2010 PUBLIC SEMINAR SCHEDULE

VIBRATION PRIMER

(Tuesday - Wednesday)

June 1-2 - Myrtle Beach, SC
September 28-29 - Charlotte, NC

DYNAMIC FIELD BALANCING

A HANDS-ON APPROACH (Tuesday - Thursday)

March 30 - April 1 - Charlotte, NC
July 27-29 - Myrtle Beach, SC
October 5-7 - Dallas, TX
Nov. 30 - Dec. 2 - Charlotte, NC

Balance Certification Test on Thursday Afternoon @ $150.

ENTRY LEVEL - VIBRATION ANALYSIS

A HANDS-ON APPROACH
(Tuesday - Thursday, ½ day Friday Testing)

January 19-22 - Charlotte, NC
February 9-12 - San Diego, CA
February 23-26 - Charlotte, NC
March 16-19 - San Francisco, CA
April 6-9 - Dallas, TX
April 27-30 - Philadelphia, PA
May 18-21 - Myrtle Beach, SC
June 1-4 - Denver, CO
June 8-11 - Myrtle Beach, SC
July 13-16 - Myrtle Beach, SC
August 3-6 - Myrtle Beach, SC
September 14-17 - Cincinnati, OH
October 12-15 - Dallas, TX
October 26-29 - San Diego, CA
December 7-10 - Charlotte, NC

ANALYSIS I

(Tuesday - Thursday, Class: ½ Day Friday Testing)

January 26-29 - Orlando, FL
February 16-19 - San Diego, CA
March 2-5 - Charlotte, NC
March 23-26 - San Francisco, CA
April 13-16 - Dallas, TX
May 4-7 - Philadelphia, PA
May 11-14 - Seattle, WA
May 25-28 - Myrtle Beach, SC
June 8-11 - Denver, CO
June 15-18 - Myrtle Beach, SC
July 20-23 - Myrtle Beach, SC
August 3-6 - Toronto, Ontario
August 10-13 - Myrtle Beach, SC
September 21-24 - Cincinnati, OH
October 5-8 - Charlotte, NC
October 19-22 - Dallas, TX
November 2-5 - San Diego, CA
November 9-12 - Richmond, VA
December 14-17 - Charlotte, NC

ANALYSIS II

(Tuesday - Thursday, Class: ½ Day Friday Testing)

February 2-5 - Orlando, FL
March 9-12 - Charlotte, NC
April 20-23 - Dallas, TX
May 18-21 - Seattle, WA
June 15-18 - Denver, CO
June 22-25 - Myrtle Beach, SC
July 27-30 - Myrtle Beach, SC
August 10-13 - Toronto, Ontario
August 17-20 - Myrtle Beach, SC
October 12-15 - Charlotte, NC
November 9-12 - San Diego, CA
November 16-19 - Richmond, VA
December 7-10 - Houston, TX

ANALYSIS III

(Tuesday - Thursday, Class: ½ Day Friday Testing)

March 16-19 - Charlotte, NC
May 25-28 - Seattle, WA
June 29-July 2 - Myrtle Beach, SC
August 24-27 - Myrtle Beach, SC
December 14-17 - Houston, TX

ADVANCED

(Monday 8am - Friday 1pm)

July 12-16 - Myrtle Beach, SC
October 18-22 - Charlotte, NC

APPLIED MODAL & ODS ANALYSIS

(Monday 8am - Friday noon)

August 16-20 - Myrtle Beach, SC

SEMINAR FEES

CLASS LEVEL	TUITION
VIBRATION PRIMER	$ 795
FIELD BALANCING	$ 995
ENTRY LEVEL	$1195
ANALYSIS I	$1395
ANALYSIS II	$1595
ANALYSIS III	$1795
ADVANCED	$1895
APPLIED MODAL/ODS	$1995

CERTIFICATION TESTING

Field Balancing is an additional $150
Entry Level (ISO CATEGORY I) thru Advanced (CATEGORY IV) is an additional $250

Discounts: A $100 discount will be given on the seminar fees for early payments or written purchase orders received at least 30 days prior to the seminar beginning date.

Cancellation Policy: No fee will be charged for any cancellations made ***two weeks prior*** to Seminar beginning date. Cancellations after this date, but before the Seminar begins will be charged a ***$250 cancellation fee***. No refund is available after the Seminar begins.

