BAKER HUGHES
a GE company

Bently Nevada™

Technical Training

A WORLDWIDE PARTNER FOR OPERATIONAL EXCELLENCE

With more than 40 years of technical training experience, Baker Hughes, a GE company (BHGE) has pioneered the art of long-term skill development. All BHGE product training is conducted by our core group of instructors and experienced Field Engineers to provide a world-class training experience. BHGE offers comprehensive hands-on courses designed to help you protect and manage your machinery. Our training techniques are proven and we have strong regional expertise throughout North America with courses held at our training centers in Houston, Texas, and Minden, Nevada.

We provide a training curriculum and consulting services for applications involving all facets of power generation, mechanical drives, and petrochemical industries. Our services include needs and gap analysis, objective development, and skills-based training solutions. BHGE technical training programs provide you the knowledge and skills required to optimize the performance of your equipment and technology. Overall, our training maximizes your return-on-investment by ensuring machinery availability and reliability, avoiding unplanned events, and limiting disruption risks and costs.

WHAT WE OFFER

- Two state-of-the-art technical training centers
- 15 training modules
- A pool of over 12 certified full and part time Instructors
- Option to conduct training at customer sites upon request
- Training on new and legacy Bently Nevada products and solutions
- Actual equipment and software used in labs
- Fully equipped dedicated training rooms
- Individual technical documentation

POWER UP YOUR KNOWLEDGE

BHGE training centers provide a full range of training in Bently Nevada solutions. These courses encompass all aspects from fundamentals to in-depth solution knowledge and are based on several value-added pillars.

EXPERIENCE from our field engineers and technical experts. With more than 40 years of technical training experience, BHGE has pioneered the art of long-term skill development.

TECHNICAL EXPERTISE with over 12 full and part-time experienced trainers in North America. Our team combines product installation, operation, maintenance, or engineering experience with technical expertise, proven teaching skills, and a commitment to knowledge transfer.

HANDS-ON WORKSHOPS to guarantee operational excellence and to ensure training combines theory and practice. Workshops include practice with 'live' monitors and racks. Class sizes are kept small to ensure that students have the opportunity to fully explore the capabilities of the system. As a result, it will help you protect your machinery.

CUSTOMIZED TRAINING to fit with your needs and enhance your team's performance. With 15 training modules you will find the courses adapted to your trainees' knowledge level and objectives. A training curriculum can be developed, including needs and gap analysis, objective development, and skills based training solutions.

UP-TO-DATE MATERIAL to optimize learning. Course content and workshops are continually revised to reflect latest technologies, experience and local regulatory standards.

NORTH AMERICAN TRAINING CENTERS

BHGE
4425 Westway Park Blvd.
Houston, TX 77041

BHGE
1631 Bently Parkway South
Minden, NV 89423

Global Training : Global Training Center Schedule

Training Inquiries: BNTraining.NA@ge.com

For on-site training inquiries or pricing, please contact:

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Baker Hughes, a GE company

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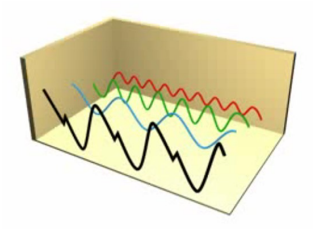
OUR COURSES



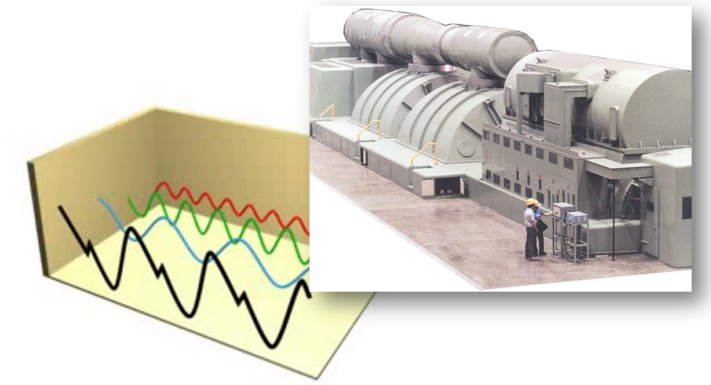
BASICS

SYSTEMS & INSTRUMENTATION

MACHINERY DIAGNOSTICS

LEGACY PORTABLE DATA COLLECTION

Introduction to Vibration for Continuous Monitoring



ITV-CM

Duration

2 Days

Cost: $1,800 per person (Training Centers only)

