Introduction to Machinery Vibration Sheet

Chapter 1: Vibrations Sources and Uses

1. Name some sources of vibrations.
2. What are the common types of vibrations?
3. How do vibrations help us in manufacturing?
4. How do vibrations hinder us in manufacturing?
5. Name some common uses of vibrations and explain their function.
6. What is the function of a trigger?
7. Explain the role of machine vibrations in acceptance testing.
8. Explain the role of machine vibrations in maintenance.
9. Explain the concept of trending and alarm levels.

Chapter 2: Basic Machinery Vibration

10. What is the physical nature of vibration?
11. What factors govern the amount and frequency of vibration?
12. What are the units of displacement and acceleration?
13. What are the units of electrical signals obtained from vibration sensors?

    - volts
    - amperes
    - ohms
    - farads
    - volts and ohms

14. Define period and frequency of vibration.
15. What are the units of period?
16. What is the period of the data shown in Figure 1?

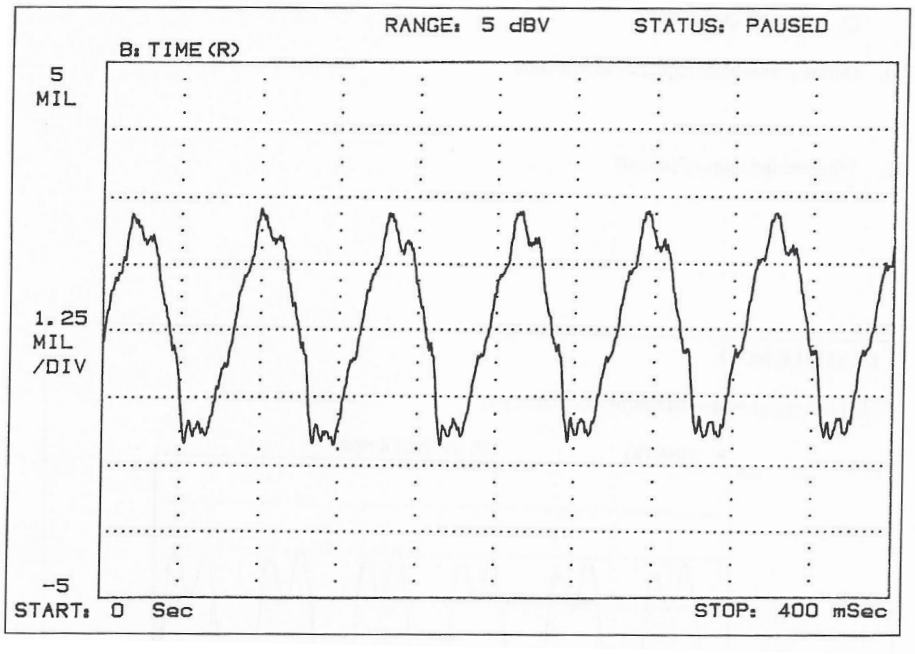


Figure 1. Time Waveform

17. What is the frequency of the data in Figure 1?
18. What is the amplitude of the data shown in Figure 1?
19. What is a spectrum and how are peak amplitude units changed to RMS amplitude units?
20. What is excitation and what does it do?
21. What is the one most important frequency measured on a machine?

- operating speed
- bearing defect frequencies
- blade pass
- vane pass
- gearmesh

22. What governs the forcing frequencies in a machine?
23. What is a natural frequency?
24. What is a resonance? a critical speed?
25. What is the overall peak amplitude of vibration in Figure 2? How does this relate to the spectrum which is in RMS units?

