

Engine Bearing Failure Analysis Guide

Fatigue of Aluminum Lining



Appearance:

Cracks, cratered & distressed bearing surface due to loss of aluminum lining material.

Possible causes:

- Wrong selection of engine bearing material
- Engine power increased beyond original design
- Excessive clearance
- Fuel detonation/advanced ignition
- Geometry defects causing localized bearing overloading

Corrective actions:

- Select a bearing material with higher load capacity
- Check: clearances and component geometry
- Retard ignition or use fuel with higher octane number
- Repair/replace distorted parts

Fatigue of Babbitt Overlay



Appearance:

Irregular spider web-like cracks and craters in the overlay. Fatigue may lead to partial flaking of the overlay, followed by fatigue of the copper-lead intermediate layer.

Possible causes:

- Wrong selection of engine bearing material
- Engine power increased beyond original design
- Excessive clearance
- Fuel detonation/advanced ignition
- Geometry defects causing localized bearing overloading

Corrective actions:

- Select a bearing material with higher load capacity
- Check: clearances and component geometry
- Retard ignition or use fuel with higher octane number
- Repair/replace distorted parts

Fatigue of Bronze Intermediate Layer



Appearance:

Babbitt surface missing and intermediate layer cracked and cratered. Fragments are detached from the steel back causing imminent bearing failure.

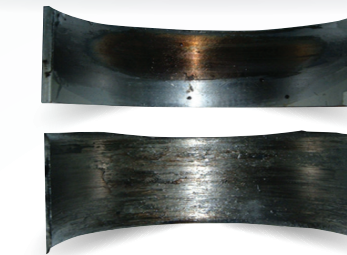
Possible causes:

- Wrong selection of engine bearing material
- Engine power increased beyond original design
- Excessive clearance
- Fuel detonation/preignition
- Geometry defects causing localized bearing overloading

Corrective actions:

- Select a bearing material with higher load capacity
- Check: clearances and component geometry
- Retard ignition or use fuel with higher octane number
- Repair/replace distorted parts

Surface Wear



Appearance:

- Accelerated wear - shiny surface
- Heavy wear - signs of overheating (blackening), partial melting/removal of overlay (top shell)
- Severe wear - torn surface, heavy overheating, melted/missing overlay and lining material (bottom shell)

Possible causes:

- Insufficient oil supply (starvation)
- Non-uniform/unstable oil film (due to bearing fatigue)
- Geometrical irregularities or poor journal surface finish
- Grinding chatter marks and lobing
- Contaminated oil

Corrective actions:

- Check oil supply system, prevent oil dilution/contamination
- Change bearing material
- Verify proper grinding/polishing procedures
- Improve cleaning procedures, replace oil and filter more frequently

Edge Wear Due to Distorted Connecting Rod



Appearance:

Localized excessive wear of the bearing surface along the bearing edge. Possibility of fatigue cracks in the affected area.

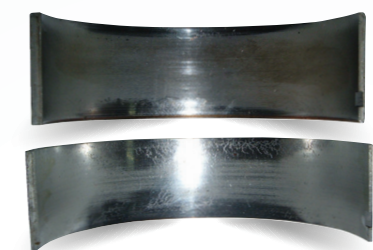
Possible causes:

- Rod distortion caused by:
 - Overloading
 - Detonation
 - Excessive torque
- Distorted rod produces non-parallel orientation of the bearing and journal surfaces
- Metal-to-metal contact occurs along the bearing edge

Corrective actions:

- Replace the distorted parts
- Prevent engine detonation and pre-ignition (check cooling system, air-fuel ratio, ignition timing, knock sensor, octane number of fuel)
- Choose higher strength connecting rods

Imperfect Journal Geometry



Appearance:

Localized wear in parts of the bearing surface. Fatigue cracks may occur in these areas.

Possible causes:

- Inconsistent journal diameter. Areas of greater diameter produce metal-to-metal contact with the bearing surface, causing local wear
- Use of worn or improperly dressed grinding wheel when resizing the crankshaft. Journals may result as tapered, hourglass shape or barrel shape

Corrective actions:

- Replace/redress grinding wheel
- Re-grind the crankshaft

Cavitation Erosion



Appearance:

Erosion damaged areas on the overlay due to sharp changes of pressure in the oil film.

Possible causes:

Vapor cavities (bubbles) in the oil – when the load applied to a bearing fluctuates at high frequency (high RPM). The oil pressure can instantly fall, causing vapor cavities (bubbles) due to fast evaporation (boiling). When the pressure rises, vapor cavities (cavitation bubbles) contract at high velocity. Such collapse results in impact pressure, that can erode the bearing material.

Corrective actions:

- Select stronger (harder) bearing material
- Decrease oil clearance
- Avoid running the engine at extremely high rotation speeds

Spinning of the Bearing in the Housing



Appearance:

Highly polished area on the bearing back caused by bearing spinning in the housing.

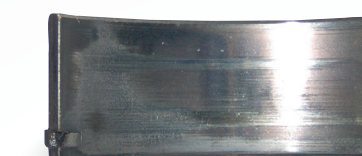
Possible causes:

- Insufficient crush height
- Oil starvation/lugging the engine causing seizure
- Housing diameter greater than specified value

Corrective actions:

- Choose bearings with sufficient crush height for the application
- Eliminate the cause of seizure
- Check housing diameter for size and roundness
- Tighten bolts to the specified torque value

Fatigue in the Crush Relief Area



Appearance:

Fatigue cracks in the area of crush relief.

Possible causes:

- Excessive crush height - upon torquing the housing, the parting line region of the bearings deflects inward. This reduces the gap between the journal and bearing surfaces. Such change of bearing profile at the parting line region produces localized peak oil film pressure, which can cause fatigue of the bearing material.
- Excessive RPM producing rod bore stretch

Corrective actions:

- Prevent excessive crush height
- Check the housing diameter
- Avoid over-torquing the rods
- Choose more rigid connecting rods

Damage Caused by Foreign Particles



Appearance:

Circumferential scores or scratches on the bearing surface.

Possible causes:

- Particles of grinding abrasive entrapped in crankshaft oil passages and/or other engine block components
- Ambient dirt, sand or dust
- Metal particles (e.g. fragments of fatigued material from failed components)

Corrective actions:

- Find the origin of the abrasive particles and other contaminants
- Replace air filter, oil and oil filter
- Check crankshaft oil passages and all engine components. Thoroughly clean them with hot soapy water prior to assembly.