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2010 SEMINAR AGENDAS

FIELD BALANCING

DEFINITION OF UNBALANCE

TYPES OF UNBALANCE
- Static Unbalance
- Couple Unbalance
- Quasi-Static Unbalance
- Dynamic Unbalance

HOW TO ENSURE THE DOMINANT PROBLEM IS UNBALANCE
- Review of Typical Spectra and Phase Behavior for Unbalance as well as other Common Problems
- Summary of Normal Unbalance Symptoms

CAUSES OF UNBALANCE
- Assembly Errors
- Casting Blow Holes
- Fabrication Tolerance Problems
- Key Length Problems
- Rotational Distortion
- Deposit Buildup or Erosion
- Unsymmetrical Designs

DYNAMIC FIELD BALANCING TECHNIQUES

Numerous Hands-on Exercises:
- Recommended Trial Weight Size
- How the Phase Mark on a Rotor Moves When a Trial Weight is Moved
- Single Plane Balancing Using Vector Diagrams and Portable Data Collectors
- Two-Plane Balancing Using a Portable Data Collector
- Overhung Rotor Balancing
- Multi-Plane Balancing
- Splitting of Balance Correction Weights
- Combining Balance Correction Weights
- Effect of Angular Measurement Errors on Potential Unbalance Reduction

RIGID VERSUS FLEXIBLE ROTORS

RECOMMENDED BALANCING SPEED AND NUMBER OF PLANES

BALANCING MACHINES - SOFT VERSUS HARD BEARING TYPES

RECOMMENDED VIBRATION AND BALANCE TOLERANCES
- Vibration Tolerance Tables
- Balance Tolerances (ISO, API & MIL Standards) on Allowable Residual Unbalance

BALANCING CERTIFICATION TEST OFFERED ON THURSDAY AFTERNOON

OBJECTIVE

This course has 5 primary objectives: (1)Use many Hands-on Demonstrations to teach how to properly balance a variety of machinery using both graphical and electronic methods. (2)Teach Single-plane and Dual-plane field balancing techniques using a variety of today's data collector systems. (3)Teach special balancing techniques required on overhung rotors. (4)Instruct how to confirm unbalance is one of the dominant problems (using straightforward spectral & phase analysis). (5) Provide & clearly explain today's balancing tolerances. Many different analyzers are demonstrated.

PREREQUISITES

Previous field balancing experience is helpful, but is not required prior to taking the class. General familiarity with using today's data collectors or portable balancing instruments is also beneficial (a variety of such instruments will be demonstrated during interactive class exercises). Good math skills and the ability to use and interpret graphs and tabular information will be beneficial in order to maximize understanding.

ENTRY LEVEL

INTRODUCTION TO PREDICTIVE MAINTENANCE (PdM) AND MACHINE VIBRATION ANALYSIS
- Critical Role of Vibration Analysis in PdM

MACHINE VIBRATION - BASIC THEORY & ANALYSIS
- Characteristics of Vibration (Frequency & Period)
- Amplitude - Magnitude of Vibratory Motion
- RMS, Peak, & Peak-to-Peak Conversions
- Frequency - How Often the Vibration Occurs
- Phase - How one Machine Component or Support Frame Vibrates Relative to Another

PREPARATION FOR DATA COLLECTION
- Types of Vibration Transducers
- Effect of Transducer Mounting on its Performance, Accuracy & Repeatability
- Choosing the Optimum Transducer Location
- Choosing an Optimum PdM Data Collector

INTRODUCTION TO DATA COLLECTION SYSTEMS
- Setting Up a PdM Database (Plants, Trains, Machines, & Points)
- Choosing the Proper Parameter (Vibration Acceleration, Velocity and/or Displacement)
- Understanding Setup Parameters (#Lines, #Averages, Freq. Range, Window, %Overlap, etc.)
- Setting Up the Optimum PdM Routes & Intervals
- Printing Out the Proper Reports after Uploading

INTRODUCTION TO PROBLEM RECOGNITION
- How Common Machine Faults Appear in a Vibration Spectrum
- Basics of Reading a Spectrum (Identifies Peaks)
- Associating Spectral Patterns with Machine Condition and Certain Basic Faults
- Identifying Frequencies Inherent with Specific Machine Types

