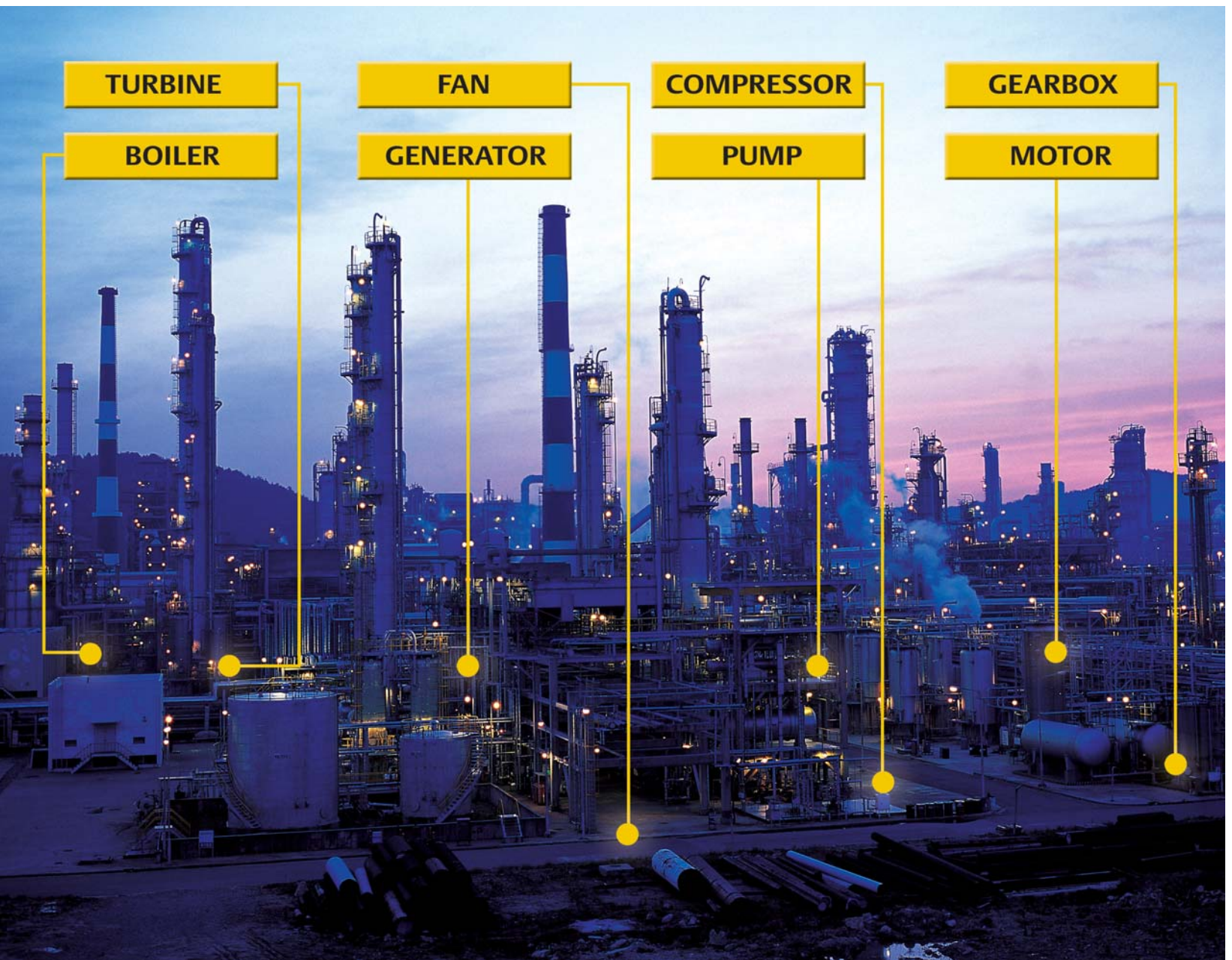


Smart Machinery Health™ Management

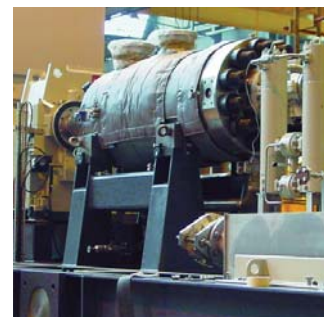
Improve Reliability, Availability and Performance



