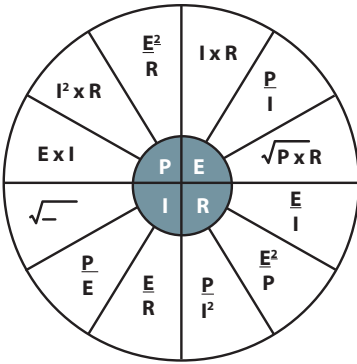


Motor Engineering Formulas

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 / 1 phase	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 120VAC			220 to 240VAC			440 to 480VAC		
	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

1HP = 746watts

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

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

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

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 & BLOWERS

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

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

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

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 lbs
 Specific gravity of water = 1.0
 Where:
D = Tank diameter (ft)
H = Height of liquid (ft)

Motor Application Formulas

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

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

Sense the difference



SUPERIOR BUILDING AUTOMATION SENSORS