New transducer technology for

Bently Nevada's High Temperature Proximity System and the 330750 Velomitor® System provide increased reliability

by Bill Zubon
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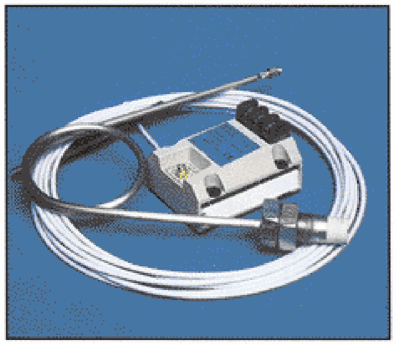
Bently Nevada's new High Temperature Proximity System allows you to measure vibration and position measurements on steam and gas turbines at much higher temperatures than our standard proximity probes and cables could endure. Benefits include:

- **Better information** for machine protection and diagnostics. The probe and cable have a broad operating range of -34° C to +350° C (-30° F to +662° F) for areas where high temperature proximity measurements are required.
- **Versatility**. Its wide range of 4 mm (160 mils) makes it appropriate for virtually all vibration and position measurements in hot sections of the machine.
- **Durability.** The ceramic tip and stainless steel construction resists heat, moisture and corrosion.
- **Convenient mounting.** Threaded and smooth case styles for probe mounting into various brackets.

Steam turbine applications

During startup, online operation and coastdown, **differential expansion** should be monitored to avoid contact between rotating and stationary machine components due to thermal growth. The High Temperature Proximity Probe provides reliable differential expansion measurements in the superheated steam environment inside steam turbines.

It can also measure bearing vibration and position near a **labyrinth steam seal.** A certain amount of steam leakage near the seal can occur during normal machine operation. In several malfunction situations, excessive leakage can occur for short periods of time or even continuously. The High Temperature Probe and integral cable withstand high temperatures and continue to transmit vital machinery information, under conditions which would cause standard proximity probes and cables to fail. These measurements may be critical to ensure safe operation of the turbine.



High temperature Proximity System

Gas turbine applications

The High Temperature Proximity System can also measure bearing vibration and thrust position at hot bearing locations inside industrial gas turbines. Usually, the probe tip isn't located in an extremely hot area, but the probe cable exits near the turbine exhaust, where temperatures can be extremely high. Due to its high temperature rating, you can **route proximity probe cables through the exhaust path** and out the hot end of the turbine. This is a cost-effective solution to vibration and thrust monitoring in hot sections of the machine.

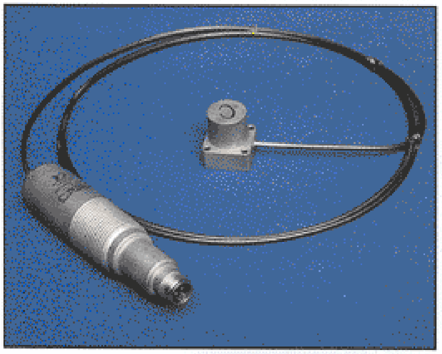
In aeroderivative gas turbines, probes are typically mounted in the gas generator turbine area or the power turbine. The probe tip needs to be located in the bearing compartment, which is usually supported by struts. While these struts are often the best place for the probe cable to exit the turbine, the areas near the struts are frequently too hot for reliable operation of conventional proximity probes. The High Temperature Proximity System now allows the probe cable to **exit the turbine through a strut** and still operate reliably. The cable can be routed through most areas of the hot gas path or a strut that goes through the hot gas path.

Mode shape analysis

Measuring radial vibration and rotor position at the turbine mid-span location can provide insight into the rotor's lateral mode shapes. Many Original Equipment Manufacturers and customers have asked Bently Nevada to develop a high temperature proximity transducer, capable of measuring radial vibration and position at this hot mid-span location. The High Temperature Proximity Probe enables you to measure rotor motion at most turbine mid-span locations, which is essential for mode shape analysis.