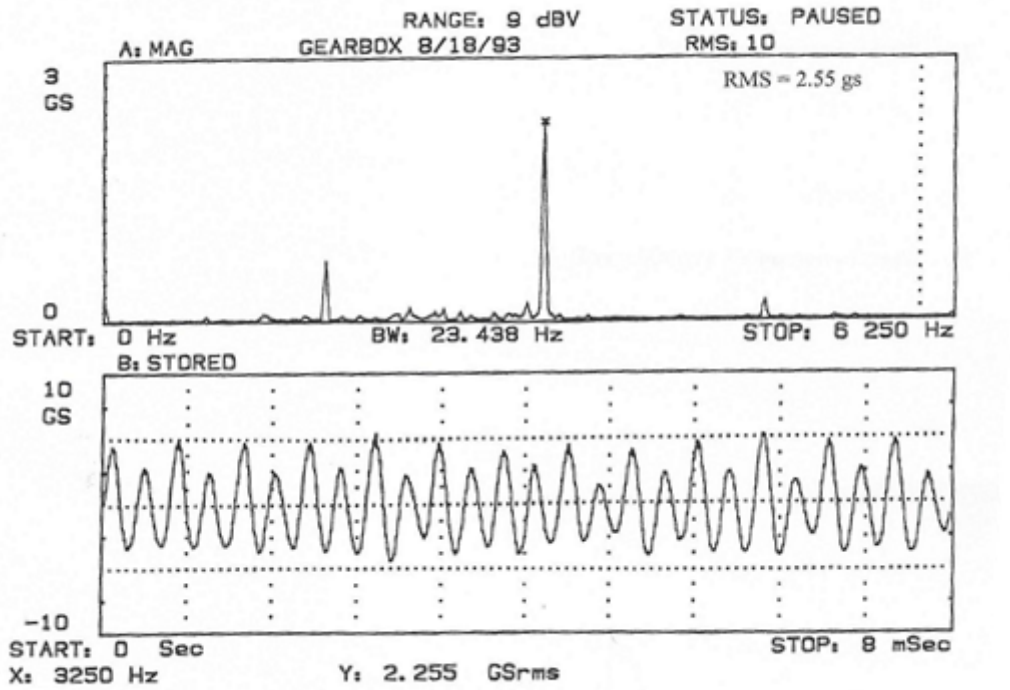


Figure 2. Acceleration Data from a 10 MW Gearbox

Chapter 3: Data Collection and Analysis

26. Name some sources of machine data that determine mechanical condition.
27. What is a frequency span?
28. What determines the size of a frequency span?
29. Explain the positioning of seismic sensors on a machine?
30. How is a sensor selected?
31. Why is load zone measurement important?
32. If a spectrum has a frequency span of 100 Hz and four hundred (400) lines, what is the lowest frequency that can be determined from the data?
33. What happens when a sensor is magnetically applied to the machine and data are immediately collected?
34. What are the frequencies of the data shown in Figure 3?
35. Does the beat frequency in Figure 3 match the difference between the two major vibration components?

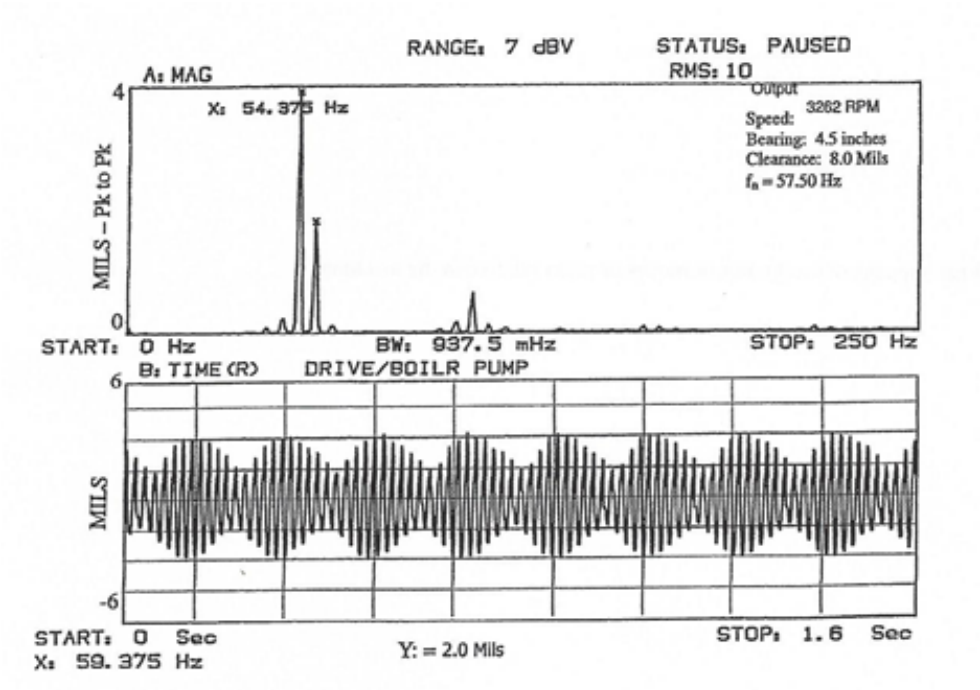


Figure 3. Clutch Drive for Motor Driven Boiler Feed Pump

Chapter 4: Machine Characteristics

36. How does machine knowledge relate to vibration analysis?

- natural frequencies gear mesh frequencies
- rolling element bearing defect frequencies
- blade pass
- vane pass frequencies

37. Briefly describe how a fluid film bearing works.
38. Briefly describe the function of a centrifugal pump and how it works.
39. What sources of machine vibration are common to all machines? What sources of machine vibrations are special to pumps, gearboxes, fans, and motors?
40. Briefly describe how an electric induction motor works?
41. Machine tools have what type of unique forces that cause vibrations?

