



calculatoratoz.com



unitsconverters.com

Important Formulas in Radiation Heat Transfer

Calculators!

Examples!

Conversions!

Bookmark calculatoratoz.com, unitsconverters.com

Widest Coverage of Calculators and Growing - **30,000+ Calculators!**
Calculate With a Different Unit for Each Variable - **In built Unit Conversion!**
Widest Collection of Measurements and Units - **250+ Measurements!**

Feel free to SHARE this document with your friends!

[*Please leave your feedback here...*](#)



List of 33 Important Formulas in Radiation Heat Transfer

Important Formulas in Radiation Heat Transfer



1) Absorptivity given Reflectivity and Transmissivity

$$fx \quad \alpha = 1 - \rho - \tau$$

[Open Calculator](#)

$$ex \quad 0.65 = 1 - 0.10 - 0.25$$

2) Area of Surface 1 given Area 2 and Radiation Shape Factor for Both Surfaces

$$fx \quad A_1 = A_2 \cdot \left(\frac{F_{21}}{F_{12}} \right)$$

[Open Calculator](#)

$$ex \quad 34.74576m^2 = 50m^2 \cdot \left(\frac{0.41}{0.59} \right)$$

3) Area of Surface 2 given Area 1 and Radiation Shape Factor for Both Surfaces

$$fx \quad A_2 = A_1 \cdot \left(\frac{F_{12}}{F_{21}} \right)$$

[Open Calculator](#)

$$ex \quad 49.99171m^2 = 34.74m^2 \cdot \left(\frac{0.59}{0.41} \right)$$



4) Emissive Power of Blackbody

$$fx \quad E_b = [\text{Stefan-BoltZ}] \cdot (T^4)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 324.2963\text{W/m}^2 = [\text{Stefan-BoltZ}] \cdot ((275\text{K})^4)$$

5) Emissive Power of Non Blackbody given Emissivity

$$fx \quad E = \varepsilon \cdot E_b$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 308.0755\text{W/m}^2 = 0.95 \cdot 324.29\text{W/m}^2$$

6) Emissivity of Body

$$fx \quad \varepsilon = \frac{E}{E_b}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 0.949983 = \frac{308.07\text{W/m}^2}{324.29\text{W/m}^2}$$


7) Energy of each Quanta

$$fx \quad E_q = [hP] \cdot \nu$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$ex \quad 5E^{-19}\text{J} = [hP] \cdot 7.5E^{14}\text{Hz}$$



8) Frequency given Speed of Light and Wavelength 

$$fx \quad v = \frac{[c]}{\lambda}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 7.5E^{14}Hz = \frac{[c]}{400nm}$$

9) Heat Transfer between Concentric Spheres 

$$fx \quad q = \frac{A_1 \cdot [\text{Stefan-BoltZ}] \cdot ((T_1^4) - (T_2^4))}{\left(\frac{1}{\epsilon_1}\right) + \left(\left(\left(\frac{1}{\epsilon_2}\right) - 1\right) \cdot \left(\left(\frac{r_1}{r_2}\right)^2\right)\right)}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 731.5713W = \frac{34.74m^2 \cdot [\text{Stefan-BoltZ}] \cdot \left(\left((202K)^4\right) - \left((151K)^4\right)\right)}{\left(\frac{1}{0.4}\right) + \left(\left(\left(\frac{1}{0.3}\right) - 1\right) \cdot \left(\left(\frac{10m}{20m}\right)^2\right)\right)}$$

10) Heat Transfer between Small Convex Object in Large Enclosure 

$$fx \quad q = A_1 \cdot \epsilon_1 \cdot [\text{Stefan-BoltZ}] \cdot ((T_1^4) - (T_2^4))$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 902.2712W = 34.74m^2 \cdot 0.4 \cdot [\text{Stefan-BoltZ}] \cdot \left(\left((202K)^4\right) - \left((151K)^4\right)\right)$$



