Bearing faults that can be detected with vibration monitoring
Vibration:
The cornerstone of condition monitoring
Bearing defects

Bearing faults which can be detected with vibration analysis

- Excessive loads
- Over heating
- True brinelling
- False brinelling
- Normal fatigue failure
- Reverse loading
- Contamination
- Lubricant failure
- Corrosion
- Misaligned bearings
- Loose fits
- Tight fits
Bearing defects

Excessive loads

- Usually causes premature fatigue
- Can be alleviated by reducing the load or redesigning with a bearing of greater capacity
Over heating

- Symptoms are discoloration of the rings, balls, and cages from gold to blue
- Temperature in excess of 400° F can anneal the ring and ball materials and degrade or destroy lubricant
- The resulting loss in hardness reduces the bearing capacity causing early failure
- In extreme cases, balls and rings will deform
Bearing defects

True brinelling

- Occurs when loads exceed the elastic limit of the ring material
- Creates brinell marks which show as indentations in the raceways and increase bearing vibration (noise)
- Caused by any static overload or severe impact
Bearing defects

False brinelling

- Creates elliptical wear marks in an axial direction at each ball position with a bright finish and sharp demarcation, often surrounded by a ring of brown debris
- Indicates excessive external vibration
- Corrected by isolating bearings from external vibration, and using greases containing antiwear additives
Bearing defects

Normal fatigue failure

- A fracture of the running surfaces and subsequent removal of small discrete particles of material
  - Also referred to as spalling
- Can occur on the inner ring, outer ring, or balls
- A “progressive” failure
  - Once initiated, it will spread with continued operation
  - It will always be accompanied by a marked increase in vibration
- Remedied by replacing the bearing or redesigning with a bearing that has a greater calculated fatigue life
Bearing defects

Reverse loading

- Angular contact bearings are designed to accept an axial load in one direction only.
- When loaded in the opposite direction, the elliptical contact area on the outer ring is truncated by the low shoulder on that side of the outer ring.
- The result is excessive stress and an increase in temperature, followed by increased vibration and early failure.
- Corrective action is to re-install the bearing correctly.

Ball band caused by ball riding over edge of raceway.
Bearing defects

Contamination

- A leading cause of bearing failure
- Symptoms are denting of the bearing raceways and balls, resulting in high vibration and wear
- Clean work areas, tools, fixtures, and hands help reduce contamination failures
- Keep grinding operations away from bearing assembly areas and keep bearings in their original packaging until you are ready to install them
Lubricant failure

- Ball bearings depend on the continuous presence of a very thin (millionths of an inch) film of lubricant between the balls and races, and between the cage, bearing rings, and balls
- Insufficient or ineffective lubricant results in excessive wear of balls, ring, and cages will that leads to overheating and subsequently catastrophic failure
- Discolored (blue/brown) ball tracks and balls can occur
- Failures are typically caused by restricted lubricant flow or excessive temperatures that degrade the lubricant’s properties
Bearing defects

Corrosion

- Red/brown areas on balls, race-way, cages, or bands of ball bearings may be present
- Results from exposing bearings to corrosive fluids or a corrosive atmosphere
- In extreme cases, can initiate early fatigue failures
- Corrected by diverting corrosive fluids away from bearing areas and using integrally sealed bearings whenever possible
Bearing defects

Misalignment

- Can be detected on the raceway of the non-rotating ring by a ball wear path that is not parallel to the raceways edges
- If it exceeds 0.001 in./in, will cause an abnormal temperature rise in the bearing and/or housing and heavy wear in the cage ball-pockets
- Appropriate corrective actions include:
  - Inspect shafts and housings for runout of shoulders and bearing seats
  - Use single point-turned or ground threads on non hardened shafts and ground threads only on hardened shafts
  - Use precision grade locknuts
Bearing defects

Loose fits

- Can cause relative motion between mating parts
- If the relative motion between mating parts is slight but continuous, fretting occurs
  - Fretting is the generation of fine metal particles which oxidize, leaving a distinctive brown color. This material is abrasive and will aggravate the looseness. If the looseness is enough to allow considerable movement of the inner or outer ring, the mounting surfaces (bore, outer diameters, faces) will wear and heat, causing noise and runout problems.

Outer ring slippage caused by improper housing fits.
Bearing defects

Tight fits

- Indicated by a heavy ball wear path in the bottom of the raceway around the entire circumference of the inner ring and outer ring
- Where interference fits exceed the radial clearance at operating temperature, the balls will become excessively loaded, resulting in a rapid temperature rise accompanied by high torque
- Continued operation can lead to rapid wear and fatigue
- Corrective action is a decrease in total interference

Discolored, wide ball path at bottom of raceways.
Meggitt Sensing Systems

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Bearing defects

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