GCC Electrical Testing Laboratory
المختبر الخليجي لفحص المعدات الكهربائية

MOBIUS INSTITUTE

Vibration CAT I-III Courses

The Best Analysts are Mobius Trained™, simply because our training is superior and more understandable.

Mobius courses are unique in the world of vibration analysis training. To make theory easier to understand we use 3D animations and software simulations.

The animations take you inside the machine and show you why failures occur and how the vibration changes as the condition worsens.

Mobius Institute software simulators provide another level of understanding; they give you the ability to adjust the type and severity of a machine fault and visually see the relationship of the fault and the corresponding vibration signal.

In addition, we have interactive case histories with actual vibration data that can be fed into your instruments and software so you can hone your diagnostic skills.

Our courses blend the important theoretical concepts with practical techniques to ensure that the trained analysts can put their knowledge to work with confidence.

Course Schedule for Year 2020

COURSE NAME / DURATION	DATES
ISO 18436-2 Basic Vibration Analysis CAT I / 4 days	Mar 15 - Mar 18, 2020
ISO 18436-2 Intermediate Vibration Analysis CAT II / 5 days	Apr 12 - Apr 16, 2020
ISO 18436-2 Advanced Vibration Analysis CAT III / 5 days	Jun 14 - Jun 18, 2020
ISO 18436-2 Basic Vibration Analysis CAT I / 4 days	Oct 4 - Oct 7, 2020
ISO 18436-2 Intermediate Vibration Analysis CAT II / 5 days	Nov 1 - Nov 5, 2020

GCCLAB Training Center, GCCIA Building, Dammam

https://goo.gl/maps/QgJRhaxaUyHwKeoRA

For more information and inquiries:

Training@gccelab.com **+966-13-8689800/EXT 227**

Mobius Institute is an SMRP Approved Provider

All Mobius Institute accredited ISO 18436 Category I-IV Vibration Analysis and iLearnReliability™ Condition Monitoring and Professional Development courses have been recognized by the Society of Maintenance & Reliability Professionals training and continuing education that align with the most relevant topics and best practices in the maintenance, reliability and physical asset management profession according to the SMRP Body of Knowledge (BoK) and/or the Asset Management Landscape, which is published by the Global Forum on Maintenance and Asset Management (GFMAM).

SMRP APPROVED PROVIDER

ISO 18436 Category I

Basic Vibration Analyst Training & Certification

CAT-I

Online Learning & Classroom Course

The Vibration Analysis Cat I course is intended for personnel who are new to vibration monitoring and analysis, and for personnel who have limited vibration analysis experience. The course focuses on periodic, single channel data collection and analysis for condition based maintenance programs. A foundation is established for in-depth understanding of spectrum and waveform relationships. This is the ideal starting place for new vibration analysts, people collecting vibration data, and those who want a better understanding of vibration analysis and condition monitoring. You will come away from this course with a very good understanding of the fundamentals; you will understand how to take good measurements (and understand the importance of repeatability); and you will be ready to begin analyzing vibration spectra.

Detailed topic list:

Maintenance Practices

- What is breakdown maintenance and when should it be employed?
- What is preventive (calendar based) maintenance, and what are its major flaws?
- What is predictive (condition based) maintenance, and what are its benefits?
- What is proactive (reliability centered) maintenance, and what are its benefits?

Condition monitoring

- Acoustic emission (ultrasound):
  - What is acoustic emission?
  - What can it tell you about rotating machinery?
  - How to you detect leaks and electrical faults?
  - How can it be used to detect bearing faults?
- Thermography
  - What is thermography?
  - How can it be used to detect faults in mechanical and electrical equipment?
  - What is emissivity, and how does it affect the accuracy of the measurements?
  - What are the key qualities of thermal imaging cameras?
- Oil analysis
  - How can it be used to check if the machine has a fault condition,
  - How can you test if the lubricant is “fit for purpose”?
  - What do viscosity, cleanliness, particle count, and other tests tell you?
- Wear particle analysis:
  - How are the tests performed?
  - How can you learn about the nature of wear?
  - How can you determine which components are wearing?
  - How does it differ from conventional oil analysis?
- Motor testing
  - What are the most common types of faults?
  - What can motor current analysis tell you?
  - What other test types tell you about the condition of the rotor, stator, and insulation?
- Vibration analysis
  - Quick introduction to vibration analysis
  - Spectrum versus overall level readings
  - Walk-around versus on-line monitoring versus protection systems

Principles of vibration

- Introduction to vibration measurement
  - A quick introduction to the accelerometer and displacement probes
  - A quick introduction to the vibration waveform (via live displays)
- An introduction to the time waveform
  - What is the time waveform?
  - How does it change with higher and lower frequency
  - What is frequency and period?
  - How does it change with amplitude
  - What are rms, peak and peak-peak?
  - What happens when the vibration includes multiple frequencies and amplitudes?
- An introduction to the spectrum
  - What is the spectrum, and what does “FFT” mean
  - How can a spectrum be used to separate each source of vibration into a graph that highlights the different frequencies of vibration

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- An introduction to forcing frequencies
    - Using units of orders instead of Hz or CPM.
    - Calculating forcing frequencies
    - Identifying shaft speed
    - Blade and vane passing frequencies, bearing frequencies, gear mesh frequencies, and more
    - Gear and belt driven machines (multiple shafts with different turning speeds)
- Explaining the different vibration units
    - What is the difference between acceleration, velocity and displacement?
    - When would you use each type of unit?
    - How to convert between each type of unit?
- A brief introduction to phase
    - What is phase (in-phase, out of phase, phase angle)?
    - Why is it important in vibration analysis?
    - How is it measured with a single-channel analyzer, two-channel analyzer, and strobe?