In an increasingly competitive market, organizations are challenged to run their plants more profitably and with greater efficiency. Yet mechanical equipment deteriorates causing a decrease in performance, a reduction in throughput and a rise in operating costs. Or an unplanned shutdown grinds production to a halt, resulting in a large loss in revenue.



IS YOUR MACHINERY'S HEALTH PUTTING YOUR OPERATIONAL GOALS AT RISK?





Deterioration in machinery health and performance is usually associated with misalignment or imbalance, corrosion and wear, fouling, sediment build-up or poorly lubricated parts.

Detecting these underlying problems early allows you to correct issues before they affect your process, optimizing the performance of your plant.

Emerson's combination of best-in-class technologies and services helps increase equipment effectiveness, reliability and performance by allowing you to be proactive in your maintenance.

With Emerson's Smart Machinery Health Management solution, you have a comprehensive view of every machine, allowing you to diagnose problems early – before they even become an issue.

- Increase throughput, availability and reliability
- Improve operating performance
- Reduce maintenance expenditures
- Avoid unplanned shutdowns
- Reduce energy consumption and costs
- Extend equipment lifespan

Turn to Emerson to ensure optimal health and performance of your mechanical equipment.

CRITICAL ASSETS IN A HIGH-STAKES WORLD

Prevent unscheduled downtime. Improve availability and performance. Ensure protection from catastrophic failures. Protect people, facilities, and the environment.

In an environment that relies on critical mechanical equipment, any failure can have a dramatic effect. A prolonged process interruption can be the difference between profit and loss. With this much at stake, having the correct protection, prediction, and performance monitoring system in place is essential. With Emerson's online machinery monitoring technologies, you can monitor mechanical assets and analyze temperature, vibration, efficiency, and deviation data for changing conditions that could result in a shutdown.

Emerson offers the most comprehensive protection, plant-wide prediction, and performance monitoring system integrated with process automation.

PlantWeb® Digital Plant Architecture

Emerson's PlantWeb digital plant architecture forms an integrated environment for process automation and asset management. Within PlantWeb, Emerson's online machinery monitoring extends protection,



prediction, and performance monitoring capabilities to a plant's most critical machinery.

Online machinery monitoring is complemented by PlantWeb Services to ensure successful implementation and to maximize investment value. These applications use the power of predictive intelligence to improve plant performance and provide greater operational benefits. You improve throughput and availability and sustain the resulting performance gains.

Emerson's online machinery monitoring capability

- For American Petroleum Institute (API) 670 standard and insurance requirements, PlantWeb's **protection** capabilities coordinate asset or plant emergency shutdown with process automation.
- Continuous online monitoring delivers real-time **predictive** diagnostics to an asset management system and triggers alerts that allow operations to make informed production decisions.
- Analysis of deterioration in **performance** identifies the root cause of equipment inefficiencies so maintenance can be proactively planned.

Combining protection, prediction, and performance capabilities makes the difference in knowing your mechanical equipment is truly reliable. Emerson ensures protection. Delivers prediction. Prevents downtime. And brings reliability to your critical assets.

