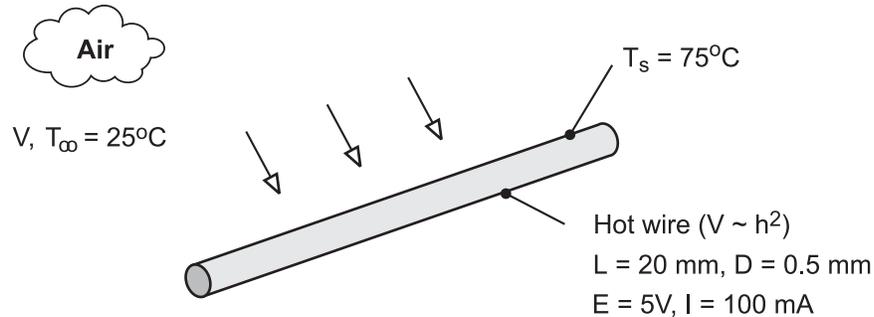


PROBLEM 1.25

KNOWN: Length, diameter and calibration of a hot wire anemometer. Temperature of air stream. Current, voltage drop and surface temperature of wire for a particular application.

FIND: Air velocity

SCHEMATIC:



ASSUMPTIONS: (1) Steady-state conditions, (2) Negligible heat transfer from the wire by natural convection or radiation.

ANALYSIS: If all of the electric energy is transferred by convection to the air, the following equality must be satisfied

$$P_{\text{elec}} = EI = hA(T_s - T_{\infty})$$

where $A = \pi DL = \pi(0.0005\text{m} \times 0.02\text{m}) = 3.14 \times 10^{-5} \text{ m}^2$.

Hence,

$$h = \frac{EI}{A(T_s - T_{\infty})} = \frac{5\text{V} \times 0.1\text{A}}{3.14 \times 10^{-5} \text{ m}^2 (50^{\circ}\text{C})} = 318 \text{ W/m}^2 \cdot \text{K}$$

$$V = 6.25 \times 10^{-5} h^2 = 6.25 \times 10^{-5} (318 \text{ W/m}^2 \cdot \text{K})^2 = 6.3 \text{ m/s} \quad <$$

COMMENTS: The convection coefficient is sufficiently large to render buoyancy (natural convection) and radiation effects negligible.