Radiation Heat Exchange with Radiation Shields

Radiant heat flux between two large parallel plates and the reduction by thin radiation shields between them, with all surfaces of equal or set emissivity.

Method: Incropera; DeWitt; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Temperature of the hot plate	526.85	°C
Temperature of the cold plate	126.85	°C
Emissivity of plate 1	0.80000	
Emissivity of plate 2	0.80000	
Emissivity of each shield (both faces)	0.10000	
Number of shields	1.0000	

Calculated results

Parameter	Value	Unit
Flux without shields	14,516	W/m²
Flux with the shields	1,062.2	W/m²
Reduction	92.683	%

Notes for this case

- Large parallel grey surfaces; each shield adds (2/ε_s − 1) to the resistance.

Formula and method

$$q'' = \frac{\sigma(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1 + N\left(\frac{2}{\varepsilon_s} - 1\right)}$$

Variables

T_1	Temperature of the hot plate	K
T_2	Temperature of the cold plate	K
ε_1	Emissivity of plate 1	-
ε_2	Emissivity of plate 2	-
ε_s	Emissivity of each shield (both faces)	-
N	Number of shields	-
q''_0	Flux without shields	W/m²
q''	Flux with the shields	W/m²
$1 - q''/q''_0$	Reduction	-

Method and standards

Radiation network with shields.

Assumptions and limits

- Large parallel grey surfaces.
- The number of shields is a whole number; a fractional entry is rounded, with a note.

References

- Incropera
- DeWitt

- Bergman and Lavine
- Fundamentals of Heat and Mass Transfer
- ch. 13 (radiation shields between parallel plates)

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-shield

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.