



Including reciprocating compressors for a holistic reliability program.

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**Real-Time Machinery Prediction for Reciprocating Compressors**

Transform vibration monitoring into predictive alerts for critical turbomachinery



**EMERSON. CONSIDER IT SOLVED.™**

# Don't give critical assets a chance to fail.

Reciprocating compressors are "beasts," the workhorse of refineries, chemical plants, and oil production facilities, designed to do tough, dirty work. They are built to last for decades as long as they receive periodic maintenance, but if a problem develops quickly, the chance to avoid a failure may be lost. When reciprocating compressors go down, it can bring down the entire line, or cause fires and throw parts, including the compressor head. Avoid this kind of catastrophe by selecting a monitoring program that can give warnings before such failures occur.

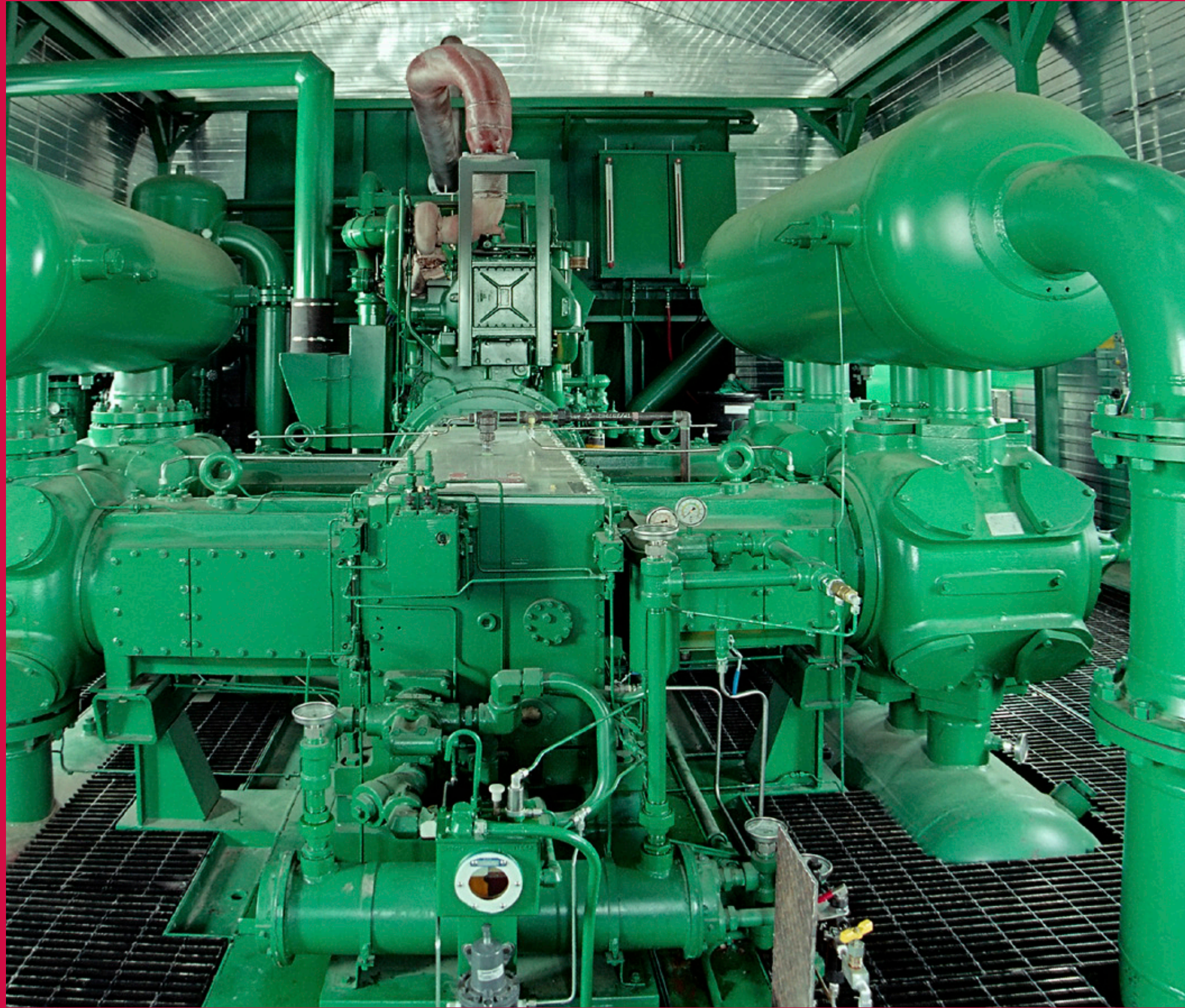
"It costs approximately 50% more to repair a failed asset than if the problem had been addressed prior to failure."  
- U.S. National Response Center



