# Ultrasound Assisted Lubrication – Time Based to Condition Based

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## Abstract

Airborne and Structure-borne ultrasound have evolved into a technology that many would consider to be the cornerstone of an effective maintenance and reliability program. From compressed air and gas leak detection, electrical inspection, and various mechanical inspections, ultrasound is truly a versatile tool for anyone's PdM "toolbox." One application in particular utilizes the technology for condition based lubrication and to reduce lubrication related failures in rotating equipment.

The most common causes of bearing failures are related to lubrication. These failures happen because of either a lack of lubrication or too much lubrication. Ultrasound assisted lubrication helps to take the guesswork out of how much lubricant to apply. Additionally, typical lubrication programs are based on timed intervals. With time based lubrication, the tendency is to over lubricate. Lubricant is applied at timed intervals whether the equipment needs to be greased or not.

This presentation will show how using structure-borne ultrasound, one can detect mechanical faults in rotating equipment and prevent failures due to either a lack of lubrication or over lubrication. The benefits of less rotating equipment failures include less unscheduled downtime, reduced maintenance costs, and reduced motor repair costs. Information will also be presented on how airborne and structure-borne ultrasound is a perfect complement to other technologies such as vibration analysis and infrared thermography.

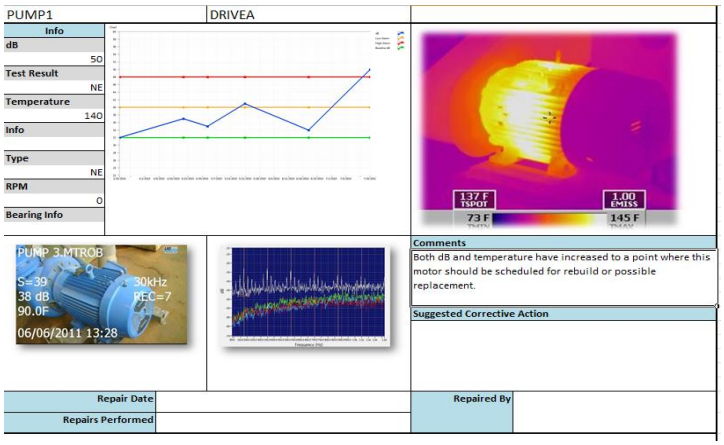
## Discussion

Keeping a handle on lubrication is easy, right? All one needs to do is make sure the right lubricant is used in the right amount and at the right time. Not so fast; if only it were that simple.

Most bearing failures are lubrication-related. Bearing failures most often lead to unplanned downtime, which can impact production, as well as affect all related components around the bearing. Downtime is costly. While the cost varies by incident and by plant, it can add up. Since the most common cause of bearing failure is lubrication-related, it's clear to see that lubrication is serious business. For the longest time, that serious business has been conducted in a way that on its face makes perfect sense but in fact borders on haphazardness.

Many technicians, unfortunately, have relied on preventive, time-based lubrication alone, that is, every certain number of months, the grease gun comes out, and the bearings are lubricated. After all, under-lubrication can be lethal, causing equipment failure, costly repairs and replacements, significant unplanned downtime, and lost profits. But, by relying solely on time-based lubrication, or even a combination of planned maintenance and temperature readings to serve as a proxy for lubrication status, one runs the risk of something just as bad, if not worse: over-lubrication. In fact, over-lubrication can cause premature bearing failure.

Relying on time-based, periodic lubrication assumes bearings need to be greased at defined time periods. Often, this evolves into a well-intentioned guessing game at best. Adding more lubrication to a bearing that is already adequately greased is a real risk. By using ultrasound technology, along with standard practices such as removing old grease and replacing it with new, technicians can combine standard, time-based maintenance with condition-based, predictive maintenance, gaining in the process both a clearer picture of what's really going on and better reliability.




**Advancements in ultrasound instrumentation have led to a greater trending & reporting capability. Reports such as Lube Route Report, Alarm Report, and a point specific 4 Image Report (above) can lead to greater decision making regarding the health of an asset, as well as combining other data such as infrared or vibration analysis.**

**Ultrasound and Lubrication**

Ultrasonic equipment detects airborne and structure-borne ultrasounds normally inaudible to the human ear and electronically transposes them into audible signals that a technician can hear through headphones and view on a display panel as decibel (dB) levels. In some instruments, the received sound can also be viewed on a spectral analysis screen. With this information, a trained technician can interpret the bearing condition in order to determine what, if any, corrective action is needed.

