Natural Convection from Finned Surfaces and PCBs

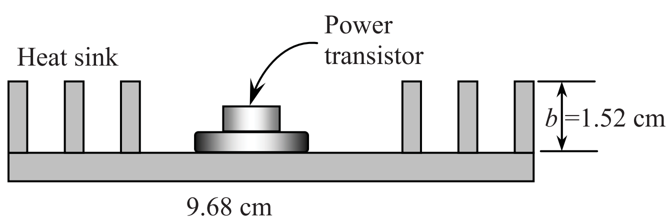
14-53C Finned surfaces are frequently used in practice to enhance heat transfer by providing a larger heat transfer surface area. Finned surfaces are referred to as heat sinks in the electronics industry since they provide a medium to which the waste heat generated in the electronic components can be transferred effectively.

14-54C A heat sink with closely packed fins will have greater surface area for heat transfer, but smaller heat transfer coefficient because of the extra resistance the additional fins introduce to fluid flow through the interfin passages.

14-55C Removing some of the fins on the heat sink will decrease heat transfer surface area, but will increase heat transfer coefficient. The decrease on heat transfer surface area more than offsets the increase in heat transfer coefficient, and thus heat transfer rate will decrease. In the second case, the decrease on heat transfer coefficient more than offsets the increase in heat transfer surface area, and thus heat transfer rate will again decrease.

14-56 An aluminum heat sink of rectangular profile oriented vertically is used to cool a power transistor. The average natural convection heat transfer coefficient is to be determined.

Assumptions **1** Steady operating conditions exist. **2** Air is an ideal gas with constant properties. **3** Radiation heat transfer from the sink is negligible. **4** The entire sink is at the base temperature.



Analysis The total surface area of the heat sink is

$$A_{fins} = 2nLb = (2)(6)(0.0762\text{ m})(0.0152\text{ m}) + (2)(0.0048\text{ m})(0.0762\text{ m}) = 0.01463\text{ m}^2$$

$$A_{unfinned} = (4)(0.0145\text{ m})(0.0762\text{ m}) + (0.0317\text{ m})(0.0762\text{ m}) = 0.006835\text{ m}^2$$

$$A_{total} = A_{fins} + A_{unfinned} = 0.01463 + 0.006835 = 0.021465\text{ m}^2$$

Then the average natural convection heat transfer coefficient becomes

$$\dot{Q} = hA_{total}(T_s - T_\infty) \longrightarrow h = \frac{\dot{Q}}{A_{total}(T_s - T_\infty)} = \frac{15\text{ W}}{(0.021465\text{ m}^2)(120-22)°\text{C}} = \mathbf{7.13\ W/m^2.°C}$$