GENERAL MACHINE KNOWLEDGE
- Common Industrial Machinery (Motors, Pumps, Fans, Compressors, etc.)
- Optimum Measurement Locations

ENTRY (ISO Category I) CERTIFICATION TEST OFFERED ON FRIDAY MORNING

HANDS-ON DEMONSTRATIONS AND IN-CLASS EXERCISES WILL BE PROVIDED FOR STUDENTS TO ENHANCE THEIR UNDERSTANDING OF SEMINAR TOPICS. STUDENTS ARE ENCOURAGED TO BRING THEIR OWN ANALYZERS TO USE IN THESE DEMOS AND "BUTTON PUSHING" EXERCISES (IF THIS IS POSSIBLE).

OBJECTIVE

Introduce a novice to vibration analysis by imparting the understanding of various parameters used to measure vibration. This new understanding is solidified by having each student perform **Hands-on Exercises** using various vibration analyzers. It also introduces the novice to the analysis of vibration data by covering spectral pattern recognition of common machine problems. Additionally, the course orients new PdM supervisors & managers to implementation and capabilities of vibration plus teaches common terminology, measurement techniques, and PdM report interpretation.

PREREQUISITES

Little previous vibration experience will be required to take the class. However, no Vibration Analyst can truly be effective without some basic skills and previous experience in maintenance of the machines that will be included in the PdM Program. Take the "**Vibration Assessment Quiz**" at **www.technicalassociates.net** to help you decide if you should attend the Entry or the Analysis I Seminar. Students are strongly encouraged to bring their own analyzer for numerous hands-on exercises.

ANALYSIS I

REVIEW OF THE BASICS OF VIBRATION
- Comparison Between Frequency & Period
- What is Displacement, Velocity & Acceleration, and When & Why Should They Be Used?
- Relationship to Machinery Condition?
- How Phase Should Be Measured and its Results Evaluated to Detect Misalignment Versus Unbalance, Bent Shaft, Looseness, etc.
- How Much is Too Much Vibration?

OVERVIEW OF VIBRATION INSTRUMENTATION

ROLE OF HIGH FREQUENCY ENVELOPING (HFE) & HFD AND HOW THEY SHOULD BE USED

VIBRATION SIGNATURE ANALYSIS TO DIAGNOSE:
- Mass Unbalance
- Eccentric Rotors
- Bent Shafts
- Misalignment
- Mechanical Looseness (3 Types)
- Belt Drive Problems
- Introduction to Rolling Element Bearing Problems
- Introduction to Resonance Problem Detection
- Introduction to Electrical Problem Detection
- Introduction to Gear Problem Detection

PROPER SETUP OF PdM COMPUTER DATABASES:
- HOW TO SPECIFY THE PROPER VIBRATION PARAMETER, FREQ. RANGE, #FFT LINES, #AVERAGES, %OVERLAP, TRANSDUCER, TRANSDUCER MOUNTING, ETC.
- HOW TO SPECIFY SPECTRAL BAND ALARMS & FREQUENCY RANGES FOR VARIOUS MACHINE TYPES AND OPERATING SPEEDS

GENERAL MACHINE KNOWLEDGE
- Common Industrial Machinery (Motors, Pumps, Fans, Compressors, etc.)
- How these Machines Work

ACCEPTANCE TESTING
- Procedures and Standards

HOW TO IMPLEMENT AN EFFECTIVE PREDICTIVE MAINTENANCE PROGRAM (PdM)

REAL-WORLD CASE HISTORIES:

Provided to clearly illustrate the diagnostic methods taught in the seminar, using real-world machines that have been evaluated by Technical Associates.

LEVEL I (ISO Category II) CERTIFICATION TEST OFFERED ON FRIDAY MORNING

OBJECTIVE

Build upon knowledge equivalent to information obtained in the Entry Course. This class is intended to provide essential information for implementing a successful PdM program. Focus on how to detect the more fundamental machinery problems by using our **"Illustrated Vibration Diagnostics Chart".** Demonstrate a Documented **Procedure** on how (and why) to specify **Spectral Band Alarms** for a variety of machine types and operating speeds. Required F$_{max}$, #FFT Lines, #Averages & Proper Vibration Measurement Parameter for Various Machine Types and Operating Speed Ranges is Documented and Taught.