11) Heat Transfer between Two Infinite Parallel Planes given Temp and Emissivity of Both Surfaces

$$fx \quad q = \frac{A \cdot [\text{Stefan-BoltZ}] \cdot ((T_1^4) - (T_2^4))}{\left(\frac{1}{\varepsilon_1}\right) + \left(\frac{1}{\varepsilon_2}\right) - 1}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 675.7228W = \frac{50.3m^2 \cdot [\text{Stefan-BoltZ}] \cdot \left((202K)^4 - (151K)^4 \right)}{\left(\frac{1}{0.4}\right) + \left(\frac{1}{0.3}\right) - 1}$$

12) Heat Transfer between Two Long Concentric Cylinder given Temp, Emissivity and Area of Both Surfaces

$$fx \quad q = \frac{([\text{Stefan-BoltZ}] \cdot A_1 \cdot ((T_1^4) - (T_2^4)))}{\left(\frac{1}{\varepsilon_1}\right) + \left(\left(\frac{A_1}{A_2}\right) \cdot \left(\left(\frac{1}{\varepsilon_2}\right) - 1\right)\right)}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 547.3353W = \frac{([\text{Stefan-BoltZ}] \cdot 34.74m^2 \cdot ((202K)^4 - (151K)^4))}{\left(\frac{1}{0.4}\right) + \left(\left(\frac{34.74m^2}{50m^2}\right) \cdot \left(\left(\frac{1}{0.3}\right) - 1\right)\right)}$$


13) Mass of Particle Given Frequency and Speed of Light

$$fx \quad m = [hP] \cdot \frac{v}{[c]^2}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 5.5E^{-36}kg = [hP] \cdot \frac{7.5E^{14}Hz}{[c]^2}$$



14) Maximum Wavelength at given Temperature 

$$fx \quad \lambda_{Max} = \frac{2897.6}{T_R}$$

Open Calculator 


$$ex \quad 499586.2\mu m = \frac{2897.6}{5800K}$$

15) Net Energy Leaving given Radiosity and Irradiation 

$$fx \quad q = A \cdot (J - G)$$

Open Calculator 

$$ex \quad 15452.16W = 50.3m^2 \cdot (308W/m^2 - 0.80W/m^2)$$

16) Net Heat Exchange between Two Surfaces given Radiosity for Both Surface 

$$fx \quad q_{1-2} = \frac{J_1 - J_2}{\frac{1}{A_1 \cdot F_{12}}}$$

Open Calculator 

$$ex \quad 245.9592W = \frac{61W/m^2 - 49W/m^2}{\frac{1}{34.74m^2 \cdot 0.59}}$$

17) Net Heat Exchange given Area 1 and Shape Factor 12 

$$fx \quad Q_{1-2} = A_1 \cdot F_{12} \cdot (E_{b1} - E_{b2})$$

Open Calculator 

$$ex \quad 3176.973W = 34.74m^2 \cdot 0.59 \cdot (680W/m^2 - 525W/m^2)$$




18) Net Heat Exchange given Area 2 and Shape Factor 21 

$$fx \quad Q_{1-2} = A_2 \cdot F_{21} \cdot (E_{b1} - E_{b2})$$

Open Calculator 

$$ex \quad 3177.5W = 50m^2 \cdot 0.41 \cdot (680W/m^2 - 525W/m^2)$$

19) Net Heat Transfer from Surface given Emissivity, Radiosity and Emissive Power 

$$fx \quad q = \left(\frac{(\varepsilon \cdot A) \cdot (E_b - J)}{1 - \varepsilon} \right)$$

Open Calculator 

$$ex \quad 15568.35W = \left(\frac{(0.95 \cdot 50.3m^2) \cdot (324.29W/m^2 - 308W/m^2)}{1 - 0.95} \right)$$

20) Radiation Heat Transfer between Plane 1 and Shield given Temperature and Emissivity of Both Surfaces 

$$fx \quad q = A \cdot [\text{Stefan-BoltZ}] \cdot \frac{(T_{P1}^4) - (T_3^4)}{\left(\frac{1}{\varepsilon_1}\right) + \left(\frac{1}{\varepsilon_3}\right) - 1}$$

Open Calculator 

$$ex \quad 699.4575W = 50.3m^2 \cdot [\text{Stefan-BoltZ}] \cdot \frac{((452K)^4) - ((450K)^4)}{\left(\frac{1}{0.4}\right) + \left(\frac{1}{0.67}\right) - 1}$$



