BEARING FAILURE ANALYSIS

Example Type B Report

Cylindrical Roller Electric Motor Bearing Failure

1. INTRODUCTION

A single cylindrical roller bearing was supplied to us for inspection and report. See Fig 1.

Fig 1

From information provided, we understand that the bearing had been fitted to an electric motor and that the end user required confirmation of the failure mode.

2. INSPECTION

The bearing was carefully removed from its packaging and rotated by hand. The movement was found to be relatively smooth. Some resistance to motion and drag was detected during this test. It was noted that the bearing was filled with a deep brown but relatively clean lubricant.

The outer ring was visually inspected, see Fig 3. There were clear fitting marks all around the outer surface. These marks were not excessive, suggesting that the bearing had not been installed for a long length of time. There was no evidence of out of square alignment or heavy handling marks.

Fig 2

There was also no evidence of abnormal rotation or fretting from within the housing.

The inner ring bore was inspected and seen to have no abnormal fitting marks. See Fig 3. This lack of marking or fretting once again suggested that the bearing had only been in service for a short time.

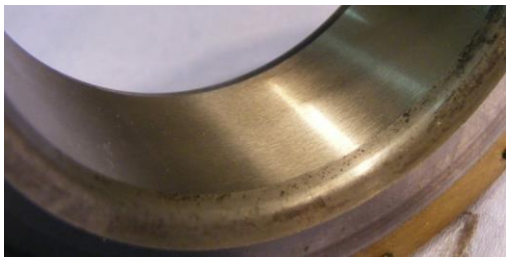

Fig 3

In order that the condition of the bearing could be further examined it was necessary to disassemble it . This was achieved by removing the heads from the cage rivets and splitting away the two halves of the machined brass cage.

2.1 Inner Ring

The inner ring prior to the cage being removed is shown in Fig 4.

Fig 4

As can be seen, as well as an ample amount of grease, the rollers appear to have a frost like band around the entire centre of all the load carrying elements.

With the cage removed, ample grease was again found along with a similar frost like band around the centre of the inner raceway. See Fig 5.

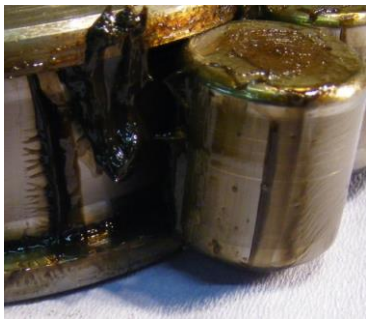

Fig 5

Following cleaning of the load bearing surfaces, fluting lines running across the load bearing surface were seen. When touched, these fluting lines felt rough and uneven and an obvious cause of bearing vibration whilst in service.

.

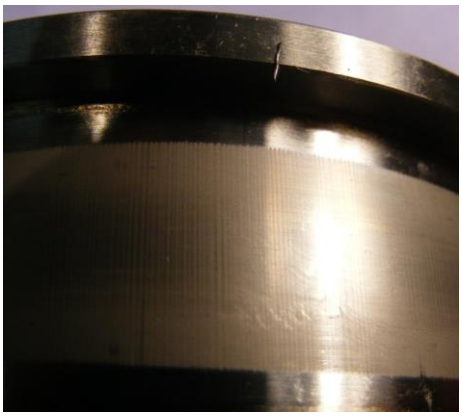

Fig 6

The fluting marks were seen to run all round the raceway for a full 360 degrees. There was no other evidence of surface marking such as pits or surface fatigue caused by overloading, out of square running or defective components.

2.2 Outer Ring

Fig 7

Fig 7 shows the outer raceway prior to cleaning.

The ring was carefully cleaned and inspected under a macro viewer. It was seen that only part of the outer ring was marked with the fluting lines, the remainder of the outer raceway groove was in a generally normal condition. As can be seen from Fig 8 and Fig 9 at the ends of the markings, the fluting becomes narrower and less pronounced.

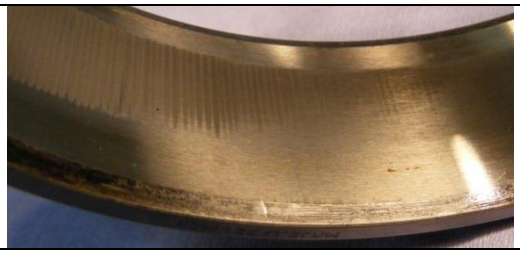

Fig 8

Fig 9

Fig 10 shows the central portion of the marking in the outer raceway, with approximately 60% of the raceway being fluted and the remainder being undamaged, see Fig 11.

Fig 10

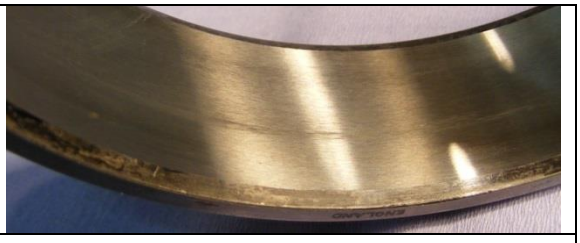

Fig 11

2.3 Rolling Elements

The thirteen cylindrical rollers were all seen to be dull and matted in the central load bearing portion, see Fig 12, rather than the shiny polished finish found at the roller ends.

Fig 12

3. DISCUSSIONS AND CONCLUSIONS

The markings seen on the inner raceway, outer raceway and cylindrical rollers are classical in nature and are referred to as electric pitting or sometimes electric corrosion.

In applications such as electric motors, if the bearing is not electrically insulated from the application, electric current may pass through the bearing. This current passage will form clusters of tiny pits on the rolling surface. Continued operation leads to corrugation of the rolling surfaces. The spacing of these corrugations is a function of the bearing internal speed and the frequency of the electrical current. The rolling elements will also experience surface pitting.

It is clear that this bearing has been damaged by electric pitting with the current flowing through the bearing inner ring and via a path through the stationary outer raceway.

The changes in colour within the flutes is a function of a localised "heat treatment" effect caused by the electric arc jumping between the rollers and the raceways through the lubricant film. This arcing causes hardened layers and tempered layers to be produced in the surface of the bearing raceways.

From the gathered evidence it is clear that this damage has occurred for reasons outside the control of the bearing supplier, namely that the bearing has been affected by electric arcing. It is not possible for us to comment upon the reason for this electrical flow through the motor and bearing, however a common cause is often a loss of insulation or the use of an inappropriate component to earth a welding operation.