

Instructor: Victor Wowk, P.E.,
author of (McGraw-Hill) *Machinery
Vibration* textbook series.

2019 Seminar Schedule

Location:
Paradise Hills Golf Course
Albuquerque, NM

Basic Vibration Analysis
April 9 - 11, 2019

Advanced Vibration Analysis
April 12, 2019

Balancing
September 24 - 25, 2019

Alignment
September 26 - 27, 2019

Basic Vibration Analysis
\$1,350 - April 9-11, 2019

Textbook: *Machinery Vibration: Measurement and Analysis*, McGraw-Hill, by Victor Wowk, 1991

Day 1

- Basic Concepts & Theory
- Oscillation
- Mass, Spring, & Damper
- Sine Waves
- Amplitude, Frequency, & Phase
- Random Vibrations & Shock Pulses
- Time & Frequency Domains
- Vectors
- Displacement, Velocity, & Acceleration
- Natural Frequencies & Resonance
- Transducers
- Cables
- Meters

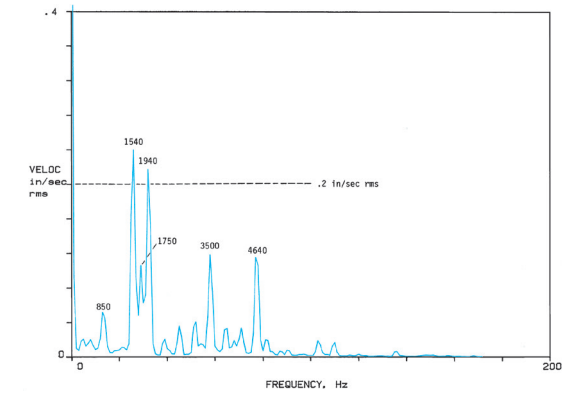
- Filters
- FFT Analyzers
- Data Loggers & Computers
- Stroboscopes
- Signal Generators
- Oscilloscopes
- Shakers
- Tape Recorders

Day 2

- Typical Vibration Problems
- Unbalance
- Misalignment
- Resonance
- Bearings

Day 3

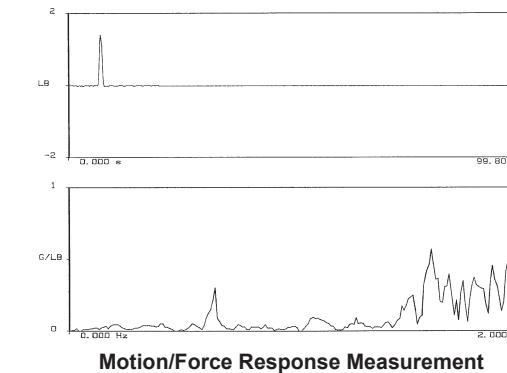
- Gears
- Vane Passing
- Fans
- Motor Vibrations
- Cavitation
- Oil Whirl
- Piping
- Bent Shafts
- Looseness
- Belts & Pulleys
- Beats



Vibration Specification

Advanced Vibration Analysis
\$450 - April 12, 2019

Text: Course Notes by Victor Wowk



Motion/Force Response Measurement

- Shock Pulses
- Whole Body Motion
- Stress Waves
- Vibration Energy
- Motion & Forces
- Structural Transmission
- Newton's Law Qualified
- Damping
- New Transducers
- Measurement Noise
- Sensors as Generators and Motors
- Check Channels
- Overall
- Vibration Severity

- Power Spectral Density
- dBEU
- Torsional Measurements
- Advanced FFT concepts
- Digital Resolution
- Frequency Resolution
- Acquisition Time
- Synchronous Time Averaging
- Demodulation
- Distortion
- Envelope
- Modal Analysis
- Dynamic Stiffness
- Mechanical Impedance

- Mobility
- Accelerance
- Two-channel Measurements
- Frequency Response Functions
- Coherence
- Analysis Strategies
- Serious & Benign Vibrations
- Alarm Setpoints
- Calibration
- Validity Checks
- Conflict Resolution
- Acoustics for Machinery

Dynamics of Machinery (in-house training only)

