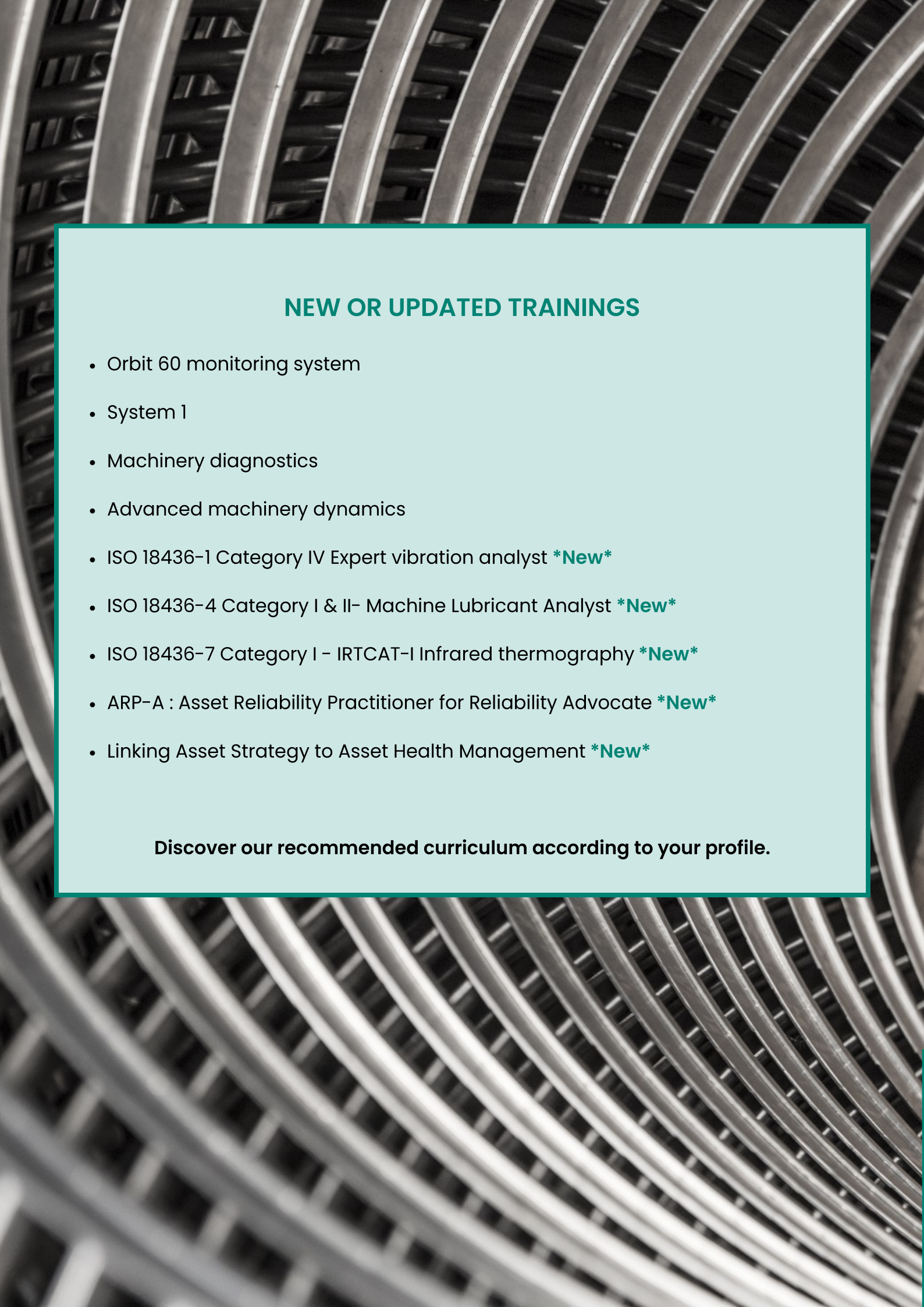
Bently Nevada
a Baker Hughes business

Technical Training

Condition Monitoring & Reliability



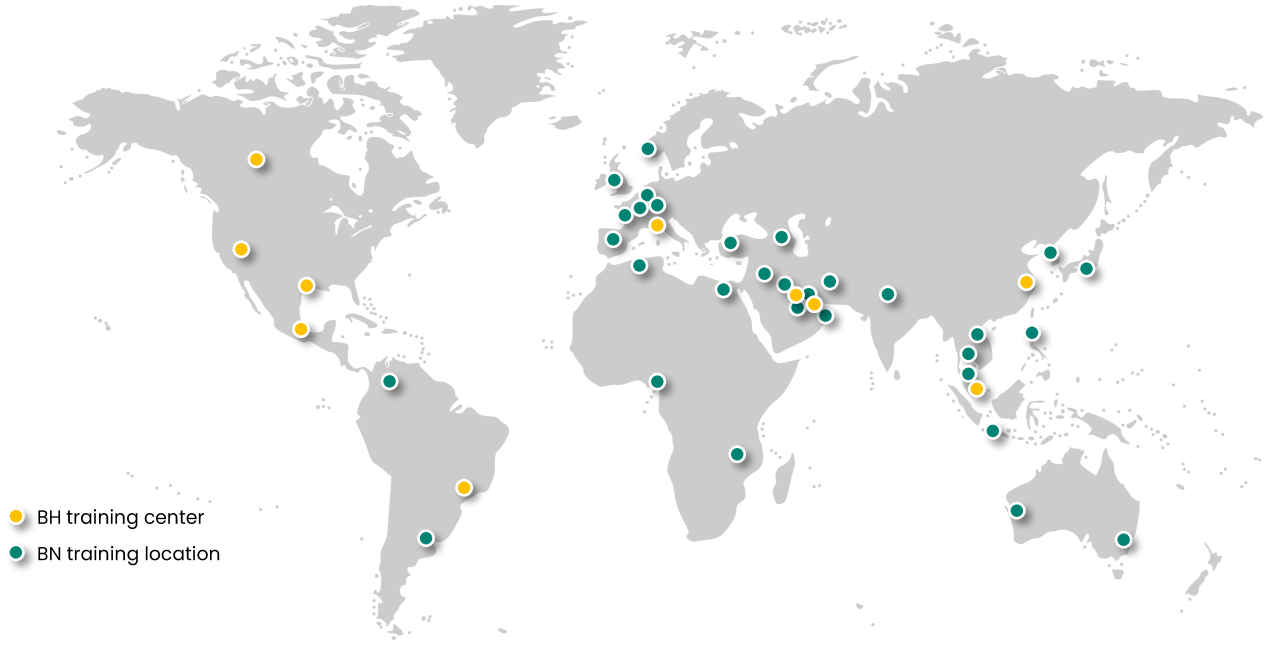
NEW OR UPDATED TRAININGS

- Orbit 60 monitoring system
- System 1
- Machinery diagnostics
- Advanced machinery dynamics
- ISO 18436-1 Category IV Expert vibration analyst ***New***
- ISO 18436-4 Category I & II- Machine Lubricant Analyst ***New***
- ISO 18436-7 Category I - IRTCAT-I Infrared thermography ***New***
- ARP-A : Asset Reliability Practitioner for Reliability Advocate ***New***
- Linking Asset Strategy to Asset Health Management ***New***

Discover our recommended curriculum according to your profile.

Bently Nevada training locations

Bently Nevada trainings can be provided anywhere and remotely.



To ask a question on training in your region or to register in a course, send an email to one of the regional addresses below.

AFRICA
BNtrainingMEA@bakerhughes.com

Algeria | Algiers

Egypt | Cairo

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BNtrainingMEA@bakerhughes.com

India | Mumbai

** Baker Hughes Training Center*

CONTENTS

A worldwide partner for operational excellence

Bently Nevada, a Baker Hughes business, offers a plant-wide, holistic suite of machine condition monitoring solutions to help you achieve the highest level of asset reliability possible. Our experienced field engineers provide technical training leveraging 60 years of domain expertise. You will benefit from comprehensive hands-on courses, starting at fundamentals to in-depth diagnostics on rotating machinery and other production equipment. With the acquisition of ARMS Reliability, Bently Nevada provides a complete solution on Asset Performance Management (APM) with trainings on asset management strategy and reliability. Our partnerships with Mobius Institute and ICML complete our training portfolio with accredited certification for asset reliability and condition monitoring specialists.

Bently Nevada technical training programs provide the skills and confidence required to protect and control your machinery and to optimize the performance and reliability of your equipment. Bently Nevada work with you to build a training plan that is best adapted to your needs.

Overall, it will maximize your return-on-investment by ensuring machinery availability and reliability, by avoiding unplanned events and limiting disruption risks and costs.

Enhance the knowledge of your team

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

Experience from our Bently Nevada field engineers and technical experts. With more than 60 years of field experience and 40 years of technical training, Bently Nevada has pioneered the art of long-term skill development.

Technical expertise with experienced field instructors. Our team combines product engineering, installation, operation, maintenance, monitoring and diagnostics with proven teaching skills and a commitment to knowledge transfer.

Hands–on workshops to combine theory and practice and guarantee operational excellence. Workshops include practice with live monitors and racks. Class sizes are kept small ensuring students get the most out of training.

Customizable training to fit with your needs and enhance your performance. A training curriculum can be developed to suit your team's role and experience (operators, managers, engineers…).

Digital and up-to-date material to optimize learning. Course content and workshops are continually revised to reflect latest technologies, experience and local regulatory standards.

Comprehensive offers to match your specific needs and what works the best for you : modular training at one of Bently Nevada training center, at your site or remotely.