"One forced outage can cost up to \$1M in lost generation and increased maintenance costs."  
- Reported in NERC Generating Availability Data System (GADS), 2007-2013



"Valves and unloaders cause around 44% of unscheduled reciprocating (compressor) shut down and this selection has a strong effect on reliability."  
- (from white paper - Control and Condition Monitoring of reciprocating comp by Amin Almasi, Lead Rotating Equipment Engineer, Tecnicas Reunidas S.A. , Madrid, Spain, published in plantservices.com. September 2009)



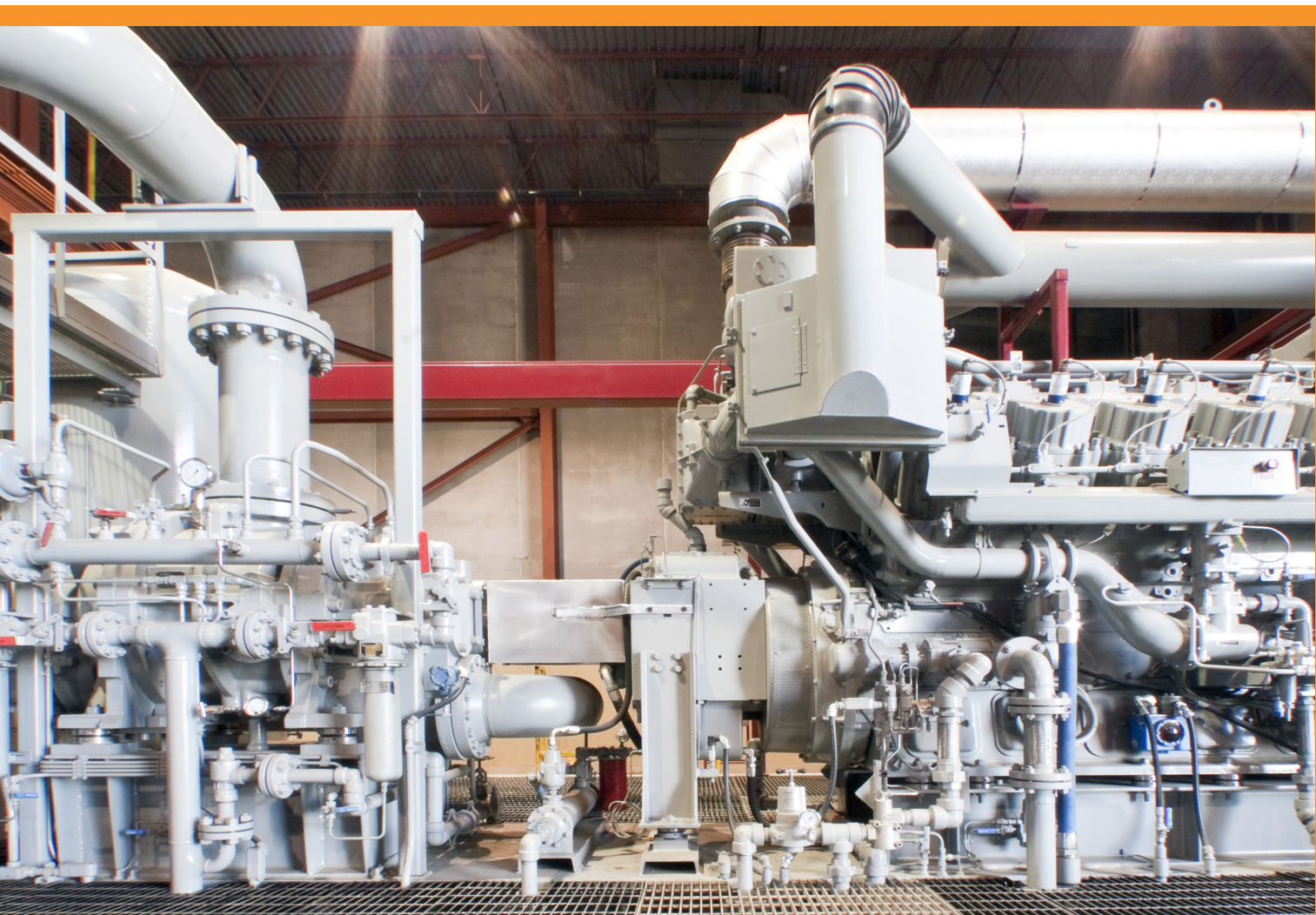
For 90% of the malfunctions, vibration, temperature, and process measurements can be monitored to detect changing conditions early, so you can avoid an unplanned shutdown. A basic monitoring program on reciprocating compressors can save you 30% or more in unplanned downtime and keep man and machine safer.