Audience

- Technicians with limited experience on vibration machinery
- Technicians working on vibration control with condition monitoring program
- Engineers involved in condition monitoring
- Technicians in preventive maintenance

Objectives

- Explain the reasons for vibration monitoring and maintenance strategies.
- Learn key components and describe vibration motion in a measurement plane.
- Define the parameters used to measure vibration motion and state the units used to express each parameter.
- Describe the principles of vibration transducer operation, the benefits and disadvantages of each type, and typical scale factor of output signal. Apply selection criteria to choose a useable vibration transducer for a specific machine vibration.
- Read values of amplitude, frequency, phase and recognize sources of vibration indicated by waveform and spectrum plots.

Program

- Machinery monitoring: history, benefits, and strategies. Typically monitored machines and considerations
- Basic vibration concepts: definition of vibration, understanding relationships of vibration displacement, velocity, acceleration, units of amplitude and vibration amplitude in analysis
- Defining frequency, units of frequency, and meaning of frequency in analysis, defining phase and measuring relative and absolute phase, understanding natural frequencies
- Vibration transducers: theory of accelerometer operation, theory of Velomitor operation, theory of Proximity Transducer System operation
- Workshops identifying amplitude, frequency and phase from timebase and spectrum plots.
- Workshops for transducer and monitoring systems for given machine scenarios

Learning Path

Prerequisites

New to condition monitoring and control of machinery

ITV-CM

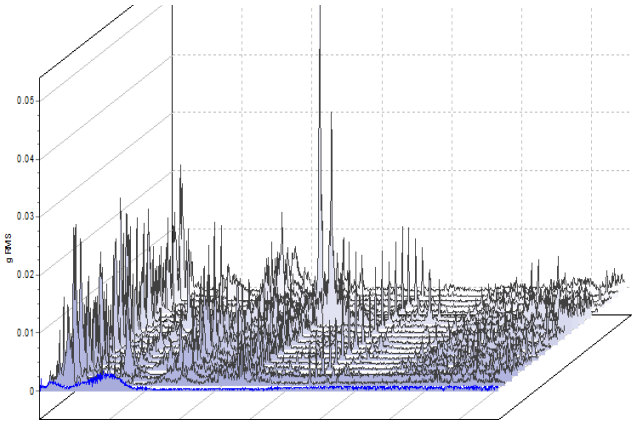
Next steps

- System and Instrumentation courses
- Machinery Diagnostics courses

BENEFITS

Master the basics of measurement, parameters, monitoring approach, and use of transducers

Introduction to Vibration for Portables



ITV-P

Duration

2 Days

Cost: $1,800 per person (Training Centers only)

Audience

- Technicians with limited experience on vibration machinery
- Technicians working on vibration control using a portables program
- Engineers involved in condition monitoring
- Technicians in preventative maintenance

Objectives

- Explain basic vibration principles and terminology.
- Identify key components and describe vibration motion in a measurement plane.
- Define the parameters used to measure vibration motion and state the units used to express each parameter.
- Explain how specific machinery faults are detected.
- Read values of amplitude, frequency, phase and recognize sources of vibration indicated by waveform and spectrum plots.

Program

- Types of maintenance and pros/cons of each type
- Types of maintenance and pros/cons of each type
- Ways to increase reliability
- Basic description of vibration analysis
- Charts
- Scales
- Units of vibration
- FFT process
- Trending/spectral/continuous analysis
- Synchronous/nonsynchronous/sub-synchronous vibrations
- Understanding patterns of vibration
- Load zones to increase reliability
- Ranges, resolutions and averages
- Points and markers
- Transducers
- Safety
- Setup parameters
- P/F curve
- 4 key elements
- 12 steps for success
- Advice and examples from the field

Learning Path

Prerequisites

New to condition monitoring and control of machinery

ITV-P

Next steps

- System and Instrumentation courses
- Machinery Diagnostic courses

BENEFITS

Master the basics of measurement, parameters, monitoring approach and use of transducers.

3500 Operation & Maintenance

Duration

3 Days

Cost- $2,300 per person (Training Centers only)

Audience

- 3500 monitoring system users
- Engineers who maintain and troubleshoot the 3500 monitoring system
- Instrument technicians

3500OM

Objectives

- Explain the role of 3500 Monitoring System in machinery monitoring and protection.
- Identify installation conditions that affect the correct operation of proximity transducer systems.
- Test monitor alarms and verify channel values in a radial vibration monitor.
- Use BHGE propriety configuration software to configure, verify, and troubleshoot the 3500 monitor system.
- Troubleshoot the 3500 monitor system and associated transducers using software and hardware techniques.

