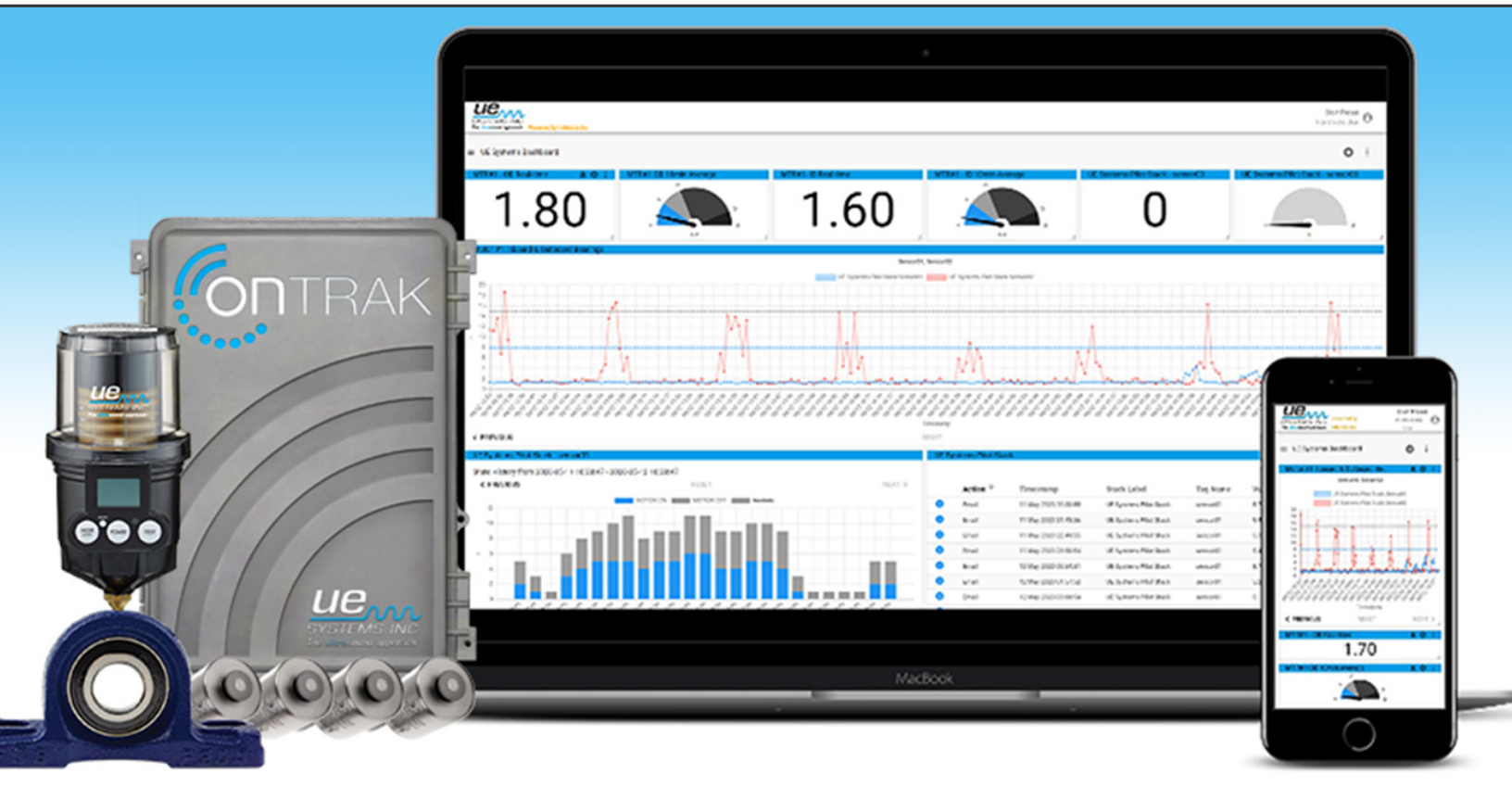
UE SYSTEMS INC

The ultrasound approach



Optimizing Regreasing Field Practices with Ultrasound Technology

Noria Corporation

Lubrication-related tasks at most sites are seen as mundane activities that operations or maintenance staff must complete with limited training or oversight. This perspective is common for site executive and management teams who tend to place little emphasis on the proper instruction and execution of lubrication tasks. In most cases, executive teams are generally unaware of the vast impact that proper lubrication plays on some of the things that are most important to leadership: equipment uptime and, in turn, production results. Utilizing the proper lubricant, volume, frequency, application and procedure removes the "guess work" out of daily lubrication activities. One of the most common and impactful areas within lubrication where this guess work occurs is the replenishment of grease or regreasing of bearings. When it comes to these important tasks, guess work should not be part of the equation.