## When it comes to maintenance you have a choice; scale your monitoring program to fit your needs.

Emerson's reciprocating compressor condition monitoring program is designed for new or existing compressors and can be scaled from single failure mode monitoring to comprehensive monitoring. With its holistic approach, this real-time prediction program can identify potential faults and track their severity, allowing maintenance planners to determine the best time to make repairs, and to order parts. Emerson's analysis method is simple and intuitive and will show and track potential failures in the most critical assets and help to minimize inventory operations.



Keep reciprocating compressors running full-speed ahead and gather the real-time data that shows the earliest indications of a failure. Emerson can help you achieve that goal with a targeted Condition Monitoring Program designed for reciprocating compressors.



### Don't let equipment failure catch you unaware.

If you have critical assets that are not being monitored, specifically reciprocating compressors, a failure could catch you unaware. Through condition monitoring, you get an early indication of developing problems in reciprocating compressors just like in other critical mechanical assets. This can help you plan outages for repairs and hold production stoppages to a minimum.

### Get ahead of high maintenance cost by making compressors more reliable.

Reciprocating compressors were built to run for decades and so there are a lot of old compressors still in use. A problem can develop quickly, and could cost you thousands of dollars in spares and lost man hours. Investing in a condition monitoring program now that includes reciprocating compressors can be an easy, cost-effective extension of your existing program.

