FORMULAS

Formulas - Electrical

VOLTS =

$$Amps \times Ohms \qquad \frac{Watts}{Amps} \qquad \sqrt{Watts \times Ohms}$$

AMPS =

$$\frac{Volts}{Ohms} \qquad \frac{Watts}{Volts} \qquad \sqrt{\frac{Watts}{Ohms}}$$

WATTS =

$$Volts \times Amps \qquad Amps^2 \times Ohms \qquad \frac{Volts^2}{Ohms}$$

OHMS =

$$\frac{Volts}{Amps} \qquad \frac{Volts^2}{Watts} \qquad \frac{Watts}{Amps^2}$$

$$Power\ Factor = \frac{KW}{KVA} = Cos\ \Theta$$

	Single Phase	Three Phase
KW =	$\frac{\sqrt{V \times A \times PF}}{1000}$	$\frac{\sqrt{3} \times V \times A \times PF}{1000}$
KVA =	$\frac{V \times A}{1000}$	$\frac{\sqrt{3} \times V \times A}{1000}$
AMPS =	$\frac{KVA \times 1000}{V}$	$\frac{KVA \times 1000}{\sqrt{3} \times V}$

$$\sqrt{3} = 1.73$$

Approx. Motor KVA = Motor Horsepower (At Full Load)

Capacitors Connected In Parallel $C_1 + C_2 + C_3 = C\ Total$

Capacitors Connected In Series

For Two

$$\frac{C_1 \times C_2}{C_1 + C_2} = C\ Total$$

More Than Two

$$\frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}} = C\ Total$$

VOLTAGE UNBALANCE

% Voltage Unbalance =

$$\frac{100 \times Max.\ Voltage\ Deviation\ From\ Average\ Voltage}{Average\ Voltage}$$

BOOST TRANS.:

Rating Plate F.L.A. x Rating Plate VOLTS = KVA

$$\frac{Rating\ Plate\ VOLTS}{Rating\ Plate\ VOLTS - Norm.\ Line\ VOLTS} = FACTOR$$

$$\frac{KVA}{FACTOR} = Trans.\ KVA\ Rating$$

$$\left(\frac{V_2}{V_1}\right)2 \times Heater\ Rating = Rating\ @\ New\ Voltage$$

V_1 *Rated Volts* V_2 *= Measured Volts*

Typical Ampere Wire Ratings*

AWG MCM	COPPER CONDUCTORS, IN CONDUIT* TEMP. RATING OF CONDUCTOR* 60°C*	75°C*	90°C*
14	15	15	25°
12	20	20	30°
10	30	30	40°
8	40	45	50
6	55	65	70
4	70	85	90
3	80	100	105
2	95	115	120
1	110	130	140
1/0	125	150	155
2/0	145	175	185
3/0	165	200	210
4/0	195	230	235
250	215	255	270
300	240	285	300
350	260	310	325
400	280	335	360
500	320	380	405
600	355	420	455
700	385	460	490
750	400	475	500
800	410	490	515
900	435	520	555
1000	455	545	585
1250	495	590	645
1500	520	625	700
1750	545	650	735
2000	560	665	775

* Summary only, refer to NEC 310-16, -17, -18, -19 (and others) for limitations.

Typical Electric Wire Size

MOTOR HP	SINGLE PH. 115 VOLT	SINGLE PH. 230 VOLT	THREE PH. 230 VOLT	THREE PH. 460 VOLT
1-1/3	14	14		
1/2	14	14	14	14
3/4	12	14	14	14
1	12	14	14	14
1-1/2	10	14	14	14
2		12	14	14
3		10	14	14
5			12	14
7-1/2			10	14
10			8	12

From Standards of the National Board of Fire Underwriters.

