



Bently Nevada*

Asset Condition Monitoring

Aeroderivative Gas Turbine Protection and Condition Monitoring

How to Select Bently Nevada for Aeroderivative Gas Turbines

- Condition monitoring sensors and transducers
- Protection and condition monitoring systems
- Analytic and diagnostic software
- Intensive signal processing
- Identify and optimize early indicators of failure modes
- Instant access to condition monitoring data for PdM
- Lower costs of installation, maintenance, and replacement
- Increase safety, reliability, and profitability



application note

Table of Contents

Aeroderivative Gas Turbine Design.....	4	Radial and Thrust Bearing Temperature.....	8
Aero GT Monitoring Best Practices.....	5	Anomaly Detection.....	9
Accelerometer Mounting.....	5	Fluid Film Thrust Bearings.....	9
GG and PT Casing (Frame) Vibration.....	6	Combustion Acoustics/Dynamic Pressure.....	10
Free-Standing Power Turbine.....	7	Bently Nevada Aero GT Monitoring Solutions.....	11
Speed and Phase Measurement.....	7	Bently Nevada Condition Monitoring Software.....	13
Gearbox Casing Vibration.....	7	Bently Nevada Condition Monitoring Services.....	14
Radial Journal Bearings.....	8	References.....	18

Background

Modern gas turbines that are used in commercial aviation are high bypass ratio engines. A lower speed power recovery turbine is used on the aft, or rear, of the engine with a shaft inside the higher speed gas-generating rotors to the forward of the engine that drives a large diameter fan to create a larger volume of airflow at lower velocities to increase efficiency and reduce noise. The lower speed shaft line is often utilized to drive other equipment for industrial purposes. The primary function of a gas turbine on jet aircraft is to generate thrust for propulsion.¹

Aeroderivative gas turbines (Aero GTs) that are derived from aircraft applications for use in industrial environments have been adapted such that thrust is converted into mechanical torque to drive a generator, compressor, blower, pump, or other driven machine by channeling hot gases into an aerodynamically-coupled power turbine rather than a nozzle or high-bypass fan. Hot gases spin the power turbine that is mechanically coupled to the driven equipment.

Uses for Aero GTs

Electric Power Generation

- Simple cycle
- Simple cycle with water or steam power augmentation
- Combined cycle: steam generation for a steam turbine generator
- Cogeneration: combination of steam generation for extra power recovery with other uses for heat (such as plant steam and heating of crude oil)

Compression Drives

- Pipeline compression
- Sales gas or flash gas
- Gas reinjection
- LNG compressors

Marine Propulsion

- Direct drive-through gear reduction
- Electric generator/motor drive

Advantages of Aero GTs

- Efficiency
- Skid mounted
- Short build time
- High power density
- Quick change out times
- Fuel variety
- Quick startup

Disadvantages of Aero GTs

- Complexity of machines
- Complexity of instrumentation driven by OEMs
- Lightweight casing subject to mounting influences
- Expensive overhauls typically performed at offsite engine depots
- Condition monitoring requires intimate knowledge of the machine, sensors, interfaces, monitors, and software

Bently Nevada protection and condition monitoring solutions help to offset these disadvantages and maximize the efficacy and efficiency of Aero GTs.



Figure 1 - GE LM6000 Aeroderivative Gas Turbine

Fundamental Aero GT Components

- Gas generator (GG) or High Pressure Turbine (HPT)
- Power Turbine (PT), which is sometimes called Reaction Turbine, or Low Pressure Turbine (LPT)

The integral turbine section of a gas generator serves only to extract enough energy to drive the compressor section. The

remaining energy that is produced by the gas generator is in the form of hot, high-pressure, high-velocity gas that drives a power turbine that is aerodynamically coupled to the gas generator (there is no shaft linking the two components).

This basic design as illustrated in Figure 2 is representative of GE's LM2500/PGT25 and Rolls Royce's Avon.

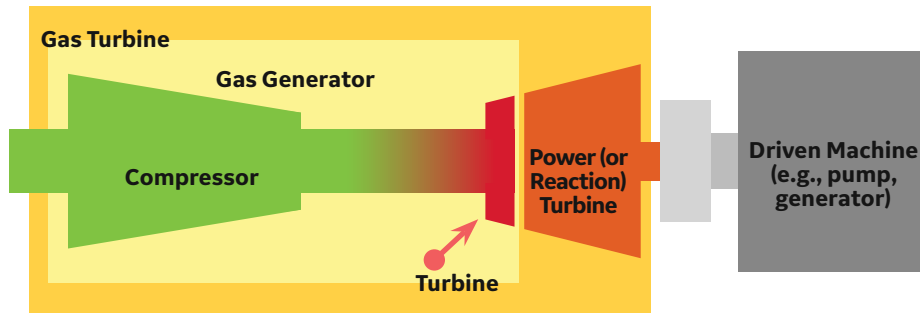


Figure 2 - Single Spool Generator

Some Aero GTs feature a power turbine that is an integral, direct-coupled part of the engine rather than a separate, aerodynamically-coupled element. They can be cold-end coupled or hot-end coupled. The hot-end coupled design as illustrated in Figure 3 is representative of the GE LM6000.

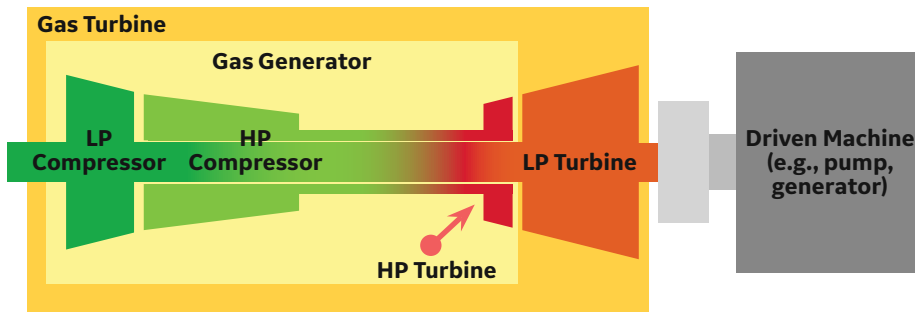


Figure 3 - Dual Spool Gas Generator

The design illustrated in Figure 4 features a dual spool gas generator with a separate power turbine. Aero GT models that follow this design include GE's LM5000 and LM1600, Rolls Royce's RB211, and Pratt & Whitney's FT4 and FT8.

