



Vibration Analyst Training Program

CAT I Introduction to Machinery Vibrations

CAT II Basic Machinery Vibrations

CAT III Machinery Vibration Analysis
Balancing of Rotating Machinery

CAT IV Advanced Vibration Control
Rotor Dynamics Analysis
Advanced Vibration Analysis

NEW! Advanced Vibration Diagnostics
Using Case Studies

Register online at vi-institute.org

**Vibration
Institute**



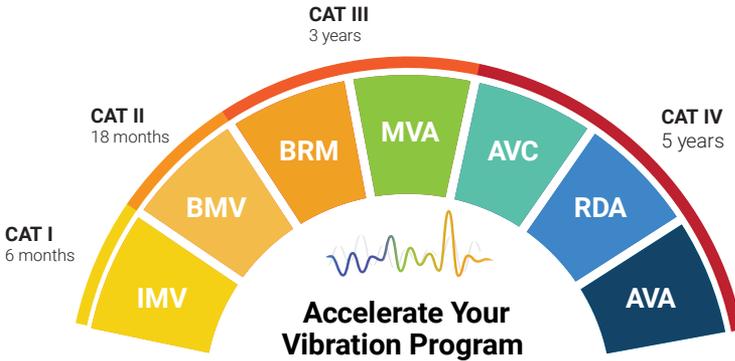
Practical Applications. Expert Knowledge. Real-World Solutions.

Vibration Institute training courses provide unique opportunities to study vibration principles in a way that goes beyond the textbook and provides real-world applications. In addition to understanding theories and techniques our courses:

- provide skills to add to your practical knowledge of machines;
- offer case studies to help analyze various types of equipment;
- include demonstrations and workshops that illustrate methods to solve vibration problems;
- have been developed using the Body of Knowledge compliant with ISO 18436-2 Vibration Condition Monitoring and Diagnostics;
- follow ISO 18436-3 Requirements for Training Bodies and the Training Process which defines the requirements for bodies operating training programs in the machine condition monitoring, diagnostic and correction technologies.



Which Course is Best for You?



The Vibration Institute Training Courses offer the highest standards of knowledge and competence among professionals in the vibration field today. Courses are taught by Category IV Vibration Analysts who have extensive field and industry experience, and are experts in vibration analysis. Their goal is to help all attendees become better analysts and provide them with an edge in an increasingly competitive marketplace.

2 Ways to Register

To register for any of the training courses listed in this brochure:



Register online at
vi-institute.org



Call the Vibration Institute
(630) 654-2254

Upon receipt of your registration and payment you will receive a confirmation letter with additional information and details for your specific training course. For the most up-to-date information please visit **vi-institute.org** and click on Vibration Analysis Training Courses.

Course Materials

Each registered attendee will receive course materials as specified for each class. These materials are intended to stimulate and assist in the learning process, as well as provide a permanent reference of information in the practice of machinery vibration analysis, vibration correction, and balancing.

Training Examinations

In accordance with ISO 18436-3 the Vibration Institute offers a training examination on the course content on the final afternoon of the class. These examinations are designed to help assess your knowledge and understanding of the training and course materials.

Each participant is given a score and a performance evaluation study guide on the training examination immediately after it is administered, in addition to a class review of the training exam. This information is intended to serve as an indicator of your technical strengths and areas for improvement.

Please note that completion of the training exam in no way qualifies the candidate for the Vibration Analyst Certification Exam. This is meant solely as a review of the materials covered during the training course only.

A combination of education, training and work field experience are required for a student to sit for a Certification Exam.

PLEASE NOTE: *Training exams are not the same as certification exams. Performance on the training exam is NOT an indication of certification exam performance.*

Onsite Corporate Courses

All of the courses listed in this brochure can be held at your company by one of our expert Vibration Institute instructors. The courses can be customized to meet your needs and interests, with course fees based on preparation and instruction time, course length, course materials, number of attendees, and associated travel expenses.

Attendance at corporate courses is not limited, but it is recommended that class size not exceed twenty-five students. If you would like additional information on any Vibration Institute training course, please contact the Institute directly at (630) 654-2254 or information@vi-institute.org.

Continuing Education Units (CEUs)

The Vibration Institute awards Continuing Education Units (CEUs) to registrants at any Institute training course. One CEU represents ten hours of classroom time, but is not a mark of achievement.



Registration Information

The registration fee covers the cost of all training course sessions, course materials, demonstrations, breakfasts, breaks and luncheons. Please register with the Institute in advance of your course online at the Institute's website. Registrations received less than ten business (10) days before the scheduled first day of a training course will be charged an additional \$100 registration fee. Participants will receive confirmation of registration and payment by e-mail. Make checks payable to the Vibration Institute. All amounts are payable in U.S. currency only.