PREREQUISITES

Previous attendance of the Entry Level Class is recommended, or equivalent vibration analysis experience. If Vibration Certification is desired, a person with at least six months spectrum analysis experience is usually more successful. In addition, a good understanding of Arithmetic & some Algebra is helpful. Take the "**Vibration Assessment Quiz**" at **www.technicalassociates.net** to help you decide if you should attend the Entry or the Analysis I Seminar.

ANALYSIS II

INTRODUCTION TO NATURAL FREQUENCY TEST METHODS AND REQUIRED INSTRUMENTATION (Impact Testing, Coastdown, Bode' & Polar Plot Generation, & Dynamic Vibration Absorber Design)

ENHANCED VIBRATION DIAGNOSTICS USING CASCADE AND WATERFALL PLOTS

PRESENTATION OF A 210 PAGE PAPER COVERING TECHNICAL ASSOCIATES' WORLD RENOWN "Illustrated Vibration Diagnostics Wall Chart":

IN-DEPTH COVERAGE ON HOW TO DETECT THE FOLLOWING PROBLEMS:
- Resonance Problems
- Tracking of Rolling Element Bearing Condition
- Plain Bearing Problems
- Rotor Rub
- Flow-Induced Vibration Problems
- Gear Problems
- Electrical Problems With AC Induction Motors
- Introduction to DC Motor Vibration Analysis
- Beat Vibration Problems
- Soft Foot/Distorted Frame Problems

HOW TO REFINE BOTH OVERALL AND SPECTRAL BAND ALARMS USING STATISTICAL TECHNIQUES

INTRODUCTION TO NARROWBAND ENVELOPE ALARMS FOR VARIOUS MACHINE TYPES AND OPERATING SPEEDS

INTRODUCTION TO TIME WAVEFORM ANALYSIS TO DETECT A VARIETY OF MACHINE PROBLEMS

PRINCIPLES OF SIGNAL PROCESSING FOR RELIABLE SPECTRAL AND TIME WAVEFORM ANALYSIS AND MEASUREMENT SETUPS

INTRODUCTION TO HIGH FREQUENCY ENVELOPING (HFE) ANALYSIS

INTRODUCTION TO VIBRATION ISOLATION

INTRODUCTION TO VIBRATION DAMPING

GENERAL MACHINE KNOWLEDGE
- Process Machines and Other Equipment (Steam Turbines, Paper Machines, Rolling Mills, Piping & Structures, etc.)
- How These Machines Work

REAL-WORLD CASE HISTORIES

LEVEL II (ISO Category III) CERTIFICATION TEST OFFERED ON FRIDAY MORNING

OBJECTIVE

Build upon Analysis I topics while providing a solid foundation for PdM Program Setup on Common Rotating Machinery by: (1) Intensive Vibration Signature Analysis via Coverage of all 48 Faults on our **"Vibration Diagnostics Wall Chart"**; (2) Introduction to Time Waveform Diagnostic Analysis; (3) Refinement of Overall & Spectral Band Alarms; (4) Introduction to Natural Frequency Test Methods & Instruments; and (5) Introduction to High Frequency Enveloping (HFE) Spectral and Time Waveform Analysis.

PREREQUISITES

At least 1 to 2 years spectrum analysis experience is recommended. Also, if Vibration Specialist Certification is desired at Level II, a student should have previously passed a Level I Certification Test. Ensure that a scientific calculator capable of obtaining Sine, Cosine, 1/x, $\sqrt{x}$, x^2 is brought to class to be of assistance in class exercises, demos and Certification Testing.

ANALYSIS III

TIME WAVEFORM DIAGNOSTIC ANALYSIS
- Use of Waveforms to Detect Cracked or Broken Gear Teeth, Extensive Gear Wear, Rolling Element Bearing Faults, Motor Electrical Problems, Machine Tool Chatter, Misalignment, Unbalance, Looseness, Rotor Rubs, etc.
- Proper Setup of Time Waveforms for Fault Detection (#Samples, Sampling Time or t_{max}; Relationship of t_{max} with Frequency Range, etc.)

