calorimeter. A least squares fit for the data with T in degrees Kelvin and h = 0 at $T_1 = 298^{\circ}$K is

$$h = 16960(1/T - 1/T_1) - 0.09818(T - T_1) + 4.842 \times 10^{-4}(T^2 - T_1^2)$$

The standard deviation from the least squares fit is less than 3/4% of the largest enthalpy increment measured.

Shock Measurements

Four explosive shots were performed to obtain high pressure equation of state data using an impedance match technique.[1] Each shot assembly contained both cold and hot liquid samples.

A cross section of an assembly showing the brass cells containing the liquid samples is illustrated in Fig. 1. Plane shocks were induced in the liquid samples by the interactions produced by a brass flier striking the cells. The driver system for the flier plate was a P-80 plane-wave lens in contact with a 4-inch pad of high explosive. Shocked conditions in the liquid were varied by varying the composition of the explosive pad.

Direct measurement of shock velocity in the liquid and indirect measurement of the shocked condition in the brass at the cell-liquid interface suffice to calculate the shocked state in the liquid. The measurements were recorded on 70-mm Tri-X film with a Beckmann & Whitley 770 camera writing at a speed of 10 mm/μsec; object-to-image ratio was 2.6/1 and the slit overwrite time was 0.01 μsec. Figure 2 shows a detailed drawing of a streak camera view of the liquid cells. Changes of reflectivity of the steel shims E and C, the brass surface DF, and the mirrored surface H produce signals that depict the series of events for the cold cell in the shock experiment. A typical streak record is shown in Fig. 3, where the letters identifying the signals match the letters in Fig. 2. The figure shows (a) the flier plate striking the cold cell at C and J; (b) the time of arrival of the shock at the surface of the brass at D, F, G, and I; (c) the time of arrival of the free surface of the brass at E; (d) entrance of the shock into the liquid at G and I; and (e) time of arrival of the shock at the liquid-glass interface at H. The shock velocity through the liquid was calculated from times recorded at G, I, and H. The shock velocity in the cold brass and its free surface velocity determine conditions at the brass-liquid interface. The shock velocity in the cold cell was calculated using the time differences of location C and D divided into a corrected thickness of the brass at location D. The corresponding free-surface velocity was calculated from times at D, F, and E. The time differences between locations were reduced by 0.022 μsec to account for the transit time through the steel shim at location E. Similar calculations were made for the hot cell.

Pressure in the brass was calculated using Eq. 2 with $p_o = 0$ and with the particle velocity assumed to be one-half free surface velocity. Comparison of the calculated (p-u) points for hot and cold brass with the (p-u) points of McQueen and Marsh[8] for brass initially at 20^{o}C shows that only the 20^{o}C Hugoniot curve need be considered for the impedance match calculations. The mirror-image approximation was used for the brass isentropes. Thus pressure and particle velocity at the brass-liquid interface were calculated at the intersection of the Rayleigh line for the liquid and the brass rarefaction curve, assumed to be a reflection of the Hugoniot curve through the measured free surface velocity. The specific volume of the shocked liquid was then calculated using Eq. 1, and the corresponding change of internal energy was calculated using the Hugoniot equation in the form $e - e_o = \frac{1}{2}u^2$.

The shock wave data are summarized in Table I. The precision of the data is controlled mainly by the pressure uniformity and planarity of the explosive driver system.