

Plantwide asset health solutions



Something for every asset

In addition to the most important assets found in industrial facilities, there are often a host of "supporting" assets that make up the balance of the plant such as pumps, motors, blowers, heat exchangers, fans, and others. This auxiliary or plantwide equipment may be spared or unspared, and its impact on the process stream may vary from moderate to minor. Regardless, such machines—just like their more highly important counterparts—can benefit from condition monitoring. Baker Hughes provides affordable and effective portable and permanent condition monitoring platforms for these assets. All can be connected to the System 1 plantwide software, resulting in a proven solution that is delivering tangible benefits for tens of thousands of customers around

Financial justification

For many assets, failure can mean substantial or total loss of production, often worth millions per day. Or it can lead to the release of hazardous substances, fires, and even explosions resulting in a severe safety hazard as well as fines for violating environmental regulations.

Maintenance costs

When viewed on a per-asset basis, maintenance costs for plantwide assets can appear modest. However, when viewed collectively across the dozens, hundreds, or even thousands of assets in a typical plant, these costs can be appreciable. Reducing the maintenance costs on each asset through effective condition monitoring—even by a mere 10%—has a large impact on plant profitability. Condition monitoring is a predictive tool that allows more effective insight in planning and asset management, allowing maintenance to be done in advance of a functional failure.

60+

years of condition monitoring experience

140+

expert machinery diagnostic engineers worldwide

10 million+

sensor monitoring points installed on machines globally

15,000+

machine diagnostics projects completed

product services

jobs performed

Increased performance

Informed priorities



Drive focus and ROI

60,000+

We design and deliver solutions for all of your monitoring needs—including sensors, portable data analyzers, distributed and rack-based monitors, software, and supporting services—with the following goals in mind:

- Increased availability and production
- Lowered maintenance costs

Why Baker Hughes?

· Reduced risk in terms of safety, environmental, and asset upsets

And we have impressive statistics to back up our extensive experience:

- More than 600 patents globally, issued and pending
- Over 500,000 assets monitored
- 15,000+ wireless systems deployed
- 15,000+ speed detection systems deployed
- 38,000+ wind turbine monitoring systems deployed
- 100,000+ rack-based machinery protection systems deployed

10,000+

System 1 users worldwide

1,200+

System 1 installations worldwide

The benefits of plantwide predictive maintenance



Cost of unplanned events vs. planned maintenance



Reduction in



maintenance cost

55%



Reduction in





30%

Increase in plant machinery life



production

Reduction in



parts cost



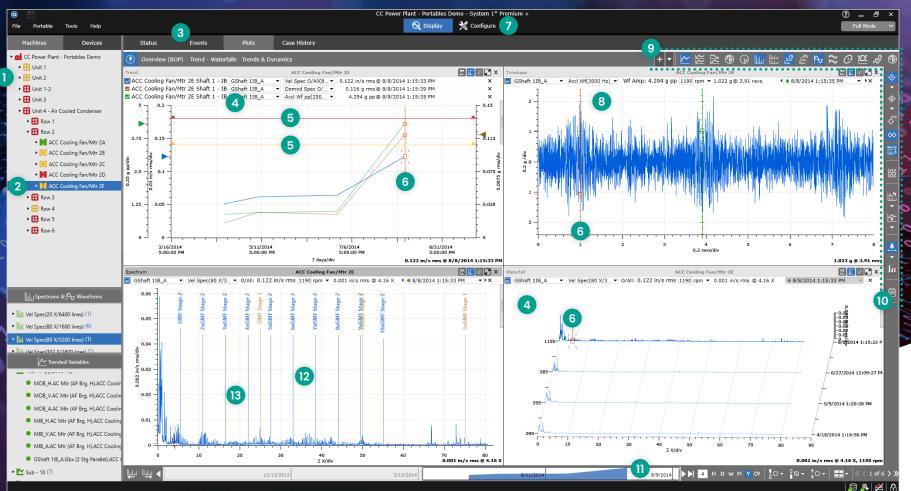
Reduction when process data was combined with condition monitoring data 30%