Program

- Overview of the 3500 Monitoring System
- 3300 Proximity Transducer system operation
- 3500 Monitor System support components
- TDI/RIM hardware connections and communications
- Power supply, TDI/RIM, and Keyphasor configuration
- Radial vibration
- Thrust position
- Relays
- 3500 System utilities
- 3500/92 Communications Gateway (Optional)
- Troubleshooting the 3500 System

Learning Path

Prerequisites

Introduction to Vibration for Continuous Monitoring

3500OM

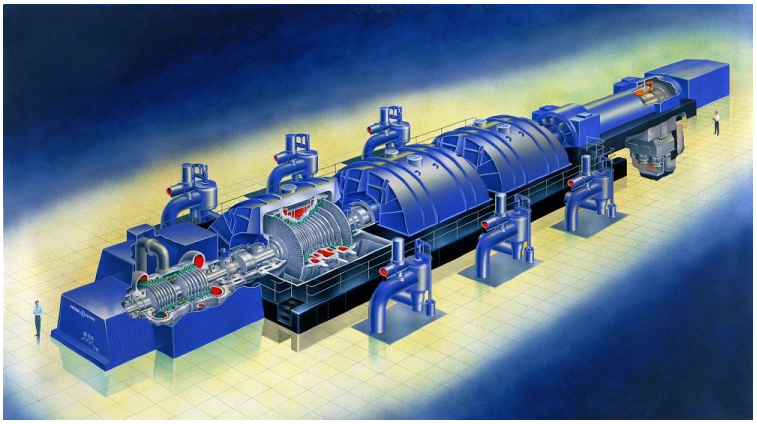
Next steps

System 1*

BENEFITS

Practice with 'live' monitors and racks

3500 Operation & Maintenance-TSI



3500TSI

Duration

2 Days

Cost- $1,800 per person (Training Centers only)

Audience

- 3500 monitoring system users
- Engineers who maintain and troubleshoot the 3500 monitoring system
- Instrument technicians

Objectives

- Explain the operational differences between the 8mm, 25mm, 35mm, and 50mm probes.
- Demonstrate the proper technique to install and verify the scale factor for an LVDT for Case Expansion or Valve Position while verifying at the 3500 system for accuracy.
- Explain and show mathematically the voltages required for installing Differential Expansion probes and verify at the 3500 system.
- Explain and show mathematically the voltages required for installing the Eccentricity probe and verify at the 3500 system.
- Explain the proper procedure for installing Keyphasor and Rotor speed/Rotor Acceleration probe.
- Connect field wiring for specific input signals to the 3500 Monitoring System and verify signals.

Program

- Review of the 3500 Monitoring System
- 3300 Proximity Transducer System (11mm, 25mm, 50mm probes) and LVDT operation
- Eccentricity
- Rotor speed and acceleration
- Differential expansion (complimentary and ramp)
- Case expansion

Learning Path

Prerequisites

Introduction to Vibration for Continuous Monitoring

3500OM

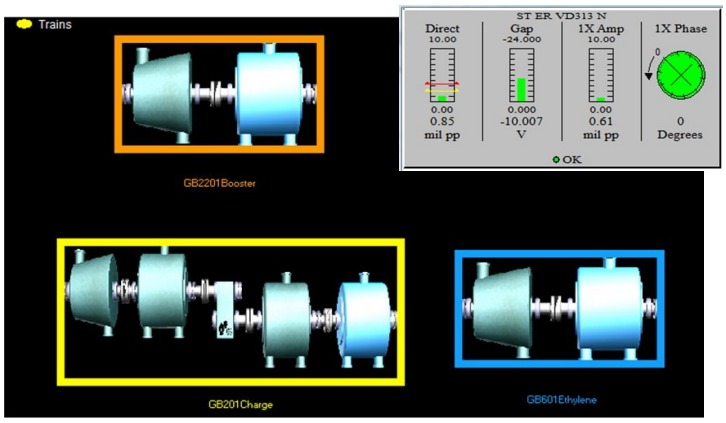
Next steps

System 1* Version 6 (Classic) or System 1* for Turbo or Portables

BENEFITS

Practice with 'live' monitors and racks

System 1* Version 6 (Classic)



S1FU

Duration

3 Days

Cost: $2,300 per person (Training Centers only)

Audience

- System 1* Version 6 platform users
- Reliability engineers
- Condition monitoring engineers
- Engineers involved in preventive maintenance

Objectives

- Use various System 1* software tools and plots to detect subtle changes in asset condition.
- Retrieve and display data in bar graphs and various plot formats.
- View alarms and events in the event manager.
- Enter observations and notes with the journal editor. Use DOCUVIEW* to create links to various reference documents.
- Create reports on monitored plant assets.
- Gain a practical understanding of how our communication processors such as TDI or TDXnet™ collect transient data.

