Apergy™ | Unlocking Energy

Premium Online Monitoring for Reciprocating Machinery

WINDROCK PLATINUM™

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

Windrock

THE PLATINUM SYSTEM: PROTECT. SAVE. OPTIMIZE.

Windrock Platinum provides continuous monitoring and in-depth condition information to protect critical machinery, improve safety, increase reliability and availability, and make more cost-effective maintenance decisions.

Windrock systems do not simply rely on static data and make assumptions about idealized operation. Platinum measures dynamic data and then apply the principles of thermodynamics and science to precisely assess machinery condition.

WHY MONITOR YOUR MACHINERY WITH A PLATINUM SYSTEM?

Protection against catastrophic failure

A Platinum system monitors key machinery parameters with every revolution of the machine. Vibration levels are evaluated and safety related parameters and measurements such as rod load and reversal are calculated during each rotation. Through onboard relays, it can communicate warnings and alarms to machinery control systems for alerts or shutdowns if catastrophic failure is imminent. The event recorder and playback capabilities allow in-depth degree-bydegree analysis of abnormalities.

Monitor mechanical condition

Effective reliability programs depend on accurate evaluation of equipment health. In addition to manufacturing the tools to monitor the health of reciprocating and rotating machines, Windrock provides the expertise to assess current and future conditions. The Platinum system's automated diagnostics provide a non-intrusive mechanical evaluation of the health of wear components, including valves, rings, packing, piston liners and rider bands.

In-depth performance analysis

The Platinum 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 the operation against theoretical and OEM designs. Additionally, the system performs valve efficiency comparisons, load step curve verification, clearance validation and rod load and reversal monitoring.

Support Economic Decision-making

With Platinum systems, you can measure the efficiency of compressors and related drivers to compare the economic return of different types of units across stations or enterprises. Using this information, you can make informed decisions on how to reduce fuel or electricity consumption while maximizing system throughput. A Platinum 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.

COMPRESSOR MONITORING

Accurate protection and assessment of a reciprocating compressor requires high-speed measurement and processing of dynamic data - most important is in-cylinder pressure relative to crank-angle. Used with thermodynamic calculations, pressure measurements provide the basis for total machinery monitoring, including protection, health, performance and economics. Vibration and Rod Position measurements play critical roles in machinery protection and condition monitoring.

	PRESSURE	VIBRATION	ROD POSITION
PROTECTION			
Cross-Head		X	X
Frame		X	
Rod Load/Reversal	X		
Over Pressure	X		
Rod Looseness		X	X
CONDITION MONITORING			
Valve, Ring, Packing Leakage	X		
Rider Band Wear			X
Bearing Wear		X	
Liner and Piston Wear		X	
Rod Wear			X
Internal/External Looseness		X	
PERFORMANCE MONITORING			
Power Consumed	X		
Gas Throughput	X		
System Efficiency and Validation	X		
ECONOMIC MONITORING			
Compressor & Driver Efficiency	X		
Recirculation Losses	X		

Platinum systems are Class 1, Division 2 hazardous area compliant.
Windrock compressor monitoring technology is protected under US Patent #6292757.

SENSORS & MEASUREMENTS

Modular design and extensive data acquisition options allow Platinum systems to be custom-configured for your application.

A. Cylinder Pressure Sensors: head end and crank end cylinder pressures

B. Head Accelerometer: acceleration and velocity for valve, liner and piston monitoring, as well as cylinder stretch

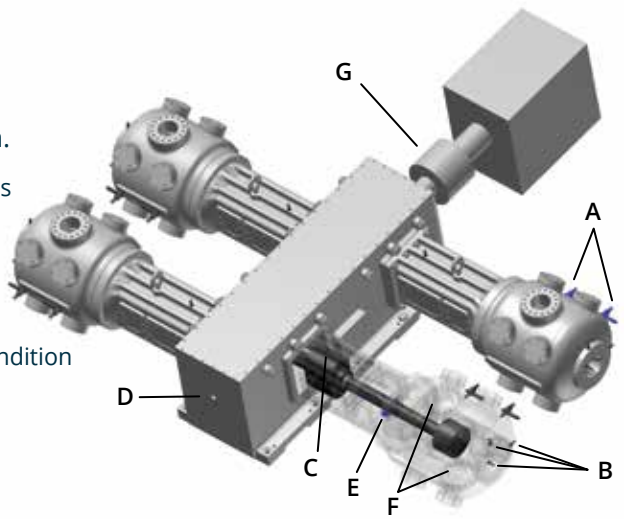
C. Crosshead Accelerometer: acceleration and velocity for vibration associated with high or low frequency impacts or loose components

D. Opposing Frame Accelerometer: frame integrity and main bearing condition

E. Piston Rod Proximity Probe: movement for rod drop, rod run-out and rider band wear

F. Temperature: suction and discharge

G. Magnetic Pickup : compressor speed



CASE STUDY

Leak Detection Yields Savings

Background & Challenge

A major oil refinery uses electric motor-driven reciprocating compressors for their hydrogen processes with energy costs being a significant operating expense. Their critical compressors are protected and monitored with Windrock Platinum online systems, providing real-time measurement of head-end and crank-end pressure, crosshead and frame vibration, rod drop and rod run out.

