PUMP SYSTEM FORMULAS IN AMERICAN UNITS

USEFUL EQUATIONS	
Flow vs. velocity	$v(ft/s) = 0.4085\frac{Q(USgal./\min)}{D^2(in)^2}$
Specific gravity vs. fluid density	$SG = \frac{\rho_F}{\rho_W}$
Kinematic viscosity ν vs. dynamic (absolute) viscosity μ	$\nu(cSt) = 62.45 \times \frac{\mu(cP)}{\rho\left(\frac{lbm}{ft^3}\right)}$
Kinematic viscosity vs. dynamic (absolute) viscosity	$\nu(SSU) = 4.63\frac{\mu(cP)}{SG}$
Kinematic viscosity SSU vs. cSt	$\nu(SSU) = \nu(cSt) \times 4.635 \text{ for } \nu(cSt) > 50$
Pressure vs. pressure head or fluid column height	$H_f(ft\ of\ fluid) = 2.31\frac{p(psi)}{SG}$
Reynolds number	$R_e = 7745.8\frac{v(ft/s)D(in)}{\nu(cSt)}$
Pipe friction loss	$\frac{\Delta H_{FF}}{L}\left(\frac{ft\ of\ fluid}{100\ ft\ of\ pipe}\right) = 1200 f \frac{v^2(ft/s)^2}{D(in) \times 2g(ft/s^2)}$
Fittings friction loss	$\Delta H_{FF}(ft\ fluid) = K\frac{v^2(ft/s)^2}{2g\,(ft/s^2)}$
Frictioin parameter for the laminar flow regime	$f = \frac{64}{R_e}$
Friction parameter for the turbulent flow regime	$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{R_e\sqrt{f}}\right)$
(Same as above) Swamee & Jain equation	$f = \frac{0.25}{\left(\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{5.74}{R_e^{0.9}}\right)\right)^2}$

Total Head	$\Delta H_P = \Delta H_{P1-2} + \Delta H_{EQ1-2} + \frac{1}{2g}(v_2^2 - v_1^2) + z_2 + H_2 - (z_1 + H_1)$ see Figure A-1 at bottom
N.P.S.H. avail.	$N.P.S.H._{avail} = -(\Delta H_{P1-s} + \Delta H_{EQ1-s}) + \frac{v_1^2}{2g} + (z_1 - z_s + H_1) + H_B - H_{va}$ see Figure A-2 at bottom
Pump shaft brake power	$P(hp) = \frac{SG\Delta H_p(\text{\# of fluid})\ Q(\text{USgal/mn})}{3960\ \eta}$

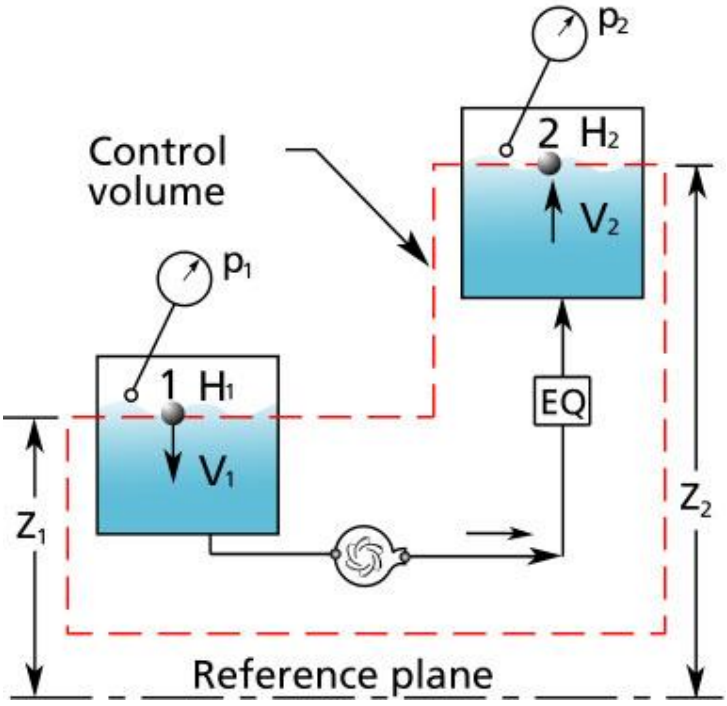


Figure A-1

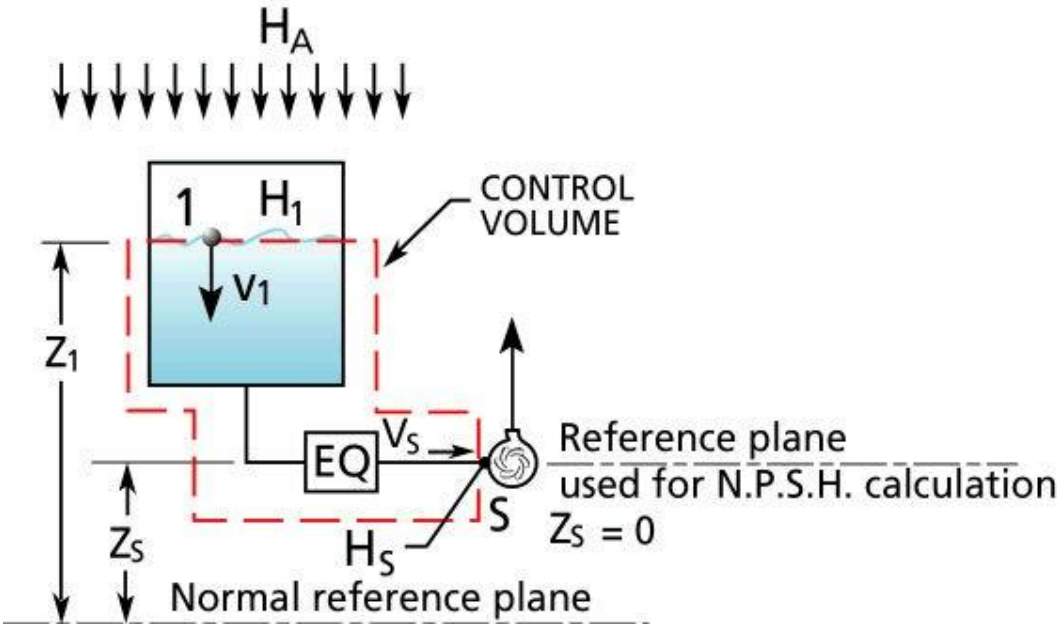


Figure A-2

Symbols

A: area: in^2 (inch square)
D: pipe diameter: in (inch)
f: pipe friction factor
g: acceleration due to gravity: 32.17 ft/s^2: ft/s^2 (feet/second squared)
H: head: ft (feet)
ΔH_P: Total Head: ft
ΔH_{DS}: discharge static head: ft
ΔH_{EQ}: equipment head difference: ft
ΔH_F: friction head difference: ft
ΔH_{SS}: suction static head: ft
ΔH_{TS}: total static head: ft
ΔH_v: velocity head difference: ft
L: length of pipe: ft
p: pressure: psi (pound per square inch)
P: power: hp (horsepower)
Re: Reynolds number
SG: specific gravity; ratio of the fluid density to the density of water at standard conditions
q: volumetric flow rate: ft^3/s
V: volume: ft^3
v: velocity: ft/s
z: vertical position: ft

Greek terms
Δ: delta: the difference between two terms
ε: epsilon: pipe roughness: ft

ν: nnu: kinematic viscosity SSU (Saybolt Universal Second)
η: efficiency
μ: mu: dynamic viscosity
ρ: rho: density: lbm/ft^3
γ: gamma: specific weight: lbf/ft^3