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Conduction in Cylinder Formulas

Calculators! Examples! Conversions!

List of 14 Conduction in Cylinder Formulas

Conduction in Cylinder

1) Convection Resistance for Cylindrical Layer

Open Calculator

fx $$R_{th} = \frac{1}{h \cdot 2 \cdot \pi \cdot R \cdot l_{cyl}}$$

ex $$1.130362 K/W = \frac{1}{2.2 W/m^2{*}K \cdot 2 \cdot \pi \cdot 0.160 m \cdot 0.4 m}$$

2) Heat Flow Rate through Cylindrical Composite Wall of 2 Layers

Open Calculator

fx $$Q = \frac{T_i - T_o}{\frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k_1 \cdot l_{cyl}} + \frac{\ln\left(\frac{r_3}{r_2}\right)}{2 \cdot \pi \cdot k_2 \cdot l_{cyl}}}$$

ex $$9.276513 W = \frac{305 K - 300 K}{\frac{\ln\left(\frac{12 m}{0.8 m}\right)}{2 \cdot \pi \cdot 1.6 W/(m{*}K) \cdot 0.4 m} + \frac{\ln\left(\frac{8 m}{12 m}\right)}{2 \cdot \pi \cdot 1.2 W/(m{*}K) \cdot 0.4 m}}$$

3) Heat Flow Rate through Cylindrical Composite Wall of 3 Layers

Open Calculator

fx $$Q = \frac{T_i - T_o}{\frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k_1 \cdot l_{cyl}} + \frac{\ln\left(\frac{r_3}{r_2}\right)}{2 \cdot \pi \cdot k_2 \cdot l_{cyl}} + \frac{\ln\left(\frac{r_4}{r_3}\right)}{2 \cdot \pi \cdot k_3 \cdot l_{cyl}}}$$

ex $$8.408143 W = \frac{305 K - 300 K}{\frac{\ln\left(\frac{12 m}{0.8 m}\right)}{2 \cdot \pi \cdot 1.6 W/(m{*}K) \cdot 0.4 m} + \frac{\ln\left(\frac{8 m}{12 m}\right)}{2 \cdot \pi \cdot 1.2 W/(m{*}K) \cdot 0.4 m} + \frac{\ln\left(\frac{14 m}{8 m}\right)}{2 \cdot \pi \cdot 4 W/(m{*}K) \cdot 0.4 m}}$$

4) Heat Flow Rate through Cylindrical Wall

Open Calculator

fx $$Q = \frac{T_i - T_o}{\frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k \cdot l_{cyl}}}$$

ex $$47.23903 W = \frac{305 K - 300 K}{\frac{\ln\left(\frac{12 m}{0.8 m}\right)}{2 \cdot \pi \cdot 10.18 W/(m{*}K) \cdot 0.4 m}}$$

5) Inner Surface Temperature of Cylindrical Wall in Conduction

Open Calculator

fx $$T_i = T_o + \frac{Q \cdot \ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k \cdot l_{cyl}}$$

ex $$313.2306\text{K} = 300\text{K} + \frac{125\text{W} \cdot \ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 10.18\text{W/(m*K)} \cdot 0.4\text{m}}$$

6) Length of Cylindrical Wall for given Heat Flow Rate

Open Calculator

fx $$l_{cyl} = \frac{Q \cdot \ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k \cdot (T_i - T_o)}$$

ex $$1.058447\text{m} = \frac{125\text{W} \cdot \ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 10.18\text{W/(m*K)} \cdot (305\text{K} - 300\text{K})}$$

7) Outer Surface Temperature of Cylindrical Composite Wall of 2 Layers

Open Calculator

fx $$T_o = T_i - Q \cdot \left(\frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k_1 \cdot l_{cyl}} + \frac{\ln\left(\frac{r_3}{r_2}\right)}{2 \cdot \pi \cdot k_2 \cdot l_{cyl}}\right)$$

ex $$237.6255\text{K} = 305\text{K} - 125\text{W} \cdot \left(\frac{\ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 1.6\text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{8\text{m}}{12\text{m}}\right)}{2 \cdot \pi \cdot 1.2\text{W/(m*K)} \cdot 0.4\text{m}}\right)$$

8) Outer Surface Temperature of Cylindrical Wall given Heat Flow Rate

Open Calculator

fx $$T_o = T_i - \frac{Q \cdot \ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k \cdot l_{cyl}}$$

ex $$291.7694\text{K} = 305\text{K} - \frac{125\text{W} \cdot \ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 10.18\text{W/(m*K)} \cdot 0.4\text{m}}$$

9) Thermal Conductivity of Cylindrical Wall given Temperature Difference

Open Calculator

fx $$k = \frac{Q \cdot \ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot l_{cyl} \cdot (T_i - T_o)}$$

ex $$26.93747\text{W/(m*K)} = \frac{125\text{W} \cdot \ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 0.4\text{m} \cdot (305\text{K} - 300\text{K})}$$

