Machinery Diagnostics Institute

Case Study: Outer Race Bearing Defect

Introduction

Outer race bearing defects are one of the most common types of bearing defects that can occur in rotating machinery. Outer race bearing defects are faults or damages that occur in the outer ring or raceway of a rolling element bearing. Outer race bearing defects can occur due to various reasons, including fatigue, wear, corrosion, or improper lubrication. In this study, we will examine real-life examples of outer race bearing defects.

Analysis

MDI was commissioned to perform routine data analysis at a Pulverized Coal Mill. Outer race defects were found on two machines:

- Gland Steam Condensation Fan
- Service Water Pump

MDI utilized the following hardware for this analysis:

- CTC's AC294 Compact Size, Side Exit, 100 mV/g Accelerometer
- CTC's MH214-3A Magnetic Mounting Base
- CTC's CB104-C555-006-K2C-SF Cable and Connectors Assembly
- CSI 2130 Data Collector

Utilizing a cable with a breakaway safety feature for portable data collection (as shown here) is extremely important for analyst safety while collecting data on large operating machinery

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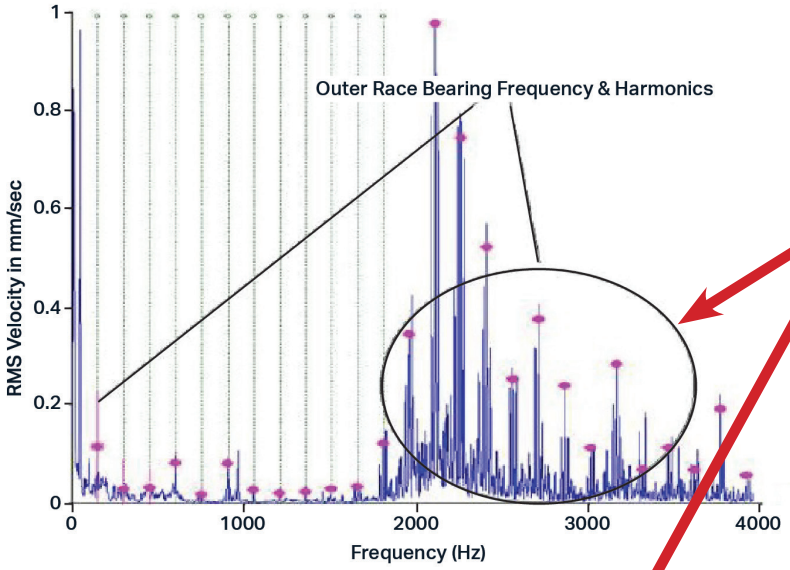
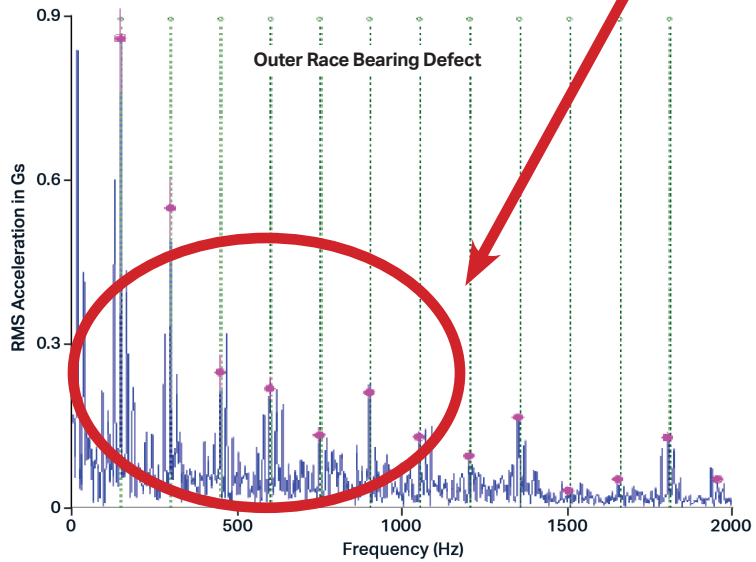
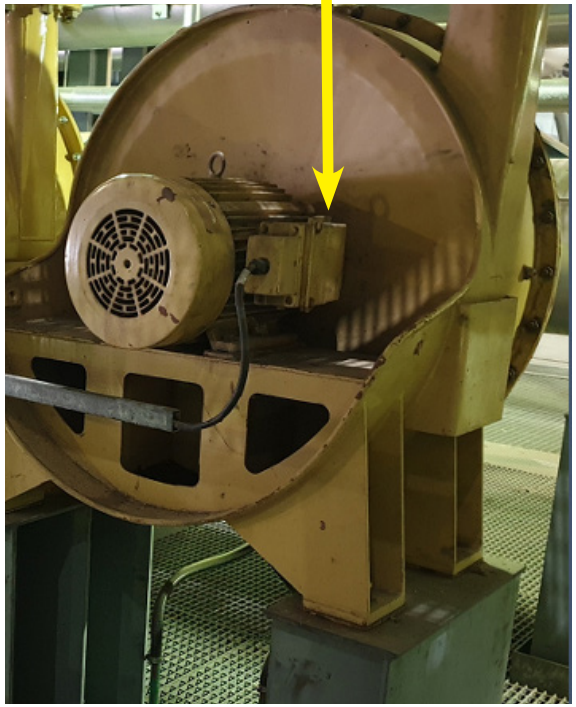




