VIBRATION INSTITUTE OF SOUTH AFRICA
Vibration Institute of South Africa
Your Training partner in
Condition Monitoring
Since 1986
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Overview

The Vibration Institute of South Africa (V.I.S.A.) was formed in 1986.

Over the years the institute has held numerous very successful training courses in Johannesburg, Durban and Cape Town, with well over 6000 participants from all over the world.

V.I.S.A.’s courses are presented by V.I.S.A.’s own lecturers as well as by local and overseas guest lecturers, bringing many years of combined experience to the classroom. The courses are held at professional training venues or Smaller, tailor-made, in-house courses can be held at your own plant.

V.I.S.A.’s programme focuses on machine-Condition Monitoring and Asset optimization through courses such as Vibration Analysis, Electric Motor Diagnostics, Alignment, Balancing, Lubrication Analysis, Data Collection & Analysis, Transient Data and Modal Analysis.

V.I.S.A.’s training vision is to equip our participants with the necessary insight and skills to be proficient and successful in the world of Reliability and Condition Monitoring.
# Course Information

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<tr>
<th>Key</th>
<th>Course Description</th>
<th>Duration</th>
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<tr>
<td>CAT 1</td>
<td>ISO - Vibration Analyst Category 1</td>
<td>5 Days</td>
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<td>IFB</td>
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<td>BFA</td>
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<tr>
<td>VAday</td>
<td>Vibration Analysis in a Day</td>
<td>1 Day</td>
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Scheduling and pricing on request from rfq@aveng-acs.com

**Terms and Conditions**

- All Courses are held at a venue confirmed at the time of registration enquiry
- 10% discount for all paid bookings made 30 days in advance
- 5% discount for booking three or more candidates on a course
- All courses mentioned in the Brochure can be presented at the customer’s site
- The individual course content and duration can be tailor-made to suit your needs
- Orders and payment must be addressed to Aveng Automation & Control Solutions
- All payment must be made in full upfront
ISO Certification

Prerequisites
There are prerequisites for each certification level. It is undesirable for people without practical experience to hold Category 2 or higher certification levels.

- Category 1 (6 months practical experience)
- Category 2 (18 months practical experience)
- Category 3 (36 months practical experience)
- Category 4 (60 months practical experience)

At all VISA CAT1, CAT 2, and CAT 3 courses you may optionally take the certification exam which follows the ISO 18436.2 standard.

The ISO 18436.2 exams follow the format listed below:

- Category 1  50 Questions  2Hrs  Pass mark:  75%
- Category 2  100 Questions  Hrs  Pass mark:  75%
- Category 3  100 Questions  4Hrs  Pass mark:  75%
- Category 4  60 Questions  5Hrs  Pass mark:  75%

All questions are multiple choice (4 options). You are required to perform some calculations, so please bring a calculator. The exam is “closed book”, however you will be provided with a booklet of standard tables, charts, formulae and basic reference material.

Quote from the standard: “Question shall be of practical nature, yet test the candidate on concepts and principles required to conduct machinery condition evaluations.

Re-examination
To quote the standard: “A candidate who fails to obtain the pass grade required for certification may be re-examined any number of times, provided that the re-examinations take place not sooner than 30 days after a previous examination.

A certification body may use its discretion in allowing an earlier re-examination, in the event that further training acceptable to the certification body concerned is undertaken.

Period of validity
As per the standard, certification remains valid for five Years. If the analyst remains active in the Field, then re-exam is not required.
The Vibration Analyst Introduction course is tended for newcomers or for personnel who have limited vibration analysis experience. The course focuses on periodic, single channel data collection and analysis for predictive maintenance programs. A foundation is established for in-depth understanding of spectrum and waveform relationships.

**Condition Monitoring & Equipment Knowledge**
Review of condition monitoring technologies - Vibration, oil, wear particle, infrared, acoustic emission, electric motor testing. Review of failure modes and appropriate use of condition monitoring technologies.