- **Protect against catastrophic failures**
- **Reduce process disruption**
- **Improve maintenance effectiveness**
- **Start-up safely**
- **Increase plant profitability**
- **Reduce operating costs**



PROVEN RESULTS

Emerson's machinery management and reliability solutions have been deployed in a variety of sites and processes around the world. Here are some of the quantifiable results that our customers report:

- **Rompertrol Petromidia** saved an estimated \$10.1M by avoiding an unnecessary shutdown
- **Atlantic LNG** recognized a 1.5% increase in performance of production equipment
- **Premcor** increased hydrotreater production by 25% after implementing a lubrication program
- **Energy** saved nearly \$1M by minimizing loading on a boiler through performance monitoring
- **Amerada Hess** increased gas export by 10% following the identification of an under-performing compressor
- **Great River Energy** saved \$55,000 immediately and another \$60,000 annually by monitoring critical atomizer bearings
- **Johns Manville** reduced mechanical emergency maintenance by 43%
- **Belgian Navy** saved \$2M by applying predictive maintenance technologies aboard ships

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BEST-IN-CLASS DIAGNOSTICS PROMOTE OPERATIONAL EXCELLENCE

From API 670 machinery protection to real-time analysis of critical machines, Emerson is the single source for optimizing your mechanical assets.

With a proven track record of implementing plant-wide predictive diagnostic solutions, you can count on Emerson to unlock the maximum potential in your machinery. Emerson's AMS® Suite predictive diagnostic software integrates information from robust diagnostic technologies. This powerful combination of software, online technologies, and portable technologies builds a predictive diagnostic foundation for your machinery management program leading to improved productivity.



Online Machinery Monitoring



Portable Continuous Vibration Monitoring

Route-based Vibration Analysis and Balancing



SOFTWARE

- **Machinery Health Management** – multi-technology integration, analysis and reporting tools allowing enterprise-wide predictive maintenance planning.
- **Performance Monitoring** – analyze and obtain peak performance of critical mechanical and process equipment in real time.

ONLINE TECHNOLOGIES

- **Online Machinery Monitoring** – a complete protection, prediction and performance monitoring system integrated with process automation.



AMS Suite

- **AMS Suite**
- Machinery Health Diagnostics
- Performance Monitoring
- Asset Health Dashboard



Wireless Vibration Transmitter



Infrared Thermography



Lubrication Analysis



Laser Alignment

PORTABLE TECHNOLOGIES

- **Vibration Analysis** – conclusive condition information about bearings, gears and other rotating components; implement on a periodic basis.
- **Alignment and Balancing** – ensure precise alignment and balance of rotating machinery.

- **Lubrication Analysis** – determine that lubricants and fluids are clean and moisture-free; detect particles in oil after onset of wear.
- **Infrared Thermography** – thermal imaging detects mechanical and electrical anomalies.

TRANSMITTERS

- **Wireless Vibration Transmitter** – interface with existing plant monitoring systems to deliver vibration levels on critical equipment.

THE SOFTWARE TOOLS FOR ASSET MANAGEMENT AND PREDICTIVE DIAGNOSTICS

The performance and health of mechanical equipment will deteriorate over time. Early detection is vital.

Ensure gradual deterioration doesn't strip away performance or your peace of mind. Knowing the health and performance of your mechanical equipment allows you to be proactive with your maintenance planning instead of reacting to unexpected events. When your maintenance and operations staff are alerted to degrading asset health, critical production decisions can be made to eliminate outages and improve the bottom line.

The PlantWeb Advantage

PlantWeb empowers your organization with predictive intelligence. AMS Suite distributes this intelligence to the right people at the right time so accurate, timely decisions can be made. The integrated family of AMS Suite predictive maintenance applications brings together information from critical production assets, including mechanical equipment, process equipment, instruments and valves.

Machinery Health Management

AMS Suite integrates Emerson's protection and prediction maintenance technologies. You gain a comprehensive view of each machine so you can accurately diagnose developing problems. Unsurpassed analytical capabilities through automated diagnostics, plotting, and reporting help determine machinery health. Through AMS Suite, you can document, trend and communicate all details of machinery health.