560
courses

4,300
trainees

92%
customer satisfaction

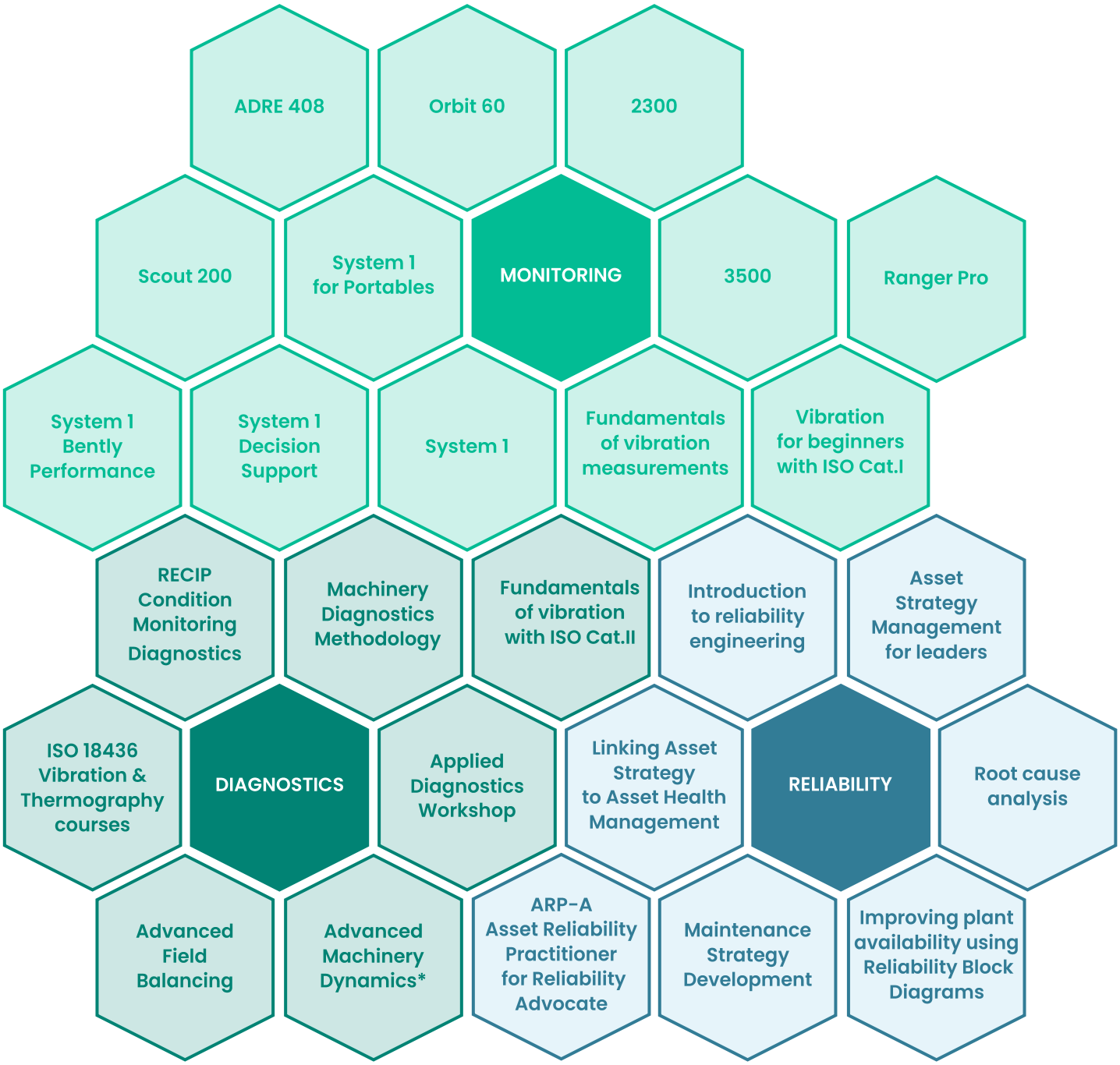
In 2022

Comprehensive training for your needs

Modular training

Provide your team with the right skills and knowledge, according to their profile, to increase their motivation, performance and productivity.

Our core offer includes 33 training modules on monitoring, diagnostics, and reliability with an emphasis on practice. The benefits of training on real equipment is instantaneous. In small groups, trainees learn both theory and practice, the "why" and the "how-to". Trainings can be customized to match your site specific needs. Additional trainings are also available upon request.

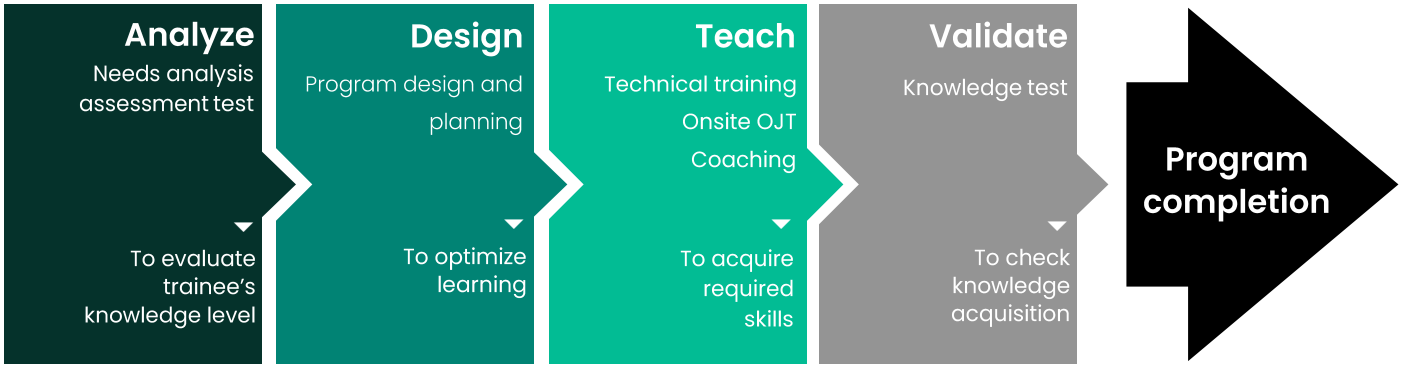


** AMD course is accredited by Mobius Institute as the in-class course for ISO18436 Cat.IV certification*

— COURSE SYLLABI AND DURATION MAY DIFFER ACCORDING TO TRAINING LOCATION —

Skills Development Program

Bring your team to a higher confidence and competence level with our customer-specific program, based on proven technical competency matrix.



Bently Nevada works with you to develop a comprehensive Skills Development Program specifically designed to address your needs. It will help you to build sustainable competencies and maximize your return on investment in condition monitoring and reliability.

The first step is establishing a role-based competency matrix. This will be achieved by combining your organization's job descriptions with condition monitoring best practices from Bently Nevada. The team will be assessed against a competency matrix specific to their role to identify skills and competency gaps. Based on the skills gaps identified, condition technologies deployed at site and operational constraints, a roadmap to build sustainable competencies will be developed.

By using customized training content, our certified instructors will conduct training sessions at a Bently Nevada training center or at your site. Training will be combined with onsite On-the-Job-Training to ensure learned methodology is put into practice in the day-to-day job. Some coaching sessions complete the program to go one step further or fill-in any gap. Your employees, equipped with plant-specific knowledge and advanced knowledge on condition monitoring and reliability, will be able to extract maximum benefit from the solutions deployed and improve the ROI.

In-house training

Onsite training

Remote learning

You can select the training solution matching your operational and financial constraints:

- In-house training to provide standard public trainings to raise skills of your engineers with optimized costs in one of our training center
- Onsite training to provide standard & customized trainings to a team in your facility for reduced T&L costs
- Remote learning for your team to learn anywhere with engaging session with live instructor, virtual machines and step-by-step self-paced workshops.

Bently Nevada Curriculum

Bently Nevada recommends some step-by-step curriculum to grow the knowledge and expertise of your instrumentation and diagnostics team helping you in better monitoring your machines and solving potential issues. Curriculum can be customized to your profile, assets and specific learning objectives. Your team will leverage Bently Nevada culture, practice and expertise.

Instrumentation learning path for Instruments Technicians, Operation and Maintenance engineers.

INSTRUMENTATION BASIC

1 Fundamentals of vibration

- Vibration overview
- Vibration measurement
- Transducers overview

— 2 days —

2 Transducers installation

- Vibration transducers
- Proximity transducer operation and installation
- Seismic transducer operation and installation
- Instrument grounding

— 2 days —

3 3500 Operation & Maintenance

- 3500 functions
- Proximity transducers
- Alarms
- Maintenance
- Troubleshoot

— 3 days —

4 System 1

- Online systems & data collection
- Machine Building
- Data Analysis & Diagnostics
- Condition Monitoring Based Variables & Alarms

— 3 days —

5 Exam & Certificate

- Quiz
- Onsite On-the-Job training audit

— 1 day —

INSTRUMENTATION INTERMEDIATE

1 3500 System Troubleshooting

6 self-paced videos + quiz

- 3500 configuration options
- Events analysis
- LEDs and buffered outputs
- Faults at the rear of 3500
- 3500 software tool
- Linearity check

— 1 hour —

2 3500 RECIP monitoring

- Basic elements of a RECIP
- Monitoring and protection
- Crankshaft timing
- 3500/25 configuration
- 3500/70M configuration
- Rod drop and rod position
- 3500/72M configuration
- Probe calibration workshop
- 3500/77M configuration

— 1 day —

3 3500 System for TSI application

- Overview of 3500 system
- 3300 proximity transducer
- LVDT operation
- Eccentricity
- Rotor speed and acceleration
- Differential expansion (complimentary and ramp)
- Case expansion

— 2 days —

4 Bently Nevada monitoring systems

- Orbit 60
- 2300
- ADAPT 3701
- Ranger Pro
- vbOnline Pro

— 1 to 3 days —

5 Exam & Certificate

- Quiz
- Onsite On-the-Job training audit

— 1 day —

Diagnostics learning path for condition monitoring engineers, reliability engineers, rotating equipment engineers and engineers involved with the design & acceptance testing.

DIAGNOSTICS BASIC

1 Asset Strategy to Asset Health

- Integrated APM
- Scope and Criticality
- Maintenance Strategy Development with RCM approach
- Simulation of Run to Failure
- Preventative & Predictive Maintenance
- Task Optimization
- CM Technologies & Reporting

— 3 days —

2 Mobius ISO 18436 Cat.I

- Maintenance practices
- Condition monitoring
- Principles of vibration
- Vibration measurement
- Data acquisition
- Signal processing
- Vibration analysis
- Common fault conditions
- Setting alarm limits

— 4 days —

3 Intro to reliability engineering

- Reactive Cycle
- Reliability & Excellence
- Reliability Engineering Tools:
  - Root Cause Analysis
  - Reliability Centered Maintenance
  - Life Cycle Costing
  - Reliability Block Diagrams
  - Asset Criticality
  - Failure Mode Effects & Criticality

— 1 day —

4 Mobius ISO 18436 Cat.II

- Principles of vibration
- Data acquisition
- Probes, sensors, accelerometers
- Signal Processing
- Vibration & fault analysis
- Equipment testing/diagnostics
- Successful CM program
- Acceptance Testing

— 5 days —

5 Practical data collection

- Enterprise creation
- Machine building
- Instrumentation building
- Route building
- SCOUT Data collection techniques
- Plot reviews using S1

— 1 day —

DIAGNOSTICS INTERMEDIATE

1 Machinery Diagnostics

- CM & diagnostics Intro
- Interpret Phase/steady state data/transient data
- Fundamental Synchronous response
- Single plane balance
- Detection of anomalies such as fluid induced instability, rubs, preloads, shaft cracks etc..

— 5 days —

2 System 1

- Online systems & data collection
- Machine Building
- Data Analysis & Diagnostics
- Condition Monitoring Based Variables & Alarms

— 3 days —

3 Applied Diagnostics Workshop

- Analyze actual machine case histories using S1 and or ADRE databases
- Malfunctions covered are unbalance, loose parts, misalignment, shaft crack, rub etc.
- Machines covered are GTs, STs, Motors, pumps, centrifugal compressors etc.

— 5 days —

4 Diagnostics assignment

- Real data cases analysis from customer data using S1 or ADRE as applicable
- Coaching on analysis methodology, report writing etc..

