DEFINITIONS
- spm = strokes per minute
- rpm = prime mover revolutions per minute
- R = gear reducer ratio
- D = gear reducer sheave pitch diameter (in)
- d = prime mover sheave pitch diameter (in)
- v = belt velocity (ft/min)
- π = (pi) 3.1416
- PL = belt pitch length (in)
- CD = shaft center distance (in)
- U = see general dimensions
- V = see general dimensions
- AB = see general dimensions
- AA = see general dimensions
- b = prime mover backing (vertical distance from mounting feet to center of shaft) (in)
- hp = horsepower
- bbl/d = barrels per day at 100% pump efficiency
- Depth = pump setting (ft)
- L = stroke length (in)

Strokes per minute

<table>
<thead>
<tr>
<th>Formula</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>spm = ( \frac{rpm \times d}{R \times D} )</td>
<td>SPM = ( \frac{1,170 \times 12}{30.12 \times 47} = 9.9 )</td>
</tr>
</tbody>
</table>

where
- spm = 1,170 rpm of prime mover
- R = 30.12 ratio (320D gear reducer)
- d = 12-in pitch diameter of prime mover sheave
- D = 47-in pitch diameter of gear reducer sheave

Prime mover sheave diameter

<table>
<thead>
<tr>
<th>Formula</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>d = ( \frac{spm \times R \times D}{rpm} )</td>
<td>d = ( \frac{12 \times 30.12 \times 47}{1,170} = 14.5 \text{ in} )</td>
</tr>
</tbody>
</table>

where
- spm = 12
- R = 30.12 ratio (320D gear reducer)
- D = 47-in pitch diameter of gear reducer sheave
- rpm = 1,170 rpm of prime mover

Use the nearest size available depending upon belt section and number of grooves in sheave.

Belt velocity

<table>
<thead>
<tr>
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<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>v = ( \frac{\pi \times d \times rpm}{12} )</td>
<td>v = ( \frac{3.1416 \times 14.5 \times 1,170}{12} = 4,441 \text{ ft/min} )</td>
</tr>
</tbody>
</table>

Where:
- d = 14.5-in pitch diameter
- rpm = 1,170 rpm of prime mover

Limit between 2,000 and 5,000 feet per minute (ft/min).
Belt velocity less than 2,000 ft/min results in poor belt life. Belt velocity greater than 5,000 ft/min requires dynamically balanced sheaves.

Belt length

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>PL = 2CD + 1.57(D + d) = ( \frac{(D-d)^2}{4 \times CD} )</td>
</tr>
</tbody>
</table>

Example
- PL = \( 2 \times 66.21 + 1.57(47 + 14.5) = \frac{(47-14.5)^2}{4 \times 66.21} = 232.96 \text{ in} \)

Where:
- CD = 66.21-in center distance of shafts
- D = 47-in pitch diameter of gear reducer sheave
- d = 14.5-in pitch diameter of prime mover sheave

Use the nearest belt size available depending on type of sheave.
**DEFINITIONS**
- **spm** = strokes per minute
- **rpm** = prime mover revolutions per minute
- **R** = gear reducer ratio
- **D** = gear reducer sheave pitch diameter (in)
- **d** = prime mover sheave pitch diameter (in)
- **v** = belt velocity (ft/min)
- **π** = (π) 3.1416
- **U** = see general dimensions
- **V** = see general dimensions
- **AA** = see general dimensions
- **UU** = see general dimensions
- **VV** = see general dimensions
- **b** = prime mover backing (vertical distance from mounting feet to center of shaft) (in)
- **hp** = horsepower
- **bbl/d** = barrels per day at 100% pump efficiency
- **Depth** = pump setting (ft)
- **L** = stroke length (in)

### Center distance

**Formulas**

\[
CD = \sqrt{\frac{U + \frac{V^2}{2} + (AB - b)^2}{2}} \quad \text{and} \quad CD = \sqrt{\frac{UU + \frac{VV^2}{2} + (AA - b)^2}{2}}
\]

**Example:** Hi-prime electric motor driven C-320D-256-100 conventional unit

\[
CD = \sqrt{\frac{31 + \frac{33.25^2}{2} + (54 - 8)^2}{2}} = 66.21 \text{ inches}
\]
where
- **UU** = 31 (see general dimensions)
- **VV** = 33.25 (see general dimensions)
- **AA** = 54 (see general dimensions)
- **b** = 8 (assume 25 hp, Frame 324T, motor)

### Horsepower of prime mover (approximate)

**Formula A**

\[
HP = \frac{BPD \times Depth}{56,000}
\]

**Formula B**

\[
HP = \frac{BPD \times Depth}{45,000}
\]

**Example:** High-slip (NEMA D) motor

\[
HP = \frac{217 \times 5,600}{56,000} = 21.7 \text{ (Use 25 HP motor)}
\]

Where:
- **bbl/d** = 217 @ 100% pump efficiency
- **Depth** = 5,600 ft, pump setting

**Formula A:** For high-slip (NEMA D) electric motors and slow-speed engines

**Formula B:** For normal slip electric motors and multicylinder engines

Multiply HP by 0.8 for Mark II units.

### Maximum strokes per minute (based on the free fall speed of the rod)

**Formulas**

**Conventional units**

\[
spm = 0.7 \sqrt{\frac{60,000}{L}}
\]

**Air-balanced units**

\[
spm = 0.63 \sqrt{\frac{60,000}{L}}
\]

**Mark II units**

\[
spm = 0.56 \sqrt{\frac{60,000}{L}}
\]

**Example:** For a C-320D-256-100 conventional unit.

\[
spm = 0.7 \sqrt{\frac{60,000}{100}} = 17.15 \text{ spm maximum}
\]