IMPORTANT NOTICE: *Certification Exams are held on the day after the conclusion of the noted course dates. Typically, this will occur on Saturday morning. Please adjust your travel plans to accommodate the certification exam if you plan to take it. Separate registration is required in order to take the Certification Exam.*

Cancellation Policy

Transferring registration to another course: Transferring registration to another course date is allowed, and encouraged instead of canceling. There is no cost to transfer a registration if received at least ten (10) U.S. business days before the week of the scheduled course. A \$250 administration fee will be assessed for requests made within ten (10) business days before the week of the scheduled course.

Cancellation Fees: If canceling a training course registration and not transferring to another course date, a \$250 cancellation fee will be assessed. For cancellations received within fifteen (15) U.S. business days

before the week of the scheduled course, a \$500 administrative fee will be assessed. Cancellations received within five (5) U.S. business days before the week of a course and no-shows for the course will not receive a refund. There are additional cancellation fees applied for exam cancellations.

Hotels

Attendees are responsible for making and paying for their own hotel reservations. The Institute reserves blocks of rooms at the hotel(s) where all the courses are scheduled if applicable. Room blocks are available for attendees of Institute training courses until approximately one month before a course begins. If you need accommodations, please contact the hotel directly and inform them that you are attending a Vibration Institute-sponsored training course to receive the special room rate. All rates are single occupancy unless otherwise noted.

Airline Travel

VI is not responsible for the purchase of non-refundable airline tickets or the cancellation/charge fees associated with canceling a flight. Please confirm that the course will be held before purchasing an airline ticket. The Vibration Institute retains the right to cancel a course up to three weeks before the first day of any scheduled class.



Instructors

Vibration Institute instructors are integral in the development and application of vibration technology and have extensive experience as industry speakers and instructors. Our instructors draw on their extensive industrial experience for case histories and examples to illustrate measurement and computational techniques.



BRAD BARTON has over 25 years' experience in troubleshooting rotating equipment and structural problems. Prior to focusing on vibration, he worked in the plastics industry, cement production industry, and ran steam turbine/generator overhaul projects. He has worked with customers across many heavy industries to solve a wide variety of problems. Brad holds a BS in Mechanical Engineering

Technology from Indiana State University, and has been a Certified Category IV Vibration Analyst since 1996 through the Vibration Institute.



NELSON L. BAXTER is President of ABM Technical Services, Inc. and co-founder of Machinery Health Monitoring and Electro-mechanical Diagnostic Services. His 34 years of experience in the utilities industry include trouble-shooting rotating equipment, structural testing, and balancing. He is a contributing editor of

Sound & Vibration Magazine, a Registered Professional Engineer, a Level IV Certified Vibration Analyst and Instructor for Level IV Class. Baxter holds an M.S. in Nuclear Engineering from Purdue University.

Instructors



STAN BOGNATZ, P.E. is President of M&B Engineered Solutions, Inc., a company providing vibration analysis, balancing, alignment, and predictive maintenance services for rotating equipment users, along with providing condition monitoring systems design, installation & service, and customer training. Over 30 years of vibration analysis & reliability experience in power generation, petrochemical, pulp/paper, and wastewater facilities, and provides specific support for power generation clients, with extensive experience on large gas, steam and hydro-turbines. Prior to 2005, he managed and staffed Bently Nevada's Machinery Diagnostic Services (MDS) team for almost 20 years. Stan is a certified Category IV Vibration Analyst through the Vibration Institute, and has authored & presented technical papers covering diagnostic techniques, balancing, modal analysis, optical alignment, condition monitoring systems, and lube oil analysis, among others. He earned a B.S. degree in Mechanical Engineering from Penn State University, and a Master's Degree in Business Administration from Wilkes University. He is also a registered Professional Engineer in the commonwealth of Pennsylvania, a member of the American Society of Mechanical Engineers, and is a Certified Maintenance & Reliability Professional (CMRP).



BARRY T. CEASE is President of Cease Industrial Consulting, Charleston, SC and co-owner of Custom Machinery Solutions, Bristol, VA. Mr. Cease holds a M.S. in Mechanical Engineering from Georgia Tech and is an ISO certified category IV vibration analyst through the Vibration Institute. He spent 14 years as an engineer in the Paper & Pulp Industry where his work focused on predictive maintenance & reliability. In 2006 he started his company Cease Industrial Consulting which provides predictive maintenance & reliability services to customers in a wide range of industries. He is a member of the Institute's Board of Directors and ASME.



RAY KELM, P.E. is owner and Chief Engineer of Kelm Engineering, LLC located in Friendswood, Texas. The company specializes in numerical modeling and field testing of dynamic systems including rotating and reciprocating machinery as well as piping systems and other equipment. He has 30+ years of experience in the oil & gas, power, manufacturing and petrochemical industries. He holds a B.S. in Mechanical Engineering from Texas A&M University and a M.S. in Mechanical and Aerospace Engineering from the University of Virginia. He is a registered professional engineer in the State of Texas.



