



# 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 Analysis  
Advanced Vibration Control  
Balancing of Rotating Machinery

**NEW!** Advanced Vibration Diagnostics Using Case Studies  
Vibration Analysis Overview  
Online Training Courses

Register online at [vi-institute.org](http://vi-institute.org)

**Vibration  
Institute**



## VIBRATION ANALYST TRAINING PROGRAM

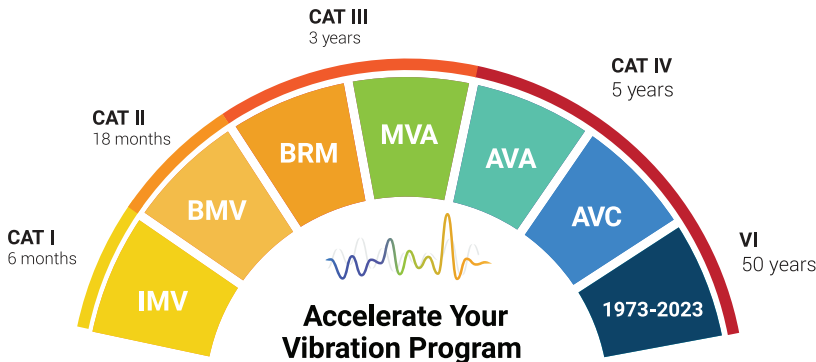
# Practical Applications. Expert Knowledge. Real-World Solutions.



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.
- Those who attend our classes come from all walks of life including Newport News Shipbuilding, Prognost, many nuclear energy facilities, paper mills, steel mills, power plants, and more.

# 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 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/events**



Call the Vibration Institute  
**(630) 654-2254**

Upon receipt of your registration and payment you will receive a confirmation email 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. If you would like materials shipped to you in advance of the course, there will be a non-refundable expedited materials fee of \$100 and 50% deductible on the course registration fee if canceling the course after receiving materials in advance.

Register online at **vi-institute.org** **3**

## 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.

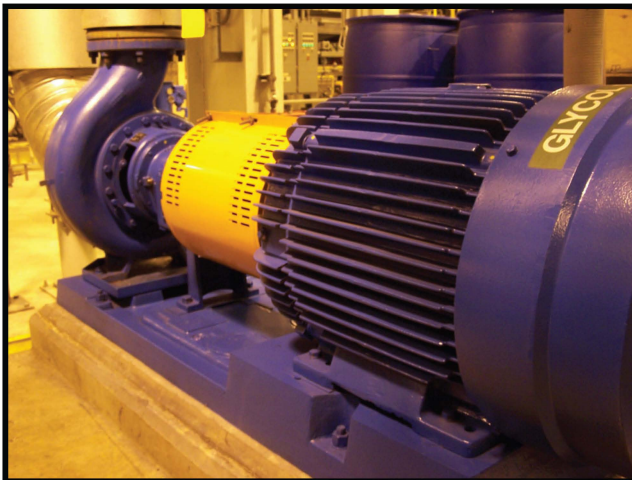
Each participant is given a score and a performance evaluation study guide on the training examination immediately after it is administered, in addition to a class review of the training exam. This information is intended to serve as an indicator of your technical strengths and areas for improvement.

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.*

## 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, breaks and luncheons. Please register with the Institute in advance of your course online on the Institute's website.

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

The cancellation of and transfer to a training course and certification exam will be honored, provided that written notification is received by the Institute office via e-mail or mail no later than ten (10) business days before the first day of the scheduled course.

### **Our cancellation fees are as follows:**

Transfer to another training course (and certification exam, if applicable): \$0

Cancellation without transfer to another course (and certification exam, if applicable) 10 or more days before first date of course: 10% of course (and exam, if applicable) cost.

Cancellation less than 10 days of first date of course (and certification exam, if applicable): \$500 20% of course (and exam, if applicable) cost.

Absentees for the course will not receive a refund. This cancellation policy supersedes all prior published information. We appreciate that this is an important investment for you and your company and would like to accommodate your needs the best we can. If you have a concern, please call our office at 1-630-654-2254.