— 3 days —

5 Mobius ISO 18436 Cat.III

- Signal processing
- Time waveform and phase analysis
- Dynamics and testing for natural frequencies
- Operating deflection shape
- Modal and FEA intro
- Rolling element bearing fault detection
- Electric motor testing

—5 days —

DIAGNOSTICS ADVANCED

1 Advanced Field Balancing

- Balancing fundamentals
- Balancing calculations and conventions
- Single plane balancing workshop
- Static/couple and Influence vector balancing with workshop
- Multiplane balancing using Bently balance

— 5 days —

2 Mobius ISO 18436 Cat.IV online course

- Principles of vibration
- Signal processing
- Fault analysis
- Phase analysis
- Rotor/bearing dynamics
- Corrective action
- Equipment testing & diagnostics
- Fault severity determination

— 5 days —

3 Advanced Machinery Dynamics

- Model of the rotor
- Bearing design
- Modal and ODS analysis
- Anisotropy
- Rotor model
- Torsional
- Malfunction detection and analysis

Mobius ISO18436 Cat.IV exam

— 5 days —

4 System 1 Bently Performance

- Bently performance in S1
- Basic concepts of Thermodynamic performance
- Machine applications
- Monitoring performance of various machine types such as pumps, compressors, GTs, STs, Generators and Turboexpander

— 3 days —

5 System 1 Decision Support

- Decision support overview
- Configuration of DS
- Building customs rules
- InsighPaks overview
- Solving problems with DS
- Demo of deployment management
- Self-paced workshops

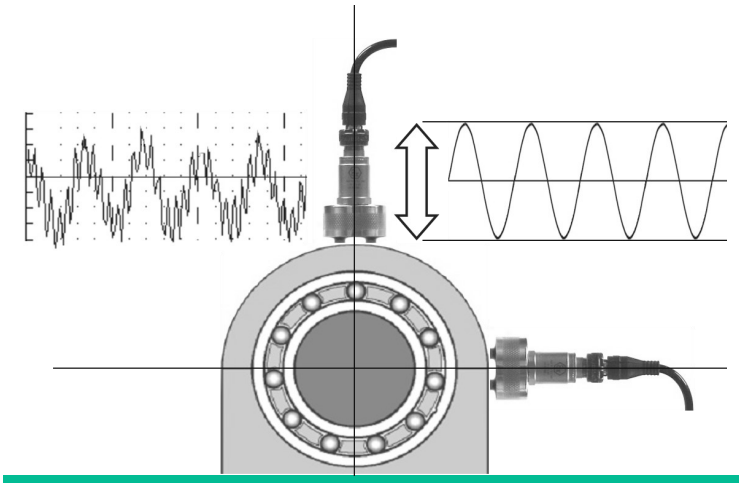
— 2 days —

BENTLY NEVADA

MONITORING COURSES

Fundamentals of vibration measurements

Bently Nevada



VIBFU

Duration

2 days (14 hours)

Delivery

Classroom or remote

Audience

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

Objectives

- Explain the reasons for vibration monitoring and maintenance strategies
- 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
- 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

Day 1

- Machinery monitoring: history, benefits, and strategies; typically monitored machines and considerations
- Basic vibration concepts: definition, understanding relationships of vibration displacement, velocity, acceleration, units of amplitude and meaning of vibration amplitude in analysis
- Defining frequency, units of frequency, and frequency in analysis, defining phase and measuring relative and absolute phase, understanding natural frequencies

Day 2

- Vibration transducers: theory of accelerometer operation, theory of Velomitor operation, theory of proximity transducer system operation
- Exercises on identifying amplitude, frequency and phase from time-based and spectrum plots
- Exercises on transducers and monitoring systems for given machine scenarios

Learning path

Prerequisites

VIBFU

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

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

3500 operation & maintenance

3500OM

Duration

3 days (21 hours)

Delivery

Classroom or remote

Audience

- 3500 monitoring system users
- Engineers involved in maintenance and troubleshooting of the 3500 monitoring system
- Instrument technicians

Objectives

- Explain the role of the 3500 monitoring system in machinery monitoring and protection
- Identify installation conditions affecting the correct operation of proximity transducer systems
- Test monitor alarms and verify channel values in a radial vibration monitor
- Use Bently Nevada propriety configuration software to configure and/or reconfigure the 3500 monitor system
- Troubleshoot the 3500 monitor system and associated transducers using software and hardware techniques

Program

Day 1

- Overview of 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

Day 2

- Radial vibration
- Thrust position
- Relays

Day 3

- 3500 system utilities
- Troubleshooting 3500 system
- 3500/92 communications gateway (Optional)

Optional: The last day focus can vary depending on audience needs

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

3500OM

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Practice workshops with live monitors and racks

3500 for TSI applications

3500TSI

Duration

2 days (14 hours)

Delivery

Classroom or remote

Audience

- 3500 monitoring system users
- Engineers involved in maintenance and trouble-shooting of 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 and eccentricity probes 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

Day 1

- Overview of 3500 monitoring system
- 3300 proximity transducer system
- LVDT operation

Day 2

- Eccentricity
- Rotor speed and acceleration
- Differential expansion (complimentary and ramp)
- Case expansion.

Learning path

Prerequisites

- 3500 operation & maintenance

3500TSI

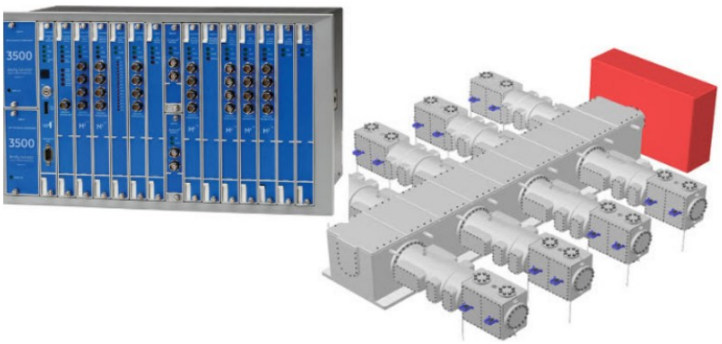
Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Practice workshops with live monitors and racks

3500 RECIP monitoring & protection



Duration

1 day (7 hours)

Delivery

Classroom or remote

Audience

- 3500 monitoring system users
- Engineers involved in maintenance and troubleshooting of the 3500 monitoring system
- Instrument technicians

3500-R

Objectives

- List the basic components of an API-618 reciprocating compressor
- Explain the value of monitoring reciprocating compressors and describe a typical monitoring strategy in line with API-618 and API-670 guidelines
- Explain the importance of crank angle reference measurement in Recip monitoring and diagnostics
- Configure RECIP-specific 3500 monitoring modules
- Identify, calibrate, set up, and maintain rod drop and rod position measurements
- Calibrate, set up, and maintain rod drop and rod position measurements

Program

- Basic elements of a reciprocating compressors
- Monitoring and protection of reciprocating compressors
- Crankshaft timing
- 3500/25 configuration
- 3500/70M configuration
- Rod drop and rod position
- 3500/72M configuration
- Probe calibration workshop
- 3500/77M configuration

Learning path

Prerequisites

- 3500 operation & maintenance

3500-R

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Practice workshops with live monitors and racks

3500 troubleshooting

3500-TS

Duration

1 hour

Delivery

eLearning (Video series)

Audience

- 3500 monitoring system users
- Engineers involved in maintenance and troubleshooting of the 3500 monitoring system
- Instrument technicians

Objectives

- Go one step further from the learning of the 3500 operation and maintenance course
- Develop knowledge and skills on troubleshooting the 3500 monitor system
- Discover key troubleshooting techniques for the 3500 monitoring system

eLearning

Program

6 self-paced videos + quiz

- Explore the 3500 rack configuration software connection options
- Access event lists to identify problems with the 3500 rack
- Identify problems using LEDs and buffered outputs
- Identify faults starting at the rear of a 3500 rack
- Troubleshoot using other 3500 rack configuration software tools
- Perform a linearity check

Optional: Combine this self-paced learning program with one-hour remote coaching with an expert to go one step further

Learning path

Prerequisites

- 3500 operation & maintenance

3500-TS

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Self-paced videos at your own rhythm

Orbit 60 monitoring system

Duration

3 days (21 hours)

Delivery

Classroom

Audience

- Orbit 60 monitoring system users
- Engineers involved in maintenance and troubleshooting of the Orbit 60 monitoring system
- Instrument technicians

O60

Objectives

- Explain the role of the Orbit 60 monitoring system in machinery monitoring and protection
- Learn how to configure and maintain the Orbit 60 monitoring system
- Test alarms and troubleshoot the Orbit 60 monitoring system

Program

Day 1

- Orbit 60 components, functions, settings, properties
- Configuration, firmware updates.
- Probe and cable resistance
- Proximitor operations

Day 2

- Create online configuration
- Orbit 60 protection system security
- Online configuration, Studio verification utility
- Modules & errors system utilization
- Protection groups and states
- Troubleshooting, errors management

Day 3

- Radial vibration channels
- Thrust position setpoints & relays
- Map measurements, setpoints status to CGM Module
- Offline diagnostics
- Importing device into System 1
- Collecting data from Orbit 60

Program subject to change based on product development

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

O60

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Practice workshops with equipment

2300 vibration monitor

Duration

30 minutes

Delivery

eLearning (Video series)

Audience

- 2300 vibration monitor users
- Instrument technicians

2300

Objectives

- Develop knowledge and skills on 2300 vibration monitor system
- Discover key troubleshooting techniques for the 2300 monitoring system

eLearning

Program

- Overview of the 2300 vibration monitor hardware and differences between the /20 and the /25 models.
- Interactions with software applications such as the Bently Nevada monitor configuration software and different versions of System 1.
- Sensors connections and 2300 vibration monitor configuration.

Learning path

Prerequisites

2300

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Self-paced videos

ADRE 408 DSPi/Sxp

Duration

3 days (21 hours)

Delivery

Classroom or remote

Audience

- ADRE 408 users
- Condition monitoring engineers
- Engineers involved in preventive maintenance

ADRE

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

Day 1

- Overview and introduction
- Using the front panel
- Communication and networking
- Vibration fundamentals
- Planning data sampling
- Basic sampling

Day 2

- Static data plotting
- Signal processing
- Dynamic data plotting
- Advanced sampling

Day 3

- Using the ADRE 408 replay card
- Collecting and replaying raw continuous data
- Sharing and exporting data
- Advanced utilities

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

ADRE

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Advanced database manipulation tools

Ranger Pro using System 1

RP

Duration

3 days (21 hours)

Delivery

Classroom or remote

Audience

- Users of System 1 who have purchased Ranger Pro wireless
- Condition monitoring engineers
- Engineers involved in preventive maintenance

Objectives

- Use gateways and Ranger Pro software with System 1, learners will successfully install, operate, and maintain Ranger Pro sensors
- Deploy, operate, and manage Ranger Pro wireless condition monitoring system in industrial plants
- Customer individual gateway will be the subject of training (Honeywell, Yokogawa or Emerson).

