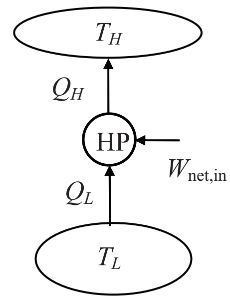
7-117 The claim of a heat pump designer regarding the COP of the heat pump is to be evaluated.

Assumptions The heat pump operates steadily.



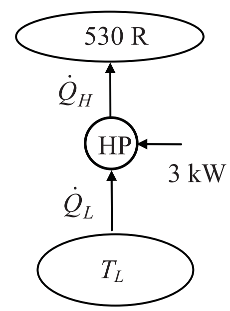
Analysis The maximum heat pump coefficient of performance would occur if the heat pump were completely reversible,

$$\text{COP}_{\text{HP,max}} = \frac{T_H}{T_H - T_L} = \frac{300\text{ K}}{300\text{ K} - 260\text{ K}} = 7.5$$

Since the claimed COP is less than this maximum, this heat pump is **possible**.

7-118E The operating conditions of a heat pump are given. The minimum temperature of the source that satisfies the second law of thermodynamics is to be determined.

Assumptions The heat pump operates steadily.



Analysis Applying the first law to this heat pump gives

$$\dot{Q}_L = \dot{Q}_H - \dot{W}_{\text{net,in}} = 100{,}000\text{ Btu/h} - (3\text{ kW})\left(\frac{3412.14\text{ Btu/h}}{1\text{ kW}}\right) = 89{,}760\text{ Btu/h}$$

In the reversible case we have

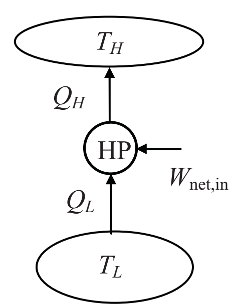
$$\frac{T_L}{T_H} = \frac{\dot{Q}_L}{\dot{Q}_H}$$

Then the minimum temperature may be determined to be

$$T_L = T_H \frac{\dot{Q}_L}{\dot{Q}_H} = (530\text{ R})\frac{89{,}760\text{ Btu/h}}{100{,}000\text{ Btu/h}} = \mathbf{476\text{ R}}$$

7-119 The claim of a thermodynamicist regarding the COP of a heat pump is to be evaluated.

Assumptions The heat pump operates steadily.



Analysis The maximum heat pump coefficient of performance would occur if the heat pump were completely reversible,

$$\text{COP}_{\text{HP,max}} = \frac{T_H}{T_H - T_L} = \frac{293\text{ K}}{293\text{ K} - 273\text{ K}} = 14.7$$

Since the claimed COP is less than this maximum, the claim is **valid**.