Radiation Heat Transfer Between Surfaces

Net radiant heat exchange by the Stefan–Boltzmann law for a body in large surroundings or two large parallel plates, with the radiation coefficient.

Method: Stefan–Boltzmann law (CODATA 2018 σ)

Input parameters

Unit system: SI

Parameter	Value	Unit
Arrangement	Small body in large surroundings	
Surface area (of the body, or of one plate)	10.000	m²
Hot surface temperature	300.00	°C
Cold surface or surroundings temperature	30.000	°C
Emissivity of the hot surface	80.000	%
Emissivity of the cold plate (plates only)	80.000	%

Calculated results

Parameter	Value	Unit
Net heat exchange	45.121	kW
Heat flux	4.5121	kW/m²
Radiation heat transfer coefficient	16.712	W/(m²·K)
Effective emissivity	80.000	%

Notes for this case

- Grey, diffuse surfaces and a transparent gap (no absorbing gas such as flue gas between them).

Formula and method

$$\dot{Q} = F_\varepsilon \, \sigma \, A \, (T_1^4 - T_2^4) \qquad F_\varepsilon = \varepsilon_1 \ \text{(small body)} \quad F_\varepsilon = \frac{1}{1/\varepsilon_1 + 1/\varepsilon_2 - 1} \ \text{(plates)} \qquad h_r = \frac{q}{T_1 - T_2}$$

Variables

case	arrangement	–
A	area	m²
T_1	hot surface temperature	K
T_2	cold surface temperature	K
ε_1	hot emissivity	–
ε_2	cold emissivity	–
$\dot{Q}$	net heat exchange	W
q	heat flux	W/m²
h_r	radiation coefficient	W/(m²·K)
F_ε	effective emissivity	–
σ	Stefan–Boltzmann constant	W/(m²·K⁴)

Method and standards

Stefan–Boltzmann law for grey diffuse surfaces in the two limiting geometries.

Assumptions and limits

- Grey, diffuse surfaces; non-absorbing medium.

References

- Stefan–Boltzmann law (CODATA 2018 σ)

Report details

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Release checks	3 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/radiation-heat-exchange

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.