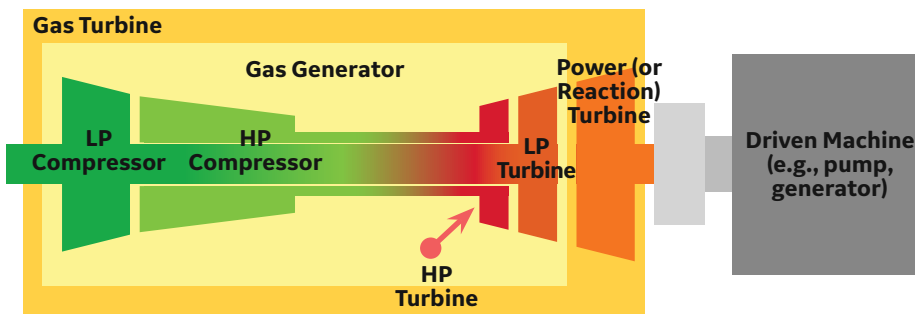


Figure 4 - Dual Spool Gas Generator with Separate PT

Aero GT Design Characteristics

- Emphasis on power to size/weight ratios to reduce fuel consumption
- Rolling element, rather than fluid-film, bearings
- Concentric shafts
- Compressor and turbine stages can run at different speeds to produce large pressure ratios required in some engine designs

- Compressors and turbines can operate at more efficient speeds
- Figure 5 shows a cross-section of the GE LM2500 Aero-derivative Gas Turbine with the basic diagram from "Figure 2 – Single Spool Gas Generator" on page 3 to illustrate how the complexity of Aero GT design can be broken down into smaller components.

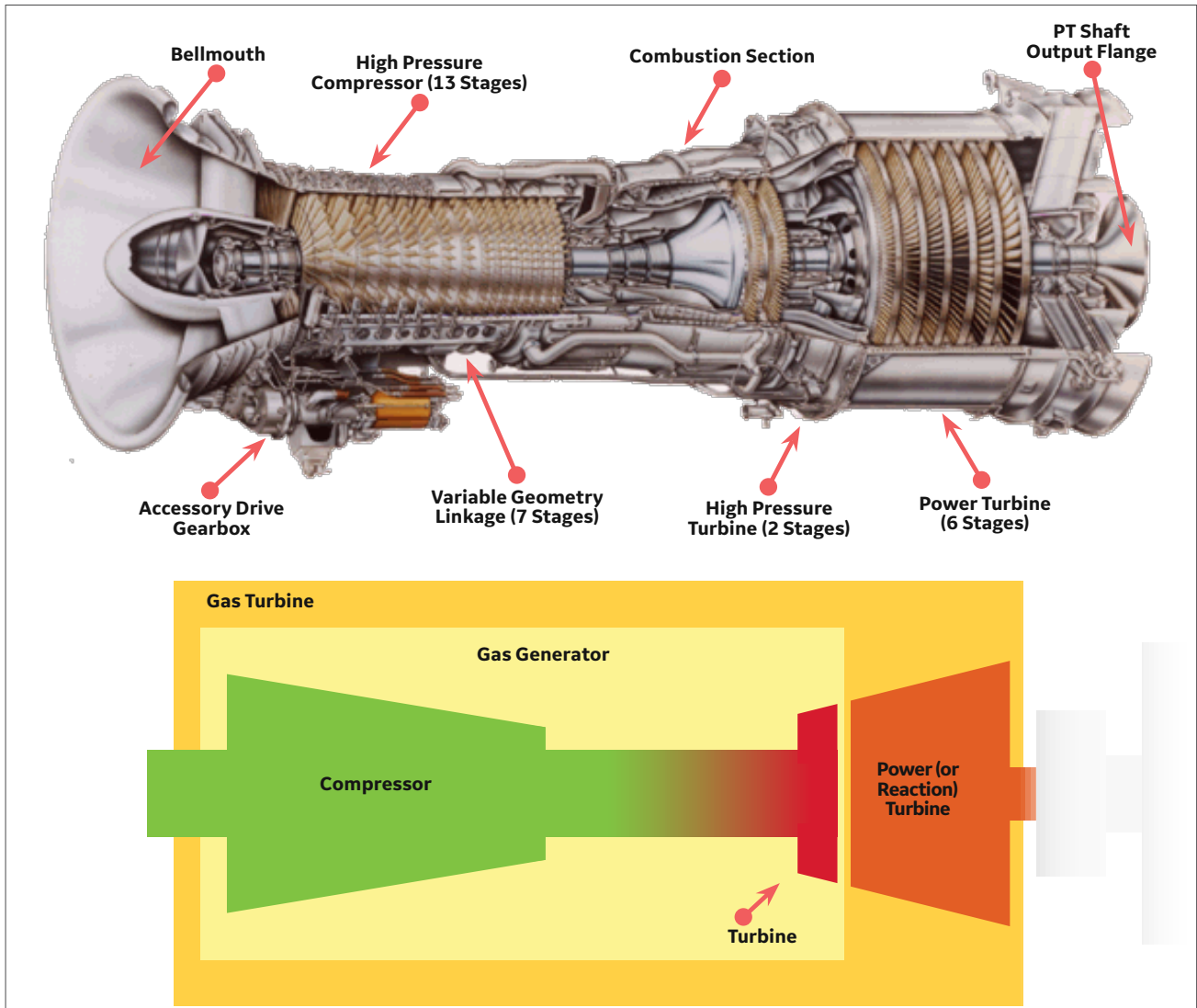


Figure 5 - GELM2500 Aero-derivative Gas Turbine

Typical OEM-supplied vibration monitoring provides basic machinery protection but lacks the diagnostic information required for in-depth condition assessment that can be achieved with proximity probes. Almost all OEM engine monitoring specifications call for installation of one or more casing-mounted accelerometers that can withstand high temperatures on the gas turbine.