Both motor drive end bearing velocity and the Peakvue spectrum showed elevated vibration at the outer race defect frequency indicative of bearing fault

From bearing inspection it was found that false brinelling is the root cause of the failure



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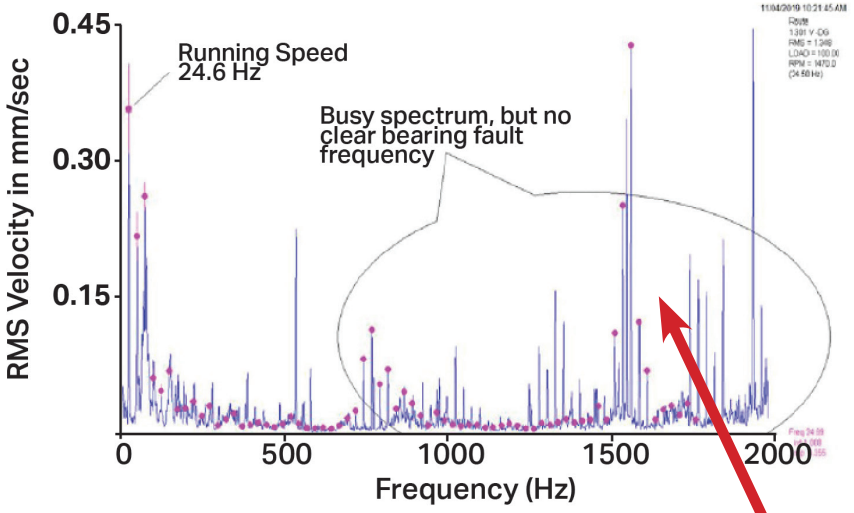

