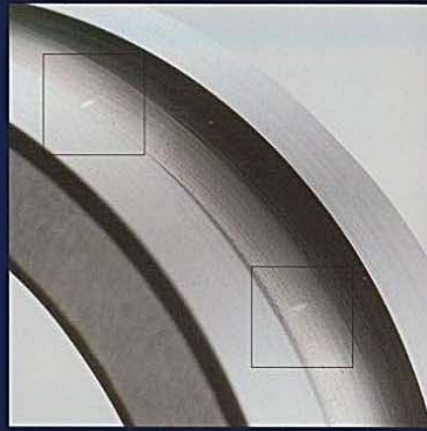
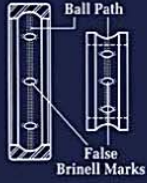
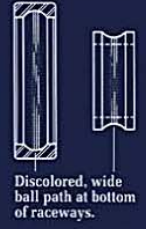


BEARING FAILURE: CAUSES AND CURES

FALSE BRINELLING – False brinelling—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. A small relative motion between balls and raceway occurs in non-rotating ball bearings that are subject to external vibration. When the bearing isn't turning, an oil film cannot be formed to prevent raceway wear. Wear debris oxidizes and accelerates the wear process. Isolate bearings from external vibration, and use greases containing anti-wear additives such as molybdenum disulfide.



TIGHT FITS – A heavy ball wear path in the bottom of the raceway indicates a tight fit. Where interference fits exceed the radial clearance at operating temperature, the balls will become excessively loaded. Continued operation can lead to rapid wear and fatigue. Corrective action includes a decrease in total interference—better matching of bearings to shafts and housings—taking into consideration the differences in materials and operating temperatures. Increased radial clearance could also increase bearing life.



OVERHEATING – Symptoms are discoloration of the rings, balls and cages from gold to blue. Temperatures in excess of 400°F can anneal the ring and ball materials. The resulting loss in hardness reduces the bearing capacity causing early failure. In extreme cases, balls and rings will deform. The temperature rise can also degrade or destroy lubricant. Common culprits are heavy electrical heat loads, inadequate heat paths, and insufficient



cooling or lubrication when loads and speed are excessive. Thermal or overload controls, adequate heat paths, and supplemental cooling are effective cures.



NORMAL FATIGUE FAILURE – Fatigue failure—usually referred to as spalling—is the fracture of the running surfaces and subsequent removal of small, discrete particles of material. Spalling can occur on the inner ring, outer ring, or balls. This type of failure is progressive and once initiated will spread as a result of further operation. It will always be accompanied by a marked increase in vibration, indicating an abnormality. The remedy is to replace the bearing or consider redesigning to use a bearing having a greater calculated fatigue life.



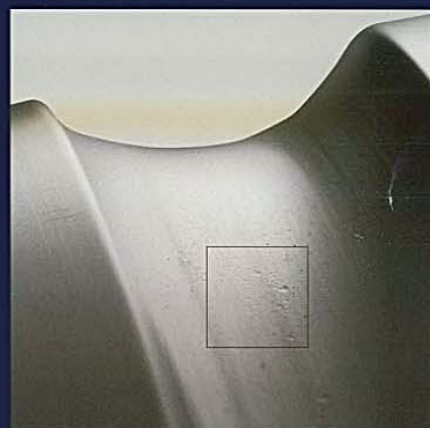
REVERSE LOADING – Angular contact bearings are designed to accept an axial load in one direction only. When loaded in the opposite direction, the elliptical contact area on the outer ring is truncated by the low shoulder on that side of the outer ring. The result is excessive stress and an increase in temperature, followed by increased vibration and early failure. Failure mode is very similar to that of heavy interference (tight) fits. The balls will show a grooved wear band caused by the ball riding over the outer edge of the raceway. To prevent reverse loading problems, make sure bearings are properly installed.



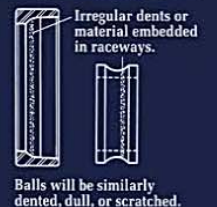
TRUE BRINELLING – Brinelling occurs when loads exceed the elastic limit of the ring material. Brinell marks show as indentations in the raceways which increase bearing vibration (noise). Severe brinell marks can cause premature fatigue failure. Any static overload or severe impact can cause brinelling. Examples include: using hammers to remove or install bearings, dropping or striking assembled equipment, and pressing a bearing onto a shaft by applying force to the outer ring. Install bearings by applying force only to the ring being press-fitted.



