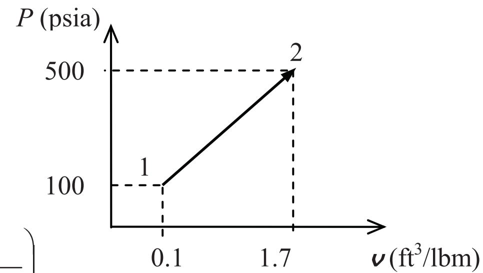
8-114E The work produced for the process 1-2 shown in the figure is to be determined.

Assumptions Kinetic and potential energy changes are negligible.

Analysis The work integral represents the area to the left of the reversible process line. Then,



$$w_{\text{in},1\text{-}2} = \int_1^2 v\,dP$$

$$= \frac{v_1 + v_2}{2}(P_2 - P_1)$$

$$= \frac{(0.1+1.7)\text{ft}^3/\text{lbm}}{2}(500-100)\text{psia}\left(\frac{1\text{ Btu}}{5.404\text{ psia}\cdot\text{ft}^3}\right)$$

$$= \mathbf{66.6\ Btu/lbm}$$

8-115 Liquid water is to be pumped by a 25-kW pump at a specified rate. The highest pressure the water can be pumped to is to be determined.

Assumptions **1** Liquid water is an incompressible substance. **2** Kinetic and potential energy changes are negligible. **3** The process is assumed to be reversible since we will determine the limiting case.

Properties The specific volume of liquid water is given to be v_1 = 0.001 m^3/kg.

Analysis The highest pressure the liquid can have at the pump exit can be determined from the reversible steady-flow work relation for a liquid,

$$\dot{W}_{\text{in}} = \dot{m}\left(\int_1^2 v\,dP + \Delta ke^{\nearrow 0} + \Delta pe^{\nearrow 0}\right) = \dot{m}v_1(P_2 - P_1)$$

Thus,

$$25\text{ kJ/s} = (5\text{ kg/s})(0.001\text{ m}^3/\text{kg})(P_2 - 100)\text{k Pa}\left(\frac{1\text{ kJ}}{1\text{ kPa}\cdot\text{m}^3}\right)$$

It yields

$$P_2 = \mathbf{5100\ kPa}$$