Program

Day 1

- Network requirements
- Gateway and routers connection
- Ranger Pro deployment
- Ranger Pro mounting considerations
- Ranger Pro configuration software
- Using the NFC USB reader
- Ranger Pro battery installation

Day 2

- Adding gateway to System 1
- Adding Ranger Pro devices to System 1
- Configuring machines and measurement points
- Configuring trended variables and alarm setpoints
- Mapping device points to machine
- Ranger Pro data on demand
- Ranger Pro data on vibration
- Ranger Pro data on severity

Day 3

- Alarm management in System 1
- Display bargraphs, XvsY, and trends
- Display time waveform and spectra
- Plot sets and plot records
- Case history and diagnostic report

Additional one day required
for each additional type of gateway

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

RP

Next steps

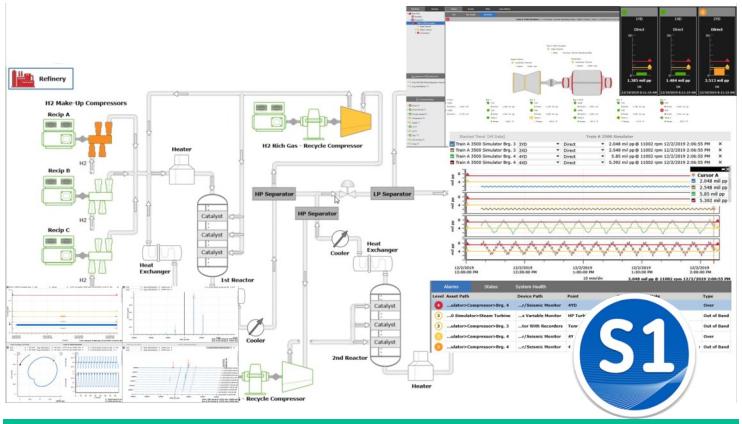
- Monitoring courses
- Diagnostics courses

Benefits

Deploy the latest wireless condition monitoring equipment

System 1

Bently Nevada



S1

Duration

3 days (21 hours) | 2 additional days for remote session

Delivery

Classroom or remote

Audience

- System 1 platform users
- Reliability engineers
- Condition monitoring personnel
- Personnel involved in preventive maintenance

Objectives

- Manage alarms and generate diagnostic reports with actionable information
- Configure and manage alarm setpoints with statistical tools
- Verify transient and steady state data using various types of plots, analyze, and visualize data to report on machine health and determine appropriate actions
- Maintain healthy System 1 databases to ensure operational efficiency

Program

Day 1

- Overview of System 1 platform
- Configure database preferences
- Alarm types and alarm management
- Display and manage alarms and events
- Types of steady-state plots and their usages
- Display and manipulate trends and steady-state plots

Day 2

- Configure and display machine states and state-based alarms
- Connect to online system simulator and display live data
- Configure and display reference data
- Configure and display specialized alarm setpoints
- Create and display plot sets and plot records
- Generate case histories and diagnostic reports

Day 3

- Types of Transient plots and their usages
- Use audit file for transient analysis
- Display and manipulate transient plots
- Generate and display overlay and compensation plots
- Configure and manage Notifications
- Database, users, and security management

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

S1

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Practice workshops at each step of the course.

System 1 for portables

Duration

3 days (21 hours)

Delivery

Classroom

Audience

- System 1 platform users
- Reliability personnel
- Condition monitoring engineers
- Personnel involved in preventive maintenance

S1-P

Objectives

- Configure and navigate machine and device hierarchy
- Create machine databases and machine templates for data collection
- Configure, display and manage spectral bands and fault frequencies
- Configure and manage alarm setpoints with statistical tools, data collection routes
- Manage data communication with all the Scouts in the field
- Manage alarms and generate diagnostic reports with actionable information
- Verify, analyze, and visualize data to report on machine health and determine appropriate actions

Program

Day 1

- Create database and set preferences
- Build machines using library and templates
- Build measurement points using automated methods
- Configure and manage data collection routes
- Synch route with portable instrument using file, instrument, and Remote comms methods
- Collect route-based data using portable instrument

Day 2

- Condition monitoring alarms
- Alarm management
- Configure measurement points manually
- Configure machine alarm setpoints (import/export)
- Configure fault frequencies and frequency bands
- Configure 6Pack and PeakDemod measurements
- Configure dual channel from panel and triaxial measurements
- Modify routes
- Synch route with instrument
- Collect route-based data using portable instrument

Day 3

- Create and display statistical alarms
- Display trends, x-y, time waveform and spectrum and waterfall plots
- Manage alarms and display spectral bands and fault frequencies
- Generate case histories and diagnostic reports

System 1 version 16 and above

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

S1-P

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Practice workshops at each step of the course.

Scout 200

Duration

1 hour

Delivery

eLearning (Video series)

Audience

- Portable users
- Reliability personnel
- Condition monitoring engineers
- Personnel involved in preventive maintenance

S200

Objectives

- Discover the primary aspects of safety, navigation, setup, pairing, and data collection for Bently Nevada's SCOUT200 series portable vibration device.

eLearning

Program

Self-paced videos + quiz

- Safety Precautions
- Kit Components
- Key Features of the SCOUT200
- Charging the Batteries
- Updating the System 1 Collector App and Firmware
- Navigation Buttons and Home Screen Functions
- Pairing Devices
- System 1 Collector App Settings
- Sensor Settings
- Sending Route Data from S1 to SCOUT200 via File Mode
- Receiving Route Data from SCOUT200 to S1 via File Mode
- Direct Comms via USB Tethering
- Direct Comms via WIFI
- Sync via Remote Comms
- Route Selection and Navigation
- Route Collection Using Accelerometers
- Route Collection from a 3500 Panel

Learning path

Prerequisites

- System 1 for Portables

S200

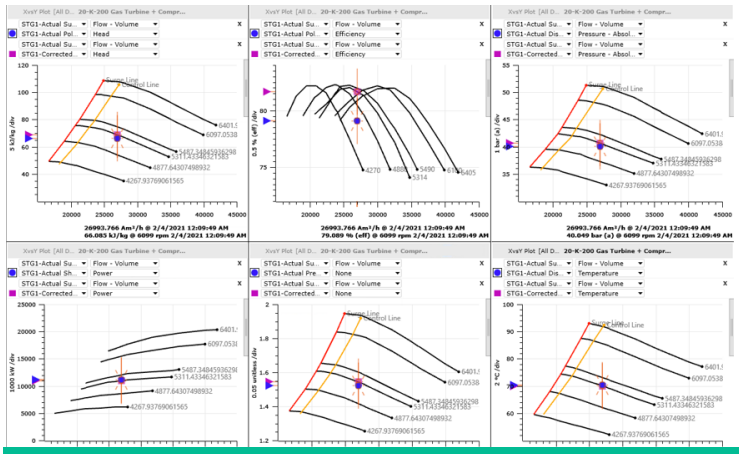
Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Self-paced videos

System 1 Bently Performance



BP

Duration

3 days (21 hours)

Delivery

Classroom or remote

Audience

- System 1 Users who want to use Bently Performance

Objectives

- Describe the value of monitoring machinery performance
- Identify the general inputs and expected outputs for performance monitoring on machinery such as pumps, compressors, gas turbines, steam turbines, generators, and turbo expanders. the general inputs and expected outputs for performance monitoring on various types of machinery.
- Use the System 1 Bently Performance tool to monitor and troubleshoot performance

Program

Day 1

- Overview:
  - Benefits of machine monitoring
  - Bently Performance in System 1 architecture
- Basic concepts for thermodynamic performance
  - Performance monitoring KPI terminology
  - Performance monitoring outputs
- Demo of System 1 Bently Performance monitoring software

Days 2 & 3

Machine applications:

- Operation of machine
- Instrumentation and inputs
- Outputs
- User interface
- OEM data design workshops

Customers can select from the following machine types:

- Pumps
- Compressors
- Gas turbines
- Steam turbines
- Generators
- Turbo expander

Additional time can be added based on the number of machine types chosen.

Learning path

Prerequisites

- System 1 courses

BP

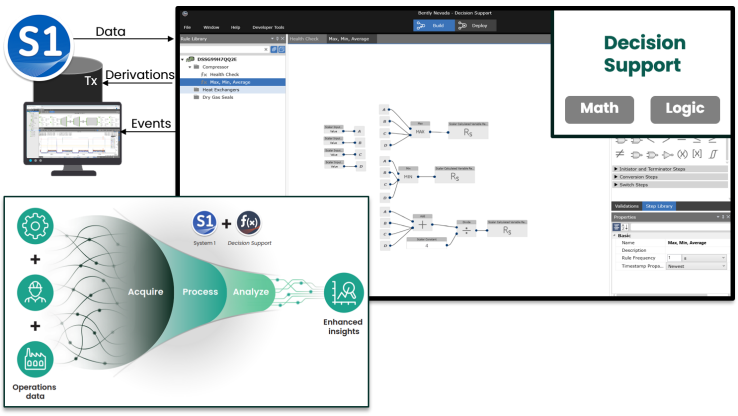
Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Monitor performance of critical equipment and prioritize repairs appropriately

System 1 Decision Support



DS

Duration

2 days (14 hours)

Delivery

Classroom or remote

Audience

- Customers new to Decision Support for System 1 v20.1 or later
- Reliability personnel
- Condition monitoring engineers
- Personnel involved in preventive maintenance

Objectives

- Install and configure the Decision Support product.
- Identify the major benefits of using Decision Support.
- Deploy rules from the Extraction Database.
- Build and deploy custom rules. Create and deploy interdependent rules and rules with advanced steps.
- Revise and upgrade existing rules.

Program

Day 1

- Overview & benefit of Decision Support systems
- Configuration of Decision Support and System 1
- Demonstration of rule building & deployment into S1
- Self-paced workshops on:
  - Installation, configuration & connections
  - Build temperature offset rule
  - Deploy the temperature offset rule
  - Build a timer counter rule
  - Deploy the timer counter rule
  - Problem solving Min/Max/Avg

Day 2

- DS analytics overview
- Solving problems with Decision Support
- Using rules with intermediate values
- Demonstration of deployment management
- Demonstration of upgrading rules
- Demonstration of file libraries
- Demonstration of software alarms
- Self-paced workshops on:
  - Create and deploy rotor property and resonance ratio rules
  - List all rule deployments, Upgrade a rule
  - File Libraries
  - Set a software alarm based on a DS rule result

Learning path

Prerequisites

- System 1 courses

DS

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Self-paced workshops on online virtual machine

3500 operation & maintenance and System 1

Bently Nevada

3500OMS1

Duration

5 days (35 hours)

Delivery

Classroom or remote

Audience

- 3500 monitoring system and System 1 users
- Engineers involved in maintenance and troubleshooting of the 3500 monitoring system
- Instrument technicians

Objectives

- Explain the role of the 3500 monitoring system in machinery monitoring and protection
- Identify installation conditions affecting the correct operation of proximity transducer systems
- Test monitor alarms and verify channel values in a radial vibration monitor
- Use Bently Nevada configuration software to configure and/or reconfigure the 3500 monitor system
- Discover System 1 and learn how to create, configure, display and manage machine database and alarms
- Use various System 1 software tools and plots to detect subtle changes in asset condition.
- View alarms and events in the event manager; Create reports on monitored plant assets.

