Steady Flow Process

Criteria;

1. All system properties (intensive & extensive) do not change with time
   - m_{cv}= constant; Δm_{CV}= 0
   - V_{CV}= constant; ΔV_{CV}= 0
   - E_{CV}= constant; ΔE_{CV}= 0

- Fluid properties at all inlet/exit channels do not change with time (Values might be different for different channels)

$$(\dot{m}, \vec{V}, A, etc.)$$

- Heat and work interactions do not change with time

$$\dot{Q} = constant$$

$$\dot{W} = constant$$

Implication of Criterion 1 (**Mass**)

$\Delta m_{CV} = 0$,

From Mass Conservation;

$$\sum \dot{m}_{in} - \sum \dot{m}_{out} = \Delta m_{CV}$$

$$\therefore \quad \boxed{\sum \dot{m}_{in} = \sum \dot{m}_{out}}$$

Recall that

$$\dot{m} = \rho \vec{V} A = \frac{\vec{V} A}{v}$$

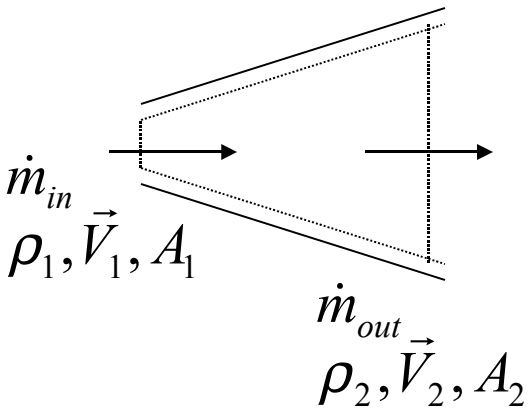
so

$$\boxed{\sum_{i=1}^{n} \rho_i \vec{V}_i A_i \Big|_{in} = \sum_{o=1}^{k} \rho_o \vec{V}_o A_o \Big|_{out}}$$

for 1 inlet/ 1 exit;

$$\dot{m}_{in} = \dot{m}_{out}$$

$$\rho_1 \vec{V}_1 A_1 = \rho_2 \vec{V}_2 A_2$$



Implication of Criterion 1

(Volume)

$$\Delta V_{CV} = 0,$$

$$\therefore \quad \boxed{W_B = 0 \qquad \text{(boundary work = 0)}}$$

$$\Delta E_{CV} = Q - W + \Sigma E_{flow(in)} - \Sigma E_{flow(out)}$$

$$W = W_{electrical} + W_{shaft} + W_{boundary} + W_{flow} + W_{etc.}$$

$W_{boundary} \rightarrow 0$

$W_{flow} \rightarrow$ in **h**

W not necessarily 0, only W_B is 0