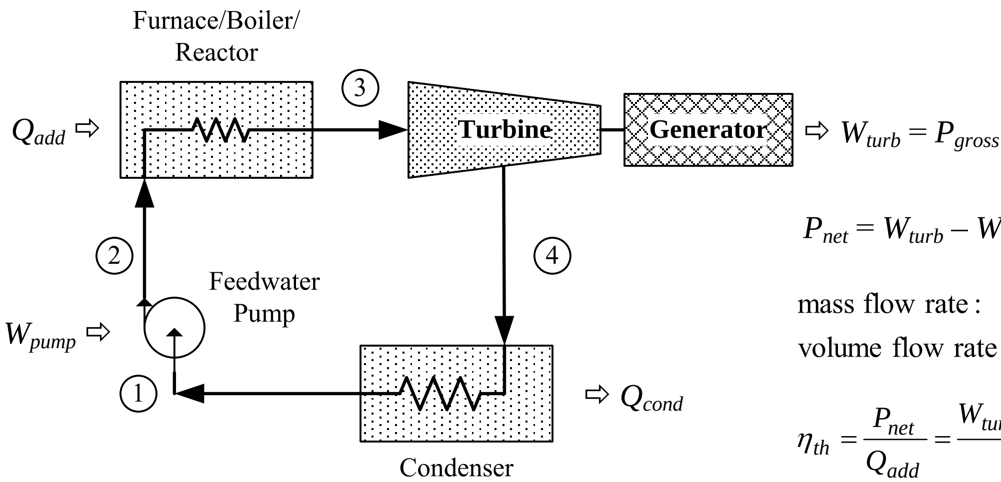
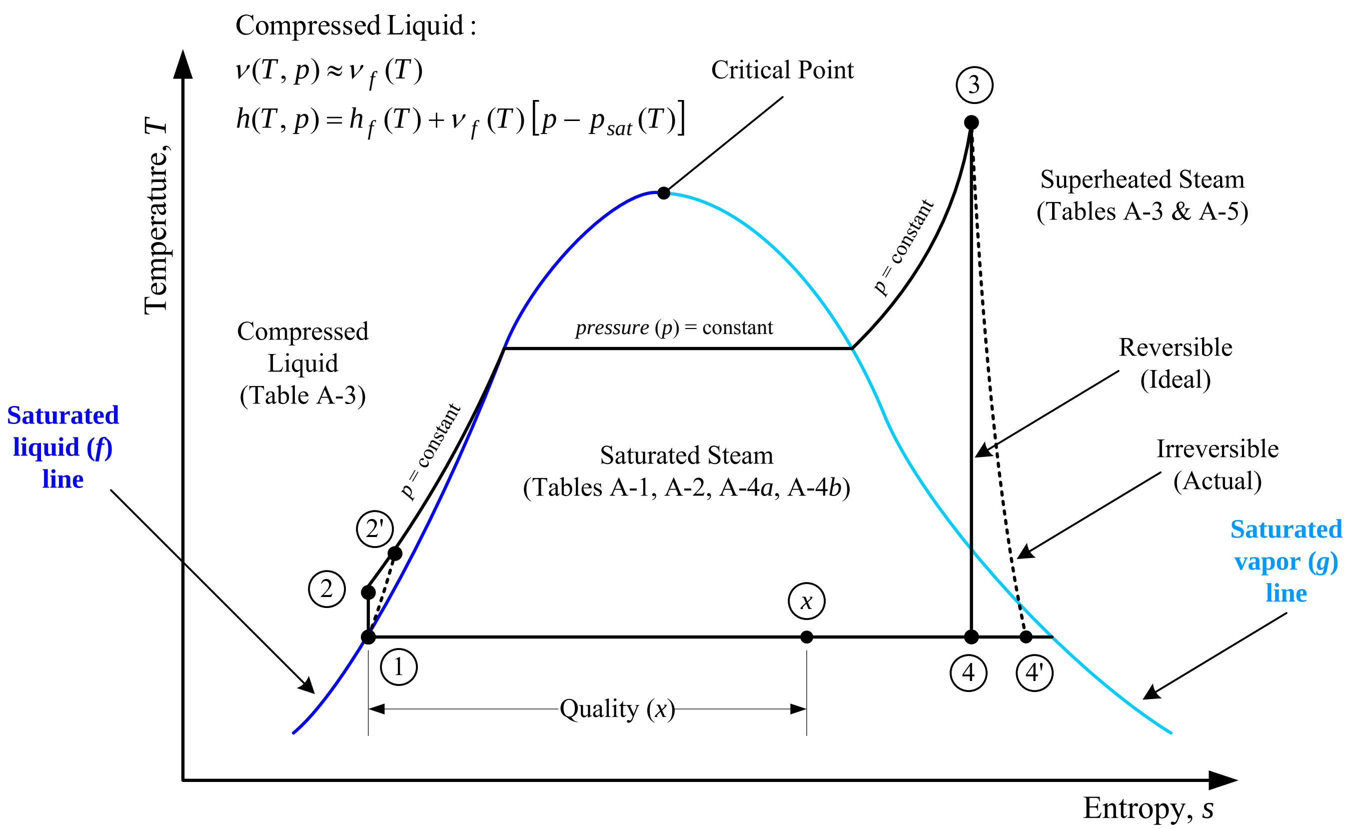


$$P_{net} = W_{turb} - W_{pump}$$

mass flow rate : $\dot{m}$

volume flow rate : $G = v\,\dot{m} = \dot{m}/\rho$

$$\eta_{th} = \frac{P_{net}}{Q_{add}} = \frac{W_{turb} - W_{pump}}{Q_{add}}$$



<u>①→②; Pump</u>: $(Q = 0;\ s_2 = s_1)$

$$W_{pump}^{ideal} = \dot{m}\,(h_2 - h_1) \cong \dot{m}\,v_1\,(p_2 - p_1)$$

$$W_{pump}^{actual} = \dot{m}\,(h_{2'} - h_1) \neq \dot{m}\,v_1\,(p_{2'} - p_1)$$

$$\eta_{pump} = \frac{W_{pump}^{ideal}}{W_{pump}^{actual}} = \frac{\Delta h_{ideal}}{\Delta h_{actual}} = \frac{h_2 - h_1}{h_{2'} - h_1}$$

<u>③→④; Turbine</u>: $(Q = 0;\ s_4 = s_3)$

$$W_{turb}^{ideal} = \dot{m}\,(h_3 - h_4)$$

$$W_{turb}^{actual} = \dot{m}\,(h_3 - h_{4'})$$

$$\eta_{turb} = \frac{W_{turb}^{actual}}{W_{turb}^{ideal}} = \frac{\Delta h_{actual}}{\Delta h_{ideal}} = \frac{h_3 - h_{4'}}{h_3 - h_4}$$

<u>②→③; Heating</u>: $(W = 0)$

$$Q_{add} = \dot{m}\,(h_3 - h_{2/2'})$$

<u>④→①; Condenser</u>: $(W = 0)$

$$Q_{cond} = \dot{m}\,(h_{4/4'} - h_1)$$

Steam Quality : $x = \dfrac{mass\ of\ vapor}{mass\ of\ liquid\ \&\ vapor} = \dfrac{h_x - h_f}{h_g - h_f} = \dfrac{s_x - s_f}{s_g - s_f} = \dfrac{v_x - v_f}{v_g - v_f}$