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Condition-based approach rewrites the book on lubrication

KEY CONCEPTS

- Lubricating by “the book” may no longer be valid.
- Use ultrasonic translators to get an audible signal that prevents over-lubrication.
- Set baselines to compare with later machine readings.

Ask any maintenance manager how frequently his machinery is lubricated and you’ll probably hear this reply: “We go by the, book,” referring to instructions in the factory manual that comes with new equipment.

Lubricating by the book — preventive lubrication — may be the way it’s been done since the dawn of the industrial revolution. Today, time-based lubrication frequency alone may no longer be valid. In fact, it could be harmful to the health of bearings and other vital machine parts.

Not all bearings need to be lubricated on a predetermined schedule. If they do, they might not need as much lubricant as the manual recommends. This could result in over-lubrication, a condition that outranks lubrication starvation as one of the most common causes of bearing failure.

Many companies are starting to follow a condition-based approach to lubrication. This strategy utilizes ultrasound monitoring equipment to determine precisely which bearings need lubrication and when.

Using ultrasonic detectors, a program can be established that reveals these conditions, while enabling the technician to know how much lubricant to apply. Simply put, the condition of the bearing determines the frequency and amount of lubricant, and whether lubrication at any given inspection interval is really necessary at all. This information is transmitted by easy-to-distinguish high frequency sound waves that are translated by ultrasonic instruments (Fig. 1)

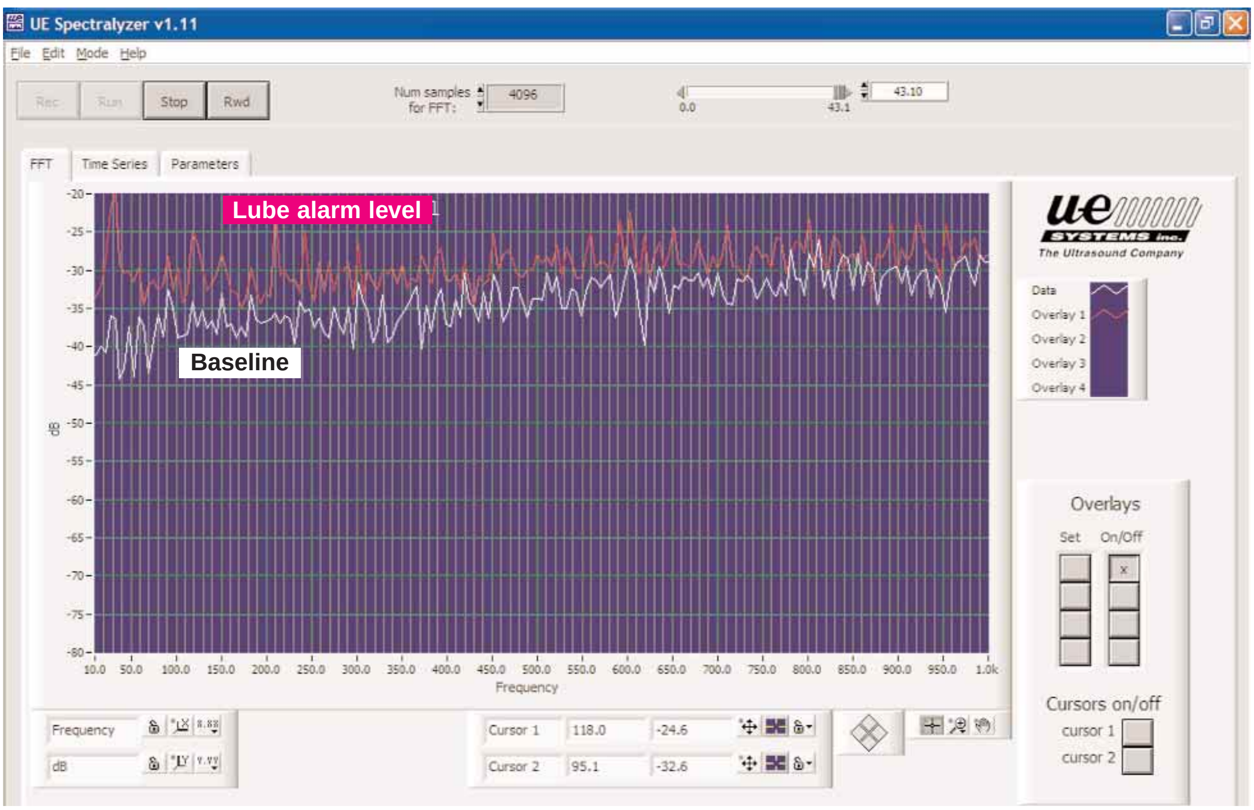

Fig. 1. The lube alarm level indicates a need for lubrication. The baseline shows when application is complete.

