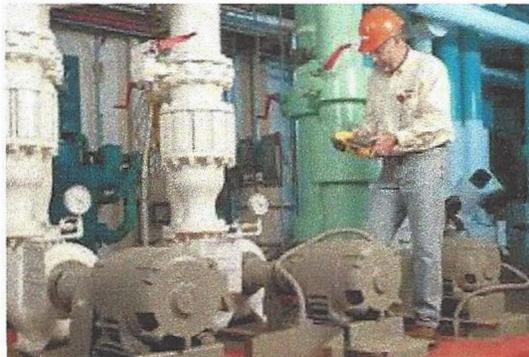


## VIBRATION MEASUREMENT AND VIBRATION ANALYSIS

**General Course Description:** A solid course in vibration analysis and condition monitoring for the millwright, mechanic, maintenance technician, maintenance engineer, or maintenance manager involved in building or industrial maintenance. Learn how to monitor the condition of rotating machinery (and other critical assets), the importance of improved reliability, and how the vibration can be successfully measured and analyzed to provide an early warning of a wide range of fault conditions. You will come away as with knowledge that can be used operate any vibration instrument no matter who the manufacturer. You are invited to bring your own vibration equipment or use ours. When you complete the training you will know enough to make a valuable contribution to an existing program; be in a position to start a new program; determine if you should implement a program at your site; or better understand the program that exists in your plant. If you are contemplating purchase of vibration equipment, this course will give you the information needed to make a wise choice.

### Short Synopsis of Course:

- The benefits of performing condition monitoring and improving reliability
- How to choose the correct transducers and instruments
- How excessive vibration harms machines and what correction is required.
- What vibration measurements can tell you about the condition of the machine
- How to collect good, repeatable measurements
- How to analyze vibration spectra, and the basics of fault diagnosis: unbalance, misalignment, looseness, rolling element bearings faults, resonance, and other conditions
- The steps to setting up a predictive maintenance program using vibration tools
- An introduction to setting alarm limits
- (See reverse side for details)



### HANDS-ON ACTIVITIES

More than 50% of the course will be "hands-on" and each student will receive work books and supervised instruction as well as individual one-on-one assistance to make sure they can accomplish the tasks assigned. It is expected that an attendee will leave the class with the basic knowledge and skill to perform vibration measurement and vibration analysis on small to medium equipment. Class books can be used on the job site in the future to assist with vibration diagnosis and refresh the tasks that need to be done. In addition, the student will set up a model program with routing for vibration monitoring and vibration analysis of typical industrial equipment. Discussions will include what is involved to correct machinery defects such as bearing problems, shaft misalignment, sheave misalignment, lubrication problems, balancing, and resonance.

### DURATION AND ATTENDANCE

Two days (8 hours each day). Minimum of 6 students.

## I. BASICS OF VIBRATION

- **What is vibration — What causes vibration**
- **Characteristics of vibration**
  - Frequency — Displacement — Velocity — Acceleration — Phase — Acoustical emission
  - Other Characteristics
    - Forced vibration, Free vibration, Natural frequency, Resonant frequency, Critical speed
  - Measurement units
  - Peak-to-peak — in/sec peak — RMS
  - Conversion of vibration measurements
- **Significance of vibration characteristics**
  - Information provided by vibration frequency
  - Information provided by vibration amplitude
  - When to use velocity measurement
  - When to use displacement measurement
  - When to use acceleration measurement
  - Information provided by phase
- **Assessing vibration severity**
  - How much vibration is too much
  - General vibration severity chart
  - Acoustical emission bearing failure chart

## II. VIBRATION MEASUREMENT

- **Seismic velocity pickups (moving coil)**
  - Theory of operation — Characteristics — Magnetic interference
- **Accelerometers**
- **Non-contact (Proximity) transducers**
  - Theory of operation — Installation
- **Mounting of transducers**
- **Seismic velocity pickups and accelerometers**
  - Stud mounted — Epoxy mounted — Hand-held without a probe — Hand-held with a probe — Magnetic holder — Vice-grip pliers — Shaft stick
- **Guidelines for transducer selection**
  - Selecting transducers
  - Mechanical characteristic of the machine
  - Considering measurement parameters
  - Measurement parameters
  - Frequency range

## III. DATA ACQUISITION

- **What is vibration analysis**
- **Machine design and operating characteristics**
  - Machine characteristics
  - Purpose of measurement
  - Selection of measurement parameters
- **Measurement positions and directions**

- **Selection of vibration measurement instruments**
  - Vibration meters - features
  - Vibration analyzers - features
- **Selection of measurement transducers**
- **Determination of data required**
- **Taking measurements**
  - Things to consider
  - Common types of measurements
  - Taking waveform measurements
  - Use of filtering
  - Long and short time samples
  - Measuring frequency
  - Setting up a PdM program that works

## IV. DATA INTERPRETATION

- **General analysis procedures**
- **Diagnosing machinery vibration**
- **Vibration due to unbalance**
- **Vibration due to misalignment**
- **Vibration due to eccentricity**
- **Vibration due to faulty anti-friction bearings**
- **Vibration due to faulty sleeve bearings (plain bearings)**
- **Vibration due to mechanical looseness**
- **Vibration due to drive belts**
- **Vibration due to gear problems**
- **Vibration due to electrical faults**
- **Vibration due to resonance**
- **Vibration due to aerodynamic and hydraulic forces**
- **Vibration due to reciprocating forces**
- **Vibration due to rubbing**
- **Beat vibration**
- **Use of strobe light and phase for diagnosis**
- **Background vibration**