David Keffer, Department of Chemical Engineering, University of Tennessee

Bridgman Tables
Convenient for Single-component Pressure Explicit Equations of State and Constant Volume Heat Capacity

I. Volume

1. $(\partial p)_V = -(\partial V)_p = \left(\frac{\partial p}{\partial T}\right)_V$

2. $(\partial T)_V = -(\partial V)_T = 1$

3. $(\partial S)_V = -(\partial V)_S = \frac{C_V}{T}$

4. $(\partial U)_V = -(\partial V)_U = C_V$

5. $(\partial H)_V = -(\partial V)_H = C_V + V\left(\frac{\partial p}{\partial T}\right)_V$

6. $(\partial A)_V = -(\partial V)_A = -S$

7. $(\partial G)_V = -(\partial V)_G = -S + V\left(\frac{\partial p}{\partial T}\right)_V$

II. Temperature

1. $(\partial V)_T = -(\partial T)_V = -1$

2. $(\partial p)_T = -(\partial T)_p = -\left(\frac{\partial p}{\partial V}\right)_T$

3. $(\partial S)_T = -(\partial T)_S = -\left(\frac{\partial p}{\partial T}\right)_V$

4. $(\partial U)_T = -(\partial T)_U = p - T\left(\frac{\partial p}{\partial T}\right)_V$

5. $(\partial H)_T = -(\partial T)_H = -T\left(\frac{\partial p}{\partial T}\right)_V - V\left(\frac{\partial p}{\partial V}\right)_T$

6. $(\partial A)_T = -(\partial T)_A = p$

7. $(\partial G)_T = -(\partial T)_G = -V\left(\frac{\partial p}{\partial V}\right)_T$

III. Pressure

1. $(\partial V)_p = -(\partial p)_V = -\left(\frac{\partial p}{\partial T}\right)_V$

2. $(\partial T)_p = -(\partial p)_T = \left(\frac{\partial p}{\partial V}\right)_T$

3. $(\partial S)_p = -(\partial p)_S = \frac{C_V}{T}\left(\frac{\partial p}{\partial V}\right)_T - \left(\frac{\partial P}{\partial T}\right)_V^2$

4. $(\partial U)_p = -(\partial p)_U = C_V\left(\frac{\partial p}{\partial V}\right)_T - T\left(\frac{\partial P}{\partial T}\right)_V^2 + p\left(\frac{\partial p}{\partial T}\right)_V$

5. $(\partial H)_p = -(\partial p)_H = C_V\left(\frac{\partial p}{\partial V}\right)_T - T\left(\frac{\partial P}{\partial T}\right)_V^2$

6. $(\partial A)_p = -(\partial p)_A = p\left(\frac{\partial p}{\partial T}\right)_V - S\left(\frac{\partial p}{\partial V}\right)_T$

7. $(\partial G)_p = -(\partial p)_G = -S\left(\frac{\partial p}{\partial V}\right)_T$

IV. Entropy

1. $$(\partial p)_S = -(\partial S)_p = -\frac{C_V}{T}\left(\frac{\partial p}{\partial V}\right)_T + \left(\frac{\partial P}{\partial T}\right)_V^2$$

2. $$(\partial T)_S = -(\partial S)_T = \left(\frac{\partial p}{\partial T}\right)_V$$

3. $$(\partial V)_S = -(\partial S)_V = -\frac{C_V}{T}$$

4. $$(\partial U)_S = -(\partial S)_U = p\frac{C_V}{T}$$

5. $$(\partial H)_S = -(\partial S)_H = -\frac{V}{T}\left[C_V\left(\frac{\partial p}{\partial V}\right)_T - T\left(\frac{\partial P}{\partial T}\right)_V^2\right]$$

6. $$(\partial A)_S = -(\partial S)_A = p\frac{C_V}{T} - S\left(\frac{\partial p}{\partial T}\right)_V$$

7. $$(\partial G)_S = -(\partial S)_G = -\frac{V}{T}\left[C_V\left(\frac{\partial p}{\partial V}\right)_T - T\left(\frac{\partial P}{\partial T}\right)_V^2\right] - S\left(\frac{\partial p}{\partial T}\right)_V$$

V. Internal Energy

1. $$(\partial p)_U = -(\partial U)_p = -C_V\left(\frac{\partial p}{\partial V}\right)_T + T\left(\frac{\partial P}{\partial T}\right)_V^2 - p\left(\frac{\partial p}{\partial T}\right)_V$$

2. $$(\partial T)_U = -(\partial U)_T = -p + T\left(\frac{\partial p}{\partial T}\right)_V$$

3. $$(\partial V)_U = -(\partial U)_V = -C_V$$

4. $$(\partial S)_U = -(\partial U)_S = -p\frac{C_V}{T}$$

5. $$(\partial H)_U = -(\partial U)_H = -p\left[C_V + V\left(\frac{\partial p}{\partial T}\right)_V\right] - VC_V\left(\frac{\partial p}{\partial V}\right)_T + VT\left(\frac{\partial P}{\partial T}\right)_V^2$$

