Calculating Bowl Lateral Requirement

200.A.09 (Effective June 1, 2006)

When determining the bowl lateral required, shaft and impeller weight are not considered. When the impeller is correctly positioned prior to start up, any stretch due to the shaft and impeller weight has already occurred. Also, Head Shaft or Mechanical Seal Sleeve force is not considered as this force affects only the elongation of the line shaft above the sleeve. Impeller thrust then is the only force normally affecting lateral.

Bowl lateral requirement may be calculated by determining impeller thrust and then referring to Shaft Elongation Charts 2 or 2a. The impeller thrust equation is:

\[ T_{imp} = K \times H \times SG \]

**NOTE:** For bowl lateral calculations, Lab Head and "K" value selected should be the maximum anticipated. (Example: if unit operates near shut-off, the Lab Head and "K" value corresponding to this flow should be selected.)

**EXAMPLE:**

What is the load carried by the motor bearing at design conditions when:

- Capacity 400 GPM
- Head 1800 ft.
- SpGr 1.03
- Discharge Pressure 803 PSI
- Suction Pressure Flooded
- Bowl Model 10 AHC
- Speed 3550 RPM
- Head Shaft Dia. 1\(\frac{11}{16}\)
- Setting (Product Lube) 100'

From the 10 AHC thrust capacity curve, Pg. 2J.3, the "K" factor at design is 2.6.

**Impeller Thrust:**

\[ T_{imp} = K \times H \times SG \]

\[ = 2.6 \times 1800 \times 1.03 \]

\[ = 4820 \text{ lbs.} \]

**Dead Weight:**

\[ \text{Wt.} = \text{Shaft wt. per ft.} \times \text{Setting} \]

\[ = 6.7 \times 100 \]

\[ = 670 \text{ lbs.} \]

**Shaft Area Force:**

\[ \text{S.A.F.} = \text{Shaft Area} \times \text{Suction Pressure} \]

\[ = 2.2 \times 0.0 \]

\[ = 0 \]

**Seal Sleeve Force:**

\[ \text{S.F.} = \text{Sleeve Area} \times \text{Discharge Pressure} \]

\[ = 1.5 \times 803 \]

\[ = 1204 \text{ lbs.} \]

**Motor Bearing Load:**

\[ = T_{imp} + \text{wt.} - \text{Shaft Area Force} - \text{Sleeve Force} \]

\[ = 4820 + 670 - 0 - 1204 \]

\[ = 4286 \text{ lbs.} \]

**NOTE:** In addition to the design point, the motor bearing load should be calculated at shutoff and runout. Should these points indicate excessive down thrust or any upthrust, a simple plot of shutoff, design and runout thrust against capacity will establish the maximum allowable operating range of the pump.
Calculating Motor Bearing Load

200.A.10 (Effective June 1, 2006)

MOTOR BEARING SIZING

As previously stated, for short setting non-hydraulic balanced umps below 50 feet with discharge pressures below 600 psi and can pump with suction pressures below 100 psi, only impeller thrust need be considered.

Under these conditions:

\[ \text{Motor Bearing Load (lbs.) } T_{imp} = K \times H_L \times SG \]

Where:

- \( K \) = Thrust Factors (lbs./ft.)
- \( H_L \) = Lab Head (ft.)
- \( SG \) = Specific Gravity

For more demanding applications, the forces which should be considered are impeller thrust plus dead weight minus any sleeve or shaft area force.

In equation form:

Motor Bearing Load = \( T_{imp} + \text{Wt.}^{(1)} - \text{Sleeve Force}^{(2)} - \text{Shaft Area Force}^{(3)} \)

### Table: Shaft Diameter (in.)

<table>
<thead>
<tr>
<th>Shaft Diameter (in.)</th>
<th>Shaft Dead Weight (lbs./ft.)</th>
<th>Shaft Area (in²)</th>
<th>Sleeve Area (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open Lineshaft</td>
<td>Closed Lineshaft</td>
<td></td>
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<tr>
<td>1</td>
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<td>2.6</td>
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<td>2(\frac{3}{16})</td>
<td>11.2</td>
<td>12.8</td>
<td>3.7</td>
</tr>
</tbody>
</table>

(1) Weight = Shaft Dead Weight x Setting in Feet
(2) Sleeve Force = Sleeve Area x Discharge Pressure
(3) Shaft Area Force = Shaft Area x Suction Pressure

**NOTE:** Also see complete weight chart on Page 200.B2. *Oil Lube shaft does not displace liquid above the pumping water level and therefore has a greater net weight.