Mode shape analysis is important for **research and development** of a new steam or gas turbine design or **when troubleshooting** an existing design. Mode identification probes provide lateral mode shape information, which is extremely valuable for balancing rotating machinery and identifying faults, such as shaft cracks, bearing failures, rotor-to-stator rubs, etc. If lateral mode

high temperature applications



330750 Velomitor® System

shape information and the location of rotor nodal points (zero motion) are not known, XY proximity probes may be inadvertently located at nodal points where they observe little or no shaft motion and provide insufficient information. Used in conjunction with XY probes at each bearing, mode identification probes also provide valuable information necessary for basic machinery monitoring, to calculate dynamic stiffness, and deflection and stress data for baseline and diagnostic purposes.

Mid-span measurement **of interstage seal radial (and axial) clearances** can be made using the High Temperature Proximity System. These measurements help determine true seal clearance conditions when casing distortion may alter the design clearances and cause a rotor-to-casing seal rub.

Advanced proximity transducer

The Bently Nevada High Temperature Proximity Probe is an advanced proximity transducer designed for your most demanding applications. We developed this transducer, based on customer feedback and ten years of field experience conducted by our Custom Products Department on Extended Temperature Range (ETR) proximity transducers. We are confident our latest transducer product will meet your high expectations. ■

by Paul Shaklovitz
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Extreme temperatures and high cross-axis vibration are normal conditions in a gas turbine. These machines need a special vibration transducer to ensure that they are protected from catastrophic failure. Our 330750 Velomitor System is built to withstand high temperatures and cross-axis vibration. It indicates case-related vibration better than an accelerometer and is the best case-mounted transducer for high temperature applications.

The 330750 Velomitor transducer system's sensor and integral hardline cable are rated for 400°C (752°F). It has a threaded electronics housing for easy bulkhead or enclosure mounting. The integral hardline cable is available in lengths up to 8 metres (26 feet).

The 330750 Velomitor System uses a high temperature piezoelectric sensing element to convert seismic vibration into a voltage signal. One of the functions of the electronics is to then integrate the acceleration signal into a velocity signal. The piezoelectric sensing element and the electronics that process the signal are in two separate cases, permanently connected by a flexible hardline cable. The sensor is located in the high temperature area on the gas turbine casing; the electronics can be located nearby in a cooler area. Connectors between the piezoelectric sensing unit and the electronics have been eliminated. In the past, these connectors were a major source of nuisance alarms on gas turbines fitted with piezoelectric, accelerometer-based, seismic vibration monitoring systems.

Velocity pickups versus the 330750 System

High temperature moving coil velocity transducers were once widely-used to measure rotor-related vibration on the casings of aeroderivative gas turbines. However, these transducers have a limited lifespan. The moving parts wear out, and cross-axis vibration causes accelerated degradation.

As velocity transducers degrade, the likelihood of false and missed alarms increases. False alarms often cause major business disruptions. Missed alarms can result in substantial machinery damage and higher costs than if the vibration monitor had detected an unacceptable vibration increase and the machine had been safely shut down.

One approach to the problem of transducer degradation is to replace them on a periodic basis. This increases costs in labor and material. Also, machines must be shut down to physically replace the transducer.

The 330750 is a better alternative. It has no moving parts and is priced comparable to a high temperature velocity pickup. Its velocity output more clearly indicates case-related vibration for better machine protection. Velocity transducers are being replaced by the 330750 Velomitor System for increased reliability.

Available velocity monitors

Casing vibration is widely monitored on gas turbines because an increase in vibration is often an indication of internal damage. The 330750 Velomitor System is compatible with our 3300/55 Dual Velocity Monitor when the -05 transducer option is selected. It is also compatible with our 3500/42 Proximitor®/Seismic Monitor Module and our 2201/03-02 and 2201/03-03 monitors. ■

Editor's Note: A gas turbine vibration monitoring system with seismic pickups only is generally less effective than one that uses proximity probes. Machinery problems can be detected earlier when machinery is monitored with proximity probes measuring shaft motion and position directly.