Introduction to Machinery Vibration Sheet

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 maintenance.
8. Explain the concept of trending and alarm levels.

9. 400 mv-pk to pk was measured by a displacement transducer that has a scale factor of 200 mv/mil. What is the displacement amplitude?

10. Find the period and frequency of the data shown in fig. 1

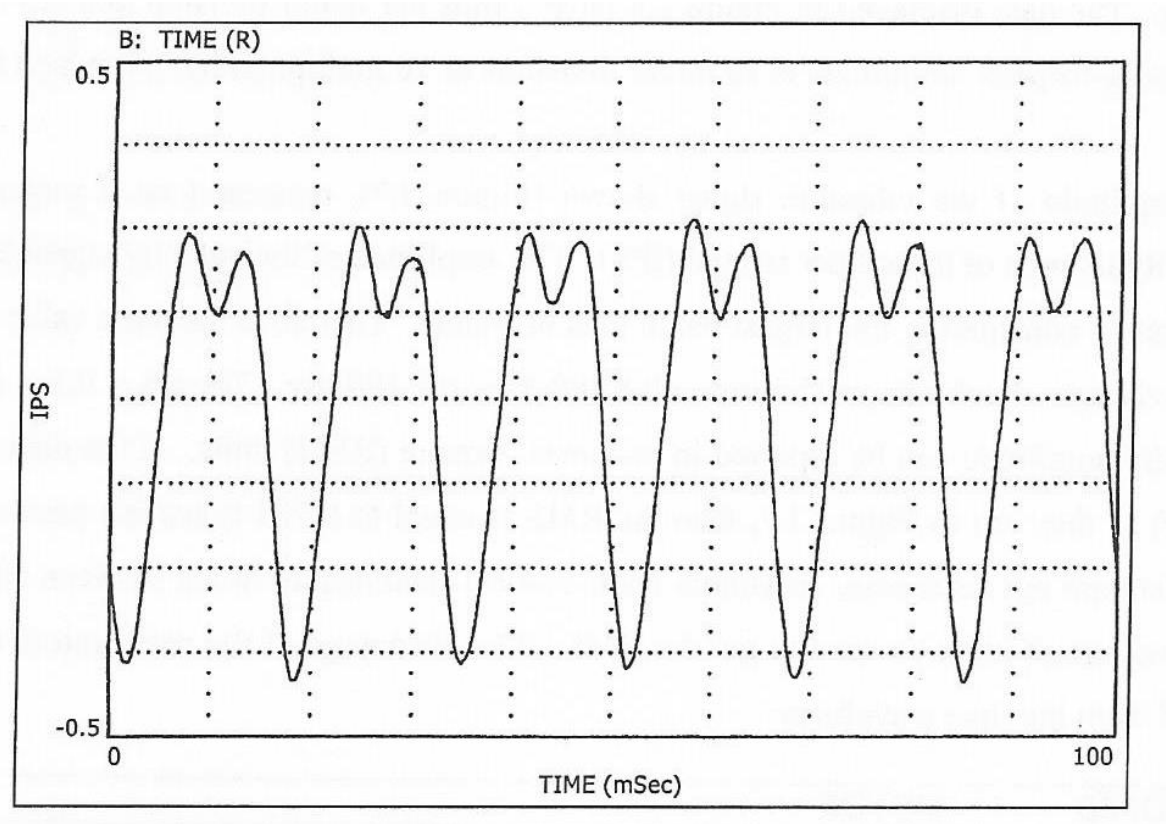


Figure 1. Periodic Generator Vibration Velocity

11. Find the amplitude of the acceleration and velocity of a vibration displacement of 5 mils-pk to pk at a frequency of 100 Hz
12. Find the amplitude of the acceleration and velocity of a vibration displacement of 6.4 mils-pk to pk at a frequency of 10 Hz
13. Find the amplitude of the displacement and velocity of a vibration

acceleration of 3.2 gs-peak at a frequency of 1000 Hz

14. What are the units of displacement and acceleration?
15. What are the units of electrical signals obtained from vibration sensors?

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

16. Define period and frequency of vibration.
17. What are the units of period?
18. What is the period of the data shown in Figure 2?

