7-11C If the system undergoes a reversible process, the entropy of the system cannot change without a heat transfer. Otherwise, the entropy must increase since there are no offsetting entropy changes associated with reservoirs exchanging heat with the system.

7-20C Yes. This will happen when the system is losing heat, and the decrease in entropy as a result of this heat loss is equal to the increase in entropy as a result of irreversibilities.

7-34C According to the conservation of mass principle,

$$\frac{dm_{\text{CV}}}{dt} = \sum_{\text{in}} \dot{m} - \sum_{\text{out}} \dot{m}$$

$$\frac{dm}{dt} = -\dot{m}_{\text{out}}$$

An entropy balance adapted to this system becomes

$$\frac{dS_{\text{surr}}}{dt} + \frac{d(ms)}{dt} + \dot{m}_{\text{out}} s \geq 0$$

When this is combined with the mass balance, it becomes

$$\frac{dS_{\text{surr}}}{dt} + s\frac{dm}{dt} - s\frac{dm}{dt} \geq 0$$

Multiplying by *dt* and integrating the result yields

$$\Delta S_{\text{surr}} + m_2 s_2 - m_1 s_1 - s(m_2 - m_1) \geq 0$$

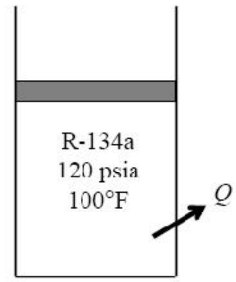
Since all the entropies are same, this reduces to

$$\Delta S_{\text{surr}} \geq 0$$

Hence, the entropy of the surroundings can only increase or remain fixed.

7-42E A cylinder is initially filled with R-134a at a specified state. The refrigerant is cooled and condensed at constant pressure. The entropy change of refrigerant during this process is to be determined

Analysis From the refrigerant tables (Tables A-11E through A-13E),



$$\left.\begin{array}{l} P_1 = 120 \text{ psia} \\ T_1 = 100°\text{F} \end{array}\right\} s_1 = 0.22361 \text{ Btu/lbm} \cdot \text{R}$$

$$\left.\begin{array}{l} T_2 - 50°\text{F} \\ P_2 = 120 \text{ psia} \end{array}\right\} s_2 \cong s_{f@90°\text{F}} = 0.06039 \text{ Btu/lbm} \cdot \text{R}$$

Then the entropy change of the refrigerant becomes

$$\Delta S = m(s_2 - s_1) = (2 \text{ lbm})(0.06039 - 0.22361)\text{Btu/lbm} \cdot \text{R} = \mathbf{-0.3264 \ Btu/R}$$

7-55 The heat transfer for the process 1-3 shown in the figure is to be determined.

Analysis For a reversible process, the area under the process line in *T-s* diagram is equal to the heat transfer during that process. Then,

$$\begin{aligned} q_{1\text{-}3} &= \int_1^2 Tds + \int_2^3 Tds \\ &= \frac{T_1 + T_2}{2}(s_2 - s_1) + 0 \\ &= \frac{(120+273)+(30+273)\text{K}}{2}(1.0 - 0.02)\text{kJ/kg} \cdot \text{K} \\ &= \mathbf{341.0 \ kJ/kg} \end{aligned}$$