East Lime Mud Precoat Filter Vacuum Pump vibration analysis. There has been elevated vibration levels present in the motor of this unit. We have collected numerous readings on the reducer and motor tyring to determine the root cause of the vibration. Some think that the vibration is coming from the reducer. I am convinced that the majority of the vibration is being generated by the motor. This report will go into detail concerning the vibration from the motor and reducer. The problem in this unit is not related to faulty bearings.

We uncoupled the motor on 3-14-14 trying to pinpoint the vibration. The reducer pinion shaft has two moderate spalled area’s on one tooth and a small spall on another. Refer to pictures below

The data does show an impact in the reducer but the high vibration is not at the gearmeshing frequencies.
The following waveform indicates a low level impact that I would relate to the spall located on the pinion shaft.

The impacts seen in this waveform is from the spall on the pinion shaft.
The next set of data is of the motor and reducer.

The highest vibration is coming from the motor compared to the reducer vibration.
The reducers gear frequencies are related to the number of teeth on the pinion (14 teeth) and the bull gear (64 teeth). If we suspected problems with the gear set we would expect to see vibration peaks at these frequencies. The calculation for this is this.

14 teeth X 1192 RPM = 16,688 CPM (278.13 Hz)

This meshing frequency is the same for the output shaft but the output shaft speed and teeth counts are different.

1192 CPM/4.571 gear ratio on reducer = 261 CPM

16,688 CPM (278.13 Hz) / 261 CPM = 64 teeth on the bull gear

We look for 16,688 CPM peaks in the data to indicate suspected problems in the gear set.

These peaks are not present in the data.
The motor vibration we are seeing is not related to bearing faults. I suspect there is a mechanical fault related to the electrical components of the motor construction. Rotor and Stator faults show up in vibration data at motor slip frequencies times the number of poles. Our motor is a 1200 CPM motor and was running at 1192.8 CPM.

\[
1200 \text{ CPM} - 1192.5 \text{ CPM} = 7.5 \text{ CPM slip frequency}
\]

\[
7.2 \text{ CPM slip freq} \times 6 \text{ poles} = 45 \text{ CPM}
\]

So if we were analyzing data of a motor we would look for this 43.2 CPM frequency to diagnose a rotor problem.

Let’s take a look at Low Frequency High resolution data from the motor around 1X turning speed.
See the frequencies around our 1X ts and 2X ts peaks. Let’s zoom in and see what these freq are.
Let's look at the high vibration that exists in the motor around 83X ts.

These peaks are 45.5 CPM off of the 1X ts peak.
Sidebanding off of the 83X ts is related to shaft speed and 2X line freq.

If we zoom in further it reveals that we have sidebanding around all these frequencies at the 45 CPM.
3/11/2014 10:00:54 AM

Analyze

0.211 V-DB

Fk = 0.279

LOAD = 100.00

RPM = 1192.1

(19.87 Hz)
83X turning speed

Sidebanding of 45 CPM which is related to electrical faults

Reference:
Freq 99964.3
Ord 30.04
Amp 0.287

Primary:
Freq 98939.9
Ord 30.03
Amp 0.158

Dif 45.81
In conclusion I wanted to show the data that we took on the motor uncoupled. The vibration at 83X turning speed remains in the motor uncoupled from the reducer. The vibration at this frequency is at .1 inches per second. The frequency has 120 Hz sidebands around it as well as turning speed sidebands. When you run a motor uncoupled you basically have no load. In order for vibration to show electrical faults the motor has to be under no less than 70% load. I have consulted with Mr. Plymon with Plymon and associates. His comments are below.
Todd,

Looking at it on my phone but it appears that you're on it. The sidebands should not be present on a healthy motor. As you know, that indicates either a rotor bar issue or dynamic eccentricity. Current would validate which one but I agree that there is an issue worthy of pursuit. Keep me posted!

I have attached the motor data that I acquired from Baldor/Reliance

I have attached the info on the reducer from B&D.