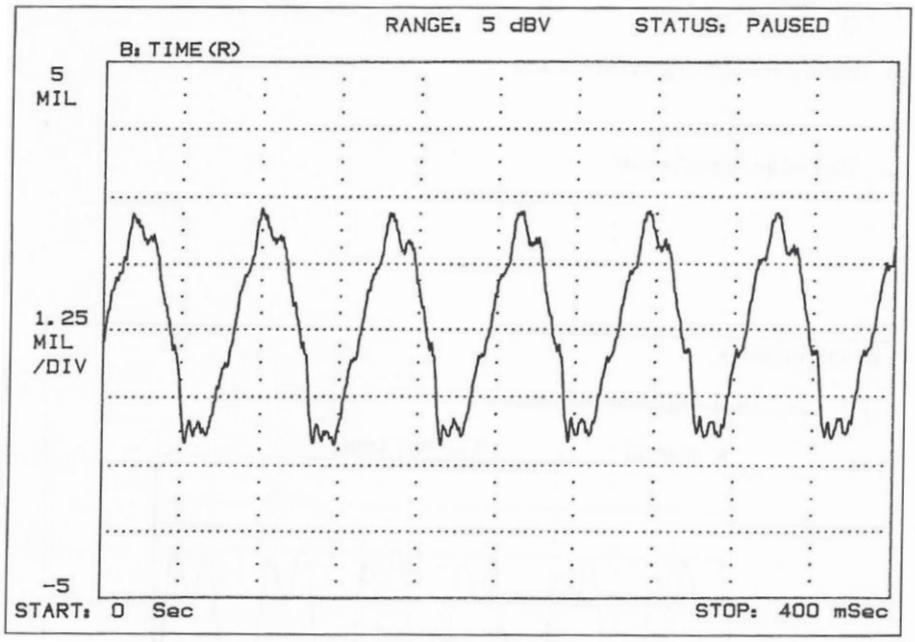


Figure 2. Time Waveform

19. What is the frequency of the data in Figure 2?
20. What is the amplitude of the data shown in Figure 2?
21. What is a spectrum and how are peak amplitude units changed to RMS amplitude units?
22. What is the one most important frequency measured on a machine?

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

- gearmesh

23. What governs the forcing frequencies in a machine?
24. What is a natural frequency?
25. What is a resonance? a critical speed?
26. What is the overall peak amplitude of vibration in Figure 3? How does this relate to the spectrum which is in RMS units?

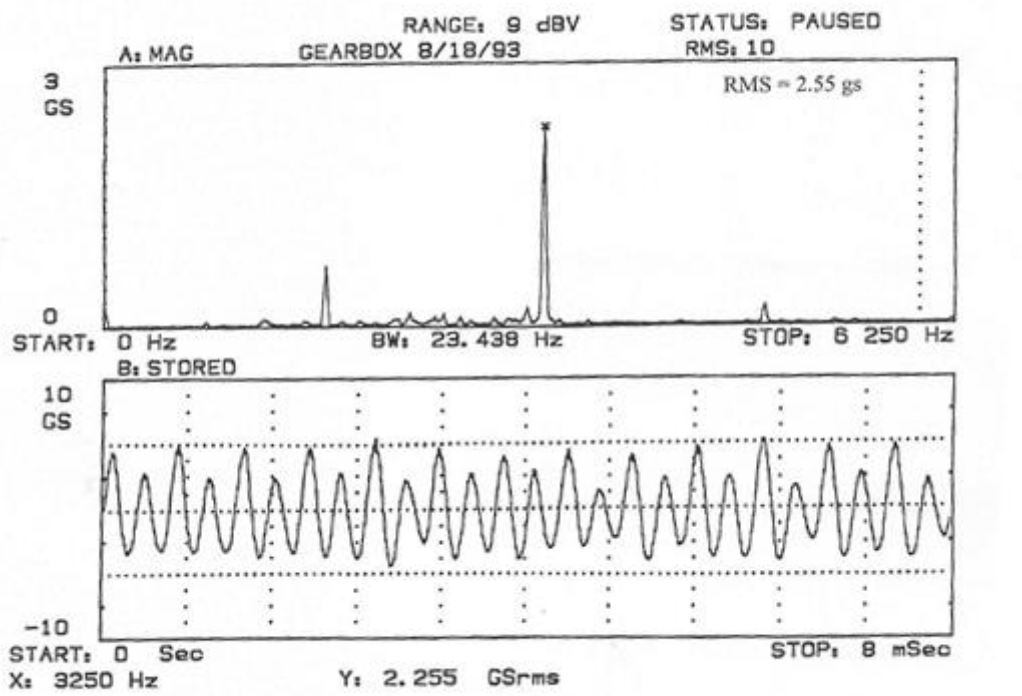


Figure 3. Acceleration Data from a 10 MW Gearbox

27. Name some sources of machine data that determine mechanical condition.
28. Explain the positioning of accelerometers on a machine?
29. How is a sensor selected?
30. Why is load zone measurement important?
31. What are the frequencies of the data shown in Figure 4?
32. Does the beat frequency in Figure 3 match the difference between the two major vibration components?