Typical OEM Monitoring Recommendations

OEM monitoring guidelines usually call for some combination of these methods:

- 1X rotor tracking monitoring for blade loss events or similar (usually in velocity or displacement integrated from the high temperature accelerometer)
- Specific filter bandpass monitoring for other rotor region engine events (usually in velocity or displacement integrated from the high temperature accelerometer)
- Unfiltered signal monitoring or availability for diagnostic purposes (usually in acceleration)

While it is imperative to follow OEM guidelines when installing basic monitoring systems on new engine installations to ensure safe operation and warranty protection, more elaborate monitoring methodologies can significantly increase early problem detection, lower maintenance costs, and increase safety and reliability.

Installation of instrumentation closer to bearings (using internal sensors) can yield better and more useful operational and diagnostic data. Internal sensors are somewhat difficult to install due to the complexity of the machines.

Aeroderivative gas turbine GGs and PTs are typically designed with internal embedded rolling element bearings that are inaccessible for directly-mounted conventional rotor or casing vibration transducers.

Accelerometer Mounting Best Practice

In a simplified diagram, Figure 6 shows the recommended mounting locations for an Aero GT with a single spool gas generator.

1. Front frame
2. Compressor rear frame or mid-frame
3. Turbine rear frame
4. Power turbine (seismic and/or proximity)

Bently Nevada best practice recommendation is for the use of the Velomitor* 350900 High-Temperature Velocity and Acceleration Sensor (HTVAS) as shown in Figure 7.



Figure 7 - Velomitor* 350900 High-Temperature Velocity and Acceleration Sensor (HTVAS)

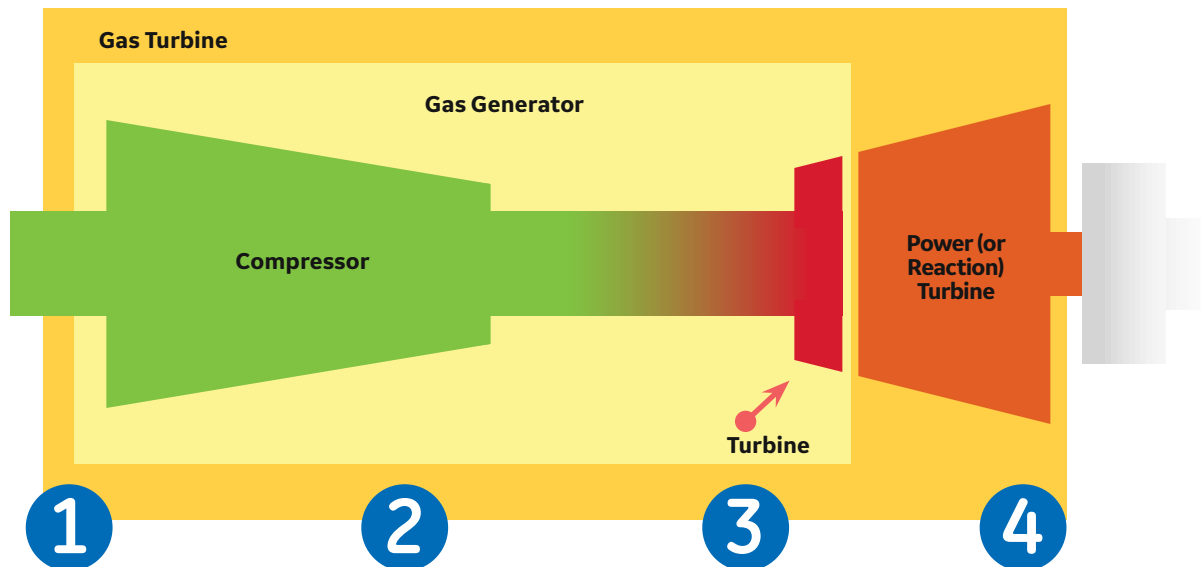


Figure 6 - Recommended Accelerometer Mounting Locations

Gas Generator (GG) and Power Turbine (PT) Casing (Frame) Vibration

Monitoring and Protection Best Practice

- Casing (or frame) vibration
- Velocity sometimes integrated to displacement
- Integrated velocity units from acceleration

Power turbines that utilize sleeve bearings allow for condition monitoring with proximity probes, bearing case, and seismic transducers. Many OEMs follow API 670² specification criteria for these applications.

Protection parameters related to overall vibration amplitude and component defect characteristics can be monitored using appropriate seismic sensors. Chronic problems and acute fault conditions (i.e., misalignment, unbalance, and bearing defects) can be detected and protected against using the dynamic signal from a casing-mounted transducer with appropriate signal conditioning and machine protection systems in place.

The simplified diagram in Figure 8 shows the recommended installation of a high temperature seismic sensor.

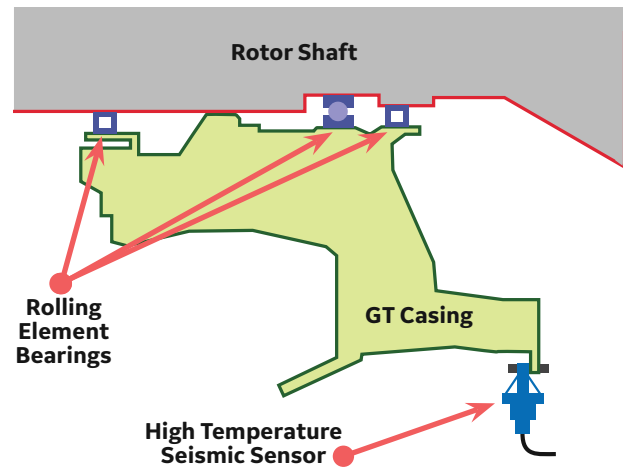


Figure 8 - High Temperature Accelerometer Installation

Speed Sensors

Magnetic pickups for sensing engine rotor speeds (typically supplied and installed on the engine by the OEM) observe multi-event gears. The conditioned signals are required for operation of the tracking 1X speed filter modules and for diagnostics.