The refinery received a warning from the Platinum system when the Leak Index exceeded the alarm set point of 4.5 on the crank-end of one cylinder. The proprietary Leak Index algorithm is derived from pressure measurements and is used to identify suction and discharge leaks, as well as ring leakage. The system trends Leak Index for each cylinder over time in Windrock MD software and provides automatic warnings to the facility. As seen in the plot (Figure 1), the crank end of the cylinder was trending at an average of 3.8 before it increased above the yellow warning line.

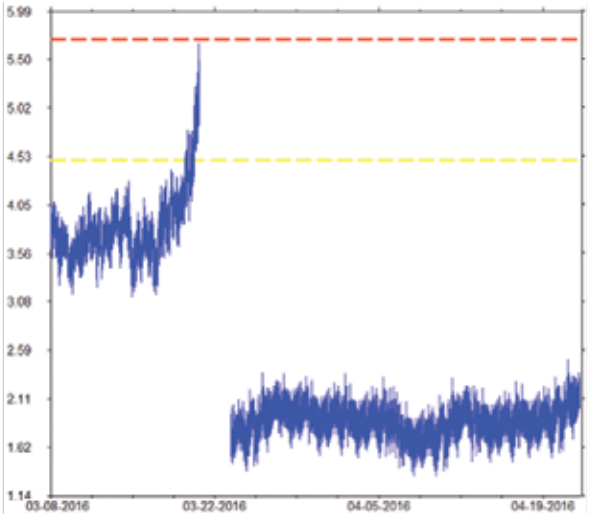


Figure 1 – Leak Index trend (repair was completed during the gap in the plot)

Response

The refinery used automated diagnostics provided by the Platinum system and Windrock MD software to identify a discharge valve leak (Figure 2). Additional Windrock system tools, including P-V analysis and performance data, confirmed the diagnosis. The software also quantified production and economic losses caused by gas recirculation within the cylinder. Using this information, the refiner scheduled a fast-track repair, limiting downtime of the critical unit while restoring the required gas throughput.

Results

After repairs, the Leak Index verified the problem was corrected and leakage was eliminated (Figure 3). Performance and economic reporting from the Platinum system confirmed a 7.5% improvement in gas flow with a 5.6% reduction in required horsepower. With the unit in operation 24 hours per day, electric cost savings were calculated at $12,915 per month[1]. Quick repair turnaround also limited production losses and avoided the potential development of a catastrophic machinery failure.

[1] *US dollars, based on $0.10 per kWh.*

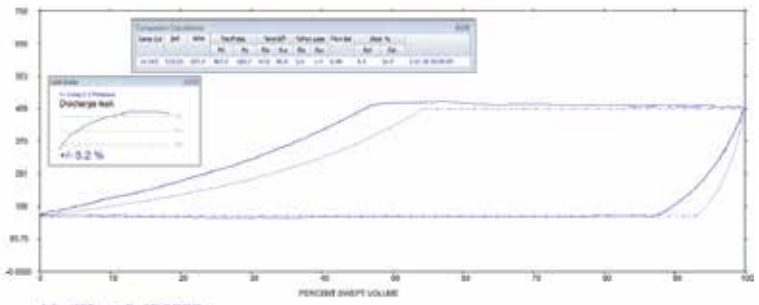


Figure 2 - Leak Index showing discharge leak

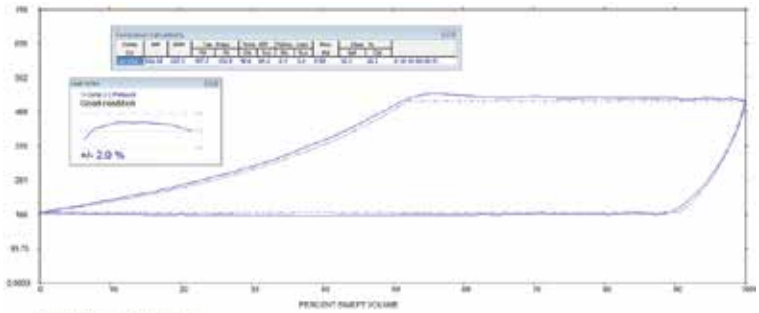


Figure 3 - Leak Index showing good condition after repair

ENGINE MONITORING

Platinum online engine monitoring systems utilize power cylinder pressure and vibration measurements to protect, assess health, monitor performance and derive economic data. The addition of frame and turbocharger vibration measurements provides additional protection and condition monitoring.