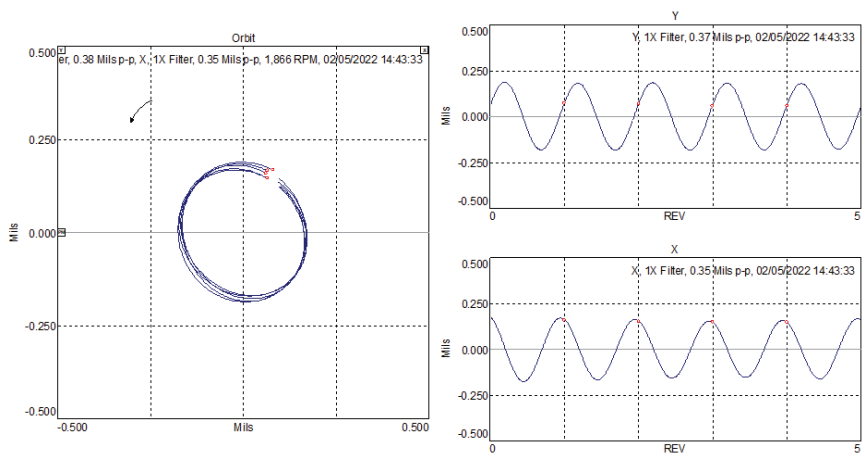
Additional cancellation fees will be applied for exam cancellations. Absentees for the course will not receive a refund. This cancellation policy supersedes all prior published information.

## Hotels

Attendees are responsible for making and paying for their own hotel reservations. The Institute reserves blocks of rooms at the hotel(s) where or near 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 two 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 maintenance services for rotating equipment users, along with providing condition monitoring systems design, installation & service, and customer training. 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.



**EMANUELE GROSSI, Ph.D., P.E.**, is a Managing Engineer at Exponent. He received his Ph.D. in mechanical engineering from the University of Illinois at Chicago and he is an ISO certified Category III vibration analyst through the Vibration Institute. His doctoral research focused on computational dynamics and vibration of machines and vehicles. Dr. Grossi performs vibration analysis, performance evaluation, and failure analysis of mechanical systems in various industries, but primarily in consumer products, automotive, industrial machinery, rail, and mining. He has provided expert witness testimony in the United States and internationally.



**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 Houston, 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.

# Instructors



**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.



**GYORGY SZASZ** holds a Ph.D. degree from Auburn University in Mechanical Engineering, and he is a certified Category 4 vibration analyst. He is currently a Principal at Stress Engineering Services and he is also the president of the board of directors of the Vibration Institute. Over the course of 25+ years as a vibration analyst, he has worked on and led numerous vibration analysis projects in the oil & gas and power generation industries.



**BOB MARTIN** is a CMRP and a Category Three Certified Vibration Analyst. Bob has been helping establish and support companies with their predictive maintenance programs for over 30 years. This work started with his time at Computation Systems followed by Emerson Process Management and PCB Piezotronics. His experience with spectrum analysis extends back over 40 years beginning with his work in the US Navy as an anti-submarine warfare systems operator, flying as aircrew, on P-3 Orion patrol aircraft.

***“My IMV course included plenty of real life examples. The instructor worked out all of the math problems in class. He did not use a PowerPoint to work out the problems which is great!***

***– Knoxville, TN  
March 2023***



# Instructors



**BOB SAYER, P.E.** is the Past President of the Vibration Institute and owner of Applied Structural Dynamics (Westerville, Ohio). He has over forty-five 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. Dave 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 across the chemical, oil & gas, pump improvment and many more industies, 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.

# Instructors



**TOM WALTER**, has over 40 years' experience in the assessment of machinery components. He 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.



**AHMED A. EL-SHAFEI**, is a Vibration Institute Category III Vibration Analyst. He holds a B.Sc. in Mechanical Engineering from the University of Massachusetts, Amherst. His current role is Predictive Maintenance Engineer on the Skyler team at relayr. He previously served as Senior Engineer Facility & Equipment Performance on the Predictive Diagnostics Team at Johnson Controls in Milwaukee.

Prior to that at RITEC, Ahmed had been involved in numerous Condition Monitoring & Troubleshooting activities across the MENA region in the Oil & Gas, Power Generation, Steel, and Marine Industries. He has taught 30+ Vibration CAT I, CAT II, and Shaft Alignment Courses. He is sole developer of the RITEC Library & Tools Page providing free, interactive, simulators for: Vibration, Signal Processing, & Precision Maintenance, which have more than 10,000 registered users.