Program

- System 1* overview
- Viewing information with System 1* display
- Event Manager and Asset Active Alarm in System 1* display
- Customizing trend plots
- Vibration signal fundamentals
- Introduction to plot sessions and plot groups
- Working with plot sessions and plot groups
- Shaft centerline plots
- Plotting dynamic data and using collection groups
- Collecting data in transient mode
- System 1* asset information storage
- System 1* administrative tasks

Learning Path

Prerequisite

Introduction to Vibration for Continuous Monitoring

S1FU

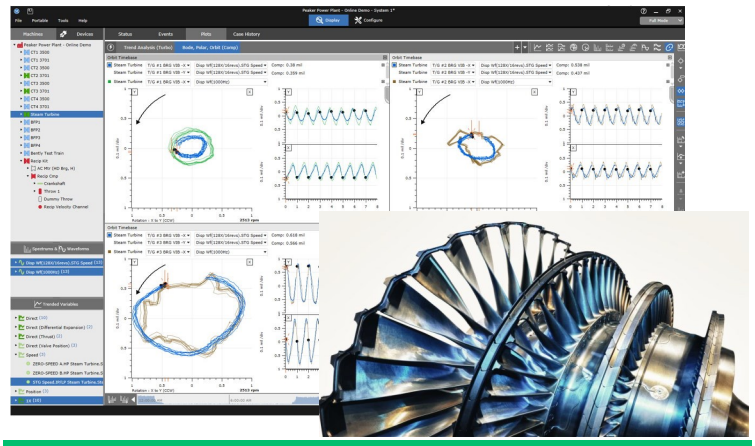
Next steps

Machinery Diagnostics courses

BENEFITS

Practice on efficient use of the platform to support decision making.

System 1* for Turbo Machinery



S1EVOT

Duration

3 Days

Cost: $2,300 per person (Training Centers only)

Audience

- System 1* Platform users
- Reliability engineers
- Condition monitoring engineers
- Engineers involved in preventive maintenance

Objectives

- Connect to an Enterprise to view data.
- Check for alarms of a certain severity through event manager and create alarm plots of the latest events.
- Use status screens to find bad actors and using alarm plots to look for trend and data correlations at train, machine and bearing levels as well as point in alarm data.
- Use Quick plots to further investigate reason for alarm. Create a base line from first sample and overlay in spectra and time base.
- Generate waterfall plots on points and dynamic data of interest.
- Generate Quick report of the findings in a word document on at least one machine problem.

Program

- Creating a database
- Data analysis and diagnostics
- Creating templates
- Analyzing collected data (Turbo)
- Using Quick Plots
- Collecting reference data
- Compensating plots
- Status, alarms and reports
- Database manager
- Collecting transient data
- Analyzing collected data
- Faults and alarms
- Security Manager

Learning Path

Prerequisite

Introduction to Vibration for Continuous Monitoring

S1EVOT

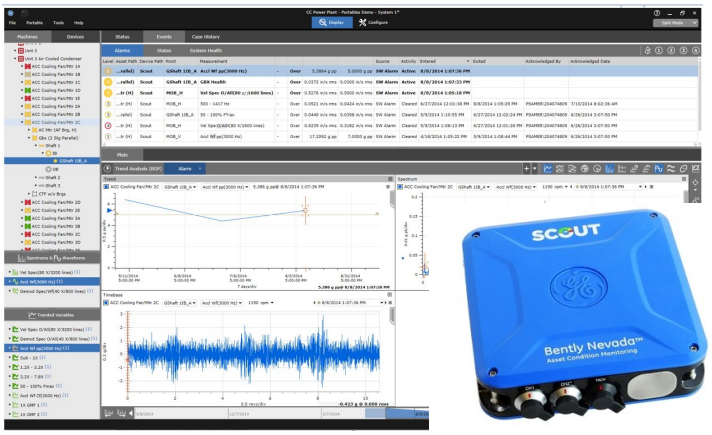
Next steps

Machinery Diagnostics courses

BENEFITS

Practice workshops at each step of the course

System 1* for Portables



S1EVOP

Duration

3 Days

Cost: $2,300 per person (Training Centers only)

Audience

- System 1* Platform users
- Reliability engineers
- Condition monitoring engineers
- Engineers in preventive maintenance

Objectives

- Explain portable data measurement.
- Use the Scout or Vb instrument to collect data and then send to System 1*.
- Use the Status tab and Plots tab to analyze the collected data.
- Analyze faults and alarms.
- Manage access through the Security Manager.