High-frequency sounds

Ultrasound technology is based on the sensing of high-frequency sounds. Most ultrasonic instruments employed to monitor equipment will sense from 20 kHz up to 100 kHz. This transcends the range of human hearing, which averages 16.5 kHz. The way Low-frequency and high-frequency sounds travel helps to understand why this technology can be effective in bearing monitoring and lubrication programs.

The physical differences in wavelength underscore why ultrasound is idea for condition monitoring. Low-frequency sounds maintain a high intensity of sound volume and travel further than high-frequency sounds. High-frequency emissions are more localized.

As high-frequency sound waves move away from the point of generation, their intensity levels drop rapidly, which helps inspectors identify the location of a sound source.

Fig. 2. As an operator lubricates, there is a visual and audible indication when lubrication is completed.

Ultrasonic translators

In condition-based lubrication, sophisticated ultrasonic translators are used to electronically receive and translate normally inaudible high-frequency sounds to the range of human hearing through a process called heterodyning. This provides an accurate translation of ultrasound produced by machinery and equipment, enabling users to readily identify one sound component from another..

Most ultrasonic translators provide feedback via headphones and through a single strength indicator where the amplitude of these sounds can be viewed as intensity increments or as decibels.

Reading these strongly identifiable sound signatures with non-invasive detectors, a technician can easily pinpoint sources of friction and stress, even while machinery is operating.

If there is a lubricant film on the surface of these moving parts, the stress distribution will be low. Should the lubrication film be reduced to a point where stress distribution is high, the exposed surface deficiencies, although microscopic in size, release acoustic energy that indicates a pre-failure condition. Aside from normal wear, the service life of a bearing is strongly influenced by the relative film thickness produced by an appropriate lubricant.

Over-lubrication

Over-lubrication is also addressed by ultrasound inspection. When too much lubricant is put into a bearing housing, pressure builds up and can lead to a viscous shear condition. This makes it harder for the rolling elements to move, causing the rolling elements to begin to produce heat and go out of tolerance.

This creates stress and deformity of the bearing, or can burst the bearing seal, allowing lubricant to spill out into unwanted areas such as motor windings, or allow contaminants to enter the raceway. Any of these can lead to bearing failure.

By easily detecting changes related to friction, ultrasound monitoring can prevent these failures. As the bearing rolls, it produces a recognizable rushing sound, similar to the sound of an air leak. This normal or safe sound is referred to as white noise. With an ultrasonic translator, these signals can be detected with little or no interference from other mechanical noises generated by other components such as a shaft or nearby bearing.

As the lubrication level in a bearing falls or deteriorates, the potential for friction increases. This results in a corresponding rise in the ultrasound amplitude level that can be noted and heard. Knowing when and when not to lubricate can prevent over-lubrication. This is achieved by setting a baseline, and monitoring the equipment on a set schedule to determine if lubricant is needed, and if so, exactly how much.

A baseline for a bearing reflects in decibels the level at which it is operating under normal conditions with no discernable defects due to improper lubrication.

Setting a baseline

One method involves the comparison of identical bearings through measurement of decibels and sound quality. A difference of less than 8 dB usual-Ly signifies there are no substantial differences in friction; hence a baseline dB level is then set for each bearing. This is usually performed with a portable ultrasonic detector.

A second method of setting a baseline is accomplished while lubrication is being applied. The technician listens as the sound level drops. When it does, no additional lubricant is added, and that dB value is used as the baseline (Fig. 2).

Determine the highest-rated environment in which the tester will be used, and select a model that meets or exceeds it. If no rating is available, don't buy it!

A third method utilizes the bearing dB levels from an initial survey. Repeat the inspection 30 days later to verify the readings. If there is little, less than 8 dB, or no change in dB, the baselines are then set and used for comparison for subsequent inspections. If a bearing exceeds 8 dB, but is no higher than 10 dB, over a set baseline, with no change in the translated sound quality, it can be presumed to need lubrication.

Prevent over-lubrication

Monitor the bearing ultrasonically as lubricant is being applied. Lubricant should be added slowly, allowing sufficient time to uniformly cover the bearing's surface, until the baseline dB is reached.

Digitally recording, documenting, and storing company-wide lubrication inspections are now possible with trending software. Some manufacturers of ultrasonic detectors integrate software with their instruments, permitting data logging, record keeping, and translated ultrasonic signature recordings.

With these tools, inspectors can produce trend reports and alarm groups to help identify those bearings in need of lubrication. This software can also categorize lubrication tendencies and failure potential for each machine, based on user-set performance baselines.

In addition to serving as an invaluable management tool by pointing out lubrication tendencies of components of each machine in the plant, the software can offer savings in lubricant and in manhours devoted to maintenance.

More Info:

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