Another equation for D_0 has been proposed by Zener³⁹ who treated the impurity jump as an equilibrium thermodynamic process:

$$D_{0} = \delta \alpha^{2} \vee \exp\left(\frac{\Delta S}{R}\right) \tag{11}$$

In this equation, a is the lattice constant, \checkmark is a characteristic frequency which is not well defined but usually taken to be the Debye frequency, \checkmark is a geometric constant equal to 1 for both interstitial and vacancy diffusion in a fcc lattice, and \triangle S represents the entropy increase of the system due to adding one mole of activated complexes.

Using equation 11 and a known value of the isothermal compressibility (K), it can be shown that, to first order:

$$\frac{D_{o}(P)}{D_{o}(O)} = \left(I - \frac{K}{3}P\right)^{3/2} e_{X}P\left(\frac{\Delta S(P) - \Delta S(O)}{R}\right) \quad (12)$$

Using the graphically determined values of D_0 , along with Zener's expression for ΔS at zero pressure:

$$\Delta S = \lambda \beta \frac{Q}{T_{m}} \tag{13}$$

(Where β is a dimensionless quantity equal to .5 for lead; and λ is an empirical constant equal to .55 for vacancy diffusion in a fcc lattice, and equal to 1 for interstitial diffusion), the following values are obtained:

| Pressure | $\Delta S(P) - \Delta S(0)$ | $\triangle S(P) *$ | △ S(P) ** |
|----------|-----------------------------|-------------------------|-------------------------|
| Kilobars | cal/mole ^O K | cal/mole ^O K | cal/mole ^O K |
| 0.0 | 0.0 | 7.26 | 13.22 |
| 12.0 | + 0.03 | 7.29 | 13.25 |
| 17.5 | - 0.27 | 6.99 | 12.95 |
| 22.5 | - 1.24 | 6.02 | 11.98 |
| 24.5 | - 2.01 | 5.25 | 11.21 |
| 38.0 | - 2.08 | 5.18 | 11.14 |

* vacancy mechanism

** interstitial mechanism