



PdM-102: Vibration Analysis... *Level 1 Plus*™

Abstract

Vibration analysis is often the cornerstone of modern machinery reliability programs. This seminar is designed to create a solid foundation of vibration understanding, with emphasis on terminology, data collection, and the capabilities and limitations of vibration analysis. In order to see the maximum benefit from any training it is imperative that attendees come away with practical knowledge pertaining to their job function and the ability to apply the information covered in the classroom. The *Level 1 Plus*™ concept addresses this issue by teaching the attendee “how to” as well as preparing the candidate for level 1 certification.

Level 1 Plus™

This seminar aims to first qualify individuals to perform vibration data collection and analysis tasks associated with ASNT vibration level 1 certification, and then certify them to ASNT level 1. The result of this approach is that individuals who successfully complete the seminar will be qualified to perform level 1 vibration tasks, such as:

- A. Load and unload route data from the host software
- B. Navigate the route in the data collector
- C. Gather valid vibration data
- D. Be able to recognize bad data
- E. Generate routine data collection reports

Also included in the seminar is information about construction, operation, and common failure modes of various common machine types.

Using our unique Activity Based Training™ format, attendees do not just learn concepts, but receive detailed information on how to implement these concepts as a part of an effective machinery reliability program. The many guided hands-on activities are designed to maximize the retention of information.

Seminar Duration

The standard duration of this seminar is 32 hours. Optional ASNT Level 1 certification is available subsequent to the seminar.



Who should attend?

Although designed to prepare the attendee for level 1 certification the practical nature of the information provided in the seminar is of tremendous value to those who do not necessarily specialize in vibration analysis. Personnel who work with and support the performance of vibration analysis processes are encouraged to attend. Including personnel who collect vibration data, those who perform initial basic analysis tasks, and those who manage or supervise vibration data collection and analysis activities.

Highlights

In this seminar, you will gain knowledge and experience relating to:

- Maximizing Machinery Reliability
- The Benefits of Effective Condition Monitoring
- Vibration Fundamentals and Terminology
- Data Collection Procedures
- Common Symptoms, Major Causes, General Analysis of and Practical Prevention Techniques for the following vibration problems:
 - Resonance
 - Unbalance
 - Misalignment
 - Looseness
 - Bearings
 - Electrically-induced vibration
 - Flow-induced vibration
- Hands-on Activities on all Subjects
- Vibration Qualification and Certification Testing

Associated Tasks

VA1: Effectively perform the following condition monitoring functions using an FFT data collector including:

- F. Load and unload route data from the host software
- G. Navigate the route in the data collector
- H. Gather valid vibration data
- I. Be able to recognize bad data
- J. Generate routine data collection reports

VA2: Recognize the common symptoms, of the following machinery problems:

- A. Resonance
- B. Unbalance
- C. Misalignment



- D. Looseness
- E. Bearing Defects
- F. Electrically-induced Vibration
- G. Flow-induced Vibration

Overall Seminar Goals

Upon completion of this training the student will be able to properly:

1. Explain key elements and the benefits of an effective condition-based maintenance program.
2. Explain the terminology associated with condition-based maintenance and vibration analysis.
3. Explain how to determine vibration severity and associated precautions.
4. Explain precautions associated with data collection using modern FFT instruments.
5. Understand the machinery analysis approach, including the different types of data required.
6. Explain the construction, operation and common failure modes of the following common machines
 - a. Motors
 - b. Pumps
 - c. Gearboxes
 - d. Air handlers
 - e. Compressors
 - f. Turbines
7. Explain common symptoms, major causes, general analysis of and practical prevention techniques for the following common machinery problems:
 - a. Resonance
 - b. Unbalance
 - c. Misalignment
 - d. Looseness
 - e. Bearing Defects
 - f. Electrically-induced Vibration
 - g. Flow-induced Vibration

NOTE: *The objectives above highlight overall seminar goals. A complete copy of the specific objectives is available upon request.*



Typical Seminar Outline/Schedule

- 1.0 Introduction
 - 1.1 Reliability Overview
 - 1.2 Brief History of NDT/PdM and vibration analysis
 - 1.3 Purpose of vibration analysis

