Motor Application Formulas

OUTPUT

$$Hp = \frac{\text{torque (lb·ft)} \times \text{rpm}}{5250} \qquad \text{Torque (lb·ft)} = \frac{Hp \times 5250}{\text{rpm}}$$

$$kW = \frac{\text{torque (N·m)} \times \text{rpm}}{9550} \qquad \text{Torque (N·m)} = \frac{kW \times 9550}{\text{rpm}}$$

TIME FOR MOTOR TO REACH OPERATING SPEED (SECONDS)

$$\text{Seconds} = \frac{WK^2\ (\text{lb·ft}^2) \times \text{speed change (rpm)}}{308 \times \text{avg. accelerating torque (lb·ft)}}$$

$$\text{Seconds} = \frac{J(\text{kg·m}^2) \times \text{speed change (rpm)}}{9.55 \times \text{avg. accelerating torque (N·m)}}$$

$$\left.\begin{matrix} WK^2 \\ J \end{matrix}\right\} = \text{inertia of rotor} + \frac{\text{inertia of load} \times \text{load rpm}^2}{\text{motor rpm}^2}$$

$1\ \text{lb·ft}^2 = 0.4214\ \text{kg.m2}$
$1\ \text{kg·m}^2 = 23.73\ \text{lb.ft2}$

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

Where: FLT = full-load torque
BDT = breakdown torque
LRT = locked-rotor torque

$$\text{Load } WK^2 \text{ (at motor shaft)} = \frac{WK^2 \text{ (load)} \times \text{load rpm}^2}{\text{motor rpm}^2}$$

Shear Stress

$$\text{Shear stress (psi)} = \frac{Hp \times 321{,}000}{\text{rpm} \times D^3\ \text{(in)}}$$

$$\text{Shear stress (kg/mm}^2) = \frac{kW \times 4.96 \times 10^6}{\text{rpm} \times D^3\ \text{(mm)}}$$

Where:
D = shaft diamater
Hp = motor output
kW = motor output
psi = pounds per square inch
rpm = revolutions per minute