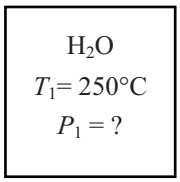
4-62 The water in a rigid tank is cooled until the vapor starts condensing. The initial pressure in the tank is to be determined.

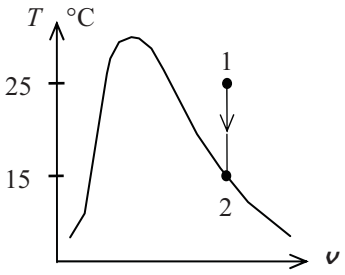
Analysis This is a constant volume process ($v = V/m$ = constant), and the initial specific volume is equal to the final specific volume that is

$$v_1 = v_2 = v_{g@150°C} = 0.39248 \text{ m}^3/\text{kg} \quad \text{(Table A-4)}$$

since the vapor starts condensing at 150°C. Then from Table A-6,

$$\left.\begin{array}{l} T_1 = 250°\text{C} \\ v_1 = 0.39248 \text{ m}^3/\text{kg} \end{array}\right\} P_1 = \mathbf{0.60 \text{ MPa}}$$





4-63 Heat is supplied to a piston-cylinder device that contains water at a specified state. The volume of the tank, the final temperature and pressure, and the internal energy change of water are to be determined.

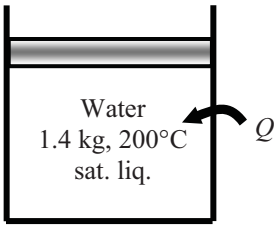
Properties The saturated liquid properties of water at 200°C are: $v_f = 0.001157 \text{ m}^3/\text{kg}$ and $u_f = 850.46$ kJ/kg (Table A-4).

Analysis (*a*) The cylinder initially contains saturated liquid water. The volume of the cylinder at the initial state is

$$V_1 = mv_1 = (1.4 \text{ kg})(0.001157 \text{ m}^3/\text{kg}) = 0.001619 \text{ m}^3$$

The volume at the final state is

$$V = 4(0.001619) = \mathbf{0.006476 \text{ m}^3}$$



(*b*) The final state properties are

$$v_2 = \frac{V}{m} = \frac{0.006476 \text{ m}^3}{1.4 \text{ kg}} = 0.004626 \text{ m}^3/\text{kg}$$

$$\left.\begin{array}{l} v_2 = 0.004626 \text{ m}^3/\text{kg} \\ x_2 = 1 \end{array}\right\} \begin{array}{l} T_2 = \mathbf{371.3°C} \\ P_2 = \mathbf{21{,}367 \text{ kPa}} \\ u_2 = 2201.5 \text{ kJ/kg} \end{array} \quad \text{(Table A-4 or A-5 or EES)}$$

(*c*) The total internal energy change is determined from

$$\Delta U = m(u_2 - u_1) = (1.4 \text{ kg})(2201.5 - 850.46) \text{ kJ/kg} = \mathbf{1892 \text{ kJ}}$$