Equations and Fluid Power Symbols

Note: be careful to distinguish between pressure p and power P; viscosity ν, velocity v, and volume V.

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

$p = \gamma h$

$A_{circle} = \frac{\pi}{4} d^2$

$\beta = \frac{-\Delta p}{\Delta V / V}$

$V = S\,A$

$v = \frac{S}{t} = \frac{Q}{A}$

$\gamma_{oil} = \gamma_{water}\, S.G._{oil}$

$BP = \frac{2\,t\,\sigma_{TS}}{D_i}$

$WP = \frac{BP}{F.S.}$

$Q = \frac{V}{t}$

$Q_1 = Q_2 \frac{p_2}{p_1} \frac{T_1}{T_2}$

$P = pQ = \frac{F\,S}{t}$

$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$

$\eta = \frac{P_{out}}{P_{in}}$

$F = \mu N$

$\gamma_{oil} = \gamma_{water} \text{S.G.}_{oil}$

$\gamma_{water} = 62.4 \frac{\text{lb.}}{\text{ft.}^3} = 9800 \frac{\text{N}}{\text{m}^3}$

$BP = \frac{2\,t\,\sigma_{UTS}}{D_i} \qquad WP = \frac{BP}{F.S.}$

$1 \text{ hp} = 1714 \text{ psi}\cdot\text{gpm} = 550 \frac{\text{ft.lb.}}{\text{s}}$

$1 \text{ hp} = 745.5 \text{ W}$

$\text{Pa} = \frac{\text{N}}{\text{m}^2} \qquad \text{N} = \frac{\text{kg m}}{\text{s}^2}$

1 gal. = 231 in.^{3} = 128 fluid ounces

$1 \frac{\text{ft.}^3}{\text{s}} = 449 \text{ gpm}$

1 psi = 6895 Pa

1 lb. = 4.448 N

1 m^3 = 1000 liters

$p_{(psia)} = p_{(psig)} + 14.7$ psi

$p_{(Pa\ abs)} = p_{(Pa\ ga.)} + 101{,}000$ Pa

$T_{(°R)} = T_{(°F)} + 460°$

$T_{(K)} = T_{(°C)} + 273°$

$p_f = \frac{0.1025\ \ L\ \ W^2}{3600\ \ CR\ \ d^{5.31}}$ for p (psi), L (ft.), Q (scfm), d (in.), $CR = \frac{p}{p_{atm}}$

$Q = 38.1\ C\ A \sqrt{\frac{\Delta p}{S.G.}}$ for Q (gpm), A (in.^{2}), p (psi)

$\text{Efficiency} = \frac{\text{\# particles trapped}}{\text{\# particles presented}}$

$\beta_N = \frac{\text{\# upstream particles} > \text{N μm}}{\text{\# downstream particles} > \text{N μm}}$

Metric prefixes

G-	giga-	10^9
M-	mega-	10^6
k-	kilo-	10^3
c-	centi-	10^{-2}
m-	milli-	10^{-3}

Common SI & U.S. units

Length.....mm, m.....in., ft.
Volume.....ℓ, cm^3, m^3 .....gal., in.^{3}, ft.^{3}
Force.....N, kN.....lb., kip
Pressure.....Pa, kPa, MPa...psi, ksi

Air flow rate.....m^3/min.....cfm, scfm
Oil flow rate.....ℓpm.....gpm
Velocity.....m/min., m/s.....ft./min., ft./s, in./s
Power.....hp.....W

Bernoulli Equations

$$Z_1+\frac{p_1}{\gamma}+\frac{v_1^2}{2g}+H_P-H_M-H_L = Z_2+\frac{p_2}{\gamma}+\frac{v_2^2}{2g}$$

$$v=\frac{Q}{A}$$

$N_R = \frac{7740\ \ v\ \ D\ \ S.G.}{\mu}$ for v (ft/s), D (in.), μ (cP)

$N_R = \frac{1000\ \ v\ \ D\ \ S.G.}{\mu}$ for v (m/s), D (mm), μ (cP)

$N_R = \frac{7740\ \ v\ \ D}{\nu}$ for v (ft/s), D (in.), ν (cSt)

$N_R = \frac{1000\ \ v\ \ D}{\nu}$ for v (m/s), D (mm), ν (cSt)

$$f=\frac{64}{N_R}$$

$$L_E=\frac{K\,D}{f}$$

$$H_L=f\,\frac{L}{D}\frac{v^2}{2g}$$

$$H_P=\frac{3950\,\text{gpm ft.}}{\text{hp}}\,\frac{P_{pump}}{Q\cdot S.G.}$$ with P_{pump} (hp), Q (gpm)

$$H_M=\frac{3950\,\text{gpm ft.}}{\text{hp}}\,\frac{P_{motor}}{Q\cdot S.G.}$$ with P_{motor} (hp), Q (gpm)