**Principles of vibration**
- Motion, rms/peak/peak-peak, frequency/period
- Displacement, velocity and acceleration
- Units and unit conversion
- Waveform and spectrum (FFT)
- Natural frequencies and generated frequencies
- Basic forcing frequency calculations

**Data acquisition**
- Instrumentation
- Transducers and transducer mounting
- Measurement point naming conventions
- Routes/surveys: Loading and unloading the route
- Data collection / Following a route / Repeatable procedures
- Observations: best utilization of your time in the field

**Basic Vibration analysis**
- Overall level measurements
- Spectrum analysis
- Harmonics, sidebands and the analysis process
- Alarm limits, trending and exception reports
- Fault diagnosis
- Imbalance, misalignment, looseness, rolling element bearings and electric motors
The Vibration Analyst Intermediate course is intended for personnel who have at least twelve months vibration analysis experience and a thorough understanding of vibration theory and terminology.

The course provides an in-depth study of machinery faults and their associated spectrum, time waveform and phase characteristics. Additional topics covered include: signal processing, data collection, and corrective actions.

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 / 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
- Harmonics, sidebands, and the analysis methodology
- Time waveform analysis / Orbit analysis (introduction)
- Phase analysis: bubble programs 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 diagnosis
- Impact testing (bump test)
- Phase analysis

Corrective action
- 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 (avoiding common problems)
- Report generation / Reporting success stories /
  Acceptance testing and review of ISO standards
The vibration Specialist Advanced course is intended for personnel who have at least 5 years vibration analysis experience and a thorough understanding of vibration theory and terminology. The course provides an in-depth study of diagnostic measurement techniques and the associated applications of the techniques.

**Principles of vibration**
- Very quick review of fundamentals / waveform, spectrum, phase, vectors and orbit
- Signals: transients, pulses, modulation, beating, sum / difference
- Force, response, damping, and stiffness / Spectrum analysis

**Data acquisition**
- Review of transducer types, mounting, measurement and Locations
- Review of transducer selection and mounting
- Special tests: phase, triggering, strobes, low and variable speed machines

**Signal processing**
- Sampling, resolution, Fmax, averaging, windowing, dynamic range, signal/noise ratio
- A/D conversion: constant and variable sampling rate

**Vibration analysis, testing and diagnostics**
- Spectrum analysis, Harmonics, sidebands, and the analysis Methodology
- Time waveform analysis / Orbit analysis
- Shaft centre-line analysis / Transient analysis: order tracking, run-up and coast-down
- Phase analysis: bubble diagrams and ODS
- Enveloping (demodulation), shock pulse, spike energy, Peak Vue
- Impact testing (bump tests)
- Phase analysis / Transient analysis / Cross channel measurements
- Operation deflection shape analysis / Introduction to modal analysis

**Fault analysis in detail**
- Natural frequencies and resonance
- Imbalance, eccentricity and bent shaft
- Misalignment, cocked bearing and soft foot
- Mechanical Looseness / Rubs and instabilities
- Rolling element bearing analysis
- Analysis or turbo-machinery and sleeve bearings
- Analysis of AC, DC and variable frequency drives
- Analysis of gears / Analysis of belt driven machines
- Analysis of pumps, compressors and fans

**Corrective action**
- General maintenance repair activities
- Balancing process: single-plane and two-plane
- Review of shaft alignment procedures: dial and laser
- Flow control and replacement of machine parts
- Resonance control, isolation and damping

**Running a successful condition monitoring program**
- Setting baselines
- Setting alarms: band, envelope/mask, statistical
- Setting goals an expectations
- Database setup and maintenance
- Appropriate use of condition monitoring technologies
The Master Vibration Analyst Course qualifies you to lead condition monitoring teams, having a deep understanding of machine dynamics and failure modes. With your knowledge and qualifications you are able to design tests to solve difficult problems and identify underlying issues to prevent reoccurrence. There are no rotating machine problems too difficult to solve. You will carry the highest regard in the field of machine condition monitoring.

What the MASTER Vibration Analyst course teaches you?

- Advanced measurement signal processing techniques
- Torsional vibration and cross-channel measurements
- Dynamics including mass / stiffness / damping and natural frequencies
- Modal analysis and operating deflection shapes
- Orbit and centerline analysis
- Rotor dynamics
- Correction techniques including isolation
- Damping, and tuned absorbers, and other advanced topics.