Increase in

Portable condition monitoring

World-class portable instruments for route-based data collection and analysis

Not every asset can justify the expense of online monitoring. For some assets, a portable approach is exactly the right strategy, allowing operators, machinery specialists, and others to collect data at regular intervals and on demand. Our data collectors feature a powerful suite of capabilities, ensuring that the solution delivers more than just System 1 integration—it delivers the sophisticated toolset and signal processing that today's practitioners expect for rolling element bearing diagnostics, balancing, bump testing, multi-channel analysis, and much more. And when it comes to ergonomics, we're blazing the trail with our innovative 200-series SCOUT and COMMTEST products. These data collectors detach the user interface from the data acquisition electronics through a hip-mounted design that wirelessly pairs the two via Bluetooth, freeing you to choose from a wide variety of off-the-shelf Android-based industrial tablets and smartphones. The result is light, easy to carry, with the flexibility to take pictures/videos, check email, track your location, create SOS alerts, and run other enterprise apps.



- Navigational intuitiveness by plant/unit/ asset or by device.
- Comprehensive advanced alarm management tools, including statistical
- No need to look at every spectrum, every plot. Use the Alarms or Events list to focus on machines with degrading conditions.
- Intuitive and interoperable trending tools.
- Flexible alarm setpoint and alarm event
- Easily synchronize cursors across plots.
- Ultra-fast, ultra-easy setup using "Quick Confia" to address measurement parameters, alarm bands, and initial thresholds based on industry standards.
- Advanced time-waveform analysis tools
- Industry-leading toolset and diagnostic capabilities for both rolling element and fluid-film bearings.
- Comprehensive reporting of fault diagnosis, either within System 1 as Plot Records, or for sharing externally as professionally formatted Word documents
- Easily navigate to time period of interest
- 12. Built-in rolling element bearing database with 180,000+ entries-configuration of cursors and spectral bands for bearing
- Superior spectral analysis tools including advanced cursors and fault frequency indication for quick indication of other components.



SCOUT200 Series

Our wearable data collectors deliver unparalleled ergonomics and a world-class feature set. Available in 2-channel + tach (SCOUT220-IS) and 4-channel + tach (SCOUT240-IS) versions, the SCOUT200 series goes everywhere—even hazardous areas with global Zone 0/1 and Division 1 approvals.



COMMTEST200 Series

Identical to our SCOUT200 series, but without hazardous area approvals. Same System 1 integration. Same powerful feature set. Same 2-channel (220) and 4-channel (240) versions. Same innovative ergonomics. And same unparalleled flexibility in Android-based user interface devices, whether tablet- or phone-sized.









	COMMTEST220	COMMTEST240	SCOUT220-IS	SCOUT240-IS
Channels	2	4	2	4
Fmax (max)	40 KHz	80 KHz	40 KHz	80 KHz
Lines of resolution	6,400	12,800	6,400	12,800
System 1	•	•	•	•
Cellular, Wifi, and Bluetooth	•	•	•	•
Integrated camera w/color display	•	•	•	•
Balancing	•	•	•	•
Tri-axial sensor		•		•
Signal processing	6Pack classic/peak demodulation	6Pack classic/peak demodulation	6Pack classic/peak demodulation	6Pack classic/peak demodulation
IP ratings	IP65	IP65	IP65	IP65
Hazardous area ratings	General purpose	General purpose	ATEX ZONE 1 & 21CSA CL1 DIV1Grp A,B,C,D,E,F	ATEX ZONE 1 & 21CSA CL1 DIV1Grp A,B,C,D,E,F
Memory	16GB Expandable	16GB Expandable	16GB Expandable	16GB Expandable
Warranty	Collector, 5 yearHandheld, 3 year	Collector, 5 yearHandheld, 3 year	Collector, 5 yearHandheld, 3 year	Collector, 5 yearHandheld, 3 year



Unmatched flexibility

Portable instruments

key features

When we decoupled the data acquisition hardware from the user interface in our new SCOUT200- and COMMTEST200-Series instruments, we revolutionized the industry. Our users told us they wanted choices. Choice of screen size, choice of device form factor, and choice of additional complementary applications that could run on the same device.