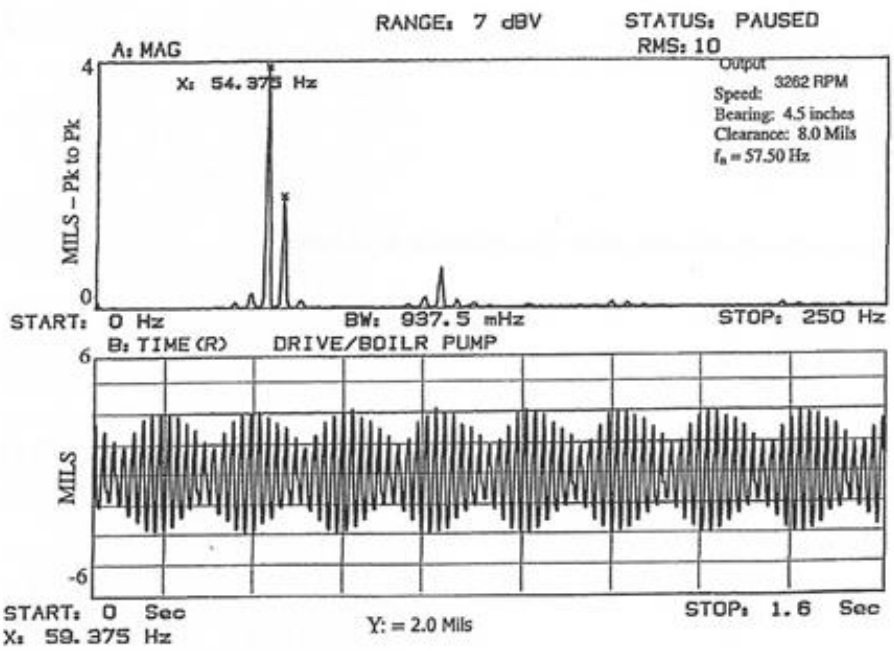


Figure 4. Clutch Drive for Motor Driven Boiler Feed Pump

33. What sources of machine vibration are common to all machines? What sources of machine vibrations are special to pumps, gearboxes, fans, and motors?
34. Machine tools have what type of unique forces that cause vibrations?
35. What are the basic instruments available for vibration analysis?
36. What is the function of the computer in condition monitoring?
37. What does grease, dirt, and paint do to the vibration data collected from a machine with a magnet mounted sensor?
38. What information is used to conduct basic fault analysis?

39. What is the overall amplitude and fundamental frequency of the data provided in Figure 5?
40. What does the shape of the time waveform in Figure 5 indicate?

