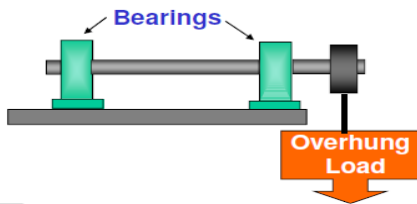


WP0317

Overhung load

Dodge® Customer/Order Engineering
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The transfer of power from one shaft to another involves load transfer as well. This is often referred to as overhung load (OHL). Without proper design OHL can have adverse effects on the system and system components. In simple terms OHL is a radial load exerted on the center line of the shaft which is the result from transmission of power. This OHL has direct relation to the other shaft components, such as bearings. OHL is illustrated in the diagram below.



OHL directly influences:

- Bearing L₁₀ life
- Shaft deflection
- Bearing seal effectiveness
- Reliability of other machine components
- Shaft Stresses
- Bearing loads

OHL has direct influence on bearing L₁₀ life. A 10% reduction in OHL can increase bearing life by 42% for roller bearings and 37% for ball bearings. The L₁₀ life equation for roller bearings below illustrates this.

$$L_{10} \text{ Life, Hours} = \left(\frac{C}{P} \right)^{10/3} \times \left(\frac{16867}{\text{RPM}} \right)$$

In this equation P is equivalent radial load which corresponds to OHL. Therefore, when P reduces L₁₀ increases by power of 10/3.

To illustrate this further consider a 2 inch bore spherical roller bearing running at 1200 rpm. If the initial OHL of 750 lbs was decreased by 10% to 675 lbs then the L₁₀ life increases by 42%.

OHL Load (lbs)	L ₁₀ Life (Hrs)
Condition (a) 750 lbs	1,081,116
Condition (b) 675 lbs	1,536,021 (42% Increase)

OHL is generated whenever a pulley, sprocket, chain, gear or cable assembly drive is connected to a motor, gear box, or other devices. The factors that influence OHL are:

- Power: Design HP, Demand HP and/or Brake HP
- Type of drive
- RPM
- Diameter of the sheave or sprocket.

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To understand how the above factors affect OHL, it is important to know how OHL is calculated. OHL equation is as follows:

$$\text{OHL} = (63,025 \times \text{HP} \times \text{SF} \times \text{DF}) / (\text{RPM} \times \text{RADIUS})$$

Where HP=Horsepower of the drive

SF=Service factor for the application

RPM= RPM of given shaft

Radius= Radius of the sheave/sprocket/pulley in inches on given shaft

DF= Drive Factor (which is 1.0 for roller chain drive, 1.3 for synchronous drive 1.5 for v belt drive and 2.5 for flat belt drive)

In the above equation of OHL $(63025 \times \text{HP} \times \text{SF}) / \text{RPM}$, is actually the torque equation, therefore the above equation can also be written as follows:

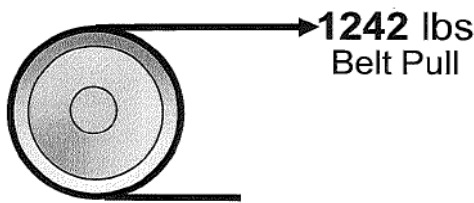
$$\text{OHL} = \text{Torque} \times \text{DF} / \text{Radius}$$

Example below would explain how diameter and weight of a sheave or sprocket affects OHL (Belt Pull).

Example: 100HP at 1770 RPM (Torque=3561 lb-in) & DF of 1.5

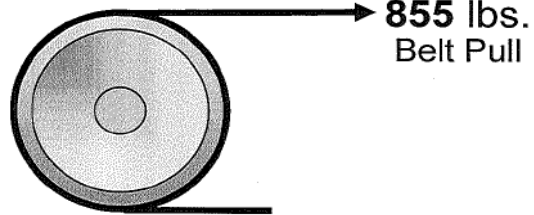
NEMA Min. Sheave

8.6" Dia., (4.3" Radius)

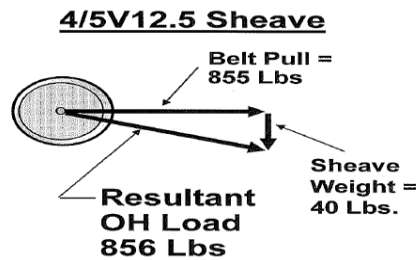
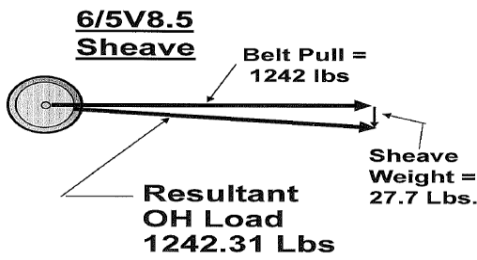


Larger Sheave

12.5" Dia., (6.25" Radius)



As can be seen from the above illustration the larger sheave reduces the OHL by almost 31%. Hence, the larger the sheave/sprocket diameter, the less the belt pull. However, with larger sheave/sprocket diameters the weight of the sheave/sprocket increases but does not significantly contribute to OHL. This can be seen in the illustration below.



From the example above and with most drive designs diameter change would have greater impact on OHL reduction than influences from sheave sprocket weight.

The location of the sheave/sprocket on the drive shaft affects the life of the bearings. The load on the bearing increases when the sheave is farther away from the outboard bearing. The load decreases when it is nearer the outboard bearing. These arrangements are common with motors and gear reducers and an example is shown below.

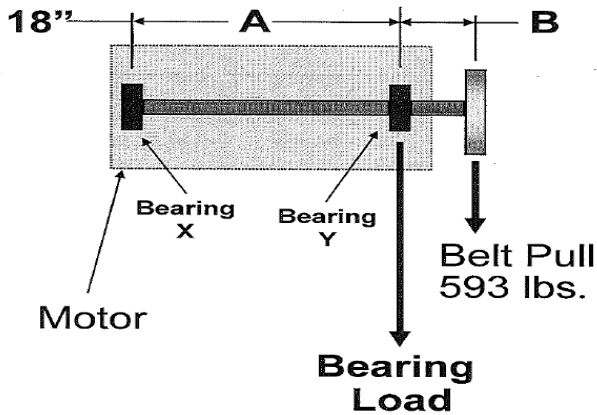
The equation used to calculate the load on the outboard bearing Y:

$$= \text{Belt Pull} \times (A+B) / A \text{ in lb}$$

Similarly load on bearing X:

$$= \text{Belt Pull} \times B/A$$

Therefore as dimension B increases load on the bearing increases.



Dim. "B"	Bearing Load
5"	758 lbs
3"	692 lbs

The above example shows the effect from sheave/sprocket placement. The closer the sheave/sprocket is placed to the outboard bearing; the less loading is placed on the outboard bearing.

The National Electrical Manufacturers Association (NEMA) has a set standard for minimum sheave or sprocket dimensions (diameter and face width) in order to minimize damaging effects to motor bearings. These are referenced in DODGE PT Components Catalog.

Reducing OHL through proper drive selection has the following benefits:

- Less downtime
- Longer belt life
- Longer bearing life
- Longer component life
- Reduces cost

Optimizing OHL is important in drive design; the result is less downtime and a more cost-effective machine.

For any questions please contact PT Components engineering at (864) 284-5700.