Apergy™ | Unlocking Energy

Premium Portable Monitoring for Reciprocating and Rotating Machinery

WINDROCK 6400 PORTABLE ANALYZER

Compressors | Engines | Fans | Motors



The **Windrock 6400 portable analyzer** system puts next-generation analyzer technology in the palm of your hands. In utility, performance and efficiency it makes portable machine monitoring and analysis more practical and effective than ever before.

- Machine Protection
- Condition Monitoring
- Economic Evaluation
- Performance Analysis

Windrock

WINDROCK 6400: BENEFITS OF MACHINERY ANALYSIS

The Windrock 6400 portable analyzer system is an indispensable tool for compression and combustion machinery reliability programs. It provides fundamental information used to assess the mechanical condition and performance of reciprocating compressors and engines, as well as rotating equipment. The 6400 system also provides early warnings of potentially catastrophic running conditions and gives actionable economic data to support maintenance and operational decision-making.

Monitor Mechanical Condition

Effective reliability programs depend on accurate evaluation of equipment health. For reciprocating compressors and engines, Windrock 6400 systems are used to assess the mechanical condition of machinery, identifying conditions such as cylinder leakage, worn parts and bearing issues. In addition to manufacturing the tools to monitor equipment health, Windrock provides the expertise to assess current and future conditions. The 6400 analyzer and Windrock MD software use automated diagnostics to give a non-intrusive mechanical evaluation of equipment condition.

In-depth Performance Analysis

The 6400 system ensures your machines are operating as designed, even when environmental and process conditions change. It evaluates power production/consumption, gas throughput and efficiency and compares actual operation against theoretical models. The 6400 system is commonly used to evaluate control system data, such as power or capacity loading curves, to ensure that actual performance matches the anticipated operational model.

Protection Against Catastrophic Failure

By evaluating key machinery parameters with every revolution, the 6400 system is able to identify existing machinery deficiencies or operating conditions that may lead to a catastrophic event. In reciprocating machinery, indications of developing malfunctions are often masked within normal operating signals. The 6400 system can precisely distinguish between normal and abnormal to identify developing problems. In addition, the 6400 is able to identify dangerous operating conditions that can progress into malfunctions before the fault develops.

Support Economic Decision-making

With the Windrock 6400 system, you can measure the efficiency of compressors and drivers to compare the economic return of different types of units across facilities or enterprises. With this information, users can make informed decisions about how to reduce fuel or electricity consumption while maximizing system throughput. The Windrock system also calculates performance degradation due to part wear and malfunctions, such as valve leakage, which can be used as an economic basis for performing repairs.

TECHNOLOGY OVERVIEW

Windrock 6400 analyzers measure dynamic data relative to crank position and then apply the principles of thermodynamics and science to precisely assess machinery condition and performance. The portable analyzer utilizes multiple sensor technologies to collect data degree-by-degree with respect to crank-angle. Measurement points include in-cylinder pressure, vibration on the frame, crosshead and cylinder, ultrasonic on the valves and injectors, proximity of rod movement and angular velocity of the crankshaft. Using gas laws, equations of state and proprietary diagnostics, Windrock analyzers and software are able to assess the mechanical condition, performance and economic return of reciprocating compressors and engines.

Windrock analyzers also incorporate tools to evaluate rotating equipment. In additional to the crank-angle-based vibration necessary for reciprocating machinery evaluation, Windrock analyzers incorporate the time waveform and FFT tools for evaluation of rotating machinery such as pumps, fans and motors. Advanced features are included to analyze the condition of turbomachinery, either directly or connecting to existing protection systems. All the capabilities of Windrock portable analyzers, as well as Windrock online systems, come together in Windrock MD software. This application automatically makes performance calculations, provides plotting tools, runs what-if scenarios, automates reporting and gives automatic diagnostics to help the analyst. It also allows users to easily transfer data among colleagues and industry experts for remote analysis. The Windrock approach does not rely on process parameters and apply assumptions about operating conditions. Instead, we measure the internal operating conditions and apply science to make assessments. For this reason, Windrock portable analyzers are the trusted choice for compressor and engine OEMs, equipment packagers, aftermarket parts companies and consulting service organizations to provide unbiased, fact-based analysis.