21) Radiation Heat Transfer between Plane 2 and Radiation Shield given Temperature and Emissivity

$$\text{fx } q = A \cdot [\text{Stefan-BoltZ}] \cdot \frac{(T_3^4) - (T_{P2}^4)}{\left(\frac{1}{\varepsilon_3}\right) + \left(\frac{1}{\varepsilon_2}\right) - 1}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

$$\text{ex } 1336.2\text{W} = 50.3\text{m}^2 \cdot [\text{Stefan-BoltZ}] \cdot \frac{((450\text{K})^4) - ((445\text{K})^4)}{\left(\frac{1}{0.67}\right) + \left(\frac{1}{0.3}\right) - 1}$$

22) Radiation Temperature given Maximum Wavelength

$$\text{fx } T_R = \frac{2897.6}{\lambda_{\text{Max}}}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

$$\text{ex } 5800\text{K} = \frac{2897.6}{499586.2\mu\text{m}}$$

23) Radiosity given Emissive Power and Irradiation

$$\text{fx } J = (\varepsilon \cdot E_b) + (\rho \cdot G)$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$\text{ex } 308.1555\text{W/m}^2 = (0.95 \cdot 324.29\text{W/m}^2) + (0.10 \cdot 0.80\text{W/m}^2)$$

24) Reflected Radiation given Absorptivity and Transmissivity

$$\text{fx } \rho = 1 - \alpha - \tau$$

[Open Calculator !\[\]\(4146d17f71dced09c6ad789cacceaa6d_img.jpg\)](#)

$$\text{ex } 0.1 = 1 - 0.65 - 0.25$$



25) Reflectivity given Absorptivity for Blackbody 

$$fx \quad \rho = 1 - \alpha$$

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0_img.jpg\)](#)


$$ex \quad 0.35 = 1 - 0.65$$

26) Reflectivity given Emissivity for Blackbody 

$$fx \quad \rho = 1 - \varepsilon$$

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1_img.jpg\)](#)

$$ex \quad 0.05 = 1 - 0.95$$

27) Resistance in Radiation Heat Transfer when No Shield is Present and Equal Emissivities 

$$fx \quad R = \left(\frac{2}{\varepsilon} \right) - 1$$

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\)](#)

$$ex \quad 1.105263 = \left(\frac{2}{0.95} \right) - 1$$

28) Shape Factor 12 given Area of Both Surface and Shape Factor 21 

$$fx \quad F_{12} = \left(\frac{A_2}{A_1} \right) \cdot F_{21}$$

[Open Calculator !\[\]\(3342c215b2a8b663596a81468d5dc314_img.jpg\)](#)

$$ex \quad 0.590098 = \left(\frac{50m^2}{34.74m^2} \right) \cdot 0.41$$



29) Shape Factor 21 given Area of Both Surface and Shape Factor 12 

$$fx \quad F_{21} = F_{12} \cdot \left(\frac{A_1}{A_2} \right)$$

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)


$$ex \quad 0.409932 = 0.59 \cdot \left(\frac{34.74m^2}{50m^2} \right)$$

30) Temperature of Radiation Shield Placed between Two Parallel Infinite Planes with Equal Emissivities 

$$fx \quad T_3 = \left(0.5 \cdot \left((T_{P1}^4) + (T_{P2}^4) \right) \right)^{\frac{1}{4}}$$

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)


$$ex \quad 448.541K = \left(0.5 \cdot \left(((452K)^4) + ((445K)^4) \right) \right)^{\frac{1}{4}}$$

31) Total Resistance in Radiation Heat Transfer given Emissivity and Number of Shields 

$$fx \quad R = (n + 1) \cdot \left(\left(\frac{2}{\varepsilon} \right) - 1 \right)$$

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

$$ex \quad 3.315789 = (2 + 1) \cdot \left(\left(\frac{2}{0.95} \right) - 1 \right)$$

