$$R_{air} = 287.05 J/kg\,^\circ K \qquad 1\,atm = 1.013\times 10^5 N/m^2 \qquad \gamma_{air} = 1.4 \qquad a = \sqrt{\gamma R T}$$

Isentropic flow formulas

$$\frac{T_0}{T} = \left(1 + {}^1\!/_5 M^2\right)$$

$$\frac{\rho_0}{\rho} = \left(\frac{T_0}{T}\right)^{C_v/R} = \left(1 + {}^1\!/_5 M^2\right)^{5/2}$$

$$\frac{P_0}{P} = \left(\frac{T_0}{T}\right)^{C_p/R} = \left(1 + {}^1\!/_5 M^2\right)^{7/2}$$

$$\frac{A}{A_*} = \frac{1}{M}\left(\frac{5 + M^2}{6}\right)^3$$

$$M = \sqrt{5\left(\frac{P_0}{P}\right)^{2/7} - 5}$$

Normal shock formulas

These are the general form of the equations

$$M_2^2 = \frac{5 + M_1^2}{7M_1^2 - 1} \geq \frac{1}{7} \qquad \frac{M^2(\gamma-1)+2}{2\gamma M^2 - (\gamma-1)}$$

$$\frac{\rho_2}{\rho_1} = \frac{6M_1^2}{5 + M_1^2} \qquad \frac{(\gamma+1)M^2}{(\gamma-1)M^2+2}$$

$$\frac{P_2}{P_1} = \frac{7M_1^2 - 1}{6} \qquad \frac{2\gamma M^2 - (\gamma-1)}{\gamma+1}$$

$$\frac{T_2}{T_1} = \frac{(7M_1^2 - 1)(5 + M_1^2)}{36 M_1^2} \qquad \frac{P_2}{P_1}\frac{\rho_1}{\rho_2}$$

$$loss: \frac{P_{02}}{P_{01}} = \frac{P_2}{P_1}\left(\frac{T_1}{T_2}\right)^{7/2}$$

Pitot tube formula $$\frac{P_{02}}{P_1} = \frac{6^6 M^7}{5^{7/2}(7M^2 - 1)^{5/2}}$$

Duct flow

$$\dot{m} = P_0 A \sqrt{\frac{\gamma}{R T_0}} \frac{M}{\left(1 + {}^1\!/_5 M^2\right)^3} \qquad \left(= 0.6847 \frac{P_0 A_*}{\sqrt{R T_0}} \text{ when choked, } P_a/P_0 \leq 0.5283\right)$$

Oblique shock

$$M_{n1} = M_1 \sin\beta \qquad M_2 = \frac{M_{n2}}{\sin(\beta - \theta)} \qquad \tan\theta = \frac{2}{\tan\beta}\left[\frac{M^2 \sin^2\beta - 1}{M^2(1.4 + \cos 2\beta) + 2}\right]$$