HOW TO ANALYZE LOW-SPEED MACHINES (PARTICULARLY 6 TO 120 RPM MACHINES)

HOW TO ANALYZE HIGH-SPEED MACHINES GENERATING FREQUENCIES OF 10,000-60,000 Hz (600,000-3,600,000 CPM)

HOW TO ANALYZE VARIABLE-SPEED MACHINES

HOW TO AND HOW NOT TO CREATE MEANINGFUL NARROWBAND SPECTRAL ENVELOPE ALARMS
- Definition of Narrowband Envelope Alarms
- Influence of Statistical Analysis
- Demonstration on How to & How Not to Create Meaningful Narrowband Alarms

INTRODUCTION TO MOTOR CURRENT SPECTRAL ANALYSIS TECHNIQUES & INSTRUMENTATION:
- Instruments & Transducers Required
- Comparison of Motor Current With Vibration Spectral Analysis
- Presentation of TAs ***"Motor Current Severity & Recommended Corrective Actions Chart"***

HOW TO DETECT PROBLEMS WITH DC MOTORS AND THEIR ELECTRONIC CONTROLS

DETECTION OF ELECTRICAL CONTROL PROBLEMS IN AC AND DC MOTORS (SCR'S, FIRING CARDS, COMPARITOR CARDS, ETC.)

DETECTION AND PREVENTION OF ELECTRICAL FLUTING IN AC AND DC MOTORS

OPERATING DEFLECTION SHAPE ANALYSIS USING COMPUTER ANIMATED SOFTWARE

IN-DEPTH HIGH FREQUENCY ENVELOPE (HFE) SPECTRAL & TIME WAVEFORM ANALYSIS USING A VARIETY OF TODAY'S ANALYZERS

REAL-WORLD CASE HISTORIES

ISO CATEGORY IV CERTIFICATION TEST OFFERED ON FRIDAY

OBJECTIVE

Begin Coverage of a Portion of Training Requirements for ISO Category IV as per the ISO 18436-2 Document. Build upon the topics provided in our Levels I & II classes. Give in-depth coverage on Low-Speed, High-Speed and Variable-Speed machines. Cover additional analysis techniques required by these machines including Time Waveform Analysis, Digital Order Tracking, Narrowband Spectral Alarm Generation, Amplitude Demodulation, and Motor Current Spectral Analysis. Demonstrate how (and why) special instrumentation and software is required.

PREREQUISITES

Students should have approximately 2 to 4 years spectrum analysis experience. It is recommended that students previously attend both ANALYSIS I and ANALYSIS II. Students desiring certification for Level III should have previously passed both Levels I and II Certification Tests. Analysis II is strongly recommended prior to Analysis III since Analysis II covers all problems on the Technical Associates **"Vibration Diagnostic Wall Chart".**

ADVANCED

IN-DEPTH TIME WAVEFORM ANALYSIS
- Synchronous, Nonsynchronous & Circular Waveform Diagnostics
- Autocorrelation Techniques

MULTI-CHANNEL DIAGNOSTIC TECHNIQUES

ORDER TRACKING TECHNIQUES REQUIRED ON VARIABLE SPEED MACHINES

HOW TO IDENTIFY RESONANCE
- Impact Natural Frequency Test Methods
- Transient Analysis (Start-up, Coastdown, Bode' and Nyquist Plotting)
- Cross Channel Phase, Coherence & Torsional Vibration Analysis
- Operating Deflection Shape Analysis & Applications

INTRODUCTION TO MODAL ANALYSIS
- Tips on Computer Model Development of Machinery and Structures
- Required Numbers of Points and Directions
- Definition of Frequency Response Functions (FRF's) and their Significance
- How to Accurately Interpret Computer Model Animations and Detect the Problems they Reveal
- Best Practices Needed to Resolve Resonance Problems
- Real-World Modal & ODS Case Histories

COMPARISON OF ODS ANALYSIS WITH MODAL ANALYSIS USING REAL-WORLD CASE HISTORIES

IN-DEPTH VIBRATION ISOLATION MECHANISMS

IN-DEPTH VIBRATION DAMPING TREATMENTS

INTRODUCTION TO ROTOR DYNAMICS NEW!
- Sleeve Bearing Types and Applications
- Sleeve Bearing Failure Analysis Techniques
- Rotor Characteristics and Rotor Balancing
- Orbit and Shaft Centerline Analysis
- Flexible Rotor Balancing