The simplified diagram in Figure 9 shows the recommended placement of a speed sensor, appropriately "gapped" from the gear or timing disk, to observe its rotation speed and send its observations, in the form of an electrical signal, to a monitoring device.

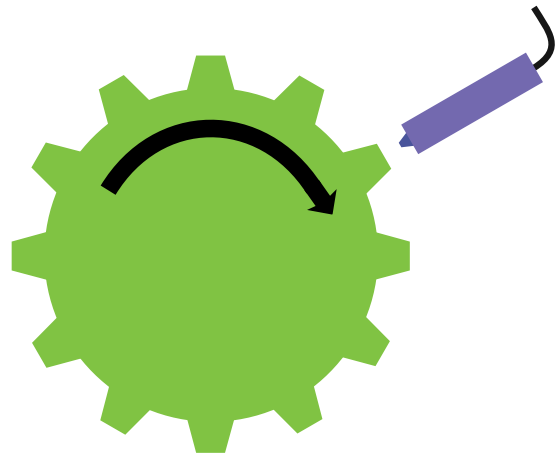


Figure 9 - Speed Sensor Placement

Stand-Alone Power Turbine Section

Proximity Probe Installation on Free-Standing Power Turbine with Sleeve-Type Bearings

- Internal - Standard Bently Nevada 3300XL series. If probes are mounted internal to the bearing cover, they are mounted to the side of the bearings to observe the PT Shaft. Extension cables are routed out from the cover using gland seals.
- External - Mount Bently 21000-type probe assemblies through the bearing cover to observe the PT Shaft. Route cabling away from PT exhaust ducting.
- Casing - Bearing casing probes: Velomitor* Transducer or High Temp Velomitor System

The simplified diagram in Figure 10 shows the recommended placement of seismic transducers and proximity probes on a power turbine.

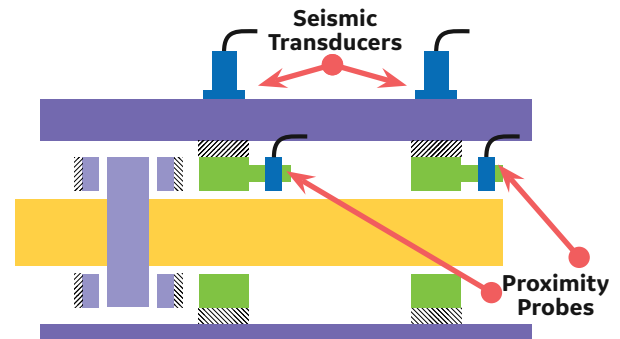


Figure 10 - Best Practice Location of Probes on Power Turbine

Power Turbine, Compressor, Pump, Generator, Gearbox Speed and Phase Measurement

A Keyphasor* transducer is necessary for accurate phase information and must be mounted on the shaft of the driver machine. The target notch or protrusion should be suitable to generate the correct signal at all machine states (confirm with OEM).

- Install one non-contact proximity transducer for once-per-rev phase reference measurements.
- Install at least one Keyphasor sensor on each shaft for once-per-rev phase reference measurements, unless already installed on the driver (i.e., the power turbine) or driven machine (compressor or generator) on the same shaft. One Keyphasor per shaft line/speed should be installed. Install two Keyphasors if redundancy is required.

The simplified diagram in Figure 11 illustrates the recommended location of sensors to observe speed and phase measurements.

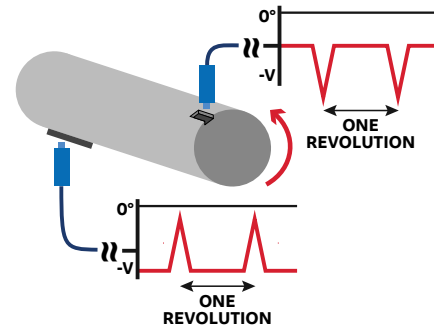


Figure 11 - Best Practice Location of Keyphasor Transducers

Gearbox Casing Vibration Measurement

Acceleration measurement on the gearbox can provide the proactive maintenance planning system with a valuable source of information on progressive damage to gear elements. Specific mechanical fault symptoms related to gear wear or sudden damage can be detected through on-line vibration analysis.

- For critical gearbox monitoring and protection, install two accelerometer transducers in accordance with API 6133. Locate the transducers at the input and output bearing, on the coupling side, and radially on or adjacent to the bearing housing. Align axis as close as practical to the principal load direction. Confirm recommended mounting orientation with OEM.

The simplified diagram in Figure 12 shows the recommended location of seismic transducers on a gearbox casing.

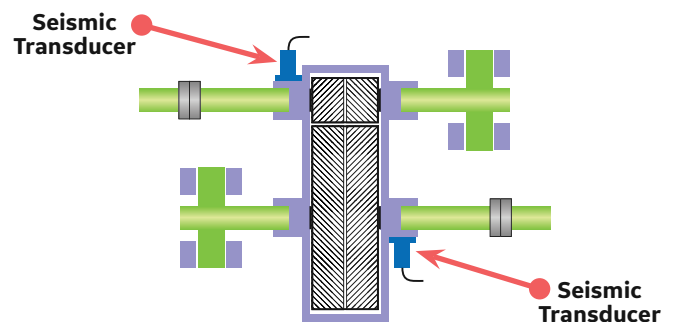


Figure 12 - Best Practice Location of Seismic Transducers

Power Turbine, Gearbox, Generator, Compressor Vibration Transducers: Radial Journal Bearings

The thin fluid film that supports the shaft in a fluid film bearing permits shaft movement relative to the bearing. Two orthogonally-mounted proximity transducers are required to observe this shaft motion.

Protection parameters directly related to machinery internal clearances can be enabled using overall amplitude and DC position measurement. Chronic problems and acute fault conditions (i.e., misalignment, unbalance, shaft rub) can be effectively diagnosed using the dynamic signal output from the proximity probes.