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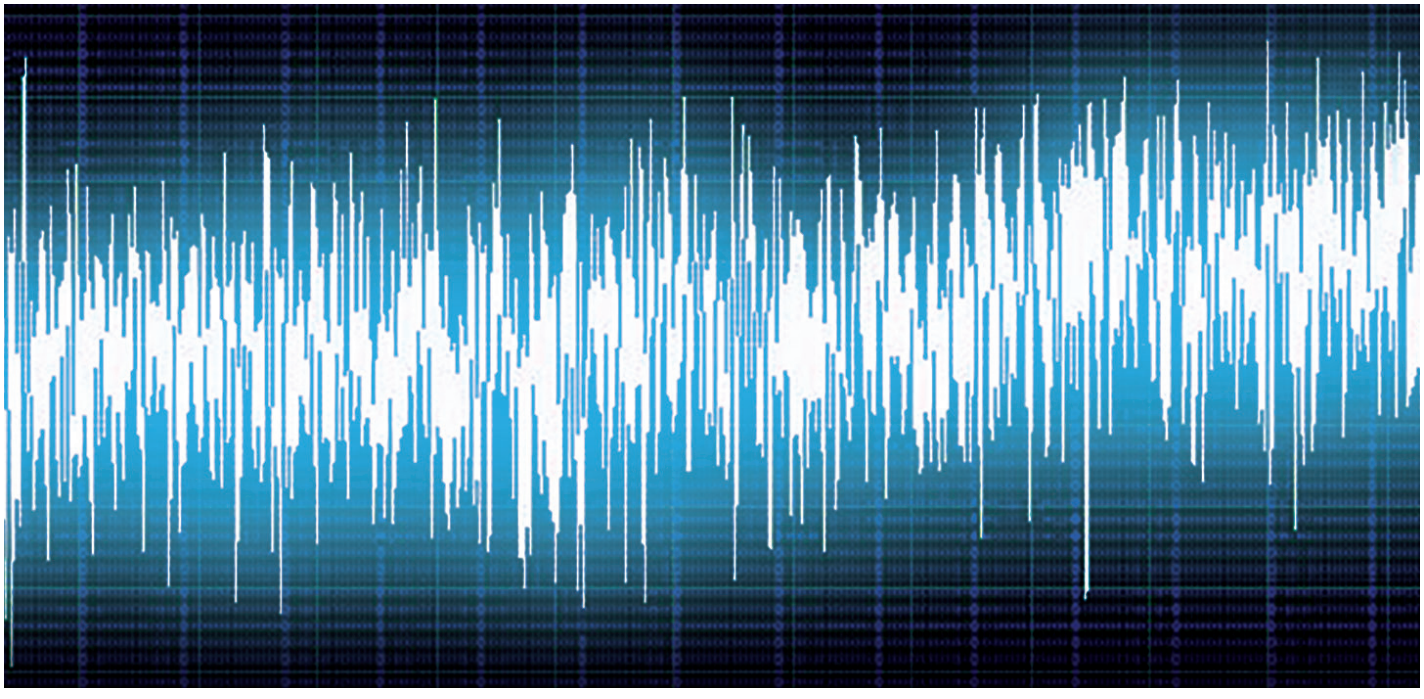
Over the years, the application method of regreasing has greatly evolved. We will talk briefly about simple manual practices to help understand the process and cover aspects of procedure documentation. From there, we will discuss a specific case example in the pharmaceutical industry along with more recent developments such as cutting-edge IIoT and automated systems that use precise ultrasonic measurements to improve decisions, reduce workload and, ultimately, improve reliability.



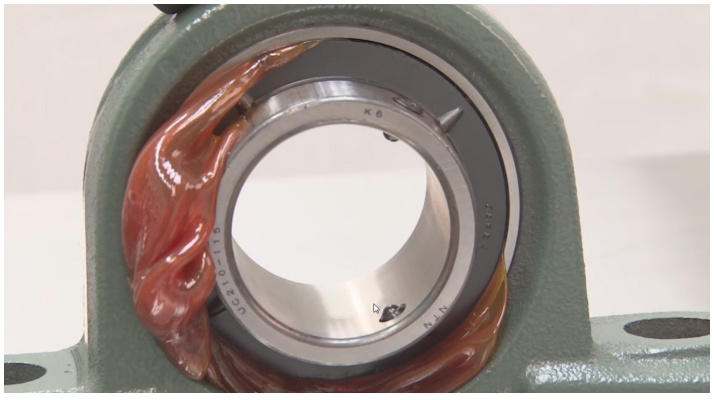
HISTORICAL REGREASING APPLICATION PRACTICES

While not necessarily the first or only form of regreasing application, manual lubrication using a grease gun is familiar to most industrial sites. Manual regreasing is so common that there isn't really a close second. While this application has the benefit of a low up-front cost and seems simple to execute in practice, the problem of variance appears immediately.