EXCESSIVE LOADS – Excessive loads usually cause premature fatigue. Tight fits, brinelling and improper preloading can also bring about early fatigue failure. This type of failure looks the same as normal fatigue, although heavy ball wear paths, evidence of overheating and a more widespread spalling (fatigue area) are usually evident with shortened life. The solution is to reduce the load or redesign using a bearing with greater capacity.



CONTAMINATION – Contamination is one of the leading causes of bearing failure. Symptoms are denting of balls and races, causing vibration. Contaminants include airborne dust, dirt or abrasive substances. Principal sources are dirty tools, contaminated work areas, dirty hands or foreign matter in lubricants or cleaning solutions. 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. Seals should be considered.

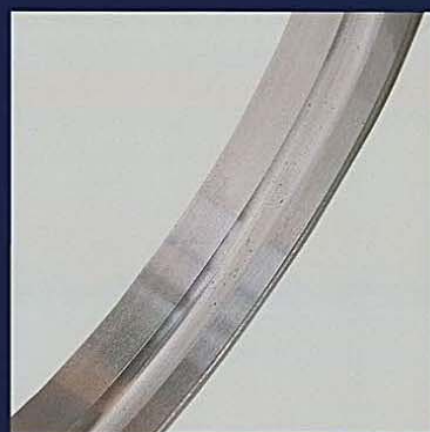


LUBRICANT FAILURE – Discolored (blue/brown) ball tracks and balls indicate lubricant failure. Excessive wear of balls, rings, and cages will follow, resulting in overheating and subsequent catastrophic failure. Ball bearings depend on the continuous presence of a thin film of lubricant between bearing components. Failures are caused by restricted lubricant

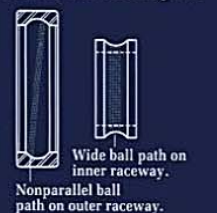


flow or excessive temperatures that degrade lubricant properties. Barden can advise users on the most suitable lubricant type and quantity to use. Correct improper fit and control preload to reduce bearing temperatures and improve lube life.

Blue/black raceways
Balls will also be blue/black.



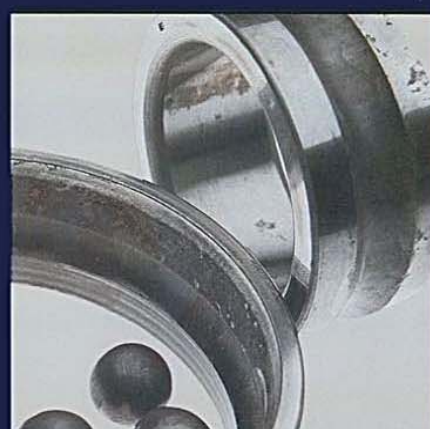
MISALIGNMENT – Misalignment can be detected on the raceway of the nonrotating ring by a wear path not parallel to raceway edges. Causes include bent shafts, burrs or dirt on shaft or housing shoulders, shaft threads that are not square with shaft seats, and locking nuts with faces that are not square to the thread axis. Maximum allowable misalignment can vary. To correct, inspect shafts and housings for runout of shoulders and bearing seats; use single point-turned or ground threads on nonhardened shafts and ground threads only in hardened shafts; use precision grade locknuts.



LOOSE FITS – 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 (bores, outer diameters, faces) will wear causing noise and runout problems. Consult Barden for fit recommendations.



Outer ring slippage caused by improper housing fits.



CORROSION – Red/brown areas on balls, raceways, cages, or bands on ball bearings are symptoms of corrosion. This condition results from exposing bearings to corrosive fluids or atmospheres. The usual result is increased vibration followed by wear, with a subsequent increase in radial clearance or loss of preload. In some cases, corrosion leads to early fatigue failures. Divert corrosive fluids away from bearing areas and use integrally sealed bearings. In hostile environments, use both external and integral seals. The use of stainless steel bearings is also helpful.

