**6-34** Air is decelerated in an adiabatic diffuser. The velocity at the exit is to be determined.

***Assumptions*** **1** This is a steady-flow process since there is no change with time. **2** Air is an ideal gas with constant specific heats. **3** Potential energy changes are negligible. **4** There are no work interactions. **5** The diffuser is adiabatic.

***Properties*** The specific heat of air at the average temperature of (20+90)/2=55°C =328 K is $c_p$ = 1.007 kJ/kg·K (Table A-2*b*).

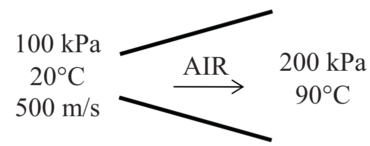
***Analysis*** There is only one inlet and one exit, and thus $\dot{m}_1 = \dot{m}_2 = \dot{m}$ . We take diffuser as the system, which is a control volume since mass crosses the boundary. The energy balance for this steady-flow system can be expressed in the rate form as

$$\underbrace{\dot{E}_{\text{in}} - \dot{E}_{\text{out}}}_{\substack{\text{Rate of net energy transfer} \\ \text{by heat, work, and mass}}} = \underbrace{\Delta \dot{E}_{\text{system}}^{\nearrow 0 \text{ (steady)}}}_{\substack{\text{Rate of change in internal, kinetic,} \\ \text{potential, etc. energies}}} = 0$$

$$\dot{E}_{\text{in}} = \dot{E}_{\text{out}}$$

$$\dot{m}(h_1 + V_1^2/2) = \dot{m}(h_2 + V_2^2/2)$$

$$h_1 + V_1^2/2 = h_2 + V_2^2/2$$




Solving for exit velocity,

$$V_2 = \left[V_1^2 + 2(h_1 - h_2)\right]^{0.5} = \left[V_1^2 + 2c_p(T_1 - T_2)\right]^{0.5}$$

$$= \left[(500 \text{ m/s})^2 + 2(1.007 \text{ kJ/kg}\cdot\text{K})(20-90)\text{K}\left(\frac{1000 \text{ m}^2/\text{s}^2}{1 \text{ kJ/kg}}\right)\right]^{0.5}$$

$$= \mathbf{330.2 \text{ m/s}}$$