Program

Day 1

- Overview of 3500 monitoring system
- 3300 proximity transducer system operation
- TDI/RIM hardware connections and communications
- Power supply, TDI/RIM and keyphasor configuration
- Radial vibration

Day 2

- Thrust position
- Relays
- 3500 system utilities

Day 3

- Overview of System 1 platform
- Configure database preferences
- Alarm types and alarm management
- Importing device into System 1

Day 4

- Display and manage alarms and events
- Types of steady-state plots and their usages
- Trends and steady-state plots
- Machine states and state-based alarms
- Reference data and specialized alarm setpoints
- Plot sets and plot records, cases & diagnostic reports

Day 5

- Types of Transient plots and their usages
- Use of audit file for transient analysis
- Transient plots, plots overlay and compensation
- Notifications management
- Database, users, and security management

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

3500OMS1

Next steps

- Monitoring courses
- Diagnostics courses

Benefits

Practice workshops with live monitors and racks

Orbit 60 monitoring system and System 1

Bently Nevada

Duration

5 days (35 hours)

Delivery

Classroom or remote

Audience

- Orbit 60 monitoring system and System 1 users
- Engineers involved in maintenance and troubleshooting of the Orbit 60 monitoring system
- Instrument technicians

O60S1

Objectives

- Explain the role of the Orbit 60 monitoring system in machinery monitoring and protection
- Identify installation conditions affecting the correct operation of proximity transducer systems
- Test monitor alarms and verify channel values in a radial vibration monitor
- Use Orbit 60 Studio software to configure and/or reconfigure the Orbit 60 monitoring system
- Discover System 1 and learn how to create, configure, display and manage machine database and alarms
- Use various System 1 software tools and plots to retrieve data and detect subtle changes in asset condition
- View alarms and events in the event manager; Create reports on monitored plant assets

Program

Day 1
- Overview of Orbit 60 monitoring system
- 3300 proximity transducer system operation
- Orbit 60 hardware connections and communications
- Orbit 60 components, functions, settings, properties
- Orbit 60 Configuration and firmware updates

Day 2
- Create online configuration
- Orbit 60 protection system security
- Online configuration, Studio verification utility
- Modules & errors system utilization
- Protection groups and states
- Troubleshooting, errors management

Day 3
- Radial vibration channels setpoints and relays
- Thrust position setpoints & relays
- Map measurements, setpoints status to CGM Module
- Overview of System 1 platform
- Configure database preferences
- Alarm types and alarm management
- Importing device into System 1

Day 4
- Display and manage alarms and events
- Types of steady-state plots and their usages
- Trends and steady-state plots
- Machine states and state-based alarms
- Reference data and specialized alarm setpoints
- Plot sets and plot records, cases & diagnostic reports

Day 5
- Types of Transient plots and their usages
- Use of audit file for transient analysis
- Transient plots, plots overlay and compensation
- Notifications management
- Database, users, and security management

Learning path

Prerequisites
- Fundamentals of vibration measurements
- ISO18436 Cat.I

O60S1

Next steps
- Monitoring courses
- Diagnostics courses

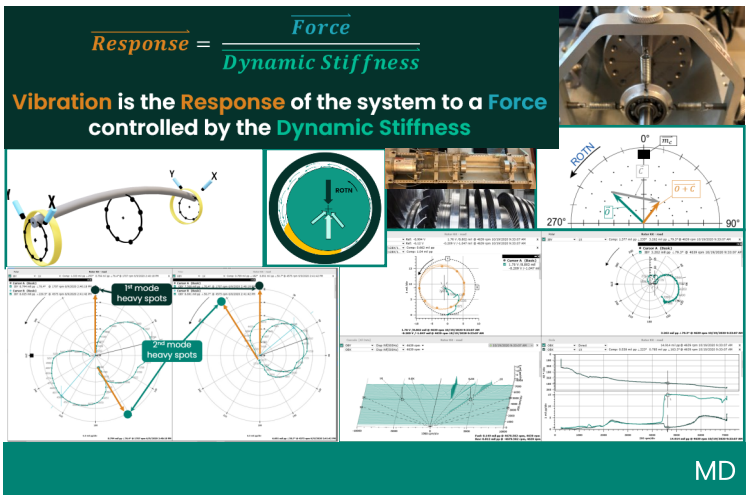
Benefits

Practice workshops with live monitors and racks

BENTLY NEVADA

DIAGNOSTICS COURSES

Machinery diagnostics methodology



Duration

5 days (35 hours)

Delivery

Classroom or remote

Audience

- Engineers who interpret machine vibration and position data to determine machine condition
- Engineers involved in the design, acceptance testing, and maintenance of rotating machinery
- Engineers who want to learn about machinery vibration diagnostic

Objectives

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

Program

Day 1

- Introduction to Condition Monitoring and Diagnostics
- How to interpret phase measurements
- How to interpret steady state data formats
- Fundamental synchronous rotor response

Day 2

- How to interpret Startup and shutdown plots
- Plot interpretation workshop
- Single plane balance response

Day 3

- Multiplane balance response
- How to detect and identify rubs and looseness
- How to evaluate preloads and radial position measurements

Day 4

- Understanding different vibration types and resonances
- How to identify fluid induced instabilities
- How to handle anisotropic systems

Day 5

- How to detect and identify shaft cracks
- Knowledge review

Learning path

Prerequisites

- Fundamentals of vibration measurements
- ISO18436 Cat.I

MD

Next steps

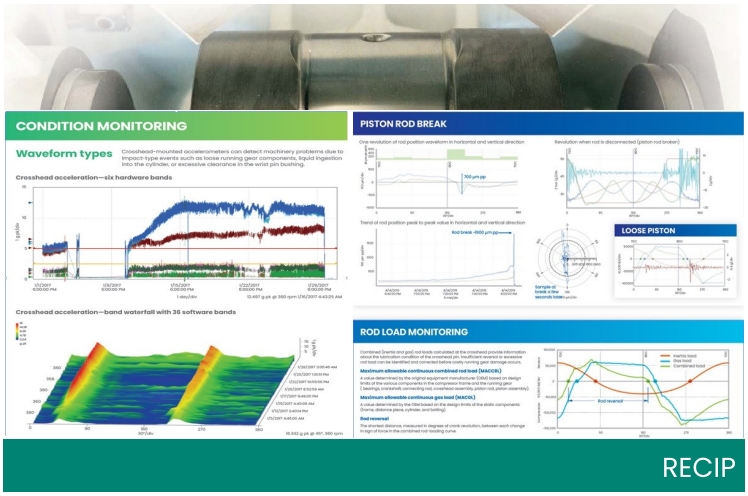
- Machinery diagnostics courses

Benefits

Provides the fundamentals needed to make confident operational decisions

Reciprocating compressor condition monitoring & diagnostics

Bently Nevada



RECIP

Duration

3 days (21 hours) | 1 additional day for remote session

Delivery

Classroom or remote

Audience

- Engineers who want to learn about reciprocating compressor components, mechanics, and performance
- Engineers who interpret reciprocating compressor vibration and analyzing malfunctions to diagnose and optimize assets
- Engineers who design and perform acceptance testing and maintenance on 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

Day 1

- Basic elements of reciprocating compressors
  - Compressor overview
  - Reciprocating compressors in industry
  - Components and nomenclature
  - Lubrication systems
  - Compressors types
- How to monitor a reciprocating compressor
- Importance of vibration and pressure measurements
- Which plots are used to evaluate the health of the Reciprocating compressor
- Monitoring strategies
- Pressure monitoring and diagnostics

Day 2

- Capacity Control
- Rod load and rod reversal
- Rod position and rod drop analysis
- Reciprocating compressor diagnostics:
  - Crosshead and frame vibration
  - Pressure analysis of multistage compressors

Day 3

- Workshops and presentation of case histories

Learning path

Prerequisites

- Machinery diagnostics methodology

RECIP

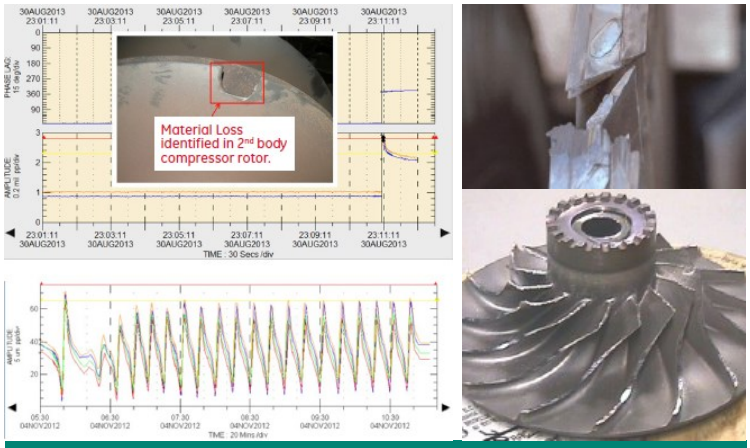
Next steps

- Advanced machinery dynamics

Benefits

Hands-on workshops at our recip-kit and actual case histories

Applied diagnostics workshop



ADW

Duration

5 days (35 hours)

Delivery

Classroom or remote

Audience

- Engineers and technicians involved in analysis and interpretation of vibration data
- New machinery diagnosticians who want to gain knowledge and confidence
- Experienced diagnostics personnel who want additional insight to efficiently solve complex

Objectives

- Discover the various types of machines and practical application of the malfunction detection methodology taught during the Machinery Diagnostics course
- Practice on real data from the field from different rotating machines and learn about their typical malfunctions
- Analyze actual machine case histories using System 1 or ADRE databases
- Organize data in plot formats believed to be indicative of the machine fault
- Present conclusions and make recommendations

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
- Gearboxes
- Pumps
- Fans

Learning path

Prerequisites

- Machinery diagnostics methodology

ADW

Next steps

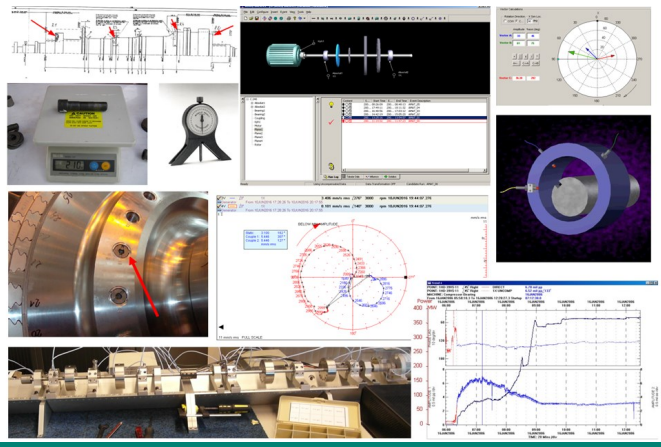
- Advanced machinery diagnostics

Benefits

Customized training according to equipment.

Be proficient in using the System 1 or ADRE systems.

