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Do you hear what I hear?

Listen For Machine Faults: Let Sounds Verify Vibration Data

Audio-replay capabilities have enhanced this author's vibration-analysis toolkit and could be doing the same for yours.

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Over the years, technicians have listened for sounds made by machines in order to identify evolving problems as early as possible. By the time a fault becomes serious enough to be heard in a noisy plant, however, it could be too late to prevent damage. Now, portable vibration collection devices aid in the early detecting of problems and maintaining the health of rotating machinery.

Even so, the use of these devices has not made listening an obsolete art. Sound remains an important element in the early recognition of deteriorating conditions and in validating potential faults in rotating machinery. When used in conjunction with vibration waveform plots, playback of recorded sounds supports the existence of a fault, helping to convince persons who may have difficulty reading graphic plots. Often, analysts must deal with managers who see only meaningless squiggly lines when shown a waveform or spectral plot. Add sound, and the lines suddenly make sense.

Put on your headphones

The sounds coming from machines provide important clues that may be missed by relying on vibration data alone. That's why I advocate the wearing of headphones by technicians who are collecting vibration data. I always try to watch the data as it is being acquired to detect abnormalities in amplitude or pattern. In most plants, there's so much noise-making activity (i.e., associated with vehicle traffic, people, machines, etc.) that it can be difficult to watch every reading as it is taken. By listening to the accelerometer signal, it's possible to

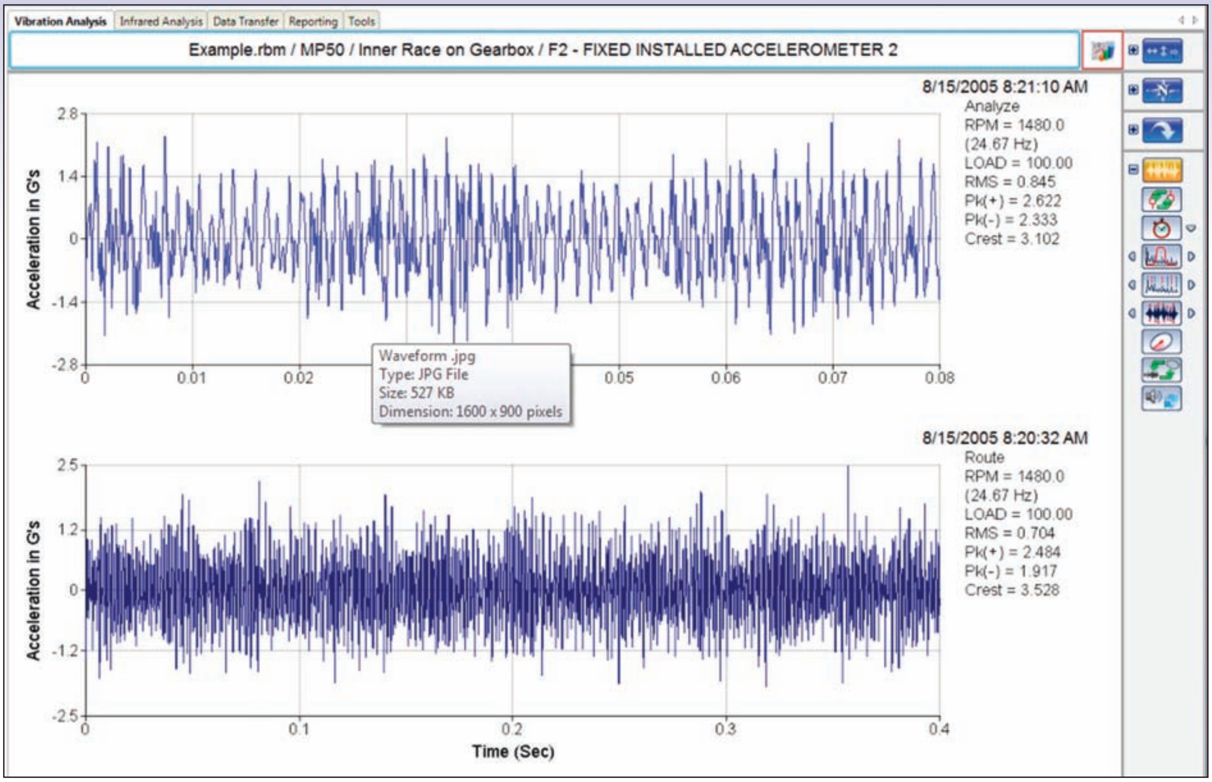

Fig. 1. Waveform audio replay starts by clicking on the Play Audio button.