**JEFFREY MOTT** is a vibration specialist with Koontz-Wagner Services (South Bend, Indiana). He has 10 years of experience as a vibration analyst and PdM technician serving a wide range of industries including Automotive, Steel, Petro-Chemical, Agricultural, Plastics and Foundries. He also has extensive experience troubleshooting complex electronic systems and is a proud veteran

of the United States Navy. Jeff is a Certified Category III Vibration Analyst & Balancing Field Specialist with the Vibration Institute. He also holds Level II certification in Infrared Thermography, Ultrasonics and Magnetic Particle Testing, as well as certification in MCA/MCE & Airborne Ultrasound.

# Instructors



**ARES PANAGOULIAS** directs the sales, operations, and engineering of IIOT Condition Monitoring products and services for Hydro in the Hydro Centaur business unit. He works directly with customers to analyze data to improve rotating equipment maintenance strategies, increase availability, and reduce downtime in the Nuclear, Power Utility, Pipeline, and Oil & Gas industries. In addition, Ares is responsible for operations and management of all functions related to testing of high energy pumps, primarily for the Nuclear (safety and non safety related), Power Utility, Pipeline, and Oil & Gas industries at Hydro's Pump Test Lab. He has contributed to numerous internal and external R&D projects, including ongoing efforts to improve condition monitoring equipment in field installations.



**KAITLIN SPAK, PH.D., P.E.**, is a Principal Engineer at Exponent, a multi-disciplinary scientific and engineering consulting company. She received her PhD in mechanical engineering from Virginia Tech in 2014. Dr. Spak's work currently includes vibration analysis of consumer products, vehicles, heavy equipment, utility and energy infrastructure, and more. Dr. Spak holds professional engineering licenses in multiple states and is an ISO certified category IV vibration analyst through the Vibration Institute. She has provided expert testimony around the world in both domestic and international litigation and arbitrations.



**SHAWN COVINGTON**, is a vibration specialist with Horner Industrial Group (Indianapolis, Indiana). He has over 16 years of experience in the field as a vibration analyst working in a broad range of industries including steel manufacturing, food processing, auto manufacturing, paper mills, chemical/pharmaceutical plants, commercial residence and farming applications. Shawn is certified and experienced in field balancing as well as a Cat III Vibration analyst with the Vibration Institute.



**MIKE INGRAM, MSME**, is a Vibration Institute Category IV Vibration Analyst since 2003, with over 30 years of experience in Condition Monitoring. He earned both a Bachelors and Masters in Mechanical Engineering from Texas A&M University working in the Texas A&M Turbomachinery Laboratory. He is a Senior Application Engineer for SKF analyzing data and developing Condition Monitoring hardware, software and programs. He has spent time in Pulp & Paper, Metals, Semiconductor, and Power Generation as well as supporting customers in a wide range of industries.

# 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

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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.

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***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](https://vi-institute.org) under Certification, prior to the course.***

***"I liked the pace of the IMV Course and the various real world examples provided by the Instructor."***

***- IMV Student, St. Paul, MN***

***May 2023***



### 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.

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#### *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.

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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:

-  Course Training Manual (printed)
-  Course PowerPoints (printed)
-  Workbook with examples, vibration related questions requiring a solution and 18436-2 Annex A from the Body of Knowledge (printed)
-  Calculator
-  Ruler
-  Electronic Certification of Course Completion

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The BMV training is a **five day course** and will begin at **8:00 a.m.** and conclude at **5:00 p.m.** Monday through Thursday. It will then begin at **8:00 a.m.** and conclude Friday afternoon. Subject to change.

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*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](http://vi-institute.org) under Certification, prior to the course.*

***"The instructors have a lot of practical knowledge;  
participation was encouraged."***

***- AVA Student, Indianapolis, IN  
November 2021***



### 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.

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#### *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.

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*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:

- 🔊 MVA Training Manual (printed)
- 🔊 MVA Course PowerPoints (printed)
- 🔊 MVA Workbook (printed)
- 🔊 Calculator
- 🔊 Ruler, Triangles and Protractor
- 🔊 Electronic Certification of Course Completion

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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.