In accordance with International Organization for Standardisation (www.iso.org), ISO 18436-2 standard, the course requires a minimum of 64 hours of training, which normally takes two or three separate classes.

The content of the entire Category IV course can be viewed over the Internet on video. All of the topics covered in the required 64 hours of training as specified in ISO 18436.2 are taught in videos using our famous 3D animations and software simulations. While you watch the videos you can also attempt the “worked examples”. These questions are practical in nature and are designed to not only test your knowledge and understanding, but also provide a way for you to test whether you are likely to be able to successfully complete the Category IV exam. You can take the lessons via video as many times as you like. You will see and hear the animations and simulations which make everything easier to understand. And you will listen to case studies where the theory is put into practice.

Following the online portions of the course, you will attend a four-day classroom session to combine education, review and question practice. Attendees will learn, and attendees will be tested. The sessions will be very interactive with ample opportunity to ask questions. In reviewing the topics covered in the on-line videos you will be challenged with exam standard practical questions. On the fifth day of the classroom portion of the course, you will be offered the optional Category IV certification exam.
Machines that have been precision balanced run longer and cost less to run. Unbalance causes fatigue and reduces the life of bearings and can make looseness and resonance conditions far worse.

This course will equip you with the knowledge and skills so that you can use a vibration analyzer / balancer, or a simple sheet of graph paper and protractor, and balance a machine, without even having to remove it from the plant.

Who should attend?
If you have to balance machines, then you need this course.

If you own a modern analyzer/balancer you have two choices; you can just take the readings and do what the analyzer tells you to do, or you can understand what you are doing and be prepared when things go wrong – and they will.

We will ensure you understand the entire process, and give you the skills to return to the plant and perform precision balancing. Note: Although we will not have time to explain the operation of every model of vibration analyzer, we will provide you with the knowledge so that you will be successful with whatever model you own.

What is unique about this course?
We use 3D animations, Flash simulations, and software simulators that completely explain and demonstrate the balancing process – you need to see them to believe them! You will understand vibration, phase, vectors and the calculations required. And you will understand the balancing process.

Topics
- What is unbalance?
- Why do machines go out of balance
- Using vibration analysis to ensure it is out of balance and not misaligned
- Dealing with runout and eccentricity etc.
- The balancing check-list
- Practical issues
- Quick review of amplitude and phase readings
- Collecting vibration and phase readings
- Understanding vectors
- Single plane balancing
- Estimating the size for the trial weight
- Adding weights
- Two-plane balancing
- The static-couple method
- Balancing overhung machines
- A quick review of balancing flexible rotors
- Balancing standards
- Why balancing may not be successful
- The four-run method – balancing without phase
- A quick introduction to shop balancing

We will demonstrate the entire process, and you will also be able to take readings and balance a machine.
Shaft Alignment

Rotating Machines that have been precision aligned run longer, and cost less to run. Alignment greatly reduces the life of bearings, seals, shafts and couplings.

This course will equip you with the knowledge and skills so that you can use a dial indicator tool or laser alignment system to precisely align two components together.

You will learn how to recognize misalignment and successfully set up the alignment job. Finally we discuss how to move the machine and deal with all the problems that you are bound to encounter at some stage. We will also review how to deal with thermal growth, and how to approach a larger machine train.

Who should attend?
If you have to align machines, then you need this course. If you own a modern laser alignment system you have two choices: you can just set up the lasers, enter the dimensions, take the readings and do what the equipment tells you to do, or you can understand what you are doing and be prepared when things go wrong – and they will.

We will ensure you understand the entire process, and give you the skills to return to the plant and perform precision alignment.

Note: Although we will not have time to explain the operation of every model of laser alignment system, we will provide you with the knowledge so that you will be successful with whatever model you own.

What is unique about this course?
Mobius makes it unique. We use 3D animations and software simulators that completely demystify and demonstrate the alignment process – you need to see them to believe them! You will completely understand the readings and the three-dimensional alignment process. If you have previously performed shaft alignment, you will find that all of those steps and instructions will suddenly make a whole lot of sense – you will find yourself saying ‘Ah, now I understand” and “I wish I took this course years ago”.