We did this by selecting Android and iOS-powered devices as the basis for our user interfaces. Available from a variety of suppliers, with a variety of industrially ruggedized packaging, and a variety of hazardous area approvals, our users are free to select from one of our recommended and tested third-party devices or to choose from dozens of other available Android-powered devices suitable for industrial use.

Unmatched functionality

Goes everywhere

Our SCOUT200-series devices are intrinsically safe, and suitable for Zone 0/1 and Div 1 environments globally.



6Pack data collection With a single press of a button, capture six

readings simultaneously with spectrum and waveform of:

- Velocity
- Acceleration
- Demodulation

Simplified configuration

Our "Quick Config" feature automatically implements the "Proven Method*" + ISO 2372 & 10816 alarming methodology.

Advanced analysis

Within our comprehensive range of portables we have models which support balancing, bump-testing, modal impact testing, transient data capture, cross-channel phase, cross-channel spectrum, and FRF data collection for operating deflection shape (ODS) analysis.

Online and offline convergence without compromise

Let's face it: portable users have special needs—configuration, analysis, alarming, and more. We understand that you don't want online software where offline is an afterthought, or viceversa. System 1 perfectly blends these two worlds in a seamless environment with features that portable users will love. Easier, faster configuration. Tools designed especially for rolling element bearings, gears, and belts. A built-in library of more than 180,000 bearing types. Intuitive navigation. Statistical alarms. The ability to clone configurations. And much, much more. With System 1 it isn't about sacrificing functionality for the sake of integration its about getting more functionality and the integration you demand. One system to learn. One system to support. One system to license. That's System 1.

^{*} Technical Associates of Charlotte

Wireless condition monitoring with Ranger Pro



A reliable, online solution to complement reliability/maintenance



Cost-effective entry to condition monitoring

Ranger Pro features

- Truly wireless: sensors, power, and radio embedded in a single package
- Velocity (5-2 kHz), acceleration (5-10 kHz)
- Supports both ISA100 and WirelessHART protocols
- Replaceable lithium-thionyl chloride battery
- IP67 hermitically sealed electronics
- CSA, ATEX, and IECEx approvals for Div 1 and Zone 0/1
- Temperature: -40°C to +85°C
- Range: 100 meters (line of sight)
- Security: 128-bit AES encryption
- Long battery life: up to 5 years
- System I connectivity—full dynamic and static data capture and display
- DCS connectivity via Modbus for static data