VIBRATION ANALYSIS OF SPECIAL MACHINE TYPES (Both Theory & Case Histories for Each Type):
- Including Centrifugal Pumps, Fans, Rotary Screw Air Compressors, Centrifugal Air Compressors, Single & Multi-Stage Gearboxes, AC and DC Motors

OBJECTIVE

This Newly Updated Seminar Completes Coverage of all Training Requirements for ISO Category IV Certification as per the ISO 18436-2 Document. (1)Provides In-Depth Coverage of **Special Diagnostic Techniques** required not only to Detect Numerous Faults on Machinery or Structures, but also gives real Insight on Fault Severity. (2)Follows with Fault Correction giving In-Depth **Vibration Reduction Techniques**. (3)Introduces Modal and Operating Deflection Shape Analysis. (4)Newly Developed section on Rotor Dynamics (including a Special Sleeve Bearing Failure Analysis paper) completes the Information an Analyst needs to Prepare for the new ISO Category IV exam.

PREREQUISITES

Students should have 5 to 8 years spectrum analysis experience. Prior experience with natural frequency testing, operating deflection shape analysis, phase analysis, time waveform analysis, synchronous time averaging techniques, and similar applications will help students to better comprehend the broad array of material presented in this information packed seminar.

APPLIED MODAL/ODS

OPERATING DEFLECTION SHAPE ANALYSIS (ODS)
- Definition of ODS Analysis and its Applications
- Required Number of Measurement Points & Directions
- Adjusting for Varying Speed & Load
- Checking for Reasonable Computer Animation Motion

ODS CASE STUDIES (Real-World)
- Structural Weakness & Flexure on a Paper Machine Support Frame
- ID Fan Frame & Bearing Pedestal Resonance
- Boiler Feedwater Pump Pedestal & Piping Flexure
- Vertical Pump Support Frame & Piping Resonance
- Soft Foot on a Belt Driven Fan

EXPERIMENTAL MODAL ANALYSIS (EMA)
- Definition of Modal Analysis & its Applications
- Definition of Mode Shapes & their Importance
- Mode Shape Type – Rigid Body, Bending, Twisting, Circular and Diametrical Mode Shapes
- Required Number of Measurement Points and Directions
- **Confirming not only that Resonance Exists, but also What Component is Resonant**

FREQUENCY RESPONSE FUNCTIONS (FRF'S)
- Definition of Frequency Response Functions (FRF's)
- Types of FRF's (Dynamic Compliance, Dynamic Stiffness, Mobility, Impedance, Accelerance & Effective Mass)
- Coherence Function - Importance in Ensuring Reliable and Quality Modal Results
- Use of Real or Imaginary Component for Plotting Mode Shapes of various Natural Frequencies
- Accurate Curve Fitting Methods
- How to Properly Interpret Modal Computer Animations

MODAL ANALYSIS CASE STUDIES (Real-World)
- Boiler Feedwater Pump Bearing Housing Resonance
- ID Fan Foundation & Bearing Pedestal Resonances
- Detection of Cracks on a Large Gearbox Due to Gearbox Housing Resonance
- Paper Machine Support Frame Resonance at Higher Operating Speeds
- Vertical Pump Main Support Plate Resonance

HANDS-ON ME'scopeVES SOFTWARE TRAINING USING TECHNICAL ASSOCIATES *"ME'scopeVES HANDBOOK"*

In-Depth Instruction on Vibrant Technology's **ME'scopeVES** Software on each of the following topics:
- ME'scopeVES Software Layout
- Creating a Structural or Machine Computer Model
- Work with Real-World Modal/ODS Data
- Importing Data from Various Instruments
- Modal Analysis Curve Fitting
- Animating & Accurately Interpreting Modal & ODS Computer Animations
- Structural Dynamics Modification Capability (SDM)
- How to Develop Optimum Corrective Actions NEW!

OBJECTIVE

This 4½-day seminar will focus upon **Applied** ODS & Modal Analysis and how they can be applied on real-world machinery and structures. Software instruction will likewise be given. Our "***ME'scopeVES Handbook***" includes 14 projects with many exercises to be completed by each student. These exercises demonstrate a wide variety of capabilities working with real data within this software. Data taken by Technical Associates on these Machines & Structures is likewise given to each student who learns to work with items such as FRF's, curve fitting, and generating & properly interpreting computer animations.

