Rotating Machinery Health and Reliability Excellence

This is a sample of slides and notes from day 3 of this course. For more samples and info please see …

http://www.feedforward.com.au/Powerpoints/Reliability/machinery_reliability_Excellence.htm

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Welcome to this course on setting-up rotating machines and equipment for a long, trouble-free operating life. The course is divided into an introduction stage and an advanced stage. During the course you will cover, and come to better appreciate, the important issues for achieving Rotating Equipment (RE) reliability. Much of our industrial machinery rotates, it uses bearings and lubrication, and is mounted onto a supporting structure. What you learn in the course to improve rotating equipment performance can be transferred and applied to all of them.

The course is brought to you by Mike Sondalini of Lifetime Reliability Solutions. Mike is an Australian equipment maintenance and reliability growth specialist who works around the world to help people and companies get outstanding reliability from their plant and equipment. His philosophy is to impart the knowledge and understanding needed to so look after all rotating equipment. Instead of focusing on specific equipment problems he provides an explanation and education that is the foundation for all rotating equipment health. To download complete 4 day course powerpoints, please see ...

http://www.feedforward.com.au/Powerpoints/Reliability/machinery_reliability_Excellence.htm

Advanced Course Topics - Day 3

- Lubrication Selection
- Process Containment Shaft Seals – Methods, Types, Designs, Process Effects
- Vibration Prevention and Isolation
- Strength of Materials for Shafts and Rotors
- Horizontal and Vertical Shaft Design
- Bearing Design and Selection – Radial and Axial Loads
- Precision Maintenance in more detail

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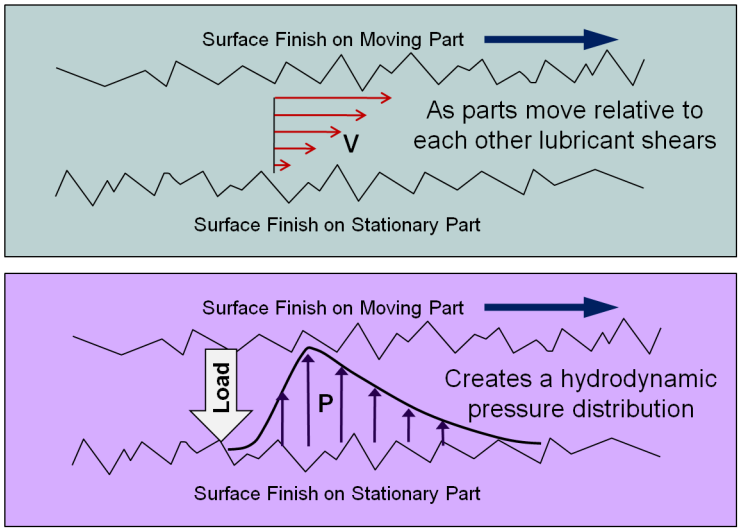
The content for third day of the course is listed in the table

Physics of Lubrication



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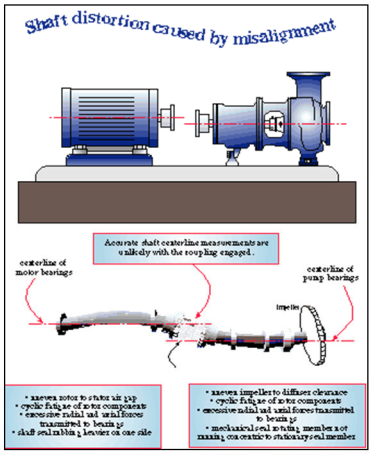
Lubrication theory explains how lubricants work. The model is based on fluid dynamics boundary layer theory. Fluid layers shear because of the different speeds each surface moves at. The shearing action combined with the imposed load carried by the lubricant produces a pressure gradient that forces the two surfaces apart and reduces friction between them.

Seal Failure Modes



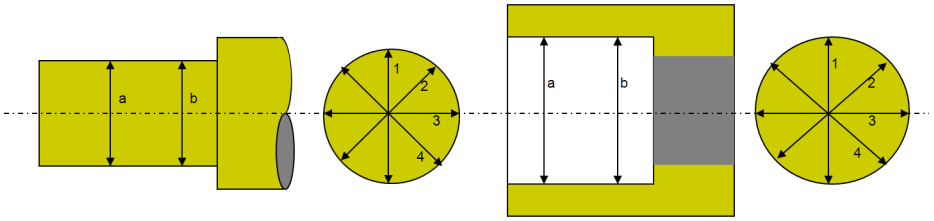
Source: Shaft Alignment Handbook, Piotrowski, 2nd Edition

