Blackbody and Grey-Body Emissive Power (Stefan–Boltzmann, Wien)

Emissive power of a black or grey surface at a temperature, the wavelength of peak emission (Wien) and the net radiation to surroundings.

Method: Stefan–Boltzmann law and Wien's displacement law (CODATA 2018 constants)

Input parameters

Unit system: SI

Parameter	Value	Unit
Surface temperature	1,000.0	°C
Emissivity	0.85000	
Surroundings temperature	30.000	°C

Calculated results

Parameter	Value	Unit
Blackbody emissive power σ T⁴	148.98	kW/m²
Grey-body emissive power ε σ T⁴	126.63	kW/m²
Net radiation to the surroundings ε σ (T⁴ − T_sur⁴)	126.23	kW/m²
Wavelength of peak emission (Wien)	2.2761	µm

Notes for this case

- Small grey surface in large surroundings for the net value.

Formula and method

$$E_b = \sigma T^4, \quad E = \varepsilon \sigma T^4, \quad \lambda_{max} T = 2897.8 \ \mu\text{m}\cdot\text{K}$$

Variables

T	Surface temperature	K
ε	Emissivity	-
T_{sur}	Surroundings temperature	K
E_b	Blackbody emissive power σ T⁴	W/m²
E	Grey-body emissive power ε σ T⁴	W/m²
q''_{net}	Net radiation to the surroundings ε σ (T⁴ − T_sur⁴)	W/m²
λ_{max}	Wavelength of peak emission (Wien)	m

Method and standards

Planck's law integrated and differentiated.

Assumptions and limits

- Grey diffuse surface.

References

- Stefan–Boltzmann law and Wien's displacement law (CODATA 2018 constants)

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/blackbody-emission

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.