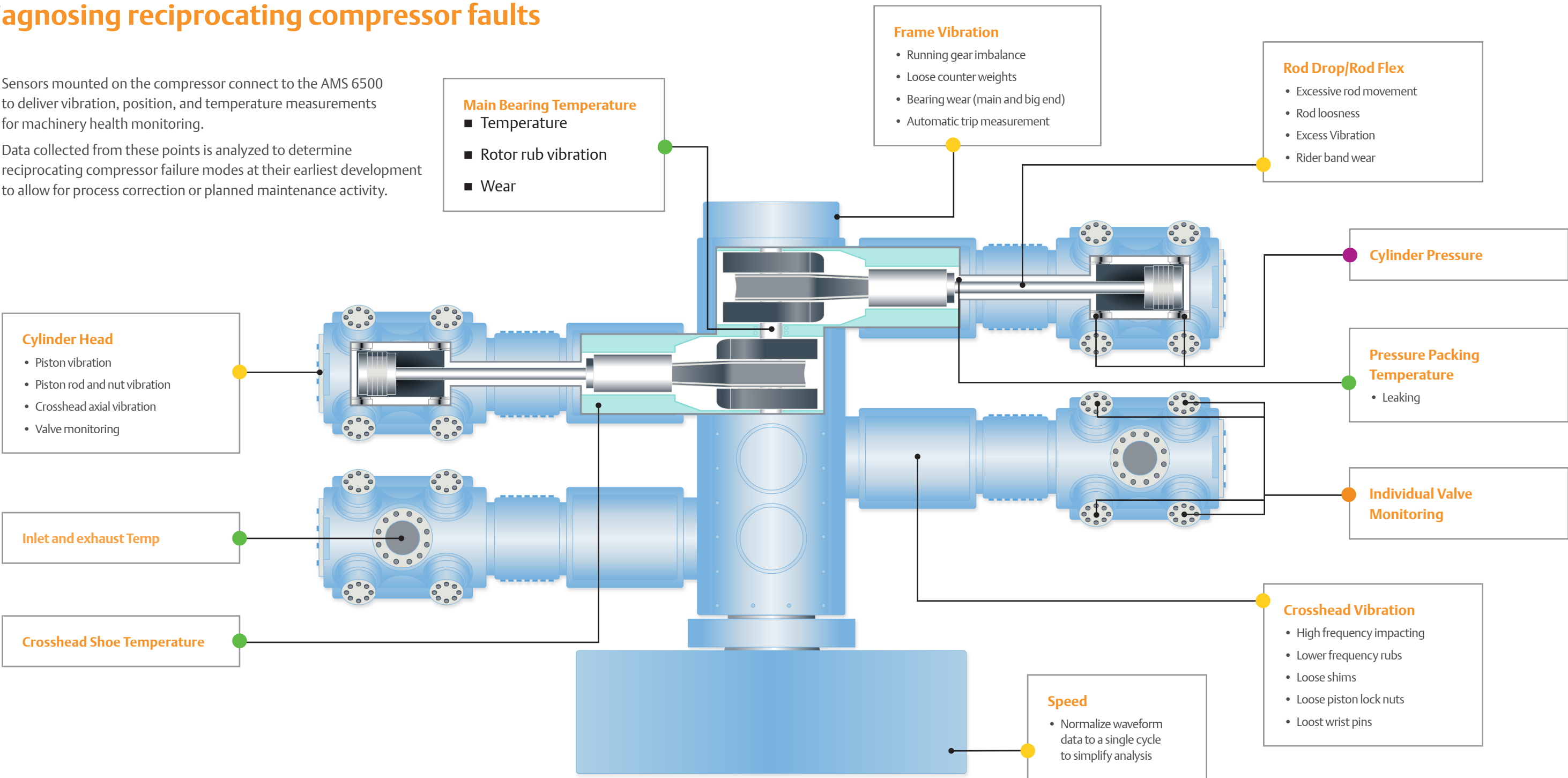
### Keeping your workers and equipment safer with advanced warnings.

Even in good working order, your reciprocating compressors operate under risky conditions because of the maximized force within the machine. However, you can increase their operational safety by advanced warning of developing problems. Using a powerful, real-time-diagnostics program now, can mean fewer safety incidents for employees and a safer environment later.

# Diagnosing reciprocating compressor faults

Sensors mounted on the compressor connect to the AMS 6500 to deliver vibration, position, and temperature measurements for machinery health monitoring.

Data collected from these points is analyzed to determine reciprocating compressor failure modes at their earliest development to allow for process correction or planned maintenance activity.