10) Thermal Resistance for Radial Heat Conduction in Cylinders

Open Calculator

fx $$R_{th} = \frac{\ln\left(\frac{r_o}{r_i}\right)}{2 \cdot \pi \cdot k \cdot l_{cyl}}$$

ex $$0.022974 \text{K/W} = \frac{\ln\left(\frac{9\text{m}}{5\text{m}}\right)}{2 \cdot \pi \cdot 10.18 \text{W/(m*K)} \cdot 0.4\text{m}}$$

11) Thickness of Cylindrical Wall to Maintain given Temperature Difference

Open Calculator

fx $$t = r_1 \cdot \left(e^{\frac{(T_i - T_o) \cdot 2 \cdot \pi \cdot k \cdot l_{cyl}}{Q}} - 1\right)$$

ex $$1.426123\text{m} = 0.8\text{m} \cdot \left(e^{\frac{(305\text{K} - 300\text{K}) \cdot 2 \cdot \pi \cdot 10.18 \text{W/(m*K)} \cdot 0.4\text{m}}{125\text{W}}} - 1\right)$$

12) Total Thermal Resistance of 2 Cylindrical Resistances Connected in Series

Open Calculator

fx $$R_{th} = \frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k_1 \cdot l_{cyl}} + \frac{\ln\left(\frac{r_3}{r_2}\right)}{2 \cdot \pi \cdot k_2 \cdot l_{cyl}}$$

ex $$0.538996 \text{K/W} = \frac{\ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 1.6 \text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{8\text{m}}{12\text{m}}\right)}{2 \cdot \pi \cdot 1.2 \text{W/(m*K)} \cdot 0.4\text{m}}$$

13) Total Thermal Resistance of 3 Cylindrical Resistances Connected in Series

Open Calculator

fx $$R_{th} = \frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k_1 \cdot l_{cyl}} + \frac{\ln\left(\frac{r_3}{r_2}\right)}{2 \cdot \pi \cdot k_2 \cdot l_{cyl}} + \frac{\ln\left(\frac{r_4}{r_3}\right)}{2 \cdot \pi \cdot k_3 \cdot l_{cyl}}$$

ex $$0.594662 \text{K/W} = \frac{\ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 1.6 \text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{8\text{m}}{12\text{m}}\right)}{2 \cdot \pi \cdot 1.2 \text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{14\text{m}}{8\text{m}}\right)}{2 \cdot \pi \cdot 4 \text{W/(m*K)} \cdot 0.4\text{m}}$$

14) Total Thermal Resistance of Cylindrical Wall with Convection on Both Sides

Open Calculator

fx $$R_{th} = \frac{1}{2 \cdot \pi \cdot r_1 \cdot l_{cyl} \cdot h_i} + \frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \cdot \pi \cdot k \cdot l_{cyl}} + \frac{1}{2 \cdot \pi \cdot r_2 \cdot l_{cyl} \cdot h_o}$$

ex

$$0.477642 \text{K/W} = \frac{1}{2 \cdot \pi \cdot 0.8\text{m} \cdot 0.4\text{m} \cdot 1.35 \text{W/m}^2\text{*K}} + \frac{\ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 10.18 \text{W/(m*K)} \cdot 0.4\text{m}} + \frac{1}{2 \cdot \pi \cdot 12\text{m} \cdot 0.4\text{m} \cdot 9.8}$$

Variables Used

- **h** Convection heat transfer *(Watt per Square Meter per Kelvin)*
- **h_i** Inside Convection Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- **h_o** External Convection Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- **k** Thermal Conductivity *(Watt per Meter per K)*
- **k_1** Thermal Conductivity 1 *(Watt per Meter per K)*
- **k_2** Thermal Conductivity 2 *(Watt per Meter per K)*
- **k_3** Thermal Conductivity 3 *(Watt per Meter per K)*
- **l_{cyl}** Length of Cylinder *(Meter)*
- **Q** Heat Flow Rate *(Watt)*
- **R** Cylinder Radius *(Meter)*
- **r_1** Radius 1 *(Meter)*
- **r_2** Radius 2 *(Meter)*
- **r_3** Radius 3 *(Meter)*
- **r_4** Radius 4 *(Meter)*
- **r_i** Inner Radius *(Meter)*
- **r_o** Outer Radius *(Meter)*
- **R_{th}** Thermal Resistance *(Kelvin per Watt)*
- **t** Thickness *(Meter)*
- **T_i** Inner Surface Temperature *(Kelvin)*
- **T_o** Outer Surface Temperature *(Kelvin)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- 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: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Thermal Resistance** in Kelvin per Watt (K/W)
  Thermal Resistance 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

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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