Wireless network personality module



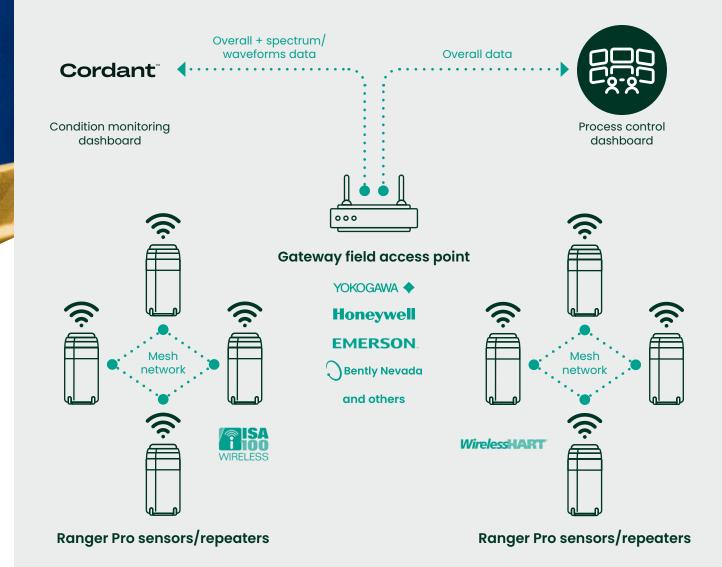


Industry-standard, user-replaceable battery



Triaxial or uniaxial embedded vibration sensor

Ranger Pro data and comunications



Ranger Pro is designed for hard-to-reach environments where wired solutions are impractical or cost-prohibitive. It does this without sacrificing the data collection frequency and rich data set of both static and dynamic data essential for proper condition monitoring. Ranger Pro sensors deliver both vibration and temperature data via an embedded temperature element and an embedded uniaxial or triaxial accelerometer that measures velocity, acceleration, and acceleration enveloping (or

demodulation) from each axis. Because it features global approvals for Div 1 and Zone 0/1, it can be installed in even the most stringent hazardous area classifications and ensures that you no longer have to manually collect data in hard-to-reach or hazardous environments. Because it supports both ISA100 and WirelessHART protocols, it can be mixed with other sensors using these industrial standards to deliver comprehensive data to both process control operators and machinery specialists.

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Economical online wired condition monitoring

While all machinery may not warrant continuous, dedicated machinery protection from Baker Hughes' Bently Nevada Orbit 60, 3500, 2300, or ADAPT platforms, many require more frequent surveillance than the weekly, monthly, or quarterly rounds made with a portable data collection instrument. Augmenting our wireless Ranger Pro system is the Orbit Distributed Condition Monitoring (DCM) system offering the improved performance of wired data acquisition while maintaining economical installation costs.

Orbit DCM

The Orbit DCM device is a flexible and scalable system fully supported by our System 1 condition monitoring and diagnostic software. It delivers economic

vibration monitoring along with reliable signal processing for important assets.

With high-speed data collection, processing on the edge, and synchronous data acquisition across all 16 channels, Orbit DCM gives operators the machine health insights they need to succeed.

Key features

- Compact and easy to install
- Cybersecure (IEC 64223) with built-in tamper detection
- Simultaneous channel data sampling
- 16 dynamic
- 4 speed (Keyphasor)
- 4 digital inputs
- Multi transducer support
- Support for use with single PC or network
- 3 wired ethernet connections
- · RS485 interface for serial communication
- 24-bit A/D conversion with high precision
- · Configurable waveforms per channel
- · Configurable setpoints with alarming and events
- · Machine operating state-based data storage
- Inbuilt Modbus (server and client) support (RTU, TCP)



Data and measurements

- Direct, bias, speed, gap, RMS
- Spectral overall, energy, peak extractions
- Transients (start up, shut down, overspeed)
- User configurable windowing
- 40 kHz max frequency
- 32 k sample waveforms
- 12,800 lines spectral resolution



State based

- Up to 12 states (user defined)
- 1 second evaluation



Alarming

- 4 severity levels
- 1 second evaluation
- In/out of band, over/under setpoints, state based
- High resolution alarm date (50 ms resolution)



Data storage

- User configurable
- All channels, states, alarms
- Internal storage (7-day min)
- Pre and post alarm spectra



Wired protection and condition monitoring

2300

Affordable, continuous vibration, and temperature monitoring

For the assets in your plant that warrant continuous monitoring and/or machinery protection, but not the channel count and costs associated with a more full-featured rack-based system, the 2300 monitoring device is a perfect fit. This self-contained package incorporates the functionality and integrity necessary for auto-shutdown protection of general-purpose machinery.

The 2300 is a compact 3-channel monitor that accepts up to two vibration inputs (two proximity, two acceleration, or two velocity) plus a Keyphasor®/speed input. It can also be configured for 3 channels of process variable signals (proportional DC voltages) when used for temperature

5 Vibration Monitor

10.042 pk

10.119 EK

or other process-related measurements. The 2300 features built-in connectivity to System 1 either via Ethernet or via an available Trendmaster interface (2300/25 only).

