6. HOW TO RECOGNIZE AND PREVENT TAPERED ROLLER BEARING DAMAGE

A. Introduction

Damage to bearings relating to handling before and during installation, improper installation, and setting and operating conditions cause, by far, the largest percentage of premature bearing problems.

In the following pages, examples are shown of the most common types of damage and their causes.

In many cases, the damage is easily identified by the appearance of the bearing. But it is not easy and sometimes it is impossible to determine the exact cause of that damage. As an example, a bearing with scored and heat discolored roller ends and rib is easily identified as a burned up bearing and damaged beyond further use. The cause of the burning or damage, however, might be traced to any one of a number of things such as insufficient or improper lubricant. It may be the wrong type of lubricant or the wrong system for supplying lubricant. Perhaps a lighter or a heavier lubricant is needed. Possibly an extreme pressure type of lubricant rather than a straight mineral oil and a circulating oil system rather than an oil level or splash system would be preferred. This type of damage could be caused by excessively tight bearing setting or a combination of excessively tight setting and inadequate lubrication.

A simple examination of a bearing will not reveal the cause of the trouble. It can reveal if the bearing is good for further service, but often it is necessary to make a thorough and complete investigation of the mounting, installation and parts affecting the bearing operation to determine the cause of the damage. Unless the true cause of the damage is found and corrected, the replacement bearing will be damaged in the same manner and again there will be premature trouble.

This information is not an attempt to make “trouble shooters” or “bearing experts” of all who read it. It is intended to caution users about possible causes of damage and alert them to take preventive action. With proper precautions during the handling, assembly and operation of bearings, almost all damage can be prevented. It is much easier, and a great deal less expensive, to prevent damage than to determine and correct the cause of damage after the machine or equipment is in operation.

B. Typical damage modes

1. Mode of contact fatigue

Fig. 6-1
Geometric stress concentration
Geometric stress concentration fatigue results from locally increased stress at the ends of roller/race contact.

Fig. 6-2
Point Surface Origin (PSO)
PSO is fatigue damage that has its origin associated with surface asperities, which act as local stress concentrations.

Fig. 6-3
Peeling
This type of fatigue is characterized by a shallow < 25 µm (.001in) deep, spalling which sometimes occurs locally around bruises, grooves, or ends of roller/race contacts where the EHD film is lost by leakage.

