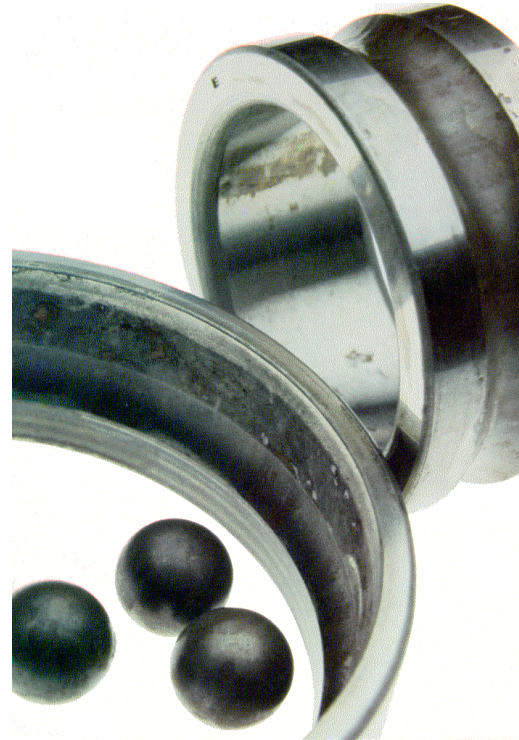


# Sensor Applications



## Bearing Failure: Causes and Cures



## Sensor Applications



# Excessive Loads

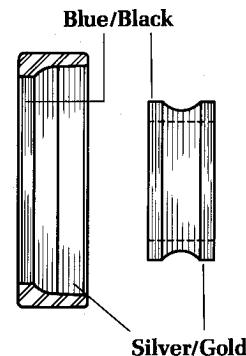
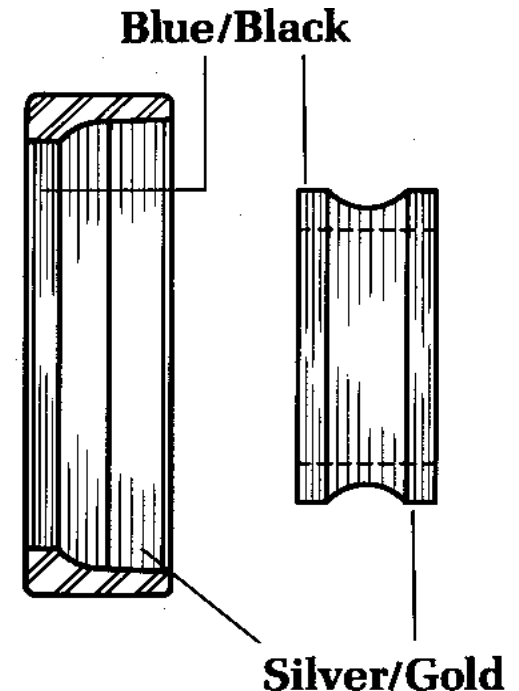
- Excessive loads usually cause premature fatigue. Tight fits, brinelling and improper preloading can also bring about early fatigue failure.
- The solution is to reduce the load or redesign using a bearing with greater capacity.





# Overheating

- Symptoms are discoloration of the rings, balls, and cages from gold to blue.
- Temperature in excess of 400F 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.



## Sensor Applications



# True Brinelling

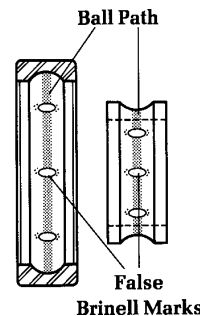
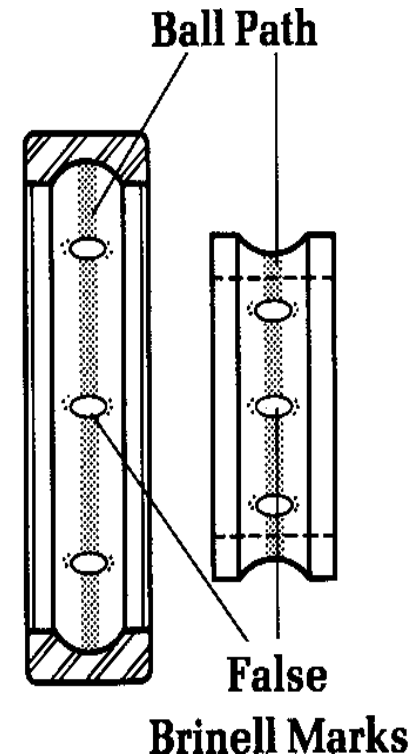
- Brinelling occurs when loads exceed the elastic limit of the ring material.
- Brinell marks show as indentations in the raceways which increase bearing vibration (noise).
- Any static overload or severe impact can cause brinelling.





