Orbit Magazine

Throwback Thursday - Plotting Average Centerline Position

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Bently Nevada has a rich history of machinery condition monitoring experience and has always placed a high priority on educating and helping customers manage & maintain their equipment better. Every week, an article or Application Note that was published by Bently Nevada ‘back in the day’ will be highlighted. Although the format may be dated, the information is just as valid and informative as the original printing.

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The measurement of relative shaft vibration using proximity probes has gained universal acceptance as a preventive and predictive maintenance tool for rotating machinery. A proximity probe provides two (2) signal outputs:

1. Shaft dynamic motion relative to the probe mounting (the ac signal output), and
2. Shaft average position relative to the probe mounting (the average gap or de signal output).

Typically, the dynamic signal is continually processed by a radial vibration monitor with associated alarm set points. However, many people using proximity probes overlook the usefulness of the de portion of the Proximitor output signal. Just as an axial thrust position probe can be used to measure axial vibration, so can a radial vibration probe be used to measure radial position .

If two orthogonal (XY) probes are installed at a radial bearing, then it is convenient to compare the two average gap dc signals. When these signals are compared in turn to the known radial bearing clearance(s). this provides an exact determination of the average shaft centerline position relative to the bearing centerline. Average shaft position measurement is the best indicator for detecting some of the more common rotating machinery malfunctions. Assuming that when a machine is at rest the shaft is located at the bottom center of the bearing clearance, then all subsequent measurements can be referenced to this original position. During machine start-up, the

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measurement of de gap voltages indicates the amount of shaft "lift-off" from the bottom of the bearing. With a machine in operation, the average shaft centerline position can be compared to the bearing centerline for measurement of shaft "attitude angle" (a), and determination of the thin -film oil thickness. The evaluation of attitude angle can determine the margin of stability for a particular machine. For typically-loaded shaft/bearing systems, an attitude angle which approaches or exceeds 90 ° indicates instability.

The measurement of average shaft centerline position and shaft attitude angle can indicate bearing wear (excessive clearance), erosion due to electrostatic discharge, and the presence of shaft preloads such as misalignment. If bearing damage is suspected on a machine, shaft centerline position measurements taken after shutdown may indicate this. One set of readings should be acquired as soon as the shaft comes to rest and a second set when the machine cools to ambient temperature.

An XY plot of average shaft position can be made by hand from probe gap information which was hand-logged during machine start-up. However, the same plot can be made "on line" as a machine starts up or from FM magnetic tape data of a machine start-up. All that is required is a plotter, a few resistors and capacitors, and of course, the output signals from radial proximity transducers or the equivalent signals from an FM tape recorder. Since average position is represented by the dc output of the Proximitor, it would seem feasible to use this signal to drive the pen of an XY plotter. The only problem is that the Proximitor also contains an ac or dynamic signal, which can interfere with proper plotter operation, especially at low shaft rotative speeds and/or low vibration frequencies . To solve this problem, a simple RC network is installed at the signal input terminal of the plotter. Since there will be a voltage drop across the resistor, calibration of the plotter must be performed using a reliable dc source.

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