Both platforms provide the level of alarming programmability, configuration flexibility, and signal processing normally associated with larger, more expensive systems. They also provide 4-20 mA and relay outputs along with the ability to communicate via Modbus TCP with plant historians and process/machine control systems.

Certifications and field installation options

The 2300 is intended primarily for field installation at or near the machine. Global approvals for Div 2/Zone 2 hazardous areas are available along with weatherproof housings meeting IP66. This monitor features a local display that allows personnel to verify readings and alarm statuses in the field.

Diagnostic capabilities

Predictive maintenance teams can use the BNC connector(s) on the front of the 2300 for supplemental data collection and analysis by portable instruments. The 2300 offers full System 1 connectivity allowing comprehensive dynamic and static data capture for rich diagnostic capabilities and supplemental software alarming to augment the device's hardware alarms.

	2300		
Input channels	2 vibration + tach OR 3 process variables		
Sensor types	Accelerometers, proximity, piezo-velocity, moving-coil velocity, magnetic speed pickups, proximity switch speed pickups		
Vibration channel types	Radial vibration, acceleration, velocity, axial position, speed		
Temperature input types	Any ¹		
Outputs	 2 x relays 2 x 4-20 mA Modbus TCP 3 x buffered out 		
System 1 (dynamic data)			
Machinery protection			
Local display	Standard (integral)		
Signal processing	Acceleration enveloping		
Hazardous area ratings	CSA CL1 DIV2 ATEX ZONE 2		
Warranty	3 Year		

1. Requires third-party interface device to convert RTD or thermocouple sensor to proportional negative DC voltage.



Setting the new standard for machinery protection systems with Orbit 60

When the world's leader in machinery protection systems delivers a next-generation platform, you can be assured that it takes state-of-the-art to a whole new level.

Say hello to Orbit 60. Our fifth generation machinery protection platform.

It's everything you've come to know and love in prior generations of our machinery protection platforms but with a host of revolutionary new features that deliver more flexibility, more connectivity, more cybersecurity—and most importantly, more value.



(XX) Flexible

Flexible deployments

Orbit 60 is designed to reduce installation costs because it is the most flexible architecture we have ever produced. Prior systems limited a "rack" to a single physical chassis. Not with Orbit 60. Using our Xtend™ technology, multiple chassis can be bridged using a high-speed, virtual backplane. This allows you to place input modules close to the machines, dramatically reducing wiring costs while placing processor(s), communication module(s), and displays remotely to support multiple remote chassis.

Channel count has been increased as well. A single system can host up to 65 dynamic channels, hundreds of static channels (such as temperature), and thousands of process variables. Orbit 60 delivers physical flexibility as well. Racks are smaller with a height of 3U instead of 6U as in our popular 3500 Series. When two chassis are stacked vertically, they fit in the same cutout as a 3500 rack, making retrofits easy. And, racks can be mounted in panel cutouts, on 19 in. EIA rails, and bulkhead-style while consuming approximately half the space for the same channel count.

Extend the virtual backplane

Expand to remote i/o, reduce field wiring lengths

through bridge modules

Connected

Orbit 60 doesn't just connect to System 1. It connects to your DCS, process historian, or other automation platform, allowing access to all of the rich process data in these repositories. Prior systems simply published data from the protection system to the process control system. Orbit 60 features our conneX™ technology, a revolutionary bi-directional interface* that eliminates the need for multiple interfaces—one to ingest process data, one to publish protection system data, and still another to publish condition monitoring system data. The result is lower integration costs, more powerful monitoring capabilities, and more value.

* Planned for release in 2025.

Secure

When we designed Orbit 60, customers told us their #1 priority was cybersecurity. We listened. And we innovated. The result is patent-pending technology that completely isolates the machinery protection network from the condition monitoring network. It's like a diode—only better. Diodes block all inbound communication with the rack. Our design allows users to communicate with the condition monitoring functions—which often need to be changed and optimized on-the-fly—while blocking all access to the protection functionality at the circuit board trace level. It completely eliminates the possibility of a breach. We call it our aXess™ technology and it delivers the best of both worlds: world-class security certified to IEC 62443 and world-class accessibility.

