Section 4.1 Subsonic Airspeed and Mach Equations

True Airspeed

$$V_T = \left[\frac{2\gamma}{\gamma - 1} \frac{P_a}{\rho_a} \left(\left[\frac{P_T - P_a}{P_a} + 1 \right]^{\frac{\gamma-1}{\gamma}} - 1 \right) \right]^{\frac{1}{2}}$$

Equivalent Airspeed

(= V_T equation with assumption of std day sea level density)

$$V_e = \sqrt{7 \frac{P_a}{\rho_o} \left(\left[\frac{P_T - P_a}{P_a} + 1 \right]^{\frac{2}{7}} - 1 \right)} = V_T \sqrt{\frac{\rho_a}{\rho_o}} = V_T \sqrt{\sigma}$$

Calibrated Airspeed

(= V_e equation with assumption of std day sea level pressure)

$$V_c = \left[\frac{2\gamma}{\gamma - 1} \frac{P_o}{\rho_o} \left(\left[\frac{P_T - P_a}{P_o} + 1 \right]^{\frac{\gamma-1}{\gamma}} - 1 \right) \right]^{\frac{1}{2}}$$

$$\sqrt{7 \frac{\mathrm{P_o}}{\rho_o} \left(\left[\frac{\mathrm{q_c}}{\mathrm{P_o}} + 1 \right]^{.2857} -1 \right)}$$

Applying British units (*lb/ft²*) and converting from *ft/sec* to knots yields

$$V_c = 1479 \sqrt{\left[\frac{P_T - P_a}{2116} + 1 \right]^{\frac{2}{7}} - 1} \quad \text{(kts)}$$

Mach Number

$$M = \frac{V_T}{a} = \sqrt{\frac{2}{\gamma - 1} \left[\left(\frac{P_T - P_a}{P_a} + 1 \right)^{\frac{\gamma-1}{\gamma}} - 1 \right]} = \sqrt{5 \left(\left[\frac{q_c}{P_a} + 1 \right]^{\frac{2}{7}} - 1 \right)}$$