**Cylinder Head**

- Piston vibration
- Piston rod and nut vibration
- Crosshead axial vibration
- Valve monitoring

**Inlet and exhaust Temp**

**Crosshead Shoe Temperature**

**Main Bearing Temperature**

- Temperature
- Rotor rub vibration
- Wear

**Frame Vibration**

- Running gear imbalance
- Loose counter weights
- Bearing wear (main and big end)
- Automatic trip measurement

**Rod Drop/Rod Flex**

- Excessive rod movement
- Rod looseness
- Excess Vibration
- Rider band wear

**Cylinder Pressure**

**Pressure Packing Temperature**

- Leaking

**Individual Valve Monitoring**

**Crosshead Vibration**

- High frequency impacting
- Lower frequency rubs
- Loose shims
- Loose piston lock nuts
- Loost wrist pins

**Speed**

- Normalize waveform data to a single cycle to simplify analysis

- Emerson Recommended Monitoring Points
- Pressure Monitoring
- Temperature Monitoring
- Individual Valve Monitoring



## Don't run-to-failure on any critical asset.

**Don't be caught unaware.** Today, there are better diagnostics for your reciprocating compressors and it's easy to add them to the routine analysis that gives you peace-of-mind about your other mechanical equipment.

**Gain earliest detection of developing problems.** Emerson's AMS 6500 with PeakVue™ technology offers a unique insight into your equipment, especially early detection of imbalance, valve failure, looseness, leaks, rod flex, and rod drop.

**Plan for repairs; Control your spares.** Monitor your reciprocating compressors and plan outages for when it is convenient, and, buy spares when you need them.



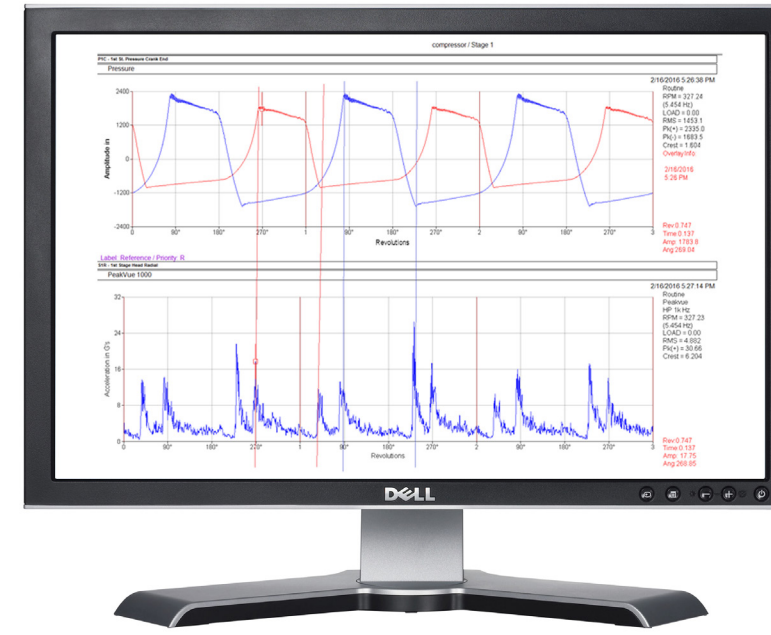
### What's your challenge?

Are you waiting, constantly worrying you have equipment that could fail? If you are not monitoring your reciprocating compressors, how will you know if they develop a problem that could lead to failure, for example, with the valves? Valve failures can be attributed to 50% of reciprocating compressor issues and if unnoticed, valve faults can quickly progress and result in catastrophic compressor damage.



### What's your opportunity?

You can incorporate reciprocating compressors into your existing condition monitoring system using Emerson's AMS 6500 Machinery Health Monitor with PeakVue technology. In fact, PeakVue technology provides a leading indicator of valve leakage compared to the lagging indication of PV analysis. Individual valves can also be monitored allowing the replacement of the faulty valve instead of having to replace all of the valves in a particular region.



## Give your hardest working machines the respect they deserve by monitoring them.

**Don't rely on old equipment to be faithful.** Even machinery that seems to be running well could be harboring signs of developing failure.

