calculatoratoz.com

unitsconverters.com

# Conduction in Cylinder Formulas

Calculators! Examples! Conversions!

# List of 16 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 $$1.130362\text{K/W} = \frac{1}{2.2\text{W/m²*K} \cdot 2 \cdot \pi \cdot 0.160\text{m} \cdot 0.4\text{m}}$$

### 2) Critical Thickness of Insulation for Cylinder

Open Calculator

fx $$r_c = \frac{k}{h_t}$$

ex $$0.771212\text{m} = \frac{10.18\text{W/(m*K)}}{13.2\text{W/m²*K}}$$

### 3) 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 $$9.276513\text{W} = \frac{305\text{K} - 300\text{K}}{\frac{\ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 1.6\text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{8\text{m}}{12\text{m}}\right)}{2 \cdot \pi \cdot 1.2\text{W/(m*K)} \cdot 0.4\text{m}}}$$

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

## 5) 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 $$47.23903W = \frac{305K - 300K}{\frac{\ln\left(\frac{12m}{0.8m}\right)}{2 \cdot \pi \cdot 10.18W/(m^*K) \cdot 0.4m}}$$

## 6) 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 $$300.9812K = 300K + \frac{9.27W \cdot \ln\left(\frac{12m}{0.8m}\right)}{2 \cdot \pi \cdot 10.18W/(m^*K) \cdot 0.4m}$$

## 7) 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 $$0.078494m = \frac{9.27W \cdot \ln\left(\frac{12m}{0.8m}\right)}{2 \cdot \pi \cdot 10.18W/(m^*K) \cdot (305K - 300K)}$$

## 8) 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 $$300.0035K = 305K - 9.27W \cdot \left(\frac{\ln\left(\frac{12m}{0.8m}\right)}{2 \cdot \pi \cdot 1.6W/(m^*K) \cdot 0.4m} + \frac{\ln\left(\frac{8m}{12m}\right)}{2 \cdot \pi \cdot 1.2W/(m^*K) \cdot 0.4m}\right)$$

## 9) 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 $$304.0188K = 305K - \frac{9.27W \cdot \ln\left(\frac{12m}{0.8m}\right)}{2 \cdot \pi \cdot 10.18W/(m^*K) \cdot 0.4m}$$

## 10) Thermal Conductivity given Critical Thickness of Insulation for Cylinder

Open Calculator

fx $k = r_c \cdot h_o$

ex $6.545\text{W/(m*K)} = 0.77\text{m} \cdot 8.5\text{W/m²*K}$

## 11) 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 $$1.997683\text{W/(m*K)} = \frac{9.27\text{W} \cdot \ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 0.4\text{m} \cdot (305\text{K} - 300\text{K})}$$

## 12) 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 $$0.022974\text{K/W} = \frac{\ln\left(\frac{9\text{m}}{5\text{m}}\right)}{2 \cdot \pi \cdot 10.18\text{W/(m*K)} \cdot 0.4\text{m}}$$

## 13) 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 $$787657\text{m} = 0.8\text{m} \cdot \left(e^{\frac{(305\text{K} - 300\text{K}) \cdot 2 \cdot \pi \cdot 10.18\text{W/(m*K)} \cdot 0.4\text{m}}{9.27\text{W}}} - 1\right)$$

## 14) 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 $$0.538996\text{K/W} = \frac{\ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 1.6\text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{8\text{m}}{12\text{m}}\right)}{2 \cdot \pi \cdot 1.2\text{W/(m*K)} \cdot 0.4\text{m}}$$

## 15) 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 $$0.594662\text{K/W} = \frac{\ln\left(\frac{12\text{m}}{0.8\text{m}}\right)}{2 \cdot \pi \cdot 1.6\text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{8\text{m}}{12\text{m}}\right)}{2 \cdot \pi \cdot 1.2\text{W/(m*K)} \cdot 0.4\text{m}} + \frac{\ln\left(\frac{14\text{m}}{8\text{m}}\right)}{2 \cdot \pi \cdot 4\text{W/(m*K)} \cdot 0.4\text{m}}$$

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

Open Calculator

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

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)*
- $h_{ext}$ External Convection Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- $h_i$ Inside Convection Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- $h_o$ Heat Transfer Coefficient at Outer Surface *(Watt per Square Meter per Kelvin)*
- $h_t$ 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 of 1st Cylinder *(Meter)*
- $r_2$ Radius of 2nd Cylinder *(Meter)*
- $r_3$ Radius of 3rd Cylinder *(Meter)*
- $r_4$ Radius of 4th Cylinder *(Meter)*
- $r_c$ Critical Thickness of Insulation *(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

Feel free to SHARE this document with your friends!

## PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

7/29/2024 | 8:05:00 AM UTC

*Please leave your feedback here...*