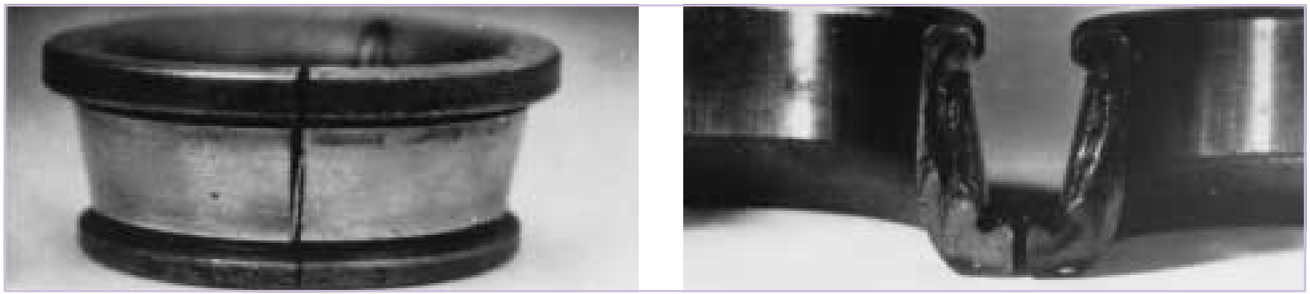
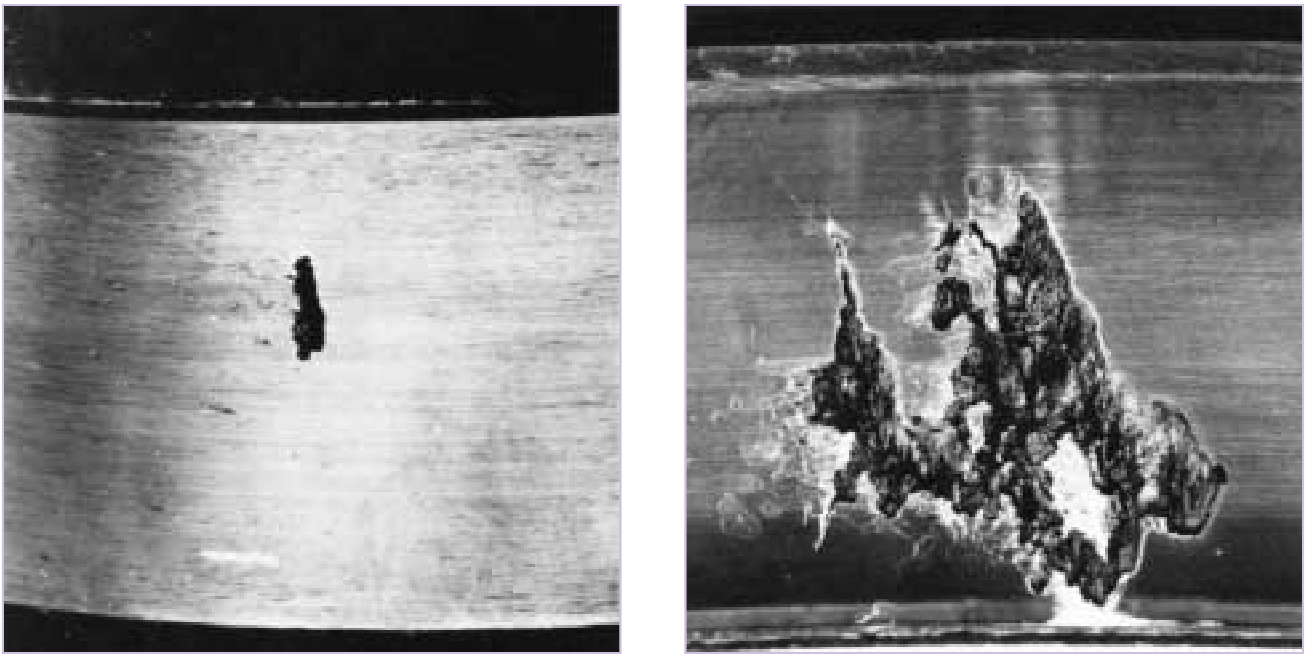


Fig. 6-4
Transverse cracking fatigue.



a) Non-propagated spall

b) Spall propagated by hydraulic pressure

Fig. 6-5
Inclusion origin spall.

2. Damage by mechanisms other than contact fatigue

Fig. 6-6
Abrasive wear.

Fig. 6-7
Spalling.

Fig. 6-9
Etching in the initial stage
Pitting caused by moisture at the roller/raceway contact line.