JACK D. PETERS, Accelent Technology LLC, provides consulting services for vibration analysis training and applications. Prior to forming Accelent Technology LLC in 2017, Mr. Peters was the Vice President of International Sales for Connection Technology Center, Inc. (2004-2016), and his international responsibilities included Asia-Pacific, Canada, and India. He worked at Eastman Kodak Company, Inc. (1977-2004) measuring, monitoring, and analyzing vibration problems on process manufacturing machines for photographic films and papers. He has an AOS degree in Automotive Technology, an AAS degree in Electrical Technology, and is a Certified Maintenance and Reliability Professional (CMRP). Certified as a Category IV Vibration Analyst in accordance with ISO 18436-2, Mr. Peters is an instructor for the Vibration Institute, Technical Director of Training, Chairman of the Training Committee, and a member of the Board of Directors for the Vibration Institute.



ALLEN PLYMON is President of Plymon Vibration Consultants, LLC. He provides consulting and training to many industrial clients including acceptance testing, root cause failure analysis, advanced testing and troubleshooting, balancing, remote monitoring and reliability concepts. Allen is a Category IV Vibration Specialist, through the Vibration Institute. He has over 30 years of experience determining and solving machine and structural issues both in repair centers and a wide variety of industrial plants. He serves on the Vibration Institute Board of Directors as the Executive Vice President, is member of the Vibration Institute Training Committee, and a current Vibration Institute Instructor.



BILL PRYOR is the Technical Director for PDM Solutions, Inc. He has over 35 years experience in the vibration analysis and rotating machinery field. Field experience includes machinery troubleshooting, balancing, alignment, structural analysis, transient testing, and commissioning of rotating equipment. In addition, he has assisted in the establishment of many PdM programs throughout industry. Before joining PDMS, Pryor was with PSEG Power from 1986 to 1999 as a Sr. Test Engineer and Bently Nevada Corporation from 1977 to 1986. He has an AAS in Product and Machine Design from the State University of New York at Alfred. He sits on the Board of Directors of the Vibration Institute. Bill Pryor is certified Vibration Analyst Category IV.

Instructors



BOB SAYER, P.E. is the President of the Vibration Institute and owner of Applied Structural Dynamics (Westerville, Ohio). He has over forty years of experience as a mechanical and structural engineering consultant to a wide range of industries including pulp & paper, mining & metals, fossil-fuel & nuclear power generation, petrochemical, food processing, glass manufacturing, and aerospace & defense. Mr. Sayer provides analytical and experimental dynamic analysis of mechanical equipment for design projects, structural and mechanical failure studies, and process reliability and efficiency studies. Mr. Sayer holds engineering degrees from Ohio University (BSCE), Cleveland State University (MSIE), and Purdue University (MSCE). He had the honor and fortune of collaborating with the late Art Crawford, a pioneer of vibration analysis, on numerous projects. Mr. Sayer is a regular contributor at technical conferences and has published over 50 technical articles and co-authored 2 chapters in "The Simplified Handbook of Vibration Analysis".



DAVID B. SZROM is President & CEO of Mechanical Consultants, Inc., a technical service company providing machinery repair, reliability improvement designs, vibration analysis and balancing, optical and laser alignment and other state of the art technologies to heavy industrial clients. A graduate of Purdue University, he has over 4 decades of experience in vibration-based technical support to a broad range of industries. He previously served as Maintenance Manager for one of the first high-speed, recycled newsprint mill in the country. Szrom has been training with the Institute for over 35 years, is a Category IV Analyst, a member of ASME, the Secretary-Treasurer of the Vibration Institute and a member of the Board of Directors.



MONROE VOYLES, P.E. is a mechanical engineer with more than 20 years of experience in across the chemical, oil & gas, pump improvement and many more industries, most recently serving as a solutions engineer for ITT Goulds Pumps. His experience with large electric motors, gas turbines, centrifugal compressors, reciprocating compressors, steam turbines, large API pumps,

ANSI pumps, liquid ring compressors, cooling tower fans/gear boxes, and large compressor gear boxes make him the perfect candidate to teach for the Vibration Institute. Monroe graduated with a B.S.M.E from Louisiana State University in 1994 and became a Professional Engineer in Louisiana in 2002 and Texas in 2014. He is a CAT IV Vibration Analyst.



TOM WALTER has over 40 years' experience in the assessment of machinery components. His has worked for both large and small companies involving product development and technical support. His career has involved equipment ranging from machinery on nuclear submarines to implantable blood pumps to hydro, steam and wind turbine generators to flywheel energy storage systems. He

has authored or co-authored more than 50 technical publications. Tom holds a BS in Mechanical Engineering from the University of Dayton and an MBA from the College of William and Mary. He is a Certified Category IV Vibration Analyst, and a member of ASME. For more than 20 years he was chairman of the Hudson-Mohawk chapter of the Vibration Institute.