Advanced field balancing



AFB

Duration

5 days (35 hours)

Delivery

Classroom

Audience

- Machinery diagnosticians
- Startup engineers
- Remote diagnostic center specialists
- Plant engineers that oversee field and shop balancing work

Objectives

- Conduct effective balancing of machine trains in the field: calculation of trials, evaluation of results, decision making
- Select strategy ensuring 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
- Get a deep understanding of balancing process allowing effective supervision of solution weights installation and troubleshooting data integrity problems

Program

Day 1

- Fundamentals
  - Imbalance and other malfunctions with similar symptoms.
  - Making the decision, selecting the strategy
  - Ensuring the repeatability and minimizing 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

Day 2

- Single plane balancing with workshop (cont.)
- Static/couple balancing with workshop
- Influence vector method (multiplane) balancing

Day 3

- Multiplane Balance Program (MBP)
- Workshop: balancing in two planes, using MBP

Day 4

- Relation between static/souple and Influence vector methods
- Workshop: influence vectors - import, export, recalculation between methods
- Balancing for compromise conditions

Day 5

- Evaluation of balancing quality: balancing report
- Workshop/Examination – multiple planes balancing.

Learning path

Prerequisites

- Machinery diagnostics methodology

AFB

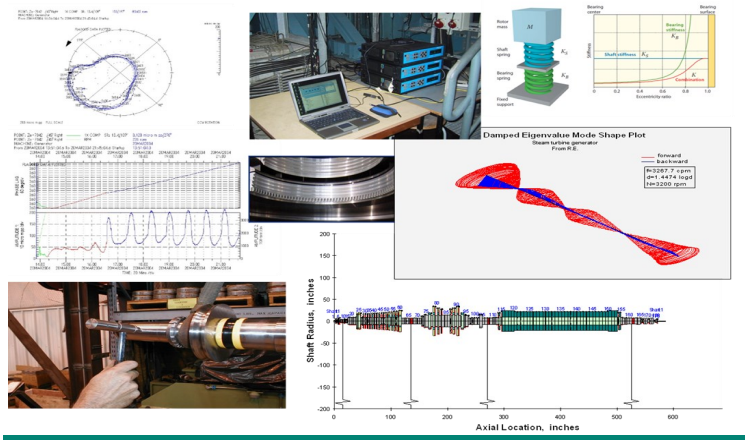
Next steps

- Advanced Machinery Dynamics

Benefits

Deepen your understanding of balancing methods and confidence with hands-on practice on test rotors

Advanced machinery dynamics



AMD

Duration

5 days (35 hours)

Delivery

Classroom

Audience

- Engineers seeking to advance their machinery vibration diagnostics skills
- Engineers involved in design, acceptance testing, maintenance of rotating machinery
- Academic researchers and professors involved in rotor dynamics
- Post-graduate engineers

Objectives

- Extend knowledge on machinery diagnostic techniques and rotor dynamics for rotating machinery
- Recognize, explain and account for effects of complex rotor dynamics interaction of modes, mode shapes, thermal changes, bearing design, torsional vibration and structural modes by using rotor modeling, actual machine data and case history
- Use standard vibration diagnostic tools on machine-simulating rotor kits through demonstration
- Analyze and discuss case histories that highlight the vibration documentation, analysis and machine malfunction corrective techniques.

Program

In order to put theory into practice, this training includes real-life demonstrations and 25 case studies:

- Rotor modeling as a machinery diagnostics tool
- Bearing design (fluid bearings and magnetic bearings)
- Diagnose and mitigation of fluid Induced Instabilities
- Modal and operating deflection shape analysis
- Tortional vibrations measurements and analysis
- Rotor model
- Anisotropy
- Shaft cracks
- Signal processing
- Balancing machines
- Rotor to stator rubs
- Gear forces analysis

Bently Nevada AMD course has been approved by our partner Mobius Institute. After the course, attendees who complete Mobius Institutes CAT IV online training can take the optional ISO 18436-2 CAT IV exam.

Learning path

Prerequisites

- Machinery diagnostics methodology
  or
- ISO 18436 category III

AMD

Next steps

Benefits

For each theme, historic cases show practice of each technique

ISO 18436 & CERTIFICATION

COURSES

ISO 18436-1 category I
Junior vibration analyst

CAT I

Duration

4 days (28 hours)

Delivery

Classroom or remote

Audience

- New vibration analysts
- Engineers collecting or analyzing vibration data
- Personnel who want to develop skills in the field of machine condition and vibration analysis
- Personnel who want to get certified to international standards (ISO-18436)

Objectives

- Prepare the participant for the ISO 18436-1 category I certification test
- Learn how to be capable of collecting quality data, and performing basic analysis and data validation
- Develop basic knowledge on vibration analysis and condition monitoring

Program

Day 1

- Maintenance practices
- Condition monitoring
- Principles of vibration

Day 2

- Introduction to vibration measurement
- Introduction to the time waveform
- Introduction to the spectrum

Day 3

- Brief introduction to phase
- Signal processing
- Vibration analysis

Day 4

- What is resonance
- Diagnosing common fault conditions
- Setting alarm limits
- Exam (60 multiple-choice questions in 2 hours)

Learning path

Prerequisites

- 6 months of experience is required for certification

CAT I

Next steps

- ISO Category II

Benefits

3D animations and software simulations make complex concept easier to understand.

ISO 18436-1 category II
Intermediate vibration analyst

CAT II

Duration

5 days (35 hours)

Delivery

Classroom or remote

Audience

- Engineers analyzing a range of fault conditions
- Engineers who want to understand balancing and alignment
- Engineers desiring to learn about machinery vibration diagnostic
- Personnel who want to become certified to international standards (ISO-18436)

Objectives

- Prepare the participant for the ISO 18436 category II certification test
- Learn how to be capable of diagnosing a wide range of faults, conducting special tests, and performing precision aligning and balancing machinery

Program

Day 1
- Review of maintenance practices & condition monitoring technologies
- Principles of vibration
- Data acquisition

Day 2
- Proximity probes, velocity sensors and accelerometers
- Signal processing

Day 3
- Vibration analysis
- Fault analysis

Day 4
- Equipment testing & diagnostics
- Corrective actions

Day 5
- Running a successful condition monitoring program
- Acceptance testing
- Review of ISO standards
- Exam (100 multiple-choice questions in 3 hours)

Learning path

Prerequisites
- 18 months of experience is required for certification
- Recommended ISO CAT I

CAT II

Next steps
- ISO Category III

Benefits

Competence in quality data acquisition and diagnosing common machine faults

ISO 18436-1 category III
Senior vibration analyst

CAT III

Duration

5 days (35 hours)

Delivery

Classroom or remote

Audience

- Engineers confident in spectrum but who want to learn about signal processing, time waveform and phase analysis
- Engineers involved in condition monitoring
- Personnel who want to become certified to international standards (ISO-18436)

Objectives

- Prepare the participant for the ISO 18436 category III certification test
- Learn how to be capable of managing the condition monitoring program, diagnosing the widest range of fault conditions, verifying and correcting resonance problems, performing complex balancing machinery

Program

Day 1

- Condition monitoring and the ISO standards
- Condition monitoring technologies
- Signal processing
- Time waveform analysis

Day 2

- Phase analysis
- Dynamics (natural frequencies and resonance)
- Natural frequency testing
- Operating deflection shape (ODS) analysis

Day 3

- Modal analysis and introduction to FEA
- Correcting resonances
- Rolling element bearing fault detection
- Journal bearing fault detection

Day 4

- Electric motor testing
- Pumps, fans and compressors
- Gearbox fault detection
- Corrective action

Day 5

- Running a successful condition monitoring program
- Acceptance testing
- Review of ISO standards
- Exam (100 multiple-choice questions in 4 hours)

Learning path

Prerequisites

- 36 months of experience is required for certification
- ISO Category II

CAT III

Next steps

- AMD
- ISO Category IV

Benefits

Developing knowledge of machine dynamics

ISO 18436-1 category IV
Expert vibration analyst

CAT IV

Duration

52.5 hours videos + 5 days course (35 hours)

Delivery

Online videos & classroom

Audience

- Engineers who want to transition from being a very good vibration analyst to a vibration super-hero!
- Engineers involved in condition monitoring
- Personnel who want to become certified to international standards (ISO-18436)

Objectives

- Prepare the participant for the ISO 18436-1 category IV certification test
- Learn how to be capable of handling any condition that may be presented, capable of performing any test, fully understanding flexible rotor machinery

Program

Distance learning online course

- 4 months access to 64 hours of videos and materials on mobiusconnect.com
- Principles of vibration
- Signal processing
- Fault analysis
- Phase analysis
- Rotor/bearing dynamics
- Corrective action
- Equipment testing & diagnostics
- Fault severity determination
- Reference standards

Advanced Machinery Dynamics course

Bently Nevada course is accredited by Mobius Institute as ISO18436 Cat.IV course. See syllabi on page 35

Exam

60 multiple-choice questions, with calculations required in 5 hours

Learning path

Prerequisites

- 60 months of experience is required for certification
- ISO Category III

CAT IV

Next steps

Benefits

Worked examples, animations and simulations to understand exactly what is going on.

ISO 18436-4 Category I Machine Lubricant Analyst

Bently Nevada

MLA I

Duration

4 days (28 hours) | 1 additional day in remote session

Delivery

Classroom or remote

Audience

- Maintenance Engineers and Technicians
- Reliability Engineers
- Lubricant Analysts
- Lubrication Engineers

Objectives

- Learn the fundamental concepts of Machinery Lubrication.
- Learn the fundamental concepts of effective Oil Sampling.
- Learn the basics of Lubricant Analysis and result interpretation.
- Understand the importance of Lubricant Analysis in machine reliability.
- Prepare for ICML Level I Machine Lubricant Analyst: MLA I (ISO 18436-4, I) certification exam.

Program

Day 1

- Maintenance strategy
- Lubrication fundamentals
  - Tribology & functions of a lubricant
  - Hydrodynamic, elasto-hydrodynamic and mixed-film lubrication
  - Base oils & additives
  - Lubricanting oil and its physical, chemical and performance properties
  - Grease lubrication

Day 2

- Lubricant selection
  - Viscosity, base oil type & additive system selection
  - Machine specific lubricant requirements
  - Application & environment adjustments
- Lubricant application
  - Lubricant application methods
  - Manual vs Automatic Lubrication
  - Single point lubricators
  - Centralized lubrication systems
- Lube storage and management

Day 3

- Lube Condition Control
- Oil Sampling
- Lubricant health monitoring
  - Lubricant failure mechanisms
  - Fluid properties test methods and measurements
- Wear Debris Monitoring and Analysis

Day 4

- ICML certification exam 100 multiple-choice questions over 3 hours. A score of 70% is required to pass

Learning path

Prerequisites

- 12 months of experience

MLA I

Next steps

MLA II

Benefits

Qualify to test for MLA I certification by ICML

ISO 18436-4 Category II Machine Lubricant Analyst

Bently Nevada

MLA II

Duration

4 days (28 hours) | 1 additional day in remote session

Delivery

Classroom or remote

Audience

- Maintenance Engineers
- Reliability Engineers
- Lubricant Analysts
- Lubrication Engineers

Objectives

- Develop expertise in the field of lubricant-analysis-based machinery condition monitoring .
- Learn about lubricant health monitoring.
- Develop knowledge and skills on lubricant contamination measurement and control.
- Be able to conduct oil analysis tests and gain knowledge in result interpretation.
- Prepare for ICML Level II Machine Lubricant Analyst: MLA II (ISO 18436-4, II) certification exam.