Program

- Asset building
- Instrumentation
- Route building
- SCOUT
- Data collection – SCOUT 100/Vb Series
- Analyzing collected data
- Faults and alarms
- 6 Pack and individual points (with optional Rack Buffered Outputs)
- Database Manager
- Creating templates
- Remote communication

Learning Path

Prerequisite

Introduction to Vibration for Portables

S1EVOP

Next steps

Machinery Diagnostics courses

BENEFITS

Practice workshops at each step of the course

Adre 408 DSPi/Sxp

ADREFU

Duration

3 Days

Cost: $2,300 per person (Training Centers only)

Audience

- Adre 408 Users
- Portable data collectors
- Condition monitoring engineers
- Engineers in preventive maintenance

Objectives

- Configure ADRE system to collect machinery data.
- Acquire data effectively for real-time analysis.
- Display vibration and other data types using various plot types for machine condition analysis.
- Edit, document, and store databases for future use.

Program

- Overview and introduction
- Using the Front Panel
- Communication and networking
- Vibration fundamentals
- Planning data sampling
- Basic sampling
- Static data plotting
- Signal processing
- Dynamic data plotting
- Advanced sampling
- Using the ADRE 408 Replay Card
- Collecting and replaying raw continuous data
- Sharing and exporting data
- Advanced utilities

Learning Path

Prerequisites

Introduction to Vibration for Continuous Monitoring

ADREFU

Next steps

Machinery Diagnostics

BENEFITS

Proficiency in advanced database manipulation tools

Machinery Diagnostics

MD

Duration

5 Days

Cost- $3,500 per person (Training Centers only)

Audience

- Engineers who interpret machine vibration and position data to determine machine condition
- Engineers who design, test, and maintain rotating machinery
- Engineers who want to learn about machinery vibration diagnostics

Objectives

- Explain how the fundamentals of machine design and behavior are reflected in the vibration measurements.
- Reduce machine vibration data into usable plot formats. Determine plot formats are best to use in the different stages of machine diagnostics.
- Describe the causes, affects, and indicators of the typical machine malfunctions; including recognition of problems such as unbalance, misalignment, rubs, shaft cracks, and fluid induced instabilities.

Program

- Introduction to machinery management and diagnostics
- Phase measurements
- Steady state data formats
- Fundamental synchronous rotor response
- Single plane balance response
- Transient data formats
- Plot interpretation
- Multiplane balance response
- Partial radial rubs
- Preloads and radial position measurements
- Vibration types and resonances
- Fluid-induced instabilities
- Shaft crack detection
- Case history workshop

Learning Path

Prerequisites

Introduction to Vibration for Continuous Monitoring or Portables

MD

Next steps

- Machinery Applied Diagnostics Workshops
- Advanced Machinery Dynamics

BENEFITS

Master the fundamentals and gain confidence in operational decision making

Reciprocating Compressor Condition Monitoring & Diagnostics

RECIP

Duration

3 Days

Cost: $2,300 per person (Training Centers only)

Audience

- Engineers who want to learn about reciprocating compressor components and mechanics
- Engineers who want to understand reciprocating compressor performance theory
- Engineers who interpret reciprocating compressor vibration and analyze malfunctions
- Engineers involved in design, acceptance testing, and maintenance of reciprocating machinery.