- Install two non-contact proximity displacement transducers in XY configuration at each journal bearing in accordance with API 670².

The simplified diagram in Figure 13 shows the recommended X-Y location of proximity probes to observe the fluid film bearing and detect shaft movement.

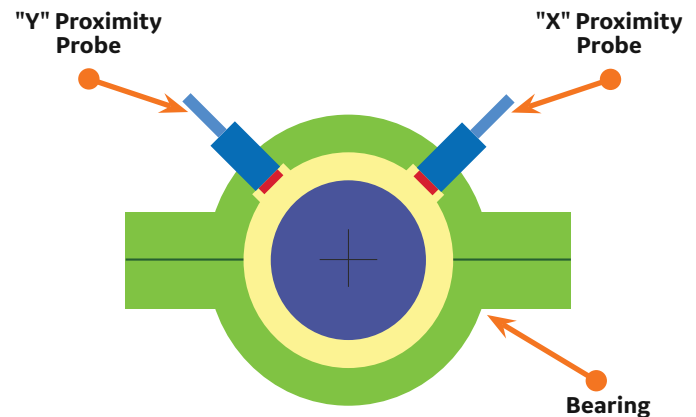


Figure 13 - Best Practice Location of Proximity Probes

Power Turbine, Gearbox, Generator, Pump, Compressor Radial and Thrust Bearing Temperatures

The simplified diagram in Figure 14 shows the design of a typical resistance temperature detector. A coiled resistance element is embedded on a core that makes contact with surface to be measured. Connector wires send temperature observations in the form of an electrical signal to a monitoring device.

- Install Resistance Temperature Detectors (RTDs) or thermocouples on radial and thrust bearings to measure bearing metal temperature. Installation shall be strictly in accordance with the practice specified in API 670².
- Install two sensors in each on-load pad of critical machinery (or within the load zone for radial bearings).
- Install two sensors in each of two pads for thrust bearing protection (actual arrangement is dependent upon bearing geometry). Consult API 670² to verify correct engineering practice.

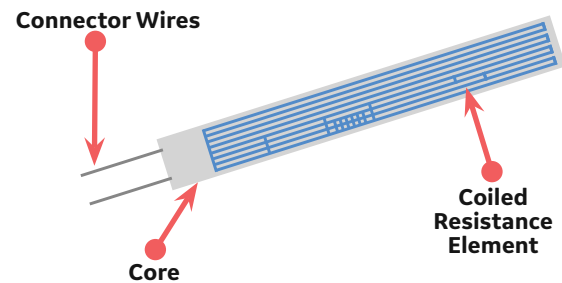


Figure 14 - Typical Resistance Temperature Detector Design

Online Generator Monitoring and Model-Based Diagnostic System

- Employ one RTD or thermocouple per phase (or two per phase where recommended by OEM) for stator winding temperature measurement.
- Fit three phase AC generators with an online anomaly detector to provide anomaly detection by measuring the generator current and voltage. The anomaly detector shall be based in an intelligent, model-based approach, providing both mechanical and electrical anomaly detection and electrical parameters (such as voltage and current imbalances and power factor).

Figure 15 shows the Bently Nevada AnomAlert, the recommended motor and generator anomaly detector for Aero GTs.



Figure 15 - AnomAlert* Anomaly Detector

Minimum Monitored Parameters and Maintenance Advisories

Electrical

- Loose windings
- Short circuits

Mechanical (both driver and driven)

- Unbalance
- Misalignment
- Roller bearings

Power Turbine, Gearbox, Compressor, Pump Thrust Transducers: Fluid Film Thrust Bearings

The simplified diagram in Figure 16 shows the recommended location of thrust transducers to observe the condition of thrust bearings.

- Install dual thrust transducers at each thrust bearing in order to detect thrust bearing degradation and/or failures that can quickly lead to catastrophic machine failure. For SIL 3 applications, install three probes that are connected to triple redundant modular monitors.
- The preferred mounting arrangement for the thrust probes is directly through the thrust bearing when machine design permits. Thrust probe installation may be engineered to observe the end of the shaft (within 300mm of the thrust collar) or another collar on the shaft within a similar proximity to the thrust bearing.
- Install two non-contact proximity displacement transducers in a dual-voting configuration at each hydrodynamic thrust bearing in accordance with API 670². For SIL 3 applications, install three probes.

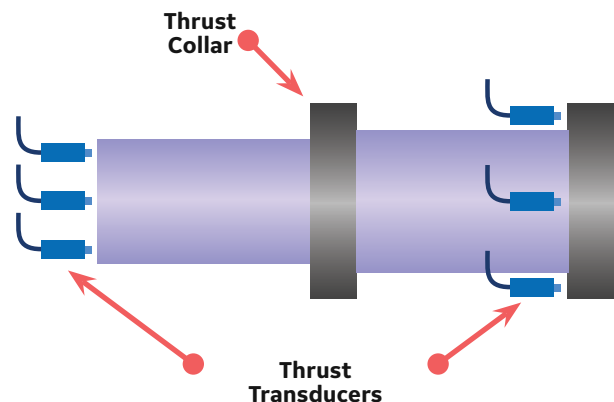


Figure 16 - Best Practice Location of Thrust Transducers

Combustion Acoustics/Dynamic Pressure

With modern Dry Low NOx combustors, the fuel to air ratio has become very lean. This lean combustion can lead to conditions that set up an acoustic resonance in the combustor can, silo, or annulus (sometimes called humming). This resonance, if left unchecked, can create pressure pulsations in the combustor and/or transition piece that are large enough to cause mechanical damage to the components. Once these components are liberated and ejected downstream, severe mechanical damage can result.

Each gas turbine has different acoustic resonant frequencies of concern. The individualities usually boil down to the granularity of the type of combustor for that specific machine.

Similar machines may have different kits for combustion depending on customer requirements and government regulators for emissions. All OEMs know what the frequencies of concern are for each model of combustor and can set up the monitoring systems to filter the dynamic pressure sensor signals for each frequency of concern.

