Vibration Analysis Training: ISO Category III + ASNT Level III

Quick facts

This five day course, including optional certification exam, 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; fault correction; and more.

If you wish to truly master 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 Recommended Practice (for vibration analysis).

The certification exam can be taken after the course. (Note: The ASNT Level III exam can only be administered by the ASNT.)

Duration:

5 days including optional ISO 18436-2 certification exam on the fifth day

Course Description:

As a Category III vibration analyst you are expected to be able to diagnose all of the common faults conditions with rolling element bearing machines; have a good understanding of fault conditions associated with sleeve bearing machines; utilise time waveforms, phase readings and enveloping/PeakVue etc. readings to diagnose faults; and understand all condition monitoring technologies, how and when to apply them, and how to combine technologies to get the best results.

You must also understand machine dynamics (natural frequencies, resonance, etc.); how to perform resonance testing; and how to correct resonance problems. You must also understand balancing, alignment, and isolation. You are also, therefore, required to understand all of the single and cross-channel measurement capabilities of your analyser.

And finally, you are also expected to be able to set up the program, run a successful program, and mentor the junior analysts.

Aims:

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

1. How a well designed program, and the reliability centered maintenance approach (with precision balancing, alignment, lubrication and resonance control), will improve the OEE and therefore the bottom line.
2. The condition monitoring technologies: acoustic emission, infrared analysis (thermography), oil analysis, wear particle analysis, motor testing – via supplementary training
3. How to select the correct measurement location and axis, and collect good, repeatable measurements
4. What the Fmax, resolution, averaging and other single-channel and cross-channel analyser settings mean, and how to select the optimum settings for a wide variety of machine types
5. How to analyse vibration spectra, time waveforms, envelope (demodulation), and phase measurements
6. How to diagnose a wide range of fault conditions: unbalance, eccentricity, misalignment, bent shaft, cocked bearing, looseness, rolling element bearings faults, journal bearing faults, gearbox faults, resonance, and other conditions
7. How mass, stiffness and damping affects the natural frequency of a structure
8. How to use phase readings, bump tests, impact tests, negative averaging, peakhold averaging, transient (run up and coast down), ODS, and modal analysis to determine natural frequencies and visualize machine movement
9. How to set alarm limits manually and with statistics
10. How to balance and align a machine, correct a resonance conditions, and employ isolation.

Who should attend?

If you are Category 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 this course is idea 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.

What is unique about this course?

RMS / Mobius make it 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. When senior vibration analysts attend our classes they often say "if only I could have learned this way when I got started" – well, now you can!

Addition benefits which are unique to RMS / Mobius Institute courses:

Classroom activities:

- Sitting and watching an instructor can be boring… When the instructor is using modern slides, 3D animations, and incredible simulators, there is no way that you will be bored, however there is nothing like hands-on participation.

Hands-on participation accelerates learning and enjoyment (depends on venue)

- In the RMS courses you can use the simulators, and you can collect readings and study real vibration patterns. There is no doubt that the simulators make it easier to understand the topics we cover – but when you can use them yourself, the learning is further accelerated.

Workbooks provide feedback – do you really understand?

- We also provide quiz questions that help you check if you really did understand the topics, and that you will be able to make the right decisions in the field (and in the exam). Every morning we have a lively discussion as we go through the questions.

Take away more than just knowledge

- We don't just deliver an excellent course. We provide you with resources that you can use before, during and after the course.

Get started before the course even starts

- Before you even start the course you can visit our Learning Zone Web site to take the self-paced iLearnVibration lessons (and read through the manual). These lessons will help prepare you for the course – you will learn so much more if you go into the course with this knowledge.

Excellent materials that you will treasure forever

- During the course you receive a vibration analysis chart, vibration analysis pocket guide, a vibration reference guide, (a very handy booklet); a mouse pad that is covered with classic spectra representing common fault conditions; access to activity sample questions and answers, and our 400+ page VA Category III manual. This new manual is easy to read, is filled with illustrations, follows the course slides exactly, contains an excellent "Equipment Knowledge" appendix, and can be used as a reference in the future.

Don't stop learning just because the course ends

- For six months after the course (or longer for a small fee), you can continue to access the iLearnVibration self-paced material on the Web site. If you forget something that you were taught, or you just want a refresher, then just jump on to the site and go through the fully narrated lessons.

Topics:

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

- 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

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

Acceptance testing

Review of ISO standards