



Analyst Training and Qualification Program

**Windrock, Inc.
1832 Midpark Road, Suite 102
Knoxville, TN 37921**

**Phone: 865.330.1100
Fax: 865.330.1101
www.windrock.com**

Analyst Qualification Program Definition

The Analyst Qualification Program is designed to provide the analyst with a structured development program for the purpose of establishing, cultivating, and sustaining the necessary skills to provide quality data collection, data analysis, diagnosis and reporting services.

Program Benefits

Upon successful completion of the applicable qualification levels, the analyst will possess the necessary skills to effectively provide reciprocating machinery analysis.

Course Materials

Each student will receive a workbook and training materials specific to the registered course. These materials are intended to stimulate and assist in the learning process, as well as provide a valuable resource for reciprocating machinery analysis.

Training Examinations

All classes are scheduled from Monday morning through Thursday afternoon. Each student will participate in a training evaluation on the afternoon of the last day of class. The evaluation results will serve as a reinforcement tool for the materials covered that week, and can be used as a study guide for students participating in the formal qualification examination. The formal qualification examination will also include questions from previous levels of the same subject.

Qualification / Attendance Certificates

Each student who successfully masters the course content, and achieves a passing grade on the qualification exam, will be awarded a Qualification Certificate presented by Windrock Incorporated's Director of Technical Services. For students who are present for all class instruction, but choose not to take the formal test, Attendance Certificates will be provided.

Training Locations

In addition to regularly scheduled courses at our Knoxville, TN Training Center and the New Orleans, LA metropolitan area, any of the Qualification Courses can be conducted at the customer's location by one of our Senior Instructors. The cost for this service will be based on the number of days on site, trainer's travel time, travel and living expenses and necessary course materials. Please contact techservices@windrock.com for a formal quotation.

Program Modules

AQA1 (Win6320 or RTWIN 9260)

Introduction to Reciprocating Machinery Analysis

(Formerly "Start-up Assistance Training")

- Mechanical relationships
- Analyzer hardware familiarization
- Sensor identification and specifications
- Proper setup of the reciprocating machinery for analysis
- Analyzer setup
- Data collection techniques
- Analyzer equipment safety
- Data collection safety

All attendees in this course will receive a workbook, and notes. This course is suitable for a new user of the appropriate analyzer system. This course satisfies the pre-requisite for both the Engine Analyst and Compressor Analyst Qualification Programs.

AQA2 (Win6320 or RTWIN 9260 Advanced Software)

Advanced Software Features

Prerequisite: Successful completion of AQA1 or Analyzer startup assistance training and 1 year analyzer experience.

- Database maintenance
- Complete software review
- Diagnostic features
- Sensor identification and specifications
- Hardware configuration editing
- Advanced reporting techniques

All attendees in this course will need a laptop with the most recent software update and machine database. Attendees will also receive a workbook. The successful completion of this class is a pre-requisite for qualification courses AQC3 and AQE3.

AQC1 (Basic Compressor)

Basic Reciprocating Compressor Analysis

Prerequisite: Successful completion of AQA1 or currently using the analyzer and have successfully completed the appropriate Analyzer Startup Assistance Training. Requires instructor interview if AQA1 was not taken.

- Definitions
- Physical characteristics
- Data collection safety
- Sensor point selection
- Visual inspection procedures
- Basic compressor theory
- Determining toe pressures, compression ratio, volumetric efficiencies, horsepower
- Pressure vs. crank-angle
- Vibration vs. crank-angle
- Ultrasonic vs. crank-angle
- Performance report
- Panel report
- Field reporting

All attendees in this course will receive a workbook. This course provides preparation for the qualification examination for Reciprocating Compressor Machinery Analyst Category I.

AQC2 (Intermediate Compressor)

Intermediate Reciprocating Compressor Analysis

Prerequisite: Successful completion of AQC1 and Qualification Exam or have completed a qualified Basic, Intermediate, or Advanced Compressor analysis course within the last year and have passed the AQC1 Qualification Exam.

- Latest software features review
- Compressor theory
- Channel resonance identification and correction
- Theoretical pressure - volume models
- On-machine data evaluation
- Log P vs. Log V plots
- Leak index
- Rod load
- Rod run out
- Rod wear
- Rod reversals
- Intermediate pattern interpretation
- Priority and probability assignment
- Formal report procedures

All attendees in this course will need a laptop with the most recent software update and machine database. Attendees will also receive a workbook. This course provides preparation for the qualification examination for Reciprocating Compressor Machinery Analyst Category II.

AQC3 (Advanced Compressor)

Advanced Reciprocating Compressor Analysis

Prerequisite: Successful completion of AQA2 and AQC2 Qualification Exams or have completed a qualified Intermediate, or Advanced Compressor analysis course within the last year and have passed the AQA2 and AQC2 Qualification Exams.

- Latest software features review
- Advanced compressor theory
- Gas properties
- Formulas used in performance evaluations
- Pulsation
- Crank-angle bearing pattern diagnosis
- Operating clearance verification and diagnostics
- Advanced leakage diagnostics
- Detailed performance data collection and horsepower curve verification
- Advanced pattern interpretation
- Detailed performance testing
- Compressor economics

All attendees in this course will need a laptop with the most recent software update and machine database. Attendees will also receive a workbook. This course provides preparation for the qualification examination for Reciprocating Compressor Machinery Analyst Category III.