Introduction to Machinery Vibrations (IMV)

Introduction to Machinery Vibrations (IMV)

IMV prepares attendees to perform a range of simple machinery vibration condition monitoring and diagnostic activities. It is recommended for individuals as an introduction to machinery vibrations and is partial preparation for the Vibration Analyst Category I Certification Exam. The workshops and demonstrations scheduled throughout the training course are used to illustrate theory and applications.

All registered attendees will receive:

- 🔊 Course Training Manual
- 🔊 Printed Copy of Course PowerPoints
- 🔊 Workbook with examples, vibration related questions requiring a solution and 18436-2 Annex A from the Body of Knowledge
- 🔊 Calculator
- 🔊 Ruler
- 🔊 Certificate of Course Completion

The IMV training is a four-day course and will begin at 8:00 a.m. and conclude at 5:00 p.m. daily (either Monday through Thursday, or Tuesday through Friday, depending on location). Subject to change.

It is recommended that attendees review the Body of Knowledge found in ISO 18436-2 Annex A, which can be found at vi-institute.org under Certification, prior to the course.

"I was blown away by how much knowledge and experience the instructor had. Having a rotating machine in the class was very helpful, and I loved the gear video."



IMV Course Content Includes:

An introduction and background to Vibration; Sources, Uses, Effects, Definitions, Predictive Maintenance, Measurement Concepts, Machines, Basic Analysis, Vibration Sensors and Vibration Instrumentation.

There is a workshop supporting each chapter. The student will test their knowledge and understanding of the material presented for that chapter by completing the workshops during the time allowed in class. The instructor will then review the workshop with the class. The student's time and understanding of the work shop materials will aid them in their preparation for the certification exam.

Training and Workshops Include:

Vibration Sources and Use; definitions, units, properties, measurements, motions, time, frequency and amplitude.

Basic Machinery Vibration; conversions, analysis, excitation, natural frequencies, resonance and critical speeds.

Data Collection and Analysis; physical observations, sensors, frequency spans, measures, triggering, sensor mounting, sensor location and instruments.

Machine Characteristics; fault sources, frequencies, design, function, acceptance testing, fault and condition analysis.

Vibration Instruments; meters, oscilloscopes, data collectors, analyzers and virtual instruments.

Vibration Testing; periodic monitoring, data collection, transducer positioning, alarms and reports.

Basic Analysis; mass unbalance, mis-alignment, looseness, rolling element bearings, blade pass, vane pass and gear mesh.

Vibration Severity; bearing housing evaluation, shaft vibration, gears, bearings, charts and graphs.

A *Vibration Analyst Category I Certification Exam* will need to be scheduled outside of this training agenda. **Typically, the Vibration Analyst Category I Certification Exam is scheduled for 2 hours on Saturday morning.** (Course and Exam schedule are always subject to change based on scheduling or unforeseen circumstances.)

Basic Machinery Vibrations (BMV)

Basic Machinery Vibrations (BMV)

BMV prepares attendees to perform basic vibration analysis on industrial machinery using single-channel measurements, with or without trigger signals, according to established and recognized procedures. It covers basics of sensors, database and data collector setup, data collection, signal processing, fault analysis, and basics of single plane balancing. It is partial preparation for the Vibration Analyst Category II Certification Exam. The workshops and demonstrations scheduled throughout the training course are used to illustrate theory and applications.

All registered attendees in the Basic Machinery Vibrations training course will receive will receive:

- Course Training Manual
- Printed Copy of Course PowerPoints
- Workbook with examples, vibration related questions requiring a solution and 18436-2 Annex A from the Body of Knowledge
- Calculator
- Ruler
- Certificate of Course Completion

The BMV training is a four and one-half day course and will begin at 1:00 p.m. and conclude at 6:00 p.m. on Monday. It will then begin at 8:00 am and conclude at 5:00 pm daily Tuesday through Friday. Subject to change.

It is recommended that attendees review the Body of Knowledge found in ISO 18436-2 Annex A, which can be found at vi-institute.org under Certification, prior to the course.

“Allen was prepared and related so much of the material to his experiences, it was real world applications, not just theoretical calculations.”



BMV Course Content Includes:

An introduction and background to Basic Vibration; Sensors, Instrumentation, Measurements, Conversion of Measurements, Analysis Techniques, Balancing, Machine Condition and Evaluation.

There is a workshop supporting each chapter. The student will test their knowledge and understanding of the material presented for that chapter by completing the workshops during the time allowed in class. The instructor will then review the workshop with the class. The student's time and understanding of the work shop materials will aid them in their preparation for the certification exam.

Training and Workshops Include:

Basic Machinery Vibrations; units, properties, measurements, motions, time, excitation, critical speeds, frequency and amplitude.