Objectives

- Describe the compression process and interpret vibration readings of reciprocating compressors.
- Relate reciprocating compressor components to various failure modes.
- Recognize and select plots used to assess the health of reciprocating compressors and interpret PV Plots.
- Calculate rod load conditions (reversal).
- Discover the full application and benefits of rod position instead of rod drop measurements.
- Conduct a compressor vibration analysis

Program

- Basic elements of reciprocating compressors
  - ♦ Compressor overview
  - ♦ Reciprocating compressors in industry
  - ♦ Components and nomenclature
  - ♦ Lubrication systems
  - ♦ Compressors types
- How to monitor a reciprocating compressor
- Vibration and pressure measurements
- Plots used to evaluate reciprocating compressor heath
- Monitoring strategies
- Reciprocating compressor diagnostics:
  - ♦ Crosshead and frame vibration
  - ♦ Pressure monitoring and diagnostics
  - ♦ Rod load and rod reversal
  - ♦ Reciprocating compressor capacity control and the impact on vibration pressure monitoring
- Rod position and rod drop analysis
- PV analysis of multistage compressors
- Workshops and presentation of case histories

Learning Path

Prerequisites

Basic understanding of reciprocating compressor construction, nomenclature, and operation

RECIP

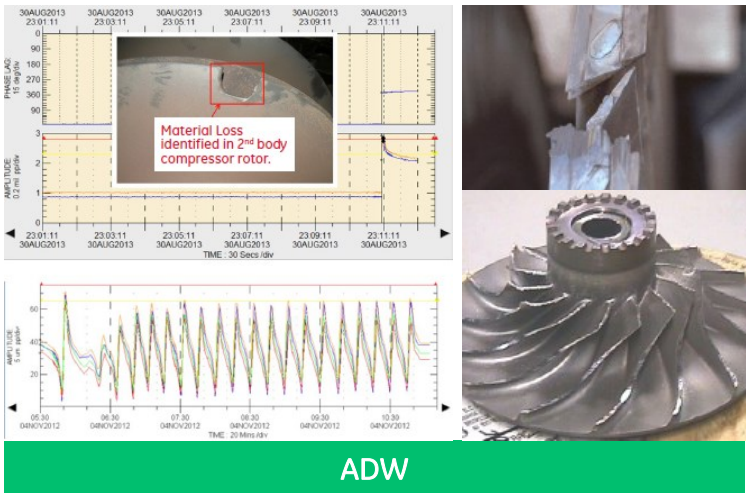
Next steps

Machinery Diagnostics

BENEFITS

Understanding reciprocating machines and working with actual archives to diagnose machine problems

Applied Diagnostics Workshops



ADW

Duration

5 Days

Cost: $3,500 per person (Training Centers only)

Audience

- Engineers and technicians who analyze and interpret vibration data
- New machinery diagnosticians seeking knowledge and confidence
- Experienced diagnostics people seeking additional insight needed to efficiently solve complex machinery problems

Objectives

- Practice on different rotating machine types and review of typical malfunctions associated.
- Analyze actual machine case histories using System 1* or ADRE databases.
- Organize data in plot formats believed to be indicative of the machinery fault.
- Present conclusions and make recommendations to solve complex machinery problems.
- Identify typical malfunctions and conduct diagnosis on real machine data from the field.

Program

Covered Malfunctions

- Unbalance
- Lose parts
- Preload and misalignment
- Instability
- Shaft crack
- Rub
- Thermal unbalance
- Coupling lockup
- ESD...

Machinery Cases

- Steam turbines
- Gas turbines
- Motors
- Centrifugal compressors
- Generators
- Exciters
- Gear boxes
- Pumps
- Fans

Learning Path

Prerequisites

Machinery Diagnostics

ADW

Next steps

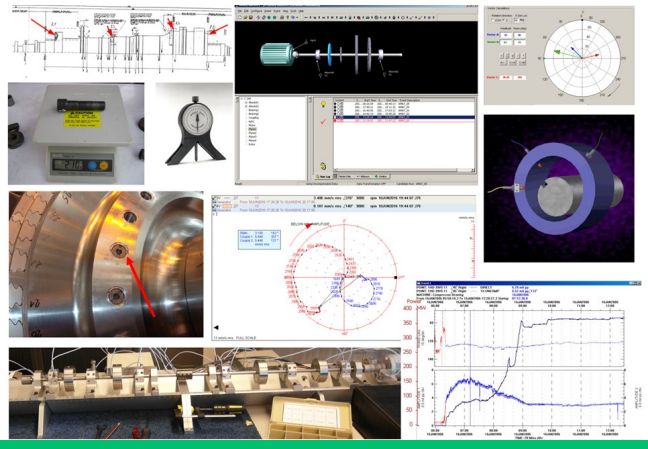
Advanced Machinery Dynamics

BENEFITS

Customized training according to equipment

Knowledge in System 1* or ADRE systems

Advanced Field Balancing



AFB

Duration

3 Days

Cost: $2,300 per person (Training Centers only)

Audience

- Machinery diagnosticians
- Startup engineers
- Remote diagnostic center specialists

Objectives

- Conduct effective balancing of machine trains in the field: calculation of trials, evaluation of results, and decision making.
- Select a strategy that ensures minimum disruption costs and proper data quality.
- Use calculation tools the most applicable to situation, evaluate inputs and outputs and recalculate between balancing methods and data conventions.
- Effectively supervise solution weights installation and troubleshooting data integrity problems using a deeper understanding of the balancing process.