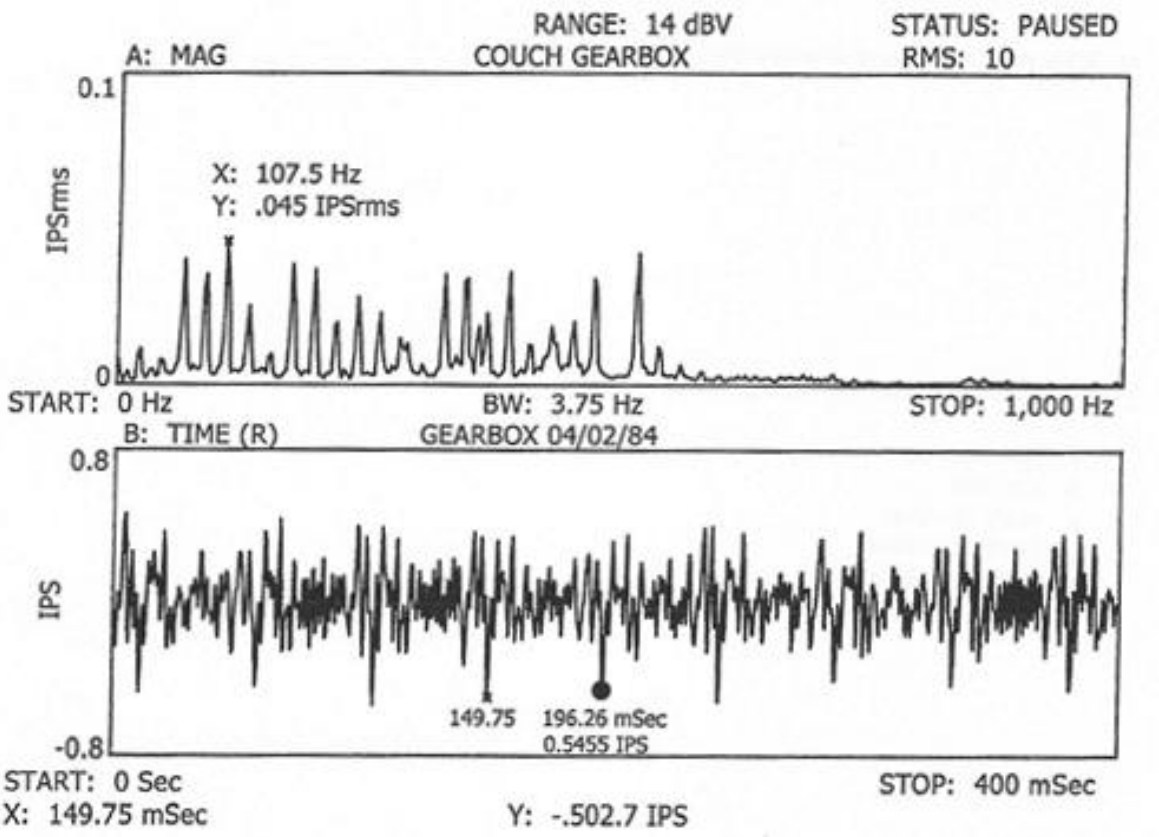


Figure 5. Gearbox Vibration Analysis

41. What is the first frequency the analyst should identify prior to analysis?
42. What are the basic electrically induced frequencies in motors?
43. What basic frequencies stand out as important in fans and pumps?

