



7.58 A thermocouple is inserted into a hot air duct to measure the air temperature. The thermocouple (T_1) is soldered to the tip of a steel *thermocouple well* of length $L = 0.15$ m and inner and outer diameters of $D_i = 5$ mm and $D_o = 10$ mm. A second thermocouple (T_2) is used to measure the duct wall temperature.

Consider conditions for which the air velocity in the duct is $V = 3$ m/s and the two thermocouples register temperatures of $T_1 = 450$ K and $T_2 = 375$ K. Neglecting radiation, determine the air temperature T_∞ . Assume that,

for steel, $k = 35$ W/m · K, and, for air, $\rho = 0.774$ kg/m³, $\mu = 251 \times 10^{-7}$ N · s/m², $k = 0.0373$ W/m · K, and $Pr = 0.686$.