AQE1 (Basic Engine)

Basic Reciprocating Engine Analysis

Prerequisite: Successful completion of AQA1 or currently using the analyzer and have successfully completed the appropriate Analyzer Startup Assistance Training. Requires instructor interview if AQA1 was not taken.

- Database setup review
- Engine systems visual inspection procedures
- Basic engine theory (Spark ignited and Diesel)
- Sensor point selection
- Data collection
- Pressure vs. crank-angle
- Pressure vs. volume
- Vibration vs. crank-angle
- Ultrasonic vs. crank-angle
- Ignition analysis
- Engine mean peak pressure balancing

All attendees in this course will receive a workbook. This course provides preparation for the qualification examination for Reciprocating Engine Machinery Analyst Category I.

AQE2 (Intermediate Engine)

Intermediate Reciprocating Engine Analysis

Prerequisite: Successful completion of AQE1 and Qualification Exam or have completed a qualified Basic, Intermediate, or Advanced Engine analysis course within the last year and have passed the AQE1 Qualification Exam.

- Latest software features review
- Intermediate engine theory (SI and CI)
- Formulas used in performance evaluations
- On machine data evaluation
- Application of spike filtering
- Calculating phase relationships
- BSFC measurement
- Creating fuel curves
- Mechanical efficiency determination
- Intermediate engine diagnostics
- Intermediate pattern interpretation
- Horsepower balancing
- Priority and probability assignment
- Formal report procedures

All attendees in this course will need a laptop with the most recent software update and machine database. Attendees will also receive a workbook. This course provides preparation for the qualification examination for Reciprocating Engine Machinery Analyst Category II.

AQE3 (Advanced Engine)

Advanced Reciprocating Engine Analysis

Prerequisite: Successful completion of AQA2 and AQE2 Qualification Exams or have completed a qualified Intermediate, or Advanced Engine analysis course within the last year and have passed the AQA2 and AQE2 Qualification Exams.

- Latest Software features review
- Advanced engine theory (SI and CI)
- Formulas used in performance evaluations
- Advanced engine diagnostics
- Engine Log P vs. Log V
- Crank-angle main bearing and rod bearing analysis
- Advanced engine pattern analysis
- 1st and 2nd derivatives
- Power cylinder compression modeling
- Advanced combustion characteristics
- Data export and spreadsheet report creation

All attendees in this course will need a laptop with the most recent software update and machine database. Attendees will also receive a workbook. This course provides preparation for the qualification examination for Reciprocating Engine Machinery Analyst Category III.

AQV1 (Basic FFT)

Basic Reciprocating Machinery Spectrum /FFT Vibration Analysis

Prerequisite: Successful completion of AQA1 or currently using the analyzer and have successfully completed the appropriate Analyzer Startup Assistance Training. Requires instructor interview if AQA1 was not taken.

- Basic Vibration
 - Time Waveform, FFT
 - Period, Phase, Frequency (CPM, Hz, Orders)
 - Amplitude (peak, peak-peak, rms)
 - Unit of Measure (displacement, velocity, acceleration)
 - Vibratory force
- Data Acquisition
 - Selecting a unit of measure
 - Transducer selection
 - Transducer mounting
 - Data collection principles
 - Safety
- Data Processing
 - Acquisition time
 - Resolution
 - Fmax
 - Basic Averaging
 - Window selection
- Route and point setup
 - Auto-generate, editing, reordering points
 - Route planning
 - Machine knowledge requirement
 - Basic Alarm Settings
- Fault Analysis
 - Basic Spectrum (FFT) analysis
 - Basic Time Waveform analysis
 - Basic Fault signatures (unbalance, misalignment, blade pass, Pulsation)
- Plot and report creation

All attendees in this course will need a laptop with the most recent software update and machine database. Attendees will also receive a workbook. This course provides preparation for the qualification examination for Reciprocating Machinery Vibration Analyst Category I.

AQV2 (Advanced FFT)

Advanced Reciprocating Machinery Spectrum /FFT Vibration Analysis

Prerequisite: Successful completion of AQV1 and Qualification Exam or have completed a qualified Basic Reciprocating Machinery Spectrum / FFT Vibration analysis course within the last year and have passed the AQV1 Qualification Exam. Requires instructor interview if AQV1 was not taken.

- Advanced Vibration
 - Time Waveform, FFT
 - Period, Phase, Frequency (CPM, Hz, Orders)
 - Amplitude (peak, peak-peak, rms)
 - Unit of Measure (displacement, velocity, acceleration)
 - Vibratory force
 - Sidebands
- Data Processing
 - Synchronous Time Averaging
- Route and Point setup
 - Alarm setting evaluation
 - Band setup
- Fault Analysis
 - Advanced Spectrum (FFT) analysis
 - Advanced Time Waveform analysis
 - Calculating fault frequencies
 - Advanced Fault signatures (unbalance, misalignment, vane/blade pass, Pulsation, bar pass, electrical, rolling element bearings, sleeve bearings, gears, belts)
- Condition Evaluation
 - Chart application
 - Using Historical vibration levels
- Machine Testing
 - Periodic Monitoring
 - Acceptance Testing
 - Impact Testing
 - Phase Measurement
 - Frame Movement
 - Cylinder Stretch
 - Pulsation
 - Transient Data collection and Analysis
- Plot and Formal Report creation

All attendees in this course will receive a workbook. This course provides preparation for the qualification examination for Reciprocating Machinery Vibration Analyst Category II.