Often, there are two or three frequencies of concern and bandpass filters are set around them. Many systems are permanently installed because gas turbines need to be retuned for differing ambient conditions and fuel qualities and types.

Online combustion dynamics monitors become more important as fuel quality changes cause a gas turbine to unexpectedly experience acoustic pulsations. If necessary, a shutdown can be initiated under extreme conditions.



Figure 17 - 350500 Dynamic Pressure Charge Amplifier

The photo in Figure 17 shows the Bently Nevada 350500 Dynamic Pressure Charge Amplifier (DPCA), a recommended component in a dynamic pressure sensing system that monitors pressure pulsations resulting from combustion instability. The dynamic pressure sensing system starts with a charge-coupled piezoelectric pressure sensor and a low noise interconnect cable that links it to the 350500 DPCA, which then converts the sensor charge signal to a low impedance voltage output signal that is suitable for Bently Nevada monitors such as the 3500/64 Dynamic Pressure Monitor, in conjunction with Bently Nevada System 1* Condition Monitoring software.

ADAPT 3701/44



3701/44 Features

- Tracking multiple rotors on a single channel
- Improved amplitude resolution
- Multiple measurements (bandpass or nX) can be added to sensor points (CRF/TMF)
- Faster data update to controllers
- Single 3701/44 can monitor Aero and driven equipment in most cases

Comparison to 3500

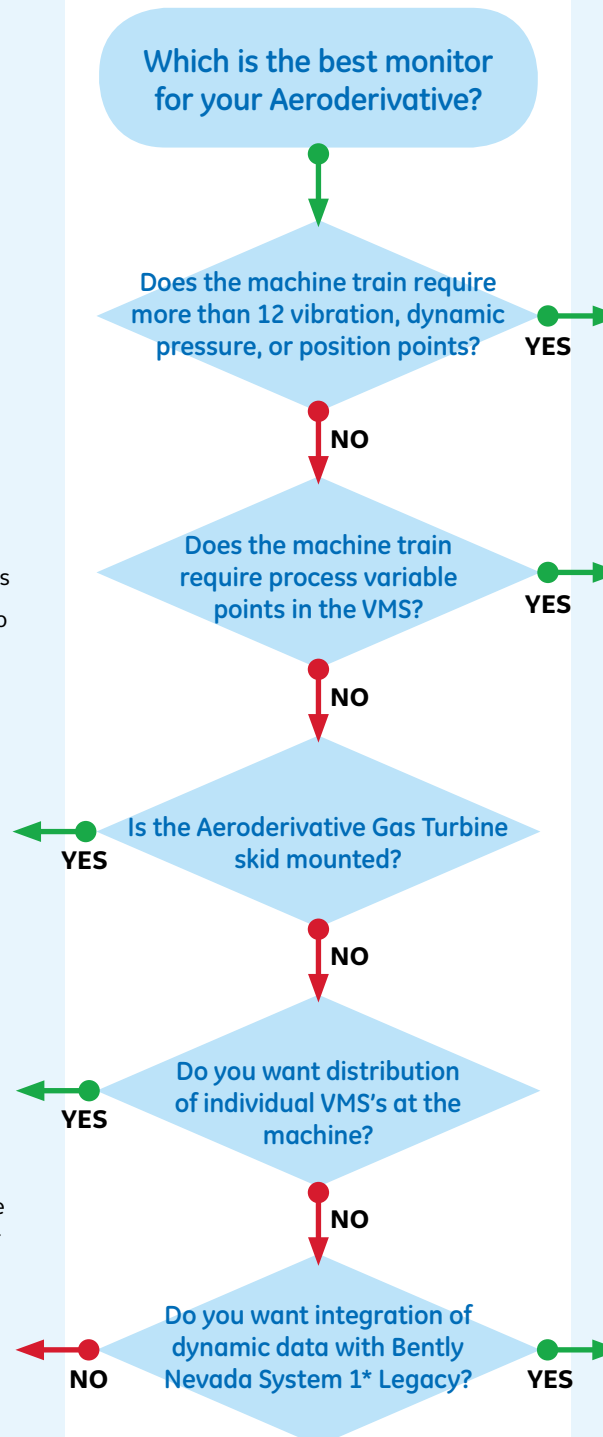
- Footprint Reduction: 64% (82% when compared to a 3500 bulkhead)
- Power Reduction: ~50%
- Volume Reduction ~80%
- Catalog level part number reduction: 90%
- Tracking a sensor point at multiple rotor speeds requires paralleling sensor to another channel
- Adding another bandpass to a CRF/TMF sensor beyond the one available requires using another channel (paralleling sensor)



3500 & 3500/44



3500 & 3500/44 Benefits

- 3500 will more often have an advantage on retrofits due to
- Ability to add more points
 - Variety of monitor types
 - System 1* Legacy connection
 - Serial Modbus
 - Flexible redundancy options
 - Internal barriers
 - Different display options
 - Ease of replacing existing VMS in 19" EIA panel or rack mount



<p>ADAPT 3701/44</p> 	<p>Feature Comparison</p>	<p>3500 & 3500/44</p> 
<p>18-36 VDC</p>	<p>Primary Power Input</p>	<p>20-30 VDC, 88-140 VDC, 110 VAC, 220 VAC</p>
<p>-30C to +65C</p>	<p>Operating temperature</p>	<p>-30C to +65C</p>
<p>12 dynamic, 2 Kph, 8 rly, EGD or Modbus TCP</p>	<p>Maximum inputs assuming min 8 relays, 2 or more Kph, and industrial comms</p>	<p>44 dynamic, 4 Kph, 16 rly, MdbS/EGD</p>
<p>✓</p>	<p>Configurable multiple static & dynamic measurements per channel</p>	<p>ⓘ Fixed by channel type</p>
<p>✓</p>	<p>Redundant Power Supplies</p>	<p>✓</p>
<p>✓</p>	<p>Modbus TCP/IP</p>	<p>✓</p>
<p>✓</p>	<p>EGD</p>	<p>✓</p>
<p>ⓘ compliant with exceptions</p>	<p>API 670</p>	<p>✓</p>
<p>✗</p>	<p>Redundant Relay Modules</p>	<p>✓</p>
<p>✗</p>	<p>Modbus Serial</p>	<p>✓</p>

