Best Technology Soultions **(BTS)**

Training Program

Vibration Analysis CAT III

Introduction:

The Category-III course covers four days, is intended for people who are confident with spectrum analysis but who wish to push on and learn more about signal processing, time waveform and phase analysis, cross-channel testing, machine dynamics, and fault correction. If you wish to truly advance in vibration analysis and be able to run a successful condition monitoring team, then you are ready for this course. The course exceeds the ISO 18436-2 Category III standard and meets the ASNT Level III

You will learn to diagnose all of the common faults conditions with rolling element and sleeve bearing machines, by utilizing time waveforms, phase readings and other techniques to diagnose faults. You will also learn machine dynamics (natural frequencies, resonance, etc.) and how to perform resonance testing and correct resonance problems. The course also covers single and cross-channel measurement capabilities of your analyzer. And after completing the CAT-III course, you will be able to set and run a successful vibration program, and mentor the junior analysts.

Mobius vibration analysis training is unique. We use 3D animations, Flash simulations, and numerous software simulators that completely demystify vibration analysis. While vibration training courses have traditionally been very theoretical, difficult to understand, (and boring), you will be captivated by the Mobius training methods, and you will enjoy our practical approach. You will take away skills that you can immediately apply to your job, and you will truly understand what you are doing.

Objectives:

You will come away from the course with a solid understanding of:

- How a well-designed program and the RCM approach will improve the OEE and the bottom line
- The condition monitoring technologies – via supplementary training
- How to select the correct measurement location and axis, and collect good, repeatable measurements
- What the Fmax, resolution, averaging and other single- channel and cross-channel analyzer settings mean, and how to select the optimum settings
- How to analyze vibration spectra, time waveform, envelope, and phase measurements
- How to diagnose a wide range of fault conditions
- How mass, stiffness and damping affects the natural frequency of a structure
- How to use phase readings, bump tests, impact tests, negative averaging, peak-hold averaging, transient, ODS, modal analysis to determine natural frequencies and visualize machine movement
- How to balance and align a machine, correct a resonance conditions, and employ isolation.

Who Should Attend?

- If you are CAT II (or Level II) certified and are ready to take your career and responsibilities to the next step, and you wish to truly master vibration analysis, diagnosis and correction, then the CAT III Vibration Analysis course is ideal for you.
- You should have over 36 months of experience and a good understanding of fault diagnosis and spectrum analysis. (Note that you require 36 months experience to be certified). The RMS / Mobius Institute course and certification program follows the ISO 18436-2:2003 standard and the ASNT Recommended Practice SNT-TC-1A.

Course Outline:

Day 1

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

DAY 2

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

Day 3

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

Day 4

Rolling element bearing fault detection

- Why do bearings fail?
- Cocked bearing, sliding on shaft or inside housing, looseness
- EDM and 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, and other techniques
- 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 analyser to acquire orbit plots
- Introduction to centerline diagrams
- Eccentricity ratio
- Glitch removal
- How the orbit changes with pre-load, unbalance, misalignment, instabilities, oil whir and whip

Electric motor testing

- How 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

Day 5

Gearbox fault detection

- Spectrum analysis versus time waveform analysis
- Wear particle analysis
- Gearmesh, 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