Chapter 5: Vibration Instruments

42. What are the basic instruments available for vibration analysis?
43. What is the function of the computer in condition monitoring?

Chapter 6: Vibration Testing

44. What are the benefits of good route design in a periodic monitoring program?
45. Describe the use of a magnetically mounted sensor.
46. What does grease, dirt, and paint do to the vibration data collected from a machine with a magnet mounted sensor?
47. What are some of the elements of a test procedure for acceptance testing?
48. What is the function of an acceptance test?

Chapter 7: Basic Analysis

49. What information is used to conduct basic fault analysis?
50. What is the overall amplitude and fundamental frequency of the data provided in Figure 4?
51. What does the shape of the time waveform in Figure 4 indicate?

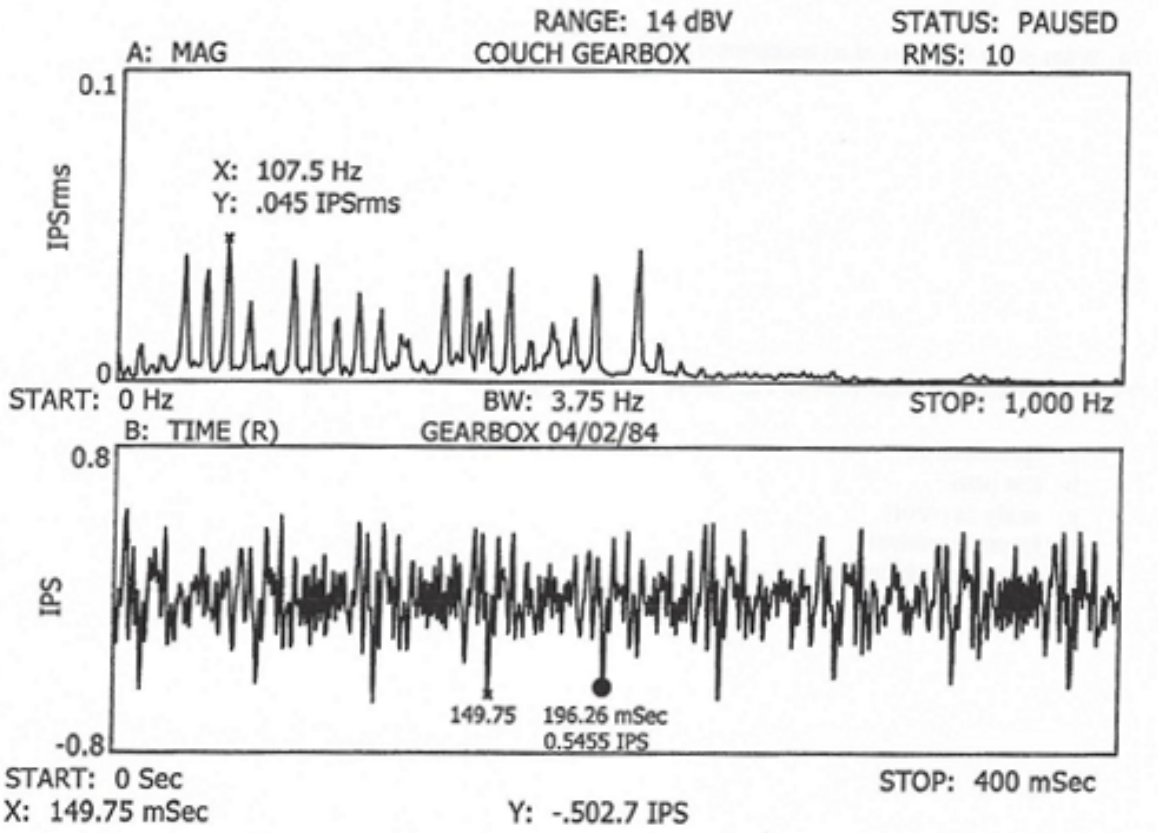


Figure 4. Gearbox Vibration Analysis

52. What is resolution?
53. What is the first frequency the analyst should identify prior to analysis?
54. When is the identification of basic electrical frequencies important?
55. What are the basic electrically induced frequencies in motors?
56. What basic frequencies stand out as important in fans and pumps?
57. What is distinct in pumps when they are improperly sized?

