Important Steady State Heat Conduction with Heat Generation Formulas PDF

Formulas Examples with Units

List of 14
Important Steady State Heat Conduction with Heat Generation Formulas

1) Location of Maximum Temperature in Plane Wall with Symmetrical Boundary Conditions Formula

Evaluate Formula

Formula

$$X = \frac{b}{2}$$

Example with Units

$$6.301\,\text{m} = \frac{12.601905\,\text{m}}{2}$$

2) Maximum Temperature in Plane Wall Surrounded by Fluid with Symmetrical Boundary Conditions Formula

Evaluate Formula

Formula

$$t_{max} = \frac{q_G \cdot b^2}{8 \cdot k} + \frac{q_G \cdot b}{2 \cdot h_c} + T_\infty$$

Example with Units

$$549.4162\,\text{K} = \frac{100\,\text{W/m}^3 \cdot 12.601905\,\text{m}^2}{8 \cdot 10.18\,\text{W/(m*K)}} + \frac{100\,\text{W/m}^3 \cdot 12.601905\,\text{m}}{2 \cdot 1.834786\,\text{W/m}^2\text{*K}} + 11\,\text{K}$$

3) Maximum Temperature in Plane Wall with Symmetrical Boundary Conditions Formula

Evaluate Formula

Formula

$$T_{max} = T_1 + \frac{q_G \cdot b^2}{8 \cdot k}$$

Example with Units

$$500\,\text{K} = 305\,\text{K} + \frac{100\,\text{W/m}^3 \cdot 12.601905\,\text{m}^2}{8 \cdot 10.18\,\text{W/(m*K)}}$$

4) Maximum Temperature in Solid Cylinder Formula

Evaluate Formula

Formula

$$T_{max} = T_w + \frac{q_G \cdot R_{cy}^2}{4 \cdot k}$$

Example with Units

$$500\,\text{K} = 273\,\text{K} + \frac{100\,\text{W/m}^3 \cdot 9.61428\,\text{m}^2}{4 \cdot 10.18\,\text{W/(m*K)}}$$

5) Maximum Temperature in Solid Sphere Formula

Evaluate Formula

Formula

$$T_{max} = T_w + \frac{q_G \cdot R_s^2}{6 \cdot k}$$

Example with Units

$$500\,\text{K} = 273\,\text{K} + \frac{100\,\text{W/m}^3 \cdot 11.775042\,\text{m}^2}{6 \cdot 10.18\,\text{W/(m*K)}}$$

6) Maximum Temperature Inside Solid Cylinder Immersed in Fluid Formula

Evaluate Formula

Formula

$$T_{max} = T_\infty + \frac{q_G \cdot R_{cy} \cdot \left(2 + \frac{h_c \cdot R_{cy}}{k}\right)}{4 \cdot h_c}$$

Example with Units

$$500\,\text{K} = 11\,\text{K} + \frac{100\,\text{W/m}^3 \cdot 9.61428\,\text{m} \cdot \left(2 + \frac{1.834786\,\text{W/m}^2\text{*K} \cdot 9.61428\,\text{m}}{10.18\,\text{W/(m*K)}}\right)}{4 \cdot 1.834786\,\text{W/m}^2\text{*K}}$$

7) Surface Temperature of Solid Cylinder Immersed in Fluid Formula

Evaluate Formula

Formula

$$T_w = T_\infty + \frac{q_G \cdot R_{cy}}{2 \cdot h_c}$$

Example with Units

$$273\,\text{K} = 11\,\text{K} + \frac{100\,\text{W/m}^3 \cdot 9.61428\,\text{m}}{2 \cdot 1.834786\,\text{W/m}^2\text{*K}}$$

8) Temperature at given Thickness x Inside Plane Wall Surrounded by Fluid Formula

Evaluate Formula

Formula

$$T = \frac{q_G}{8 \cdot k} \cdot \left(b^2 - 4 \cdot x^2 \right) + \frac{q_G \cdot b}{2 \cdot h_c} + T_\infty$$

Example with Units

$$460\,\text{K} = \frac{100\,\text{W/m}^3}{8 \cdot 10.18\,\text{W/(m*K)}} \cdot \left(12.601905\,\text{m}^2 - 4 \cdot 4.266748\,\text{m}^2 \right) + \frac{100\,\text{W/m}^3 \cdot 12.601905\,\text{m}}{2 \cdot 1.834786\,\text{W/m}^2\text{*K}} + 11\,\text{K}$$

9) Temperature Inside Hollow Cylinder at given Radius between Inner and Outer Radius Formula

Evaluate Formula

Formula

$$T = \frac{q_G}{4 \cdot k} \cdot \left(r_o^2 - r^2 \right) + T_o + \frac{\ln\left(\frac{r}{r_o}\right)}{\ln\left(\frac{r_o}{r_i}\right)} \cdot \left(\frac{q_G}{4 \cdot k} \cdot \left(r_o^2 - r_i^2 \right) + \left(T_o - T_i \right) \right)$$

Example with Units

$$460\,\text{K} = \frac{100\,\text{W/m}^3}{4 \cdot 10.18\,\text{W/(m*K)}} \cdot \left(30.18263\,\text{m}^2 - 4\,\text{m}^2 \right) + 300\,\text{K} + \frac{\ln\left(\frac{4\,\text{m}}{30.18263\,\text{m}}\right)}{\ln\left(\frac{30.18263\,\text{m}}{2.5\,\text{m}}\right)} \cdot \left(\frac{100\,\text{W/m}^3}{4 \cdot 10.18\,\text{W/(m*K)}} \cdot \left(30.18263\,\text{m}^2 - 2.5\,\text{m}^2 \right) + \left(300\,\text{K} - 10\,\text{K} \right) \right)$$

