USEFUL FORMULAS

FORMULAS FOR ELECTRIC MOTORS

TO FIND	DIRECT CURRENT	SINGLE PHASE	THREE PHASE
Horsepower	$\frac{E \times I \times EFF}{746}$	$\frac{E \times I \times EFF \times PF}{746}$	$\frac{1.732 \times E \times I \times EFF \times PF}{746}$
Current	$\frac{746 \times hp}{E \times EFF}$	$\frac{746 \times hp}{E \times EFF \times PF}$	$\frac{746 \times hp}{1.732 \times E \times EFF \times PF}$
Efficiency	$\frac{746 \times hp}{E \times I}$	$\frac{746 \times hp}{E \times I \times PF}$	$\frac{746 \times hp}{1.732 \times E \times I \times PF}$
Power Factor	——	$\frac{\text{Input watts}}{E \times I}$	$\frac{\text{Input watts}}{1.732 \times E \times I}$

E = Volts
EFF = Efficiency (decimal)
hp = Horsepower
I = Amperes
PF = Power factor (decimal)

FORMULAS FOR ELECTRICAL CIRCUITS

TO FIND	DIRECT CURRENT	SINGLE PHASE	THREE PHASE
Amperes	$\frac{\text{Watts}}{\text{Volts}}$	$\frac{\text{Watts}}{\text{Volts} \times \text{Power factor}}$	$\frac{\text{Watts}}{1.732 \times \text{Volts} \times \text{Power factor}}$
Volt-Amperes	——	Volts x Amperes	1.732 x Volts x Amperes
Watts	Volts x Amperes	Volts x Amperes x Power factor	1.732 x Volts x Amperes x Power factor

OHMS LAW	CAPACITANCE IN MICROFARADS AT 60 HZ
Ohms = Volts/Amperes (R = E/I) Amperes = Volts/Ohms (I = E/R) Volts = Amperes x Ohms (E = IR)	$\text{Capacitance} = \frac{2650 \times \text{Amperes}}{\text{Volts}}$ $\text{Capacitance} = \frac{2.65 \times \text{kVAR}}{(\text{Volts})^2}$

USEFUL FORMULAS

TEMPERATURE CORRECTION OF WINDING RESISTANCE

$$R_C = R_H \times \frac{(K + T_C)}{(K + T_H)}$$

$$R_H = R_C \times \frac{(K + T_H)}{(K + T_C)}$$

VALUE OF K	
Material	**K**
Aluminum	225
Copper	234.5

R_C = Resistance at temperature T_C (Ohms)

R_H = Resistance at temperature T_H (Ohms)

T_C = Temperature of cold winding (° C)

T_H = Temperature of hot winding (° C)

MOTOR APPLICATION FORMULAS

OUTPUT

$$\text{Horsepower} = \frac{\text{Torque (lb·ft) x rpm}}{5252} \qquad \text{Kilowatts} = \frac{\text{Torque (N·m) x rpm}}{9550}$$

$$\text{Torque (lb·ft)} = \frac{\text{Horsepower x 5252}}{\text{rpm}} \qquad \text{Torque (N·m)} = \frac{\text{Kilowatts x 9550}}{\text{rpm}}$$

For approximation, use:

Full-load torque = 1.5 ft•lb per hp per pole pair at 60 Hz

Full-load torque = 3.2 N•m per kilowatt per pole pair at 50 hZ

TIME FOR MOTOR TO REACH OPERATING SPEED

$$\text{Seconds} = \frac{Wk^2 (\text{lb} \cdot \text{ft}^2) \times \text{Speed change (rpm)}}{308 \times \text{Avg. accelerating torque (lb} \cdot \text{ft)}}$$

$$\text{Seconds} = \frac{J(\text{kg} \cdot \text{m}^2) \times \text{Speed change (rpm)}}{9.55 \times \text{Avg. accelerating torque (N} \cdot \text{m)}}$$

$1 \text{ lb} \cdot \text{ft}^2 = .04214 \text{ kg} \cdot \text{m}^2$

$1 \text{ kg} \cdot \text{m}^2 = 23.73 \text{ lb} \cdot \text{ft}^2$

$$\left.\begin{matrix} Wk^2 \\ J \end{matrix}\right\} = \text{Inertia of rotor} + \frac{\text{Inertia of load} \times \text{Load rpm}^2}{\text{Motor rpm}^2}$$

$$\text{Average accelerating torque} = \frac{[(FLT + BDT)/2] + BDT + LRT}{3}$$

Where: BDT = Breakdown torque

FLT = Full-load torque

LRT = Locked-rotor torque