44. What is the most probable fault with the ID fan whose data are shown in Figure 6?

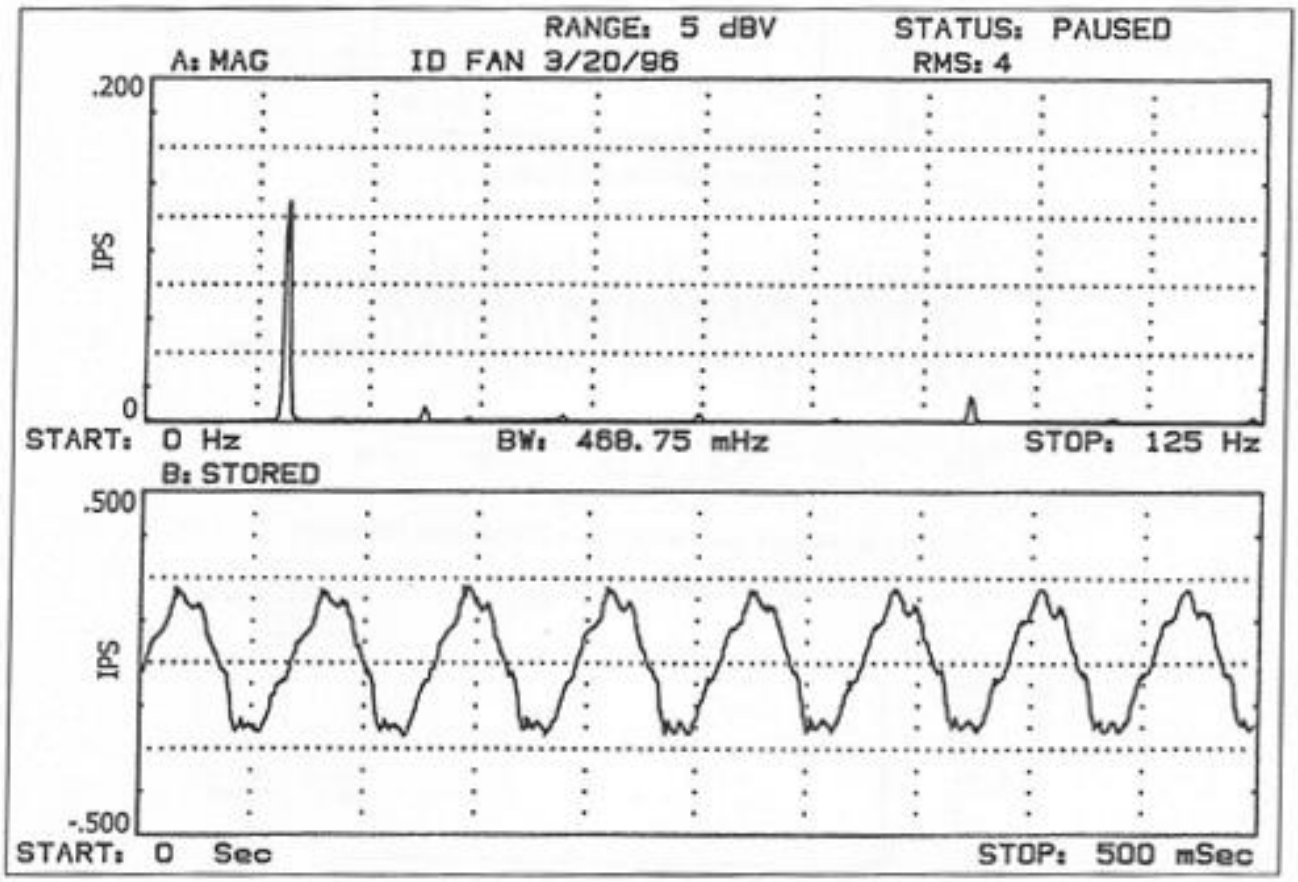
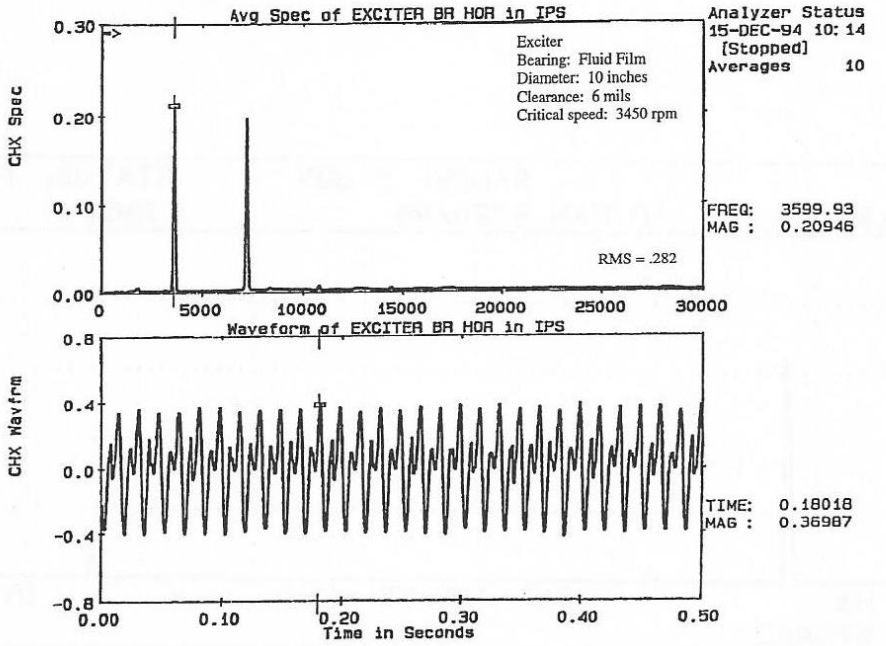
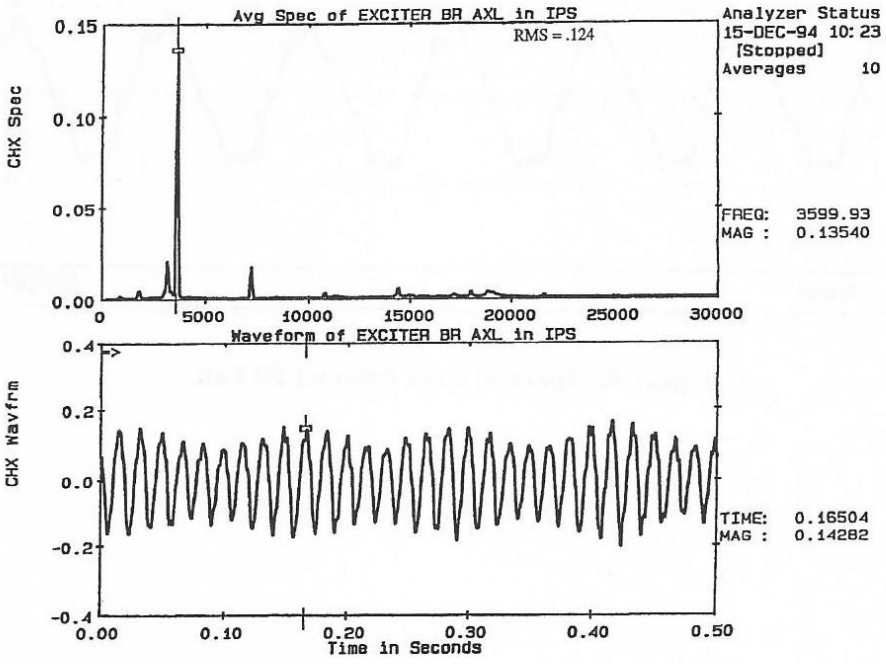


