FIG. 5. Shock temperature for water. Comparison of the constant C_v model with the Rice–Walsh constant C_p model. The shock temperatures calculated using the constant C_v model are not sensitive to the form of the Hugoniot. u_1, $u_2 = 1.28$, 1.58 (personal communication from R. W. Woolfolk); 1.2, 1.7 (Ref. 3). The other input data are in Table I.

pressure only. From the analysis of the dependence of calculated shock temperature on $(\partial p/\partial T)_v$ and C_v, we conclude that the shock temperature will be very sensitive to the value chosen for C_v. The observed difference between the present results and those obtained by Rice and Walsh is therefore regarded as not significant.

The inapplicability of the $C_v(T)$ model to water at low pressures is yet another example of water being an anomalous liquid. Specifically, the model is not valid since the value of C_v has its classical value at atmospheric pressure and temperatures where the O–H vibrations are not fully excited. It is for this reason that shock temperatures calculated by Duvall[18] using Eq. (1), the C_v model and standard conditions for the lower limits of integration are lower than those calculated by Walsh and Rice.[19] A similar calculation with the $C_v(T)$ model would give even lower values of shock temperature. Similarly to Rice and Walsh, the integration of Eq. (1) is started from a point on the Hugoniot above atmospheric pressure. As shown in Table I, the point selected was $(p_H = 10$ kbar, $v = 0.819$ cc g^{-1}, $T_H = 323°$K).

CONCLUSIONS

When compared with the Walsh–Christian method, the present method for calculating shock temperatures takes better account of the properties of liquids and the greater dependence of shock temperature on C_v than on $(\partial p/\partial T)_v$. It is therefore considered to be an improvement on the Walsh–Christian method and will yield more realistic values of shock temperature in liquid

explosives. This conclusion is substantiated by the improved agreement between the calculated and experimental temperatures for carbon tetrachloride, but account must be taken of the inapplicability of the model to water in the low pressure region. Thus the $C_v(T)$ model is expected to be better for nonassociated liquids than associated liquids. An improvement of the present model must include the variation of $(\partial p/\partial T)_v$ and a better method for calculating the variation of C_v for associated liquids.

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$$U_s = u_1 c_0 - [(u_1 - 1)c_0/\exp(u_3 u_p/c_0)] + u_2 u_p$$

with u_3 as a constant as a better form of the Hugoniot curve. This form has the advantage that it satisfies the limiting condition $U_s = c_0$ when $u_p = 0$. However the linear form is used for convenience since values of shock temperature calculated with $u_3 = \infty$ have been found[7] to be not significantly different from those calculated with $u_3 = 1$ and $u_3 = 10$.
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