

STEFAN–BOLTZMANN LAW

Josef Stefan determined from experimental data that the total power emitted by a radiant object is proportional to the fourth power of its absolute temperature T . Five years later Ludwig Boltzmann showed how to derive the same relation from principles of thermodynamics. The modern form of the Stefan–Boltzmann law is

$$P = A\varepsilon\sigma T^4$$

where P is total power, A is surface area, ε is an emissivity constant, and σ is the Stefan–Boltzmann constant

$$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$$

For example, consider a one cubic centimeter block of wrought iron at 1000 K. The emissivity constant of wrought iron is $\varepsilon = 0.94$ hence the total radiant power is

$$P = (6 \times 10^{-4} \text{ m}^2) \times 0.94 \times (5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}) \times 1000^4 \text{ K}^4 = 32 \text{ W}$$

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A = 6 * 10^(-4) * meter^2
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epsilon = 0.94
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sigma = 5.67 * 10^(-8) * watt * meter^(-2) * kelvin^(-4)
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T = 1000 * kelvin
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A * epsilon * sigma * T^4
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