Data acquisition

- A quick review of data acquisition
- How do we measure vibration?
    - The non-contact eddy current displacement probe
    - The velocity probe
    - The accelerometer
- Where to place the sensor on the machine
- Understanding axial, radial, vertical, and horizontal readings
    - Do you really need to measure in three axes?
    - What does one axis tell you that another will not?
- A quick introduction to mounting the accelerometer and surface preparation
    - Comparing handheld probes, magnetic mounts, and quick connect mounts
    - The 3D animations will highlight the important differences
    - What do you do if you cannot access the desired measurement point?
- Naming conventions
    - Where is position “1” on the machine?
    - What does “MNDE” mean?
- What are “routes” and how do you create them?
    - Downloading, following, and uploading routes
    - Why should you record your field observations when you are in the field (and why should you listen to the vibration during data collection)?
    - Recognizing bad data (and deciding what you should do if you get bad data)

Signal processing

- A quick tour of your analyzer
    - Fmax and lines of resolution (LOR)
    - The importance of selecting the correct Fmax and lines of resolution?
- Spectral averaging
    - What does averaging do, and why is it important?

Vibration analysis

- The spectrum analysis process
    - Four steps to success
    - The ISO standard
- What is resonance – a quick introduction
    - How does it affect your machines and your measurements
- Diagnosing common fault conditions
    - Unbalance
    - Misalignment
    - Looseness
    - Rolling element bearing wear
    - Common electric motor faults
    - Common pump, fan and compressor faults
    - Common belt drive and gearbox faults

Setting alarm limits

- The ISO standard for setting alarms
    - How to use them
    - Their limitations
- Band alarms
    - How they can be used to warn you of changes in vibration level
    - How they can aid your analysis process
    - Their limitations
- Envelope alarms
    - How they can be used to warn you of changes in vibration level
    - Their limitations

ISO 18436 Category II

Intermediate Vibration Analyst Training & Certification

CAT-II

Online Learning & Classroom Course

The Intermediate Vibration Analysis course is intended for personnel who have at least twelve months vibration analysis experience and a thorough understanding of vibration theory and terminology. Eighteen months of vibration analysis experience is required for Category II or Level II certification. The course provides an in-depth study of machinery faults and their associated spectrum, time waveform and phase characteristics. A Category II analyst is expected to know how to test machines correctly, how to diagnose faults accurately, perform additional diagnostic tests for verification, how to set vibration alarm limits, and how to correct certain types of faults. You need to understand what your analyzer settings mean so that you can take the best measurements. You also need to understand why the vibration patterns change the way they do and how to use time waveform analysis and phase analysis to verify the fault condition.

Detailed topic list:

Review of maintenance practices

Review of condition monitoring technologies

Principles of vibration

- Complete review of basics
- Waveform, spectrum (FFT), phase and orbits
- Understanding signals: modulation, beating, sum/difference

Data acquisition

- Transducer types: Non-contact displacement proximity probes, velocity sensors, and accelerometers
- Transducer selection
- Transducer mounting and natural frequency
- Measurement point selection
- Following routes, and test planning
- Common measurement errors

Signal processing

- Filters: Low pass, band pass, high pass, band stop
- Sampling, aliasing, dynamic range
- Resolution, Fmax, data collection time
- Averaging: linear, overlap, peak hold, time synchronous
- Windowing and leakage

Vibration analysis

- Spectrum analysis
- Time waveform analysis (introduction)
- Orbit analysis (introduction)
- Phase analysis: bubble diagrams and ODS
- Enveloping (demodulation), shock pulse, spike energy, PeakVue

Fault analysis

- Natural frequencies and resonances
- Imbalance, eccentricity and bent shaft
- Misalignment, cocked bearing and soft foot
- Mechanical looseness
- Rolling element bearing analysis
- Analysis of induction motors
- Analysis of gears
- Analysis of belt driven machines
- Analysis of pumps, compressors and fans

Equipment testing and diagnostics

- Impact testing (bump tests)
- Phase analysis

Corrective action

- General maintenance repair activities
- Review of the balancing process
- 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

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ISO 18436 Category III

Advanced Vibration Analyst Training & Certification

CAT-III

Online Learning & Classroom Course

The Vibration Specialist Advanced course is intended for personnel who have at least two years vibration analysis experience and Category II certification by a recognized certification body. The course provides an in-depth study of diagnostic measurement techniques and the associated applications of the techniques. It is expected that the attendee is either the leader of the vibration team, or takes a leading role in diagnosing faults and making the final recommendation. This person must fully understand all data collector options, special test capabilities, all analysis tools and must understand the widest range of fault conditions.

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

- 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

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- 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 analyzer 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