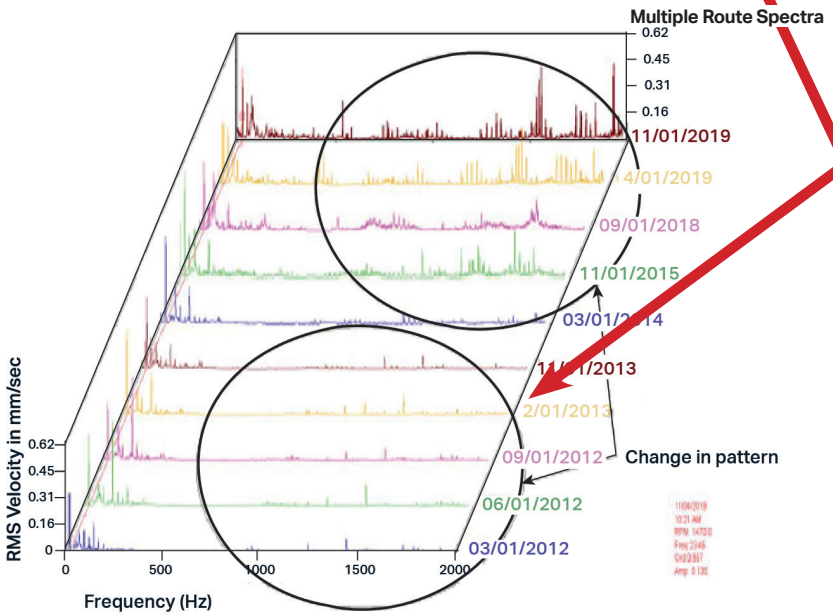

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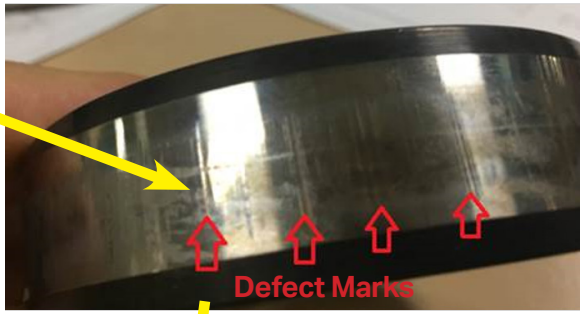
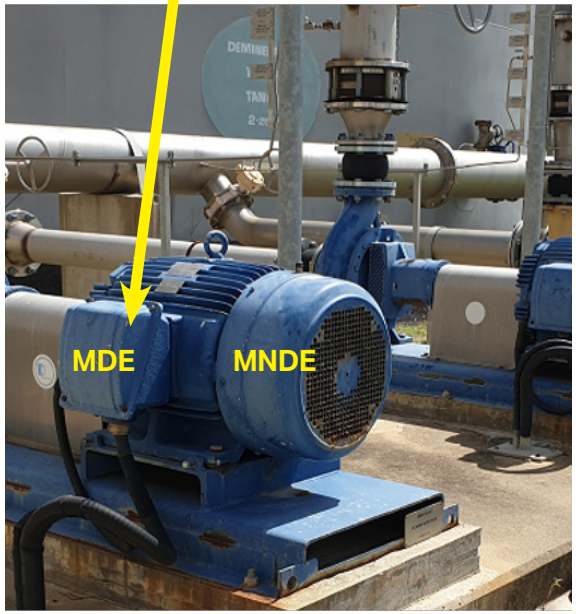


Both motor drive end bearing velocity and the Peakvue spectrum showed elevated vibration at the inner race defect frequency indicative of bearing fault.



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Conclusion

The most common type of outer race bearing defect is spalling, which occurs due to high cyclic stress on the bearing surface. Spalling is characterized by the formation of small cracks or pits on the surface of the outer race, which can lead to the loss of bearing material and reduced bearing life. Spalling is pictured on the outer race of machine 1 (pictured on page 2), the gland steam condensate fan. The root cause of this fault was determined to be false brinelling. False brinelling is caused by vibrations acting on the bearing while stationary. Since lubricant is not redistributed inside the bearing without rotational movement, lubricant can be pushed out of the loaded region in stationary bearings, resulting in wear and potential oxidation.

Other types of outer race bearing defects include cracking, which occurs due to high static loads, and fretting, which occurs due to micro-movements between the bearing and the housing or shaft. Fretting can cause wear and damage to the bearing surface and can result in premature bearing failure. Fretting can be seen on machine 2 (pictured on page 3), the service water pump. In both cases, it was recommended to replace the bearing to prevent further damage.

The frequency range for detecting outer race bearing defects depends on the size and type of bearing, the rotational speed of the machinery, and the severity of the defect. Generally, outer race bearing defects produce vibration signals in the frequency range of 1x to 4x the running speed of the bearing. For example, if the bearing is rotating at 1000 RPM, the frequency range for detecting outer race bearing defects would be 60,000 RPM to 240,000 RPM. However, the specific frequency range for detecting outer race bearing defects may vary depending on the individual case.

Related CTC Products

In addition to the CTC products used by MDI, CTC also offers a variety of vibration analysis hardware solutions that are ideal for use in applications like those explored in this case study. In general, CTC's 100 mV/g accelerometers are great multipurpose tools capable of detecting outer race defects within the range of .5 Hz to 15 kHz. CTC offers 100 mV/g accelerometers in standard, compact, and miniature sizes, in both top and side exit configurations. Additionally, CTC's 100 mV/g triaxial accelerometers are excellent multipurpose tools for taking three axes of data simultaneously to speed up routine data collection.

Top Exit 100 mV/g Accelerometers in Standard, Compact, and Mini Sizes

Side Exit 100 mV/g Accelerometers in Standard, Compact, and Mini Sizes

Triaxial 100 mV/g Accelerometers in Top and Side Exit Configurations, Shown in Standard and Low-Profile Case Styles