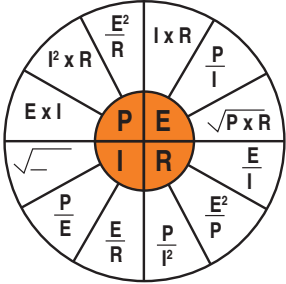


MOTOR ENGINEERING FORMULAS

Legend: E = volts I = amps W = watts PF = power factor Eff = efficiency HP = horsepower

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/DC Formulas

To Find	Direct Current	AC / 1phase	AC 3 phase
Amps when Horsepower is Known	$\frac{HP \times 746}{E \times Eff}$	$\frac{HP \times 746}{E \times Eff \times PF}$	$\frac{HP \times 746}{1.73 \times E \times Eff \times PF}$
Amps when Kilowatts is known	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{1.73 \times E \times PF}$
Amps when kVA is known		$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{1.73 \times E}$
Kilowatts	$\frac{I \times E}{1000}$	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 1.73 \times PF}{1000}$
Kilovolt-Amps		$\frac{I \times E}{1000}$	$\frac{I \times E \times 1.73}{1000}$
Horsepower (output)	$\frac{I \times E \times Eff}{746}$	$\frac{I \times E \times Eff \times PF}{746}$	$\frac{I \times E \times Eff \times 1.73 \times PF}{746}$

IEC-Style Contactors and Starters Selection Guide Average Amperages for Given Horsepower Motor Ratings

The table below provides the average full-load currents of squirrel cage motors based on NEC (National Electrical Code) Tables 430-148, 149, and 150. These values are given only as a guide - they may vary depending on the type of motor and manufacturer. Refer to the actual motor nameplate for full-load current values.

HP	110 to 120 VAC			220 to 240 VAC			440 to 480 VAC		
	Single Phase	Two Phase	Three Phase	Single Phase	Two Phase	Three Phase	Single Phase	Two Phase	Three Phase
1/10	3.0	-	-	1.5	-	-	-	-	-
1/8	3.8	-	-	1.9	-	-	-	-	-
1/6	4.4	-	-	2.2	-	-	-	-	-
1/4	5.8	-	-	2.9	-	-	-	-	-
1/3	7.2	-	-	3.6	-	-	-	-	-
1/2	9.8	4.0	4.4	4.9	2.0	2.2	2.5	1.0	1.1
3/4	13.8	4.8	6.4	6.9	2.4	3.2	3.5	1.2	1.6
1	16.0	6.4	8.4	8.0	3.2	4.2	4.0	1.6	2.1
1 1/2	20.0	9.0	12.0	10.0	4.5	6.0	5.0	2.3	3.0
2	24.0	11.8	13.6	12.0	5.9	6.8	6.0	3.0	3.4
3	34.0	16.6	19.2	17.0	8.3	9.6	8.5	4.2	4.8
5	56.0	26.4	30.4	28.0	13.2	15.2	14.0	6.6	7.6
7 1/2	80.0	38.0	44.0	40.0	19.0	22.0	21.0	9.0	11.0
10	100.0	48.0	56.0	50.0	24.0	28.0	26.0	12.0	14.0
15	135.0	72.0	84.0	68.0	36.0	42.0	34.0	18.0	21.0
20	-	94.0	108.0	88.0	47.0	54.0	44.0	23.0	27.0
25	-	118.0	136.0	110.0	59.0	68.0	55.0	29.0	34.0
30	-	138.0	160.0	136.0	69.0	80.0	68.0	35.0	40.0
40	-	180.0	208.0	176.0	90.0	104.0	88.0	45.0	52.0
50	-	226.0	260.0	216.0	113.0	130.0	108.0	56.0	65.0
60	-	-	-	-	133.0	154.0	-	67.0	77.0
75	-	-	-	-	166.0	192.0	-	83.0	96.0
100	-	-	-	-	218.0	248.0	-	109.0	124.0
125	-	-	-	-	-	312.0	-	135.0	156.0
150	-	-	-	-	-	360.0	-	156.0	180.0
200	-	-	-	-	-	480.0	-	208.0	240.0
250	-	-	-	-	-	602.0	-	-	302.0
300	-	-	-	-	-	-	-	-	361.0
350	-	-	-	-	-	-	-	-	414.0
400	-	-	-	-	-	-	-	-	477.0
500	-	-	-	-	-	-	-	-	590.0

"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

AC Efficiency and Power Factor Formulas

To Find	Single Phase	Three Phase
Efficiency	$\frac{746 \times HP}{E \times I \times PF}$	$\frac{746 \times HP}{E \times I \times PF \times 1.732}$
Power Factor	$\frac{Input\ Watts}{V \times A}$	$\frac{Input\ Watts}{E \times I \times PF \times 1.732}$

Centrifugal Applications

AFFINITY LAWS

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

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

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

Where:
 Pres = Pressure
 RPM = Revolutions per minute

PUMPS

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

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

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 x D² x 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)

Motor Application Formulas

$$\text{Horsepower} = \frac{\text{Torque (lb-ft)} \times \text{RPM}}{5252} \quad \text{Kilowatts} = \frac{\text{Torque (N-m)} \times \text{RPM}}{9550}$$

$$\text{Torque (lb-ft)} = \frac{\text{Horsepower} \times 5252}{\text{RPM}} \quad \text{Torque (N-m)} = \frac{\text{Kilowatts} \times 9550}{\text{RPM}}$$



©2004 Cerus Industrial
 Cerus Industrial provides these formulas for convenient reference; they are for use only by expert personnel. In some cases they are rules of thumb and may not be applicable to code.



Your Source For Motor Controls
 1-800-962-3787

cerusind.com