Typical Steady State Control Volume Problem Chart

(Not complete material coverage)

Inflow point ⓘ

Normally 4 variables are needed to fully determine it (since there is also an unknown velocity.)

2 known intensive variables
(May get away with T only in some approximations, eg, when using saturated values as an approximation for compressed liquids.)

- Tables, eg B.1.1-B.1.4; pv or Tv diagrams; $v = v_f + x\,(v_g - v_f)$ and similar for u and h.
- Ideal gas (applicable?) $pv = RT$ (4 forms) Tables A5-A8 for u, h.
- Make do with the formulae for *differences* in intensive variables listed below under "Device"?

Remaining intensive variables $p, T, v, (x,)u, h$.

Amount of material going through per unit time

$$w = \dot W/\dot m \quad q = \dot Q/\dot m \qquad \dot m = \dot V/v = A\mathbf{V}/v \quad A = \frac{\pi}{4}D^2$$

Device or Control Volume

C1: Type of Device? Given that $\dot Q = 0$?

Do the given device characteristics add info about ⓘ or ⓔ ?

C2: Mass: $\sum \dot m_i = \sum \dot m_e$

Adds info about ⓘ or ⓔ ?

Energy: $\dot Q + \sum \dot m_i \left(h_i + \frac{1}{2}\mathbf{V}_i^2? + gZ_i?\right) = \sum \dot m_e \left(h_e + \frac{1}{2}\mathbf{V}_e^2? + gZ_e?\right) + \dot W$

Adds info about ⓘ or ⓔ ?

C3: Device has $\dot W = 0$?

For ideal gasses:

$$h_2 - h_1 = \int_1^2 C_p \, \mathrm{d}T \approx C_{p_\text{ave}}\,(T_2 - T_1)$$

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

$$h_2 - h_1 \approx C_{(p)_\text{ave}}\,(T_2 - T_1)$$

Exit point ⓔ

Same procedures as entrance point ⓘ