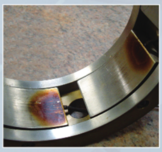
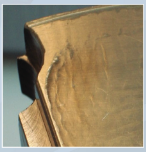
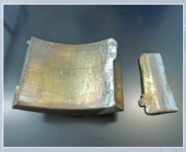
BearingsPlus
A Waukesha Bearings Business

WAUKESHA BEARINGS
A DOVER COMPANY

Fluid Film Bearing Damage

Excessive Bearing Temperatures

Coking of Oil on Surface
Oxidation of oil resulting in plating at the hot spot; also check for electrostatic discharge damage

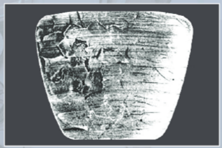
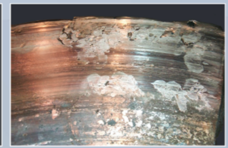
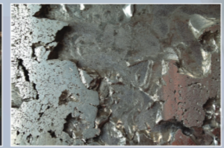
Creep
Combination of high temperature and high load causes whitemetal lining to deform

Melted Lining
Heat soak through the housing melts the whitemetal lining

Potential Solutions
- Adjust operating conditions to lower the temperature
- Use copper chromium (CuCr) backing to remove heat more quickly
- Use 'Directed Lubrication' to reduce heating
- Change to offset pivot to increase cool oil flow through pad
- Assess bearing alignment
- Check for electrostatic discharge

- Check the bearing load
- Use a lining material with higher temperature capability; below are standard maximum temperatures
  - Whitemetal: 130°C (266°F)
  - Aluminum tin (AlSn): 160°C (320°F)
  - Polymer: 250°C (482°F)
- Maintain post-lubrication flow

Thermal or Mechanical Fatigue

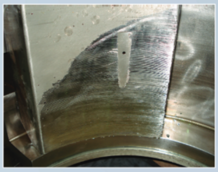




Thermal Faceting
Unique to tin-based whitemetal; caused by differential expansion in the tin's grain axes; typically not detrimental, but prolonged and severe faceting can lead to cracking

Intergranular Cracking
Cracking and pullout of whitemetal grains; a thin layer of whitemetal may remain, or in the case of poor bonding, bare steel may be exposed

Potential Solutions
- Investigate reasons for regular changes to load or temperature (e.g., repeated start-up and shutdown, dynamic misalignment, liquid slugs)
- Analyze whitemetal composition and microstructure
- Use a lining material with greater fatigue strength, such as AlSn or polymer

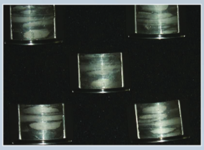
Static Misalignment



Uneven Wear
Angled damage, unevenly distributed across the bearing

Potential Solutions
- Correct the machine's alignment
- Use a bearing with greater misalignment capability (e.g., tilt pad bearing, ball and socket pivot)

Rotating Load or Dynamic Misalignment

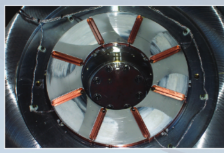
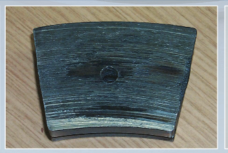
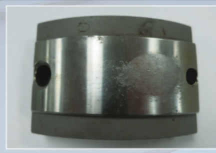



Polish
Characterized by polish across all bearing pads; can lead to intergranular cracking and wiping

Pivot Wear
Shaft orbiting in the bearing clearance results in pivot marking on each pad

Potential Solutions
- Take steps to reduce the rotating load
- Align thrust collar to shaft
- Consider using ISFD® technology – an integral squeeze film damper – to improve rotordynamics
- Consider using a Flexure Pivot® bearing to reduce pivot wear

