Increasing Data Logging Productivity Using SKF Microlog / Triaxial Measurements

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General

In the normal course of machine health monitoring, predictive maintenance measurement routes generally incorporate orthogonal measurements on each of the shaft bearing blocks. Each of the rectilinear orientations provides some data preference for achieving a complete diagnostic analysis.

For instance, the vertical direction provides insight as to how the shaft is restrained when considering bearing looseness. The horizontal orientation is preferred for bearing fault diagnosis, since the bearing load zone approximates an elliptical sector centered on the vertical axis. The bearing block transfers the vibration energy to the horizontal orientation as a rigid body with higher compliance than either the vertical or axial direction. The signal to noise characteristics in comparison to the axial and vertical direction are better. It is well known that the axial measurements provide some diagnostic clues as to the severity of shaft misalignment.

A route that includes multiple driver driven machine trains can require up to 12 manual placements of a single transducer if all three axes per machine train are to be monitored. There is a required settling time of several seconds after each transducer placement.

In addition, for accurate trending, the transducer location must be reasonably consistent for viable alarm settings. In general, the transducers are often applied with earth magnets in order to increase the speed of the data logging process. In such cases, the test points can require machining so that the vibration energy is transferred with minimum loss.

Fig. 1. The SKF Microlog with the triax accelerometer system.

The problems with adhering the transducer to the test surface with a magnetic base are:

1 The user must be careful that the initial placement of the magnetic base mounted transducer does not drive the input amplifier into saturation levels. Any measure of amplifier saturation requires a much longer settlement time to obtain stable consistent measurements for trend consideration.
2 The frequency response of a transducer positioned with a magnet can reduce the accurate measurement range below 2 kHz.
3 The exact location of the transducer is a factor in the measurement process. If the accelerometer is positioned with a magnet on an uneven surface, the trend measurement repeatability is affected and the resultant trend data can be seriously compromised.

In contrast, the SKF triax accelerometer / stud adapter / QuickConnect stud system allows for the more rapid roving measurements that are required for normal route data collection by providing a rapid mounting of the transducer to the test surface, thereby appreciably decreasing the data logging time. The advantage of this combination of triax/stud adapter system is that it not only reduces the data acquisition time, but also assures measurement accuracy and repeatability as compared with a magnetic mount. Furthermore, the stud adapter mount frequency response closely parallels the ideal stud mount.

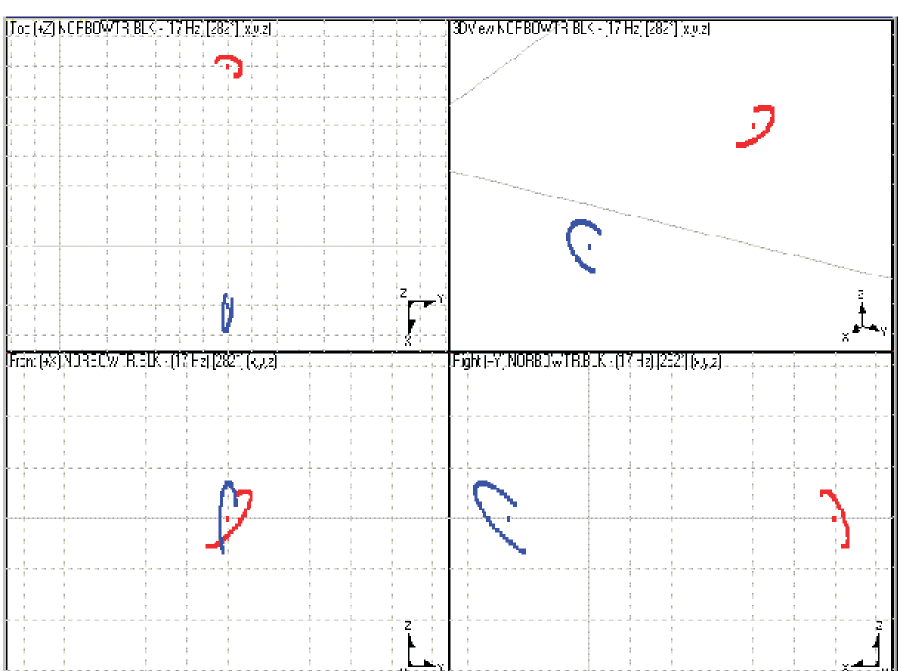
A further advantage is that precise orientation is maintained for trend analysis without having to carefully position the transducer as it occurs with the magnetic mount. The transducer orientation is always consistent each time the transducer is quick locked to the stationary stud adapter.