Variance rears its head in many forms, but sites with poor training and development in the field of machinery lubrication may not realize the impact of variance. For instance, the frequency of regreasing at a plant may be accurate if based on OEM (Original Equipment Manufacturer) recommendations, but there are other factors to consider with the component that may require adjusting those frequencies. Depending on speed, load, temperature, etc., the OEM recommendations may need to be adjusted. Regreasing volume is often the biggest concern as some sites simply apply grease until the seal is blown, new grease is visible or a certain number of shots have been applied. This practice creates the potential for both over-greasing and under-greasing.

Another factor is contamination in the form of cross contamination with other greases due to negligence or ineptitude.

Operator generated contaminant ingression at the grease fitting itself is common in plants using manual regreasing methods. Finally, variance comes up once more during operation in the form of the number of individuals using grease guns. While most sites do have experienced individuals that function within the lubrication realm, information is typically handed down in the form of tribal knowledge. Over time, steps are overlooked, precision is minimized and regreasing tasks become an amorphous, unstructured blob of activity.



How many individuals perform regreasing activities in the field? How many different methods mentioned above are utilized? Does the individual regreasing allow enough time for the grease to work itself into the component before applying another shot? Even with the best intentions at heart, the human factor and the associated variables that come along with it are of great concern for any sites that still operate inside these "historical" manual regreasing application practices with a grease gun alone.

Historical Greasing Practices at Pharmaceutical Plants

A prime example of this common problem is found in a large-scale pharmaceutical plant. This plant is a global leader in generic and specialty medicines with a portfolio consisting of over 3,500 products in nearly every therapeutic area. The plant is part of one of the largest and most complex supply chains in the pharmaceutical industry. Roughly 200 million people around the world take a medicine from this pharmaceutical company every day.

Inside of their Ontario facility, there are several Air Handler Units (AHUs) that play a crucial role in controlling vital climate conditions within designated areas. The AHUs run at 24/7 intervals and serve an indispensable role in reducing airborne pathogens that can compromise the manufacturing process. Simply put, the AHUs are ultra-critical assets and this company relies on them to help uphold their commitment to cleanliness, safety and hygiene.

Maintaining the AHUs requires special consideration as the units cannot be serviced while in operation, primarily due to accessibility issues. Technicians can only conduct routine maintenance on the assets during planned or unplanned shutdowns, making predicting future service intervals nearly impossible. As a result, it became customary for the plant's maintenance technicians to "think outside of the box" to ensure the AHU's continued operation. This included purposely over-lubricating bearings to ensure the unit did not run out of grease prematurely.

Unfortunately, this improper lubrication based on "tribal knowledge" led to problems over time – including bearing failures that resulted in costly unplanned maintenance and production downtime, as well as an increase in unnecessary grease consumption.

PROCEDURE-BASED SPECIFIC REGREASING APPLICATION PRACTICES

It's clear the site needed to review these practices, work to minimize these concerns and cut unnecessary steps wherever possible. Many sites experience similar problems as they begin to improve lubrication practices.

Efficient procedures based on engineering data must be installed to create a paradigm shift in lubrication culture. A site's lubrication culture—the beliefs, rituals, and habits of the people and processes within it—has a major impact on its lubrication program. If the goal is to improve reliability and lower maintenance costs through better lubrication, we must outfit the site with documentation based on engineering calculations rather than purely on OEM recommendations or tribal knowledge. This process is the beginning of a successful cultural shift in lubrication and in regreasing application practices.

So, what is included in the procedures? Why do we need to utilize them? Much of it comes down to standardization. Implementing task-based regreasing procedures using engineering data from the asset or component itself (bearing size, speed, type, temperature, etc.) works to address the very concerns with variance that arise during manual regreasing.

These regreasing procedures should include task type, name, operation state, estimated time of completion, location of lubrication points, interval or frequency, volume and lubricant type. Completing this level of documentation works to ensure we are supplying the "rights" of lubrication. We know we are utilizing the right grease for the application. We have calculated the right frequency of when to regrease, the right calculated maximum volume to apply, and we have addressed grease delivery and contamination as well throughout this process. It should go without saying—the deployment of procedure-based specific regreasing application practices brings accuracy and precision of field practices to a whole new level.