58. What is the most probable fault with the ID fan whose data are shown in Figure 5?

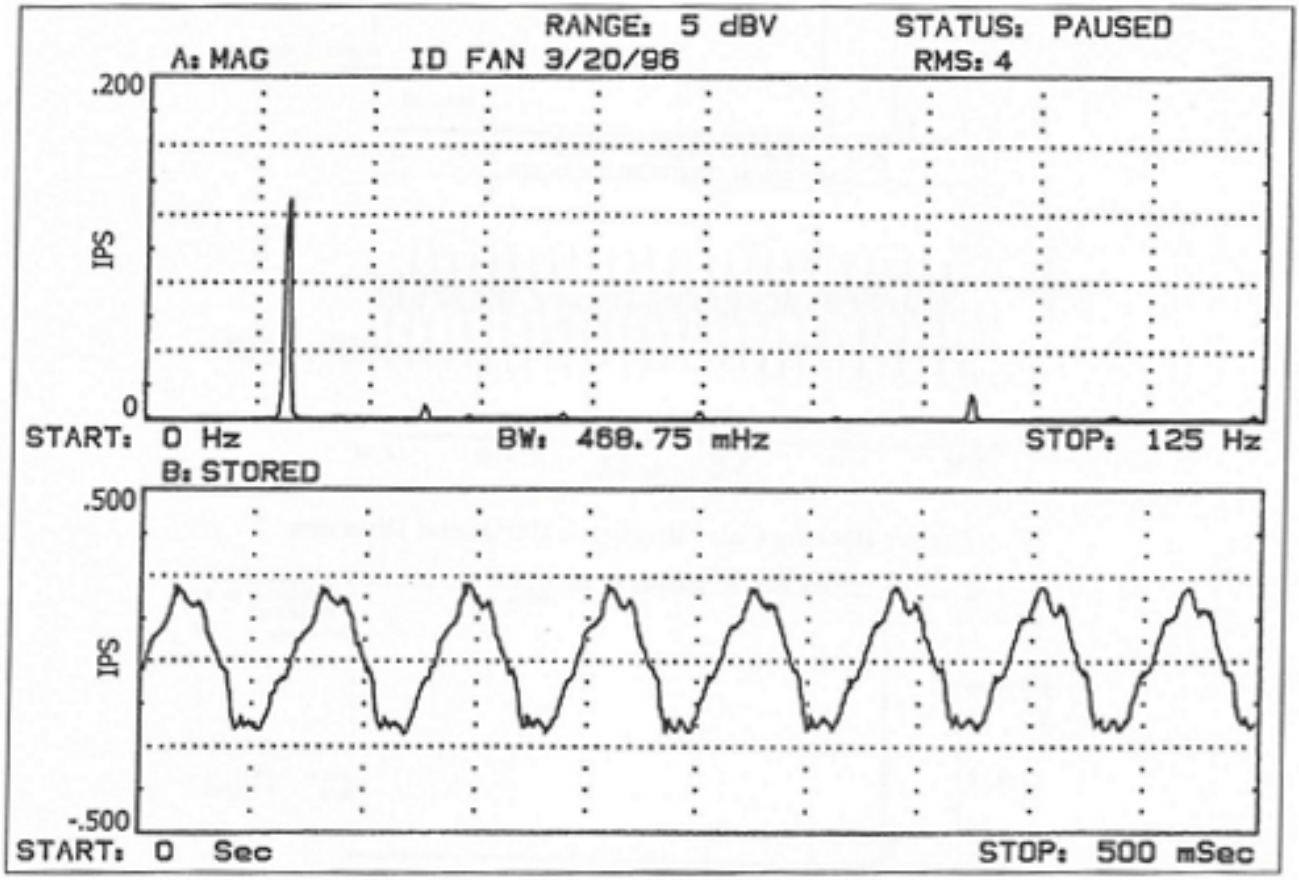
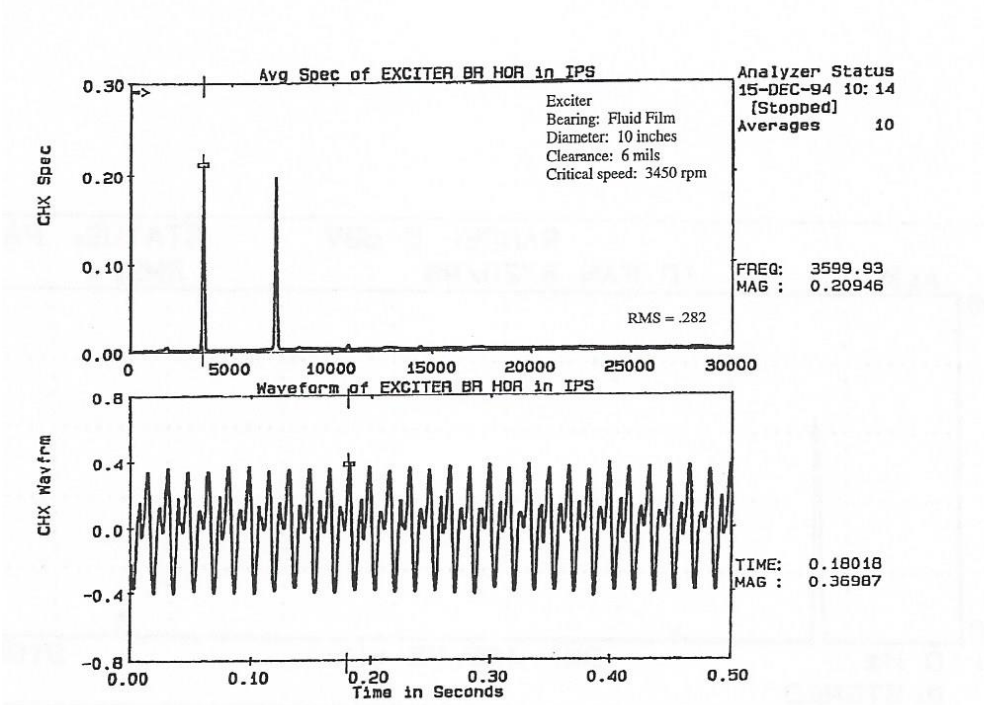
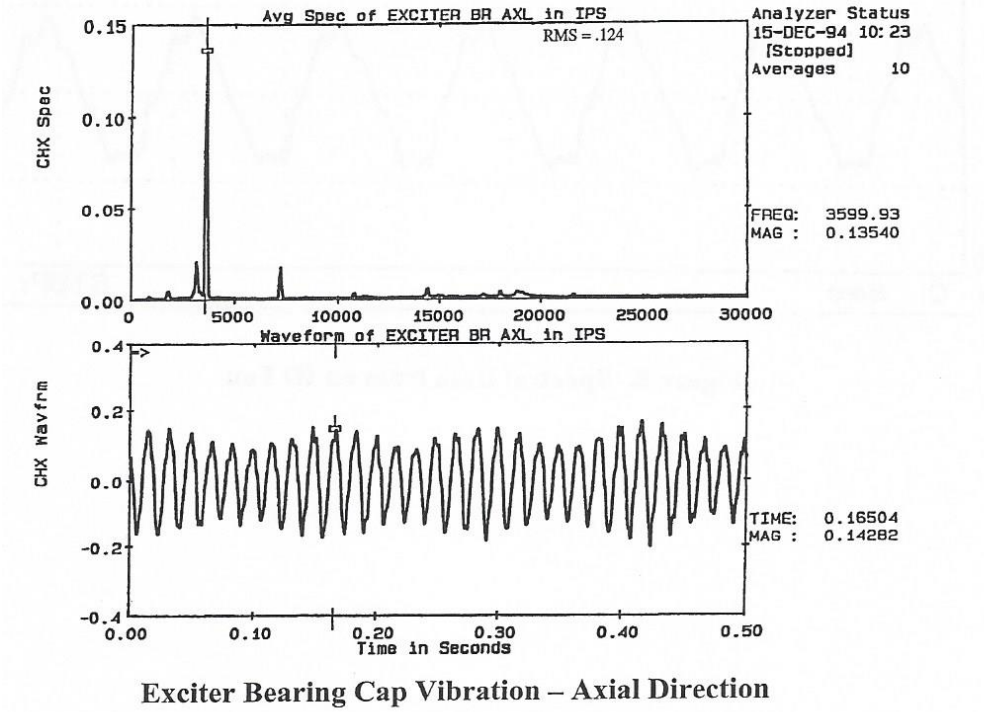


Figure 5. Spectral Data from an ID Fan

59. What is the most probable fault(s) with the exciter whose data are shown in Figure 6?



Exciter Bearing Cap Vibration – Horizontal Direction



Exciter Bearing Cap Vibration – Axial Direction

Figure 6. Pump Analysis

60. The pump shaft that is axially shutting whose data are shown in Figure 7 has what possible problem? Is there high back pressure?

