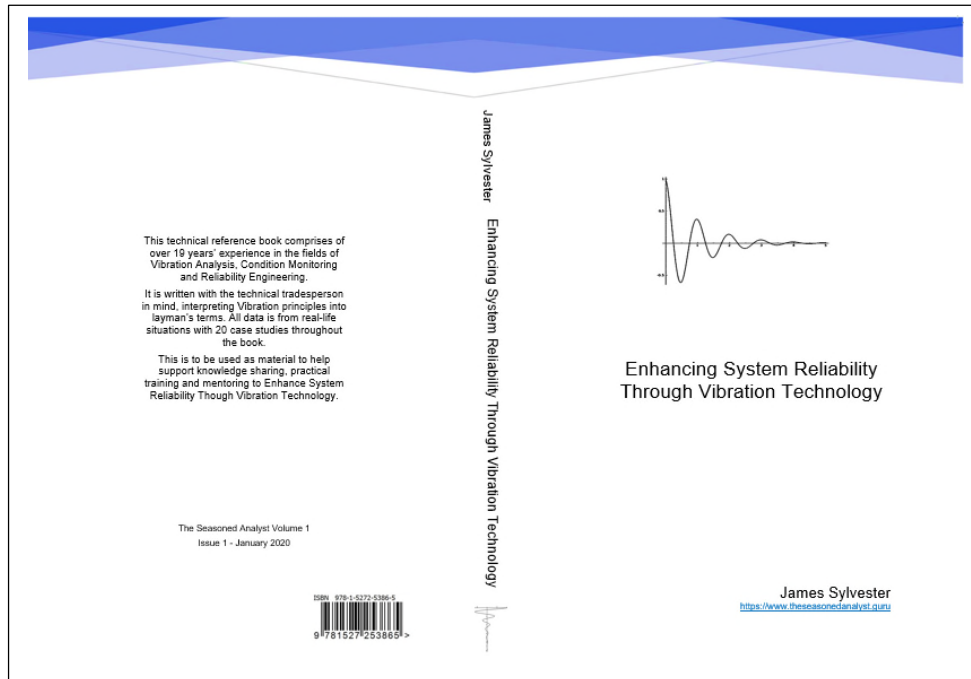


# Enhancing System Reliability Through Vibration Technology

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*“When I started my career in Engineering and Maintenance, I was frustrated by the lack of clear mentoring available to help me develop and hone my skills. Therefore, I have ventured into supporting others like myself who would benefit from a little guidance.”*

*“This technical reference book comprises of many years’ experience in the fields of Vibration Analysis, Condition Monitoring and Reliability Engineering”*

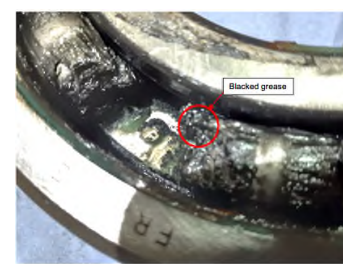


This is written with the manager and hands on tradesperson in mind, interpreting Reliability and Vibration principles into layman’s terms. So, we can all understand the benefits of increased Reliability and the aspects of Condition Monitoring.

The data is from real-life situations with case studies throughout the book.

***“This training material gives the reader the opportunity to grow by drawing experience from a Seasoned Analyst”***

This is to be used as material to help support knowledge sharing, practical training and mentoring to Enhance System Reliability Through Vibration Technology. It goes into simplified and technical description with clear documentation and graphics.



*“The book content is written with a unique flow to assist the experienced Engineer or the reader newly exposed to Condition Monitoring and Reliability, Driving support to promote best practice”*

The manual covers an introduction to Condition Monitoring and how it is a key tool in an effective Reliability Improvement Program. It covers Mechanics of Failure, Failure modes and an introduction to all the Condition Monitoring Technologies. Then the focus is on Vibration Analysis and its practical application to increase system uptime. This is all explained practically with clear data and images of failures to develop knowledge to a Seasoned Analyst level.

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**Part 4: Performing Vibration Analysis**

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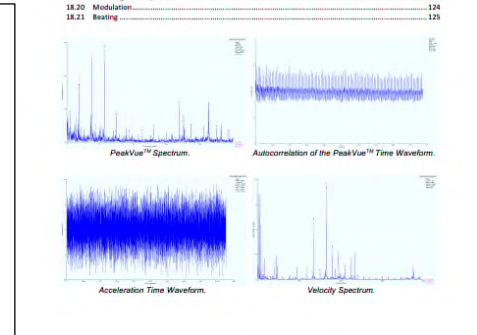
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*"The examples below taken from the manual show the clarity of images to provide a clear assessment of the failure"*



Image 13.

Image 14 is a close-up of the defected area showing the Spalling.