Performance Monitoring

AMS Suite provides real-time performance calculations, allowing you to improve the efficiency of your critical machinery – turbines, compressors, boilers and other assets. By analyzing machinery performance, you can run your process more efficiently, track operating performance against targets, schedule maintenance activities, and determine the root cause of equipment inefficiencies. Equipped with health and performance diagnostics information and backed by a team of Emerson engineers, you can move from reactive to targeted predictive and proactive maintenance programs. AMS Suite helps you focus on the assets that impact your bottom line, bringing improved performance and restoring your peace of mind.

- **Develop a planned maintenance approach**
- **Prioritize and plan maintenance activities**
- **Achieve and maintain optimum equipment performance**
- **Quantify thermodynamic efficiency losses**
- **Evaluate the effectiveness of maintenance on production and equipment condition**
- **Track key performance indicators against targets**
- **Determine the root cause of production inefficiencies**





OUR CUSTOMERS SAY IT BEST

"We have reaped rich savings in fuel costs. AMS Suite has provided the information to minimize the effect of loading on each steam boiler." – Mill Maintenance Engineer

"Using AMS Suite helps us determine the events that caused a loss in performance across each of the trains, allowing us to push our operating boundaries to generate greater throughput." – Vibration Analyst

"AMS Suite allows us to improve operational performance, by applying best-in-class technology, to maintain production and reduce the possibility of downtime." – Reliability Technician

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CONTINUOUS ONLINE MONITORING FOR PROTECTION AND PREDICTION

Critical machinery problems can bring production to a halt. A combination of shutdown protection and prediction capabilities ensure your machinery will continue to perform within acceptable parameters.

Machinery Protection

Today's plants require machinery protection systems for the most critical rotating machinery. The CSI 6500 Machinery Health® Monitor meets API 670 requirements and provides PlantWeb protection integrated with process automation systems. The modularity of design gives the CSI 6500 flexibility in retrofit applications for existing cabinets.

The CSI 6500 protection system provides vital shutdown protection to prevent catastrophic failure.

- **Continuous online monitoring for machinery prediction and protection**
- **Compliant with API 670 standard**
- **Integrated with process automation systems**

Prediction Monitoring

Visibility to machinery health before the protection system engages is considered the critical missing component of today's machinery protection solutions. Operations and maintenance personnel are no longer looking for just a protection capability when replacing an outdated protection system. They are requiring a complete protection, prediction, and performance monitoring capability integrated with process automation.

By inserting prediction modules, the CSI 6500 Machinery Health Monitor provides machinery prediction and protection in a single integrated rack. The modular architecture easily facilitates integration to an existing protection system, AMS Suite, and process automation. The CSI 6500 delivers real-time feedback to both maintenance and operations, so plant personnel can make informed decisions well ahead of a shutdown.

With prediction, a machine can continue performing as long as it is within acceptable parameters. Repairs can be made when they are economically convenient.

- **Automated, continuous, predictive machinery health monitoring**
- **PeakVue® technology provides bearing fault detection**
- **Record, view and replay transient data during startup, shutdown and trips**

Empowering Decisions

As part of Emerson's PlantWeb digital plant architecture, real-time machinery health information moves throughout the enterprise to the right people so the right decisions can be made.

When this information is delivered through the Ovation® or DeltaV™ process automation system and AMS Suite predictive maintenance software, you empower operations and maintenance with the full value of PlantWeb's predictive intelligence.



OUR CUSTOMERS SAY IT BEST

"The Modbus Importer can be a very beneficial tool to bring data from AMS Machinery Manager into the Emerson's Ovation and DeltaV DCS worlds. This tool provides a huge time savings and delivers information to our operators in a format that they are used to seeing on a standard DCS graphics screen."

– I&C/Electrical System Owner

"We've been able to trend data from the Emerson Online Monitor and compare that to process trends. We've been able to correlate spikes in vibration to operations and reduce those spikes ... anything you can do to reduce vibration is good." – Plant Engineer

"A fault missed by our current monitoring system only became visible once we employed Emerson's PeakVue technology." – Reliability Analyst

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PORTABLE DATA COLLECTION: THE FOUNDATION OF YOUR RELIABILITY PROGRAM

By improving machine reliability, you can maximize output and significantly lower production costs.