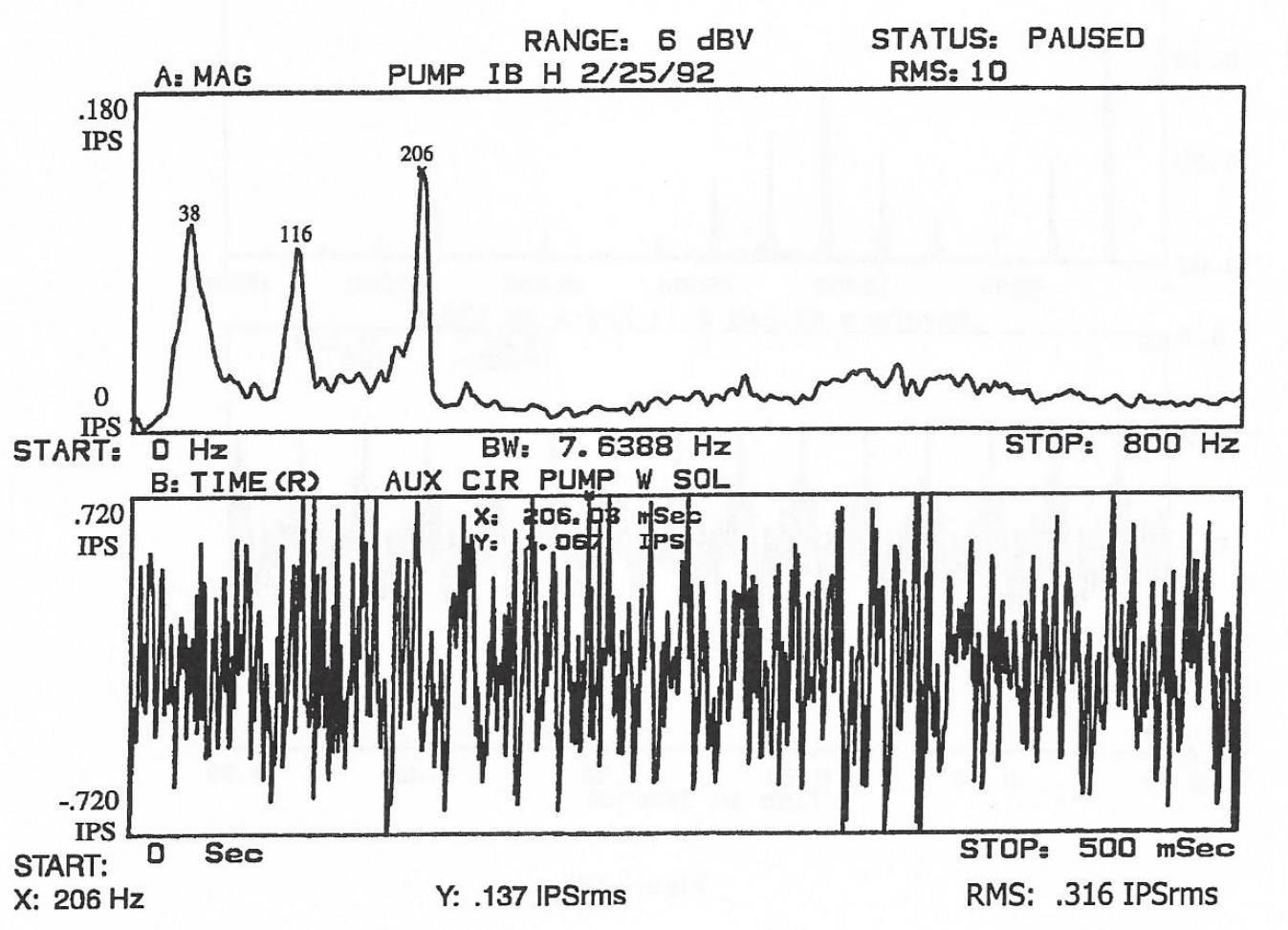


Figure 7. Pump Analysis

Chapter 8.: Vibration Severity

61. What information is used to establish the condition of gears and bearings?
62. Using overall peak vibration, what is the condition of the fan whose data are shown in Figure 8 if the service factor is 1.0 (use Table 1)?