6. $$(\partial A)_U = -(\partial U)_A = p[C_v + S] - ST\left(\frac{\partial p}{\partial T}\right)_V$$

7. $$(\partial G)_U = -(\partial U)_G = pS - [pV + ST]\left(\frac{\partial p}{\partial T}\right)_V - VC_V\left(\frac{\partial p}{\partial V}\right)_T + VT\left(\frac{\partial P}{\partial T}\right)_V^2$$

VI. Enthalpy

1. $$(\partial p)_H = -(\partial H)_p = -C_V\left(\frac{\partial p}{\partial V}\right)_T + T\left(\frac{\partial P}{\partial T}\right)_V^2$$

2. $$(\partial T)_H = -(\partial H)_T = T\left(\frac{\partial p}{\partial T}\right)_V + V\left(\frac{\partial p}{\partial V}\right)_T$$

3. $$(\partial V)_H = -(\partial H)_V = -C_V - V\left(\frac{\partial p}{\partial T}\right)_V$$

4. $$(\partial S)_H = -(\partial H)_S = \frac{V}{T}\left[C_V\left(\frac{\partial p}{\partial V}\right)_T - T\left(\frac{\partial P}{\partial T}\right)_V^2\right]$$

5. $$(\partial U)_H = -(\partial H)_U = p\left[C_V + V\left(\frac{\partial p}{\partial T}\right)_V\right] + VC_V\left(\frac{\partial p}{\partial V}\right)_T - VT\left(\frac{\partial P}{\partial T}\right)_V^2$$

6. $$(\partial A)_H = -(\partial H)_A = pC_V + [pV - ST]\left(\frac{\partial p}{\partial T}\right)_V - SV\left(\frac{\partial p}{\partial V}\right)_T$$

7. $$(\partial G)_H = -(\partial H)_G = -V\left[C_V - \frac{T\left(\frac{\partial P}{\partial T}\right)_V^2}{\left(\frac{\partial P}{\partial V}\right)_T} + S\right]\left(\frac{\partial p}{\partial V}\right)_T - ST\left(\frac{\partial p}{\partial T}\right)_V$$

VII. Helmholtz Free Energy

1. $(\partial p)_A = -(\partial A)_p = -p\left(\frac{\partial p}{\partial T}\right)_V + S\left(\frac{\partial p}{\partial V}\right)_T$

2. $(\partial T)_A = -(\partial A)_T = -p$

3. $(\partial V)_A = -(\partial A)_V = S$

4. $(\partial S)_A = -(\partial A)_S = -p\frac{C_V}{T} + S\left(\frac{\partial p}{\partial T}\right)_V$

5. $(\partial U)_A = -(\partial A)_U = -p[C_V + S] + ST\left(\frac{\partial p}{\partial T}\right)_V$

6. $(\partial H)_A = -(\partial A)_H = -pC_V + [ST - pV]\left(\frac{\partial p}{\partial T}\right)_V + SV\left(\frac{\partial p}{\partial V}\right)_T$

7. $(\partial G)_A = -(\partial A)_G = S\left[p + V\left(\frac{\partial p}{\partial V}\right)_T\right] - pV\left(\frac{\partial p}{\partial T}\right)_V$

VIII. Gibbs Free Energy

1. $$(\partial p)_G = -(\partial G)_p = S\left(\frac{\partial p}{\partial V}\right)_T$$

2. $$(\partial T)_G = -(\partial G)_T = V\left(\frac{\partial p}{\partial V}\right)_T$$

3. $$(\partial V)_G = -(\partial G)_V = S - V\left(\frac{\partial p}{\partial T}\right)_V$$

4. $$(\partial S)_G = -(\partial G)_S = \frac{V}{T}\left[C_V\left(\frac{\partial p}{\partial V}\right)_T - T\left(\frac{\partial P}{\partial T}\right)_V^2\right] + S\left(\frac{\partial p}{\partial T}\right)_V$$

5. $$(\partial U)_G = -(\partial G)_U = -pS + [pV + ST]\left(\frac{\partial p}{\partial T}\right)_V + VC_V\left(\frac{\partial p}{\partial V}\right)_T - VT\left(\frac{\partial P}{\partial T}\right)_V^2$$

6. $$(\partial H)_G = -(\partial G)_H = V\left[C_V - \frac{T\left(\frac{\partial P}{\partial T}\right)_V^2}{\left(\frac{\partial P}{\partial V}\right)_T} + S\right]\left(\frac{\partial p}{\partial V}\right)_T + ST\left(\frac{\partial p}{\partial T}\right)_V$$

7. $$(\partial A)_G = -(\partial G)_A = -S\left[p + V\left(\frac{\partial p}{\partial V}\right)_T\right] + pV\left(\frac{\partial p}{\partial T}\right)_V$$