32) Transmissivity Given Reflectivity and Absorptivity 

$$fx \quad \tau = 1 - \alpha - \rho$$

[Open Calculator !\[\]\(235bfe13ebf007ce2eea9e689707fac7_img.jpg\)](#)

$$ex \quad 0.25 = 1 - 0.65 - 0.10$$



33) Wavelength Given Speed of Light and Frequency

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

fx $\lambda = \frac{[c]}{\nu}$

ex $399.7233\text{nm} = \frac{[c]}{7.5\text{E}^14\text{Hz}}$



Variables Used










- **A** Area (Square Meter)
- **A₁** Surface Area of Body 1 (Square Meter)
- **A₂** Surface Area of Body 2 (Square Meter)
- **E** Emissive Power of Non Blackbody (Watt per Square Meter)
- **E_b** Emissive Power of Blackbody (Watt per Square Meter)
- **E_{b1}** Emissive Power of 1st Blackbody (Watt per Square Meter)
- **E_{b2}** Emissive Power of 2nd Blackbody (Watt per Square Meter)
- **E_q** Energy of Each Quanta (Joule)
- **F₁₂** Radiation Shape Factor 12
- **F₂₁** Radiation Shape Factor 21
- **G** Irradiation (Watt per Square Meter)
- **J** Radiosity (Watt per Square Meter)
- **J₁** Radiosity of 1st Body (Watt per Square Meter)
- **J₂** Radiosity of 2nd Body (Watt per Square Meter)
- **m** Mass of Particle (Kilogram)
- **n** Number of Shields
- **q** Heat Transfer (Watt)
- **q₁₋₂** Radiation Heat Transfer (Watt)
- **Q₁₋₂** Net Heat Transfer (Watt)
- **R** Resistance
- **r₁** Radius of Smaller Sphere (Meter)
- **r₂** Radius of Larger Sphere (Meter)



- T Temperature of Blackbody (Kelvin)
- T_1 Temperature of Surface 1 (Kelvin)
- T_2 Temperature of Surface 2 (Kelvin)
- T_3 Temperature of Radiation Shield (Kelvin)
- T_{P1} Temperature of Plane 1 (Kelvin)
- T_{P2} Temperature of Plane 2 (Kelvin)
- T_R Radiation Temperature (Kelvin)
- α Absorptivity
- ϵ Emissivity
- ϵ_1 Emissivity of Body 1
- ϵ_2 Emissivity of Body 2
- ϵ_3 Emissivity of Radiation Shield
- λ Wavelength (Nanometer)
- λ_{Max} Maximum Wavelength (Micrometer)
- ν Frequency (Hertz)
- ρ Reflectivity
- τ Transmissivity



Constants, Functions, Measurements used

- **Constant:** [c], 299792458.0 Meter/Second
Light speed in vacuum
- **Constant:** [hP], 6.626070040E-34 Kilogram Meter² / Second
Planck constant
- **Constant:** [Stefan-BoltZ], 5.670367E-8 Kilogram Second⁻³ Kelvin⁻⁴
Stefan-Boltzmann Constant
- **Measurement: Length** in Meter (m)
Length Unit Conversion 
- **Measurement: Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement: Temperature** in Kelvin (K)
Temperature Unit Conversion 
- **Measurement: Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement: Energy** in Joule (J)
Energy Unit Conversion 
- **Measurement: Power** in Watt (W)
Power Unit Conversion 
- **Measurement: Frequency** in Hertz (Hz)
Frequency Unit Conversion 
- **Measurement: Wavelength** in Nanometer (nm), Micrometer (μm)
Wavelength Unit Conversion 
- **Measurement: Heat Flux Density** in Watt per Square Meter (W/m²)
Heat Flux Density Unit Conversion 



Check other formula lists

- [Gas Radiation Formulas](#) 
- [Important Formulas in Gas Radiation, Radiation Exchange with Specular Surfaces & more Special Cases](#) 
- [Important Formulas in Radiation Heat Transfer](#) 
- [Radiation Exchange with Specular Surfaces Formulas](#) 
- [Radiation Formulas](#) 
- [Radiation Heat Transfer Formulas](#) 
- [Radiation System consisting of Transmitting and Absorbing Medium between Two Planes. Formulas](#) 

Feel free to SHARE this document with your friends!

PDF Available in

[English](#) [Spanish](#) [French](#) [German](#) [Russian](#) [Italian](#) [Portuguese](#) [Polish](#) [Dutch](#)

7/8/2023 | 2:13:33 AM UTC

[Please leave your feedback here...](#)