Orbit conneX

Publish alarm, event, and overall values

and
Retrieve high-s

Retrieve high-speed process data



Orbit aXess

Isolates condition monitoring network



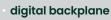
from Cordant

Machinery protection network with patented circuit design

Orbit Xtend



Extend full bandwidth



Up to 2 km via bridging





Full featured continuous vibration monitoring and protection systems













3500 Series

3701 ADAPT

and Ethernet Global Data (EGD)

protocols.

Our 3701 ADAPT platform is designed for overspeed/ emergency shutdown device (ESD) protective systems. The small form-factor packaging allows it to be easily mounted on the machine skid when required, without sacrificing the rich functionality normally found only in larger systems.

The 3701 platform boasts our most powerful signal processing capabilities for selected applications and is recommended when equivalent capabilities are not yet available in our Orbit 60 platform. Like all our other protection systems, full connectivity to plant and machinery control systems is supported via Modbus TCP



For more than two decades, the 3500 Series has been the industry standard in machinery protection. No other system enjoys such widespread use or is trusted by so many customers for

mission-critical applications. During the last 25 years, the system has undergone continuous improvement to ensure it delivers the functionality required in new installations while retaining necessary global approvals and certifications that allow customer to continue to specify it with confidence.

With the introduction of our Orbit 60 platform, 3500 will not go away. There remains a place for both systems—particularly for customers with large installed base of 3500. Both systems will be supported in parallel. In fact, a similar situation existed in 1995 when 3500 was introduced, co-existing alongside our 3300 Series platform. Full 3300 support continued for more than 20 years until it was eventually retired in 2018. You can count on similar support and longevity for 3500.

Probes, sensors, and transducers

Baker Hughes offers the largest catalog of Bently Nevada proximity, acceleration, and velocity sensors of any condition monitoring provider. This is supplemented by specialty pressure, position, torsional, and other sensors used for machinery measurements, along with a broad selection of all necessary brackets, housings, junction boxes, and accessories for comprehensive installation solutions. Our installed base of more than 10 million vibration transducers for continuous monitoring applications is the largest in the world.





80,000+

3500 racks in service globally

3rd Gen circuit boards and

functionality

50+ available channel types

25 Years leading the industry Packaged systems We have packaged thousands of systems over the years We deliver more than a cabinet—we deliver an to exacting customer requirements including enclosure engineered solution from either our standard package types, color matching of existing panels, and inclusion of designs or your own specifications when a customized auxiliary systems such as purges, fans, coolers, heaters, solution is needed. Every detail is carefully reflected convenience outlets, UPSs, and lighting—to name just a in our craftsmanship incorporating six decades of few. Our factory acceptance testing (FAT) capabilities field experience designing and working in industrial are second-to-none and include not just the monitoring panels. This ensures every panel incorporates industry best practices for lighting, serviceability, convenience, systems but the communications with plant controls and condition monitoring software as well. RFI protection, conductor segregation, labeling, and documentation.

Improve equipment reliability, uptime, and efficiency with Cordant™, built on System 1

Cordant™, built on System 1, is the heart of our plantwide condition monitoring solution. And while it integrates all of your assets into a single dashboard, it's far more than a dashboard. It's a combination of technologies and capabilities that deliver what matters most to your organization: results. Improved asset reliability, improved uptime, and improved efficiency. By staying connected to our customers—and by using our own tools—we have continually advanced what you need in a condition monitoring platform ranging from cybersecurity to scalability to world-class usability innovations and enhancements. After more than two decades on the market, System 1 is better than ever and represents a major area of ongoing product development investment.



