Vibration Analysis

Level-Advanced

Course Objectives:

The Vibration Analysis Advanced course is intended for experienced vibration personnel. The course provides an in-depth study of diagnostic measurement techniques and the associated applications of the techniques. After the course the attendee will be able to make final recommendations regarding fault diagnostics, understanding of the widest range of fault conditions and acquire special test capabilities.

Detailed topic list:

Review of condition monitoring technologies and the ISO standards

Signal processing and data acquisition

- Filters: Low pass, band pass, high pass, band stop
- Signal to noise ratio
- Analog and digital integration
- Testing low speed machines
- Sampling, aliasing, dynamic range
- Resolution, Fmax, data collection time
- Averaging: linear, overlap, peak hold, negative
- averaging, time synchronous
- Windowing and leakage
- Order tracking
- Cross channel testing
- Correlation and coherence

Time waveform analysis

- Collecting data - ensuring you have the correct setup
- When should you use time waveform analysis
- Diagnosing unbalance, misalignment, bend shaft, eccentricity, cocked bearing, resonance, looseness and other conditions

Phase analysis

- Collecting data
- Bubble diagrams

Diagnosing unbalance, misalignment, bent

- shaft, eccentricity, cocked bearing, resonance, looseness and other conditions

Dynamics (natural frequencies and resonance)

- Natural frequencies and resonances
- Mass, stiffness and damping
- SDOF and MDOF

Testing for natural frequencies

- Run-up coast down tests
- Bode plots and Nyquist (polar) plots
- Impact and bump tests
- Analysis of induction motors

Operating Deflection Shape (ODS) analysis

- Can we prove the existing of a natural
- frequency?
- Visualizing vibration
- Setting up the job
- Collecting phase readings correctly
- Interpreting the deflection shape

Modal analysis and intro to FEA

- How does modal analysis differ from ODS?

How does Finite Element Analysis (FEA) differ from

- Modal analysis
- A quick review of the modal testing process

Correcting resonances

- The effect of mass and stiffness
- Beware of nodal points
- Adding damping
- A 'trial and error' approach
- A 'scientific' approach
- Isolation
- Tuned absorbers and tuned mass dampers

Rolling element bearing fault detection

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- Why do bearings fail?
- Cocked bearing, sliding on shaft or inside housing,
- looseness
- DC motors and VFDs
- Bearing frequencies and what to do when you don't have all the details
- The four stages of bearing degradation
- Ultrasound
- High frequency detection techniques
- Shock Pulse, Spike Energy, Peak Vue
- Demodulation/enveloping
- Selecting the correct filter settings
- Spectrum analysis
- Time waveform analysis
- Low speed bearings

Journal bearing fault detection

- What are journal bearings
- Measuring displacement
- Introduction to orbit plots
- Using your analyzer to acquire orbit plots
- Introduction to centerline diagrams
- Eccentricity ratio
- Glitch removal
- How the orbit changes with pre-load, unbalance, misalignment, instabilities, oil whirl and whip

Electric motor testing

- w do motors work?
- Diagnosing a range of fault conditions:
- eccentric rotor, eccentric stator, soft foot, phasing, broken rotor bars, rotor bar and stator slot pass frequencies
- Motor current analysis

Pumps, fans and compressors

- Unique fault conditions
- Flow turbulence, recirculation, cavitation

Gearbox fault detection

- Spectrum analysis versus time waveform analysis
- Wear particle analysis
- Gear mesh, gear assembly phase frequency (and common factors)
- Tooth load, broken teeth, gear eccentricity

And misalignment, backlash and more

Corrective action

- General maintenance repair activities
- Review of the balancing process and ISO Balance grades
- Review of shaft alignment procedures

Running a successful condition monitoring program

- Setting baselines
- Setting alarms: band, envelope/mask,
- statistical
- Setting goals and expectations (avoiding
- Common problems)
- Report generation
- Reporting success stories

Acceptance testing

Review of ISO standards

Course Duration

- The course consists of Five full days of training & 1-hour exam

Hours

- 9.00 am to 4.00 pm (Days 1-5)
- Exam: 1 hour - end of Day 5

Who should attend

- Maintenance Professionals
- Plant/Rigs Supervisors
- R & D Personnel
- QA/QC Supervisors
- Equipment designers
- HVAC Engineers
- Plant Technicians
- Vibration Engineer
- Inst. Technicians
- Maintenance Technicians
- Equipment Operators
- Reliability Engineers
- Industrial Engineers
- Operations Managers

Practical Applications of Training Course

This course provides unique opportunities to study Vibration principles beyond the textbook.

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Learning Outcomes

- Correctly undertake vibration data collection
- Operate portable instrumentation on pre-assigned routes
- Acquire readings from installed instrumentation
- Conduct vibration testing using pre-defined procedures
- Compare vibration measurements with alert levels
- Correct data collection and control
- Evaluate and report measurement results
- Develop assessment criteria.
- Operate portable instrumentation on pre-assigned or pre-programmed routes
- Acquire readings from permanently installed instrumentation
- Input results into a database and download routes from a computer
- Able to recognize the Vibration signal
- Able to compare overall or single value vibration measurements against pre-established alert settings
- make corrective recommendations