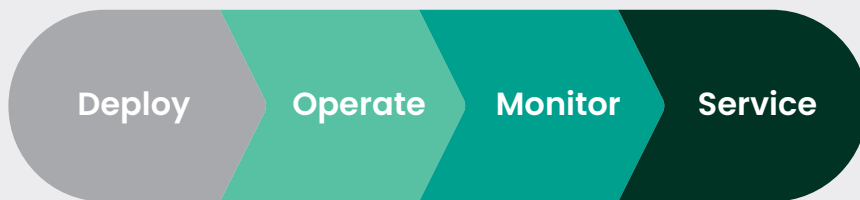


# Reciprocating compressor monitoring solution



# Why monitor compressors?

## Reciprocating compression offering



- Automated analytics—performance and diagnostics
- Subject matter expert data review
- Regular summary reports and coordination calls
- Intuitive HMI for data visualization and detailed analysis

The upstream and midstream oil and gas markets use compressors in a variety of applications:

- Small compressors used for vapor recovery or compressed air to operate valves and other instrumentation
- Medium compressors used for gas injection, gas lift, and small gather systems
- Large compressors used in compressor stations to move gas along interstate pipelines

Unplanned or extended compressor outages can result in considerable business impacts for operators who seldom know when or why an asset failure is about to occur. In addition, the high maintenance costs associated with reciprocating compressors makes condition monitoring of these assets extremely important.

For small- to medium-sized reciprocating compressors, Bently Nevada has introduced a new remote monitoring and diagnostic (RM&D) offering aimed at providing health and performance insights using the existing instrumentation typically found on reciprocating compressors in midstream and upstream oil and gas applications.

Our reciprocating compression monitoring solution is an application built to monitor compressor health and performance remotely. It calculates compressor fleet utilization and availability and provides intelligent feedback through predictive analytics, enabling reciprocating compressor fleet managers to increase efficiency and optimize their maintenance priorities and planning.

This data yields valuable insights when monitored and properly analyzed by a compression expert.

# Easy-to-deploy solutions for compressors

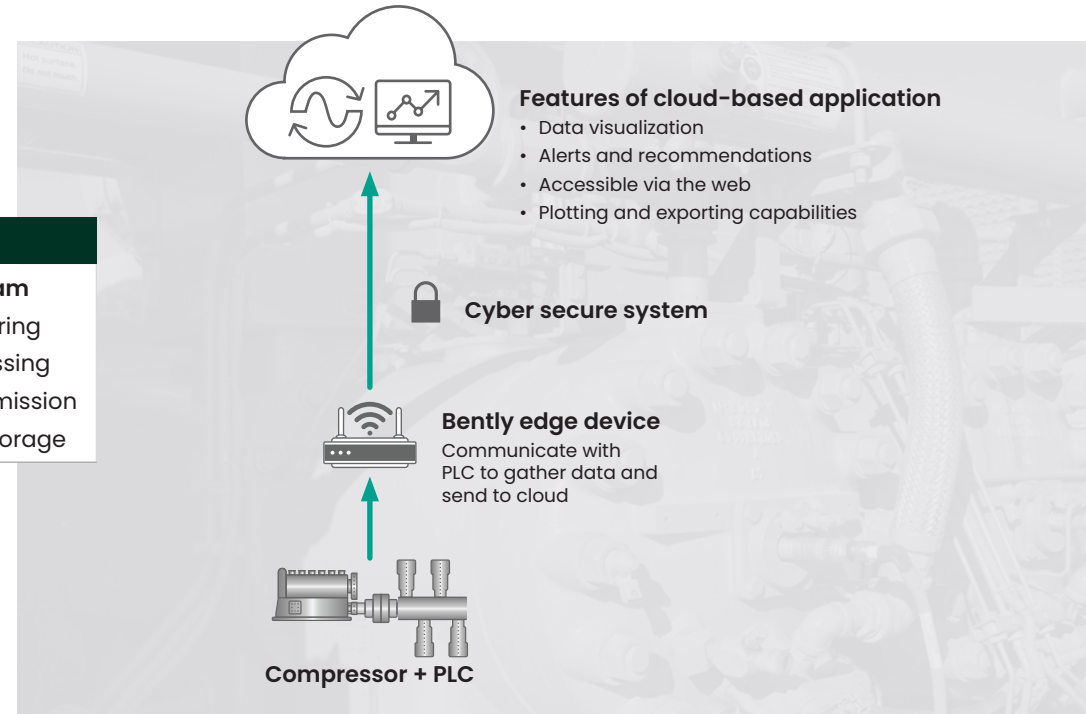
The solution is simple. We provide remote monitoring, advanced predictive diagnostics, and performance analysis for reciprocating compression. Applications range from gas injection to booster stations with the ultimate goal of maximizing unrealized benefits.

