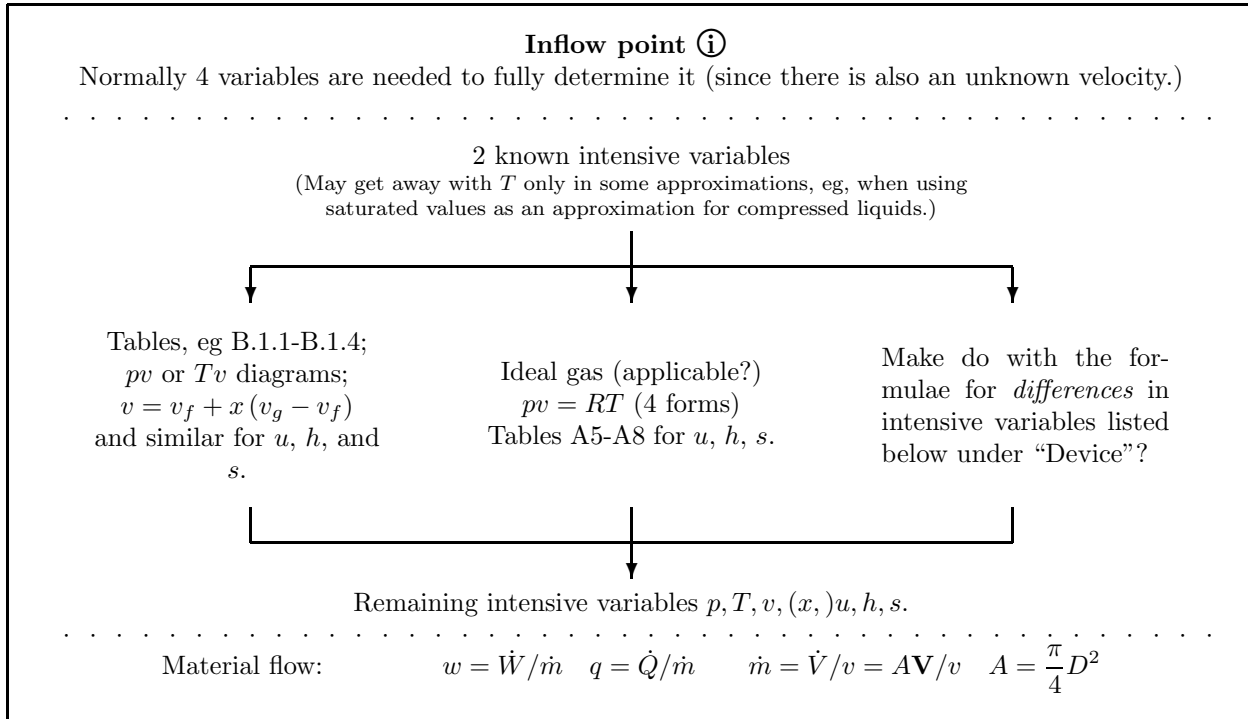


Typical Steady State Control Volume Problem Chart 2

(Not complete material coverage)



Device or Control Volume

C1: Type of device? Given that $\dot{Q} = 0$? Reversible? $\eta_{\text{turbine}} = w/w_s; \eta_{\text{compressor}} = w_s/w$

C2: Mass: $\sum \dot{m}_i = \sum \dot{m}_e$

Energy: $\dot{Q} + \sum \dot{m}_i (h_i + \frac{1}{2}V_i^2 + gZ_i) = \sum \dot{m}_e (h_e + \frac{1}{2}V_e^2 + gZ_e) + \dot{W}$

C3: $\dot{W} = 0$? Or $w + \Delta KE + \Delta PE = 0$ $-v(p_e - p_i) \left| \frac{n(p_e v_e - p_i v_i)}{1-n} \right| - pv \ln \left(\frac{p_e}{p_i} \right) ?$

$q = [0 \text{ and } s_2 = s_1] \left| T(s_2 - s_1) \right| \text{ other?} \quad \sum \dot{m}_e s_e - \sum \dot{m}_i s_i = \sum \frac{\dot{Q}}{T} + \dot{S}_{\text{gen}}$

For ideal gasses:

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

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

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 compressed liquids, *by approximation*, best at constant pressure:

$$h_2 - h_1 \approx C_{(p)\text{ave}} (T_2 - T_1) \quad s_2 - s_1 \approx C_{(p)\text{ave}} \ln \left(\frac{T_2}{T_1} \right)$$

Exit point ②

Same procedures as entrance point ①