Data Acquisition; selecting a measure, transducers, frequency spans, data displays, and calibration.

Data Processing; instruments, sampling, aliasing, windows, dynamic range, averaging, analyzer set-up, and filters.

Fault Diagnostics; techniques, operating speed, rolling element bearings, gearboxes, motors, pumps, fans and compressors.

Condition Evaluation; shaft vibration, bearing vibration, casing vibration, historical data base, charts and graphs.

Machine Testing; equipment, site inspection, acceptance testing, baseline development, transient testing, presentation of data and reports.

Periodic Monitoring; listing assets, categorizing priorities, route selections, measurement points, frequency of data collection, reporting of results.

Single Plane Balancing; type of unbalance, balancing equipment, pre-balancing checks, measurements, trial weights, vector method and balancing solution.

A *Vibration Analyst Category II Certification Exam* will need to be scheduled outside of this training agenda. **Typically, the Vibration Analyst Category II Certification Exam is scheduled for 3 hours on Saturday morning.** (Course and Exam schedule are always subject to change based on scheduling or unforeseen circumstances.)

Machinery Vibration Analysis (MVA)

Machinery Vibration Analysis (MVA)

MVA provides in-depth discussions on time waveforms, FFT's, phase and orbit analysis techniques for the evaluation of industrial machinery. This course is partial preparation for the Vibration Analyst Category III Certification Exam.

All registered attendees in the Machinery Vibrations Analysis course will receive the following printed materials:

-  MVA Training Manual
-  MVA Course PowerPoints
-  MVA Workbook
-  Certificate of Attendance
-  Calculator
-  Ruler, Triangles and Protractor

The MVA course is five days in length (40 hours) beginning at 8:00 a.m. on Monday with completion at 5:00 p.m. on Friday.

It is recommended that attendees review the Basic Machinery Vibration course materials and the Body of Knowledge found in ISO 18436-2 Annex A, which can be found at www.vi-institute.org under "Certification" before attending the Machinery Vibration Analysis course.

"The training session was exciting. The method of explanation was quite simple, and it induced a lot of stimulating discussions."



MVA Course Content Includes:

MVA provides in-depth discussions on time waveforms, FFT's, phase and orbit analysis techniques for the evaluation of industrial machinery. It includes ten chapters covering:

Principles of Vibration; the physical nature of vibration, vibratory motion, degrees of freedom, measures & magnitudes, relationships of displacement, velocity and acceleration.

Data Acquisition Procedures; accelerometers, velocity sensors, proximity probes, encoders, signal conditioning, triggering and calibration.

Signal Processing; instrumentation, digital signal processing, resolution, dynamic range, demodulation, data displays.

Time Waveform Analysis; signal processing and presentation, phase measurement and analysis, harmonic relationships, and time waveform shape analysis.

Frequency and Phase Analysis; frequency analysis, beats, orders, nonsynchronous frequencies, resonance, sidebands, modulation and spectral shapes.

Orbit Analysis and Shaft Centerline Position; orbital construction, orbital timing, orbital analysis, centerline position, and case histories.

Machine Testing; concepts, mode shapes, shaker excitation, impact testing, damping, amplification and critical speed testing.

Balancing of Rotating Machinery; mass unbalance, force, single plane balancing, critical speeds, trial weights, pitfalls, one shot methodology, and four run method.

Condition Monitoring and Evaluation; machine knowledge, types of monitoring, route based, permanent monitoring, protection, screening and trending.

Machine, Components, and Potential Fault Frequencies; common or shared fault frequencies, fluid film bearings, rotors, rolling element bearings, gearboxes, motors, generators, pumps, fans, compressors, belt and roll frequencies.

There is a twelve-question multiple choice work shop supporting each chapter. The student will be provided 30 minutes for each work shop to test their knowledge and understanding of the material presented for that chapter. The instructor will then review the workshop with the class. The student's time and understanding of the work shop materials will aid them in their preparation for the certification exam.

A *Vibration Analyst Category III Certification Exam* will need to be scheduled outside of this training agenda. **Typically, the Vibration Analyst Category III Certification Exam is scheduled for 4 hours on Saturday morning.** (Course and Exam schedule are always subject to change based on scheduling or unforeseen circumstances.)

Balancing of Rotating Machinery (BRM)

Balancing of Rotating Machinery (BRM)

BRM covers single and basic two-plane balancing techniques. It includes both field balancing and shop (balancing machine) balancing. Topics such as pre-balance checks, influence coefficients, balance quality and tolerances, residual unbalance testing and case histories are included. It is partial preparation for the Vibration Analyst Category III and IV Certification Exams, and Balancing Specialist Exam.