Experience savings by employing predictive and proactive maintenance strategies.

Vibration Analysis

In an environment where you cannot afford to constantly chase the next breakdown, you need to quickly and accurately identify developing faults and, ultimately, the underlying root cause of the machinery problem. Vibration analysis offers the most information about the condition of rotating machinery.

The CSI 2130 Machinery Health Analyzer simplifies the task of vibration analysis by monitoring virtually every machine in the plant. Onboard analysis for advanced troubleshooting is available at the push of a button, providing an instantaneous machinery health assessment.

- Unmatched data collection speed
- Powerful in-field alerts and analysis for guided, machine-side testing and troubleshooting
- PeakVue technology for advanced bearing and gear fault detection

Alignment and Balancing

Alignment and balancing can extend the life of your rotating machinery. The CSI 2130 is used to precision balance or laser align machine trains before returning them to service. It balances machines in up to 4 planes and at multiple speeds, and can automatically detect and alert you to secondary structural faults that might complicate the balancing job. Unique laser heads include dual high-speed angle sensors that measure the exact rotational position of laser heads, reducing sweep time and providing an accurate alignment solution.

- User-friendly display for faster balance and alignment jobs
- Balance four planes and multiple speeds
- Alignment within one quarter turn of shaft rotation

Electric Motor Diagnostics

After bearing problems, the most common motor problem is electrical failure. Heat and fatigue, associated with excessive motor starts or overloading, can lead to broken rotor bars in electric motors.

The CSI 2130 non-intrusively collects current, flux, and temperature data while the motors remain online. This motor analysis technology can diagnose electrical problems, providing information on rotor-related electrical faults such as broken rotor bars, high-resistance joints and cracked rotor end rings.

- Early detection of rotor and stator faults
- Collect motor analysis data while the motor is online
- Trend motor condition over time to plan and prioritize maintenance action



Unattended, 24-Channel Portable Analysis

Some critical plant assets require more than the data collected as part of a route-based vibration analysis program. Turbomachinery and other complex machines may require temporary, but continuous monitoring across a machine or multiple machines.

The CSI 2600 Machinery Health Expert is a temporary continuous monitoring and analysis system. It records data for hours or weeks at a time, and makes use of the advanced PeakVue technology for rolling element bearings and gearboxes. Real-time transient events can be viewed and replayed for further analysis with animated machine and structure views for advanced diagnosis of the most difficult reoccurring machinery problems.

- **Monitoring and troubleshooting for turbomachinery startup, coast down, and production state**
- **Record 100 hours of simultaneous, continuous time waveform across 24 channels**
- **Live oscilloscope and FFT analyzer**



OUR CUSTOMERS SAY IT BEST

"We could have suffered over 12 hours of paper machine downtime. The backside dryer bearing fault was invisible in the regular spectra and waveform, but we found it thanks to the CSI 2130's simultaneous PeakVue measurement point capability." – Mill Maintenance Engineer

"This is the new wave of maintenance, the new paradigm. We now have nearly zero unplanned downtime with production because of our reliability program." – Vibration Analyst

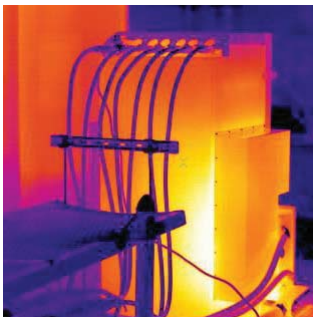
"The simple fact is that the CSI 2130 can take consecutive measurements and definitely speeds up the process tremendously." – Reliability Technician

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ADDITIONAL SOLUTIONS FOR COMPLETE MACHINERY HEALTH MANAGEMENT

While vibration analysis is the core technology for predictive maintenance, additional technologies are necessary to complete the picture of machinery health.

