

TABLE III. Sensitivity of the shock temperature of carbon tetrachloride to the values of C_v and $(\partial p/\partial T)_v$.^a

p (kbar)	v (cc g ⁻¹)	$bT_s(v_0-v_1)$ (deg)	$bI/2C_v$ (deg)	T_H-T_s (deg)	$\frac{\Delta T_H(\delta C_v)}{\Delta T_H[(\partial p/\partial T)_v]}$	
					Calc. analytically	Obs. empirically
0	0.631	0	0	0	...	...
29	0.431	169	98	223	1.8	2.4
49	0.401	207	150	515	2.4	3.4
73	0.381	233	208	978	3.2	4.5
113	0.361	262	274	1696	4.1	5.7
144	0.351	277	300	2354	5.1	7.0
188	0.341	292	328	3335	6.4	8.3
253	0.331	308	347	4853	8.4	9.7

^a Input data used; see Table I.

than to changes in $(\partial p/\partial T)_v$, and this sensitivity increases with pressure along the Hugoniot curve.

THE $C_v(T)$ MODEL

The assumptions concerning the variations of C_v and $(\partial p/\partial T)_v$ along the Hugoniot curve, necessary for calculating shock temperature with Eq. (1), should be compatible with the known properties of liquids. For example, under normal conditions of atmospheric pressure and room temperature C_v for carbon tetrachloride increases with temperature as does the coefficient $(\partial p/\partial T)_v$.⁹ Moreover, other properties of liquids in the kilobar region are known from the classical high-pressure work of Bridgman.¹⁰ Of particular interest is his investigation of the previously advanced hypothesis that liquids can adequately be described by a van der Waals' type (p - v - T) equation of state; namely, that $(\partial p/\partial T)_v$ is a function of volume only, or equivalently, that C_v is a function of temperature only. The hypothesis was found to hold well at low and moderate pressures, but to break down at high pressures where $(\partial p/\partial T)_v$ was found to decrease with increasing temperature at constant volume. For temperatures below 450°K, C_v for 18 liquids was found to be insensitive to pressure below 100 kbar.

A logical extension of the Walsh-Christian model for calculating shock temperature in initiation studies of liquids below 100 kbar would be based on the assumptions that $(\partial p/\partial T)_v$ is a function of volume and that C_v is a function of temperature. The present work, however, assumes that $(\partial p/\partial T)_v$ is a constant and that C_v is a function of temperature, i.e., $C_v(T)$. These assumptions are reasonable since our variational analysis shows C_v to be a more important parameter than $(\partial p/\partial T)_v$ in shock temperature calculations, and also because we have a better understanding of the dependence of $C_v(T)$ on temperature than of $(\partial p/\partial T)_v$ on volume. Specifically, constancy of $(\partial p/\partial T)_v$ is retained because

calculated shock temperature is relatively insensitive to its variation (Fig. 3), because the increase and subsequent decrease of $(\partial p/\partial T)_v$ with increasing pressure will tend to cancel, and because we have little insight as to the variation of $(\partial p/\partial T)_v$ along the Hugoniot curve. On the other hand, the specific heat is assumed to be a function of temperature because calculated shock temperature is sensitive to C_v , and because we expect C_v to increase with increasing pressure along the Hugoniot curve as internal molecular vibrations become more excited. The dependence of $C_v(T)$ on temperature is based on the additional assumption that internal molecular vibrations are essentially unaffected by the forces of interaction among the molecules. This approximation has also been used by Davies and Matheson.¹¹ Then the increase in $C_v(T)$ above room temperature is due primarily to the increase in the vibrational heat capacity as the vibrations become more classical. The functional dependence of $C_v(T)$ on

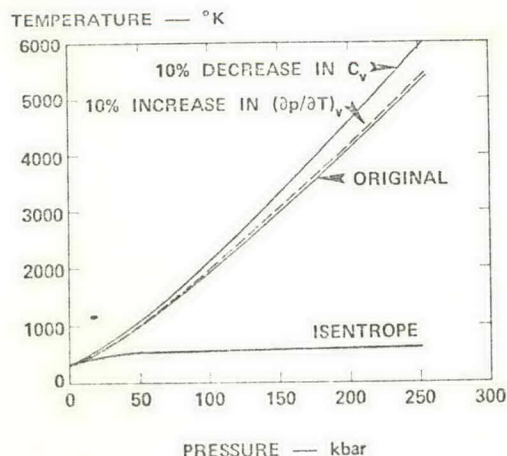


FIG. 3. Shock temperature of carbon tetrachloride. Sensitivity of the calculated temperatures to the values used for C_v and $(\partial p/\partial T)_v$. The original input data are in Table I.