All registered attendees in the Balancing of Rotating Machinery training course will receive:

- Course Training Manual
- Printed Copy of Course PowerPoints
- Workbook with examples, vibration related questions requiring a solution as found in Vibration Institute Guideline No. 1 requirement for qualification and assessment of balancing personnel.
- Calculator
- Ruler
- Balancing Tools
- Certificate of Course Completion

The BRM training is a four and one-half day course and will begin at 1:00 p.m. and conclude at 6:00 p.m. on Monday. It will then begin at 8:00 a.m. and conclude at 5:00 p.m. daily Tuesday through Friday. Subject to change.

It is recommended that attendees review the Body of Knowledge found in ISO 18436-2 Annex A, which can be found at vi-institute.org under Certification, prior to the course.



BRM Course Content Includes:

Basic aspects of machine balancing, single plane balancing, two plane balancing techniques, turbine generator balancing, roll balancing, fan balancing and shop balancing.

There is a work shop supporting each chapter. The student will test their knowledge and understanding of the material presented for that chapter by completing the workshops during the time allowed in class. The instructor will then review the workshop with the class. The student's time and understanding of the work shop materials will aid them in their preparation for the exam.

Training and Workshops Include:

Introduction to Balancing; mass unbalance, weight effects, measurements, equipment, pre-balancing checks, trial weights and types of unbalance.

Single Plane Balancing with Graphical Solution; vector method, balance sensitivity, phase lag, one shot method, weight addition, weight removal, weight splitting and combining.

Residual Unbalance and Acceptable Vibration Limits; permissible unbalance, permissible eccentricity, permissible vibration, and overall limits.

Single Plane Balancing by Influence Coefficients; vector math, application of influence coefficients, and balancing with proximity probes.

Shop Balancing; rotor classification, rotor supports, drive types, foundations, instrumentation, keyed rotors, arbors, rotation, speed, correction and residual unbalance.

Bodé and Polar Plots; critical speed, phase lag, first mode, second mode and a split critical.

Introduction to Two Plane Balancing; types of unbalance, static couple, influence coefficient, near plane and far plane effects.

Field Balancing; fans, roll balancing, spindle balancing, natural frequencies, mode shapes, and case histories

A Balancing Specialist Exam will need to be scheduled outside of this training agenda. **Typically, the Balancing Specialist Exam is scheduled for 3 hours on Saturday morning.** (Course and Exam schedule are always subject to change based on scheduling or unforeseen circumstances.)

Advanced Vibration Analysis (AVA)

Advanced Vibration Analysis (AVA)

This course teaches a wide array of advanced vibration analysis techniques including two-channel analysis, advanced signal processing, modal analysis, operating deflection shape (ODS), synchronous time averaging, and torsional vibration. It is partial preparation for the Vibration Analyst Category IV Certification Exam. The workshops and demonstrations scheduled throughout the training course are used to illustrate theory and applications.

All registered attendees in the Advanced Vibration Analysis training course will receive the following:

- Course Training Manual on signal processing and dual-channel analysis
- Workbook containing examples, workshop problems and the Body of Knowledge found in ISO 18436-2 Annex A
- Training course examination study guide
- Certificate of completion

The AVA training is a four-day course and will begin at 8:00 a.m. and conclude at 5:00 p.m. daily (either Monday through Thursday, or Tuesday through Friday, depending on location). Subject to change.

It is recommended that attendees review the Body of Knowledge found in ISO 18436-2 Annex A, which can be found at vi-institute.org under Certification, prior to the course.

“The Training materials are very nice and the Instructor provided plenty of depth to each topic.”



AVA Course Content Includes:

Signal Processing RMS, coherent and non-coherent signals, peak detection, vector addition, filters, signal-to-signal noise ratio, and FFT calculations.

Signal/Noise Demonstration

Workshop I: Signal Processing Introduction to the FFT, A/D converters, dynamic range, FFT batch process, buffer fill times, averaging, and overlap.

Workshop II: FFT Basics and Filters FFT Topics, Aliasing, windows, resolution, and demonstrations.

Workshop III: Aliasing, Windows, and Resolution FFT Accuracy, Side-lobe areas; accuracy of rectangular, Hanning, and flat-top windows, window resolution, order spectra, correction of amplitude and frequency from bin location.

Workshop IV: Window Function and Order Spectra Beats and Modulation Time domain of digitized signals, beats, AM and FM modulation, sum & difference frequencies, suppressed carrier signals and enveloping, case histories.

Workshop V: Beats and Modulation Time Series Averaging Frequency synthesizers, averaging one signal and noise, averaging two signals, effect of synchronous time averaging on bearing defects and modulation, digital filters and the FFT as a brick wall filter, case histories of synchronous time averaging.

Workshop VI: Time Series Averaging Dual-Channel Basics Test methods, transfer functions, coherence, mass/spring model, real and imaginary displays, Nyquist and Bode plots, basic mode shapes, and operating deflection shapes. Introduction to the Hilbert Transform Torsional Vibration

Workshop VII: Dual-Channel Analysis Damping Measurement and Calculation Half-power, real or imaginary plots, slope of phase shift, log decrement, dB decay of waterfall data, and demonstrations.