Correction Table For Watts - Amperes - Volts

WATTS	VOLTAGE (C - Single Phase) 120	208	240	277
	AMPERES			
500	4.2	2.4	2.1	1.8
1000	8.3	4.8	4.2	3.6
1500	12.5	7.2	6.3	5.4
2000	16.7	9.6	8.3	7.2
2500	20.9	12.0	10.4	9.0
3000	25.0	14.4	12.5	10.8
3500	29.2	16.8	14.6	12.6

FORMULAS

Electrical Units

Source: United States Bureau of Standards

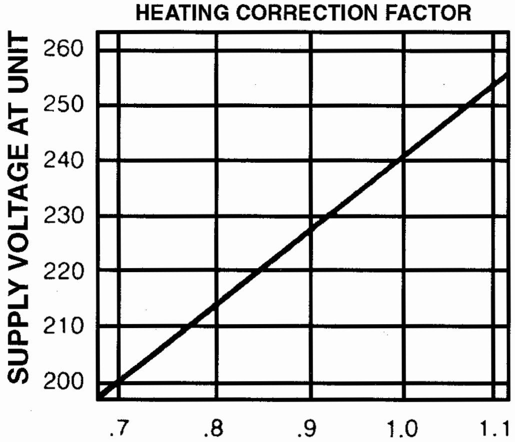
The watt is the unit expressing electrical power as horsepower (hp) in mechanics; it is equal to the product of the volts (pressure) times amperes (rate of flow). Thus, 2 volts times 2 amperes would equal 4 watts in a direct current circuit. Electrical energy is sold at so much per watt hour or more generally at a given amount per kilowatt hour - which means 1,000 watt hours. This may represent 1 watt for 1,000 hours or 1,000 watts for one hour. 746 watts are equal to one horsepower or inversely 1 kilowatt (kw) is equal to about 1-1/2 horsepower.

Horsepower represents the power required to lift a weight of 33,000 lbs. 1 foot in 1 minute or 550 lbs. 1 foot in 1 second.

The ohm is the unit of electrical resistance and represents the physical property of a conductor which offers a resistance to the flow of electricity, permitting just 1 ampere to flow at 1 volt of pressure.

Electric Heating Correction Factor

HEATING CORRECTION FACTOR



Capacity Correction Factor

For correction of unit output, multiply the correction factor times the KW rating at 240 volts.

$$TR = \frac{3160 \times KW \times VC}{CFM} \text{ or } CFM = \frac{3160 \times KW \times VC}{TR}$$

Where:

- *TR = temp rise, F°*
- *3160 = constant*
- *KW = KW rating above*
- *CFM = air flow at specified conditions*
- *VC = heating correction factor*

Formulas – Cooling Capacity *

Total BTUH = CFM x (THC_1 - TCH_2) x 4.5
THC = Total Heat Content or Enthalpy (BTU per lb. of air)

Sensible BTUH = CFM x (T_1 - T_2) x 1.08
T = Dry Bulb Temp (Degrees Fahrenheit)

Latent BTUH = CFM x (W_1 - W_2) x .683
W = Specific Humidity (Grains H_2O per lb. of air
(See Psychrometric Chart)

* Based on standard air at 13.3 cubic feet per lb.

Formulas - Heating Capacity*

BTUH = CFM x 1.08 X Rise

$$Cfm = \frac{BTUH\ Output}{108 \times Rise}$$

$$Rise = \frac{BTUH\ Output}{108 \times Cfm}$$

$$CFM = \frac{BTU/Hr.\ Input}{135 \times \Delta T}$$ Indoor Furnace 80%

$$CFM = \frac{BTU/Hr.\ Input}{144 \times \Delta T}$$ Outdoor Furnace 75%

$$CFM = \frac{KW \times 3415}{108 \times \Delta T}$$ Electric Heat 92%

* Based on standard air at 13.3 cubic feet per lb.

Formulas - General Subjects

$$Area\ of\ Circle = 3.14 \times R^2$$

$$Circumference\ of\ Circle = 3.14 \times Dia.$$

$$Area\ of\ Sphere = 3.14 \times (Dia.)^2$$

$$Volume\ of\ Sphere = 0.524 \times (Dia.)^3$$

Horsepower Conversion Chart

To convert decimal horsepower to commonly available fractional horsepower motors.

DECIMAL HORSEPOWER																	
0.010	0.014	0.017	0.020	0.025	0.033	00.40	0.050	0.067	0.083	0.100	0.125	0.167	0.250	0.333	0.500	0.750	1.000
FRACTIONAL HORSEPOWER																	
1/100	1/70	1/60	1/50	1/40	1/30	1/25	1/20	1/15	1/12	1/10	1/8	1/6	1/4	1/3	1/2	3/4	1