

Carnot theorem .

No heat engine operating in a cyclic process between two fixed temperatures can be more efficient than a reversible engine while operating between the same temperature limit.

Corollary I

All reversible engines operating between the given two temperature limits have the same efficiency.

Corollary II

Efficiency of all the reversible engine depends only on the temperature limit of the reservoirs and is independent of the nature of working fluid.

Heat extraction (Q2)

$$E = T_1 q_2 = T_2 q_1$$

Heat rejected during cycle

$$Q_2 = T_2 q_2 = T_1 q_1$$

$$W = Q_1 - Q_2 = T_1 q_1 - T_2 q_2$$

$$T_1 q_2 - T_2 q_1 = (T_1 - T_2) q_2$$

Coefficient of performance is the ratio of heat extracted

to the work done.

$$\text{COP} = \frac{\text{Heat extracted}}{\text{Work done}} = \frac{E}{W} = \frac{T_1 q_2}{(T_1 - T_2) q_2}$$

$$\text{COP} = \frac{T_1}{T_1 - T_2} = \frac{T_2}{T_2 - T_1}$$

$$\text{COP} = \frac{\text{Heat rejected}}{\text{Work input}} = \frac{T_2 q_1}{(T_2 - T_1) q_1} = \frac{T_2}{T_2 - T_1}$$

$$T_1 = T_2, T_2 = T_1$$