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Detecting Rolling Element Bearing Faults Using the ECHO® Wireless Vibration Monitoring System

Detecting Rolling Element Bearing Faults Using the Echo® Wireless Vibration Monitoring System

In an ideal world, a vibration analyst would like to have a full set of overall and broadband data continuously on all vibration monitoring points. This would provide the best set of data to detect and diagnose machinery faults. Unfortunately, it is generally prohibitive to get a full set data more than once per month or quarter due to personnel limitations with walk around monitoring systems. This could be automated using an online monitoring system, but the cost of such systems and of running the associated cable generally prohibits this on all but the most critical equipment.

The Echo® Wireless Vibration Monitoring System offers an affordable and acceptable compromise by increasing the number of "looks" at a machine by a factor of about 100 over most route-based methods. It eliminates the cost of running expensive cabling to a control room (as is generally required with continuous online monitoring systems), and provides "at-a-glance" status of all plant machinery being monitored (Figure 1). The system also makes a specifically selected set of overall measurements that when used together are sensitive to most common machinery faults, especially those in rolling element bearings.

Figure 1 – Echo® System Overview that provides "At-A-Glance" Status of Machinery

Echo® makes three overall measurements: RMS Velocity, RMS Acceleration, and True Peak Acceleration. From these measurements it then calculates Crest Factor, derived peak velocity, and derived peak acceleration.

These measurements are sensitive to various types of machinery faults:

- The velocity measurements are sensitive to common lower frequency faults such as unbalance and misalignment.
- The RMS Acceleration measurement detects higher speed faults such as gear mesh, broken rotor bars, and loss of bearing lubrication.
- True Peak Acceleration is most sensitive to impacts caused by bearing defects and some gear faults such as a chipped tooth.
- Crest Factor is often used as an indication of fault severity.

Many analysts use velocity as the primary parameter for trending and indication of a developing fault. Unfortunately, this does not always work well with rolling element bearing faults. Often the bearing frequencies and associated sidebands for severely faulted bearing are low in amplitude compared to the other vibrations in the system. Therefore they do not cause enough of a change in the overall velocity to detect the fault early. On the other hand, high pass filtered True Peak Acceleration is extremely sensitive to impulsive faults and is an excellent indicator of a bearing fault. Once the fault causes an alarm in the system, an analyst should take broadband waveform measurements on the machine to complete the diagnostics.

Figure 2 – General Purpose Accelerometer Mounted on a Centrifugal Pump sending vibration signal to a nearby EchoPlus® Wireless Junction Box

Figure 2 above shows a general purpose IMI Model 603C01 mounted on a centrifugal pump. A short standard sensor cable is run to an IMI EchoPlus® Wireless Junction Box close to the pump, as pictured in Figure 3. The EchoPlus® Wireless Junction Box “wakes up” periodically (3 times per day default), sequentially powers each sensor (8 per box), makes the overall measurements stated above, and transmits them wirelessly to a centrally located receiver. Therefore there is no need for long expensive cable runs to a control room that could be a half a mile or more away.

Figure 3 – EchoPlus® Measuring One of Eight Connected Accelerometers

Stand-alone battery powered Echo® Wireless Vibration Sensors are also available with the Echo® system and make the same set of overall measurements. Figure 4 shows IMI Echo® Wireless Vibration Sensors mounted on fan bearings.

Figure 4 – Echo® Wireless Sensors Mounted on Recirculating Fan Bearings

Below are examples of overall measurements taken with the Echo® System on a centrifugal pump. Examination of these trend plots demonstrates how True Peak Acceleration clearly detects the rolling element bearing fault before any indication is given by either RMS Velocity or RMS Acceleration.

Both the RMS Velocity (Figure 5) and the RMS Acceleration (Figure 6) trend plots shown below do not trip their alarms and the velocity would probably never be considered to be indicating a problem. When the bearing was replaced, there was little change in the RMS Velocity or RMS Acceleration vibration levels.