An AutoBalance® module works in conjunction with the Platinum system to provide automatic, continuous, peak pressure balancing for large bore, natural gas-fired engines. Maintaining a properly balanced engine reduces emissions, cuts fuel consumption, reduces mechanical wear, decreases maintenance costs and improves overall machine reliability.

	PRESSURE	VIBRATION	ROD POSITION
PROTECTION			
Unstable/Poor Combustion	X	X	X
Excessive Frame Vibration		X	
Turbocharger and Component Failure		X	
CONDITION MONITORING			
Quality of Combustion	X		
Worn valve train components	X	X	
Liner and Piston Wear		X	
Internal / External Looseness		X	
Bearing Wear		X	
PERFORMANCE MONITORING & IMPROVEMENT			
Power Consumed	M		
Overall Engine Balance	M		I
Emission Reduction			I
Maintenance Optimization			I
Increased Fuel Efficiency			I
ECONOMIC MONITORING			
Engine Efficiency	X		

Windrock AutoBalance® engine system is protected under US Patent #8522750.
Please note that in the table, M represents Monitoring and I represents Improvement.

SENSORS & MEASUREMENTS

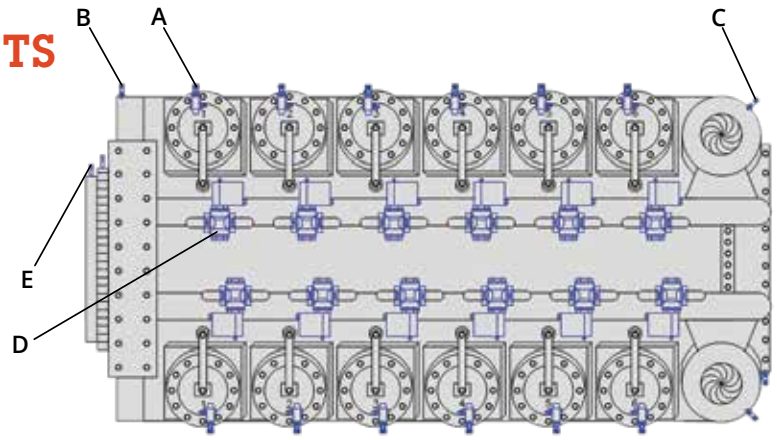
A. Power Cylinder Sensor:
dynamic in-cylinder pressure

B. Frame Velocity Sensor:
frame integrity and bearing condition

C. Turbocharger Accelerometer:
bearing condition monitoring

D. AutoBalance® Fuel Valves:
adjusts cylinder fuel flow to maintain engine balance

E. TDC and Degree Magnetic Pickup:
engine speed and angular velocity



CASE STUDY

Systems Boost Engine Availability

Background & Challenge

A midstream processor of raw natural gas uses large-bore, slowspeed integral engines for compression during gas processing. The company had repeated head and power cylinder failures, resulting in costly maintenance and production downtime. They tried to maintain adequate performance using manual balancing. However, manually balancing an integral engine is a potentially hazardous, time-consuming process. It is often performed at inadequate intervals to compensate for changes in compressor load, process parameters, ambient condition or variations in BTU fuel content.

Response

To improve performance and availability, the processor turned to Windrock's Platinum online system and AutoBalance® system. The patented AutoBalance® system continuously balances the engine load across all cylinders using peak firing pressure data from the Platinum system. During operation, poor combustion quality was identified in a cylinder (see high peak firing pressure angle deviation in Figure 1). An increase in this parameter indicates the cylinder is not firing consistently from cycle to cycle, resulting in excessive wear, poor fuel economy, and increased emissions.

