\[ W_{1-2} = h_1 - h_2 = C_p (T_1 - T_2) \]

Entropic efficiency

\[ \eta_{fs} = \frac{W_{1-2}}{W_{1-2s}} \]

\[ W_{1-2s} = h_1 - h_{2s} = C_p (T_1 - T_{2s}) \]

For an ideal gas with constant specific heats undergoing an isentropic process, the process is polytropic with \( n = \frac{k}{k-1} = \frac{C_p}{C_v} \)

\[ P_0^k = \text{constant} \quad \Rightarrow \quad T_{2s} = \left( \frac{P_2}{P_1} \right)^{\frac{k-1}{k}} \]

\[ P_0 = RT \quad \Rightarrow \quad \frac{T_2}{T_1} = \left( \frac{P_2}{P_1} \right)^{\frac{k-1}{k}} \]

\[ W_{1-2s} = C_p T_1 \left( 1 - \left( \frac{P_2}{P_1} \right)^{\frac{k-1}{k}} \right) \]

And

\[ W_{1-2} = \eta_{fs} W_{1-2s} = \eta_{fs} C_p T_1 \left( 1 - \left( \frac{P_2}{P_1} \right)^{\frac{k-1}{k}} \right) \]

If pressure reduced to, say, \( P_3 \), and we assume \( \eta_{fs} \) is unchanged.

\[ \frac{W_{1-3}}{W_{1-2}} = \frac{\eta_{fs} C_p T_1 \left( 1 - \frac{P_3}{P_1} \right)^{\frac{k-1}{k}}}{\eta_{fs} C_p T_1 \left( 1 - \left( \frac{P_2}{P_1} \right)^{\frac{k-1}{k}} \right)} \]