**Motor info:**

[02vaq04863.pdf](#)

**Reducer info:**

Good morning Todd,

Falk 425A1-AS, ratio: 4.571, MO# 8-966201:

High Speed Bearings:

(2) Timken HH224346

(2) Timken HH224310

Low Speed Bearings:

(2) Timken 99575

(2) Timken 99100

Tooth Counts:

High Speed Pinion Shaft – 14T

Low Speed Gear – 64T
Please let us know if you would like for us to provide any additional information, diagram, etc.

Thank you,

We have took countless amounts of data on this unit, ran uncoupled, tested reducer oil. My recommendation is to change the motor and plan a reducer change in the future. If you still don’t think the motor is a problem then electrically test the motor and perform a rotor influence check (RIC) test.
Rotor Testing With MCE

By Noah Bethel

ROTOR PROBLEMS!! How often have you been in a situation where you have to determine whether a rotor problem exists and the only indication you have is rotor bar pass frequency and a gut feeling. Squirrel cage induction rotors can be one of the toughest things to analyze. Few methods exist that instill the confidence you need to make a call, and without historical data, you may be shooting into the dark. However, with the right tools and some basic knowledge, you can proceed with plenty of confidence. This article will discuss rotor defects and the tools available to diagnose them.

Rotor Defects were estimated to be responsible for approximately 10% of motor failures based on a 1980’s research effort on squirrel cage induction motors sponsored by EPRI and performed by General Electric. Things have certainly changed since the 1980’s. Not only in rotor design, but more importantly, in the analysis equipment available to detect rotor defects. Equipment like the MCE has increased the ability for the technician to identify rotor defects long before they become catastrophic.

What is a catastrophic rotor defect? What are the various types of rotor defects? Most people think of broken rotor bars, when you mention rotor defects. Mechanically, one might think of imbalance or misalignment. These things appear to be very visible and obvious defects. The problem with squirrel cage induction rotors is that the defects that occur are many times invisible to the naked eye, yet can still be catastrophic to the motor. And even more interesting is how the same defect in two identical motors can act completely different when placed in separate applications.

The squirrel cage induction rotor comes in many different varieties. These various types of rotor designs may affect the severity of a rotor defect. The first thing that usually comes to mind when discussing a squirrel cage induction rotor design is whether the rotor bars are comprised of copper or aluminum. These bars are either cast or pressed into the rotor slots then shorted together at either end of the rotor using copper or aluminum “shorting” rings. Shorting rings are commonly referred to as end rings. The rotor bars are welded, brazed, or bolted to the end rings. If it is a cast aluminum rotor the shorting ring and the rotor bars are cast at the same time and no connecting joints exist. Both aluminum and copper have advantages and disadvantages. Aluminum is more likely to have porosity, while copper is more likely to develop high resistance connections at the end rings.

Porosity is more common in cast rotors and is one of those defects that is invisible to the naked eye. A certain level of porosity is expected in cast aluminum rotors, but if the porosity accumulates in one place then we can expect to have some problems. If the porosity has a significant amount of influence on the overall resistance of the rotor circuit then it will have some level of influence on the operation of the motor. This also depends on the operation and application of the motor. A motor that has numerous starts and stops or operates under various load conditions may be effected more by porosity than a motor that starts and runs at steady state for long periods of time. During starting and stopping or load variations, the magnetic flux generated by the rotor is developed from different parts of the rotor bar than that of a motor running at steady state. The current flowing through the bars can be pushed to the outer edge of the bar, or deeper in the bar towards the shaft depending on the application. This change in the magnetic field characteristics of the rotor was witnessed during a troubleshooting effort on a 2300v 300hp motor. When tested in the field, obvious distortions were present in the rotor magnetic field. After the motor was run on a dynamometer at full load, follow-up testing was performed and no magnetic field distortions were present. Further investigation showed severe porosity in numerous bars.