## How it works

1. Data is collected from a compressor PLC and sent to the cloud via existing connectivity or by deploying edge hardware on site.
2. The data is then validated, run through a series of analytics, and displayed.
3. RM&D engineers review the results and provide insightful recommendations, as timely exception reports or monthly summary reports.

These insights and recommendations help owners and operators understand the health of their compressors and make smart operational and maintenance decisions to maximize availability and reduce unplanned downtime.

Industry applications	
<b>Upstream</b>	<b>Midstream</b>
<ul style="list-style-type: none"><li>• Gas injection</li><li>• Gas lift</li><li>• Wellhead</li><li>• Landfill</li></ul>	<ul style="list-style-type: none"><li>• Gathering</li><li>• Processing</li><li>• Transmission</li><li>• Gas storage</li></ul>



## Uptime

Increase in the availability of your compressor and operations.

↑ **8 days**  
increased uptime per compressor per year



## Operating efficiency

Ensure optimization of your compressor.

↑ **8% flow efficiency**  
increase on average per compressor per year



## HSE risk

Reduce windscreen time.

↓ **75 fewer trips**  
to site per year

Performance metrics demonstrated by case studies.

# Full suite of Bently Nevada products

The Bently Nevada portfolio of condition monitoring software and associated hardware works seamlessly to provide your teams the real-time data, condition monitoring, and alarm protocols they need to prevent unexpected downtime, accurately monitor vibration, and correctly diagnose your equipment's issues. The diversity in our offerings ensures that each asset is monitored effectively and affordably given its specific application and criticality.

Light-weight solution for low criticality assets      Assets with high cost of failure

	Recip monitoring	Instrumentation + condition monitoring system	Machine protection
Data ingestion (BN hardware or legacy systems)	●		
Continuous health monitoring	●		
Summary reports and SME review	●		
Diagnostic HMI	●		
Decision Support		●	
Enhanced data set		●	
Alarm capabilities		●	
Customizable rules for machines or process conditions		●	
Thermodynamic performance monitoring		●	
Performance analytics and diagnostic capabilities		●	
Protection from catastrophic failures			●
Extended machine life			●

## Condition monitoring system

### System 1 optimization and diagnostic software



For reciprocating compressors requiring more monitoring, proactively manage them with the enhanced condition monitoring and decision support capabilities of System 1, our most advanced software ever.

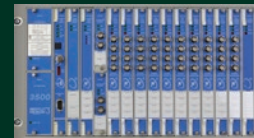
System 1 is a platform for managing every asset in your plant. It brings together a variety of condition monitoring technologies, maintenance management applications, reliability tools, process control, and historian data specifically for addressing the unique needs of reciprocating compressors.

The result is a total reciprocating compressor solution, capable of providing:

- Discharge pressure
- Suction pressure
- Minimum/maximum pressure for each crankshaft revolution
- Compression ratio
- Suction volumetric efficiency
- Power-to-median capacity ratio
- Adiabatic discharge temperature
- Vertical force plot

## Machinery protection system

At the heart of our recip monitoring solution is the Bently Nevada 3500 Series machinery protection system



In addition to condition monitoring, Bently Nevada offers integrated machinery protection and machinery management.

Our powerful 3500/22M TDI rack interface module eliminates the need for bulky external data acquisition hardware or special interface modules between the monitor rack and software. Simply plug an ethernet cable into the 3500/22M and you're ready to communicate with our powerful System 1 software for advanced diagnostics, condition monitoring, and other plant asset management functionality. The result is a zero-footprint solution requiring absolutely no additional rack or cabinet space when augmenting your basic machinery protection system with System 1 connectivity. And, the enhanced data collection technology of our 3500/22M TDI allows earlier and improved diagnosis of previously difficult-to-ascertain transient events.