10) Temperature Inside Hollow Sphere at given Radius between Inner and Outer Radius Formula

Evaluate Formula

Formula

$$T = T_w + \frac{q_G}{6 \cdot k} \cdot \left(r_2^2 - r^2 \right) + \frac{q_G \cdot r_1^3}{3 \cdot k} \cdot \left(\frac{1}{r_2} - \frac{1}{r} \right)$$

Example with Units

$$460\,\text{K} = 273\,\text{K} + \frac{100\,\text{W/m}^3}{6 \cdot 10.18\,\text{W/(m*K)}} \cdot \left(2\,\text{m}^2 - 4\,\text{m}^2 \right) + \frac{100\,\text{W/m}^3 \cdot 6.320027\,\text{m}^3}{3 \cdot 10.18\,\text{W/(m*K)}} \cdot \left(\frac{1}{2\,\text{m}} - \frac{1}{4\,\text{m}} \right)$$

11) Temperature Inside Plane Wall at given Thickness x with Symmetrical Boundary Conditions Formula

Evaluate Formula

Formula

$$t_1 = -\frac{q_G \cdot b^2}{2 \cdot k} \cdot \left(\frac{x}{b} - \left(\frac{x}{b} \right)^2 \right) + T_1$$

Example with Units

$$130.3241\,\text{K} = -\frac{100\,\text{W/m}^3 \cdot 12.601905\,\text{m}^2}{2 \cdot 10.18\,\text{W/(m*K)}} \cdot \left(\frac{4.266748\,\text{m}}{12.601905\,\text{m}} - \left(\frac{4.266748\,\text{m}}{12.601905\,\text{m}} \right)^2 \right) + 305\,\text{K}$$

12) Temperature Inside Solid Cylinder at given Radius Formula

Evaluate Formula

Formula

$$t = \frac{q_G}{4 \cdot k} \cdot \left(R_{cy}^2 - r^2 \right) + T_w$$

Example with Units

$$460.7072\,\text{K} = \frac{100\,\text{W/m}^3}{4 \cdot 10.18\,\text{W/(m*K)}} \cdot \left(9.61428\,\text{m}^2 - 4\,\text{m}^2 \right) + 273\,\text{K}$$

13) Temperature Inside Solid Cylinder at given Radius Immersed in Fluid Formula

Evaluate Formula

Formula

$$t = \frac{q_G}{4 \cdot k} \cdot \left(R_{cy}^{\ 2} - r^2 \right) + T_\infty + \frac{q_G \cdot R_{cy}}{2 \cdot h_c}$$

Example with Units

$$460.7073\,\mathrm{K} = \frac{100\,\mathrm{W/m^3}}{4 \cdot 10.18\,\mathrm{W/(m{*}K)}} \cdot \left(9.61428\,\mathrm{m}^{\ 2} - 4\,\mathrm{m}^{\ 2} \right) + 11\,\mathrm{K} + \frac{100\,\mathrm{W/m^3} \cdot 9.61428\,\mathrm{m}}{2 \cdot 1.834786\,\mathrm{W/m^2{*}K}}$$

14) Temperature Inside Solid Sphere at given Radius Formula

Evaluate Formula

Formula

$$t_2 = T_w + \frac{q_G}{6 \cdot k} \cdot \left(R_s^{\ 2} - r^2 \right)$$

Example with Units

$$473.8049\,\mathrm{K} = 273\,\mathrm{K} + \frac{100\,\mathrm{W/m^3}}{6 \cdot 10.18\,\mathrm{W/(m{*}K)}} \cdot \left(11.775042\,\mathrm{m}^{\ 2} - 4\,\mathrm{m}^{\ 2} \right)$$

Variables used in list of Steady State Heat Conduction with Heat Generation Formulas above

- **b** Wall Thickness *(Meter)*
- **h_c** Convection Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- **k** Thermal Conductivity *(Watt per Meter per K)*
- **q_G** Internal Heat Generation *(Watt Per Cubic Meter)*
- **r** Radius *(Meter)*
- **r_1** Inner Radius of Sphere *(Meter)*
- **r_2** Outer Radius of Sphere *(Meter)*
- **R_{cy}** Radius of Cylinder *(Meter)*
- **r_i** Inner Radius of Cylinder *(Meter)*
- **r_o** Outer Radius of Cylinder *(Meter)*
- **R_s** Radius of Sphere *(Meter)*
- **t** Temperature Solid Cylinder *(Kelvin)*
- **T** Temperature *(Kelvin)*
- **t_1** Temperature 1 *(Kelvin)*
- **T_1** Surface Temperature *(Kelvin)*
- **t_2** Temperature 2 *(Kelvin)*
- **T_∞** Fluid Temperature *(Kelvin)*
- **T_i** Inner Surface Temperature *(Kelvin)*
- **t_{max}** Maximum Temperature of Plain Wall *(Kelvin)*
- **T_{max}** Maximum Temperature *(Kelvin)*
- **T_o** Outer Surface Temperature *(Kelvin)*
- **T_w** Surface Temperature of Wall *(Kelvin)*
- **x** Thickness *(Meter)*
- **X** Location of Maximum Temperature *(Meter)*

Constants, Functions, Measurements used in list of Steady State Heat Conduction with Heat Generation Formulas above

- Functions: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Thermal Conductivity** in Watt per Meter per K (W/(m*K))
  Thermal Conductivity Unit Conversion
- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
  Heat Transfer Coefficient Unit Conversion
- Measurement: **Power Density** in Watt Per Cubic Meter (W/m³)
  Power Density Unit Conversion

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