- 2.0 Elements of Effective Condition Monitoring
 - 2.1 Detection
 - 2.2 Analysis
 - 2.3 Correction
 - 2.4 Verification

- 3.0 Basic Terminology of vibration analysis:
 - 3.1 Measurement Units
 - 3.1.1 Displacement
 - 3.1.2 Velocity
 - 3.1.3 Acceleration
 - 3.1.4 Frequency
 - 3.1.5 Phase

- 4.0 Components of a Condition Monitoring System
 - 4.1 Hardware Overview
 - 4.1.1 Overall Meters
 - 4.1.2 Data Collector
 - 4.1.3 Analyzers
 - 4.1.4 On-line systems

 - 4.2 Software Overview
 - 4.2.1 Purpose
 - 4.2.2 Features

 - 4.3 Fundamentals of Signal Processing
 - 4.3.1 FFT Overview
 - 4.3.2 Fmax
 - 4.3.3 Lines
 - 4.3.4 Resolution



- Data Acquisition
 - 4.4 Safety and Health
 - 4.4.1 Mechanical
 - 4.4.2 Electrical
 - 4.4.3 Environmental
 - 4.4.4 Regulations
 - 4.4.5 Equipment
 - 4.5 Transducers
 - 4.5.1 Types
 - 4.5.2 Applications
 - 4.6 Transducer Mounting
 - 4.7 Transducer Limitations
 - 4.8 Upload/Download route
 - 4.9 Following a Route
 - 4.9.1 Visual Audible Tactile Inspection
 - 4.10 Data Acquisition
 - 4.10.1 Recognize Good versus Bad data
- 5.0 Machinery Basics
- 5.1 Motors
 - 5.1.1 Construction
 - 5.1.2 Principles of Operation
 - 5.1.3 Common Failure Modes
 - 5.2 Pumps
 - 5.2.1 Construction
 - 5.2.2 Principles of Operation
 - 5.2.3 Common Failure Modes
 - 5.3 Gearboxes
 - 5.3.1 Construction
 - 5.3.2 Principles of Operation
 - 5.3.3 Common Failure Modes
 - 5.4 Air Handlers
 - 5.4.1 Construction
 - 5.4.2 Principles of Operation
 - 5.4.3 Common Failure Modes
 - 5.5 Compressors
 - 5.5.1 Construction
 - 5.5.2 Principles of Operation
 - 5.5.3 Common Failure Modes
 - 5.6 Turbines
 - 5.6.1 Construction
 - 5.6.2 Principles of Operation
 - 5.6.3 Common Failure Modes
 - 5.7 Other machine Types
 - 5.7.1 Construction
 - 5.7.2 Principles of Operation
 - 5.7.3 Common Failure Modes
- 6.0 Machinery Components



- 6.1 Bearings
 - 6.1.1 Types
 - 6.1.2 Common Failure Modes
- 6.2 Belts, Chains and Couplings
 - 6.2.1 Types
 - 6.2.2 Common Failure Modes
- 6.3 Rotors
 - 6.3.1 Types
 - 6.3.2 Common Failure Modes
- 6.4 Gears
 - 6.4.1 Types
 - 6.4.2 Common Failure Modes
- 6.5 Impellers
 - 6.5.1 Types
 - 6.5.2 Common Failure Modes

- 7.0 Analysis Approach
 - 7.1 History
 - 7.2 Machine Information
 - 7.3 Visual/Audible/Tactile Inspection
 - 7.4 Amplitude
 - 7.5 Spectrum Analysis
 - 7.6 Other Techniques

- 8.0 Vibration Symptoms of Common vibration problems
 - 8.1 Unbalance
 - 8.2 Misalignment
 - 8.3 Resonance
 - 8.4 Bearings
 - 8.5 Looseness
 - 8.6 Gears
 - 8.7 Electrical
 - 8.8 Flow related
 - 8.9 Belts

- 9.0 Introduction to Phase Analysis

- 10.0 Qualification and Certification Activities
 - 10.1 Written Test
 - 10.2 Practical Hands-on Examination