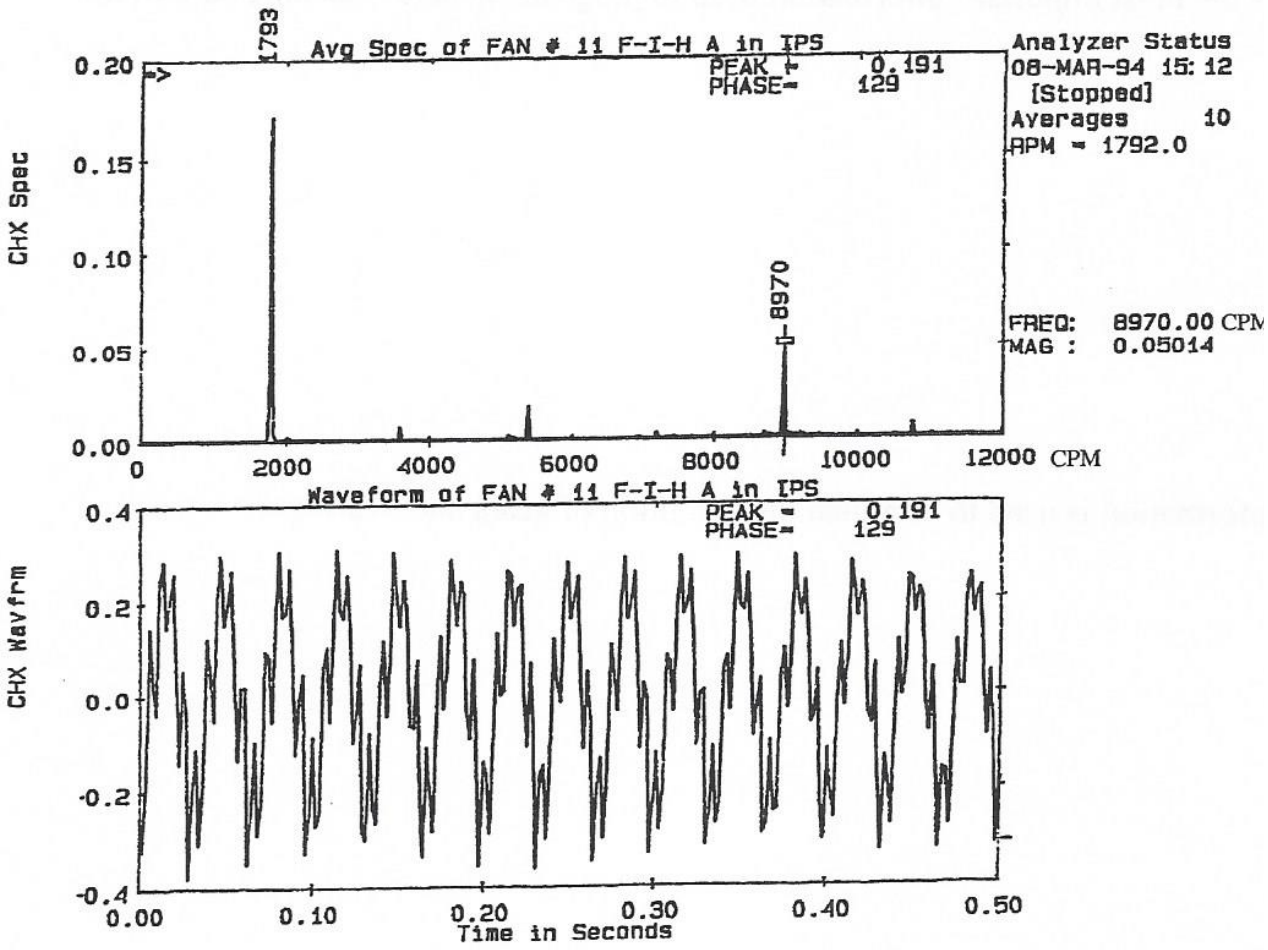


Figure 8

Table 1. Vibration Guidelines for Condition Evaluation

CONDITION	LIMITS	
	rms velocity	peak velocity
Acceptance of new or repaired equipment	0.08	0.16
Unrestricted operation - normal	0.12	0.24
Surveillance	0.12-0.28	0.24-0.7
Unsuitable for operation	0.28	0.7

