CONVENIENT MOTOR & ENERGY FORMULAS

Synchronous Speed = $\frac{120 \times \text{frequency}}{\text{No. of Poles}}$

Poles can be 2, 4, 6, 8, etc.

(Over 95% of motors sold are 2, 4, or 6 pole.)

Horsepower (HP) = $\frac{\text{Torque} \times \text{Speed}}{\text{Constant}}$

Speed in RPM

Value of Constant depends on units used for torque

Torque Units	Constant Value
Pound Feet	5252
Pound Inches	63,025
Ounce Inches	1,000,000

Horsepower Required by Pumps

Centrifugal Pumps

$$HP = \frac{\text{Gallons per Minute} \times \text{Head in Feet}}{3960 \times \text{pump efficiency}}$$

Hydraulic Pumps

$$HP = \frac{\text{Gallons per Minute} \times \text{Pounds per sq. inch}}{1714 \times \text{pump efficiency}}$$

Fans and Blowers

$$HP = \frac{\text{C F M} \times \text{Pressure (Inches of Water)}}{6356 \times \text{efficiency}}$$

Normal efficiency range is 50 to 75 percent.

Air Compressor Rule of Thumb

1 HP produces 4 CFM @ 100 PSI

Approximate Full Load Amps (3 Phase Motors)

$$\text{Amps} = \text{HP} \times 1.2 \times \frac{460}{\text{Motor Voltage}}$$

$$\text{Motor Watts (at full load)} = \frac{\text{HP} \times 746}{\text{Efficiency}}$$

Divide Watts by 1000 to get KW (Kilowatts)

OPERATING COST CALCULATION

Operating Cost on Motors

$$\text{Kilowatt Hours} = \frac{\text{HP}^{**} \times .746 \times \text{Hours of Operation}}{\text{Motor Efficiency (Decimal)}}$$

**Average Load HP (may be lower than motor nameplate HP)

GENERAL FORMULA — ALL LOADS

Average Hours per Month	= 730
Average Hours per Year	= 8760
Average Hours of Darkness per Year	= 4000
Approximate Average Hours per Month (Single Shift Operation)	= 200

Annual Operating Cost = Annual Kilowatt Hours X Cost per KW Hour

Example:

A fully loaded 20 HP motor with FL efficiency of 91.0% runs 2500 hours per year, at a location where power costs 7.5¢ per kilowatt hour.

What is the annual operating cost?

$$\text{Annual Kilowatt Hours} = \frac{20 \times .746 \times 2500}{.910} = 40{,}989$$

Annual Operating Cost = 40,989 x .075 = $3,074