PREREQUISITES

Students should have 5 to 8 years spectrum analysis experience. Prior experience with natural frequency testing and ODS analysis will help students improve comprehension of the techniques taught. Laptop computer should be brought to the class to allow participation in numerous class exercises. Full capability **ME'scopeVES** software (deluxe version) will be loaded onto student computers, along with sample computer models and actual ODS & Modal data.

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VIBRATION PRIMER

What is Vibration And How Can It Be Used To Evaluate Machinery Condition ?

- What is a Vibration Spectrum? (Also Called an "FFT or Signature")
- When to use Displacement, Velocity or Acceleration
- How Much is Too Much Vibration?
- What is Overall Vibration?
- Understanding Phase and its Applications

Introduction To Vibration Instruments:

- Instrument Comparisons
- General Capabilities of Each Instrument Type

Overview Of Various Vibration Transducers And How To Properly Select Them:

- Types of Vibration Transducers and Their Optimum Applications
- Mounting of Transducers

Role of High Frequency Enveloping (HFE) and HFD In Detecting and Tracking Certain Faults

- Acceleration Enveloping, Amplitude Demodulation, PeakVue, Shock Pulse and Spike Energy
- How these HFE Tools Detect and Track Condition of Bearings, Gears, Lubrication, Cavitation and Related Faults
- Why HFE is Needed in Addition to Vibration in a PdM Program

Use of Vibration Signature Analysis To Diagnose Machine Problems

The Predictive Maintenance Program From The Manager's Perspective:

- Predictive Maintenance Conceptual Overview
- Maintenance Program Levels - Descriptions, Objectives and Goals
- Justification, Costs and Savings
- Personnel Qualifications
- Training Required for PdM Team Members
- Advice to Those Beginning a Program

Philosophical Guidelines For Gleaning The Most From A Plant's Investment In PdM Technologies:

- Reliability Based, Proactive Maintenance
- Benchmarking an Existing PdM Program
- Quality Applied to Predictive Maintenance

Setup And Implementation Of A Predictive Maintenance Program:

- Selecting a PdM Team
- Selecting PdM Monitoring Techniques
- Establishing Alarms
- Set Up PdM Database
- Collect Baseline Measurements and Adjust Alarms
- Compile PdM Reports and Store Data
- Followup Surveys at Fixed Intervals
- Perform Vibration Signature and/or Phase Analysis
- Correct Faults and Document
- Training Needed to Prepare PdM Team
- Monitoring Effectiveness of the PdM Program

Reading and Understanding PdM Reports

OBJECTIVE

This two day course is a proven benefit to managers, engineers, schedulers and supervisors considering establishing or currently involved in vibration condition monitoring programs. It is intended to give non-practitioners the knowledge and insight needed to manage, support, or interact with analysts & technicians involved in a condition monitoring program.

PREREQUISITES

No prior experience in vibration analysis or condition monitoring is required. The purpose of this seminar is to introduce the student to each of these techniques and to effectively communicate with the PdM Team Members.

LITERATURE

Technical Papers

COMPREHENSIVE TEXT PROVIDING IN-DEPTH COVERAGE OF EACH OF THE MACHINE PROBLEMS PRESENTED IN THE **ILLUSTRATED VIBRATION DIAGNOSTIC WALL CHART**
$199 - DWD-4 *(163 PAGE BOOKLET)*

DESCRIPTION OF PEAKVUE & ILLUSTRATION OF ITS WIDE ARRAY OF APPLICATIONS IN FAULT DETECTION & PROBLEM SEVERITY ASSESSMENT
$99 - PKV-1 *(95 PAGE BOOKLET)*

PROVEN METHODS FOR SPECIFYING SPECTRAL ALARM BANDS USING TODAY'S PREDICTIVE MAINTENANCE SOFTWARE SYSTEMS - 4th EDITION
$79 - SAB-4 *(57 PAGE BOOKLET ONLY)*

