Heat exchanger efficiency

**Definitions**

Effectiveness, $\varepsilon$, is defined as the ratio of the actual heat transfer rate for a heat exchanger to the maximum possible heat transfer rate, namely,

$$
\varepsilon = \frac{q}{q_{\text{max}}} = \frac{C_h (T_{h,i} - T_{h,o})}{C_{\text{min}} (T_{h,i} - T_{c,i})} = \frac{C_c (T_{c,o} - T_{c,i})}{C_{\text{min}} (T_{h,i} - T_{c,i})}
$$

In general, it is possible to express effectiveness as a function of the number of transfer units, NTU; the heat capacity rate ratio, $C^*$; and the flow arrangement in the heat exchanger,

$$
\varepsilon = f(\text{NTU}, \ C^*, \ \text{flow arrangement})
$$

with the dimensionless number of transfer units (NTU) that is used for heat exchanger analysis and is defined as

$$
\text{NTU} = \frac{UA}{C_{\text{min}}}
$$

and the dimensionless heat capacity rate ratio

$$
C^* = \frac{C_{\text{min}}}{C_{\text{max}}}
$$

where $C_{\text{min}}/C_{\text{max}}$ is equal to $C_c/C_h$ or $C_h/C_c$, depending on the relative magnitudes of the hot and cold fluid heat capacity rates.