Figure 6. Spectral Data from an ID Fan

45. What is the most probable fault(s) with the exciter whose data are shown in Figure 7?



Exciter Bearing Cap Vibration – Horizontal Direction



Exciter Bearing Cap Vibration – Axial Direction

Figure 7. Pump Analysis

46. The pump shaft that is axially shutting whose data are shown in Figure 8 has what possible problem? Is there high back pressure?

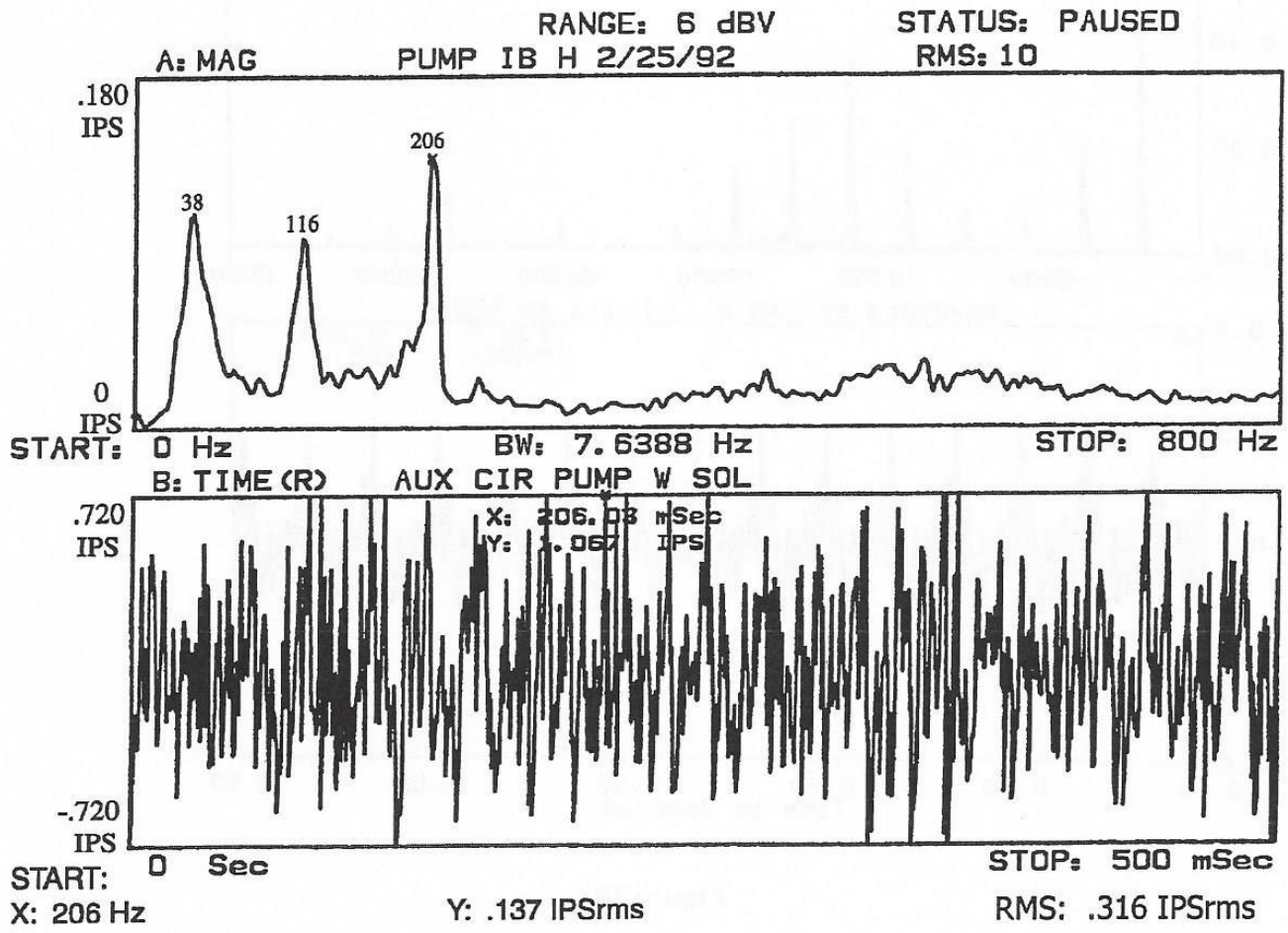


Figure 8. Pump Analysis

47. What information is used to establish the condition of gears and bearings?
48. Using overall peak vibration, what is the condition of the fan whose data are shown in Figure 9 (use Table 1)?