# False Brinelling

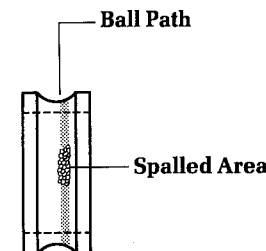
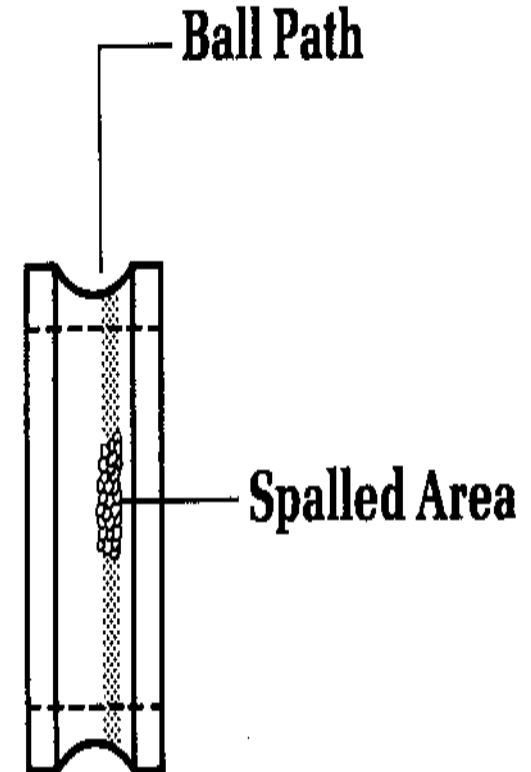
- False brinelling - elliptical wear marks in an axial direction at each ball position with a bright finish and sharp demarcation, often surrounded by a ring of brown debris - indicates excessive external vibration.
- Correct by isolating bearings from external vibration, and using greases containing antiwear additives.





# Normal Fatigue Failure

- Fatigue failure - usually referred to as spalling - is a 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.
- The remedy is to replace the bearing or consider redesigning to use a bearing having a greater calculated fatigue life.

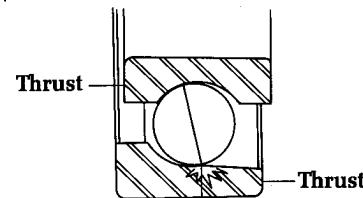


## Sensor Applications



# 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 simply install the bearing correctly.

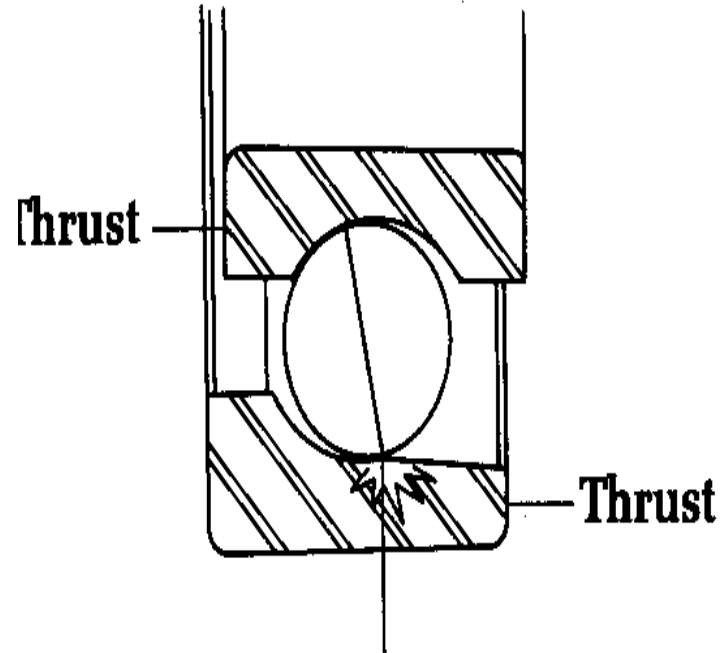


Ball band caused by ball riding over edge of raceway.

