Potentially Useful Equations

ATMS 320

$$P = IV$$

$$^\circ\mathrm{C} = \frac{5}{9}(^\circ\mathrm{F} - 32^\circ)$$

$$\tau = \frac{I}{\rho R^2 CAV_i}$$

$$C = 2\Omega v \sin\phi$$

$$\pm f_{\text{aliased}} = f_{\text{input}} - 2m f_N$$

$$S_S = \frac{d(\text{raw output})}{d(\text{raw input})}$$

$$v_1(t) = \cos(2\pi f_1 t)$$

$$1 \text{ Coulomb} \approx 6 \times 10^{18} \text{ electrons}$$

$$\frac{\partial \rho}{\partial t} = \vec{\nabla} \cdot \rho \vec{V}$$

$$\vec{F} = m\vec{a}$$

$$T = \frac{1}{2} C_d \rho A r (V - s)^2$$

$$\frac{\partial p}{\partial z} = -\rho g$$

$$\frac{mC}{UA}\frac{dT}{dt} = T_{\text{air}} - T$$

$$\tau \frac{dx}{dt} + x = x_c$$

$$p = \rho R_d T$$

$$\sigma = 5.67 \times 10^{-8} \ \frac{\mathrm{W}}{\mathrm{m^2 K^4}}$$

$$Q = \frac{S_p}{2^{N_B}}$$

$$KE = \frac{1}{2} m v^2$$

$$V(t) = V_B \left(1 - e^{-t/RC}\right)$$

$$c = 2.9979 \times 10^8 \mathrm{m\ s^{-1}}$$

$$D = \text{integer}\left[\frac{A - A_L}{Q} + 0.5\right]$$

$$x_T(t) = C_1 e^{-t/\tau}$$

$$x_S(t) = x_i(t) = x_c$$

$$x(t) = x_c + C_1 e^{-t/\tau}$$

$$\Delta p = 0.5 \rho V^2$$

$$f_N = \frac{1}{2\Delta t_s}$$

$$f V_g = -\frac{\partial \Phi}{\partial n}$$

$$V = IR$$

$$a_0 = \frac{\sum_{i=1}^{N} y_i \sum_{i=1}^{N} x_i^2 - \sum_{i=1}^{N} x_i \sum_{i=1}^{N} x_i y_i}{N \sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i\right)^2}$$

$$a_1 = \frac{N \sum_{i=1}^{N} x_i y_i - \sum_{i=1}^{N} x_i \sum_{i=1}^{N} y_i}{N \sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i\right)^2}$$

$$c_0 = -\frac{a_0}{a_1}$$

$$c_1 = \frac{1}{a_1}$$

$$x(t) = X_{\text{FS}} - (X_{\text{FS}} - X_{\text{IS}}) e^{-t/\tau} \quad \text{Step Function}$$

$$\tau = \frac{-t}{\ln\left[\frac{X_{\text{FS}} - x(t)}{X_{\text{FS}} - X_{\text{IS}}}\right]} \quad \text{Step Function}$$

$$\mathrm{RMS} = \sqrt{\frac{1}{N}\sum_{i=1}^{N} e_i^2}$$

$$\mathrm{RSS} = \sqrt{\sum_{i=1}^{N} e_i^2}$$

$$h = \frac{p}{\rho_{\text{fluid}} g}$$

$$C_T = -p_1(\beta - \alpha)T$$

$$C_G = \frac{g_L - g_0}{g_0} p_2$$

$$p_2 = p_1 + C_X + C_T$$

$$\Delta p = \frac{1}{2} C \rho V^2$$

$$\text{Flat diaphragm}: \quad p = \frac{16Et^4}{3R^4(1-\nu^2)}\left[\frac{y}{t} + 0.488\left(\frac{y}{t}\right)^3\right]$$

$$\text{Flat diaphragm}: \quad p = c_0\left[y_r + c_1 y_r^3\right]$$

$$\text{Flat diaphragm}: \quad \frac{dy_r}{dp} = \frac{1}{c_0 + 3c_0 c_1 y_r^2}$$

$$\text{Corrugated diaphragm}: \quad y_r = \frac{y}{t} = \frac{2.25\times10^5 D(1-\nu^2)}{tE}\left(1000\frac{t}{D}\right)^{-1.52} p$$