HOW TO AND HOW NOT TO CREATE MEANINGFUL NARROWBAND SPECTRAL ALARM ENVELOPES 2nd EDITION
$79 - SAE-1 *(53 PAGE BOOKLET)*

VIBRATION ACCEPTANCE STANDARDS USING BandAid SOFTWARE
$99 - VAS-1 *(60 PAGE BOOKLET INCL. 5-PAGE DIAG. CHART)*

TRACKING OF ROLLING ELEMENT BEARING FAILURE STAGES USING VIBRATION SIGNATURE ANALYSIS
$79 - REB-1 *(90 PAGE BOOKLET)*

REQUIRED VIBRATION ANALYSIS TECHNIQUES AND INSTRUMENTATION ON LOW-SPEED MACHINES (PARTICULARLY 10 TO 300 RPM MACHINERY)
$79 - LSM-1 *(95 PAGE BOOKLET)*

REQUIRED VIBRATION ANALYSIS TECHNIQUES AND INSTRUMENTATION ON HIGH-SPEED MACHINES (PARTICULARLY AT FREQS.>10,000 Hz OR 600,000 CPM)
$59 - HSM-1 *(33 PAGE BOOKLET)*

HOW TO ANALYZE VARIABLE-SPEED MACHINES AND INCLUDE THEM IN A CONDITION MONITORING PROGRAM
$59 - VSM-1 *(19 PAGE BOOKLET)*

HIGH FREQUENCY ENVELOPING AND DEMODULATION TECHNIQUES USING VARIOUS TYPES OF DATA COLLECTORS AND SOFTWARE
$59 - HFE-1 *(60 PAGE BOOKLET)*

HOW TIME WAVEFORM ANALYSIS AND TRUE SYNCHRONOUS TIME AVERAGING CAN BE USED TO EFFECTIVELY EVALUATE MACHINES WHICH HAVE PROBLEMS NOT NECESSARILY DETECTABLE BY FFT ANALYSIS ALONE
$59 - TWA-1 *(29 PAGE BOOKLET)*

DIAGNOSTIC TESTS AND INSTRUMENTATION REQUIRED FOR NATURAL FREQ. PROBLEM DETECTION AND CORRECTION
$79 - NFT-1 *(60 PAGE BOOKLET)*

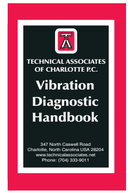
COMPARISON OF MOTOR CURRENT ANALYSIS AND VIBRATION ANALYSIS IN DETECTING ROTOR BAR AND AIR GAP ECCENTRICITY PROBLEMS IN INDUCTION MOTORS
$49 - MCA-1 *(31 PAGE BOOKLET)*

DC MOTOR & CONTROL PROBLEM DETECTION USING VIBRATION ANALYSIS
$59 - DCM-1 *(28 PAGE BOOKLET)*

HOW TO EFFECTIVELY DIAGNOSE PROBLEMS WITHIN ROTARY SCREW AIR COMPRESSORS USING VIBRATION AND HIGH FREQUENCY ENVELOPING ANALYSIS (2nd Edition)
$129 - RSC-2 *(138 PAGE BOOKLET)*

HIGH-SPEED CENTRIFUGAL AIR COMPRESSOR DIAGNOSTICS
$39 - CAC-1 *(15 PAGE BOOKLET)*

Pocket Diagnostic Wall Chart



Diagnostic Wall Chart Products

INTERACTIVE VIBRATION DIAGNOSTIC WALL CHART
$199 - IVDC-1 (CD-ROM)

ILLUSTRATED VIBRATION DIAGNOSTIC WALL CHART
$99 - DWC-4 *(LAMINATED 38" x 52" WALL CHART)*
$99 - DWCSP-4 *(WALL CHART SPANISH VERSION)*

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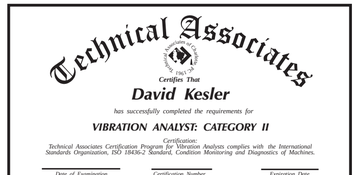
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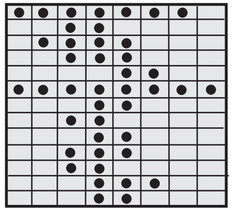

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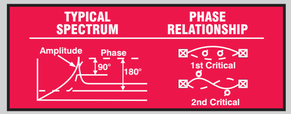

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