# Comprehensive condition monitoring services

## Proactive care for your reciprocating compressors

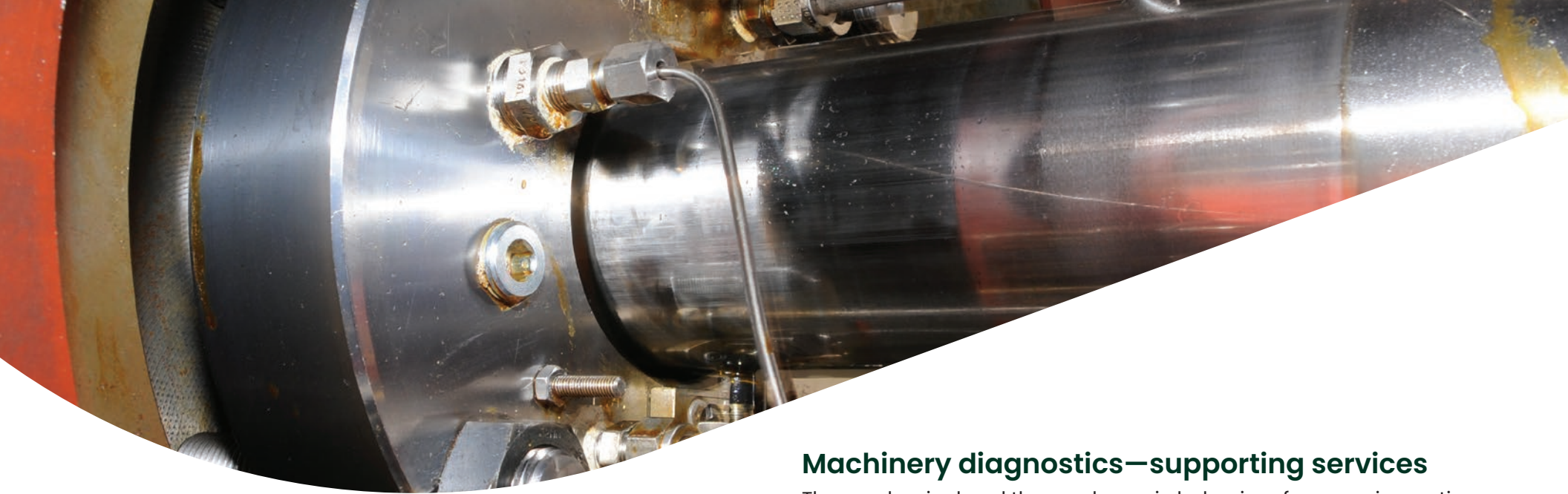
Baker Hughes' Bently Nevada reciprocating compressor condition monitoring solution continues a legacy of over 40 years. Our expertise has been proven by an installed base of more than 4,000 reciprocating compressors monitored globally. Our machinery diagnostic engineers can help you reach your safety and efficiency goals, increasing uptime, while reducing operation and maintenance costs. A worldwide team of machinery diagnostic experts is available 24/7 to assist you, providing proactive asset health information, analyzing compressor data, and performing root cause analysis on malfunctions.

## Bently HOST

Bently HOST™ is an all-in-one monthly subscription for hosted infrastructure, software, and asset health management services. It allows asset owners to benefit from our decades of domain expertise embedded in System 1 and delivered through our remote monitoring and diagnostics (RM&D) service centers to realize the full value of asset condition monitoring programs without CAPEX investment. Bently HOST provides:

- Preventive asset management strategy at an affordable monthly price
- Flexible, scalable, and secure condition monitoring by domain experts
- Peace-of-mind through outcome-focused solutions





## Risk assessment

We can audit selected assets or your entire plant and provide benchmarking data on which assets present the highest business interruption and other risks, which technologies and methodologies to use to mitigate risk, and the expected ROI of investments in our solutions.