Oil and lubrication analysis often provide the earliest indication of machine degradation, while infrared thermography and ultrasonic testing provide critical pieces of the information puzzle. Each test complements the others, confirming potential diagnosis or eliminating suspected causes of failure.



Lubrication Analysis

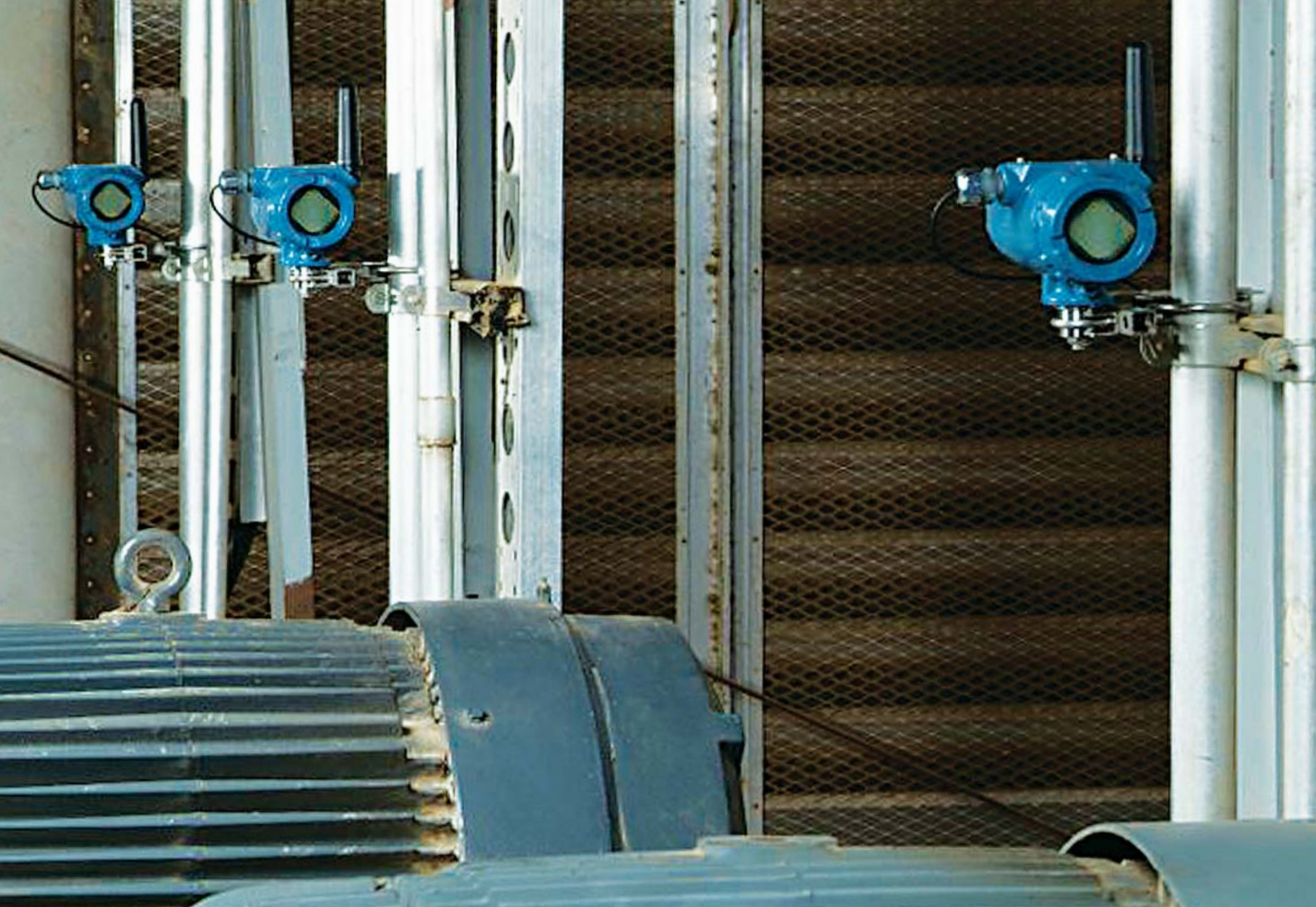
Oil and lubrication analysis are widely-accepted tools for determining the health of machinery. The CSI 5200 Machinery Health Oil Analyzer tests oil for machine wear, lube system contamination, and chemistry changes of the oil that are indicative of machinery health degradation. Results provide a warning of unseen corrosion, contaminants, improper lubrication, and machine wear, and can eliminate the root cause of equipment failure.