ADAPT 3701/ Family

























Feature Comparison

3500 Family



Separate HMI using System 1* Basic or Modbus	Display	Separate face-mounted LCD or panel mount VGA, Modbus, or System 1*
26.7 x 20 x 18.2 cm, 4.5 kg	Size, Weight	27.9 x 48.2 x 35.5 cm, 15 kg
24-bit $\sigma\delta$	A/D conversion and signal processing	16-bit $\sigma\delta$
0.5 Hz to 40,000 Hz	Signal Frequency Span	3 Hz to 30,000 Hz
>20	Flexible, configurable measurements per channel	4-8 fixed measurements/channel with configurable attributes
✓	Distributed design for plant control, protection, and CM (e.g., an FPSO)	✗
✓	Multi-rotor nX order tracking on a single channel	✗
✓	Configurable low pass and high pass filter order (roll-off)	✗
✓	Non-integer nX orders available from 0.1X to 100X	✗
✓	Integrated and non-integrated measurements on same channel	✗
✓	Peak and rms measurements on same channel	✗
✓	Support up to 3200 line spectrums	✗
✓	Supports multiple configurable peak amplitude extraction measurements based on in-the-box FFT	✗
✓	Small footprint	ⓘ mini rack only
✓	Skid mountable	ⓘ at higher cost
✓	Bulkhead mount with no need for rear access	ⓘ if full size bulkhead rack

<p>ADAPT 3701/ Family</p> 	<p>Feature Comparison</p>	<p>3500 Family</p> 
	<p>nX order amplitude and phase configurable from 1X to 100X</p>	 <p>1X and 2X amp and phase available on most channel types; Up to 20x on Hydro</p>
	<p>Radial vibration, thrust, speed, $k\phi$</p>	
 <p>(REB features in R4)</p>	<p>Small machines w/complex kinematics</p>	 <p>(no REB-specific)</p>
	<p>Multiple sensor support (accel, vel, prox, MPU)</p>	
	<p>Galvanically isolated mag p.u. speed inputs</p>	
 <p>two connections but same Hw</p>	<p>Redundant Comm Gateways</p>	
 <p>pending</p>	<p>Hazardous Rating CSA Class 1 Div 2</p>	
 <p>at higher cost</p>	<p>High channel count</p>	
 <p>at higher cost</p>	<p>Retrofit existing rack(s)</p>	
 <p>Does not connect to System 1 Legacy Connects to System 1 Evolution in 2015</p>	<p>System 1* Connection</p>	
	<p>Internal Safety Barriers for intrinsic safety</p>	 <p>not on 3500/44</p>

BNMC* (Bently Nevada Monitor Configuration)

Bently Nevada Monitor Configuration software is necessary to configure and verify the ADAPT 3701/44 Aero Monitor.

Features

- Designed and fully tested for Microsoft® Windows® 7 (32- and 64-bit) and Microsoft Windows 2008 Server (64-bit)
- Language support includes English version operating systems with keyboard preference set to English (more in development)
- Drag-and-drop to build out machine configuration
- Connect and send configuration to ADAPT 3701/44 Aero
- Available Template Configurations include GE LM2500 and GE LM6000, with more in development
- Generic System Configuration allows for selection of turbine type, make, and model, along with drive train components

System 1*

Machine condition monitoring systems provide tremendous value to asset owners in the unique operating conditions of aeroderivative applications (i.e., remote location, limited technical and maintenance resources, and sparse lead times are key drivers. Bently Nevada's System 1 condition monitoring software platform provides online machinery analysis and predictive maintenance support systems for aeroderivative monitoring applications.

System 1 provides real-time optimization of equipment and selected processes, condition monitoring, and event diagnostics. Similar in concept to a process control solution, System 1 allows you to understand, diagnose, and control your process conditions in real time for the assets that drive your process. System 1 can be applied to selected processes that are not normally addressed by a process control system such as fuel management and combustion optimization.

System 1 Basic is a simple, low cost, easily installed, and light footprint HMI. System 1 Basic is part of the System1 Evolution platform and offers a subset of System 1 Evolution functionality to provide a basic operator display.

The Modbus TCP or EGD industrial protocols can be used to serve data to an HMI where users can build display environments using standard 3rd party HMI software.

Bently Nevada 3500 Configuration Software

Bently Nevada 3500 Configuration software is necessary to configure and verify the 3500 Rack system. Three software packages are available for use with the 3500 Machinery Protection System.

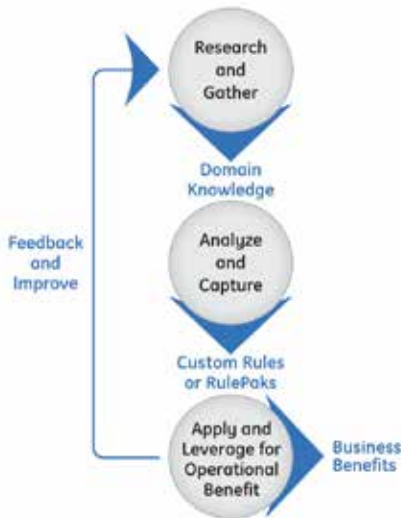
- Rack Configuration Software - This package configures all 3500 modules.
- Data Acquisition/DDE Server - This package collects and archives static data from the 3500 System. The DDE Server provides data exporting capabilities for integration with third party software such as plant historians, process control systems, and human machine interfaces.
- Operator Display - This package displays information collected by the 3500 Data Acquisition software.