Ultrasonic technology helps the lubrication technician take a lot of the guesswork out of lubrication needs. Ultrasound is a localized signal, meaning when a sensing probe is applied to a bearing it will not be affected by crosstalk and allows the technician to hear and monitor the condition of each individual bearing. Ultrasound looks at each bearing individually, much the same way medical ultrasound can detect exactly which artery is clogged or which vein is leaking.

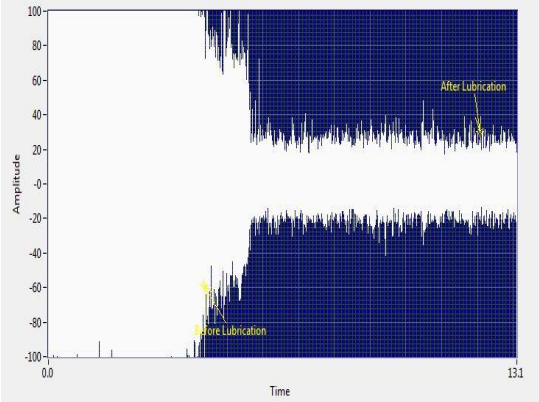
As an example of ultrasound's efficacy, consider this: a maintenance manager at a large firm reports that since adopting ultrasound technology and practicing ultrasound-assisted, condition-based monitoring, rather than running to put out the fire, his plant has gone from close to 30 rotating equipment failures per year to zero in three years. But, how does ultrasound work, exactly, vis-à-vis lubrication?

The first step is establishing both a baseline dB level and a sound sample. This is ideally done when moving through a route for the first time by first comparing dB levels and sound qualities of similar bearings. Anomalies will be easily identified. Once established, each bearing can be trended over time for any changes in either amplitude or sound quality. Generally speaking, when the amplitude of a bearing exceeds 8 dB and there's no difference in the sound quality established at baseline, the bearing needs to be lubricated.

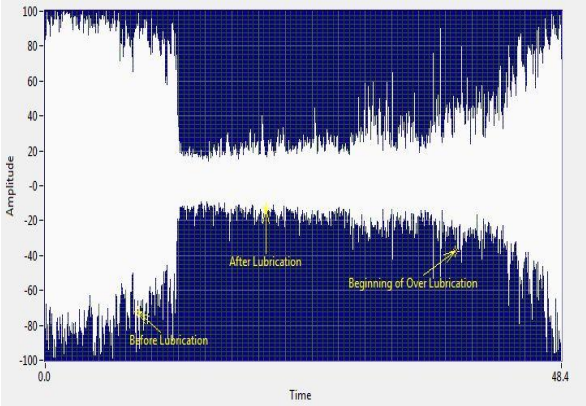
To prevent potentially disastrous over-lubrication, the technician will then apply lubrication, a little at a time, until the dB level drops. Many departments set up their condition-based lubrication programs by incorporating a two-stage approach. The reliability inspector uses a relatively sophisticated ultrasound instrument to monitor and trend bearings. A report of bearings in need of lubrication is produced. The lube technician then uses a specialized ultrasound instrument that alerts the technician when to stop adding grease. These instruments can be affixed to a regular grease gun or worn in a holster.

To improve efficiencies, it's a good practice for the technician to note when the equipment was last greased and how much grease was used to calculate roughly how much lubrication is used per week. By using ultrasound to lubricate each and every time, the technician produces historical data that can be used as a guide from previous calculations, helping the department to determine whether the lubrication schedule can be modified, perhaps saving man-hours, and whether the manufacturer's suggested lubrication amount is accurate. If less is needed, there is cost-savings potential.

While most of this discussion has focused on the dangers of under and over lubrication, ultrasound is just as reliable in picking up other potential bearing failure conditions. The technician, using ultrasound, can hear telltale grinding sounds and other anomalies, which are often accompanied by an amplitude increase. With regard to lubrication, the advantage of ultrasound is that it is able to isolate bearings and determine their individual needs, thus reducing the possibility that some bearings are too dry and prevent others from over-lubrication.




**The above example shows a bearing in the process of being lubricated. There is a very distinct before lube and after lube. Once the dB decreased to the baseline or normal level, lubrication stopped.**




**The above example shows a bearing in the process of being lubricated to the point of over lubrication. Both dB and amplitude gradually increased as more lubricant was added.**

## Conclusion

It is always a daunting proposition to make a new investment in technology. Will it pay off? Will my staff actually have an easy time using it? There are still many plants that are figuratively using crystal balls and outdated methodologies in their maintenance practices. The end result is poor reliability, unnecessary man-hours, downtime, and lost productivity and profit. While technology can't cure all reliability ills, it can offer a valuable and powerful diagnostic tool for technicians' toolkits. When it comes to something as important to reliability as lubrication, the question really becomes, "Can you afford not to use ultrasound technology?"