Text: Course Notes by Victor Wowk

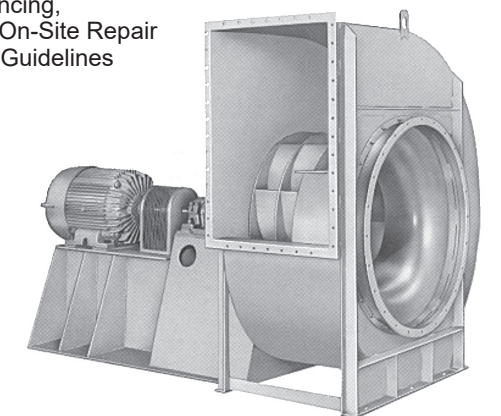
Day 1

- Materials
- Manufacturing
- Preload
- Components
- Joints
- Fits & Tolerances
- Thermal Expansion
- Built-in Stresses
- Assembly Variables
- Fasteners
- Forces
- Gravity
- Radial & Axial
- Contact
- Magnetic
- Centrifugal
- Impulse-momentum
- Gyroscopic
- Deflection & Flexibility
- Flow of Forces
- Dissipation
- Fluid Reactions
- The Laws of Nature
- Vibration Energy
- Heat
- Rotating Inertia
- Strength & Aging
- Stresses & Strains
- Fatigue
- Creep
- Endurance Limit
- Principal Stresses
- Modification Factors
- Wear

Day 2

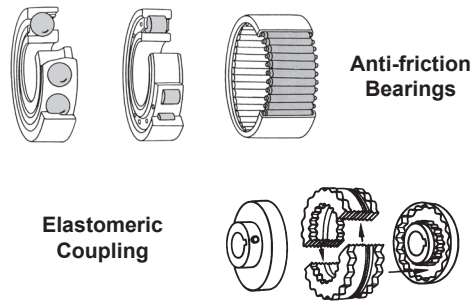
- Rotor Dynamics
- Gear Reactions
- Instabilities
- Resonance: Symptoms
- Tests
- Fixes
- Torsional Dynamics
- Characteristics & Failure Modes of Common Machines: Motors, Fans, Generators, Pumps, & Reciprocating Machines
- Machine Tools
- Root Cause Failure Analysis

- Field Fixes: Replacing Bad Parts, Balancing, Alignment, On-Site Repair
- Monitoring Guidelines
- Isolators



Bearings and Components (Shafts, Seals, Couplings, Belts, Chains, & Lubrication)
(in-house training only)

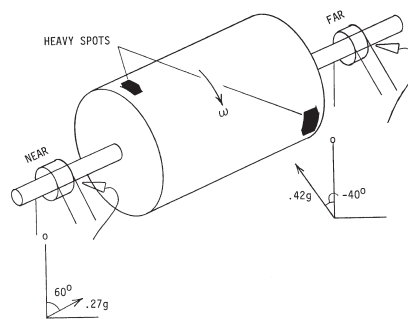
Text: *Bearings and Seals, A Basic Guide to Failure Diagnosis and Repair*, John Deere Co., 1992, *SKF Bearing Installation and Maintenance Guide*, and Course Notes



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| <p>Day 1</p> <ul style="list-style-type: none"> • Plain Bearings • Rolling Element Bearings • Manufacturing Processes • Loads • Shafts & Housings • Mounting & Removal • Tools • Fits & Tolerances • Lubrication | <p>Day 2</p> <ul style="list-style-type: none"> • Seals • Life of Bearings • Heat & Stress • Failure Modes • Inspection & Monitoring • Diagnosis & Repair • Examples of Failed Bearings | <p>Day 3</p> <ul style="list-style-type: none"> • Types of Couplings • Selection Criteria • Inspection & Maintenance • Belts & Sheaves • Tensioning Belts • Chains & Sprockets |
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Balancing
\$900 - September 24 - 25, 2019

Textbook: *Machinery Vibration: Balancing*, McGraw-Hill, by Victor Wowk, 1995



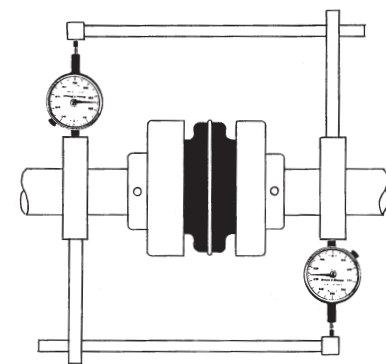
Two-Plane Balance

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| <p>Day 1</p> <ul style="list-style-type: none"> • History of Balancing • Static Balancing • Practical Aspects • Hazards • Time • Probability of Success • Runout vs. Unbalance • Vectors • Centrifugal Forces • Static, Couple, & Dynamic Unbalance • Trial Weights • Balancing with no Instruments | <p>Day 2</p> <ul style="list-style-type: none"> • Amplitude & Phase Sensors • Readout Instruments • Single-Plane Balancing • Strobe Method • Trigger Sensor Method • Calculating Correction Weights • Trim Balancing • Four-Run Method • Without Phase • Two Plane Balancing | <p>Day 2</p> <ul style="list-style-type: none"> • Cross Effect • Influence-Coefficient Method • Static-Couple Method • Three-Plane Balancing • Overhung Rotor • Flexible-Rotor Balancing • Weight Splitting • Combining Weights • Why Balancing May Not Work • Non-Linearity • Shop Balancing | <ul style="list-style-type: none"> • Soft vs. Hard Bearing Balancing Machines • Keys • Balancing Standards • Index Balancing • Mass Centering • Balancing Non-Rotating Parts |
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Alignment
\$900 - September 26 - 27, 2019