WHAT CAUSES A MECHANICAL SEAL TO LEAK?
1 Pressure hammer within the equipment caused by such occurrences as rapid closure of valves somewhere in the process.
2 Solids/dirt pinned between the seal faces during assembly or during a pressure surge.
3 Crystal build-up on the seal faces as crystallising products seep past the running faces.
4 Seal faces run dry and build-up heat and crack due to nil or poor lubrication.
5 Under-loaded springs/bellows pushing on the rotary seal when the seal was set-up on the shaft.
6 Unequal spring force on the rotary seal due to damaged or jammed springs/bellows.
7 Movement of the rotary seal housing along the shaft if the locking screw loosens.
8 The seal was damaged during installation and not corrected.

Shaft Manufacture, Diameter and Tolerance

- **The two factors affecting roller bearing clearance reduction are:**
  - Radial temperature gradient
  - Quality of fit on the shaft and in the housing
- **Once mounted, bearing internal clearance is reduced:**
  - by the tight fit at mounting
  - during operation when the inner ring becomes warmer than the outer ring - the usual case.
  - Normal Clearance (CN) is calculated such that there is appropriate operating clearance under common mounting and operating conditions

For ideal roller bearing load carrying it is essential to be sure that the shaft and housing seats are measured to be within acceptable limits of straightness, circularity and cylindricity. The measurements are to be kept as historical evidence of conformity.



How will you ensure that they will be correctly done?

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The shaft diameter must be within tolerance at all positions to ensure it is actually circular to provide the race with the circumferential support it needs

Creative Disassembly – Pre-shutdown of Equipment

Gather historical and background data whilst still in service …

- vibration, bearing, thermography, oil data for diagnostic purposes. Look at this for varied process conditions
- check for running 'soft-foot' (machine distortion when at operating under load)
- look for resonance in machine, structure, pipe work, other attachments
- look at the equipment's maintenance history for tell-tale evidence

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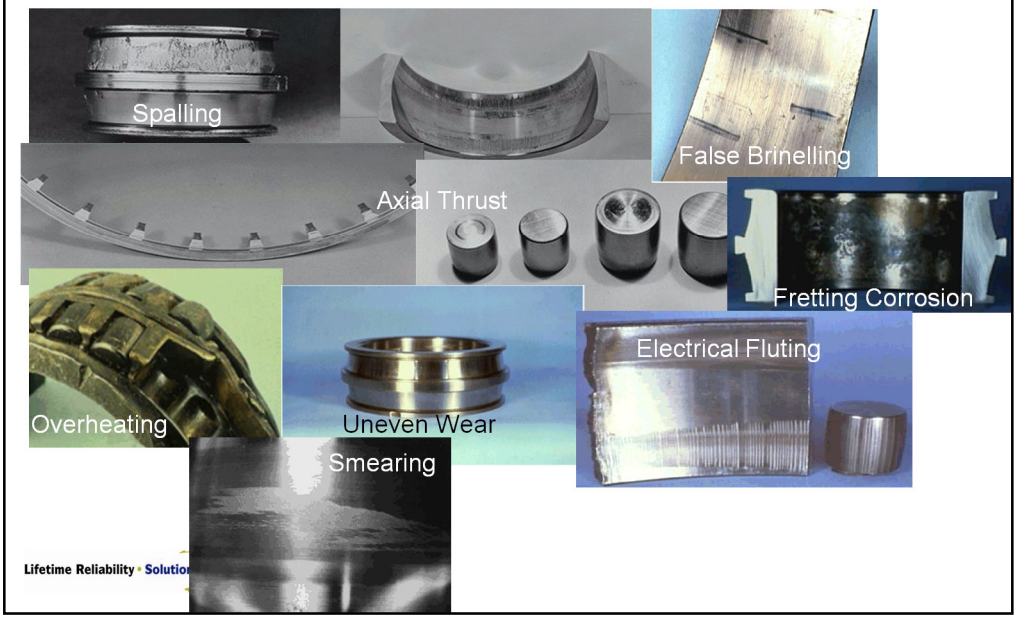
Improving machinery reliability starts with knowing where its current problems are. That information can be found from the equipment's history and by collecting evidence of its poor performance and condition while it is running.

Tell-tale Bearing Failure Signs



Each of these pictures of failed bearings tell the story of what caused its demise. When bearings are removed look at the 'story they tell' before throwing them into the bin. You will very likely be able to find the cause of the failure and fix it while doing the job.