Overloading

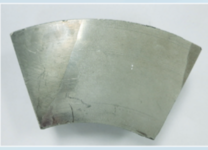
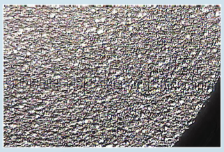
Wiping
Excessive operating load ruptures film, resulting in contact between bearing and collar

Wiping
On tilt pads, wiping caused by overloading is typically seen in conjunction with pivot deformation

Pivot Wear
Can result in increased clearance, leading to vibration

Potential Solutions
- Reduce load
- Investigate and address causes of dynamic loading
- Check that the hydrostatic jacking system is operating properly
- Increase bearing size to increase load capacity
- Reduce pivot contact stress with Flexure Pivot® bearings or ball and socket pivot

Electrostatic Discharge

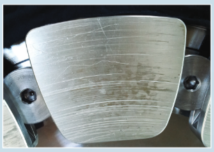
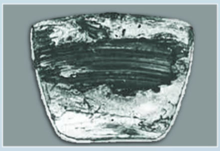



Frosting
Discharge on right side of pad shows typical "frosting"

Pitting
A magnification of the "frosting" shows pitting

Potential Solutions
- Investigate the grounding of the rotor and insulation at each bearing
- Replace metallic pads with polymer-lined pads for polymer's insulating properties
- Install Inpro/Seal® Smart™ CDR® technology

Particles in the Lubricant

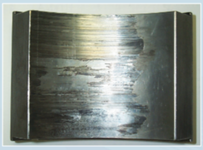
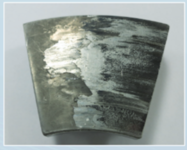
Scoring / Abrasion
Continuous circumferential scratches in the bearing surface from dirt at high speed; wandering tracks from low speed operation

Black Scab / Wire Wool
Build-up of black scab machines away mating surface into wire wool

Potential Solutions
- Avoid contamination of bearing surface and oil ways during assembly
- Properly flush bearing and housing before operating
- Improve full-flow filtration or install a filter

Potential Solutions
- Sleeve the mating surface with mild steel or hard chrome plating

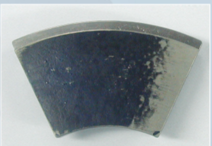
Inadequate Lubrication

Wiping
Wiping on journal and thrust pads from a loss of film

Potential Solutions
- Ensure adequate and continuous oil supply
- Install header tank or back-up pump to prevent interruption of oil supply during power loss
- Use alternate materials that can accommodate short disruptions in lubrication

Corrosion

Corrosion
Chemical attack of bearing materials by contaminants (like water) in the lubricating oil

H_2S Corrosion
Hydrogen sulfide in the oil attacks the copper in the bearing alloy, creating a soft, dark deposit and pitting on the bearing surface

Varnish
Breakdown of lubricant resulting in coating on the bearing surface, often including non-load carrying surfaces

Potential Solutions
- Monitor the oil condition, including water and acid levels
- Implement coalescers or centrifuge to limit contaminants
- Use a bearing material resistant to corrosion, such as AlSn or polymer

Cavitation

Erosion
Caused by the formation and collapse of vapor bubbles in the oil film due to rapid pressure changes

Potential Solutions
- Increase oil feed pressure
- Improve the bearing's streamline flow
- Reduce running clearance
- Change to a harder bearing material
- Modify geometry in bearing and housing to limit pressure changes

Start-up Issues


Contact Wear
Wear seen across all pads; caused by transient loss of clearance during quick start-up due to differential expansion between hot shaft and pads and cold housing

Leaves
Overload at each start-up or rundown can lead to build-up of "leaves" of whitemetal on trailing edge

Potential Solutions
- Install hydrostatic jacking system
- Use larger bearing to handle start-up loads
- Consult bearing engineer regarding design clearance
- Use alternate materials, like polymer, that provide higher load capacity at start-ups and stops

Note: Whitemetal includes both lead- and tin-based bearing alloys. The most common whitemetal for fluid film bearings is tin-based babbitt, which includes copper and antimony.

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