Program

- Fundamentals
  - Unbalance and other malfunctions with similar symptoms
  - Make the decision, select the strategy
  - Ensure the repeatability and minimize non-linearity
- Trial weight calculations
- Basic calculations and conventions
  - Vector operations
  - Locating the position of unbalance
  - Finding angular location on a rotor
- Single Plane Balancing with Workshop
- Static/Couple Balancing with Workshop
- Influence Vector Method (multiplane) Balancing
- Bently Balance™
  - Introduction and data acquisition process
  - Configuration and importing data
  - Calculations and solution evaluation
  - Workshop: balancing in two planes, using Bently Balance*
- Relation between static/couple and influence vector methods
- Workshop: influence vectors - import, export, recalculation between methods
- Balancing for compromise conditions.
- Evaluation of balancing quality, balancing report
- Workshop/Examination – multiple planes balancing

Learning Path

Prerequisites

Machinery Diagnostics

AFB

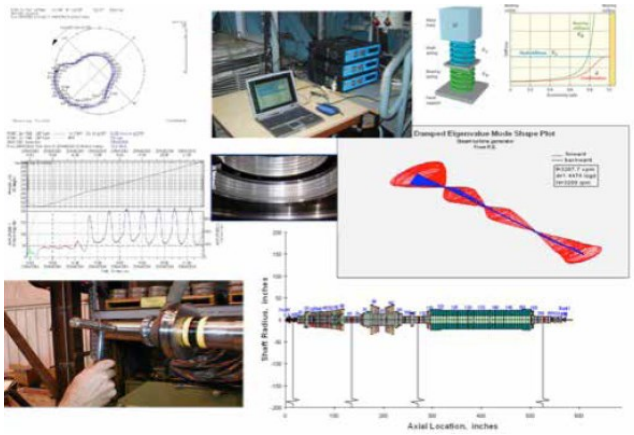
Next steps

Advanced Machinery Dynamics

BENEFITS

Understand balancing methods and gain confidence with hands-on practice

Advanced Machinery Dynamics



AMD

Duration

5 Days

Cost: $3,950 per person (Training Centers only)

Audience

- Engineers who want to advance their machinery vibration diagnostics skills
- Engineers who design, test, and maintain rotating machinery
- Academic researchers and professors in the field of rotor dynamics
- Post-graduate engineering participants

Objectives

- Use rotor modeling, actual machine data and case histories.
- Recognize, explain, and account for effects of more complex rotor dynamics interaction of modes, mode shapes, thermal changes, bearing design, torsional vibration, and structural modes.
- Explain critical speed and its impacts on resonances and natural frequencies.
- Discuss mode shape, undamped/damped modes, and effects of bearing characteristics.

Program

- Rotor Modeling as a Machinery Diagnostics Tool
- Rotor Model
- Bearing Design (Fluid bearings and Magnetic bearings)
- Balancing Machines
- Rotor to Stator Rubs
- Diagnose and Control of Fluid Induced Instabilities
- Shaft Cracks
- Signal processing
- Tortional Vibration
- Impact Testing and Analysis

Includes real-life demonstration and 25 case studies.

Learning Path

Prerequisites

Machinery Diagnostics

AMD

Next steps

BENEFITS

Extend knowledge on machinery diagnostic techniques and rotor dynamics for rotating machinery

Implementation Success Training

IST

Duration

2 Days

Cost: $1,350 per person (Training Centers only)

Audience

- Engineers seeking to learn about portable data collection.
- Engineers starting a new portable vibration program
- Engineers who interpret waveform, spectral and demodulation data to diagnose machinery health
- Engineers who create or receive reports generated from Ascent* software

Objectives

- Load the Ascent software on training lab computers.
- Build a database and routes.
- Communicate with the Vb analyzers.
- Collect data.
- Communicate actual data back into the Ascent software
- Manipulate data using charts, views, and reporting.