COMMON PROBLEMS IDENTIFIED WITH PORTABLE ANALYSIS

Operational Impact And Economic Improvement

IDENTIFIED MALFUNCTION	OPERATIONAL IMPACT	POTENTIAL ECONOMIC IMPROVEMENT
RECIPROCATING COMPRESSOR		
Broken Suction Valve	Increased Energy Costs	$2,000 to $10,000 Per Year
Clogged Suction Valve	Reduced Flow and Lost Production	Up to $2M Per Year
Broken Discharge Valve	Increased Energy Costs	$5,000 to $25,000 Per Year
Broken Piston Rings	Reduced Flow and Lost Production	$5,000 to $10,000 Per Year
Broken Rider Bands	Piston/Liner Rebuild	$10,000 to $50,000 Per Event
Loss of Crosshead Integrity	Catastrophic Failure	Up to $1M Per Event
LARGE BORE ENGINE		
Uneven Engine Balance	Increased Fuel Economy	$10,000 to $50,000 Per Year
Poor Quality of Combustion	Excessive Emissions	NOx down to 1.0 g
Power Cylinder Detonation	Increased Maintenance Costs	$20,000 to $30,000 Per Head
Crank Shaft Failure	Catastrophic Failure	Up to $2M Per Event



CASE STUDY

Windrock Technical Services Saves Money & Increases Capacity

Background

A major oil and gas producer was seeking ways to reduce maintenance costs and maximize natural gas pumping capacity. The producer primarily utilized high-speed reciprocating engine/compressor assemblies for their compression processes and had historically operated under a preventative maintenance schedule. Performing routine machine maintenance based on unit operating hours resulted in unnecessary maintenance, unexpected downtime and poor unit efficiencies.

Solution

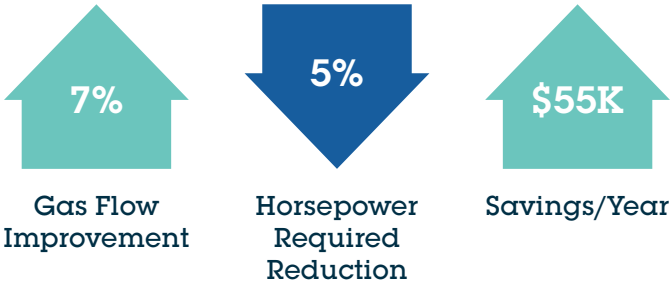
The producer turned to Windrock for assistance to assess the health of their machine, quantify machinery performance and guide maintenance efforts and expenditures. Windrock performed onsite engine and compressor diagnostics at a station with 5 engine/compressor units. After analyzing the data collected Windrock identified leaking discharge valves on one compressor unit and restricted suction valves on another compressor unit. Both machines had been operating with the faults undetected.

Results

Upon completion of the recommended repairs, all units were analyzed again. The unit with leaking discharge valves showed a 7% improvement in gas flow with a 5% reduction in the amount of horsepower required. With the unit in operation 24/7, the producer was able to document a savings of $55,500[1] per year in fuel costs by replacing two discharge valves.

Replacing the restricted suction valves on the second compressor resulted in a 39% improvement in gas flow with only a 5% increase in the amount of horsepower required. Under the new operating conditions, the producer was able to pump the same amount of gas for $30,000[2] less per year. More importantly, the resulting increased capacity was worth $1,485,000[3] in potential revenue for the producer. Windrock's Engine & Compressor Diagnostics saved the producer over $85,000 per year and provided a significant boost to their revenue earning.

UNIT 1



UNIT 2



NOTES:
1. Based on a flow rate of 13.29 MMSCFD and an average fuel cost of $4/MSCF.
2. Based on a driver cost of $0.032/HP-hr to pump 7 MMSCFD for a year.
3. Based on a 2 MMSCFD increase in capacity for a year and an average sale price of US $2.00/MMBtu.

WINDROCK 6400 MODELS

Model 6400 PA Performance Analyzer

The flagship Windrock analyzer used worldwide by reliability experts to evaluate reciprocating compressors and engines, as well as rotating machinery. The 6400 PA provides the tools to evaluate mechanical condition, equipment performance and economic return, as well as identify early development of potentially catastrophic conditions. With an optional upgrade, the 6400 PA can also evaluate the health of turbomachinery.

Model 6400 MA Maintenance Analyzer

Designed specifically for the maintenance troubleshooter, this two-channel instrument is a cost-effective tool that allows technicians to strategically detect and isolate mechanical faults of compressors and engines. The 6400 MA is an ideal maintenance tool for any site with critical reciprocating machinery.

Model 6400 VA Vibration Analyzer

A four-channel vibration analyzer that combines simultaneous data collection and spectrum analysis capability with additional features such as an oscilloscope mode, cross channel phase analysis and the ability to capture transient events in one handheld instrument.

