Useful Formulas

USEFUL FORMULAS

Required	Given	Formulas
Velocity or belt speed (V) in FPM	**Pitch Diameter of pulley in inches & RPM of shaft**	**V = .262 x P.D. x RPM**
RPM	Belt Speed or Velocity (FPM) P.D. of pulley in inches	$RPM = \frac{V}{.262 \times P.D.}$
P.D. of pulley in inches	Belt speed or Velocity (V) in FPM RPM of shaft	$P.D. = \frac{V}{.262 \times RPM}$
Horsepower (HP)	Force (F) in lbf. Belt speed or Velocity (V) in FPM	$HP = \frac{F \times V}{33{,}000}$
Horsepower (HP)	Torque (T) in lbf-in. RPM of shaft	$HP = \frac{T \times RPM}{63{,}025}$
Torque (t) in lbf-in.	Force (F) in lbf. Pulley radius (R) in. inches	$t = F \times R$
Torque (t) in lbf-in.	Horsepower (HP) RPM of shaft	$t = \frac{63{,}025 \times HP}{RPM}$
Torque (T) in lbf-ft	Horsepower (HP) RPM of shaft	$T = \frac{5{,}252 \times HP}{RPM}$
Force (F) in lbf	Horsepower (HP) Belt speed or Velocity (V) in FPM	$F = \frac{33{,}000 \times HP}{V}$
RPM of shaft	Horsepower (HP) Torque (T) in lbf-in.	$RPM = \frac{63{,}025 \times HP}{T}$
Effective Tension (Te) in lbf.	Torque (T) P.D. of pulley in inches	$Te = \frac{2 \times T}{P.D.}$
Torque (T) in lbf-ft due to inertia	Inertia (WR^2) in lbf-ft.^{2} Initial RPM_1 Final RPM_2 Time in seconds (t)	$T = \frac{(WR^2) \times (RPM_2 - RPM_1)}{307.6 \times t}$
Inertia (J_S) System including Motor and Gear Drive	Motor Inertia (J_M) Ratio of Gear Drive (M_G) Load Inertia (J_L) Gear Drive Inertia (J_G) Related to Input Coupling Inertia (J_C)	$J_S = J_C + J_M + J_G + \frac{1}{M_G^2} J_L$
Inertia Matching	Above	$JM : J_C + J_G + \frac{1}{M_G^2} J_L$

Horsepower And Torque

One (1) Horsepower (HP) = 33,000 foot pounds (lbf-ft) of work done in one (1) minute. Note that three (3) factors are involved:

Distance (ft)

Force (lbf)

Time (min)

Putting it another way, one (1) HP is equivalent to raising 33,000 pounds, one foot in one minute horsepower can be determined by the following formula:

$$HP = \frac{L \text{ (Load in lbf)} \times \text{Feet per minute}}{33{,}000}$$

To determine the relationship between horsepower and torque let:

HP = Horsepower

T = Torque in foot-pounds (lbf-ft)

t = Torque in inch-pounds (lbf-in)

N = R.P.M. (revolutions per minute)

Then, one (1) HP = A Torque (Twisting force) of 63,025 inch pounds, turning 1 revolution in 1 minute.

Therefore,

$$HP = \frac{t \times N}{63{,}025} \text{ or } \frac{T \times N}{5250}; \; t = \frac{63{,}025 \times HP}{N} \text{ or } T = \frac{5250 \times HP}{N}$$