Purpose-built historian

Your process historian can handle massive volumes of process data. But what it can't deal with is the high-bandwidth waveform data that is essential to condition monitoring and proper diagnostics. System 1 handles it with ease—even Terabytes worth when necessary. The data you need, when you need it.



Trend plots can only get you so far when it comes to isolating faults, their severity, and ultimately root cause. Machinery diagnostics is a discipline involving deep dives into the nuances of spectral content, orbit shapes, and much more. One set of tools for fluid-film bearings, and another for rolling element bearings. Special tools for gear analysis, torsional analysis, cylinder performance, mode shapes, rubs. There is simply no richer set of tools for every machine in your plant than what we deliver in System 1.



Performance analytics

Not all problems are mechanical in nature. In fact, some of your most costly problems can be related to machinery efficiency—fuel costs, wasted energy, excess emissions. System 1 combines both mechanical and thermodynamic condition into a single, integrated environment. No more switching between applications. No more cumbersome manual correlation of process, vibration, and performance trends. We bring it together in one convenient, powerful place.

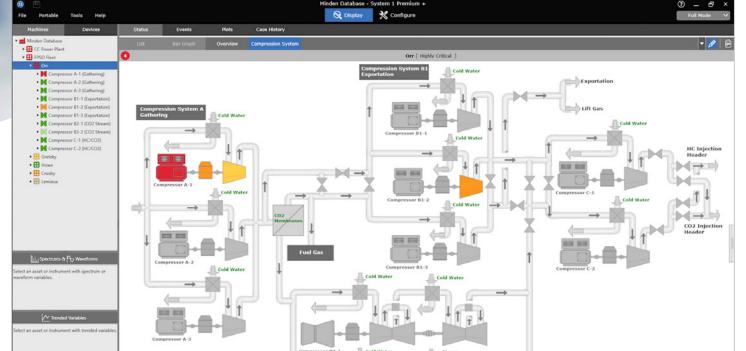


Decision Support analytics

Plowing through reams of data looking for anomalies is not a good use of anyone's time. Your time needs to be spent solving problems—not looking for them. That's why there's decision support—an embedded Al application within System 1 that sifts through your data and automatically spots malfunctions for you. Because asset management is really about management by exception—spending your time on the assets that need attention rather than those that don't.

Cordant*

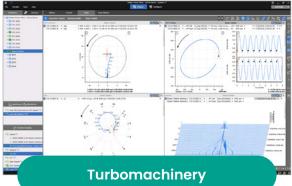


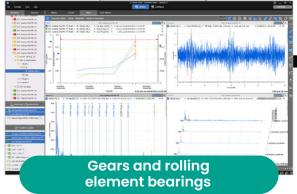


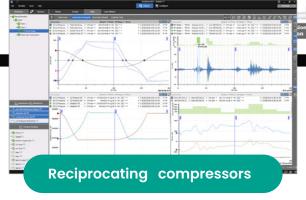




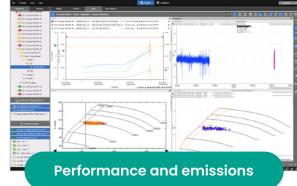












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One unified solution, endless possibilities