In setting up a triax accelerometer, where previously a single point sensor was used, it is important for the user to establish a new measurement baseline. The triax sensor can differ in the higher frequency domain from measurements taken with the single point acceleration sensor. In the lower frequency domain (< 1 kHz), if the sensitivity is the same, the measurements should be the same if measured in the same location and orientation.

Another consideration is that measurements that were previously taken in three different mounting locations for each of the three axes, and which are now taken at a single location with a triax sensor, may differ somewhat because of the different mounting location. For example, when the triax sensor is mounted vertically (axis 3 for the vertical direction), then the horizontal (axis 2) and the axial (axis 1) measurements are not taken at the same spot as was the case when a single point acceleration sensor was used.

These considerations are simple, yet important in setting up a successful triax measurement system or when converting from single point to triaxial sensors. Once the user has determined the new measurement baseline, many of the time savings and accuracy benefits of the triax arrangement will become apparent in the following paragraphs.

***Fig. 1.** This four quadrant orbit was obtained by using triax measurements on either end of the bowed roll to confirm the measurements made with the wizard applications of the bump test and run up that indicated the shortened bearing life was due to the excitation of the roll second bending mode at running speed. The SKF machine animation also showed this mode as the primary problem. The orbit display is a paused interval of the AVI movie and clearly shows the orbits at each end is 180° out of phase, which is expected if second bending is prominent. An additional analysis plus is to view the top quadrant that displays the drive end as restrained but the tending end is free to adjust to the axial thrust.*



The SKF triax accelerometer kit is supported by an SKF multiplexer and PRISM4 software and will automatically measure each axis in a group. Consider a four bearing machine train in which the triax is attached to each bearing stud in sequence. At each location the three-axis measurement automatically proceeds to store the data points at the “Enter” command. If three measurement points such as velocity, acceleration and acceleration enveloping are specified for each orientation, then 12 measurements will be stored for each bearing location.

This method reduces the route time by approximately 20% or ten minutes per machine in comparison to manually positioning the accelerometer and waiting for the impact settling time. A normal 50 machine daily route can be increased to 60 machines with improved measurement accuracy, reliability and stability.

Added benefit: example of analysis capability with the triax accelerometer

A case study of triax measurements on a paper roll

A bowed paper roll is used in both the wet and dry sections of the paper machine to re-stretch the felt to obtain proper paper thickness. These rolls have had a history of shortened life at the 1/4 and 3/4 length support bearings. It was thought that the second bending of the bowed roll was the primary cause of this condition.

An investigation of the roll using the SKF Microlog Bump and Run Up Wizard in conjunction with the SKF machine proved that this mode was being excited by the 1x running speed. Additional measurement with the SKF Microlog, triax accelerometer and SKF machine further confirmed the roll bending mode condition.

The triax was positioned first at the trending side of the roll bearing support, and phase and amplitude data recorded in “order” format referenced to a laser 1x trigger. The triax had to be used since only the axial face of the bearing support block was available for transducer mounting.

This was also true of the drive side. Once the data was uploaded to the SKF machine, a three axis 1x orbit was animated (→ **fig. 1**) revealing that the loci of the shaft end points were 180° out of phase. This again confirms the shaft bending problem at running speed. The orbit also clearly showed the drive bearing was restraining the shaft axially while the trending side allowed for axial movement.

Conclusion

The triax accelerometer is a transducer that incorporates three independent accelerometers positioned in rectilinear orthogonal space. This permits the user the opportunity to measure with precision and repeatability the axial, vertical and horizontal orientations in a more rapid sequence than the normal manual single accelerometer method. Together with the stud adapter, the triax is easily but precisely positioned each time the transducer is locked to the stud with greater assurance of trend accuracy.

Overall, there are considerable savings in route measurement time on the order of approximately 20% in comparison to manually positioning the accelerometer and waiting for the impact settling time. A normal 50 machine daily route can be increased to 60 machines with improved measurement accuracy, reliability and stability.

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