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Steady State Heat Conduction with Heat Generation Formulas

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List of 14 Steady State Heat Conduction with Heat Generation Formulas

Steady State Heat Conduction with Heat Generation

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

Open Calculator

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

ex $$6.300952\text{m} = \frac{12.601905\text{m}}{2}$$

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

Open Calculator

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

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

3) Maximum Temperature in Plane Wall with Symmetrical Boundary Conditions

Open Calculator

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

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

4) Maximum Temperature in Solid Cylinder

Open Calculator

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

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

5) Maximum Temperature in Solid Sphere

Open Calculator

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

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

6) Maximum Temperature Inside Solid Cylinder Immersed in Fluid

Open Calculator

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

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

7) Surface Temperature of Solid Cylinder Immersed in Fluid

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

12) Temperature Inside Solid Cylinder at given Radius

Open Calculator

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

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

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

Open Calculator

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

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

14) Temperature Inside Solid Sphere at given Radius

Open Calculator

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

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

Variables Used

- **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

- Function: **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

Check other formula lists

- Conduction in Cylinder Formulas
- Conduction in Plane Wall Formulas
- Conduction in Sphere Formulas
- Conduction Shape Factors for Different Configurations Formulas
- Other shapes Formulas
- Steady State Heat Conduction with Heat Generation Formulas
- Transient Heat Conduction Formulas

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