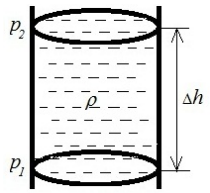
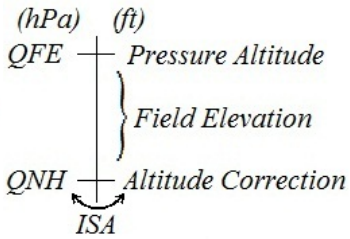
Gases Perfeitos: (ar: R=287.052874 J/(kg ·K), γ = 1.4) g = 9.80665 m/s^2

$$p = \rho \cdot R \cdot T$$

$$\frac{p}{p_0} = \frac{\rho}{\rho_0} \cdot \frac{T}{T_0} \Leftrightarrow \delta = \sigma \cdot \theta$$

Coluna de fluido:





$$p_1 - p_2 = \rho g \Delta h$$

Processo isotérmico: $p \cdot v = \frac{p}{\rho} = C^{te}$ isocórico: $\frac{p}{T} = C^{te}$

isobárico: $\rho \cdot T = \frac{T}{v} = C^{te}$ adiabático: $p \cdot v^{\gamma} = \frac{p}{\rho^{\gamma}} = C^{te}$

Atmosfera Padrão (ISA): Desvio de ISA ≡ ΔISA = t_{amb}- $t_{[ISA]}(h_p)$

$p_0 = 1013.25$ hPa; $\rho_0 = 1.225$ kg/m^3; $T_0 = 15$°C = 288.15 K; $\mu_0 = 1.78938 \times 10^{-5}$ Ns/m^2

Troposfera (h ≤ 11000 m) : $T[\mathrm{K}] = 288.15 - 0.0065 \cdot h[\mathrm{m}]$

$$\frac{p_2}{p_1} = \left(\frac{T_2}{T_1}\right)^{\frac{-g}{R\lambda}}, \lambda<0$$

$$p[\mathrm{Pa}] = 101325 \cdot \left(1 - \frac{0.0065 \cdot h[\mathrm{m}]}{288.15}\right)^{5.25588}$$

$$\rho[\mathrm{kg/m^3}] = 1.225 \cdot \left(1 - \frac{0.0065 \cdot h[\mathrm{m}]}{288.15}\right)^{4.25588}$$

Tropopausa (h = 11000 m): $p_{trop} = 226.32$ hPa ; $\rho_{trop} = 0.36392$ kg / m^3 ; $T_{trop} = 216.65$ K

Estratoesfera (h ≥ 11000 m) :

$$p[\mathrm{Pa}] = 22632 \cdot e^{-0.000157688 \cdot (h[\mathrm{m}] - 11000)}$$

$$\frac{p_2}{p_1} = \frac{\rho_2}{\rho_1}$$

$T = 216.65$ K = -56.5 °C

$$\rho[\mathrm{kg/m^3}] = 0.36392 \cdot e^{-0.000157688 \cdot (h[\mathrm{m}] - 11000)}$$

Coeficiente de viscosidade absoluta do ar: $\mu[\mathrm{Ns/m^2}] = 1.458 \times 10^{-6} (T[\mathrm{K}])^{\frac{3}{2}} \cdot \left(\frac{1}{T[\mathrm{K}] + 110.4}\right)$

Velocidade do som: $a = \sqrt{\gamma RT} = \sqrt{\gamma RT_0} \cdot \sqrt{\frac{T}{T_0}} = a_0 \sqrt{\theta}$ a_0= 340.294 m/s γ= 1.4 $M = \frac{V}{a}$

Escoamento incompressível (M < 0.3):

$$p + \frac{1}{2}\rho \cdot v^2 = C^{te} = p_T$$

$$v_2 = \frac{A_1}{A_2} \cdot v_1$$

ρ = C^{te}

Escoamento compressível (M ≥ 0.3):

$$\frac{\gamma}{\gamma - 1}\frac{p}{\rho} + \frac{1}{2}v^2 = C^{te} = \frac{\gamma}{\gamma - 1}\frac{p_T}{\rho_T}$$

$$v_2 = \frac{\rho_1 A_1}{\rho_2 A_2} \cdot v_1$$

$$TAT = SAT(1 + 0.2M^2)$$

Velocidades:

$$CAS^2 = \frac{2 \cdot a_0^{\,2}}{\gamma - 1}\left[\left(\frac{p_T - p}{p_0} + 1\right)^{\frac{\gamma - 1}{\gamma}} - 1\right]$$

$IAS = CAS$ + erro de posição

$CAS = EAS$ + erro de compressibilidade

$EAS = TAS$ + erro de densidade

$$M^2 = \frac{2}{\gamma - 1}\left[\left(\frac{p_T - p}{p} + 1\right)^{\frac{\gamma - 1}{\gamma}} - 1\right]$$

$$EAS = TAS \cdot \sqrt{\sigma}$$

$$GS = TAS + W/C$$

$$\vec{GS} = \vec{TAS} + \vec{V}_W$$