ULTRASOUND-AIDED SPECIFIC REGREASING APPLICATION PRACTICES

While task-based lubrication procedures have paved the way for efficient regreasing practices, modern regreasing technologies—specifically, ultrasound monitoring systems—are solving problems for many sites. The introduction of these devices has allowed plants to automate aspects of their lubrication program and address problems of variance in regreasing as well. These improvements can lead to less downtime and tremendous cost savings, especially for sites that have not previously used ultrasonic data to guide regreasing. While it does require some upfront investment, the benefits are tremendous.

Procedure-Based Documentation

Utilizing ultrasound doesn't negate the need for a formal documentation procedure, however. Prior to using ultrasound equipment, it is imperative that the team receives training to use these devices to their full potential. Training should include a documented checklist of tasks with detailed instructions that can serve as a useful tool to minimize variance in the task. The right procedures can also be used to upskill lube techs and qualify them in the use of devices. Talk to your ultrasound supplier about which training they recommend and what procedure documentation needs they may be able to help you with.

Advanced Feedback

One question plagues even the most experienced lubrication professional: when do we need to apply grease? We know that grease should be replenished when 50% of the oil is lost, but how can we determine that in a practical manner? Many feedback tools such as thermography, vibration and core sampling have answered this question proficiently, but ultrasound is undoubtedly the most common and, in most cases, the easiest to use for this purpose. The feedback provided by ultrasound technology is closer to real-time and allows for earlier detection of when grease needs to be replenished.

Optimum Volume Detection

Similar to the question of when to regrease, how much grease to add comes in at a close second in terms of importance. Traditionally, people grease until they see the grease being purged out, which leads to a host of issues—as we've seen in the pharmaceutical plant mentioned above. There are also some commonly referenced equations that can be used to calculate regrease volumes. These calculations are great but usually produce a "maximum" regrease volume. This is a key distinction. The "maximum" regrease volume can be very different from the actual volume that is needed at any given point. Ultrasound helps alleviate this issue by providing direct feedback either to the technician "listening" or through an automated system like the OnTrak SmartLube by UE Systems, which trends dB levels over time and allows for remote or automated greasing.

Using ultrasound, it is possible to determine not only when to regrease, but also when to stop greasing. This key element helps ensure the appropriate volume of grease is added during each event and moves away from the cycle of over- or under-greasing that many organizations are currently stuck in.

Baseline Trending

Above anything else, ultrasound is another tool that rests in our predictive maintenance toolbox. The use of this technology allows us to determine which bearings may be functioning properly versus those that are in some failure mode. We can baseline the "noise" levels coming from the bearing and trend it over time to dial in our regreasing activities as well as predict the health of the bearing itself. This goes beyond setting an interval for bearing replacement based upon an L10 value and greatly improves our maintenance activities from being in a reactive state.

AUTOMATED ULTRASOUND-AIDED REGREASING APPLICATION PRACTICES

If we continue to evolve our practices, we may wish to investigate more automated methods of applying grease with the use of ultrasound. This can help us apply grease in a much more consistent manner. With many organizations taking strides to reduce headcount and shift toward lean manufacturing processes, automated tools are becoming an increasingly valuable.

With an automated system like the OnTrak SmartLube, regreasing can be carried out manually or automatically using its IIoT-connected single-point lubricators. By trending dB levels over time with this integrated system, you can gain a deeper understanding of your bearings and what is truly the right time to add the right amount of grease.

The pharma plant mentioned has already seen significant benefits after working with UE Systems to implement their OnTrak SmartLube system on its AHUs. The team is now able to capture condition and lubrication data for bearings (at a rate of 1 second during commissioning), making tracking lubrication status and bearing health much easier. With this capability in play, the plant has listed a range of follow-on advantages, including the ability to understand the current lubrication and health status of their critical bearings within an hour of installing the system. Such instant feedback is both helpful in addressing problems and powerful in changing lubrication culture. It gives technicians a closer relationship to their bearings and clarifies what is needed to care for them. The automated system can also help the plant identify and structure planned downtime by providing better insights into the condition of bearings.

Minimized Workload

The ability to add grease automatically at the right time greatly reduces the need for an individual to walk down equipment for the sole purpose of relubrication. This should not negate the importance of having someone periodically inspect the component, but it does allow for our precious manpower to be more targeted in the areas where it is needed. The pharmaceuticals plant found these benefits by using the Ontrak SmartLube system to reduce the time required to optimally lubricate bearings by 95%, which is a significant amount of time that can now be devoted to other improvements in the overall efficiency of the plant.

