Conference:

Making Bearings Reliable

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Bearing Reliability

¡It’s very easy to achieve Reliable Rolling Element Bearings!
(Specially when you know how!)
Knowing and applying the **Best Practices** as working methods most bearing premature failures can be avoided in the industry.
The Best Practices to achieve bearing reliability are very simple and logical and **several of them do not even require extra costs or additional investments.**
Industrial Maintenance and Reliability

¿Which are these Best Practices for Bearing Maintenance?
Some of the very Best Practices for Bearing Maintenance are:

- **The Right Bearing for each and every Application.**
- **Keep the Bearings clean (Virgins) until their Mounting.**
- **Avoid Handling Damages (Impacts on the Balls hurt).**
- **The Correct Fits and Quality on Shafts and in Housings.**
- **Avoid Mounting damages.**
- **The Correct Lubrication for each and every Application.**
- **Avoid unnecessary Preventive Maintenance through Predictive and Proactive Maintenance.**

*Don’t Generalize!!!!!*
¿How can we avoid this type of failures?

¡This bearing 241/900 with a weight of 3.3 tons lasted for 105 hours in operation!
How many failures are caused by incorrect lubrication?

- 20% Incorrect lubricant
- 20% Degraded lubricant
- 15% Lack of lubricant
- 20% Solid particle contamination
- 5% Liquid contamination
- 5% Handling and mounting damages
- < 1% Material or manufacturing defects
- 10% Incorrect bearing (load capacity, seals, internal clearance)
- 5% Other causes

= 55%

Ref. FAG
A correct lubrication must include ..........

- The selection of the correct lubricant.
- Applied with the correct system.
- Applied at the correct point.
- Applied with the correct quantity.
- Applied at the correct time.
- Applied by the correct person, knowledgeable and well trained.
¿How can we assure the use of the right lubricant?

1. Selecting the optimal lubricant for each and every application.
2. Specifying at least 5 properties, both for greases and oils.

¡Don’t generalize!
The persons responsible for the lubrication must be true TRIBOLOGISTS
The particle contamination shorten bearing life according to the ISO 281/2 much more than we thought.

- 20% Incorrect lubricant
- 20% Degraded lubricant
- 15% Lack of lubricant
- < 1% Material or manufacturing defects
- 10% Incorrect bearing (load capacity, seals, internal clearance)
- 5% Other causes
- 5% Handling and mounting damages
- 20% Solid particle contamination
- 5% Liquid contamination

Ref. FAG

= 25%
## The Benefits: Oil Mist vs. Oil Bath in Centrifugal Pumps

Bearing life calculation according to ISO 281/2:2000 utilizing SKF method

<table>
<thead>
<tr>
<th>Application</th>
<th>CENTRIFUGAL PUMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearings:</td>
<td>7208 BECBM in Back-to-Back arrangement</td>
</tr>
<tr>
<td>Loads:</td>
<td>Axial $F_a$: 7,000 N Radial $F_r$: 500 N</td>
</tr>
<tr>
<td>Speed:</td>
<td>1800 rpm</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Temperature</th>
<th>Contamination Level</th>
<th>Actual Viscosity $\eta_c$ (Calc. Factor)</th>
<th>Viscosity Relation $v/v_1$</th>
<th>Factor $a_{SKF}$</th>
<th>Bearing Life $L_{10nm}$</th>
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</thead>
<tbody>
<tr>
<td>°C</td>
<td>$\eta_c$</td>
<td>cSt</td>
<td>$K$</td>
<td></td>
<td>Hours</td>
</tr>
<tr>
<td>OIL BATH LUBRICATION</td>
<td>Mineral Oil ISO VG 68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Normal ISO 18/15/12</td>
<td>0.5</td>
<td>20.2</td>
<td>1.5</td>
<td>6.3</td>
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<tr>
<td>2</td>
<td>Moderate Contamination ISO 20/17/14</td>
<td>0.2</td>
<td>20.2</td>
<td>1.5</td>
<td>1.7</td>
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<tr>
<td>3</td>
<td>Heavy Contamination ISO 22/19/16</td>
<td>0.1</td>
<td>20.2</td>
<td>1.5</td>
<td>0.9</td>
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<tr>
<td>OIL MIST LUBRICATION</td>
<td>Mineral Oil ISO VG 68</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Normal ISO 18/15/12</td>
<td>0.5</td>
<td>28.7</td>
<td>2.1</td>
<td>8.8</td>
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<tr>
<td>1</td>
<td>Improved Cleanliness ISO 16/13/10</td>
<td>0.8</td>
<td>28.7</td>
<td>2.1</td>
<td>24.7</td>
</tr>
</tbody>
</table>