**Could your bottom line be at risk?** Your aging equipment can deteriorate fast, causing a decrease in performance, a reduction in throughput, and a rise in operating costs.

**Add reciprocating compressors to your routine.** Monitoring your reciprocating compressors with your other rotating equipment can give you time to plan a shutdown instead of having a high-cost unplanned outage.



### What's your challenge?

Reciprocating compressors were built to run for decades and so there are a lot of older ones still in use. Your reciprocating compressors are unreliable but cost too much to maintain. Parts aren't cheap. A new one would be ideal but that's not in your budget for this year.



### What's your opportunity?

Regain reliability in your compressors – like your other critical assets – and extend the life of this aging asset. When you monitor them with a AMS 6500, you'll have the insight you need to plan maintenance and manage the expense of spares.



## Equipment can go awry and damage facilities, or worse, injure an employee.

**Avoid catastrophes.** When equipment fails, it can create an unsafe situation where equipment and people “get hurt.”

**Increase operational safety.** Reciprocating Compressors are by definition a little less safe than some equipment – think “compressing gas or flammable liquids.” So, they should be monitored for real-time changes.

**Are your safety measures measuring up?** Sometimes insurance companies and regulatory agencies require certain safety measures in place. A monitoring system can help and sometimes meet requirements.

### What’s your challenge?

Of course, your goal is to keep workers and equipment safe, but even in good working order, your reciprocating compressors operate under risky conditions because of the maximized force within the machine. One failure can potentially cause fires and throw parts, including the compressor head. So, how can you increase operational safety?

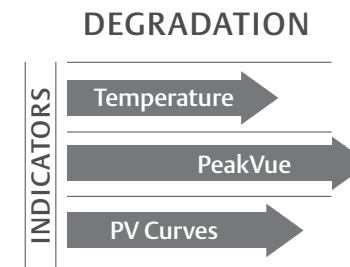


### What’s your opportunity?

By monitoring machinery health and performance, you’ll recognize the conditions that could lead to catastrophic failure and possibly put staff in harm’s way. Our monitoring equipment meets specific API requirements that insurance/agencies may require.

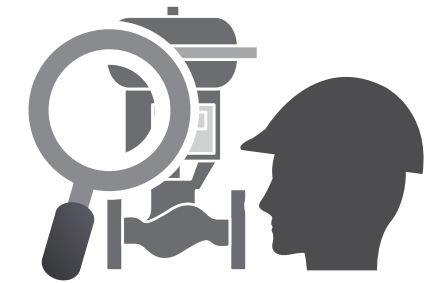
## Worry less that your equipment will fail

### Find problems early



- PeakVue technology recognizes degradation ahead of PV Curves (a comparison of pressure to the volume of gas) and before temperatures increase.

### Unique insight into valves



- Emerson monitors the health of individual valves, for early indication/severity of valve faults like leakage, blockage, stiction, and breakage, and is especially good for processes such as dirty gas.

## Protect your bottom line

### No learning curve



- Applying the same AMS Machinery Manager software used for other mechanical equipment, makes reciprocating compressor monitoring an easy, cost-effective extension of an existing program.

### Be an expert with software analytics



- It takes less time to learn how to analyze a reciprocating compressor in AMS Machinery Manager than it does to learn how to analyze mechanical equipment, thanks to easy pattern recognition in the software.

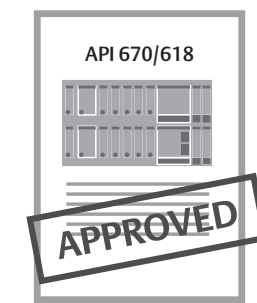
## Keep your workers and machines safe

### Safety integrity level (SIL) 1 certification



- The AMS 6500 is a certified protection system for improving reliability in Safety Instrumented System (SIS) environments and keeping equipment and people safe.

### Safety measures that measure up



- With API 670/618 certification, the machinery protection provided by the AMS 6500 helps you stay in compliance with insurance companies and regulatory agencies.