7.3 Fuel consumed during an energy climb

$$\frac{dW}{dt} = -\,C(h, V, P)\;T(h, V, P)$$

$$\frac{dE_s}{dt} = P_s(h, V, P, W) \qquad P, W \text{ Const.}$$

$$P = \text{Const} \qquad h = E_s - \frac{V^2}{2g}$$

$$\frac{dW}{dE_s} = -\,\frac{CT}{P_s}$$

$$W_f - W_o = -\int_{E_{so}}^{E_{sf}} \frac{CT}{P_s}\, dE_s$$

$$W_o - W_f = \int_{E_{so}}^{E_{sf}} \frac{dE_s}{P_s/CT}$$

Hence, fuel is a minimum when the velocity profile $V(E_s)$ is obtained from

$$\frac{\partial}{\partial V}\left(\frac{CT}{P_s}\right)\Bigg|_{E_s = \text{Const}} = 0$$

where for P, W const

$$\frac{CT}{P_s} = \frac{C(E_s - V^2/2g,\, V)\;T(E_s - V^2/2g,\, V)}{P_s(E_s - V^2/2g,\, V)}$$