Model 6400 CA Combustion Analyzer

This single-channel power cylinder balancer and ignition analyzer reduces engine detonation and misfires, while decreasing emission levels. A “must have” tool for operators and mechanics responsible for maintaining engine health, the instrument guides users through engine balancing and ignition analysis processes.

Model 6400 Diesel Analyzers

Windrock also offers a full line of analyzers specifically designed and configured for comprehensive diesel engine analysis. These models evaluate the mechanical condition and performance of large bore diesel engines used in rail, marine and power generation applications.



Windrock MD Software

All Windrock analyzers utilize innovative Windrock MD software for trending, reporting and analysis. Windrock MD software serves as a single data repository for all reciprocating and rotating information, allowing data to be easily shared between analysts for collaboration and consultation with industry experts. Windrock MD software also is the analysis application used with Windrock Platinum and Spotlight systems.



New Ultrasonic/Infrared Sensor



New Wireless Encoder

FEATURES AT A GLANCE

	6400/PA	6400/MA	6400/CA	6400/VA
BASIC ANALYSIS FUNCTIONS:				
Number of Input Channels	4 Plus Trigger	2 Plus Trigger	1 Plus Trigger	4 Plus Trigger
Hazardous Area Approval (Class I, Div. II, Groups A, B, C and D)	Optional	Optional	Optional	Optional
902-921 MHz Wireless Link to 6400 Analyzer	Standard	Standard	Standard	Standard
COMBUSTION ANALYSIS FUNCTIONS:				
Wireless Platinum or E-Guard Interface for Balancing	Optional	Optional	Optional	N/A
Peak Pressure and Balancing Functions, Statistics and Reporting	Standard	Standard	Standard	N/A
Cylinder Pressure Tracking (Up to 10 User-identified Crank Angles)	Standard	Standard	N/A	N/A
Pressure vs. Crank Angle Pattern/Pressure vs. Volume Pattern	Standard	Standard	N/A	N/A
1st & 2nd Derivative Plots	Standard	Standard	N/A	N/A
Engine Performance Report	Standard	Standard	N/A	N/A
MECHANICAL ANALYSIS FUNCTIONS:				
Secondary Ignition Statistics and Patterns	Standard	Standard	Standard	N/A
Primary and Secondary Ignition Data vs Crank Angle	Standard	Standard	Optional	N/A
Vibration (High, Low & Raw) vs. Crank Angle	Standard	Standard	N/A	Standard
Ultrasonic vs. Crank Angle	Standard	Standard	N/A	Optional
Vibration vs. Time/FFT Functions	Standard	Optional	N/A	Standard
Advanced Vibration Analysis (Transient & Orbital)	Optional	N/A	N/A	Standard
Infrared Temperature	Standard	Standard	N/A	Optional
COMPRESSION PERFORMANCE FUNCTIONS:				
Horsepower Calculations/Total Load	Standard	Standard	N/A	N/A
Compressor Performance Report (Calculated Capacities, Volumetric Efficiencies, Valve Losses, Flow Balances, Rod Loads, Calculated Clearances, Theoretical Temperatures, Leak Index, Efficiency)	Standard	N/A	N/A	N/A
Theoretical Overlay With Pressure vs. Crank Angle Pattern	Standard	N/A	N/A	N/A
Pressure vs. Crank Angle Pattern/Pressure vs. Volume Pattern	Standard	Standard	N/A	N/A
Log Pressure vs. Log Volume Pattern	Standard	N/A	N/A	N/A
Rod Load vs. Crank Angle Pattern	Standard	N/A	N/A	N/A
ECONOMIC EVALUATION:				
Unit Operating Performance	Standard	N/A	N/A	N/A
Cylinder Leakage Costs (Valves and Rings)	Standard	N/A	N/A	N/A
BSFC Calculation	Standard	Standard	N/A	N/A
Bypass Valve Leakage Calculation	Standard	N/A	N/A	N/A

WINDROCK
6400 MODELS



The Windrock 6400 system is part of a full line of advanced machine monitoring tools and analytical services from Windrock.

The 6400 system is remote-analysis ready – designed for efficient collaboration using your internal analysis personnel or experts from the Windrock Technical Services team.

- Machine Protection
- Performance Analysis
- Condition Monitoring
- Economic Evaluation

For solutions that make machines more reliable, processes more productive and your operations more profitable, get in touch with Windrock. We're ready to help you get the benefits of next-generation analysis today.

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