Textbook: *Machinery Vibration: Alignment*, McGraw-Hill, by Victor Wowk, 2000

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| <p>Day 1</p> <ul style="list-style-type: none"> • Diagnosing Misalignment • Rough Alignment Methods • Dial Indicators • Face-and-Rim Method • Reverse-Indicator Method • Optical & Laser Systems • Graphical Calculations • T+B = S+S • Example Problems • Practice: Students will do actual alignments in class on tabletop demo machines | <p>Day 2</p> <ul style="list-style-type: none"> • Moving Machines • Axial Positioning • Motor Magnetic Centers • Thrust Bearings • Height Bound • Bolt Bound • Doweling • Poor Foundations • Bent Shafts • Soft Foot • Bar Sag | <ul style="list-style-type: none"> • Thermal Growth • Pipe Strain • Hot-Alignment Checks • Alignment Tolerances • Bearing Alignment • Gear Alignment • Pulley Alignment • Vertical Shafts • Couplings • Running Alignment |
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Reverse-Indicator Alignment Setup

A 1-day Laser Alignment class is also available for **in-house training only**. Call (505) 884-9005 for details.

Location of 2019 Seminars

Paradise Hills Golf Course • 10035 Country Club Ln NW, Albuquerque, NM 87114 • 505-898-7001

Each student will receive the applicable textbooks, and a certificate with the appropriate Continuing Education Units (CEU) annotated. Additional handout materials, lists of suppliers, commercial brochures, and article reprints will be available to students.

These courses are completely non-commercial. Machine Dynamics, Inc. is not affiliated with any vibration analysis instruments. However, we believe that one reason for attending seminars is to discover what is available on the market, and where to buy it. This information will be provided, along with unbiased discussions of which choices are better for certain applications.

The Instructor, Victor Wowk, P.E., is the president of Machine Dynamics, Inc., a company that specializes in solving a wide range of vibration problems. Victor regularly applies the technologies that he teaches. Mr. Wowk is the author of the following textbooks published by McGraw-Hill: *Machinery Vibration: Measurement and Analysis*, 1991, *Machinery Vibration: Balancing*, 1995, & *Machinery Vibration: Alignment*, 2000.

A DISCOUNT IS AVAILABLE FOR THREE OR MORE FROM A COMPANY REGISTERING FOR THE SAME COURSE.

Ways to Register

- **Phone:** (505) 884-9005
- **Internet:** www.machinedyn.com (fill out contact form)
- **Mail:** PO Box 66479, Albuquerque, NM 87193-6479 (mail form below)

Payment Methods

- Tax is included in posted fee
- **Purchase Order:** Submit 2 weeks prior to attendance
- **Check:** Make payable to Machine Dynamics, Inc.
- **Credit Card:** Visa, MasterCard, Am. Express (Give credit card information by phone only.) (Payment must be secured to guarantee registration.)

Any of our seminars can be customized for you needs, and presented at your location. Call us for details.

Daily Seminar Schedule: 8:00 am - 4:30 pm

There will be hourly breaks, and **lunch is on your own from 12 noon to 1:00 p.m.** The format will be lecture/discussion with overhead presentations, and demonstrations on tabletop machines. Hands-on practice with tabletop machines will be part of the balancing and alignment workshops. You are welcome to bring your own instruments for classroom practice. FFT spectrums will be projected on an overhead screen as part of the vibration analysis courses.

Local Accommodations Students are expected to make their own travel/hotel arrangements. Hotel discounts are available to early registrants (call for details).

Cancellation Policy Substitutions can be made at any time with a different attendee. Of the total course fee, \$100 is non-refundable. The remaining fees are refundable with a written notice of at least 14 business days before the seminar begins.

Registration Form

(please mail to: Machine Dynamics, Inc., PO Box 66479, Albuquerque, NM, 87193-6479)

Attendee Name		E-mail Address	
Company Name		Company web site address	
Mailing Address		City	State Zip Code
Telephone: ()			
Course Titles & Dates (mark the courses you are planning to attend)			
Basic Vibration Analysis - \$1,350	Advanced Vibration Analysis - \$450	Balancing - \$900	Alignment - \$900
<input type="checkbox"/> April 9 - 11, 2019	<input type="checkbox"/> April 12, 2019	<input type="checkbox"/> September 24 - 25, 2019	<input type="checkbox"/> September 26 - 27, 2019
Total tuition fee: \$ _____ Payment Method: <input type="checkbox"/> PO #: _____ <input type="checkbox"/> Check <input type="checkbox"/> Credit Card			