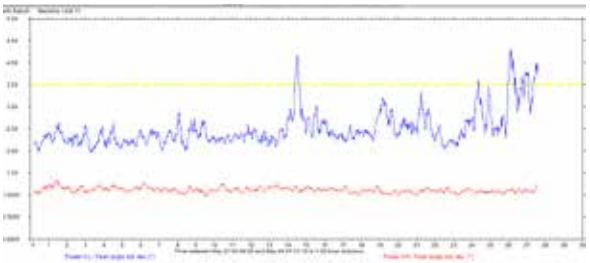


Figure 1 - Standard Deviation of peak firing pressure angle

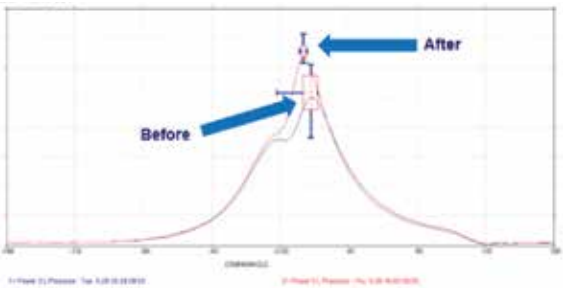


Figure 3 - Before and after power pressure curves

Based on the warning and data review, the unit was shut down and pre-combustion chambers were examined. The existing pre-combustion chamber port was found to be significantly worn (Figure 2), resulting in poor combustion since the flame front from the pre-combustion chamber does not propagate through the air/fuel mixture in the cylinder as designed.

Results

After replacing the pre-combustion chamber and restarting the unit, pressure curves for the cylinder were compared (Figure 3). These plots include the "stat boxes" that represent the maximum deviations and the standard deviations of both the peak firing pressure and the crank angle at which the PFP occurs over a 30-cycle average. The stat box improvement signifies the cylinder is now firing consistently.

Figure 4 shows how the fuel system was compensating for the poor pre-combustion chamber performance with the valve position. After repair, the system was able to maintain its share of the engine load with less fuel, improving fuel economy and reducing emissions. The producer documented average savings of 7.8% fuel per engine using the Windrock AutoBalance system. Additionally, the machine was no longer exposed to excessive wear forces, such as cylinder detonation.

Removed *New*

Figure 2 - Old and new pre-combustion chamber ports

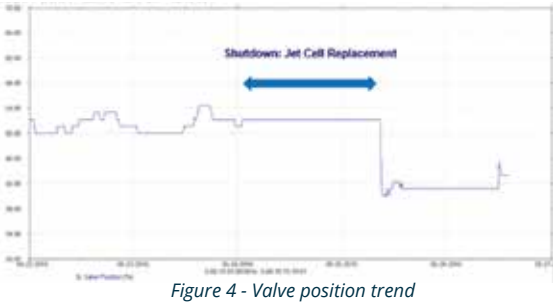


Figure 4 - Valve position trend

SPECIFICATIONS TABLE

Model	Description	Size	Weight	Power
A3615	System Controller	6.75"x4.4"x4.3"	2lb. 13oz.	28W
A3610	Power Conditioner	6.75"x4.4"x4.3"	1lb. 15oz.	186W
A3620	Phase Module	6.75"x4.4"x4.3"	1lb. 12oz.	22W
A3625	HMI	14"x11.25"x1"	5lb. 4oz.	12W
A3630	Input Module	14.875"x4.4"x4.3"	5lb.	68W

System Controller (A3615)
64GB Solid State Disk Drives (Qty 2)
Ethernet 10/100/1000 RJ-45 Connection
RS-485 Serial Connections (Qty 2)
USB-B Connection
SD Card Slot
USB-A Connections (Qty 8)
HMI Connection
OLED Local Diagnostics Display

Power Conditioner (A3610)
Output Voltages (VDC): 15, 6.5, 5, -24
Power Status LED Indicators
OLED Local Diagnostics Display

HMI (A3625)
15-Inch Diagonal Screen
1024x768 pixels
700 Contrast Ratio
80 Degree Viewing Angle
LED Backlight with 50,000 hour operating life
USB-A Connections (Qty 8)
IP-64 Rated
Touchscreen

Phase Module (A3620)
Timing Light Connector
Buffered TDC Out Connector
OK Relay N.O. & N.C. Contacts (30VDC / 1A, 125VAC / 0.3A)
Warning Relay N.O. & N.C. Contacts (30VDC / 1A, 125VAC / 0.3A)
Danger Relay N.O. & N.C. Contacts (30VDC / 1A, 125VAC / 0.3A)
TDC Input
Degree Input
Qualifier Input (4-20mA, Accelerometer, Prox Inputs Supported)
Status LED Indicators
OLED Local Diagnostics Display

Input Module (A3630)
Up to 16 Channels per Bay
16-bit Resolution
80 KHZ Sampling Frequency
480 Mbps USP Connection to System Controller
16 Buffered Outputs
Status LED Indicators
OLED Local Diagnostics Display
Supports 4-20mA, Acceleromter ICP, Proxy, & Voltage Inputs

WINDROCK PLATINUM ONLINE MONITORING SYSTEM

GET READY TO INCREASE UPTIME.

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

The Platinum 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 reach new heights in uptime.

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