Workshop VIII: Damping Measurement Modal Testing Testing, analysis, natural frequencies, damping, and modes. Structural Measurements Vertical pumps, machine supports, floors, phase leads, turbine blades and fans, axial resonance on motors with sleeve bearings.

Workshop IX: Modal Testing

Course Review

Training Examination on Course Content (3 hours)

Training Examination Review

Advanced Vibration Control (AVC)

Advanced Vibration Control (AVC)

This course is targeted at solving complex vibration problems involving transient and forced vibrations; resonance, isolation and damping in both structural dynamic and rotor dynamic systems. It is partial preparation for the Vibration Analyst Category IV Certification Exam. The workshops and demonstrations scheduled throughout the training course are used to illustrate theory and applications.

All registered attendees in the Advanced Vibration Control training course will receive the following:

- Course Training Manual
 - Workbook containing examples, workshop problems and the Body of Knowledge found in ISO 18436-2 Annex A
 - Certificate of completion
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The AVC training four-and-a-half day course will begin at 1 p.m. and conclude at 5:00 p.m. on Monday; then will begin at 8:00 a.m. and conclude at 5:00 p.m, Tuesday through Friday.

It is recommended that attendees review the Body of Knowledge found in ISO 18436-2 Annex A, which can be found at vi-institute.org under Certification, prior to the course.



AVC Course Content Includes:

Introduction Effect of vibration level on fatigue, structural vs. mechanical vibration severity evaluation, industry specific severity standards.

Transient Free Vibrations Damped and undamped free vibrations of single and multiple degree-of-freedom systems. Modal testing to determine natural frequencies, damping, and mode shapes. Intro to the concept of modal participation. Log decrement, equivalent spring and natural frequency calculations. Tuning natural frequencies to avoid resonance by changing stiffness and/or mass. Linear & non-linear stiffness, and temperature & strain rate effects on stiffness.

Workshop I: Free Vibrations

Forced Vibrations Forced harmonic response, damping analysis, and base motion response. Forced response to periodic non-harmonic and impulse forces. Sensitivity of modes to placement of dynamic forces. Case histories involving force modification as a form of vibration control.

Workshop II: Forced Vibrations

Basic Rotor Dynamic Vibration Control Single & multiple degree-of-freedom models, modal mass, mode shapes, limitations of different modeling techniques, support and rotor stiffness asymmetry, flexible impellers, gyroscopic effects, centrifugal stress stiffening, and Lomakin effect in pump rotors. Natural frequency tuning techniques for rotors.

Workshop III: Rotor Dynamics

Basic Structural Dynamics Dynamic response of structural components of machines and flexible floor framing systems. Natural frequency tuning techniques to reduce vibration of structures. Theory and application of tuned Dynamic Vibration Absorbers (DVA) and Auxiliary Mass Dampers.

Rigid Foundations Rules-of-thumb for foundation design. Single & multiple degree-of-freedom models. Soil-foundation interface stiffness and damping calculations. Uncertainties in natural frequency calculations for foundations. Natural frequency tuning methods for foundations.

Workshop IV: Vibration Control for Structures & Foundations

Isolation Theory of dynamic force Isolation, advantages and disadvantages of different isolator types, stability requirements for isolation systems, decoupling of isolated systems from support system. Case histories involving proper and improper use of isolation.

Workshop V: Isolation

Systems Subjected to Dynamic Pressure Pulsations Sources of pulsations in pumps, fans and compressors, structural dynamics of piping and ductwork, acoustic resonance, vibration severity criteria for pipes, vortex shedding problems and solutions.

Rotor Dynamics Analysis (RDA)

Rotor Dynamics Analysis (RDA)

This course teaches both practical diagnostic and theoretical modeling of rotating systems using journal and rolling element bearings. It is partial preparation for the Vibration Analyst Category IV Certification Exam.

The workshops and demonstrations scheduled throughout the training course are used to illustrate theory and applications.

All registered attendees in the Rotor Dynamics Analysis training course will receive the following:

- 📖 Course notes
 - 📖 Workbook containing examples, workshop problems and the Body of Knowledge found in ISO 18436-2 Annex A
 - 📖 Training course examination study guide
 - 📖 Certificate of completion
-

The RDM training is a five-day course and will begin at 8:00 a.m. and conclude at 5:00 p.m. daily (Monday through Friday). Subject to change.

It is recommended that attendees review the Body of Knowledge found in ISO 18436-2 Annex A, which can be found at vi-institute.org under Certification, prior to the course.

“Ray presented practical materials, tips, techniques, etc. that were very helpful to us in real life.”