- Accurate onsite analysis of oil health information
- Early indication of machine wear and fatigue
- Verifies correct oil usage by screening oil supplies

Infrared Thermography

Emerging faults are frequently accompanied by excessive heat or heat loss. The CSI 9830 Machinery Health Imager is a handheld, route-based infrared detector that captures thermal images of potential problems, and can upload them to AMS Suite for further analysis and reporting.

- Diagnose anomalies in electrical systems
- Scan mechanical equipment for heat-related problems
- Detect hot spots



TRANSMITTERS: KEEPING YOU CONNECTED TO THE HEALTH OF YOUR MACHINERY

Careful monitoring of critical assets prevents lost profit from unplanned downtime.

Wireless Vibration Transmitter

As part of Emerson's Smart Wireless solution, the rugged CSI 9420 Wireless Vibration Transmitter connects quickly, easily, and economically to any machine. It delivers vibration information over a highly-reliable, self-organizing WirelessHART™ network for use by both operations and maintenance personnel.

- Measure vibration, temperature, and bearing wear with PeakVue
- Ideal for hard-to-reach and cost-prohibitive locations
- Measure vibration on any plant asset

Wired Vibration Transmitter

To gain continuous access to vibration levels on your critical machinery, the CSI 9330 Vibration Transmitter interfaces with existing plant monitoring systems while automatically detecting vibration levels.

- Continuous monitoring of machinery
- Convert vibration data into a 4-20 mA signal
- Measure overall vibration and Peakvue or temperature





A COMPLETE PICTURE OF MACHINERY HEALTH

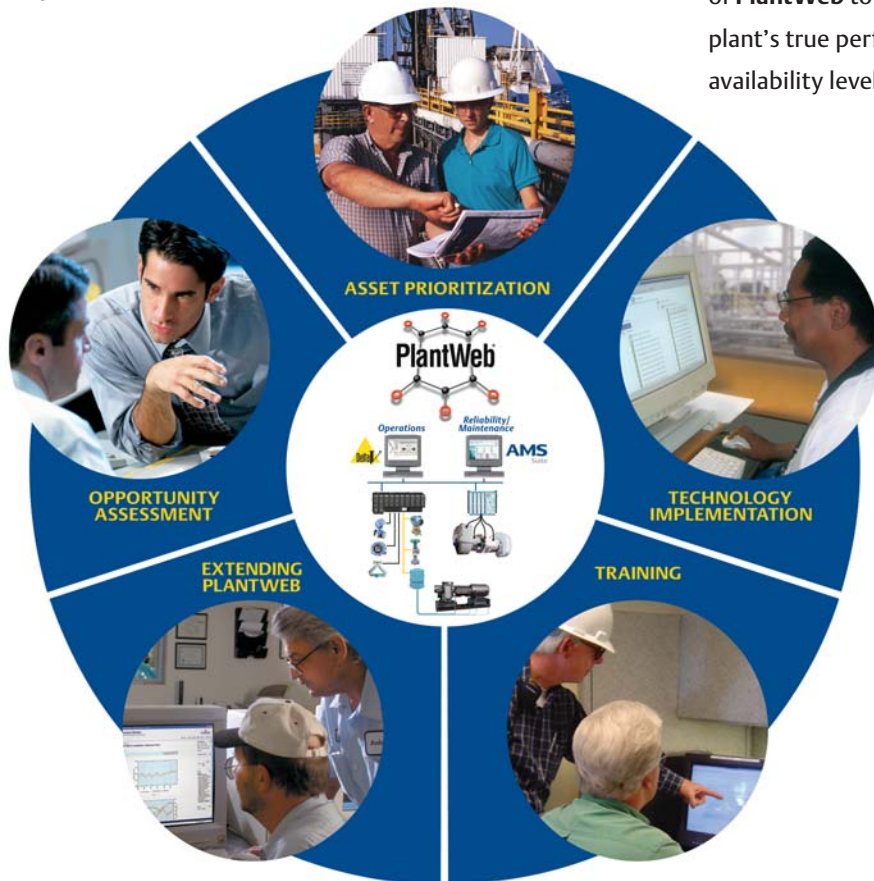
From online monitoring with protection, prediction, and performance to portables for vibration analysis and more, Emerson's integrated Smart Machinery Health Management solution delivers critical predictive diagnostic information on your high-stakes assets in AMS Suite. You get a holistic view that allows you to make informed decisions about your operation. Depend on the innovation and expertise of Emerson for a complete picture of machinery health.