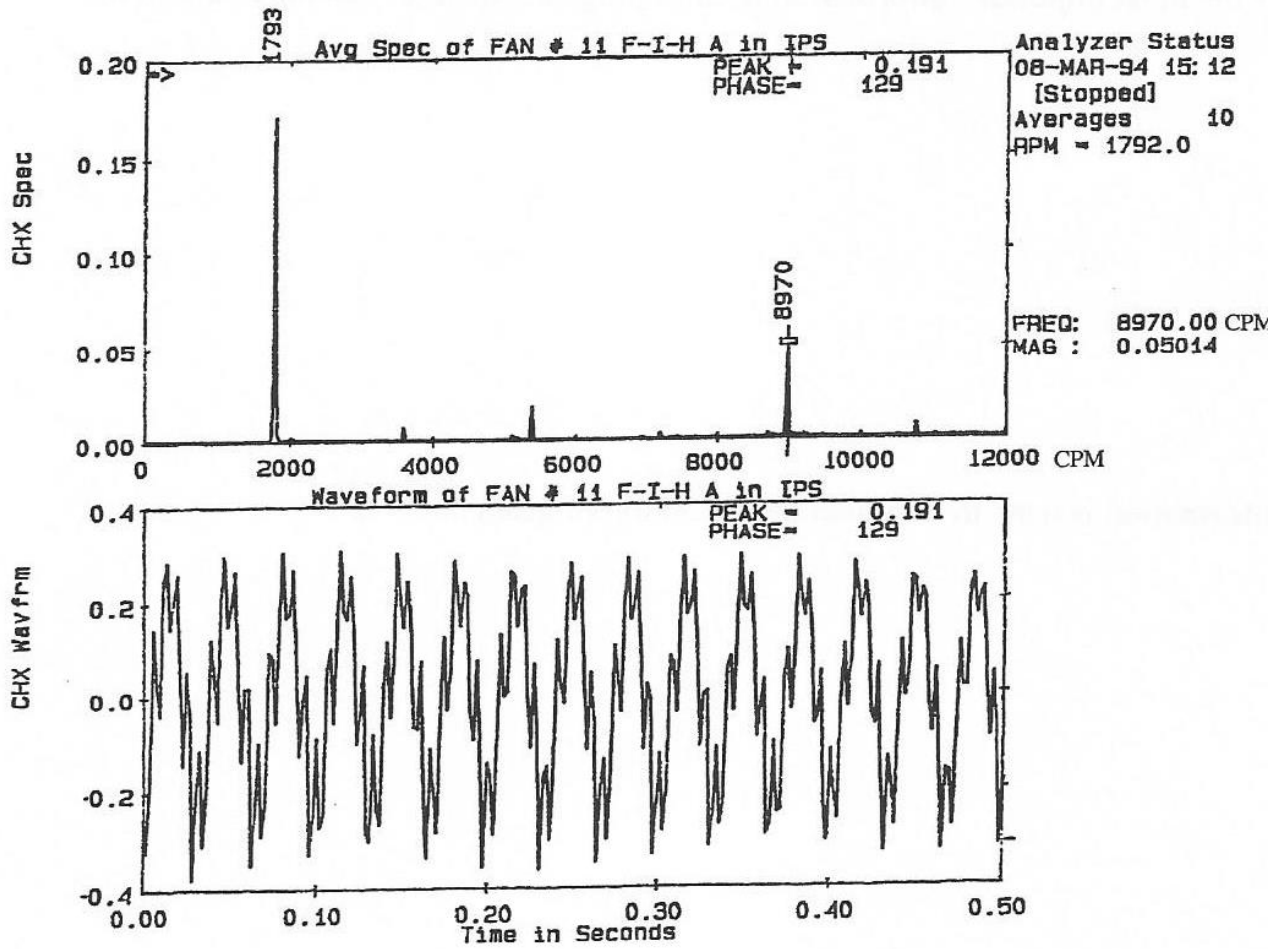


Figure 9

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

49. What is the condition of a pump whose data are shown in Figure 10 when evaluated with the RMS values in Table 1?