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*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](http://www.vi-institute.org) under "Certification" before attending the Machinery Vibration Analysis course.*



## 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.

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*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

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The BRM training is a **four and one-half day course** and will begin at **8:00 a.m.** and conclude at **5:00 p.m.** on Monday through Thursday. It will then begin at **8:00 a.m.** and conclude at **12:00 p.m.** Friday. Subject to change.

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***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](http://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.

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#### *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

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*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, transient and forced harmonic 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:

- 📖 Course Training Manual (printed)
- 📖 Course PowerPoints (printed)
- 📖 Workbook with examples, vibration related questions requiring a solution and 18436-2 Annex A from the Body of Knowledge (printed)
- 📖 Calculator
- 📖 Ruler
- 📖 Electronic Certification of Course Completion

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The AVA training is a **five day course**. It will run Monday through Thursday **8:00 a.m. - 5:00 p.m.** daily. Friday running from **8:00 a.m. - 2:00 p.m.** Subject to change.

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*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](http://vi-institute.org) under Certification, prior to the course.*



## 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:** Basic Modal Testing. Coherence, impact and response measurement techniques. Use of real and imaginary components to measure damping and provide mode shape information. Modal mass.

**Workshop X:** Torsional Vibration -Sources of torsional vibration, torsional test techniques, basic torsional modeling

**Workshop XI:** Transient and Forced Harmonic vibrations- Basic shaft and bearing modeling, response to unbalance

### **Course Review**

**Training Examination** on Course Content (2.5 hours)

### **Training Examination Review**

# Advanced Vibration Control (AVC)

## Advanced Vibration Control (AVC)

AVC 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 case studies scheduled throughout the training course are used to illustrate theory and applications.

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

- Course Manual (printed)
- Workbook with vibration related questions requiring a solution and Equation Sheet (printed)
- Calculator
- Electronic Certificate of course completion

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The AVC course begins Monday at **1:00 P.M.** and ends at **5:00 P.M.** Tuesday - Friday starts at **8:00 A.M.** and ends at **5:00 P.M.** Subject to Change.

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*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](http://vi-institute.org) under Certification, prior to the course.*



## AVC Course Content Includes:

### *Workshop I: Concepts of Vibration Severity*

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

### *Workshop II: Free Vibrations*

**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 III: Forced 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 IV: Rotor Dynamics*

**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 V: Structural Dynamics*

**Basic Structural Dynamics Vibration Control** 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 (TMB). Using multiple degree-of-freedom equations to describe interaction between structures and rotors.

### *Workshop VI: Isolation*

**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 VII: Dynamic Pulsations*

**Systems Subjected to Dynamic Pressure Pulsations** Sources of pulsations in pumps, fans & compressors, structural dynamics of piping and ductwork, acoustic resonance, vibration severity criteria for pipes, vortex shedding problems and solutions. Pulsation issues in both centrifugal and positive displacement machines.