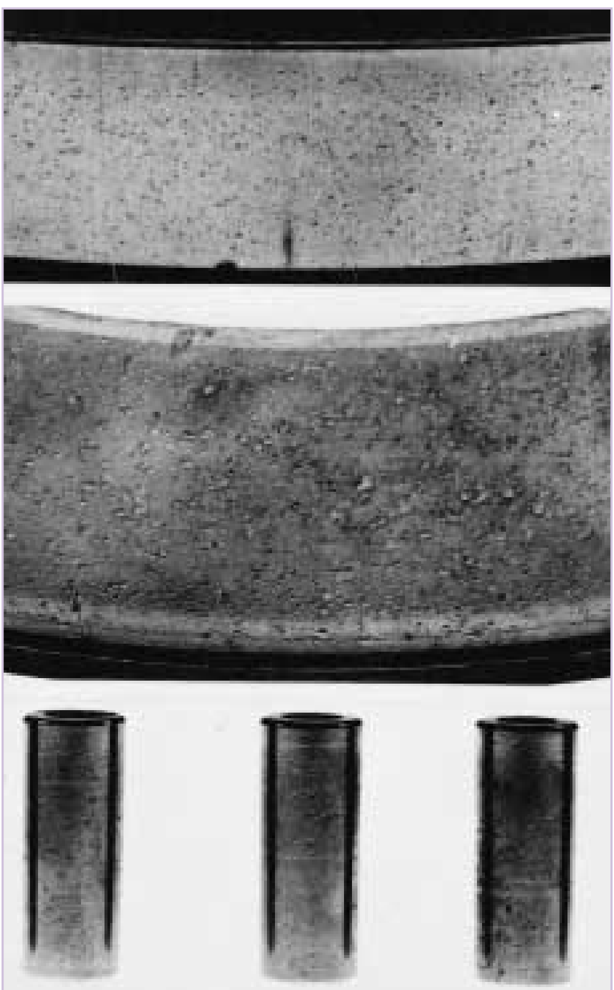


Fig. 6-8
Wear from foreign material
Debris bruises on all contact surfaces due to hard particles in the lubricant.

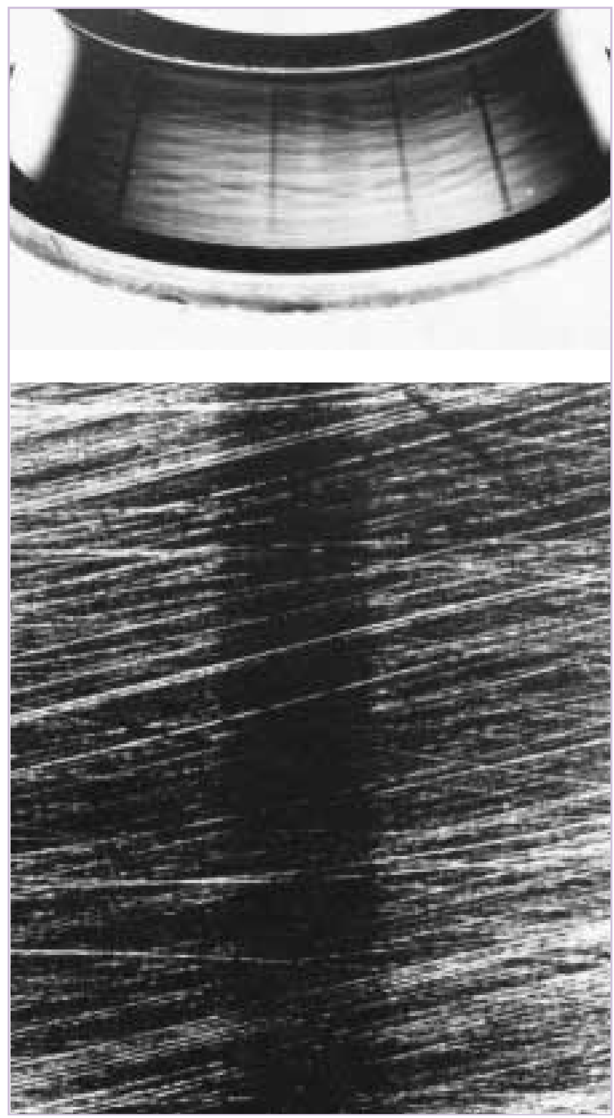


Fig. 6-10
Brinelling
Brinelling is the plastic deformation of bearing element surfaces due to extreme or repeated shock loads.

