MGNewell

We Make It Work Better.




Common Pump Formula

Product		
Viscosity	$v = \frac{\mu}{p}$	where: v = Kinematic viscosity (mm^2/s) μ = Absolute viscosity (mPas) p = fluid density (kg/m^3)
	Or	
	$v = \frac{\mu}{SG}$	where: v = Kinematic viscosity (cSt) μ = Absolute viscosity (cP) SG = specific gravity
	Or	
	$\mu = v \, x \, SG$	where: 1 poise = 100 cP 1 stoke = 100 cSt
Flow		
Velocity	$V = \frac{Q}{A}$	where: V = fluid velocity (m/s) Q = capacity (m^3/s) A = tube area (m^2)
	Or	
	$V = \frac{Q \text{ x } 353.6}{D^2}$	where: V = fluid velocity (m/s) Q = capacity (m^3/h) D = tube diameter (mm)
	Or	
	$V = \frac{Q \text{ x } 0.409}{D^2}$	where: V = fluid velocity (ft/s) Q = capacity (US gal/min) D = tube diameter (in)
Reynolds Number (ratio of inertia forces to viscous forces)	$Re = \frac{D \text{ x } V \text{ x } \rho}{\mu}$	where: D = tube diameter (m) V = fluid velocity (m/s) ρ = density (kg/m^3) μ = Absolute viscosity (Pas)
	Or	
	$Re = \frac{D \text{ x } V \text{ x } \rho}{\mu}$	D = tube diameter (mm) V = fluid velocity (m/s) ρ = density (kg/m^3) μ = Absolute viscosity (cP)

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Or

$$Re = \frac{21230 \text{ x } Q}{D \text{ x } \mu}$$

where:
D = tube diameter (mm)
Q = capacity (l/min)
μ = Absolute viscosity (cP)

Or

$$Re = \frac{3162 \text{ x } Q}{D \text{ x } v}$$

where:
D = tube diameter (in)
Q = capacity (US gal/min)
v = Kinematic viscosity (cSt)

Pressure/Head

Pressure
(total force per unit area exerted by a fluid)

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

where:
F = Force
A = Area

Static Pressure/Head
(relationship between pressure and elevation)

$$P = \rho \text{ x } g \text{ x } h$$

where:
P = Pressure head (Pa)
ρ = density (kg/m^3)
g = acceleration due to gravity (m/s^2)
h = height of fluid (m)

Or

$$P = \frac{h \text{ x } SG}{10}$$

where:
P = Pressure head (bar)
h = height of fluid (m)
SG = specific gravity

Or

$$P = \frac{h \text{ x } SG}{2.31}$$

where:
P = Pressure head (psi)
h = height of fluid (ft)
SG = specific gravity

Total Head

$$H = H_t - (\pm H_s)$$

where:
H_t = total discharge head
H_s = total suction head

Total Discharge Head

$$H_t = h_t + h_{ft} + p_t$$

where:
h_t = static discharge head
h_{ft} = pressure drop in discharge line
$p_t > 0$ for pressure
$p_t < 0$ for vacuum
$p_t = 0$ for open tank

Total Suction Head

$$H_s = h_s + h_{fs} + (\pm p_s)$$

where:
h_s = static suction head
> 0 for flooded section
< 0 for flooded section
h_{fs} = pressure drop in suction line
$p_s > 0$ for pressure
$p_s < 0$ for vacuum
$p_s = 0$ for open tank

Friction Loss (Miller equation)	$$Pf = \frac{f_D \text{ x } L \text{ x } \rho \text{ x } V^2}{D \text{ x } 2}$$	where: Pf = friction loss (Pa) f_D = friction factor (Darcy) L = tube length (m) V = fluid viscosity (m/s) ρ = density (kg/m^3) D = tube diameter (m)
	Or	
	$$Pf = \frac{5 \text{ x } SG \text{ x } f_D \text{ x } L \text{ x } V^2}{D}$$	where: Pf = friction loss (bar) f_D = friction factor (Darcy) L = tube length (m) V = fluid viscosity (m/s) SG = specific gravity D = tube diameter (mm)
	Or	
	$$Pf = \frac{0.0823 \text{ x } SG \text{ x } f_D \text{ x } L \text{ x } V^2}{D}$$	where: Pf = friction loss (psi) f_D = friction factor (Darcy) L = tube length (ft) V = fluid viscosity (ft/s) SG = specific gravity D = tube diameter (in)
Darcy Friction Factor	$$f_D = \frac{64}{Re}$$	where: f_D = friction factor (Darcy) Re = Reynolds number
NPSHa (Net Positive Suction Head available)	NPSHa = Pa ± h_s – h_{fs} – Pvp (+h_s for flooded section) (-h_s for suction lift)	where: Pa = pressure absolute above fluid level (bar) h_s = static suction head (m) h_{fs} = pressure drop in suction line (m) Pvp = vapor pressure (bar a) Or Pa = pressure absolute above fluid level (psi) h_s = static suction head (ft) h_{fs} = pressure drop in suction line (ft) Pvp = vapor pressure (psia)