In thermodynamics, the concept of entropy, $q$, is crucial for understanding the flow of energy in a system. The expression for $q$ is given by:

$$ q = \int T \, ds $$

where $T$ is the temperature of the system. The entropy change, $\Delta S$, is related to the heat flow, $q$, and the change in internal energy, $\Delta U$, by the relation:

$$ \Delta S = \frac{q}{T} $$

For the system in question, the heat flows as follows:

1. From $T_1$ to $T_2$: $q = \int T_1 \, ds$
2. From $T_2$ to $T_3$: $q = \int T_2 \, ds$
3. From $T_3$ to $T_1$: $q = \int T_3 \, ds$

The heat flow is irreversible, meaning $q > 0$. The work, $w$, done by the system is given by:

$$ w = \int T \, ds $$

The efficiency of the system can be expressed as:

$$ \eta = \frac{w}{q} $$

The temperatures $T_1$, $T_2$, and $T_3$ are constant during the process.

For the given cycle, the efficiency is compared between the two cycles. The first cycle has a higher efficiency because the temperature ratio of heat sink to heat source (or average basis) is lower for cycle I compared to cycle II.

$$ \eta_I > \eta_{II} $$

This indicates that cycle I is more efficient, with less "waste" work in cycle II.
T2 (h-s diagrams, Gibbs, integral mean)

Assume:
- adiabatic non-ideal fan,
- core mass flow negligible

\[ c_1 = c_2 \]

\[ W_s = \dot{m}(h_{t_e} - h_{t_0}) \]

\[ h_{t_0} = h_{t_1}, \quad h_{t_e} = h_{t_2} \]

\[ \dot{m} = \frac{W_s}{c_p(T_{t_2} - T_{t_1})} \]

\[ T_{t_1} = T_{t_0} + 300 \, \text{K} \]

\[ c_1 = c_2 = \sqrt{2c_p(T_{t_2} - T_{t_1})}, \quad T_2 = T_{t_2} - \frac{c_s^2}{2c_p} = 320 \, \text{K} \]

\[ \dot{m}_{fan} = \frac{W_s}{w_s} = \frac{T_{t_2} - T_{t_1}}{T_{t_2} - T_{t_1}} \]

\[ M_2 = \frac{c_s}{\sqrt{R}T_{t_2}} \]

\[ s_2 - s_1 = c_p\ln\left(\frac{T_{t_2}}{T_{t_1}}\right) - R\ln\left(\frac{P_{t_2}}{P_{t_1}}\right) \]

\[ T = \dot{m} \left( c_{e} - c_{0} \right) = \dot{m} c_{e} \]

\[ T = 173.7 \, \text{Kw} \]
\( T_3 \)

\[ \frac{u_0}{T_0} \]

\[ \frac{u_1}{T_1} \]

Know: \( u_0, u_1, T_0, T_1, c_p \)

Assume: ideal cycle

Skeezee chart figure

Ideal gas, \( c_p = \text{const} \)

Concepts: ideal Brayton cycle

\( h-s \) diagrams

\( \text{overall, prop. eff.} \)

\[ q_R = c_p (T_1 - T_0) \] from 1st law

\[ q_A = q_{\text{net}} = w_{\text{net}} \]

\[ w_{\text{net}} = \frac{u_1^2 - u_0^2}{2} \]

\[ q_{\text{net}} = \frac{u_1^2 - u_0^2}{2} \]

\[ \gamma_{\text{prop}} = \frac{w_{\text{net}}}{q_{\text{net}}} = \frac{1}{1 + \frac{q_R}{w_{\text{net}}}} \]

\[ \gamma_{\text{prop}} = \left( 1 + \frac{2c_p(T_1 - T_0)}{u_1^2 - u_0^2} \right)^{-1} \]

\[ \gamma_0 = \gamma_{\text{prop}} \gamma_{\mu_0} \]

\[ \gamma_{\text{prop}} = \frac{\text{Thrust power}}{\text{mass flow} \cdot \text{power}} = \frac{u_0^2 (u_1 - u_0)}{\frac{1}{\gamma_0} (u_1^2 - u_0^2)} \]

\[ \gamma_{\text{prop}} = \frac{2}{1 + \frac{u_1}{u_0}} \]

\[ \gamma_0 = \frac{2}{1 + \frac{u_1}{u_0}} \frac{(u_1^2 - u_0^2)}{u_1^2 - u_0^2 + 2c_p(T_1 - T_0)} \]

\[ \gamma_0 = \frac{2u_0 \cdot (u_1 - u_0)}{u_1^2 - u_0^2 + 2c_p(T_1 - T_0)} \]