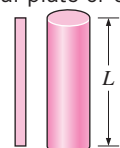

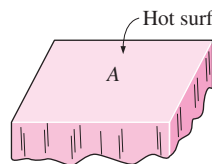
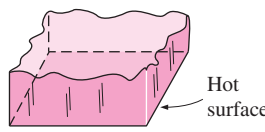

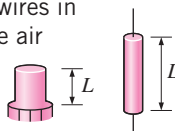
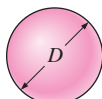


TABLE 15-1

Simplified relations for natural convection heat transfer coefficients for various geometries in air at atmospheric pressure for laminar flow conditions

(From Refs. 4 and 5.)

Geometry	Natural convection heat transfer coefficient	
	W/m ² · °C (ΔT in °C, L or D in m)	Btu/h · ft ² · °F (ΔT in °F, L or D in ft)
Vertical plate or cylinder 	$h_{\text{conv}} = 1.42 \left(\frac{\Delta T}{L} \right)^{0.25}$	$h_{\text{conv}} = 0.29 \left(\frac{\Delta T}{L} \right)^{0.25}$
Horizontal cylinder 	$h_{\text{conv}} = 1.32 \left(\frac{\Delta T}{D} \right)^{0.25}$	$h_{\text{conv}} = 0.27 \left(\frac{\Delta T}{D} \right)^{0.25}$
Horizontal plate ($L = 4A/p$, where A is surface area and p is perimeter)  (a) Hot surface facing up	$h_{\text{conv}} = 1.32 \left(\frac{\Delta T}{L} \right)^{0.25}$	$h_{\text{conv}} = 0.27 \left(\frac{\Delta T}{L} \right)^{0.25}$
 (b) Hot surface facing down	$h_{\text{conv}} = 0.59 \left(\frac{\Delta T}{L} \right)^{0.25}$	$h_{\text{conv}} = 0.12 \left(\frac{\Delta T}{L} \right)^{0.25}$
Components on a circuit board 	$h_{\text{conv}} = 2.44 \left(\frac{\Delta T}{L} \right)^{0.25}$	$h_{\text{conv}} = 0.50 \left(\frac{\Delta T}{L} \right)^{0.25}$
Small components or wires in free air 	$h_{\text{conv}} = 3.53 \left(\frac{\Delta T}{L} \right)^{0.25}$	$h_{\text{conv}} = 0.72 \left(\frac{\Delta T}{L} \right)^{0.25}$
Sphere 	$h_{\text{conv}} = 1.92 \left(\frac{\Delta T}{D} \right)^{0.25}$	$h_{\text{conv}} = 0.39 \left(\frac{\Delta T}{D} \right)^{0.25}$