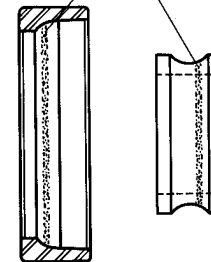


# Contamination

- Contamination is one of the leading causes of bearing failure.
- Contamination 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.



Irregular dents or material embedded in raceways.



**Ball band caused by ball riding over edge of raceway.**

Balls will be similarly dented, dull, or scratched.



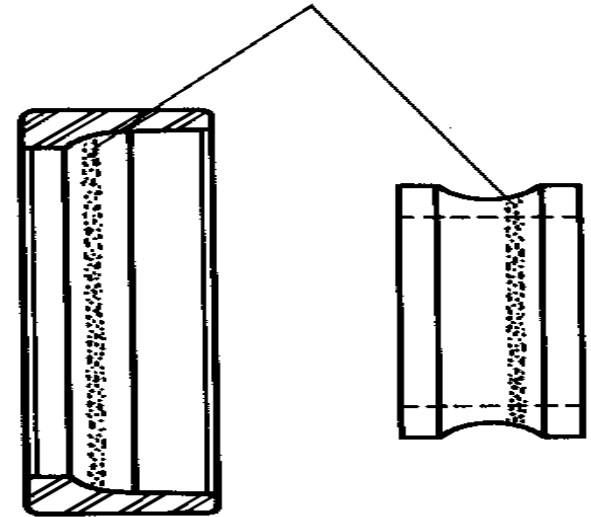
## Sensor Applications



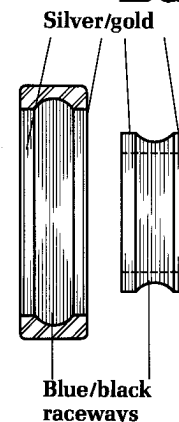
# Lubricant Failure

- Discolored (blue/brown) ball tracks and balls are symptoms of lubricant failure. Excessive wear of balls, ring, and cages will follow, resulting in overheating and subsequent catastrophic failure.
- Ball bearings depend on the continuous presence of a very thin -millionths of an inch - film of lubricant between balls and races, and between the cage, bearing rings, and balls.
- Failures are typically caused by restricted lubricant flow or excessive temperatures that degrade the lubricant's properties.

**Irregular dents or material embedded in raceways.**



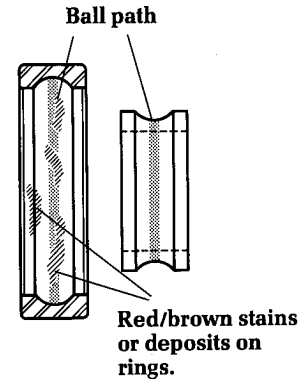
**Balls will be similarly dented, pitted, or scratched.**





# Corrosion

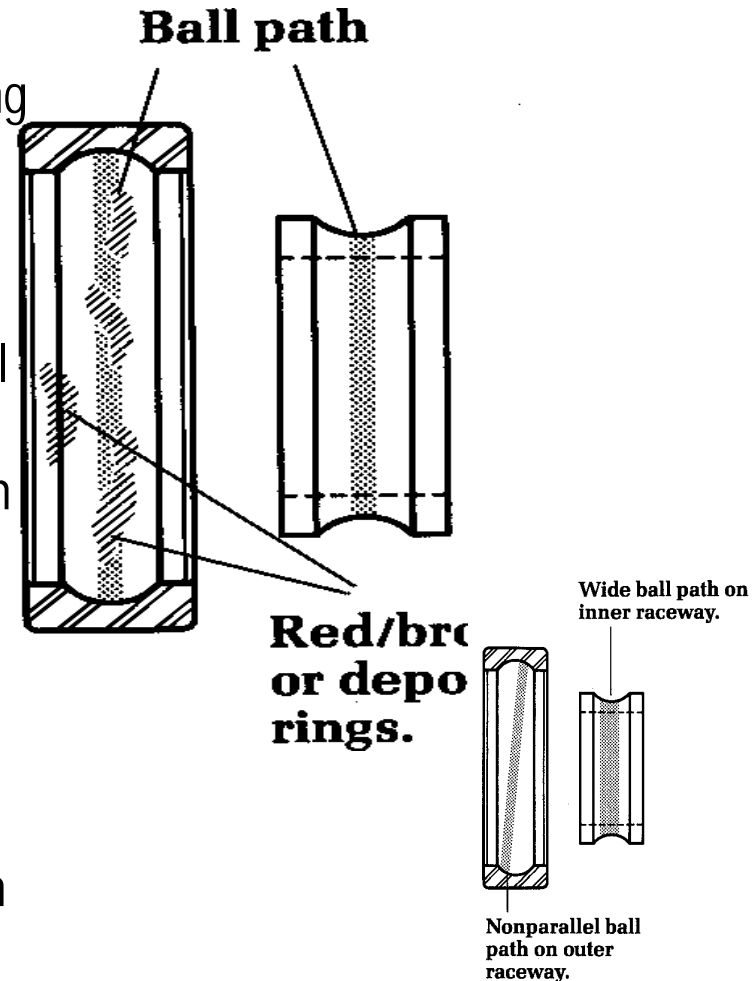
- Red/brown areas on balls, race-way, cages, or bands of ball bearings are symptoms of corrosion.
- This condition results from exposing bearings to corrosive fluids or a corrosive atmosphere.
- In extreme cases, corrosion can initiate early fatigue failures.
- Correct by diverting corrosive fluids away from bearing areas and use integrally sealed bearings whenever possible.