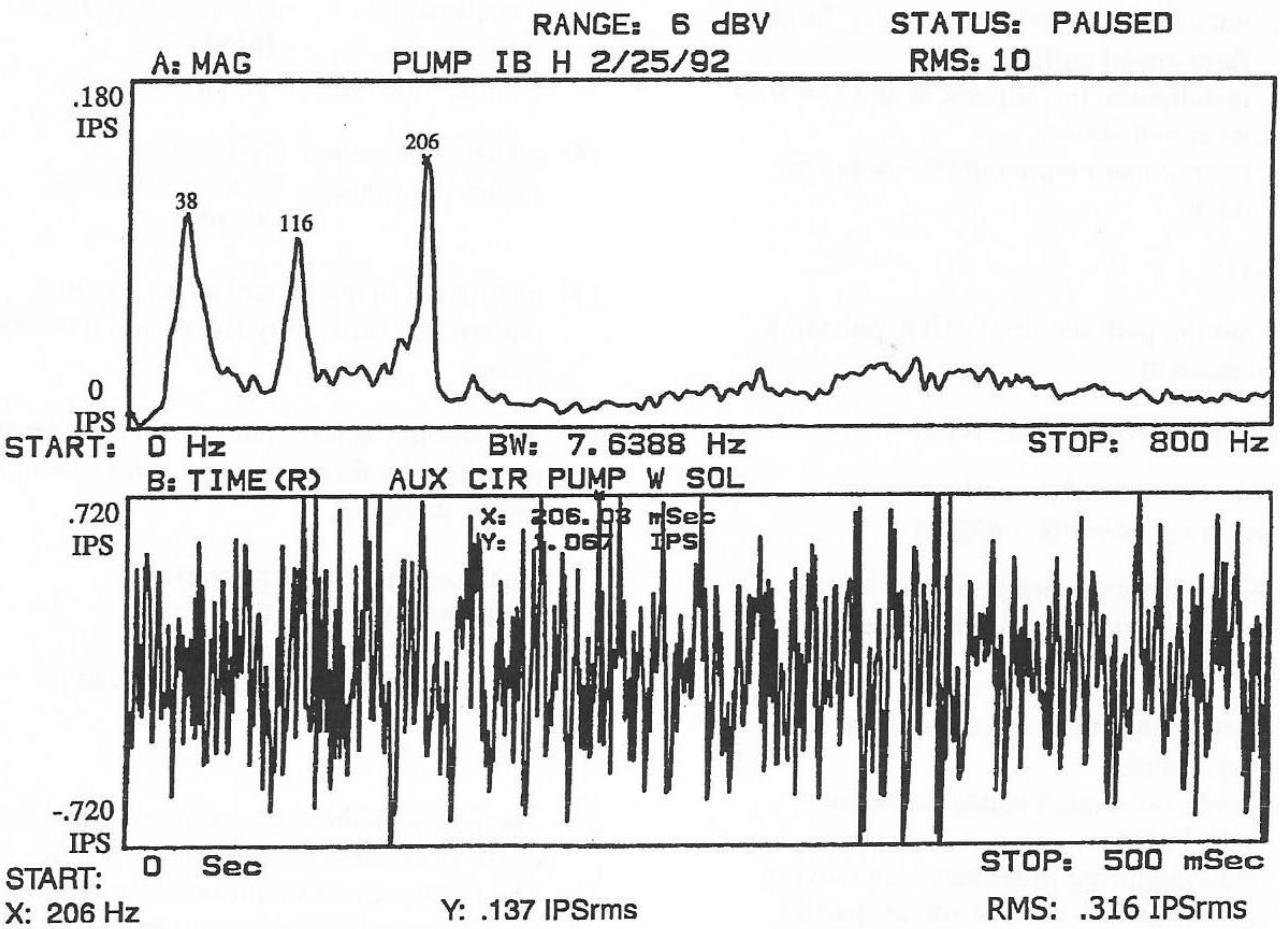


Figure 10. Pump Analysis

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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.