RDA Course Content Includes:

- Introduction to Rotordynamic Analysis and Purpose**
- Review of Vibration Basics**
- Hand Calculations for Lateral Rotor Critical Speeds**
- Forced Response Estimates Using Hand Calculations**
- Basic Rotor Instabilities**
- Torsional Vibration**
- API RP 684 Review - Dustin**
- Bearing Modeling Using Computer Methods**
- Modeling of Rotors**
- Modeling Lab**
- Natural Frequency and Unbalanced Response**
- Modeling Rotor/Bearing Instabilities**
- Model Validation**
- Rotor Balancing Examples**
- Troubleshooting Techniques**



Advanced Vibration Diagnostics Using Case Studies

NEW! Advanced Vibration Diagnostics Using Case Studies

Designed for more advanced users, this 3.5 day course presents digital signal analysis and advanced vibration control techniques, together with natural frequency testing, experimental modal analysis (EMA) and operating deflection shape (ODS) testing. Case studies will be used to reinforce principles showing how all these techniques, along with vibration video amplification (VVA) and experimental stress analysis (ESA) complement each other.

The course content is an accumulation of over 40 years of the instructor's experiences, including numerous studies that were done with the late Art Crawford. All Attendees will learn a wealth of information concerning equipment-specific diagnostics. The course content is thus valuable for higher level vibration analysts (Cat 3 and Cat 4), reliability and maintenance professionals, structural engineers, and machine designers.





Day 1:

Introduction to the basics of vibration diagnostics, including time waveform and frequency spectral analysis, and advanced diagnostic techniques including operating deflection shape (ODS), experimental modal analysis (EMA), vibration video amplification (VVA) and finite element analysis (FEA). Review of natural frequencies, mode shapes, and the concept of modal participation.



Day 2:

Review of digital signal analysis principles that effect diagnostic studies. Principles & demonstration of the impact method and the use of variable speed data to determine natural frequencies and damping. Special considerations for Shop Testing versus Field Testing. Introduction to and demonstration of experimental modal techniques used to determine mode shapes. Verification of Modal Data.



Day 3:

Introduction to and demonstration of operating deflection analysis testing techniques, including common mistakes made when performing an ODS. Review of using ODS testing as a substitute for experimental modal testing; obtaining mode shapes with ODS data instead of modal data. Introduction to the basics of vibration control techniques.



Day 4:

Using EMA/ODS/FEA to diagnose and correct vibration problems in Fans and Pumps. Using EMA/ODS/FEA to diagnose and correct vibration problems in Mixers, Gearboxes, Screens, and Other Equipment. Using EMA/ODS/FEA to diagnose and correct vibration problems in Piping and Ductwork.

2.8 CEUs

Onsite Corporate Courses

All of the courses listed in this brochure can be held at your company by one of our expert Vibration Institute instructors. The courses can be customized to meet your needs and interests, with course fees based on preparation and instruction time, course length, course materials, number of attendees, and associated travel expenses. There is no limit to the number of individuals who can attend any corporate course. If you would like additional information on any Vibration Institute training course, please contact the Institute directly at (630) 654-2254 or information@vi-institute.org.

2 Ways to Register

To register for any of the training courses listed in this brochure:



Register online at
vi-institute.org



Call the Vibration Institute
(630) 654-2254

Upon receipt of your registration and payment you will receive a confirmation letter with additional information and details for your specific training course. For the most up-to-date information please visit vi-institute.org and click on Vibration Analysis Training Courses.



Correspondence Courses

For those individuals who are not able to attend scheduled Vibration Institute Training Courses, or prefer the flexibility to study at their own pace, the Vibration Institute provides correspondence courses for the following topics:

CAT I: Intro to Machinery Vibrations

CAT II: Basic Machinery Vibrations

CAT III: Machinery Vibration Analysis

CAT IV: Advanced Vibration Control

CAT IV: Rotor Dynamics Analysis & Advanced Vibration Analysis

For each course, the participant is provided with course notes, workbook, and study guide. The course notes cover the principles, procedures, example problems, and case histories in machinery vibration analysis, rotor dynamics, and advanced vibration control.

The workbook contains practical industrial problems and exercises designed to provide the participant training in basic principles of the subject, as well as some experience in solving problems.

The study guide is divided into lessons that lead the participant through the material in an organized manner. Each lesson contains a reading assignment in the textbook that is followed by assigned problems in the workbook.

The participant is expected to return the workbook to the Institute upon completion. Contact the Institute at information@vi-institute.org or (630) 654-2254 for assistance and clarification of technical concepts.

Upon completion of a correspondence course the participant receives a Certificate of Completion including CEUs.

Correspondence courses also provide training points toward recertification as a Vibration Analyst, and they satisfy necessary prerequisites for scheduled Vibration Institute training courses.

For additional details please contact the Institute (630) 654-2254 or information@vi-institute.org.

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– **Greg Nelson**, Membership Chair

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- Discount on all training courses and events, including the Vibration Institute Annual Training Conference & Expo.
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