# Misalignment

- Misalignment can be detected on the raceway of the nonrotating ring by a ball wear path that is not parallel to the raceways edges.
- If misalignment exceeds 0.001 in./in you can expect an abnormal temperature rise in the bearing and/or housing and heavy wear in the cage ball-pockets.
- Appropriate corrective action includes: inspecting shafts and housings for runout of shoulders and bearing seats; use of single point-turned or ground threads on non hardened shafts and ground threads only on hardened shafts; and using precision grade locknuts.

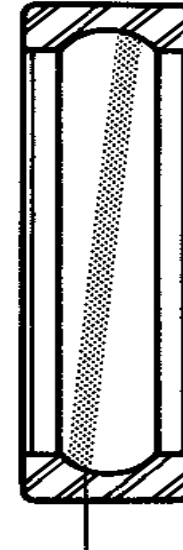
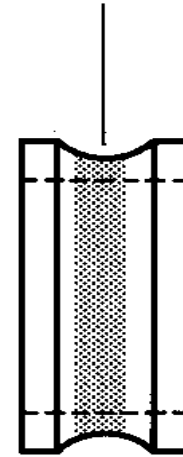




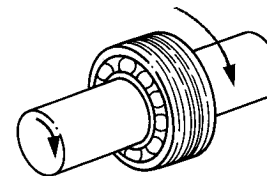
# Loose Fits

- 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 (bore, outer diameters, faces) will wear and heat, causing noise and runout problems.

**Wide ball path or inner raceway.**



**Nonparallel ball path on outer raceway.**



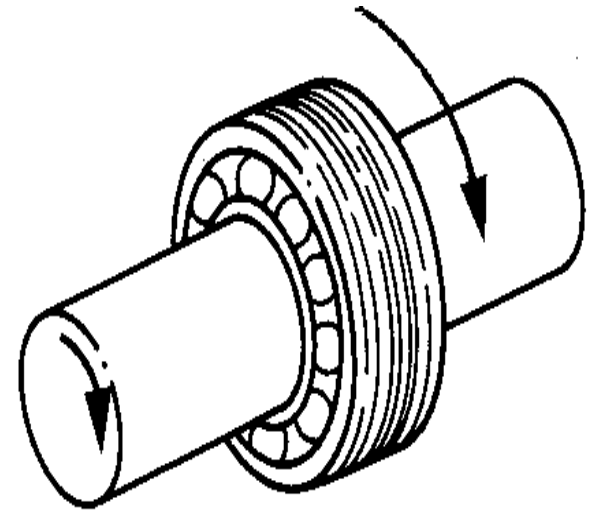
Outer ring slippage caused by improper housing fits.

## Sensor Applications

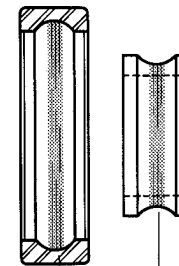


# Tight Fits

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



**Outer ring slippage  
d by improper  
ng fits.**



Discolored, wide ball path at bottom of raceways.