may be pictured as follows: The value of $\kappa$ may be changed to raise or lower the $D-\rho_0$ curve without greatly changing its shape (Fig. 1); $\beta$ may then be used to change its shape and slope, while $\kappa$ is varied so as to preserve a given value of $D$ at one point (Fig. 2). Then the calculated C−J pressure may be changed by varying $\alpha$, with $\beta$ and $\kappa$ always adjusted so as best to match $D-\rho_0$ (Figs. 3 and 4). Alpha also has a considerable effect on the C−J temperature (Fig. 3).[22] There exist no accurate experimental data on $T_{CJ}$, but it is noteworthy that the $T$ *vs* $\rho_0$ curve for $\alpha=0.45$ is similar to that obtained at this laboratory from preliminary calculations with the Lennard-Jones-Devonshire free-volume equation of state.[23]

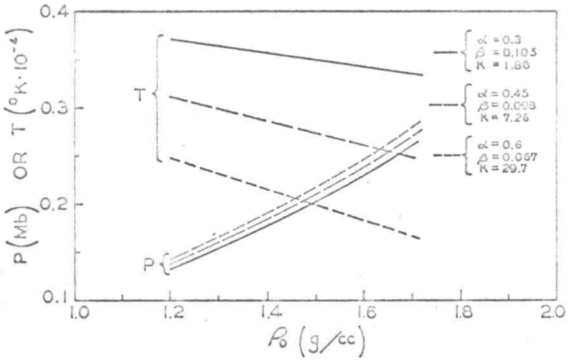


FIG. 3. The effect of $\alpha$ on $p$ *vs* $\rho_0$ and $T$ *vs* $\rho_0$; $\beta$ and $\kappa$ chosen to match experimental $D-\rho_0$.

In order to gain some idea of the effect of the carbon equation of state, calculations were made with the assumption that the carbon retained its normal volume, and also with the two equations of state for carbon mentioned earlier.[15,21] The results are shown in Fig. 5.

## 5. RESULTS

By assuming a fixed product composition and varying the parameters as described above, a set of values for $\alpha$, $\beta$, and $\kappa$ was found which gave results in good agreement with experiment for 65/35 RDX/TNT. It was found that with equilibrium composition (and the "geometrical" $k_i$ discussed below) a not very different set also produced good agreement. The question of how well a single set of parameters could be made to serve for several explosives was then investigated.

The experimental data used were measurements of $D-\rho_0$ and of $p_{CJ}$ at maximum loading density for a group of five related explosives. These data are given in Table II and were obtained as follows.

Measurements of the detonation velocity for infinite diameter, $D_\infty$, were available [24–26] for each

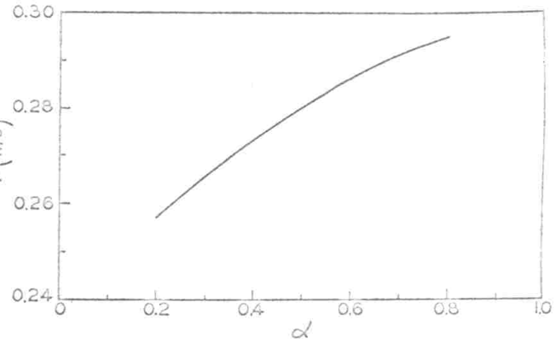


FIG. 4. The effect of $\alpha$ on $p_{CJ}$ ($\rho_0=1.715$); $\beta$ and $\kappa$ chosen to match experimental $D-\rho_0$.

explosive at two densities, $\rho_0=1.2$ g/cc and the highest $\rho_0$ obtainable by pressing or casting. (Values of $D_\infty$ were obtained by firing charges of different diameter $d$ and extrapolating $D$ *vs* $1/d$.) It was assumed on the basis of previous work, both at this laboratory and elsewhere, that over this range of loading density $D$ *vs* $\rho_0$ could be represented by a straight line within experimental error.[27]

The Dural pressures in Table II were obtained from measurements of shock and free-surface velocities in Dural plates driven by the appropriate explosive.[13] The explosive C−J pressure $p_i$ is given in terms of the metal pressure $p_t$ by the matching conditions at the H.E.-metal interface:

$$\frac{p_i}{p_t}=\frac{1+R(\rho_{0i}D_i/\rho_{0t}D_t)}{1+R},$$

where (13)

$$R\equiv\rho_{0r}D_r/\rho_{0i}D_i$$

$$=\{(p_t-p_i)(v_0-v_i)/(v_i-v_t)(p_i-p_0)\}^{\frac{1}{2}}.$$

The subscripts $i$, $r$, and $t$ refer to the incident, reflected,

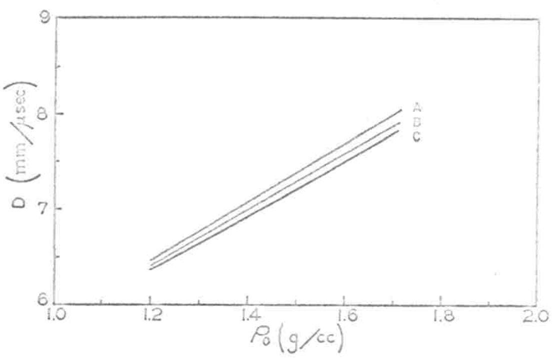


FIG. 5. Effect of the graphite equation of state on $D-\rho_0$: $A$—incompressible, $B$—graphite equation of state used in the parameter studies,[21] $C$—graphite equation of state used in the final calculations.[15] All curves are for $\alpha=0.6$, $\beta=0.06$, $\kappa=30$.

[22] Such effects on the calculated pressure and temperature are also shown by a somewhat similar equation of state used by Cook *et al.*[7]

[23] W. W. Wood and W. Fickett (to be published).

[24] Campbell, Malin, James, Mautz, and Urizar (LASL), unpublished communications.

[25] Campbell, Malin, Boyd, and Hull (to be published).

[26] Campbell, Malin, and Holland (to be published).

[27] This assumption is being subjected to further investigation. While the experimental detonation velocities in Table II may be subject to slight revision, it is believed that they are accurate to within ±50 m/sec above $\rho_0=1.2$.