Ref: Conference by Per Arnold Elgqvist, May 2005, STLE 2005 Annual Meeting, Las Vegas, USA
My recommendation:

“Bearings should be kept as Virgins until their mounting”
Wrong Bearing is the 2nd biggest cause for bearing premature failures!

Why do I say this?
The lack of knowledge of bearing designations is the main reason for the usage of wrong bearings:

**Examples (Suffixes):**

What do the suffix C3 indicate?

Are bearings with the suffix 2Z or ZZ really sealed?

For which bearing types is it indispensable to specify the type of cage?

What indicates CB in SKF or UA in FAG?
¡Wrong Bearing is the 2nd biggest cause for bearing premature failures!

Example (Suffixes):

Which is the importance of the suffixes $CB$ for SKF and $UA$ for FAG bearings of the type 7 (Single row angular contact ball bearings)?
Simple example of wrong Bearing:

Monophasic electrical motor: Bearing 6203-2Z works perfect.

Automotive alternator: Bearing 6203-2Z won’t work!

1760 RPM vs. 16,000 to 20,000 RPM
Mostly clean environment vs. dusty and hot environment (+ motor washings)!

Bearings for alternators therefor need:
Greater internal clearance than Normal +
High temperature grease +
Contact seals.
Look at the real problem: The enormous world of suffixes.

Examples (SKF):

6205-2RS1 NR TN9 / P63 LT20C VB123

23064 CC K / HA3 C084 S2 W33
## Opportunities for the CMMS Systems

12 different SAP Numbers, but

**Not one single is correct!**
How many of You can assure me that the Bearings in your warehouses are:

1. The *Correct* and

2. Are in *Perfect Conditions* (Virgins)
How shall a Warehouse be administrated?

As a Supermarket:

Package you open =

Product you must take out from the Warehouse
Industrial Maintenance and Reliability

Does this inspire Reliability?
And these?
Some Key Messages:

“Bearings have First Name and Second Name”

“The Reliability starts with the Bearings in the Warehouse”

“The conditions of the Bearings in the Warehouse indicate the Bearing Culture in the Plant”

“The Warehouse must be administrated as a Supermarket”

“Bearings must reach their Mounting still being Virgins”

“Bearings are innocent until you can prove the opposite”
Bearing Fits on Shaft and in Housing:

Effects of out of roundness of bearing seating on bearings:

Example: Electrical motor:

- Housing roundness
- Roundness of the raceway before mounting
- Roundness of the raceway after mounting

Bearings are Innocent until you can prove the opposite!

( Talyrond, resolution 2μm)
Mounting forces must always be applied to the ring you are mounting!
“Impacts on the Balls hurt”
The Challenge for Maintenance:

“To do the correct job, at the correct moment and to do it correctly”

Result: Increased Efficiency

Advise: Implement Predictive, or even better, a Proactive Maintenance
How is the life cycle of an equipment?

“Infant mortality”

Run-in period

Requirement of intensive TEMPORARY condition monitoring

Wear period

Vibrations, Noise, temperature

Unnecessary Preventive Maintenance:
Unnecessary spending, new run in period, new risks of totally unnecessary failures!
Don’t forget to close the circle!

1. Detection  
   (Condition Monitoring)

2. Analysis  
   (Vibration Analysis, Oil Analysis, Root Cause Failure Analysis)

3. Correction  
   (Key Performing Indicators)

4. Follow UP  
   Review the results of the corrective actions

¡Close the Circle!
Opportunity: My workshop Bearing Failure Analysis, tomorrow 10:45 to 11:45

- Operational Errors
- Lubrication
- Handling Damages
- Wrong Bearing
- Electrical Etching
- Contamination
- Low Quality Seating
- Misalignment
- False Brinelling
- Wrong Setup
- Fitting Practices
- Overload
¡Thanks for your Attention and Good Luck!