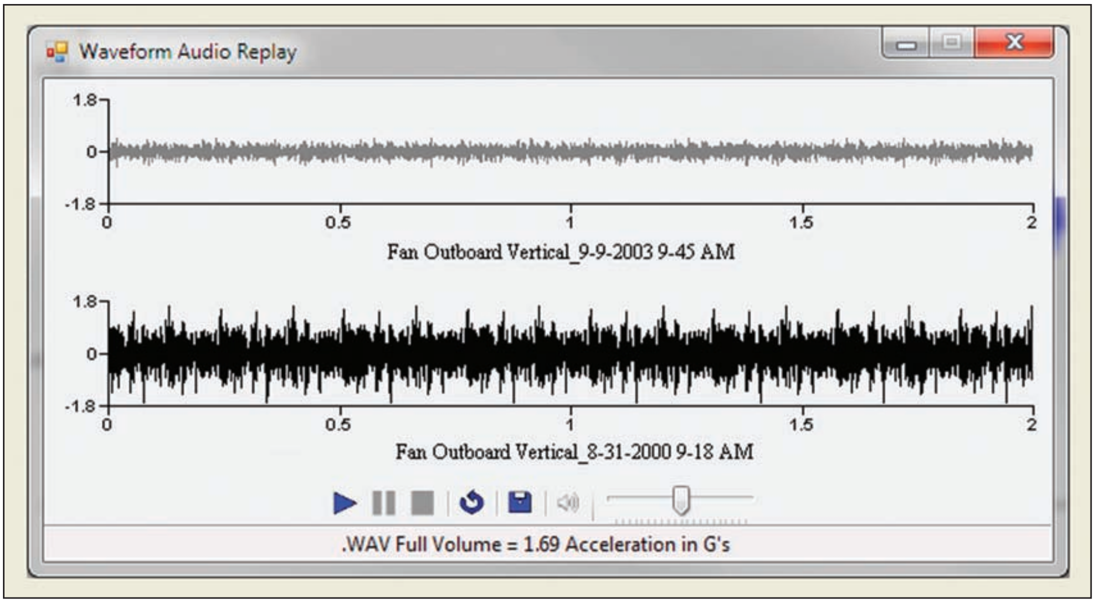

Fig. 2. Two waveforms are easily compared using the audio replay.

instantly recognize a change from the normal hum of a smoothly functioning machine.

I've been wearing headphones during route collection of vibration data for many years in order to hear unfiltered sounds covering the entire frequency spectrum. Emerson's portable CSI 2130 Machinery Health Analyzer records the waveform vibrations emanating from a machine. Anytime I hear something abnormal, I make a "note" on the analyzer to take a careful look at the waveform data after uploading it to a computer. When reviewing the data later, I'll see the note calling attention to the waveform collected from that particular machine.

The analyzer generates plots of frequency spectra as well as the waveforms. Analysts look at the waveform to determine the severity or impact of the vibration, and they look at the

Sounds clips can clearly illustrate machinery vibration problems, even for individuals who have had no formal vibration training.

spectrum to determine the cause—*be it imbalance, a bearing defect, a lubrication-related issue or something else*. The information can later be uploaded to computer-based software for detailed analysis. That's where the latest version of Emerson's AMS Suite: Machinery Health™ Manager comes in. It incorporates the ability to convert the audio portion from waveform data collected periodically or online. Users can actually hear an audible indication of a problem.

The easiest way to do this using the Machinery Health Management software is to plot the waveforms to be played, right-click on the waveform, and select "Play Audio" to launch the Waveform Audio Player (Fig. 1). A loop button allows repetition of short-duration audio replays for close study.

What you're listening for

The sound of a waveform collected from a "problem" machine is distinct from that of a similar machine where no fault is present. Similarly, waveforms collected from one machine at different times can be used to demonstrate a change in performance.

In practice, any vibration data obtained during a routine collection can be used as a benchmark, as sound from each machine is obtained at the same time as the physical vibration data. If an abnormal sound is heard on a subsequent round, the audio portion of each waveform can be compared, as in Fig. 2. This can be played back or sent to someone with minimal understanding of vibration data in a format anyone can grasp. Simply put, it's like listening to the machine at different times with a stethoscope.

Some caveats in the use of this technology…

- Care must be taken to be sure both recordings are set at the same scale and not to let each file autoscale. The volume on both clips should be the same as when they were generated. This way they will all be set at the same scale. When they are played back with the loop icon selected, the recording will play in an endless loop.

- Waveforms used for comparison should be acquired using the same units and same fmax setting. If different fmaxes are used and the energy from a fault is above the lower frequency selected, the abnormal sound on the lower one will not be heard. If the data collection technician thinks he/she is hearing high-frequency energy from a fault that may be the result of poor lubrication, it's necessary to acquire and analyze a waveform with a much higher fmax than normal route data so it can be heard when replayed. Remember: The signal that a technician hears is not filtered, so it could be a lot different than the low-pass filtered data acquired by the portable data collector.

- Long-term time waveform data can also be taken if the analyzer has Transient capability. This data can also be stored and played back as a sound file. Any energy that is above a chosen fmax will be filtered out and not heard on replay.

A real-world value proposition

Data taken recently on a motor with a severe bearing inner-race defect was compared with data from a motor on an identical machine (since no historical data on the faulty bearing was available). These sound clips were attached to a vibration report that was sent to the maintenance manager to illustrate the severity of the defect. This individual had no vibration training, but the sound clips clearly illustrated the difference between the machines in a way he could recognize. As a result, the motor was changed out before the faulty bearing could fail and cause damage to the machine—*and possibly disrupt production.*

An unplanned failure of this particular machine would have resulted in three to four hours of downtime. I maintain that this type of situation—*as well as other costly unscheduled events*—can be avoided by listening to sounds recorded during vibration collection. **MT**

Retiring after 30 years in mechanical maintenance at the Alcoa Warrick Operations (including 18 of them spent as a Reliability Technician), Jim Crowe established Jim Crowe Vibration Analysis, based in Rockport, IN, in 1999. Telephone: (812) 430-2457; email: jcrowevt@gmail.com.