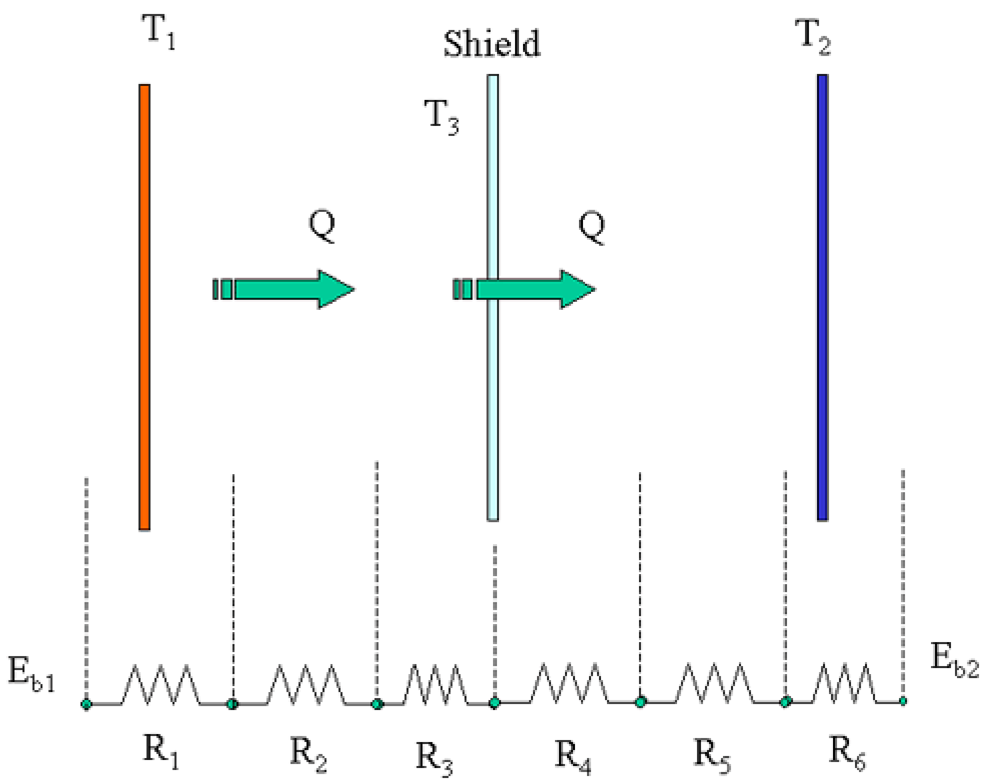
Radiation Shielding between two Parallel Plates



$$R_1 = \frac{1-\varepsilon_1}{\varepsilon_1 A_1}, \quad R_2 = \frac{1}{A_1 F_{13}}, \quad R_3 = \frac{1-\varepsilon_{3,1}}{\varepsilon_{3,1} A_3}, \quad R_1 = \frac{1-\varepsilon_{3,2}}{\varepsilon_{3,2} A_3}, \quad R_1 = \frac{1}{A_3 F_{32}}, \quad R_1 = \frac{1-\varepsilon_2}{\varepsilon_2 A_2}$$

The figure above shows one shield for which the modified heat transfer rate is:

$$\dot{Q}_{12,one} = \frac{A\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1\right)}$$

Where we have assumed that the plate surface areas are equal and $F_{13}=F_{23}=1$.
The above formulation may be generalized for N shields:

$$\dot{Q}_{12,N} = \frac{A\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1\right) + ... + \left(\frac{1}{\varepsilon_{N,1}} + \frac{1}{\varepsilon_{N,2}} - 1\right)}$$

This equation can be further simplified if the emissivities of the surfaces are all equal

$$\dot{Q}_{12,\mathrm{N}} = \frac{A\sigma(T_1^4 - T_2^4)}{(N+1)\left(\frac{1}{\varepsilon}+\frac{1}{\varepsilon}-1\right)} = \frac{1}{N+1}\dot{Q}_{12,\text{no shield}}$$