

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,  $\varepsilon$  is an emissivity constant, and  $\sigma$  is the Stefan-Boltzmann constant

$$\sigma = 5.67 \times 10^{-8} \text{ watt meter}^{-2} \text{ kelvin}^{-4}$$

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

$$P = \underbrace{(6 \times 10^{-4} \text{ meter}^2)}_{\text{surface area 1 cm cube}} \times \underbrace{0.94}_{\varepsilon} \times \underbrace{(5.67 \times 10^{-8} \text{ watt meter}^{-2} \text{ kelvin}^{-4})}_{\sigma} \times \underbrace{1000^4}_{T^4} \text{ kelvin}^4 = 32 \text{ watt}$$