5.12

SHOW :

$$\frac{U_9/U_0}{(U_9/U_0)_0} = \left[\frac{\tau_{\lambda b}}{\tau_\lambda - \tau_r(\tau_c - 1)}\right]^{1/2}$$

$$\left(\frac{U_9}{U_0}\right)^2 = \frac{a_9^2 M_9^2}{a_0^2 M_0^2} = \frac{\gamma R T_9 M_9^2}{\gamma R T_0 M_0^2} = \frac{T_9 M_9^2}{T_0 M_0^2}$$

$$T_{t9} = T_9\left(1 + \frac{\gamma-1}{2} M_9^2\right) = \frac{T_{t9}}{T_{t5}} \frac{T_{t5}}{T_{t4b}} \frac{T_{t4b}}{T_{t4a}} \frac{T_{t4a}}{T_{t4}} \frac{T_{t4}}{T_{t3}} \frac{T_{t3}}{T_{t2}} \frac{T_{t2}}{T_{t0}} \frac{T_{t0}}{T_0} T_0$$

$$\frac{T_9}{T_0}\left(1 + \frac{\gamma-1}{2} M_9^2\right) = \tau_{tb}\, \tau_{AB}\, \tau_{ta}\, \tau_\lambda = \tau_{tb}\, \tau_{\lambda b} \quad (1)$$

$$P_{t9} = P_9\left(1 + \frac{\gamma-1}{2} M_9^2\right)^{\frac{\gamma}{\gamma-1}} = \frac{P_{t9}}{P_{t5}} \frac{P_{t5}}{P_{t4b}} \frac{P_{t4b}}{P_{t4a}} \frac{P_{t4a}}{P_{t4}} \frac{P_{t4}}{P_{t3}} \frac{P_{t3}}{P_{t2}} \frac{P_{t2}}{P_{t0}} \frac{P_{t0}}{P_0} P_0$$

ASSUME $P_9 = P_0$ AND $\pi_b = \pi_{AB} = 1$

$$\left(1 + \frac{\gamma-1}{2} M_9^2\right)^{\frac{\gamma}{\gamma-1}} = \pi_{tb}\, \pi_{ta}\, \pi_c\, \pi_r$$

$$\pi = \tau^{\frac{\gamma}{\gamma-1}}$$

$$1 + \frac{\gamma-1}{2} M_9^2 = \tau_{tb}\, \tau_{ta}\, \tau_c\, \tau_r \quad (2)$$

PLUGGING THIS INTO (1):

$$\frac{T_9}{T_0}\left(\cancel{\tau_{tb}}\, \tau_{ta}\, \tau_c\, \tau_r\right) = \cancel{\tau_{tb}}\, \tau_{\lambda b}$$

$$\frac{T_9}{T_0} = \frac{\tau_{\lambda b}}{\tau_{ta}\, \tau_c\, \tau_r}$$

FROM (2):

$$M_9^2 = \frac{2}{\gamma-1}\left(\tau_{ta}\, \tau_c\, \tau_r - 1\right)$$

$$\frac{U_9}{U_0} = \left[\frac{\tau_{\lambda b}}{\tau_{ta}\, \tau_c\, \tau_r}\left(\tau_{ta}\, \tau_c\, \tau_r - 1\right)\frac{2}{\gamma-1}\right]^{1/2}$$

$$\tau_{\lambda b} = \tau_{AB}\, \tau_{ta}\, \tau_\lambda$$

W/ THE BURNER OFF , $\tau_{AB} = 1 \implies \tau_{\lambda b} = \tau_{ta}\, \tau_\lambda$

$$\left(\frac{U_9}{U_0}\right)_0 = \left[\frac{\tau_\lambda}{\tau_c\, \tau_r}\left(\tau_{ta}\, \tau_c\, \tau_r - 1\right)\frac{2}{\gamma-1}\right]^{1/2}$$