Radiation in a Two-Surface Gray Enclosure: Cylinders, Spheres, Plates

Net radiation between two diffuse gray surfaces forming an enclosure (concentric cylinders or spheres, parallel plates or a general pair) by the radiosity network.

Method: Two-surface radiosity network for diffuse gray surfaces

Input parameters

Unit system: SI

Parameter	Value	Unit
Geometry	Long concentric cylinders	
Area of the inner (or first) surface	1.0000	m²
Radius ratio (cylinders, spheres) or area ratio (general)	0.60000	
View factor from 1 to 2 (general only)	1.0000	
Emissivity of surface 1	80.000	%
Emissivity of surface 2	30.000	%
Temperature of surface 1	300.00	°C
Temperature of surface 2	50.000	°C

Calculated results

Parameter	Value	Unit
Net radiation from 1 to 2	2.0757	kW
Net flux on surface 1	2,075.7	W/m²
Effective emissivity $q/(\sigma A_1(T_1^4 - T_2^4))$	0.37736	
Area ratio used	0.60000	
Radiosity of surface 1	5,600.1	W/m²
Radiosity of surface 2	3,524.4	W/m²

Notes for this case

- Radiosity network of two diffuse gray surfaces: $q = \sigma A_1(T_1^4 - T_2^4)/[(1 - \varepsilon_1)/\varepsilon_1 + 1/F_{12} + (1 - \varepsilon_2)/\varepsilon_2 \cdot A_1/A_2]$. For cylinders the areas are per unit length ($A_1 = 2\pi r_1 L$).

Formula and method

$$q_{12} = \frac{\sigma A_1 (T_1^4 - T_2^4)}{\frac{1-\varepsilon_1}{\varepsilon_1} + \frac{1}{F_{12}} + \frac{1-\varepsilon_2}{\varepsilon_2}\frac{A_1}{A_2}}, \quad \frac{A_1}{A_2} = \frac{r_1}{r_2}\ \text{(cylinders)}, \quad \left(\frac{r_1}{r_2}\right)^2\ \text{(spheres)}$$

Variables

$\mathrm{geometry}$	Geometry	-
A_1	Area of the inner (or first) surface	m²
r_1/r_2 or A_1/A_2	Radius ratio (cylinders, spheres) or area ratio (general)	-
F_{12}	View factor from 1 to 2 (general only)	-
ε_1	Emissivity of surface 1	-
ε_2	Emissivity of surface 2	-
T_1	Temperature of surface 1	K
T_2	Temperature of surface 2	K

q_{12}	Net radiation from 1 to 2	W
q_{12}/A_1	Net flux on surface 1	W/m²
ε_{eff}	Effective emissivity q/(σA₁(T₁⁴ − T₂⁴))	-
A_1/A_2	Area ratio used	-
J_1	Radiosity of surface 1	W/m²
J_2	Radiosity of surface 2	W/m²

Method and standards

Radiosity network for a two-surface gray enclosure.

Assumptions and limits

- Diffuse gray surfaces, uniform temperatures and radiosities, non-participating gas.

References

Two-surface radiosity network for diffuse gray surfaces

Report details

Report reference	FCC-457N-TZB2 (the same inputs always give the same reference)
Generated	23 November 2026, 18:00 UTC
Calculator	Radiation in a Two-Surface Gray Enclosure: Cylinders, Spheres, Plates
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	4 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/heat-transfer/gray-surface-enclosure-radiation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.