Baker Hughes' condition monitoring ecosystem

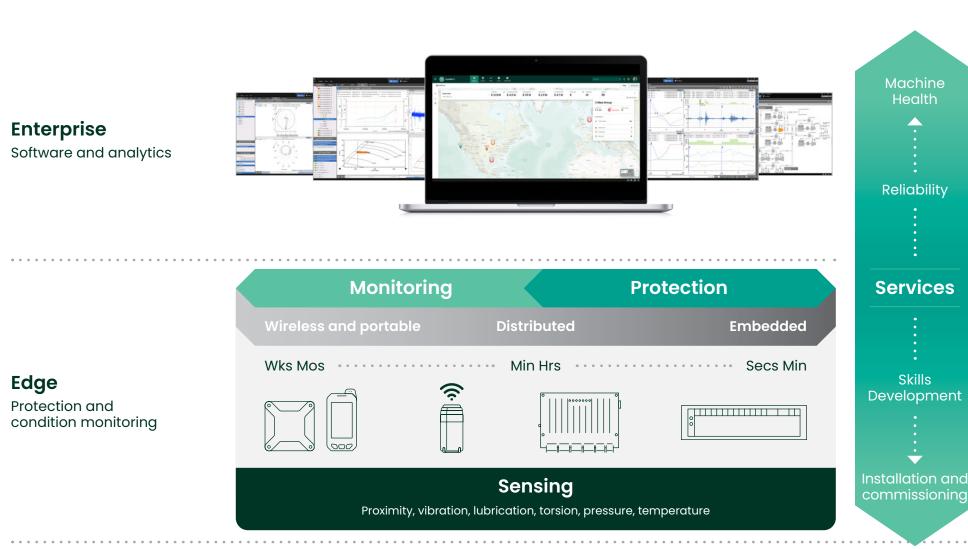
Our machine condition monitoring solutions combine advanced hardware, intelligent software, and trusted service and support—providing a comprehensive, connected view of your operations. Together, they enable you to mitigate risk, boost safety, and reduce maintenance costs. From mission-critical to less-critical equipment, our technology enables better data collection and improved insights across your operations.

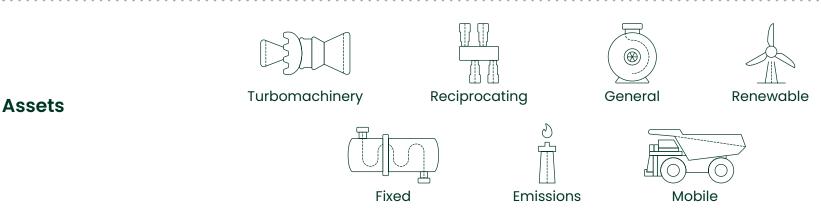
Process data

Very few machinery problems can be solved when armed only with vibration data. Only by understanding the conditions that surround the machine—pressures, flows, levels, temperatures, viscosities, gas compositions, and other parameters—can the cause-effect interactions between process and asset be properly understood. That's why we've taken such care to ensure process data can be easily integrated with System 1, and relevant machinery data can be shared with operators via their process control screens.

Our architecture provides numerous ways to get data in and out—at both the hardware level and the software level—because one size does not always fit all. We use de-facto and recognized industry standards like ISA SP50, OPC, Modbus, ISA100, and WirelessHART. The result is a condition monitoring ecosystem that isn't an island—it's a seamless part of your larger plant control and automation ecosystem, ensuring everyone has the data they need, when they need it.







0 21

Baker Hughes service menu

	 Get it right the first time Ensure your assets are protected and monitored when you're ready to start up Avoid costly delays and rework One source to design, plan, manage, and execute the installation Avoid startup trips due to improper installation and configuration 	Key benefits		
Implementation services		Up to \$1M/day Avoided cost from lost production, secondary process, and equipment damage	100% Service work guarantee I year warranty standard on all service work	
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 	80% Industry-wide percentage of alarms and events due to instrumentation and not machinery	>90% Typical reduction in non-actionable alarms and events	
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 Tailored alarming and customized artificial intelligence to detect specific malfunctions	100% ROI A single machine save often results in complete monitoring contract payback and more	5-10X Cost reduction for well-planned maintenance outage vs. unplanned, reactive outage	
Cybersecurity ¹	 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 	29% Patch management can reduce your attack surface up to 29%	243 days Average time before detection that a system is compromised	
Training and education	 Critical skills that amplify your machinery management capabilities Enable your personnel to operate and maintain your monitoring and protection systems Enable your organization to maximize the value of your systems, leveraging expert product and application training and knowledge 	Customer courses o	400+ Customer courses delivered each year in 10 languages and over 45 global locations	

Cordant

Learn more

Contact us to learn more about Cordant™ Asset Health

bakerhughes.com/cordant

