Detonation Parameters as Derived from Shock Adiabats of Reaction Products

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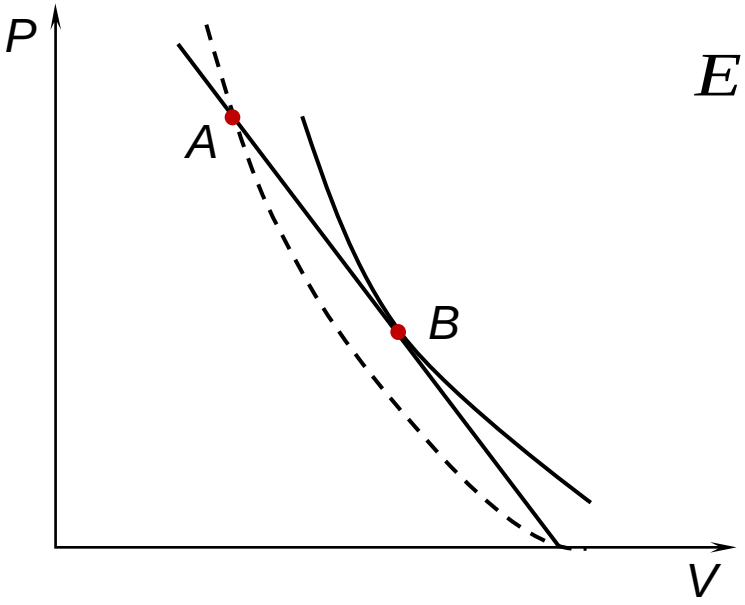


$$E(P,V) = E_s(V) + \frac{V}{\Gamma(V)}\left[P - P_s(V)\right]$$

$E(P,V)$ is the specific internal energy

$E_s(V)$ and $P_s(V)$ the specific internal energy and pressure, respectively

$\Gamma(V) = V\dfrac{P_T}{C_V T}$ Grüneisen coefficient

$$V_s(P) = \sum \alpha_i V_i(P)$$

α_i mass fraction of the i-th product;

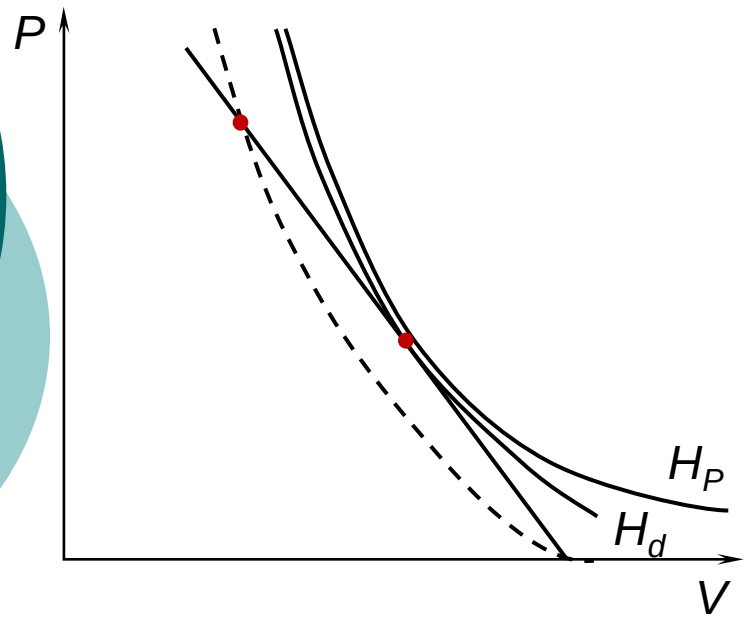
$V_i(P)$ the specific volume on the shock adiabat of the i-th product

$$P_d = P_s(V)\frac{V(\Gamma+2) - V_0\Gamma}{V(\Gamma+2) - V_{00}\Gamma} + \frac{2\Gamma Q_P}{V(\Gamma+2) - V_{00}\Gamma}$$

V_{00} is the specific volume of HE in its initial state

V_0 the specific volume of detonation products in their condensed state at normal conditions

Q_P the reaction heat of HE at P = const



$$E(P,V) = E_s(V) + \frac{V}{\Gamma(V)}\left[P - P_s(V)\right]$$

$$P_s = \frac{\rho_0 a^2}{b}\frac{X}{(1-X)f^2(X)}$$

$\rho_0 = 1/V_0$

a initial 3D velocity of sound

$X = b(V_0 - V)/V_0$ non-dimensional variable

$f(X) = 1 - gX + hX^2$

$b = 4/3$, $g = 1.50848$ and $h = 0.75424$

$$\Gamma = \Gamma_0 + \Gamma_a X + \Gamma_b X^2 + \Gamma_c X^3$$

At $P = \infty$ $X = 1$, and

$$\Gamma = \Gamma_0 + \Gamma_a + \Gamma_b + \Gamma_c = 2/3.$$

Γ_0 is the Grüneisen coefficient at $V = V_0$.

Measured and calculated detonation velocities and pressures at the Jouget point

HE	ρ_{00}, kg/m^3	ρ_{00}/ρ_0	*D*, m/s (meas)	*D*, m/s (cltd)	*P*, GPa (meas)	*P*, GPa (cltd)
Amatol 50/50, ρ_0 = 1111 kg/m^3	1650	1.0	7798	7779	–	24.8
	1485	0.9	7113	7152	–	19.1
	1320	0.8	6428	6583	–	15.3
	1155	0.7	5743	6151	–	13.1
	990	0.6	5059	5926	–	12.0
RDX, ρ_0 = 1063 kg/m^3	1720	1.0	8460	7933	30.9	27.6
	1548	0.9	7933	7306	24.1	20.7
	1376	0.8	7304	6679	18.2	15.8
	1204	0.7	6629	6142	14.4	12.8
	1032	0.6	6008	5789	10.9	11.2
	860	0.5	5386	5711	7.8	10.6
TNT, ρ_0 = 1295 kg/m^3	1620	1.0	6980	6841	18.3	18.7
	1458	0.9	6523	6343	14.4	15.6
	1296	0.8	5987	5971	11.2	13.6
	1134	0.7	5447	5764	8.7	12.6
	972	0.6	4908	5771	6.2	12.3