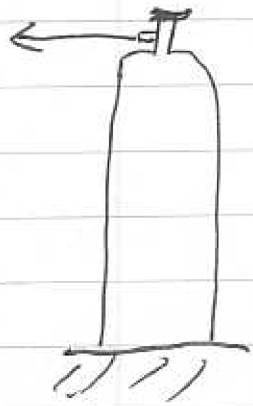
M.S. 4.93 R-134a $V = 2\,ft^3$



①	②
$P_1 = 100\,psi$	$P_2 = 100\,psi$
$V_f = 1.6\,ft^3$	$V_f = 0.8\,ft^3$
$V_g = 0.4\,ft^3$	$V_g = 1.2\,ft^3$

$m_e = ?$

$Q = ?$

$$\frac{dE}{dt} = \dot{Q} - \cancel{\dot{W}} + \cancel{\dot{m}_i\left(h_i + \frac{V_i^2}{2} + g z_i\right)} - \dot{m}_e\left(h_e + \cancel{\frac{V_e^2}{2}} + \cancel{g z_e}\right)$$

$$\frac{dU}{dt} = \dot{Q} - \dot{m}_e h_e$$

NOTE: P_{tank} is always 100 psi and saturated vapor is what leaves the tank. Hence the exit state is constant (e.g. h_e = constant).

$$\int dU = \int \dot{Q}\,dt - h_e \int \dot{m}_e$$

$$U_2 - U_1 = Q - h_e m_e$$

$$m_2 u_2 - m_1 u_1 = Q - h_e m_e$$

$$h_e = h_g(100\,psi)$$

$$m_e = m_1 - m_2$$

M.S. 4.93 (Continued)

To Solve

(1) Get v_f and v_g for states (1) and (2) from the saturated tables for R-134a

(2) Compute $m_1 = \frac{V_{f1}}{v_{f1}} + \frac{V_{g1}}{v_{g1}}$ and $m_2 = \frac{V_{f2}}{v_{f2}} + \frac{V_{g2}}{v_{g2}}$

(3) Get h_e from the saturated table ($h_e \equiv h_g$ (100 psi))

(4) $m_e = m_1 - m_2$

(5) Compute $x = \frac{m_g}{m_{Total}} \Rightarrow x_1 = \frac{m_{g1}}{m_1} = \frac{V_{g1}/v_{g1}}{m_1}$

$$x_2 = \frac{V_{g2}/v_{g2}}{m_2}$$

(6) Compute $u = (1-x)u_f + x u_g$ for states (1) and (2)

$$u_1 = (1-x_1)u_{f,1} + x_1 u_{g,1}$$

We get

$m_1 = 120.9$ lb $\quad m_2 = 62.6$ lb

$m_e = 58.3$ lb

$h_e = 112.5$ Btu/lb

$x_1 = 0.0069$, $x_2 = 0.0404$

$u_1 = 37.2$ Btu/lb $\quad u_2 = 39.5$ Btu/lb

$m_2 u_2 - m_1 u_1 = Q - h_e m_e \Rightarrow (62.6\text{ lb})(39.5\text{ Btu/lb}) - (120.9\text{ lb})(37.2\text{ Btu/lb})$

$= Q - (112.5\text{ Btu/lb})(58.3\text{ lb})$

M.S. 4.93 (continued)

$$\boxed{Q = 4534 \text{ Btu}}$$