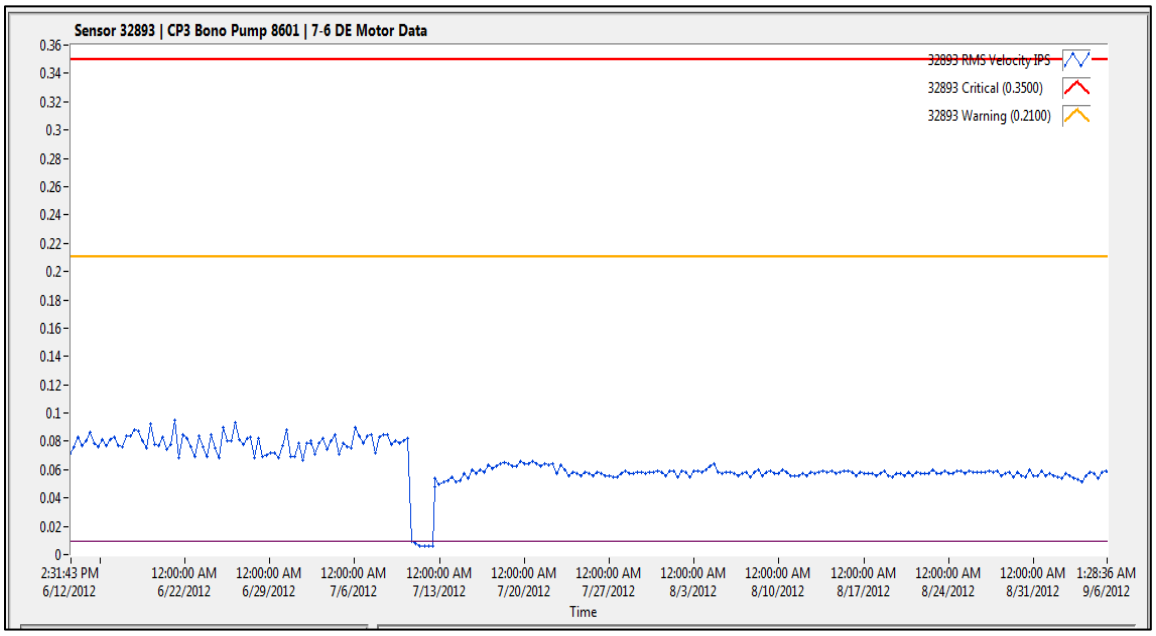

Figure 5 – RMS Velocity Trend Plot of Faulted Bearing

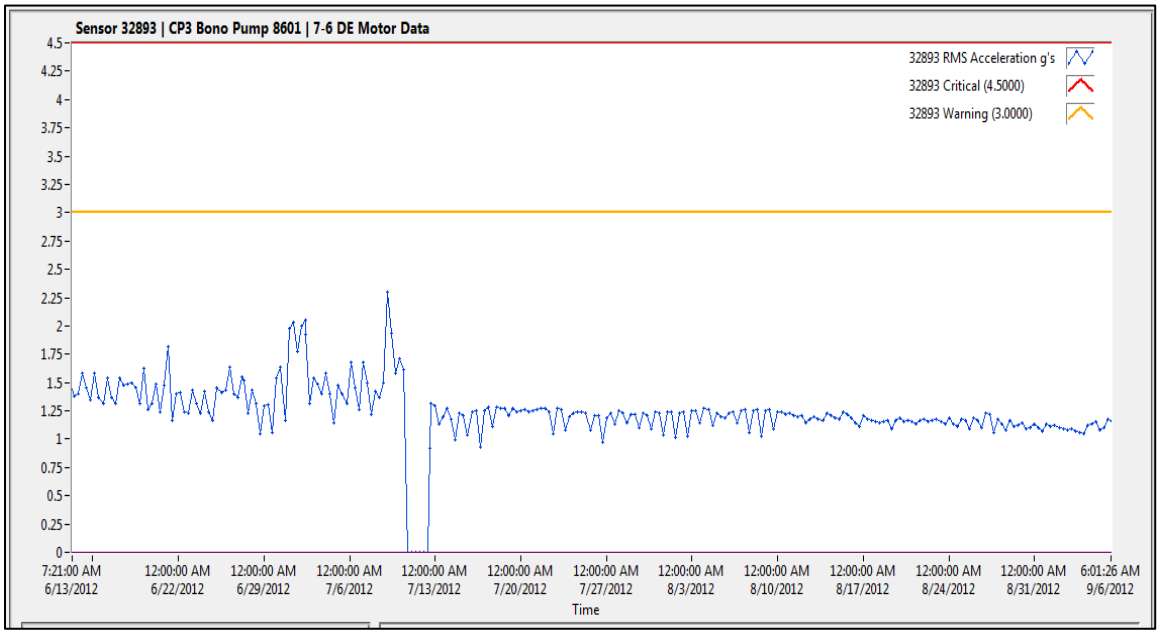

Figure 6 – RMS Acceleration Trend Plot of Faulted Bearing

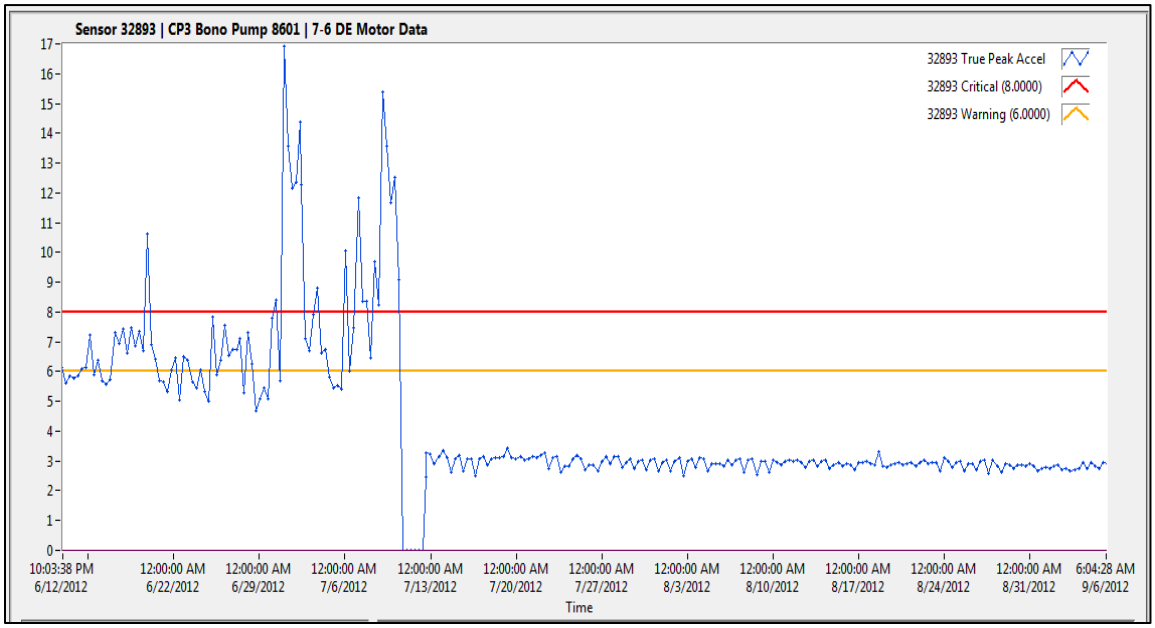

Figure 7 – True Peak Acceleration Trend Plot of Faulted Bearing

The True Peak Acceleration trend plot (Figure 7 above) clearly shows high amplitudes exceeding the alarm levels of the faulted rolling element bearing. When the bearing was replaced, the vibration smoothed out well below the warning alarm level.

Clearly the High Pass Filtered True Peak Acceleration measurement is the most sensitive to rolling element bearing faults. It is a technique that not only works on machinery like pumps and motors but also on slow speed systems like paper rolls.

Contact IMI Sensors for a demonstration of the Echo® Wireless Vibration Monitoring System and find out how Echo® can help you avoid unexpected failures, lost production, high maintenance costs and keep your production machinery running.

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3425 Walden Avenue, Depew, NY 14043 USA

pcb.com/imi-sensors | imi@pcb.com | 800 959 4464 | +1 716 684 0003

WPL_48_1121