Program

Overview

Building structure in your database

- Manual creation using toolbar
- Description of each level as it is created
- Site/folder/machine/point/location/ schedule entry (pset)/alarm bands
- Proven Method (Machine-Building Wizard)

Details about structure

- Alarms – alarm templates
- Order-based alarms, psets
- Speed
- Route

Basic SW functions

- Library
- Export/import
- Speed changes
- Psets – editing parameters sets “globally”

Communications to the vb

- Overview of SEND/RECEIVE
- What is sent to the vb

Hardware – (Scout instrument)

- Options/Folders
- Route collection
- Record/review collection and display of data

Learning Path

Prerequisites

Introduction to Vibration for Portables

IST

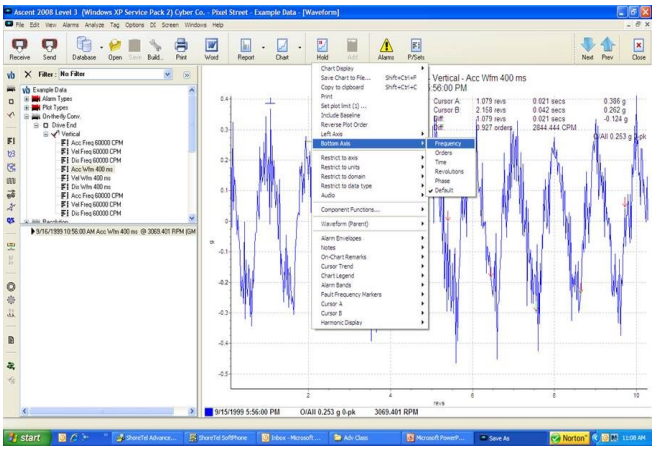
Next steps

- Advanced Ascent
- Balancing

BENEFITS

Hands-on workshops configuring databases and navigating the Ascent software

Advanced Ascent



AA

Duration

3 Days

Cost: $2,000 per person (Training Centers on-

Audience

- Engineers who want to learn about statistical alarming
- Engineers looking to understand the deeper capabilities of Ascent software
- Engineers who want to create custom views and reports within Ascent
- Engineers seeking to optimize their vibration analysis program

Objectives

- Explain how to work with databases.
- Identify fault frequencies.
- Manipulate data.
- Create reports.
- Describe basic database management principles and practices.
- Review hardware options, measurements, and routes.

Program

- Working with databases
  - Variable speed applications
  - Multi-shaft applications
  - Template machines
  - Alarms
    - Alarm templates
    - Statistical
    - Machine families
    - Envelope
- Fault Frequencies- User Defined, Bearing, Gear
- Schedule Entries- Keypad, Attached File
- Data Manipulation
- Customized view/charts
- Review
  - Fault frequency display
  - Cursors, axes, notes, chart annotation
- Fault frequencies
- Reporting
- Database Management
- Data thinning
- Cleanup utilities
- Backup/restore
- Rebuild
- Hardware
  - Review of folder, options, and routes
  - Measure

Learning Path

Prerequisites

- 6 months of field experience
- IST

AA

Next steps

- Balancing
- Machinery Diagnostics

BENEFITS

Learn the advanced features of Ascent software in hands-on workshops

Balancing Principles

BAL

Duration

1 Day

Cost: $695 per person (Training Centers only)

Audience

- Engineers who want to learn about the causes and different types of unbalance
- Engineers seeking to understand the forces that create unbalance conditions
- Engineers who actively balance machines using the Scout and Vb balancing instruments

Objectives

- Define and diagnose unbalance conditions.
- Describe how to use balance for correction.
- Identify the types and causes of unbalance.
- Perform single-plane and dual-plane balancing techniques.
- Set up balancing.
- Discuss the potential pitfalls and failures of balancing and use a checklist for success.

Program

- Defining an unbalance condition
- Diagnosing unbalance
- Units of unbalance
- Causes and types of unbalance
- Effects on bearing load
- Typical setup
- Single vs. dual plane balancing
- Combining and splitting weights
- Potential pitfalls, failures, and checklist for success

Learning Path

Prerequisites

- 6 months of field experience
- IST

BAL

Next steps

- Advanced Ascent
- Machinery Diagnostics

BENEFITS

Hands-on workshops with our PDCs and small motors for balancing practice

CONTACT US

Strengthen your employees' competencies

BHGE can define the competency matrix and setup the competence development plan to make sure your team is equipped with all the knowledge and confidence to efficiently manage your assets.

For more information, visit:
https://www.gemeasurement.com/services/bently-nevada-training

Or email us at BNtraining.NA@ge.com.