Useful Formulas

Strokes per Minute

Formula:

$$SPM = \frac{RPM}{R} X \frac{d}{D}$$

Example:

$$SPM = \frac{980}{28.79} X \frac{12}{50} = 8.17$$

Where: RPM = 980 Revolutions per minute of prime mover
R = 28.79 (912D Gear Reducer)
d = 12" Pitch Diameter of Prime Mover Sheave
D = 50" Pitch Diameter of Gear Reducer Sheave

Prime Mover Sheave Diameter

Formula:

$$d = \frac{SPMxRxD}{RPM}$$

Example:

$$d = \frac{12x28.79x50}{980} = 17.6inches$$

Where: SPM = 12 Strokes per Minute
R = 28.79Ratio (912D Gear Reducer)
D = 50" Pitch Diameter of Gear Reducer Sheave
RPM = 980 Revolutions per Minute of Prime Mover
Use nearest size available depending upon belt section and number of grooves in sheave.

Belt Velocity

Formula:

$$V = \frac{\pi xdxRPM}{12}$$

Example:

$$V = \frac{3.1416x17.6x980}{12} = 4515FPM$$

Where: d = 17.6inch Pitch Diameter
RPM = 980 Revolutions per minute of Prime Mover
Limit between 2000 and 5000 feet per min. (FPM)
Belt Velocity less than 2000 FPM results in poor belt life.
Belt Velocity greater than 5000 FPM requires dynamically balanced sheaves.

Center Distance

Formula:

$$CD = \sqrt{\left(S + \frac{T}{2}\right)^2 + (I - b)^2} \qquad \sqrt{\left(SS + \frac{TT}{2}\right)^2 + (II - b)^2}$$

Example:Assumes Hi-Prime Electric Motor Driven C-912D-305-168 Conventional Unit

$$CD = \sqrt{\left(26.25 + \frac{50.5}{2}\right)^2 + (47.125 - 11)^2} = 62.9inches$$

Where: SS = 26.25 (see General Dimensions)
TT = 50.5 (see General Dimensions)
II = 47.125 (see General Dimensions)
b = 11 (assume 55 HP)

Belt Length

Formula:

$$PL = 2CD + 1.57(D + d) + \frac{(D - d)^2}{4XCD}$$

Example:

$$PL = 2X62.9 + 1.57(50 + 17.6) + \frac{(50 - 17.6)^2}{4X62.9} = 236.1inches$$

Where: CD = 66.21 inch Center Distance of Shafts
D = 47 inch Pitch Diameter of Gear Reducer Sheave
d = 14.5 inch Pitch Diameter of Prime Mover Sheave
Use nearest belt size available depending on type of sheaves selected.

Horsepower of Prime Mover

For High Slip Electric Motors And Slow Speed Engines

$$HP = \frac{BPDXDepth}{56000}$$

For Normal Slip Electric Motors And Multi-cylinder Engines

$$HP = \frac{BPDXDepth}{45000}$$

Example: Assumes high slip (Nema D) motor.

$$HP = \frac{250X5000}{56000} = 22.32$$ Use 55 HP Motor

Where: BPD = 250 @ 100% pump efficiency
Depth = 5600 feet, pump setting

Maximum Strokes per Minute (based on the free fall speed of the rod)

Conventional Units:

$$SPM = .7\sqrt{\frac{60000}{L}}$$

FM Units:

$$SPM = .56\sqrt{\frac{60000}{L}}$$

Example: Assumes a C-912D-305-168 Conventional Unit.

$$SPM = .7\sqrt{\frac{60000}{168}} = 13.23$$ SPM Maximum

Definition of Symbols Used

SPM = Strokes per Minute
RPM = Revolutions per Minute of Prime Mover
FPM = Feet per Minute
R = Gear Reducer Ratio
D = Gear Reducer Sheave Pitch Diameter, inches
d = Prime Mover Sheave Pitch Diameter, inches
v = Belt Velocity, Feet per Minute
= 3.1416 (Pi)
PL = Belt Pitch Length, inches
CD = Shaft Center Distance, inches
S = see General Dimensions
T = see General Dimensions
I = see General Dimensions
SS = see General Dimensions
TT = see General Dimensions
II = see General Dimensions
b = Prime Mover Backing (vertical distance from mounting feet to center of shaft), inches
HP = Horsepower
BPD = Barrels per Day at 100% Pump Efficiency
Depth = Pump Setting, feet
L = Stroke Length ,inch