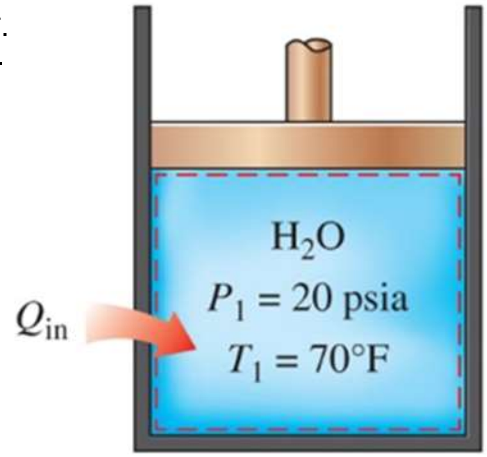
Given:
A piston cylinder device initially contains 3 lbm of liquid water at 20 psia and 70°F.
The water is now heated at constant pressure by the addition of 3450 Btu of heat.



Required:
Determine the entropy change of the water during this process.

Solution:
The mass of water is defined as

$$m_w := 3\ \text{lbm}$$

The initial conditions are defined as

$$P_1 := 20\ \text{psi} \qquad T_1 := 70\ °\text{F} = 529.67\ °\text{Ra}$$

The amount of heat added is defined as

$$Q_{in} := 3450\ \text{BTU}$$

The final pressure is

$$P_2 := P_1 = 20.00\ \text{psi}$$

Going to Table A-4E @ $T_1 = 70.00\ °\text{F}$ shows

$$P_{sat} := 0.36334\ \text{psi}$$

Since $P_1 > P_{sat}$, the state is a compressed liquid. Going to Table A-7E shows that the tables are inadequate and the state will be approximated as a saturated liquid. Thus, going back to Table A-4E @ $T_1 = 70.00\ °\text{F}$ shows

$$s_f := 0.07459\ \frac{\text{BTU}}{\text{lbm}\ °\text{Ra}} \qquad h_f := 38.08\ \frac{\text{BTU}}{\text{lbm}}$$

The state 1 properties are then

$$s_1 := s_f = 0.07459\ \frac{\text{BTU}}{\text{lbm}\ °\text{Ra}} \qquad h_1 := h_f = 38.08\ \frac{\text{BTU}}{\text{lbm}}$$

1st Law for system with no changes in ke and pe

$$\Delta E_{sys} = \Sigma E_{in} - \Sigma E_{out}$$

$$\Delta U + \Delta KE + \Delta PE = Q_{in} - W_b$$

$$\Delta U + W_b = \Delta H = \text{m} \cdot \Delta h = Q_{in}$$

$$m_w \cdot \left(h_2 - h_1\right) = Q_{in}$$

$$h_2 := \frac{Q_{in}}{m_w} + h_1 = 1188\ \frac{\text{BTU}}{\text{lbm}}$$

Going to Table A-5E @ $P_2 = 20.00\ \text{psi}$ shows

$$h_g := 1156.2\ \frac{\text{BTU}}{\text{lbm}}$$

Solution (contd.):

Since $h_2 > h_g$, the state is superheated. Going to Table A-6E @ $P_2 = 20.00\ \text{psi}$ and $h_2 = 1188\ \frac{\text{BTU}}{\text{lbm}}$ shows that interpolation is needed. This is shown below.

$$h_a := 1181.9\ \frac{\text{BTU}}{\text{lbm}} \qquad h_b := 1201.2\ \frac{\text{BTU}}{\text{lbm}}$$

$$s_a := 1.7679\ \frac{\text{BTU}}{\text{lbm}\ {}^\circ\text{Ra}} \qquad s_b := 1.7933\ \frac{\text{BTU}}{\text{lbm}\ {}^\circ\text{Ra}}$$

$$s_2 := \frac{h_2 - h_a}{h_b - h_a} \cdot \left(s_b - s_a\right) + s_a = 1.776\ \frac{\text{BTU}}{\text{lbm}\ {}^\circ\text{Ra}}$$

The change in entropy for the process may then be found by

$$\boxed{\Delta S := m_w \cdot \left(s_2 - s_1\right) = 5.104\ \frac{\text{BTU}}{{}^\circ\text{Ra}}}$$