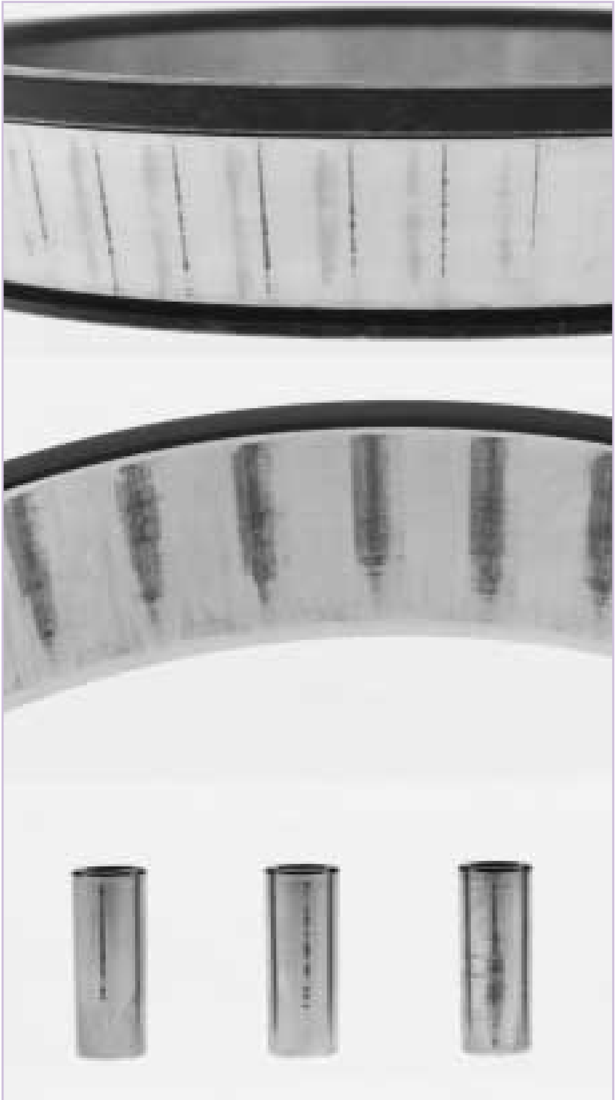


Fig. 6-11
False brinelling
False brinelling is recognizable by the grooves worn into the raceways by axial movement of the rollers during transportation.

Fig. 6-12
Cage damage.

Fig. 6-13
Cage breakage.

C. Results of good practices

The preceding section showed the results of bad handling, improper assemblies, adjustments and operating conditions.

Figure 6-14 shows what happens when there is good lubrication, good assembly and maintenance and the proper fitting practice for the bearing application has been followed. This bearing shows that, with reasonable care in machining the parts and in the assembly and maintenance, it is not difficult to get excellent life. This bearing operated for over 400,000 km (250,000 miles) in a bus and is still in excellent condition and probably would last an extended period of time.

Fig. 6-14

D. Bearing damage analysis

How to determine probable causes

Probable causes	Stress concentration	PSO - Point surface origin	Peeling	Transverse cracking	Subcase fatigue	Spalling	Burn up	Abrasive wear	Pitting - Grooving	Etching - Corrosion	Brinelling	False brinelling (Fretting)	Cage damage / breakage	Gouges or nicks	Burns / fluting damage
Mode of damage	**Mode of contact fatigue**					**Damage by mechanisms other than contact fatigue**									
Mounting															
Incorrect handling													●	●	
Incorrect assembly	●						●						●	●	
Incorrect setting (excessive PL)			●				●								
Incorrect setting (excessive EP)	●										●	●	●		
Improper storage										●					
Misalignment	●		●												
Deflection	●														
Loose fit				●										●	
Operating conditions															
Impact or shock loads											●		●		
High static overload											●				
Heavy load					●	●									
Vibrations - Oscillations												●	●		
Environment															
Water or moisture in lubricant								●	●	●					
Foreign particles (metallic)								●							
Foreign particles (sand, dust...)								●							
Defective seals								●		●					
Improper cleanning of housing								●	●						
Chemical contamination										●					
Electric current															●
Lubrication															
Quality of lubricant	●	●	●			●	●	●		●		●	●		
Quantity of lubricant (oil film)	●	●	●			●	●			●		●	●		

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Notes