• An introduction to shaft alignment
• A quick overview of the shaft alignment process
• Pre-alignments checks
• Soft foot checks and correction
• Understanding dial indicators
Bearing Failure Analysis

Overview of Bearing Analysis
• Bearing classification and construction
• Brief discussion on different bearings
• Bearing life and lubrication
• Storage and handling procedures

Anti-friction Bearings
• Calculation of rolling element bearing defect frequencies
• Recognize bearing defect frequencies in spectral data
• Use of time waveform when diagnosing defects
• Determining defect severity

Other Predictive Maintenance Tools
• High frequency detection (HFD)
• Demodulation
• Thermography

Bearing Inspection
• Inspection sequence of external and internal surfaces

Post Failure Analysis
• Fatigue failure
• Misalignment
• Brinelling & False brinelling
• Contamination
• Electric current, Thrust failure & Fretting

Note
We encourage students to bring case histories and actual plant data with documented results to class, as well as samples of failed bearings.
Electric Motor Analysis

This course is aimed at providing delegates with a thorough understanding of electric motors through an interactive lecturing environment as well as practical exposure to the various aspects of manufacturing, repairing and testing of electric machines.

**Introduction**
Overview of electric motors explaining the various types and applications for their respective uses.

**AC Motor Theory**
Basic introduction to AC motor theory outlining the principles of operation and performance.

**DC Motor Theory**
Basic introduction to DC motor theory, outlining the principles of operation and performance.

**AC/DC Motor Construction**
Description of the various motor components and materials utilised in the manufacture of these machines as well as the limitations of these materials.

Specifically focusing on copper and iron losses and the impact of heat on insulation materials.

**AC/DC Motor Testing and Procedures**
Explanation of the various QA and performance tests carried out to ensure motors comply with the industry specifications. Detailed tour of AC/DC manufacturing facility witnessing practical application of the above theory.

**AC Motor Diagnostics**
Vibration spectrum and waveform analysis. Unbalance, misalignment, looseness, bearing defects, broken rotor bars, eccentricity and acceptance criteria.

**Case Histories**
Discussion regarding smart sensors such as the current clamp and flux coil.
Vibration analysis can tell you a great deal about the health of rotating machinery. But if you have a program, or you use consultants, then all of the terms and jargon can seem very confusing and misleading. Here is a chance to end all of that. With this one-day course you will learn the vibration fundamentals which will demystify the terms and concepts, and you will see how spectrum analysis can be used to diagnose faults, which is sure to make you a true believer.

Who should attend?
If you need to understand vibration analysis but don’t have the time or desire to learn the details. Managers, Engineers If you have a consultant that presents reports that are impossible to understand, or an internal group that presents recommendations that are just as confusing, then this course will help to make sense of it all. And if you do not really trust that vibration analysis can accurately detect or diagnose faults, then you really need this course.

What is unique about this course?
Vibration analysis can be confusing and very difficult to remember. Our courses are unforgettable in every sense of the word. Rather than making it theoretical, and boring, we take a very animated approach. Our 3D animations, Flash simulators, software simulators, and library of live case studies make the topics come alive.

An introduction to vibration analysis
- A brief explanation of why it is important to know the condition of the machine and the benefits of improved reliability
- A quick demonstration of vibration measurements and samples of data that indicate machine faults

Vibration fundamentals
- Where does vibration come from?
- How do the forces in a machine due to unbalance, worn bearings, and other conditions generate vibration
- Relating the vibration waveform to the vibration you feel on a machine
- Introducing frequency: Hz, RPM, CPM, and orders
- Introducing vibration amplitude: micron, mm/s, and G’s
- Introducing rms, peak, and peak readings

Using spectrum analysis to diagnose fault conditions
- Relating the spectrum patterns and amplitude to the fault condition and severity
- Diagnosing fault conditions

A brief overview of high frequency vibration analysis
- What are PeakVue, Shock Pulse, Spike Energy, Demodulation/enveloping, and HFD?
- Diagnosing rolling element bearing faults

A brief overview of orbit analysis
- Detecting faults in turbines and compressors with journal bearings
- A quick overview of time waveform analysis
- A quick overview of phase analysis
- Lots of case studies will be presented using historical graphs and live data recordings that make you feel as if you are standing next to the machine
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