The variation of non-dimensionalized maximum shear stress, $-3(\sigma+p)_m/4K^*$, with maximum density is shown for both cases in Fig. 5. So also is the variation of the density ratio, $\rho_1/\rho_0$, at which the maximum shear stress occurs. A fairly significant difference occurs between the thermal and non-thermal analyses.

The results shown in Figs. 1–5 do not involve the plastic strain rate (37) and are, therefore, not restricted to the material characterization of (39) except through the values established thereby for conditions at the precursor wavefront. In the thermal case, the results also depend on the values selected for the parameters $\beta T_0$ and $\mu$.

In Fig. 6, the non-dimensionalized maximum plastic strain rate, $-\tau\dot{\varepsilon}^p_m$, for the material of (39) is plotted versus maximum density. A substantial difference occurs

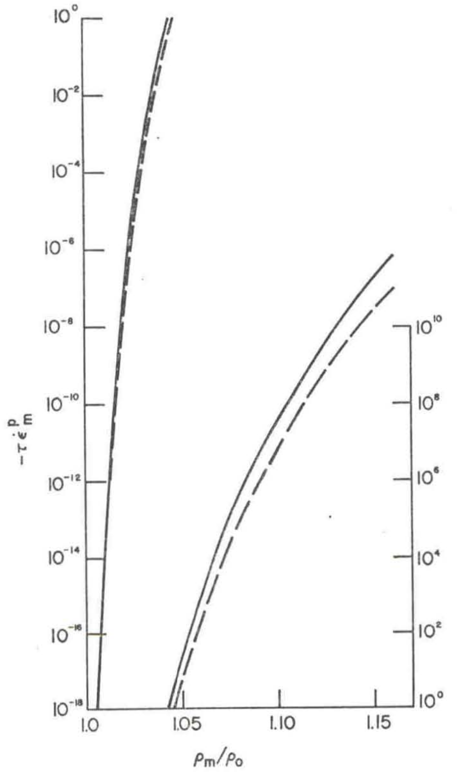


FIG. 6. Largest non-dimensionalized plastic strain rate versus the ratio of maximum to initial density for a material governed by (39): $-\tau\dot{\varepsilon}^p = (1 - M\varepsilon^p)[-\rho_0(\sigma + p)/\rho S]^n$. Here, $M = 10^3$, $S = 10^{-3}K$ and $n = 10$ in addition to the previous material characterizations $G = 3K/8$, $\mu = 5$, $\beta T_0 = 10^{-2}$ and $\rho_h = \rho_0$. The dashed curve is obtained disregarding temperature effects.

here between the thermal and non-thermal analyses which is a magnification of the maximum shear stress difference of Fig. 5 raised to the 10th-power in the plastic strain rate equation. Variation of non-dimensionalized shock thickness as a function of density ratio is pretty much the reciprocal of Fig. 6 since the maximum rate of change of density is roughly equal to the largest plastic strain rate and the total change of density is not tremendously variable.

The second material to be considered is a species of thermally activated material. We take

$$\dot{\varepsilon}^p = -(1/\tau) \exp \{-[1+(\sigma+p+2Y/3)(v\rho/\rho_0)qT_0/T\}. \tag{40}$$

Equation (40) contains three material constants in addition to the shear strength $Y$: $\tau$ is the characteristic relaxation time, $v$ is the ratio of activation volume to activation energy, and $q$ is the ratio of activation energy to the average thermal energy $kT_0$ at the reference temperature. These material characteristics are simply assumed to be constants since the present purpose is merely to illustrate the numerical technique rather than to attempt any direct evaluation of proposed constitutive relations.

The values selected for the numerical parameters are $q = 40$, $v = 100/K$ and $2Y/3 = 10^{-3}K$. In Fig. 7, the variation of non-dimensional maximum plastic strain rate, $-\tau\dot{\varepsilon}^p_m$, with maximum density is shown for this material. Here it is apparent that there is an enormous effect obtained by considering the temperature change. This effect will substantially modify the profile of the wave and suggests that the use of temperature independent material constitutive relations may be quite misleading in judging whether the dynamic material response will be an important aspect in shock wave computations.

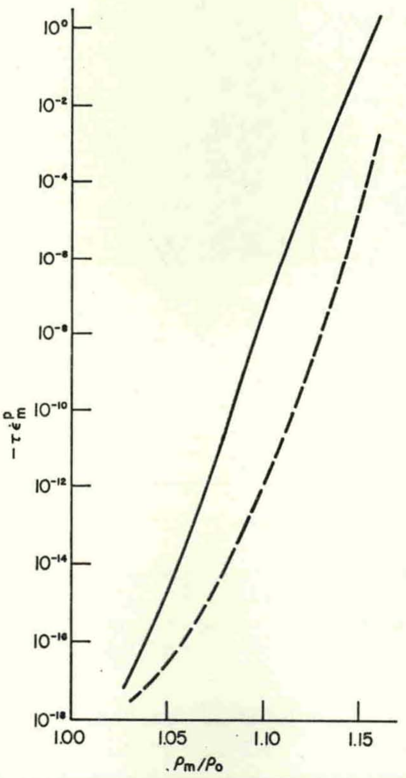


FIG. 7. Non-dimensionalized plot of largest plastic strain rate versus maximum density for a material governed by (40): $-\tau\dot{\varepsilon}^p = \exp\{-[1 + (\sigma + p + 2Y/3)(v\rho_0/\rho)]qT_0/T\}$. Here, $2Y/3 = 10^{-3}\,K$, $v = 100/K$ and $q = 40$. Additional material characteristics are $\mu = 5$, $\beta T_0 = 10^{-2}$ and $G = 3K/8$. The dashed curve is obtained disregarding temperature effects.