Physics in Fluids and Gases

Thermal expansion

$$\frac{\Delta L}{L} = \alpha \cdot \Delta T$$

$$\frac{\Delta V}{V} = \beta \cdot \Delta T$$

$$\beta = 3 \cdot \alpha$$

Specific Heat Capacity

$$Q = m \cdot c \cdot (T_{\text{end}} - T_{\text{start}})$$

Melting Heat

$$Q = m \cdot l_{\text{m}}$$

Steam Generation Heat

$$Q = m \cdot l_{\text{s}}$$

Effect

$$P = \frac{dW}{dt}$$

Density

$$\rho = \frac{m}{V}$$

Force

$$F = m \cdot g$$

Pressure

$$p = \frac{F}{A}$$

Water Pressure

$$p_{\text{tot}} = \rho \cdot g \cdot h + p_{\text{above}}$$

Ideal Gas Law

$$p \cdot V = n \cdot R \cdot T$$

$$p \cdot V = N \cdot k \cdot T$$

$$n = \frac{N}{N_A} = \frac{m_{\text{tot}}}{M}$$

$$\rho = \frac{p \cdot M}{R \cdot T} \qquad n_0 = \frac{p}{k \cdot T}$$

Barometric Height Formula

$$p = p_0 \cdot e^{-\frac{\rho_0 \cdot g \cdot h}{p_0}} \qquad h = \frac{p_0}{\rho_0 \cdot g} \cdot \ln \frac{p_0}{p}$$

Relative Air Moisture

$$R_{LF} = \frac{p_{\text{water}}}{p_{\text{saturated}}}$$

Van der Waal's Equation

$$\left(p + a \cdot \frac{n^2}{V^2}\right) \cdot (V - n \cdot b) = n \cdot R \cdot T$$

Critical Point

$$V_K = 3 \cdot n \cdot b, T_K = \frac{8 \cdot a}{27 \cdot R \cdot b}$$

$$p_K = \frac{a}{27 \cdot b^2}$$

The Vapor Pressure Curve

$$p = A \cdot e^{\frac{M \cdot l_{\text{v}}}{R \cdot T}}$$

Reynold's Number

$$Re = \frac{\rho \cdot v \cdot d}{\eta}$$

Laminar if $Re < 2300$, Turbulent if $Re > 2300$.

Volume Flow

$$\phi = v \cdot A$$

Bernoulli's Equation

$$p_1 + \frac{\rho \cdot v_1^2}{2} + \rho \cdot g \cdot y_1 = p_2 + \frac{\rho \cdot v_2^2}{2} + \rho \cdot g \cdot y_2$$

Poiseuille's Law

$$\phi = \frac{\pi \cdot R^4}{8 \cdot \eta} \cdot \frac{(p_1 - p_2)}{L}$$

Heat Conduction

$$P = -\lambda \cdot A \cdot \frac{dT}{dx} \quad \text{(general)}$$

$$P = \lambda \cdot A \cdot \frac{T_1 - T_2}{L} \quad \text{(linear)}$$

$$P = \lambda \cdot 2\pi \cdot L \cdot \frac{T_1 - T_2}{\ln(\frac{R_2}{R_1})} \quad \text{(cylindrical)}$$

Heat Transfer

$$P = \alpha \cdot A \cdot \Delta T$$

k-number (U-number)

$$\frac{1}{k} = \frac{1}{\alpha_1} + \frac{L_1}{\lambda_1} + \frac{L_2}{\lambda_2} + \cdots + \frac{1}{\alpha_2}$$

$$P = A \cdot k \cdot \Delta T$$

Heat flow(intensity)

$$I = \frac{P}{A} = \lambda \cdot \frac{T_1 - T_2}{L} \quad \text{(linear)}$$

Heat Radiation

$$P_{\text{ideal}} = \sigma \cdot A \cdot T^4$$

$$P_{\text{real}} = e \cdot P_{\text{ideal}}$$

$$P_{\text{net}} = P_{\text{out}} - P_{\text{in}} = e \cdot \sigma \cdot A \cdot (T_{\text{out}}^4 - T_{\text{in}}^4)$$

$$\sigma = 5.67 \cdot 10^{-8} \text{ J/(s·m}^2\text{·K}^4)$$

Wien's Displacement Law

$$\lambda_{\max} \cdot T = 2.898 \cdot 10^{-3} \text{ m} \cdot \text{K}$$