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ABOUT THESE EQUATIONS

These equations are commonly used to solve power estimating problems.

To obtain, for use with these equations, specific heat, latent heat of fusion and latent heat of vaporization of common substances, refer to the properties of non-metallic solids, metals, metals in a liquid state, liquids, and air and gases under Reference Data.

Equation 1-- *Heat Required To Raise The Temperature of A Material*

$$Q_1\ (Btu) = W \cdot CP \cdot \Delta T \quad or \quad Q_1\ (kWh) = \frac{W \cdot C_p \cdot \Delta T}{3412}$$

Where:

Q_1 = Heat required to raise temperature
W = Pounds of material
C_p = Specific heat of material (Btu/lb-°F)
ΔT = Temperature rise of material (T_{Final} - $T_{Initial}$) °F

Equation 2--*Heat Required To Vaporize A Material (To Melt a Substance, Substitute Latent Heat of Fusion ---H_f---for Latent Heat of Vaporization)*

$$Q_2\ (Btu) = W \cdot Hv \quad or \quad Q_2\ (kWh) = \frac{W \cdot H_v}{3412}$$

Where:
Q_2 = Heat required to vaporize
W = Pounds of material
H_v = Latent heat of vaporization (Btu/lb)

Equation 3--*Heat Losses From Surfaces*

$$Q_3\ (Btu) = 3.412 \cdot A \cdot F_{SL} \cdot t$$
or
$$Q_3\ (kWh) = \frac{A \cdot F_{SL} \cdot t}{1000}$$

Where:
Q_3 = Surface heat losses
A = Surface area (ft^2)
F_{SL} = Surface loss factors (W/ft^2) evaluated at surface temperature
t = Exposure time (hours)

Equation 4--*Heat Losses By Conduction Through Materials*

$$Q_4\ (Btu) = \frac{K \cdot A \cdot \Delta T \cdot t}{X}$$
OR
$$Q_4\ (kWh) = \frac{K \cdot A \cdot \Delta T \cdot t}{3412 \cdot X}$$

Where:
Q_4 = Conduction heat losses
K = Thermal Conductivity (Btu · in/ft^2 · °F · hour)
A = Heat transfer surface area (ft^2)
X = Thickness of material (inches)
T = Temperature difference across material (T_2 - T_1)°F
t = Conduction time (hours)