Reference Data

Power Calculations

Conduction and Convection Heating

Radiant Heating

When the primary mode of heat transfer is radiation, we add a step after Equation 5.

Equation 6 is used to calculate the net radiant heat transfer between two bodies. We use this to calculate either the radiant heater temperature required or (if we know the heater temperature, but not the power required) the maximum power which can be transfered to the load.

Equation 6—Radiation Heat Transfer Between Infinite Size Parallel Surfaces

$$\frac{P_R}{A} = \frac{S\ (T_1^4 - T_2^4)\left(\frac{1}{e_f}\right)\ F}{(144\ \text{in}^2/\text{ft}^2)\quad(3.412\ \text{BTU/Wh})}$$

P_R = power absorbed by the load (watts) - from equation 4 or 5

A = area of heater (in²) - known or assumed

S = Stephan Boltzman constant
= $0.1714 \cdot 10^{-8}$ (BTU/hr. sq. ft. °R⁴)

T_1(°R) = emitter temperature (°F + 460)

T_2(°R) = load temperature (°F + 460)

e_F = emissivity correction factor - see Emissivity Correction Factor information to the right

F = shape factor (0 to 1.0) - see Shape Factor for Radiant Application graph to the right

Emissivity Correction Factor (e')

$$e_f = \frac{1}{e_S} + \frac{1}{e_L} - 1$$ plane surfaces

$$e_f = \frac{1}{e_S} + \frac{D_S}{D_L}\left(\frac{1}{e_L} - 1\right)$$ concentric cylinders inner radiating outward

$$e_f = \frac{1}{e_S} + \left(\frac{D_S}{D_L} \times \frac{1}{e_L}\right) - 1$$ concentric cylinders outer radiating inward

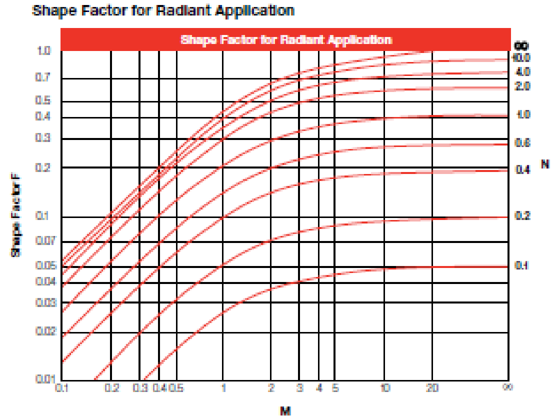
e_S = heater emissivity (from material emissivity tables)

e_L = load emissivity (from material emissivity tables)

D_S = heater diameter

D_L = load diameter

Shape Factor for Radiant Application



For Two Facing Panels:

$$\mathbf{N} = \left(\frac{\text{Heated Length}}{\text{Distance to Material}}\right)$$

$$\mathbf{M} = \left(\frac{\text{Heated Width}}{\text{Distance to Material}}\right)$$