

## CALCULATORS

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Calculators will help you to properly size up your pump, piping and fittings. With these tools, you can determine suction loss, friction loss, specific gravity, along with the useful conversion tables.

### HEAD & PRESSURE FORMULA

$$\text{Head in feet} = \frac{(\text{Head in psi}) \times 2.31}{(\text{Sp. Gr.})}$$

$$\text{Head in psi} = \frac{(\text{Head in feet}) \times (\text{Sp. Gr.})}{2.31}$$

### NET POSITIVE SUCTION HEAD

#### Suction Lift:

$$\text{NPSH} = h_a - h_v - h_s - h_l$$

#### Flooded suction:

$$\text{NPSH} = h_a - h_v + h_s - h_l$$

$h_a$  = the absolute pressure in feed of liquid on the surface of the supply liquid

$h_v$  = the vapor pressure of the liquid being pumped expressed in feet of head

$h_s$  = the height in feed of the supply liquid surface with respect to the pump inlet

$h_l$  = suction line friction losses express in feet of head

These calculations yield the available net positive suction head for a given system.

This must be compared to the required net positive suction head NPSHR calculated by the manufacturer.  $\text{NPSH}_A$  must exceed  $\text{NPSH}_R$ .

### AFFINITY LAWS

Centrifugal Pumps

#### For constant speed:

$$\frac{D_1}{D_2} = \frac{Q_1}{Q_2} = \frac{\sqrt{H_1}}{\sqrt{H_2}}$$

$$\frac{\text{BHP}_1}{\text{BHP}_2} = \left(\frac{D_1}{D_2}\right)^3$$

#### For constant impeller diameter:

$$\frac{S_1}{S_2} = \frac{Q_1}{Q_2} = \frac{\sqrt{H_1}}{\sqrt{H_2}}$$

$$\frac{\text{BHP}_1}{\text{BHP}_2} = \left(\frac{S_1}{S_2}\right)^3$$

D = Impeller diameter in inches ??? H = Head in feet

S = Speeds in RPM ??? Q = Capacities in GPM

BHP = Brake Horsepower

## VACUUM PRESSURE EQUIVALENTS:

1 Atmosphere = 29.92 in. Hg = 760mm Hg = 14.7 psi

1 mm Hg = 1 Torr =  $(3.937 \times 10^{-2})$  in. Hg = 1000? Hg = 1.333 millibars

1 bar = 103 millibars = 106 microbars = 750.06 mm Hg

1 microbar = 0.75 micron

1 inch Hg = 2.54 x 101 mm Hg

x in. Hg vacuum =  $(29.92/x)$  in. Hg absolute

y mm Hg vacuum =  $(760-y)$  mm Hg absolute

z PSIG =  $(z + 14.7)$  PSIA

w PSIA =  $(w-14.7)$  PSIG

## PUMPING POWER FORMULA

### Centrifugal pumps:

$$\text{Brake hp} = \frac{\text{gpm} \times H_f \times \text{Sp. Gr.}}{3960 \times \text{Efficiency}}$$

### Rotary and reciprocating pumps:

$$\text{Brake hp} = \frac{\text{gpm} \times \text{psi}}{1714 \times \text{Efficiency}}$$

$$\text{KW} = \frac{\text{pump bhp} \times 0.7457}{\text{motor efficiency}}$$

## GENERAL INFORMATION

1 HP = .746 KW or 746 Watts

GPM = Bbls. / Hr. x 0.70

GPM = Bbls. / Day x 0.2917

One Barrel Oil = 42 Gallons

## VISCOSITY

### Relationships

$$\text{Centistokes} = \frac{\text{Centipoises}}{\text{Density}} \quad (\text{usually the same as specific gravity})$$

$$ft^2 / \text{sec} = \text{Centistokes} \times 1.07639 \times 10^{-5}$$

$$\text{Centistokes} = ft^2 / \text{sec} \times 92903.4$$

### Approximate Conversions

$(50 < \text{SSU} ? 100)$  Centistokes =  $\text{SSU} \times 0.226 ? 205.3 / \text{SSU}$

$(100 < \text{SSU} ? 350)$  Centistokes =  $\text{SSU} \times 0.220 ? 147.7 / \text{SSU}$

$(\text{SSU} > 350 @ 100? F)$  Centistokes =  $\text{SSU} \times 0.21576$

$(\text{SSU} > 350 @ 210? F)$  Centistokes =  $\text{SSU} \times .021426$

**FLOW**

Lbs. Of Water / Hr x 0.002 = Gal Min.

Gal / Min. x 500 = Lbs of Water / Hr

Lbs of Fluid / Hr  
Specific Gravity \_\_\_\_\_ = Gal Min.

Liter Min. x 0.264 = Gal / Min. (US)

GPM x 3.785 = Liters / Min.

Cu. Meters / Hr x 4.4 = Gal / Min. (US)

Gal / Min. x 227 = Cu. Meters / Hr

Kg of Water / Min. x 0.264 = Gal / Min. (US)

Gal Min. x 3.8 = Kg of Water / Min.

**PRESSURE**

Ft of Water x 0.433 = PSI

PSI x 2.31 = Ft of Water

Inches Hg. X 0.491 = PSI

Inches Hg. X 1.133 = Ft of Water

ATM x 14.7 = PSI

ATM x 33.9 = Ft of Water

Kg / Sq cm x 14.22 = PSI

Meters of Water x 1.42 = PSI

ATM x 760 = mm Hg.

mm Hg. X 0.39 = Inches Hg.

Bar x 14.5 = PSI

Newton / Meter<sup>2</sup> x 1 = Pascal

PSI x 6.9 = kPa (Kilopascal)

kPa x 0.145 =PSI

**VOLUME**

Lbs Water x 0.119 = Gal

Gal (Brit) x 1.2 = Gal (US)

Gal x 128 = Fluid Ounces

Cubic Ft x 7.48 = Gal

Cubic in. x 0.00433 = Gal

Gal x 3.785 = Liters

Liter x 0.264 = Gal

Cubic Meters x 264.2 = Gallons

Cubic Meter x 1000 = Liters

Liters x 1000 = Cubic Centimeters

Cubic Centimeters x 0.338 = Fluid Ounces

Fluid Ounces x 29.57 = Cubic Centimeters

**MASS**

Gal of Water x 8.336 = Lbs  
Cubic Ft of Water x 62.4 = Lbs  
Ounces x 0.625 = Lbs  
Kilograms x 2.2 = Lbs  
Lbs x 0.454 = Kilograms  
Metric Ton x 2205 = Lbs

**MASS**

Mils x 0.001 = Inches  
Meters x 3.281 = Feet  
Centimeters x 0.394 = Inches  
Millimeters x 0.0394 = Inches  
Microns x 0.0000394 = Inches

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