PARTNER ICML

Program

Day 1

- Lubricant roles and functions
- Oil analysis & maintenance strategies (RCM, CBM)
- Oil sampling
  - Objectives for lube oil sampling
  - Equipment specific sampling
  - Sampling methods
  - Managing interference
  - Sampling process management

Day 2

- Lubricant health monitoring
  - Lubricant failure mechanisms
  - Testing for wrong or mixed lubricants
  - Fluid properties test methods and measurement units
- Lubricant contamination measurement and control (Particle, moisture and glycol coolant contamination)

Day 3

- Lubricant contamination measurement and control (Soot, fuel and air contamination)
  - Filtration and separation technologies
  - Filter rating, design, and filter selection
  - Advantages and limitations of different filtration technologies
- Wear Debris Monitoring and Analysis
  - Common wear mechanisms
  - Detecting abnormal wear
  - Wear debris analysis

Day 4

- ICML Certification exam 100 multiple-choice questions over 3 hours. A score of 70% is required to pass.

Learning path

Prerequisites

- 24 months of experience
- MLA I certification or grandfathering

MLA II

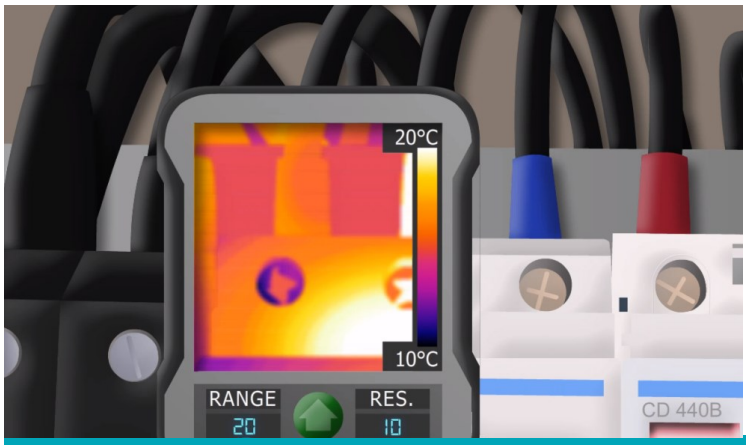
Next steps

MLA III

Benefits

Qualify to test for MLA II certification by ICML

ISO 18436-7 category I
IRTCAT-I Infrared thermography



IRT I

Duration

5 days (35 hours)

Delivery

Classroom or remote

Audience

- Engineers interested in Thermography
- Engineers involved in condition monitoring
- Personnel who want to become certified to international standards (ISO-18436)

Objectives

- Set up and operate the thermal imaging equipment for safe thermographic data collection
- Verify the calibration of thermographic measurement systems
- Identify, prevent minimize and control poor data acquisition and error sources
- Apply a specified thermographic measurement technique
- Evaluate and report test results and highlight areas of concern

Program

Day 1
- Maintenance practices
- Condition monitoring
- Principles of infrared thermography

Day 2
- Thermal conduction
- Thermal convection
- Thermal radiation: Emitted, reflected and transmitted radiation, Radiation wavelengths and the electromagnetic spectrum, Emissivity and the Stefan-Boltzmann Law, Incident and excitant radiation

Day 3
- Equipment and data acquisition: infrared camera, lenses, color palette selection, Error source recognition, prevention and control, thermal camera, environmental and operational conditions, Image storage and management
- Safety rules and guidelines

Day 4
- Thermographic applications: basic principles of diagnostics (ISO 13379) and prognostics (ISO 13381) Machinery engineering principles, Electrical application, Mechanical application, Civil applications, Process applications
- General image interpretation guidelines

Day 5
- Report generation providing actionable information
- Exam (50 questions in 2 hours)

Learning path

Prerequisites
- 12 months of experience for certification
- Ishihara perception test

IRT I

Next steps

Benefits

Modern learning methodology: interactive simulations, 3D animations, and a wealth of case studies

ARP-A : Asset Reliability Practitioner for Reliability Advocate

ARP-A

Duration

3 days course (21 hours)

Delivery

Classroom or remote

Audience

- Engineers involved in reliability improvement
- Managers who are thinking of starting an initiative in reliability improvement
- Personnel who want to become certified to international standards (ED161)

Objectives

- Prepare the participant for the ED161 certification test
- Get a holistic view of how to improve reliability and plant performance
- Understand the implementation process and all the essential elements necessary to have a successful program

Program

Day 1

- Reliable plant and benefits
- Introduction to implementation
- Assessing the value
- Selling senior management
- Strategy
- Plantwide engagement

Day 2

- Getting maintenance under control
- Defect elimination
- Understanding failure
- Asset strategy
- Work management
- Spares management

Day 3

- Precision work
- Proactive asset care
- Condition monitoring
- Continuous improvement
- Exam (60 multiple-choice questions in 2 hours)

Learning path

Prerequisites

- 6 months of experience is required for certification

ARP-A

Next steps

ARP-E

Benefits

Videos covering every topic to be prepared and get the most from the course

ARMS

RELIABILITY COURSES

Linking Asset Strategy to Asset Health Management

ASM-CM101

Duration

3 days (21 hours) | 1 additional day for remote session

Delivery

Classroom or remote

Audience

- Reliability Engineers
- Asset Performance Managers
- Project Engineers
- Maintenance Analysts
- Maintenance Supervisors
- Design Engineers
- Plant Performance Engineers

Objectives

- Provide a logical pathway link from Asset Strategy to Asset Health Management.
- Perform worked examples leading from Scope and Criticality into RCM judgement for Maintenance Strategy Development and the key elements of Condition Monitoring.
- Learn the complete Condition Monitoring cycle encompassing reporting and review, and triggering RCA.
- See how RCA can be performed to add value into Asset Strategy and Asset Health framework.
- Leverage powerful software to act as a tool to quickly create Criticality Studies, Maintenance Strategies justification and add links to Condition Monitoring approaches and Root Cause Analysis.

Program

Day 1

- Introduction to Integrated Asset Performance Management
- Scope and Criticality
- Maintenance Strategy Development following an RCM approach
- Simulation of Run to Failure
- Preventative & Predictive Maintenance

Day 2

- Evaluate Options & Task Optimization
- Condition Monitoring Technologies

Day 3

- Reporting

Learning path

Prerequisites

MDS-CM101

Next steps

- RBD201: Improving Plant Availability with RBD
- REL201: Reliability Methods

Benefits

Provides all engineers with a key pathway for Asset Strategy & Asset Health development

Maintenance strategy development

RCM201

Duration

2 days (14 hours) | 1 additional day for remote session

Delivery

Classroom or remote

Audience

- Reliability Engineers
- Project Engineers
- Maintenance analysts or supervisors
- Design Engineers
- Plant Performance Engineers
- RCM Team Members

Objectives

- Learn how to develop logical, justified maintenance strategies following the Reliability Centered Maintenance (RCM) approach.
- Leverage powerful reliability software to optimize your plans in a simulated environment leading to effective plan implementation. Analyze and utilize failure data to drive improvement.
- Deliver successful outcomes and meet business objectives through quantifying and calculating business benefits and risk reduction.

Program

Day 1

- Analyzing failure data utilizing MTBF & MTTR
- Introducing the Weibull distribution and its benefits for Reliability data analysis.
- Practical exercises analyzing failure and suspensions data with Weibull.
- Introducing the RCM methodology approach for maintenance optimization.
- How to justify maintenance by linking through Business Goals & Asset Strategies.
- Identifying system boundaries, functional analysis & failure mode definitions.
- Applying failure consequences for cost & risk, and failure frequencies. Analyzing the Run-To-Failure strategy.
- Inspections, predictive maintenance & preventative choices. Understanding P-F intervals.

Day 2

- Understanding the complexities of calculating maintenance justification without computers.
- Building an RCM model from scratch. Performing task optimization as a group, identifying the optimal strategy & intervals, and justifying the reasons.
- Grouping of tasks to create maintenance plans.
- Preparing for implementation; load sheet into CMMS creation and preventative maintenance instruction documents.

Day 3 (optional)

- Further learning by doing exercises, add complexity
- Importing failure data, creating Weibull sets, linking to the RCM model

Learning path

Prerequisites

RCM201

Next steps

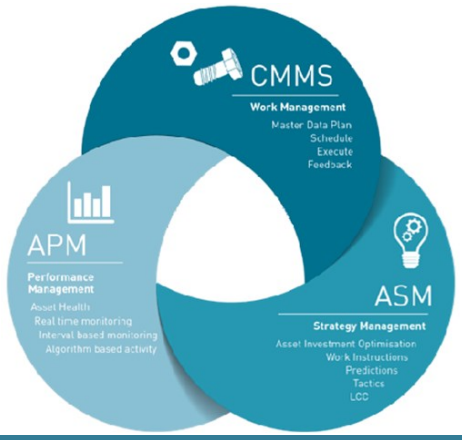
Key method specific courses:

- FMECA101
- RBD201

Benefits

Enables engineers to develop justified, optimized maintenance strategies

Asset Strategy Management for leaders



ASM101

Duration

6 hours

Delivery

Classroom or remote

Audience

- Reliability leaders,
- Maintenance and asset managers,
- Asset managers,
- Project managers,
- Operations managers,
- Continuous improvement managers,
- Strategy optimization managers

Objectives

- Broaden knowledge of the role of ASM in the asset management system and the value it delivers.
- Learn the key elements for effective reliability strategy development.
- Understand the foundations of ASM and how to implement them.

Program

- Establish current state of the reliability function in most industries and organizations
- Describe the elements of reliability strategy covering an assets life cycle
- Learn the key elements required for sound reliability strategy development or review
- Provide an overview of the Asset Strategy Management process
- Cover the three foundational phases of ASM; Build, Deploy, Sustain
- Explore the value in connected reliability strategies and how to achieve them
- Outline how ASM supports the development of a culture of reliability
- Study the implementation options for ASM

Learning path

Prerequisites

ASM101

Next steps

- Maintenance Strategy Development

Benefits

Provides a foundation for Reliability growth

Introduction to reliability engineering

REL101

Duration

1 day (7 hours) | 1 additional day for remote session

Delivery

Classroom or remote

Audience

- Graduate engineers
- Project engineers
- Asset managers
- Maintenance and reliability engineers
- Design engineers
- Operators, safety engineers, risk engineers
- Defect elimination managers

Objectives

- Gain a solid understanding of the essential reliability and maintainability concepts and principles
- Determine which key methods and tools to employ to achieve reliability improvement across the asset lifecycle
- Know what the objectives are of reliability management and how does the reliability discipline interact with the rest of the organization

Program

- Reliability Concepts
- Breaking The Reactive Cycle
- Benefits of Reliability Based Maintenance
- Definition of Reliability Terms
- Overview of key Reliability Engineering Tools:
  - Root Cause Analysis (RCA)
  - Reliability Centered Maintenance (RCM)
  - Life Cycle Costing (LCC)
  - Reliability Block Diagrams (RBD)
  - Asset Criticality
  - Failure Mode Effects & Criticality Analysis (FMECA)

Learning path

Prerequisites

REL101

Next steps

- Reliability specific courses

Benefits

Provides a solid foundation for Reliability growth across all levels

Root Cause Analysis

RCA201

Duration

2 days (14 hours) | 1 additional day for remote session

Delivery

Classroom or remote

Audience

- Supervisors, engineers, design engineers
- LEAN and 6 Sigma specialists,
- Maintenance trades,
- Operators, Administrators, Safety representatives,
- Continuous / Healthcare improvement specialists,
- Business Analysts,
- IT Professionals, HR Personnel.

