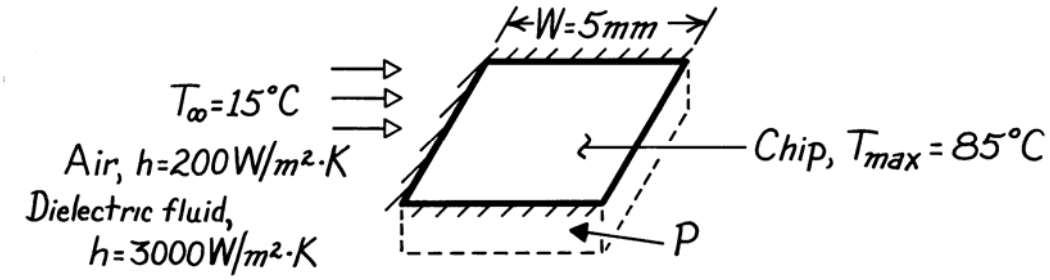
PROBLEM 1.26

KNOWN: Chip width and maximum allowable temperature. Coolant conditions.

FIND: Maximum allowable chip power for air and liquid coolants.

SCHEMATIC:



ASSUMPTIONS: (1) Steady-state conditions, (2) Negligible heat transfer from sides and bottom, (3) Chip is at a uniform temperature (isothermal), (4) Negligible heat transfer by radiation in air.

ANALYSIS: All of the electrical power dissipated in the chip is transferred by convection to the coolant. Hence,

$$P = q$$

and from Newton's law of cooling,

$$P = hA(T - T_\infty) = h\, W^2(T - T_\infty).$$

In *air*,

$$P_{max} = 200\ W/m^2 \cdot K(0.005\ m)^2(85 - 15)\ ^\circ C = 0.35\ W. \quad <$$

In the *dielectric liquid*

$$P_{max} = 3000\ W/m^2 \cdot K(0.005\ m)^2(85\text{-}15)\ ^\circ C = 5.25\ W. \quad <$$

COMMENTS: Relative to liquids, air is a poor heat transfer fluid. Hence, in air the chip can dissipate far less energy than in the dielectric liquid.