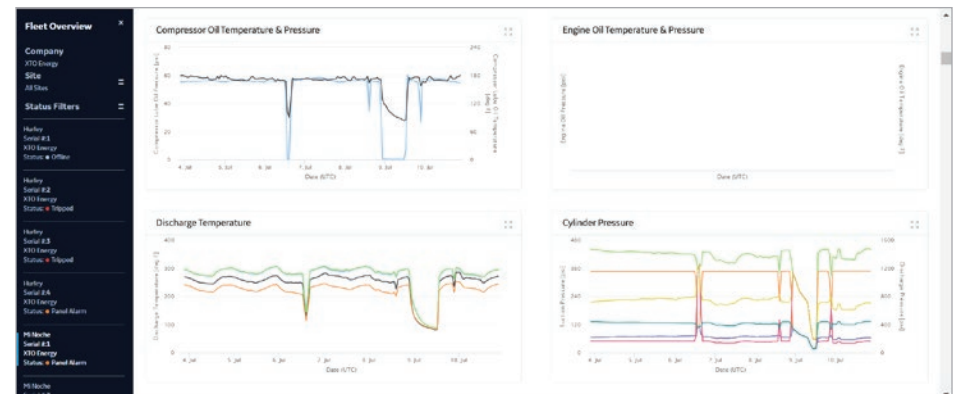
## Services and total solution packages (supporting service agreements)

To help you get the most from our installed condition monitoring solution, we back it up with a full array of support services. Our total solution packages can boost the reliability and efficiency of your reciprocating machinery—and help you make informed maintenance decisions. We offer training to plant personnel on all aspects of system use and maintenance, from instrumentation basics to in-depth mechanical and thermodynamic data analysis. These services can be tailored in a supporting service agreement, ensuring our availability any time you need us.

## Machinery diagnostics—supporting services

The mechanical and thermodynamic behavior of your reciprocating compressors is analyzed by our machinery diagnostics experts; machinery diagnostic services (MDS) can be provided either remotely or onsite, on call, periodically, or continuously. This includes:

- Startup, commissioning, and operational assistance. Data analysis, system optimization (hardware and software), fine tuning of settings, and customization of data visualization and management (based on actual operations and users' needs)
- Alarm and event management (daily, weekly, 24/7): Baseline audits (onsite/remote), asset "baseline" and report for diagnostic and alarming purposes
- Periodic audits (onsite/remote), asset audit, and diagnostic report



# Service and support

Bently Nevada services offer complete lifecycle support coverage from initial design, commissioning, and integration with your operating processes, and continue throughout the operational life of your facility with available upgrades, replacements, and retrofits. This enables you to get the most out of your investment. Our service offerings are carefully designed to ensure they deliver the maximum benefit to your operation. Bently Nevada service professionals undergo rigorous training and certification processes developed through our 60+ years of machinery protection and condition monitoring experience. This focused approach ensures we provide the highest quality and most expert services in the industry. With more than 500 service and support professionals in over 50 countries, we have the global reach and local presence to be there with expert support when and where you need us.

## Bently Nevada service menu

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### Implementation services

#### Get it right the first time

- Ensure your assets are protected and monitored when you're ready for startup
  - Avoid costly delays and rework
  - One source to design, plan, manage, and execute the installation
  - Avoid startup trips due to improper installation and configuration
- 

### Proactive support

#### Keep your system healthy and optimized

- Prevent instrumentation-related false trips
  - Prevent and minimize potential data loss events
  - Keep up to date and compliant with the best technologies available
  - Access the expert support you need when you need it most
- 

### Asset health and consulting

#### Actionable insights you can trust

- Understand your asset health to optimize outage and maintenance planning
  - Plug into our global network of machinery experts with remote monitoring
  - Professional OEM-agnostic machinery diagnostics when and where you need them
  - Custom analytic development and tuning to pinpoint specific conditions
- 

### Cybersecurity<sup>1</sup>

#### Stay ahead of evolving cyber threats

- Ensure your system is up to date and protected as threats continually evolve
  - Identify and mitigate cybersecurity risks to your operation
  - Keep your system both secure and accessible with advanced security technologies and architectures leveraging data diodes and database replication
- 

### Training and education

#### Critical skills that amplify your machinery management capabilities

- Enable your personnel to operate and maintain your monitoring and protection system
  - Enable your operation to maximize the value of your system by leveraging expert product and application training and knowledge
- 

1. [https://us-cert.cisa.gov/sites/default/files/documents/Seven%20Steps%20to%20Effectively%20Defend%20Industrial%20Control%20Systems\\_S508C.pdf](https://us-cert.cisa.gov/sites/default/files/documents/Seven%20Steps%20to%20Effectively%20Defend%20Industrial%20Control%20Systems_S508C.pdf)

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