63. What is the condition of a pump whose data are shown in Figure 9 when evaluated with the RMS values in Table 1?

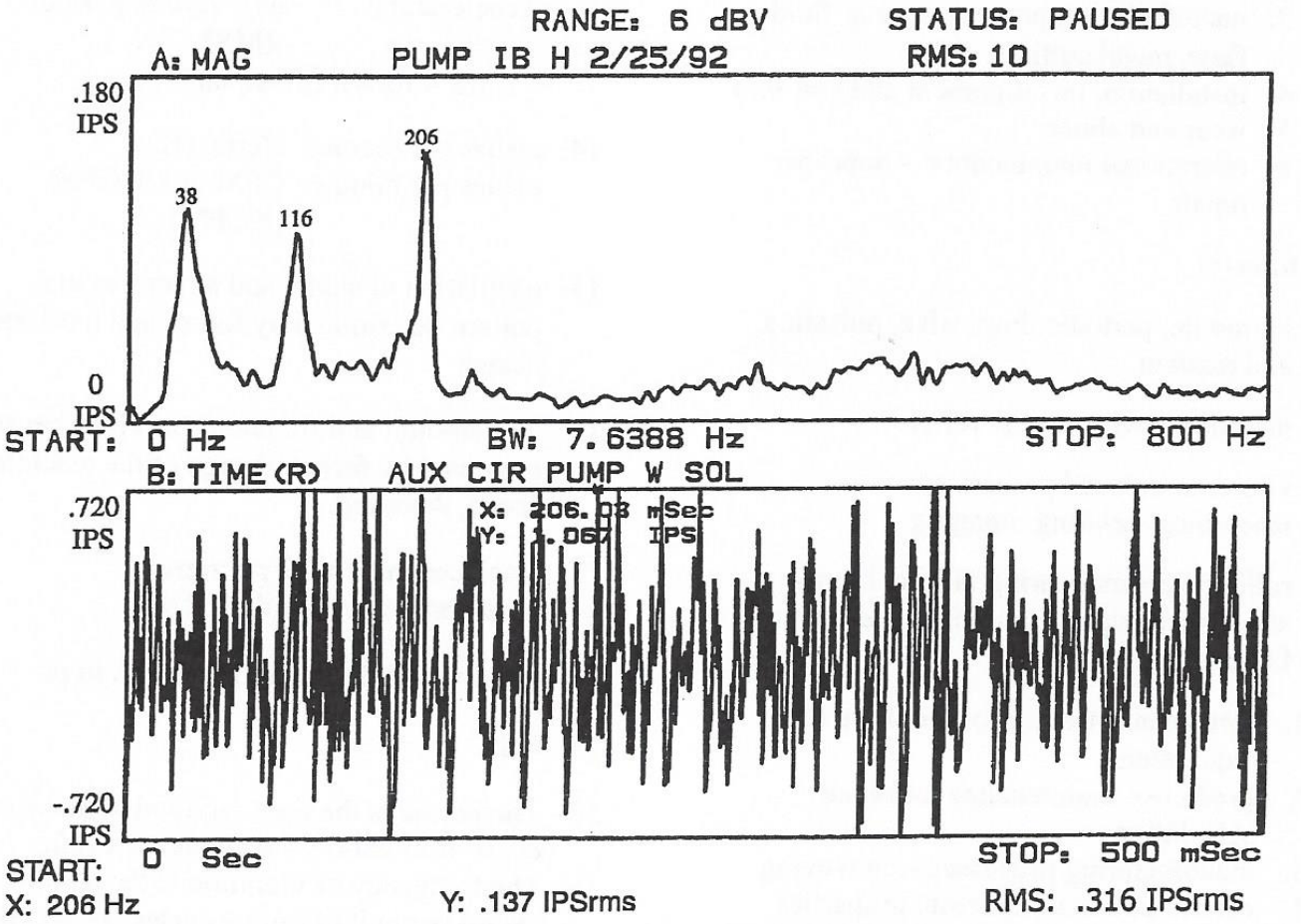


Figure 9. Pump Analysis

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	rms velocity	peak velocity
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Unrestricted operation - normal	0.12	0.24
Surveillance	0.12-0.28	0.24-0.7
Unsuitable for operation	0.28	0.7

* Service factors may be necessary for some special equipment, depending on design, speed, and/or process.