REALIZE FULL VALUE FROM YOUR MACHINERY MANAGEMENT SOLUTION

When you consider a critical technology investment, you cannot afford to overlook service.

Emerson understands the requirements for comprehensive expertise to ensure start-up success and long-term support. We are fully committed to supporting you through all of the installation steps and to keep your system running smoothly and reliably.

- Identify and quantify your largest and most significant opportunities for improvement through an **opportunity assessment** to uncover performance gaps and potential opportunities in your current maintenance plan.
- Develop a roadmap for **asset prioritization** that allows you to focus PlantWeb technologies on the assets with the highest benefit.
- Implement a structured approach to **technology implementation**, based on proven experience, to ensure your reliability program starts right and endures over the years.
- Assess the skill sets of your workforce and deliver **training** programs with an emphasis on implementing maintenance practices that take full advantage of new technologies.
- Extend the predictive power of **PlantWeb** to help reach your plant's true performance and availability levels.



Asset Optimization Services is a structured approach to implementing PlantWeb technology, designed to address specific business barriers that move you from a reactive plant to a best-cost producer. Emerson's expertise enables you to streamline daily maintenance procedures, implement predictive maintenance, enhance planning time, and operate with your maintenance resources fully optimized.

EMERSON – YOUR PARTNER FOR ASSET OPTIMIZATION

Realize the true potential of your plant.

When you partner with Emerson, you achieve optimal health and performance while experiencing the value of a predictive environment:

- Prevent catastrophic failures and unplanned shutdowns
- Meet production targets
- Diagnose the root cause of performance degradation
- Reduce maintenance and repair costs
- Reduce inventory and overtime
- Achieve predictive or proactive maintenance

Emerson is your single source for reliability technology. Since the introduction of our first portable vibration analyzer in 1986, Emerson has led the market in the development of advanced vibration technologies. With an annual investment in machinery health research and development that exceeds the sales revenue of many reliability suppliers, Emerson continues to lead the industry in the release of new products for monitoring the health and performance of your mechanical equipment.

In addition to our expertise in mechanical equipment, no one knows instruments, valves, electrical systems and process control like Emerson. With a view to the complete manufacturing process

and the combined power of Emerson's PlantWeb digital plant architecture with Asset Optimization Services expertise, we provide real-time predictive diagnostics on all your key production assets to drive operational excellence within your facility.

With Emerson, you have the complete portfolio of machinery health management technologies, software and services ensuring your mechanical equipment is maintained correctly for optimal health and performance.

Turn to Emerson as your critical machinery management partner to manage and realize your machinery's potential to achieve your operational goals.





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