Objectives

- Acquire the knowledge and skills necessary to facilitate an effective problem analysis.
- Create a common reality and gain buy-in from all stakeholders to effectively solve problems, through identifying all the solutions
- Lead and facilitate an RCA

Program

Day 1

- Problems
- Problem definition – what, when, where
- Why "who" is not important
- Causes and timelines
- 5 Whys and beyond
- Review of RealityCharting® software and practical experience using the software to generate charts and reports
- Cause and Effect Chart creation

Day 2

- The need for Evidence
- Solution brainstorming
- Solution qualification
- Selecting effective solutions
- Group facilitation skills
- Common Traps
- Putting it all together
- Effective Problem Solving Culture

Learning path

Prerequisites

RCA201

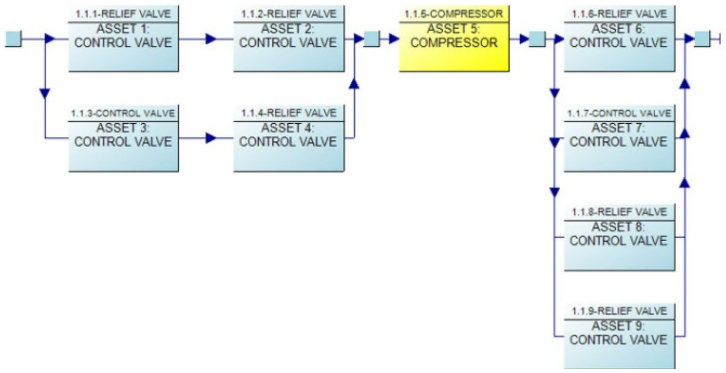
Next steps

- RCA Incident Investigation
- Super-User Courses RCA301 / RCA302

Benefits

First-hand experience of performing root cause analysis

Improving Plant Availability using Reliability Block Diagrams



RBD201

Duration

2 days (14 hours) | 1 additional day for remote session

Delivery

Classroom or remote

Audience

- Reliability Engineers
- Asset Performance Managers
- Project Engineers
- Maintenance Analysts
- Maintenance Supervisors
- Design Engineers
- Plant Performance Engineers

Objectives

- Engage in RAM (Reliability Availability Maintainability) modelling to drive plant improvements
- Learn how to perform system availability simulation modelling using Reliability Block Diagrams (RBD)
- Leverage powerful reliability software to create RBD quickly and efficiently with multiple features to replicate reality
- Perform numerous interactive real world exercises to fully understand the key factors in availability calculation and drive improvements to your system and plant performance

Program

Day 1

- Introduction to System Availability Analysis
- Types of Reliability Block Diagram modelling
- Creating Reliability Block Diagrams; Series vs Parallel
- How to represent Capacity or Throughput
- The Process; including Consequences & Simulation
- Alternate Scenario Analysis
- Interactive Exercises to Build-up the RBD complexity

Day 2

- RBD Software Exposure
- Adding Failure Modes & Maintenance
- Increasing Complexity with Nodes & Phases
- Interactive Exercises to Build-up RBD Skills
- Non Linear Capacity Loss
- Putting it all together
- Importing Data to Accelerate Model Building

Day 3 (optional)

- Further learning by building an RBD as a group using a client system

Learning path

Prerequisites

RBD201

Next steps

- Maintenance Strategy Development
- Advanced RBD Modelling

Benefits

Enables engineers to develop techniques for improving plant availability

For the things we have to learn
before we can do them,
we learn by doing them.

Aristotle

Training locations | Americas

A single email address to contact all Americas training centers:

BNTrainingNA@bakerhughes.com

ARGENTINA | Buenos Aires
Juana Manso 205
Piso 4, Edificio Puerto Leon
Puerto Madero
Ciudad Autónoma de Buenos Aires

BRAZIL | Campinas
Boa Vista 13067-230
Campinas / SP
IE: 244.677.912.110
CNPJ: 01.128.902/0002-51

CANADA | Leduc
3905 71 Ave
AB T9E OR8

COLOMBIA | Bogota
Carrera 7 # 123
35, Edificio Torre 123
4to y 5to piso
Bogotá D.C.

MEXICO | Queretaro
Campo Real 1692. Col. Ampliacion
Queretaro, Queretaro
76146

UNITED STATES | Houston
4425 WestWay Park Boulevard
Houston, TX

UNITED STATES | Minden
1631 Bently Parkway South
Minden, NV

Training locations | China & Asia Pacific

A single email address to contact all Asian training centers:

BNTrainingAsia@bakerhughes.com

AUSTRALIA | Perth
631 Karel Avenue,
Jandakot, West
WA 6164

AUSTRALIA | Sydney
Level 7, 275 Alfred Street
North Sydney, NSW 2060

CHINA | Shanghai
Huatuo Rd No. 1
Pudong, Shanghai
China 201203

INDONESIA | Jakarta
South Quarter Tower B, Lantai 18- 19, JL.
R.A. Kartini Kav. 8, Cilandak Barat
Jakarta Selatan – DKI Jakarta

JAPAN | Tokyo
4-16-13 Tsukishima
Daiwa Tsukishima
Chuo-ku, Japanabud

MALAYSIA | Kuala Lumpur
Level 19, Menara Tan & Tan,
207 Jalan Tun Razak
50400 Kuala Lumpur

PHILIPPINES | Muntinlupa
Filinvest One Building, North
Alabang Zapote Road corner
Northgate Ave, Filinvest
Alabang, 1781 Muntinlupa City

SINGAPORE | Singapore City
10 Lok Yang Way
Singapore 628631

SOUTH KOREA | Pangyo
Global R&D Center, 22
Daewangpangyo-ro,
Seongnam, South Korea

THAILAND | Rayong
267/373 Sukhumvit
Road, Map ta phut
Rayong, 21150, Thailand

VIETNAM | Hanoi
360 Kim Ma Street
Ba Dinh District
Hanoi, Vietnam

Training locations | Europe

A single email address to contact all European training centers:

BNtrainingEU@bakerhughes.com

AZERBAIJAN | Baku
BEGOC Business Center
Z. Aliyeva str. 93, AZ1000

FRANCE | Nantes
14 rue de la Haltinière
44300 Nantes

GERMANY | Frankfurt
Darmstädter Landstraße 116
60598 Frankfurt

HUNGARY | Budapest
East Gate Business Park,
Akacos HRSZ0221/12| 2151 Fot

ITALY | Florence
Via Perfetti Ricasoli, 78
Firenze, 50127

NETHERLANDS | Delft
Delftechpark 26
2628 XH Delft

NORWAY | Bergen
Ytrebygdveien 215
Blomsterdalen, 5258

SPAIN | Madrid
C/Ramirez de Arellano 35 planta 3
Puerto Roja - Madrid, 28043

TURKEY | Istanbul
Dereboyu Cad. Bilim Sok.No:5
Kat:7 Sisli - Istanbul, 34398

UK | Warrington
Unit 910, Birchwood Bvd
Birchwood, WA3 7QZ

Training locations | Middle East India Africa

A single email address to contact all MEIA training centers:

BNtrainingMEA@bakerhughes.com

ALGERIA | Algiers
Triangle building
Lot 18&19 micro zone d'activité
Hydra, Algiers

EGYPT | Cairo
Kattamaya – Old Ain Sokhna Road
KM#11 – industrial Area

INDIA | Mumbai
4th Fl Kensington Wing
Hiranandani Business Park Powai
Mumbai 400076 Maharashtra

IRAQ | Baghdad
Al Mansour, Al Amerat
District 601, Alley 11 House 39

KUWAIT | Kuwait City
Eastern Plaza Building
Commercial Bank Str. Plot No.8
East Al Ahmadi, Al Ahmadi
P.O.Box 9751, 61006

NIGERIA| Port Harcourt
7, Nkpogu Road,
Trans Amadi Industrial Layout,

OMAN | Muscat
Way #652 Building #481
2nd Floor Al Raid House, Qurum

PAKISTAN | Islamabad
Plot # 435, Street # 11
Sector I-9/2
Industrial Area Islamabad

QATAR | Doha
Al Jazeera Tower, Floor 29
Conference Center Street
Diplomatic Area , West Bay
PO Box 55771

SAUDI ARABIA | Dhahran
Dhahran Techno Valley
University Blvd

SOUTH AFRICA | Midrand
Unit 4, 86 Tsessebe Crescent
Corporate Park South Midrand

UAE | Abu Dhabi
MW4 Plot No 13A-A 16 St.
Mussafah Opposite to NPCC store

UAE | Dubai
Plot no – MO0531,
Road no. N 302,
Jebel Ali Free zone

ARMS Reliability training locations

A single email address to contact
all ARMS Reliability training centers:
ARMS.info@bakerhughes.com

AMERICAS

USA | Austin, TX

Canada | Edmonton

ASIA

Australia | Perth

Australia | Melbourne

Australia | Newcastle

Australia | Brisbane

EUROPE

UK | London

MIDDLE EAST

Saudi Arabia | Dhahran

ARMS Reliability trainings can be provided in any Bently Nevada training location and remotely.

What our customers say...

You cannot just learn by a lecture in a classroom, Skills Development Program is different, you learn with your bare hands, you apply what you learn onsite, you analyze, you write reports and you discuss them. We saw the results, it gave confidence in diagnostics and in decision making. It is very powerful.

Oil & Gaz company in the Middle East

An excellent and interactive course with a great combination of theory and hands on training. The course met all of our requirements and we look forward to applying ARMS technique at site.

Industrial company in Australia

The remote learning was the best virtual event we have experienced so far, after experiencing other trainings from other vendors, and virtual conferences that were not at all successful.

Power company in the US

There were two significant positive points. Firstly, workshops were very good and secondly, I have enjoyed learning by doing which made the training more practical and useful.

Oil company in North Europe

In-depth knowledge and practical experience of the instructor and on the other hands interactive sessions with a lot of cases simulations which made the training useful and efficient.

OEM in Asia

Very interesting and the best way to learn at a distance, without a doubt this is the future of training!

Oil company in Latin America

Fundamentals of vibration and phase explanations were practical. Moreover, methodologies of vibration diagnostics and use of graphs brought me more confidence for my job.

Gaz company in West Europe

Additional courses available | Basics of vibration & transducers, Fundamentals of vibration for portables, ADAPT 3701, System 1 v6.x, System 1 Fundamentals, Modal Analysis and Operating Deflection Shape ...

Baker Hughes

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