Motor Engineering Formulas

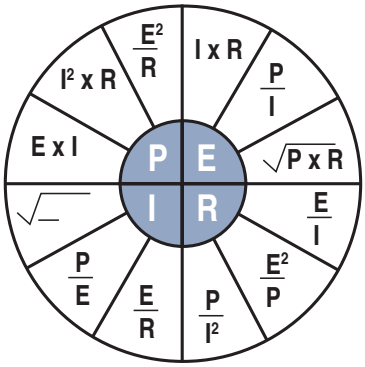
Legend

E = Volts I = Amps W = Watts PF = Power Factor Eff = Efficiency HP = Horsepower 1HP = 746 Watts

AC/DC Formulas

To Find	DC	1 Phase	3 Phase
Amps when HP is known	$\frac{HP \times 746}{E \times Eff}$	$\frac{HP \times 746}{E \times Eff \times PF}$	$\frac{HP \times 746}{E \times Eff \times PF \times 1.73}$
Amps when kW is known	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{E \times PF \times 1.73}$
Amps when kVA is known	-	$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{E \times 1.73}$
kW	$\frac{I \times E}{1000}$	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times PF \times 1.73}{1000}$
kVA	-	$\frac{I \times E}{1000}$	$\frac{I \times E \times 1.73}{1000}$
HP (Output)	$\frac{I \times E \times Eff}{746}$	$\frac{I \times E \times Eff \times PF}{746}$	$\frac{I \times E \times Eff \times PF \times 1.73}{746}$

Ohm's Law



Three Phase Values

For 208 volts x 1.732, use 360
For 230 volts x 1.732, use 398
For 240 volts x 1.732, use 416
For 415 volts x 1.732, use 719
For 440 volts x 1.732, use 762
For 460 volts x 1.732, use 797
For 480 volts, x 1.732, use 831

AC Efficiency & Power Factor Formulas

To Find	Single Phase	Three Phase
Efficiency	$\frac{HP \times 746}{E \times I \times PF}$	$\frac{HP \times 746}{E \times I \times PF \times 1.73}$
Power Factor	$\frac{\text{Input Watts}}{V \times A}$	$\frac{\text{Input Watts}}{E \times I \times PF \times 1.73}$

Motor Application Formulas

$$HP = \frac{\text{Torque (lb-ft)} \times RPM}{5252}$$

$$\text{Torque (lb-ft)} = \frac{HP \times 5252}{RPM}$$

Centrifugal Applications

AFFINITY LAWS

$$\frac{Flow_2}{Flow_1} = \frac{RPM_2}{RPM_1}$$

$$\frac{Pres_2}{Pres_1} = \frac{(RPM_2)^2}{(RPM_1)^2}$$

$$\frac{HP_2}{HP_1} = \frac{(RPM_2)^3}{(RPM_1)^3}$$

Where:
Pres = Pressure
RPM = Revolutions per minute

PUMPS

$$HP = \frac{GPM \times FT \times \text{Specific Gravity}}{3960 \times \text{Efficiency of Pump}}$$

$$HP = \frac{GPM \times PSI \times \text{Specific Gravity}}{1713 \times \text{Efficiency of Pump}}$$

Where:
FT = Head in feet*
GPM = Gallons per minute
PSI = Pounds per square inch
*Head in feet = 2.31 x pounds per square inch gravity

FANS AND BLOWERS

$$HP = \frac{CFM \times PSF}{33000 \times \text{Efficiency of Fan}}$$

$$HP = \frac{CFM \times PIW}{6356 \times \text{Efficiency of Fan}}$$

$$HP = \frac{CFM \times PSI}{229 \times \text{Efficiency of Fan}}$$

Where:
CFM = Cubic feet per minute
PIW = Inches of water gauge
PSF = Pounds per square foot
PSI = Pounds per square inch

VOLUME OF LIQUID IN A TANK

Gallons = $5.875 \times D^2 \times H$
1 gallon (US) of water weighs 8.33 lb.
Specific gravity of water = 1.0
Where:
D = Tank diameter (ft)
H = Height of liquid (ft)

"Guesstimating" Motor Current Draw*

At 575 volts, a 3-phase motor draws 1 amp per horsepower.
At 460 volts, a 3-phase motor draws 1.27 amps per horsepower.
At 230 volts, a 3-phase motor draws 2.5 amps per horsepower.
At 230 volts, a single-phase motor draws 5 amps per horsepower.
At 115 volts, a single phase motor draws 10 amps per horsepower.
These will vary by motor type and application

1 HP = 746 watts

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