Anti-Friction Bearing Lubrication
Anti-friction Bearing Lubrication

- Consistent, adequate lubrication is needed to achieve $L_{10}$ bearing design life
- Most bearings require re-lubrication (adding grease) during normal operation
- Loss of effective lubrication is primary cause of premature bearing failure or contamination
Rolling Element Bearings

Motor and Pump Housing
- Ball, Deep Groove
  - Radial
  - Radial & Axial

Pillow Block (Forced Draft Fan)
- Spherical Roller
  - Radial & Axial
- Cylindrical Roller
  - Radial

© 1999-2013 IMPACT Engineering, Inc.
Shielded vs. Sealed Bearings

- Double shielded style - ZZ - metal shield
  - prevent entrance of only coarse particles

- Sealed style - 2RS - 2 rubber seals
  - prevent loss of lubricant
  - prevent entrance of fluids and particles
  - runs hotter due to seal friction, but most applications are below max (5000 RPM)

- Both styles assembled with grease inside
Shielded (ZZ) / Sealed (2RS) Bearing Lubrication Problems

- Oxidation and oil loss typically occur
- Grease cannot be replenished or renewed
- Dry running bearing will fail before $L_{10}$ life

Recommendation:
- install open style (greaseable) bearings
- for non-greaseable applications, switch from shielded to sealed type bearings

© 1999-2013 IMPACT Engineering, Inc.
Lubrication Frequency
Source: SKF Bearing Installation and Maintenance Guide

- **Recommended interval based on:**
  - speed, bearing size/type, shaft orientation - horizontal or vertical (twice as often), operating temperature/environment, and grease type.

- **If greasing interval is less than 6 months:**
  - Replenish grease at 0.5 times interval.
  - Renew all the grease after 3 replenishments.

- **If interval greater than 6 months:**
  - Renew all the grease at re-lubrication interval.
Re-lubrication Amount

Source: SKF Bearing Installation and Maintenance Guide

- Recommended amount based on:
  - bearing outside diameter, and bearing width.

- Work grease into spaces by hand if possible.

- AFBMA recommends that grease fill 1/3 to 1/2 of bearing housing volume.

- An over-supply results in churning and breakdown (oxidation at high temp) of grease.

- Fine line between under and over lubrication
Types of Grease

Typical (EP2) petroleum base
- 160°F max temp (oil bleeds out of grease)
  - *FD Fan bearing internal temps can be higher*
- Prone to oxidation and lubricant breakdown
  - *Oxidation can be recognized by dark/black color*

Synthetic EP2 (Example: Mobil SHC460)
- Rated to 600°F
- Higher dynamic load rating
- Superior water resistance and wear protection
Greasing Frequency for a Typical Forced Draft Fan Bearing

- Assume 8000 running hours/year
- Replenish at 750 hours (30 days)
- Renew at 1500 hours (60 days)

Problem: Bearing may be over-lubricated at time of greasing and under-lubricated between replenishments.  *Spike Lubrication*
Automatic Lubricator
Perma™

✓ Mounted adjacent to bearing
✓ Grease container using a spring or gas charge device to push grease into bearing
✓ Adjustable, metered flow rate
✓ Extends bearing life:
  – Eliminates *Spike Lubrication*
  – Provides steady flow of fresh grease

© 1999-2013 IMPACT Engineering, Inc.
Under-Lubricated Bearing

Runs relatively cool

Sounds rough under UT monitoring: clicking and popping due to rolling element impacting

Elevated vibration due to internal looseness
# UT Sound Quality

**Bearing:** good - pause - bad

<table>
<thead>
<tr>
<th>Typical Operating Speeds (rpm)</th>
<th>Typical or Normal UT Levels</th>
<th>High Friction (Lubrication Required)</th>
<th>Bearing Fault Present (Extreme Clicking/Popping)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 - 1,200</td>
<td>1 - 15 dB</td>
<td>15 - 25 dB</td>
<td>&gt; 25 dB (clicking)</td>
</tr>
<tr>
<td>1,800</td>
<td>10 - 25 dB</td>
<td>25 - 35 dB</td>
<td>&gt; 30 dB (clicking)</td>
</tr>
<tr>
<td>3,600</td>
<td>20 - 30 dB</td>
<td>30 - 45 dB</td>
<td>&gt; 40 dB (clicking)</td>
</tr>
</tbody>
</table>

© 1999-2013 IMPACT Engineering, Inc.
Adding Grease to an Under-Lubricated Bearing

- Elevates operating temperature (due to lubricant churning) reducing internal clearances and associated looseness - Thermal growth
- Typically reduces vibration levels due to reduced looseness
- Reduces or eliminates ultrasound clicking/popping (friction effects)
- Reduces ultrasound (UT) levels
Bearing Lubrication Summary

- Loss of effective lubrication is primary cause of premature bearing failure
- Use open (greaseable) style bearings when possible
- Lubricate at proper intervals and quantity
- Use synthetic grease for high ambient temp and high load conditions
- UT can identify lubrication problems prior to bearing defects
Bearing Installation / Lubrication Problem