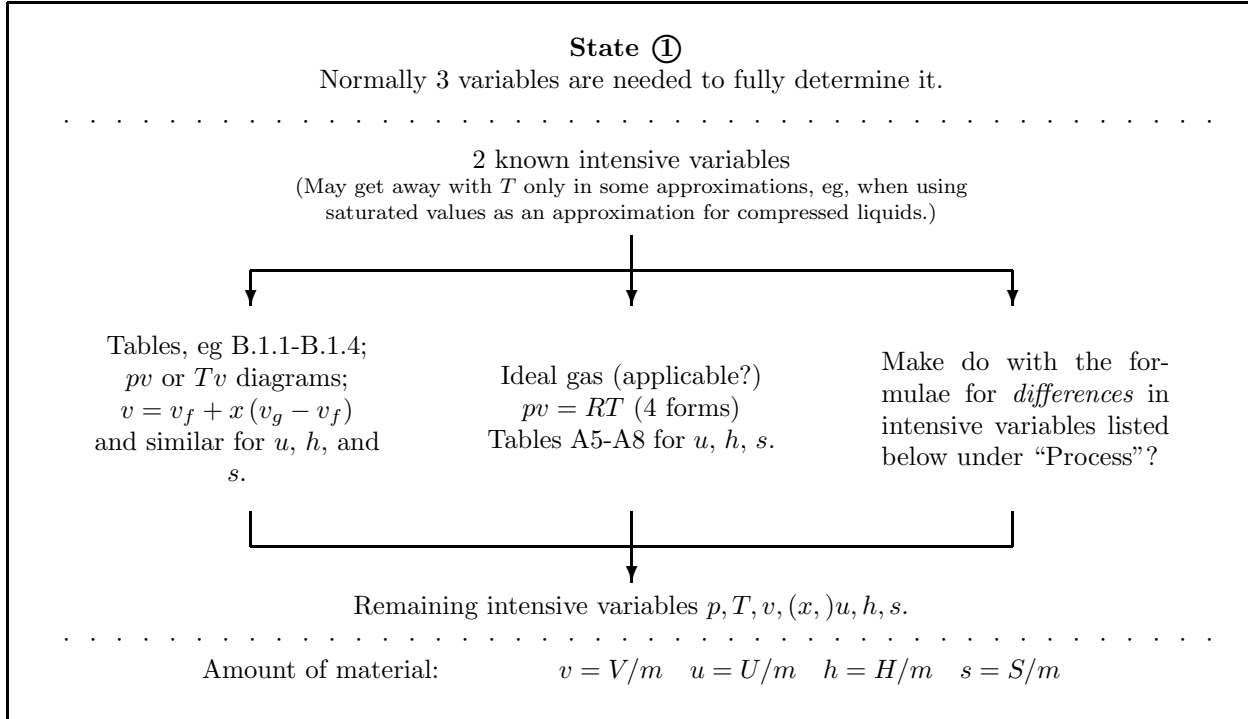


Typical Control Mass Problem Chart 2

(Not complete material coverage)



Process

C1: Type of process ($V = C$, $p = C$, p linear in V , $pV^n = C$, $T = C$, ${}_1Q_2 = 0$, reversible?)

C2: Mass: $m_1 (+m_{\text{added}}) = m_2$

Energy: $E_2 - E_1 = {}_1Q_2 - {}_1W_2$ ($E = U + KE? + PE?$)

C3: ${}_1W_2 = 0$ | $p(V_2 - V_1)$ | $\frac{p_1 + p_2}{2}(V_2 - V_1)$ | $\frac{p_2 V_2 - p_1 V_1}{1 - n}$ | $p_1 V_1 \ln\left(\frac{V_2}{V_1}\right)$ | other?
 ${}_1Q_2 = [0 \text{ and } S_2 = S_1]$ | $T(S_2 - S_1)$ | other? ${}_1S_{2,\text{gen}} = \Delta S_{\text{net}} = S_2 - S_1 - \frac{{}_1Q_2}{T_{\text{surr}}}$

For ideal gases:

$$u_2 - u_1 = \int_1^2 C_v dT \approx C_{v,\text{ave}}(T_2 - T_1) \quad h_2 - h_1 = \int_1^2 C_p dT \approx C_{p,\text{ave}}(T_2 - T_1)$$

$$s_2 - s_1 = s_T^0(T_2) - s_T^0(T_1) - R \ln\left(\frac{p_2}{p_1}\right) \approx C_{p,\text{ave}} \ln\left(\frac{T_2}{T_1}\right) - R \ln\left(\frac{p_2}{p_1}\right) = \dots$$

Polytropic: $\frac{p_2}{p_1} = \left(\frac{v_1}{v_2}\right)^n = \left(\frac{T_2}{T_1}\right)^{\frac{n}{n-1}}$ isothermal: $n = 1$?
 isentropic and k constant: $n = k$

For solids and compressed liquids, *by approximation*, best at constant pressure:

$${}_1Q_2 = m \int_1^2 C_{(p)} dT \approx m C_{(p),\text{ave}}(T_2 - T_1) \quad s_2 - s_1 \approx C_{(p),\text{ave}} \ln\left(\frac{T_2}{T_1}\right)$$

State ②

Same procedures as state ①