

Conversion Factors

Mass & Force:

$$\frac{14.59 \text{ kg}}{\text{slug}} \quad \frac{32.174 \text{ lb}_m}{\text{slug}} \quad \frac{2.205 \text{ lb}_m}{\text{kg}} \quad \frac{2000 \text{ lb}_m}{\text{ton}_m} \quad \frac{1000 \text{ kg}}{\text{metric ton}_m} \quad \frac{4.448 \text{ N}}{\text{lb}_f} \quad \frac{10^5 \text{ dynes}}{\text{N}}$$

Length:

$$\frac{3.281 \text{ ft}}{\text{m}} \quad \frac{39.37 \text{ in}}{\text{m}} \quad \frac{12 \text{ in}}{\text{ft}} \quad \frac{1.609 \text{ km}}{\text{mi}} \quad \frac{5280 \text{ ft}}{\text{mi}}$$

Volume:

$$\frac{7.48 \text{ gal}}{\text{ft}^3} \quad \frac{3.785 \text{ L}}{\text{gal}} \quad \frac{1000 \text{ L}}{\text{m}^3} \quad \frac{1.201 \text{ U.S. gal}}{\text{Imperial gallon}}$$

Volume Flow Rate:

$$\frac{449 \text{ gal/min}}{\text{ft}^3/\text{s}} \quad \frac{3.785 \text{ L/min}}{\text{gal/min}} \quad \frac{60,000 \text{ L/min}}{\text{m}^3/\text{s}} \quad \frac{2119 \text{ ft}^3/\text{min}}{\text{m}^3/\text{s}}$$

Energy & Power:

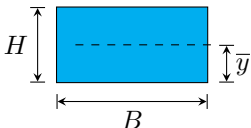
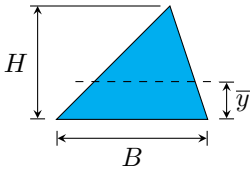
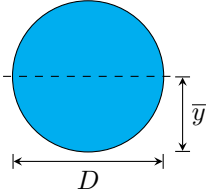
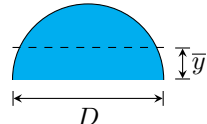
$$\frac{1.356 \text{ J}}{\text{lb} \cdot \text{ft}} \quad \frac{1.0 \text{ J}}{\text{N} \cdot \text{m}} \quad \frac{1.055 \text{ kJ}}{\text{Btu}} \quad \frac{745.7 \text{ W}}{\text{hp}} \quad \frac{550 \text{ lb} \cdot \text{ft/s}}{\text{hp}} \quad \frac{3.412 \text{ Btu/hr}}{\text{W}}$$

Properties of water at 15°C / 59°F

$$\gamma = 9.81 \text{ kN/m}^3 = 62.4 \text{ lb/ft}^3 \quad \rho = 1000 \text{ kg/m}^3 = 1.94 \text{ slugs/ft}^3$$

$$\eta = 1.15 \times 10^{-3} \text{ Pa} \cdot \text{s} = 2.40 \times 10^{-5} \text{ lb} \cdot \text{s/ft}^2 \quad \nu = 1.15 \times 10^{-6} \text{ m}^2/\text{s} = 1.24 \times 10^{-5} \text{ ft}^2/\text{s}$$

Properties of Areas

	Area	Distance to Centroidal axis (\bar{y})	Moment of Inertia about Centroidal Axis (I_c)
	BH	$H/2$	$BH^3/12$
	$BH/2$	$H/3$	$BH^3/36$
	$\pi D^2/4$	$D/2$	$\pi D^4/64$
	$\pi D^2/8$	$2D/(3\pi)$	$\left(\frac{\pi}{128} - \frac{1}{18\pi}\right) D^4$

Key Equations

PRESSURE	$p = \frac{F}{A}$	BULK MODULUS	$E = \frac{-\Delta p}{(\Delta V)/V}$
DENSITY	$\rho = m/V$	SPECIFIC WEIGHT	$\gamma = mg/V$
DYNAMIC VISCOSITY	$\eta = \tau \left(\frac{\Delta y}{\Delta v} \right)$	KINEMATIC VISCOSITY	$\nu = \eta/\rho$
ABSOLUTE AND GAUGE PRESSURE			$p_{\text{abs}} = p_{\text{gauge}} + p_{\text{atm}}$
PRESSURE-ELEVATION RELATIONSHIP			$\Delta p = \gamma h$
FORCE ON A SUBMERGED PLANE AREA			$F_R = \gamma h_c A$
LOCATION OF CENTER OF PRESSURE			$L_p = L_c + \frac{I_c}{L_c A}, \quad h_p = h_c + \frac{I_c \sin^2 \theta}{h_c A}$
PIEZOMETRIC HEAD	$h_a = p_a/\gamma$	BUOYANT FORCE	$F_b = \gamma_f V_d$
VOLUME, WEIGHT AND MASS FLOW RATE			$Q = Av, \quad W = \gamma Q, \quad M = \rho Q$
CONTINUITY EQUATION			$\rho_1 A_1 v_1 = \rho_2 A_2 v_2, \quad A_1 v_1 = A_2 v_2 \text{ (LIQUIDS)}$
GENERAL ENERGY EQ. (FLOW: $1 \rightarrow 2$)			$\frac{p_1}{\gamma} + z_1 + \frac{v_1^2}{2g} + h_A - h_R - h_L = \frac{p_2}{\gamma} + z_2 + \frac{v_2^2}{2g}$
POWER ADDED TO FLUID BY A PUMP			$P_A = h_A W = h_A \gamma Q$
PUMP EFFICIENCY			$e_M = \frac{\text{Power delivered to fluid}}{\text{Power consumed by pump}} = \frac{P_A}{P_I}$
POWER REMOVED FROM FLUID BY A MOTOR			$P_R = h_R W = h_R \gamma Q$
MOTOR EFFICIENCY			$e_M = \frac{\text{Power output from motor}}{\text{Power delivered by fluid}} = \frac{P_O}{P_R}$
REYNOLDS NUMBER – CIRCULAR SECTIONS			$N_R = \frac{vD\rho}{\eta} = \frac{vD}{\nu}$
DARCY'S EQUATION FOR ENERGY LOSS			$h_L = f \times \frac{L}{D} \times \frac{v^2}{2g}$
MINOR LOSSES			$h_L = K (v^2/2g) \quad (K = \text{Resistance coefficient})$
K FOR VALVES AND FITTINGS			$K = (L_e/D) f_T$
K FOR SUDDEN ENLARGEMENT			$K \approx [1 - (A_1/A_2)]^2$
K FOR SUDDEN CONTRACTION			$K \approx 0.45 \left[1 - (A_2/A_1)^2 \right]^2$
FORCE EQUATION IN X-DIRECTION			$F_x = \rho Q \Delta v_x = \rho Q (v_{2x} - v_{1x})$
DRAW FORCE	$F_D = C_D (\rho v^2/2) A$	LIFT FORCE	$F_L = C_L (\rho v^2/2) A$
STOKE'S LAW	$F_D = 3\pi\eta v D$	IDEAL GAS LAW	$\frac{p}{\gamma T} = \text{constant} = R$