

WP0203

Dodge® mounted bearings: frosty raceway failure analysis

Dodge Customer/Order Engineering

04-15-2015



If you have ever read a bearing failure analysis report, you might have seen the term “frosty raceways.” But what do frosty raceways look like and what causes them? In this article, we will take a closer look at this phenomenon and try to answer these questions.

To investigate, we will look at a ball bearing pulled from service after approximately one year. This bearing supported a take-up pulley on a conveyor which transports wood material at a biofuel energy plant. The conveyed material ranged in size from softball sized chunks to fine sawdust. Poor maintenance

practices allowed the sawdust to become compacted around the bearings. Further evidence showed the bearings had not been properly re-lubricated.



Figure 2. Subject bearing

Upon teardown and inspection of the bearing, significant contamination was found beneath the rubberized flinger and within the bearing cavity. Proper re-lubrication would have prevented this by forcing contaminants out before they could reach the bearing cavity. The grease had turned from light green to almost black, indicating the lubrication had begun to breakdown. Bearings rely on proper lubrication to reduce friction and prevent metal to metal contact. As the grease begins to breakdown, its lubricating properties diminish and the probability of metal to metal contact increases. Again, proper re-lubrication would have supplied fresh grease and maintained adequate lubricity.

Once the bearing was completely disassembled and the components cleaned, the inner and outer ring raceways were inspected. While the majority of the raceway surfaces appeared shiny and new, a dull track was evident around the entire circumference of both the inner and outer ring raceways. This dull track, shown in **Figure 3**, is what we refer to as a frosty raceway.

To get a better feel for what is going on, let us take a look at the raceway under a scanning electron microscope. **Figure 4** shows the shiny area of the outer ring at 500 times magnification



Figure 1. Subject bearing in



EXTERNAL/PUBLIC DOCUMENT

ABB Motors and Mechanical Inc.

6040 Ponders Court

Greenville, SC 29615

Phone: +1 864 284 5700

Email: DodgeEngineering@abb.com

The straight circumferential lines are score marks left by the honing operation during manufacturing and are what you would expect to see on a new bearing. Now let's look at the dull, or frosty, area of the outer ring. **Figure 5** shows this area as seen under the same 500 times magnification. Here, nearly gone are the score marks from the grinding operation. Instead, the area is covered with microscopic dents and pits.

Now that we know what frosty raceways look like, what causes them and why should we care? Like our subject bearing exposed to fine sawdust, a bearing that is not properly sealed or re-lubricated can become contaminated. As contamination works its way into the bearing cavity, it becomes trapped in the grease. Ultimately, these particles can get between the rollers and raceways and act as a lapping compound, creating the wear damage seen in **Figure 5**. This wear is what gives the raceway a dull, or frosty, appearance in the ball track.

There are several modes of mechanical bearing wear, such as adhesion, microspalling, and fatigue. Often several modes occur at the same time and it can be difficult to determine the initial cause of failure. This is particularly true in the advanced stages when smearing occurs. (Smearing is simply adhesive wear on a large scale.) However one thing is certain, frosty raceways indicate an early sign of bearing failure.

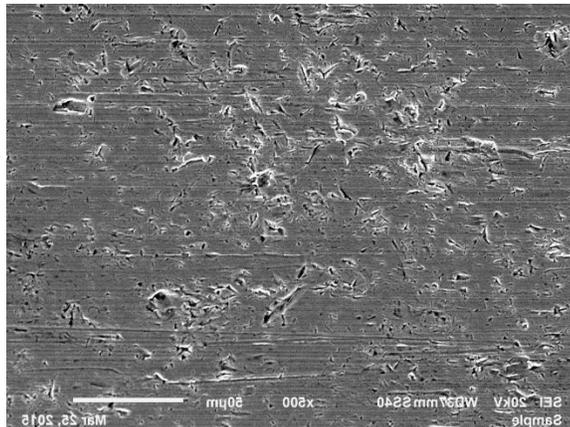


Figure 5. Frosty area of the outer ring

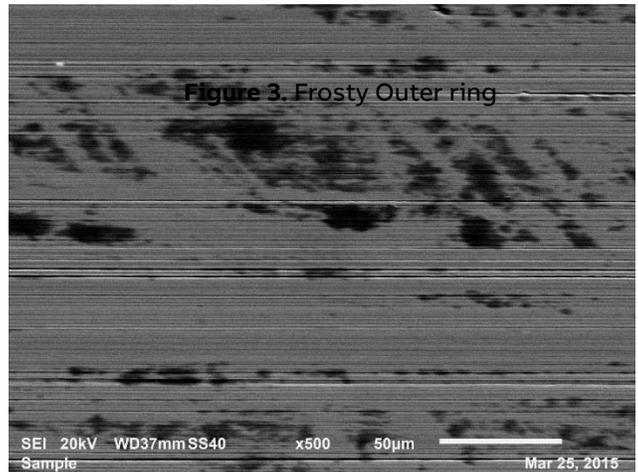


Figure 4. Shiny area of the outer ring at 500x magnification

The particles created during this initial wear serve to further contaminate the bearing with hard particle contamination. From there is a progressive downward spiral of increased wear, contamination, and bearing temperature all of which degrade lubrication and lead to more wear, contamination, and even higher bearing temperatures.

Be sure to look for the next article where we will take a look at spalling. For questions regarding frosty raceways, or bearing failures in general, contact Dodge CO Engineering for bearings and PT components at (864) 284-5700 or email at

DodgeEngineering@abb.com.