$$x(t) = (x_0 + a\tau)e^{-t/\tau} + a(t-\tau) \quad \text{Linear Ramp}$$

$$\varepsilon_d = x(t) - x_i(t)$$

$$\lambda = \frac{m_c}{\rho C A}$$

$$h(t) = \int_{t_{\text{last emptied}}}^{t_{\text{present}}} R(t)\,dt$$

$$R = \frac{dh}{dt} = (A_c \rho_w g)^{-1}\frac{dw}{dt}$$

$$C = \frac{K\varepsilon_0 A}{d}$$

$$p = p_0 \exp\left[\frac{L}{R}\left(\frac{1}{T_0} - \frac{1}{T}\right)\right]$$

$$V_3 = G(V_1 - V_2)$$

$$R_T = \exp\left(a_0 + \frac{a_1}{T} + \frac{a_3}{T^3}\right)$$

$$p_{\text{sfc}} = \int_0^\infty g(z)\rho(z)\,dz$$

$$T = \frac{h}{c_p}$$

$$x_i(t) = A_i \sin(\omega t)$$

$$x_S(t) = \frac{A_i}{\sqrt{1 + (\tau\omega)^2}}\sin(\omega t + \phi)$$

$$\phi = \tan^{-1}(-\tau\omega)$$

$$dq = c_v dT + p\,d\alpha$$

$$y = \frac{K\Delta T L^2}{t}$$

$$\Delta V = \pi r^2 \Delta h = \beta_d V_0 \Delta T$$

$$V_d = \frac{d}{2}\left(\frac{1}{t_1} - \frac{1}{t_2}\right)$$

$$S = \frac{\Delta V}{\Delta T}$$

$$\Delta V = (a + b\Delta T)\Delta T$$

$$Q = \pi_{\text{AB}} I$$

$$R_T = R_0\left[1 + a(T - T_0) + b(T - T_0)^2\right]$$

$$V_1 = \frac{V_R R_T}{R_0 + R_T}$$

$$V_3 = G V_R\left[\frac{R_T}{R_T + R_0} - \frac{1}{2}\right]$$

$$e_s = e_{s_0} \exp\left[\frac{L}{R_v}\left(\frac{1}{T_0} - \frac{1}{T}\right)\right]$$

$$L = 2.501 \times 10^6 \text{ J kg}^{-1} - (2340 \text{ J kg}^{-1} \text{ K}^{-1})\text{T}_{\circ\text{C}}$$

$$R_v = 461.5 \text{ J kg}^{-1} \text{ K}^{-1}$$

$$T_0 = 273.15 \text{ K}$$

$$e_{s_0} = 610.78 \text{ Pa}$$

$$e = e_s(T_w) - \frac{pc_{p_d}}{\varepsilon L}(T - T_w)$$

$$\gamma = \frac{pc_{p_d}}{\varepsilon L} \approx 0.65 \frac{\text{mb}}{\text{K}} \text{ at standard SLP}$$

$$S_{S(\text{RTD})} \approx \frac{aGV_R R_0^2}{(R_0 + R_T)^2}$$

$$P_{\text{RTD}} = I^2 R_T = \frac{V_R^2 R_T}{(R_T + R_0)^2}$$

$$V_1 = \frac{R_{T_2}(R_2 + R_{T_1})V_R}{R_{T_2}(R_1 + R_2 + R_{T_1}) + R_1(R_2 + R_{T_1})}$$

$$\tau = \frac{\lambda}{V_i}$$

$$1 \text{ std. atmos.} = 101325 \text{ Pa}$$

$$1 \text{ std. atmos.} = 29.9213 \text{ in. Hg @273.15 K}$$

$$R = \rho \frac{L}{A}$$

$$I^2 = A + B\sqrt{V}$$

$$c = \sqrt{\gamma RT} = \sqrt{\gamma R_d T_v}; \quad \gamma = 1.4$$

$$V_g \equiv \vec{k} \times \frac{1}{\rho f} \nabla \vec{p}$$

$$\frac{\partial \vec{V}_g}{\partial \ln p} = -\frac{R}{f}\vec{k} \times \nabla_p T$$

$$g_0 = 9.80665 \text{ m s}^{-2}$$

$$g_\phi = 9.80616\left[1 - 2.6373 \times 10^{-3}\cos(2\phi) + 5.9 \times 10^{-6}\cos^2(2\phi)\right]$$

$$g_L = g_\phi - 3.086 \times 10^{-6} z + 1.118 \times 10^{-6}(z - z')$$

$$\left[\nabla^2 + \frac{\partial}{\partial p}\left(\frac{f_0^2}{\sigma}\frac{\partial}{\partial p}\right)\right]\chi = -f_0 \overrightarrow{V_g} \cdot \nabla\left(\frac{1}{f_0}\nabla^2\Phi + f\right) - \frac{\partial}{\partial p}\left[-\frac{f_0^2}{\sigma}\overrightarrow{V_g} \cdot \nabla\left(-\frac{\partial \Phi}{\partial p}\right)\right]$$

$$\left(\nabla^2 + \frac{f_0^2}{\sigma}\frac{\partial^2}{\partial p^2}\right)\omega = \frac{f_0}{\sigma}\frac{\partial}{\partial p}\left[\overrightarrow{V_g} \cdot \nabla\left(\frac{1}{f_0}\nabla^2\Phi + f\right)\right] + \frac{1}{\sigma}\nabla^2\left[\overrightarrow{V_g} \cdot \nabla\left(-\frac{\partial \Phi}{\partial p}\right)\right]$$