Consider: Moist Air \( T_1, P_1, \phi_1, M_{\text{mixture}} = 1 \text{ lbm} \)

Compressed isothermally: \( P_2/P_1 = 3 \)

Does moisture condense?
If yes, how much?
Focus on vapor only,

\[ P_{v1} = 0.2537 \text{ kPa} = \phi_1 P_g \left|_{T_1} \right. \]

\[ \text{onset of condensation: } 0.5024 \text{ kPa} \]

So, if \( P_v > P_g \left|_{T_1} \right. \) condensation will occur

If no condensation,

\[ P_{v2} = \frac{y_{H_2O} P_2}{y_{H_2O} P_1} = \frac{P_2}{P_1} = 3 \]

If \( P_{v2} = 3 P_{v1} = 0.75 \text{ kPa} \) no condensation
But if \( P_v > 0.5024 \text{ kPa} \) condensation occurs

How much condensed?

Moisture balance

\[ \dot{m}_{w1} = \dot{m}_{w2} + \dot{m}_{\text{condensed}} \]

\[ \dot{m}_{\text{condensed}} = \dot{m}_{w1} - \dot{m}_{w2} \\
= \dot{m}_0 (\omega_1 - \omega_2) \]
\omega_1 = \frac{0.622 \phi_1 P_g H_f}{(P_i - \phi_i P_g H_f)} = \ldots

Recognize that \phi_2 = 100\%

\omega_2 = \frac{0.622 \phi_2 P_g H_f}{(P_2 - \phi_2 P_g H_f)} = \ldots

\frac{38}{3}\phi_i

M_a = \text{?} \quad \text{M}_{\text{mix}} = M_a + M_a

= M_a (1 + \omega_i)

\boxed{M_a} = \frac{\text{M}_{\text{mix}}}{1 + \omega_i} = 0.985 \text{lbm} / \text{lbm}

2. Moist Air expanded through nozzle

\text{S} = \text{constant} \quad P_i, \phi, T_i

Find \text{P}_{2, \text{mix}} for no condensation

Just think about moisture

\text{P}_{V_1} = \phi_1 P_g H_f = \ldots

\begin{align*}
S_i &= \text{Steam Table} \\
S_i &= S(P_{V_1}, T_i)
\end{align*}

\begin{align*}
S_1 &= \text{Steam Table} \\
S_1 &= S(\text{P}_{V_2}, T_i)
\end{align*}

\begin{align*}
S_1 &= \text{Steam Table} \\
S_1 &= S(\text{P}_{V_2})
\end{align*}

\text{condensation will occur when } S_1 = S_g|_{P_{V_2}}

\text{field this}
\[ \frac{P_2}{P_1} = \frac{P_{v_2}}{P_{v_1}} = \frac{\sqrt{\frac{P_2}{\gamma H_2O}}}{\gamma H_2O P_1} \]