Features

- System 1 Evolution Basic provides visibility to online data from ADAPT 3701/44 Aero (overall vibration data in trend, bar graph, and time base formats, alarms, and event lists with a thirty-day history)
- System 1 Evolution Turbo will provide full System 1 support
- Data analysis made available for hard-to-reach locations through the use of remote access (e.g., offshore platforms, remote unmanned locations, etc.)
- Trip and spurious shutdown analysis performed using alarm event files
- Inclusion of a knowledge-based decision support root-cause fault diagnostic rule library for automated detection and communication of commonly-experienced machinery fault conditions, including a customizable machine and process diagnostic rule generator
- Creation of user advisories
- Integrated electronic documentation management, electronic operator journal, and automated electronic report capabilities

Decision Support*

The Decision Support software suite helps to optimize your business operations, assisting you with early detection of mechanical, operational, instrument, and business events. Easy-to-use graphical tools help you write rules comprised of equations and algorithms to easily acquire, capture, disseminate, and leverage your knowledge of equipment, processes, and your business.



Bently PERFORMANCE SE*

Bently PERFORMANCE SE software is complimentary to System 1, extending its functionality to include online thermodynamic performance monitoring.

Features

- Gas turbine performance calculations performed in accordance with ASME PTC 22-1997⁴ with respect to heat rate and thermal efficiency parameters
- Gas turbine compressor calculations performed using Real Gas Equation of State for air gas mixture, including moisture content derived from Relative Humidity input (automatic from DCS/met station or manual input)
- Inlet filter screen differential pressure is accounted for inlet pressure drop performance correction
- Compressor performance calculations computed using isentropic and polytropic analysis for head and efficiency
- Compressor pressure ratio included in list of displayed parameters

System 1 RulePaks*

RulePaks software is a system extender to System 1 software with a pre-configured set of rules that perform real-time data validation, calculations, analysis, and detection of specific events and malfunctions.

Benefits

- Maximize plant availability
- Optimize plant maintainability
- Mitigate operational risks
- Rapid application of expertise from outside your business
- Asset life extension

Capabilities

- Configurable advisories
- Robust IT security
- Easy plug-in to System 1 platform
- RulePaks can be deployed across your business
- Can drive user notifications with actionable information

SmartSignal*

Proficy SmartSignal statistical modeling software package provides automated and accurate early warning of a wide range of plant asset abnormalities by utilizing vibration and process data collected from DCS/Data Historians and Bently Nevada monitoring racks. With these early warnings, users can then take a “deeper dive” into diagnostic and analytical techniques using System 1. Process data needed for adequate modeling includes (but is not limited to) load, temperature, speed, vibration, and pressure.

Features

- Early detection and diagnosis
- High true positives
- Works across all assets: rotary, reciprocal, and fixed
- Fast implementation using engineered templates and personalized with your data
- Finds impending equipment issues early and with confidence

Bently Nevada Training and Optimization

Recommended Five-Day Training Program

Well-structured user training is essential to drive long-term, sustainable value from a comprehensive monitoring and diagnostic platform such as Bently Nevada System 1.

Include on-site classroom training in the project scope:

- Instrument and Control: Sensor operation, monitoring and protection system operation and maintenance, basic on-line monitoring software operation
- Condition Monitoring Training: on-line monitoring software operation, thermodynamic performance analysis, vibration condition monitoring

System Optimization

To correctly establish monitoring and evaluation baseline references, statistical thresholds and database storage allocation settings, plan an “optimization” service at six months and twelve months from the date of system commissioning. Include refresher training to reinforce earlier technical training.

Bently Nevada Results Supporting Services Agreement (SSA)

The Bently Nevada Results Supporting Services Agreement (SSA) is a subscription-based service that offers production facility owners and operators an easy way to access state-of-the-art Bently Nevada machinery optimization, event diagnostics, and condition monitoring capabilities without the significant costs and resources that are associated with capital installation and equipment ownership.

The Results SSA package is a great option for facilities that have Bently Nevada 3500 Series monitoring systems but do not use System 1* software. Facilities that need consistent machinery health and performance information but face financial and resource constraints such as time, personnel, or expertise experience the most benefit from Results SSA.

With Results SSA GE’s Bently Nevada owns all hardware and software included in the solution and our experts perform regularly scheduled audits and provide you with periodic machinery condition reports.

Benefits

Detailed analysis and recommendations for optimum response time and knowledgeable decision-making

Alerts to important machinery health events

Continuous, reliable plant coverage and easier long-term cost forecasting

Takes the worry out of machinery condition monitoring and gives you more time to focus on core competencies and produce products

Included in the Results SSA Package

- System 1 server and network switch/hub
- System 1 software, including configuration and optimization
- Remote notification configuration for remote alarming and event management
- Periodic machinery condition reports
- Access to dedicated SSA web portal and the Bently Nevada Technical Support portal
- Regularly scheduled teleconferences with Bently Nevada experts
- Preferred access to additional Bently Nevada services

References

- 1 "Gas Turbine Vibration Monitoring: An Overview", Mel Maalouf, ORBIT Magazine, Vol. 25 No. 1, First Quarter 2005, pp. 49-62.
- 2 American Petroleum Institute (API) Standard 670 (R2010) Machinery Protection Systems, Fifth Edition.
- 3 American Petroleum Institute (API) Standard 613 (R2007) Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services, Fifth Edition.
- 4 ASME PTC 22-1997 Performance Test Code on Gas Turbines, STANDARD published 04/24/1997 by ASME International.

About Bently Nevada

GE's Bently Nevada product line has been synonymous with machinery protection and condition monitoring for more than 50 years. Our network of global experts is dedicated to helping our customers solve some of their toughest challenges in the oil and gas and power generation industries. From refineries and petrochemical plants to hydroelectric facilities and wind farms, Bently Nevada Asset Condition Monitoring offers trusted and proven vibration monitoring equipment and a comprehensive services portfolio to help improve the reliability and performance of production assets like turbines, compressors, motors, generators, and everything in between.

Behind every suite of great products is a team of great people, and the Bently Nevada team is one of the most experienced in the industry. That experience translates into high-quality, flexible and scalable solutions coupled with a dedicated services team focused on providing proactive, consistent support throughout the lifecycle of your operations. Our domain experts can help you operate safely while maximizing plant uptime and efficiency.

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