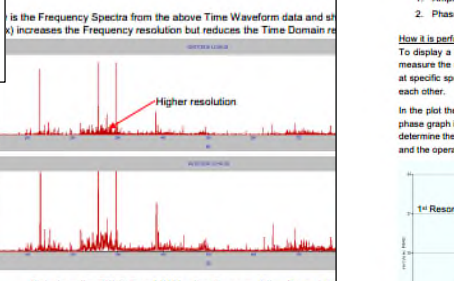
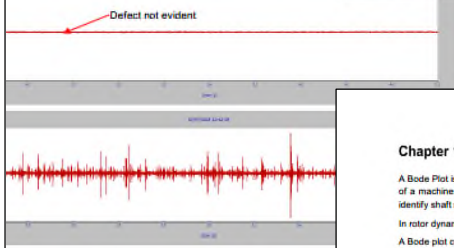


Image 14

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**and Resolution Example:**  
 below shows the importance of correct signal processing. In this real life example we have the m/Vg Accelerometer at the same data point with the data collected at the same time on a shaft 29 RPM with a known bearing defect.  
 er of samples is fixed at 131,072 (51,200 LOR) and the only variable is the sample rate (Fmax). f data has a sample rate of 25,600 (10,000Hz Fmax) and the other has a sample rate of 2,560 Fmax).

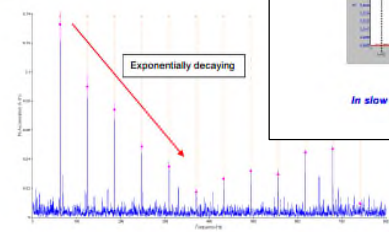
Waveform data and shows with the higher sample rate (10,000 Fmax) there is higher Time and the defect is evident, this is especially important when analysing slow rotating bearings.



**Vibration Analysis:**  
 Figure 1 is the PeakVue™ Spectrum from the drive end of the motor. The high frequency drive electrical 2X pulse frequency has been highlighted other activity.

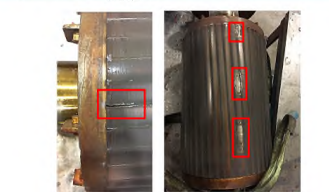
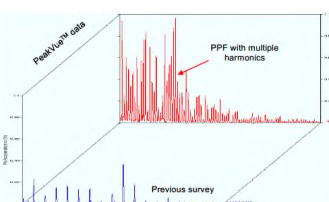
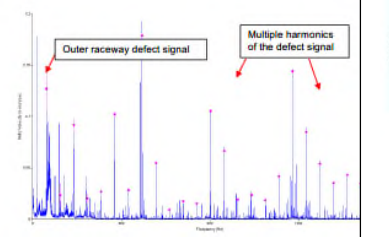
This data shows an exponentially decaying signal at 3.14k.

Fig 1:



To confirm the severity of this we then analysed the Velocity and Acceleration spectrum.  
 Figure 2 is the Velocity spectrum, the motor has low overall vibration but a lot of harmonics at 3.104 Orders is evident.

Fig 2:



200	0.50	1.00		
300	0.75	1.50		
450	0.88	1.75	3.50	7.00
600	1.00	2.00	4.00	8.00
750	1.30	2.60	5.20	10.40
1000	2.00	4.00	8.00	16.00
1500	3.40	6.80	13.60	27.20
3000	8.70	17.40	34.80	69.60
7200	20.00	40.00	80.00	160.00

Table of RPM, Bearing Modes of failure and High Frequency Acceleration Pk-Pk.



**Bearing Inspection:** Motor Drive End Bearing FAG 6316-C3.  
 On visual inspection, it was found as expected, a large visible defect in the load zone of the bearing outer raceway.

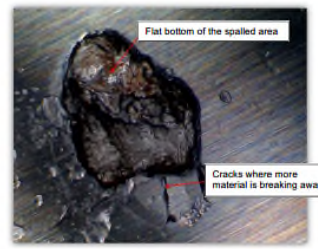
Image 1 is the drive end bearing sectioned and cleaned.

Image 1:



Image 2:

Notice the flat bottom of the spalled area and the "neat" cracks on the circumference. These are sub-surface cracks that have risen to the surface, and in time more material will break away.



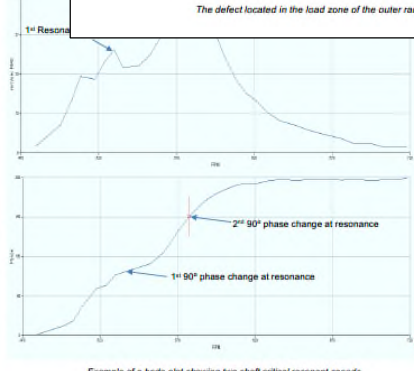
The defect located in the load zone of the outer raceway.

**Chapter 1**

A Bode Plot is a graph of the magnitude and phase of a machine's response to a sinusoidal input. It is used to identify shaft resonance in rotor dynamics. A Bode plot consists of:  
 1. Amplitude  
 2. Phase

**How it is performed:**  
 To display a Bode plot, the user must measure the magnitude and phase at specific speeds. The magnitude and phase are measured at each speed.

In the plot the phase graph is used to determine the phase change at resonance.



Example of a bode plot showing two shaft critical resonant speeds.



*“As Seasoned Analysts we can then support the growth and development of the maintenance team, with training that suites your environment and requirements”*

In addition to training and mentoring I am also able to support you and your team to ensure that the business is realising the potential of the Reliability and Condition Monitoring programs.

To do this I can offer further support with, Condition Monitoring Techniques as well as a program review. Ensuring that you are using the best techniques to detect the correct the failure modes that may occur in your system. I welcome an opportunity to assist my readers and develop suitable Condition Monitoring systems that meet your unique demands.

## **Enhancing System Reliability Through Vibration Technology**



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