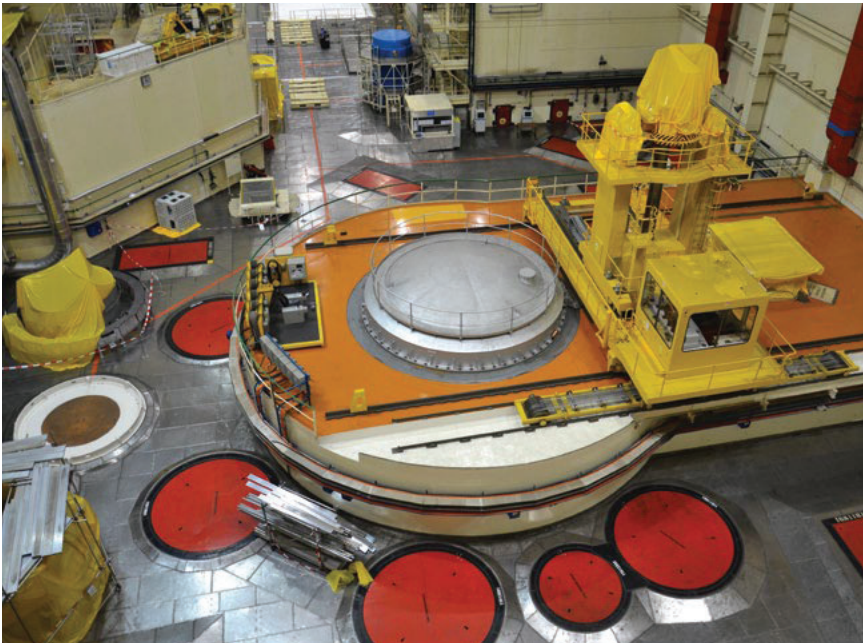


# Advanced Vibration Diagnostics Using Case Studies

## **NEW!** Advanced Vibration Diagnostics Using Case Studies

Designed for more advanced users, this 4-day course presents digital signal analysis and advanced vibration analysis techniques, including 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 45 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.

*3.2 CEUs*

# Onsite Corporate Courses

It's important to research and evaluate the reputation and expertise of any training provider, such as the Vibration Institute, to ensure they meet your organization's requirements and offer high-quality training programs. All classes should have a minimum of at least 10 students.

We recommend that class sizes do not exceed 25 students. If you wish to hold a class exceeding 25 students, please contact the Institute directly at [information@vi-institute.org](mailto:information@vi-institute.org).

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**If you would like to receive a quote to hold training at your facility, please visit:**

**<https://www.vi-institute.org/corporate-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 III: Machinery Vibration Analysis**

**CAT IV: Advanced Vibration Analysis**

**CAT IV: Advanced Vibration Control**

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 participant is expected to return the workbook to the Institute upon completion. Contact the Institute at [information@vi-institute.org](mailto: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. Correspondence courses must be completed within four months of purchase.

**For additional details please contact the Institute (630) 654-2254 or visit our website at:**

**<https://www.vi-institute.org/correspondence-coursesself-study/>**





# Vibration Analysis Overview for Non-Practitioners (VAO)

## **NEW!** Vibration Analysis Overview for Non-Practitioners (VAO)

Vibration analysis has been found to be a cost-effective means of increasing the availability and reliability of machines. It involves the vibration measurement and analysis of physical motions created by forces acting on machines or structures. This process translates into reliability, increased production, higher profitability, greater safety, and less stress on personnel.

"An Informational Vibration Analysis Overview for Non-Practitioners" (VAO) has been provided for individuals that require some understanding of vibration analysis as it relates to their daily work lives. This will assist management, sales, engineering and purchasing in their communication with vibration analysts regarding machine and plant reliability.

This manual acquaints the non-practitioner with the necessary concepts and basic practices involved in vibration analysis. It will add everyday practical knowledge to their skill sets and improve interaction with vibration teams; on their plant site, at customer plant sites or remotely through electronic based communication. It can also be used for self-study and preparation prior to attending Introduction to Machinery Vibrations, Category I or Basic Machinery Vibrations, Category II.





# Online Courses



**NEW!**

**CAT I - (IMV)  
Introduction to  
Machinery Vibration**



**CAT II – (BMV)  
Basic Machinery Vibration**

As of August 2022, the Vibration Institute offers online learning. Vibration Institute online courses use the Desire2Learn (D2L) Brightspace Learning Management System (LMS). You will interact with one of our highly qualified instructors and other students through chapters and discussion boards through D2L.

In order to register for an online class, you will need reliable access to a windows or macintosh computer and high speed internet connection. Basic internet skills are also a requirement for online learning.

It is important to check your computer, so it meets the requirements for D2L Brightspace before you register for an online course.

Our courses are on a rolling basis, and you may register at any time. Our courses are asynchronous, which allows you to learn according to your schedule. You will receive an electronic certificate of completion in our member portal in which you may download. You will receive an email once it has posted. If you wish to request a paper copy of your certificate, you may do so through our online store.

Our certification exams are not online and will need to be scheduled to take in person through our events calendar at <https://www.vi-institute.org/events/> once you have completed your class.

**For more information, visit: <https://www.vi-institute.org/online-learning/>**

**For online learning FAQs, visit: <https://www.vi-institute.org/faq/>**

[WWW.VI-INSTITUTE.ORG/MEMBERSHIP](http://WWW.VI-INSTITUTE.ORG/MEMBERSHIP)



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