Minimized Contamination

The team at the pharma plant is able to perform their grease disposal remotely through their automated system. Since grease is piped into the component directly, there is a significantly lower risk of a maintenance-induced contamination event. This system ensures the right lubricant gets applied in a closed environment keeping dirt and moisture at bay.

Decreasing the Human Element Variable

Because the regreasing is controlled by a single element, the variance between application styles from different people and different grease guns is practically eliminated. Bearings and other applications receive a more consistent level of care, which prolongs their life and allows us to plan our maintenance more strategically. Employees report confidence knowing exactly how much grease is going into the system and no longer worry as much about the differing techniques among the team. This reduces the need for complicated trainings and re-trainings to keep lubrication teams aligned to the same best practices and standards and allows training to focus on optimizing the system instead.

OnTrak Sensor Installed on AHU

Micro-Dosing Capability

It is far better to apply a small volume of grease more often than a large amount less often. This keeps the bearing in a more optimal lubrication realm and reduces energy consumption as well as temperature generation. In the case of the pharma plant, the

instinct was to over-grease the units to reduce time spent lubricating down the road—however, upon implementing the ultrasound technology, the bearings were allocated just the right amount of lubricant at the proper time, reducing their grease consumption by an estimated 30%. The ability for an automated system to "micro-dose" the application yields better results when compared to a manual practice of adding a large amount of grease.

UE Insights Dashboard

Readily Available

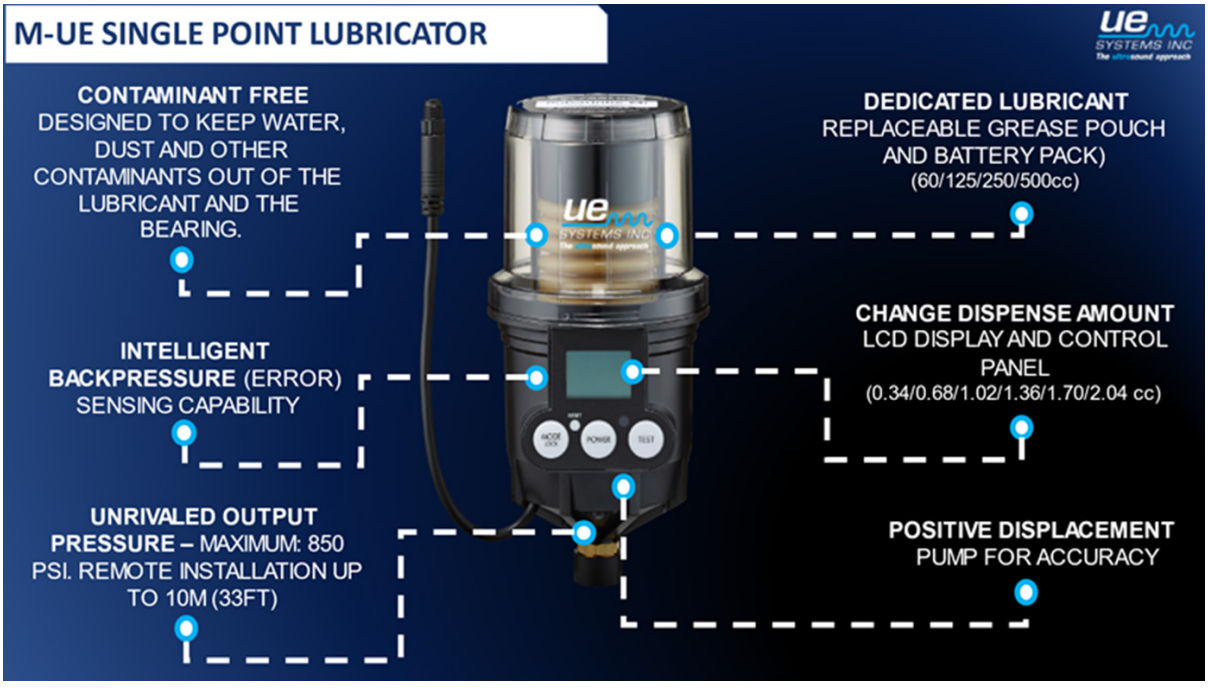
Waiting for downtime or shutting down machines is no longer a requirement with ultrasound technology. Some devices are installed in areas that are either inaccessible or unsafe to get to during operation, ultimately making it a no-brainer solution. If we can reduce the number of employees that need to enter potentially hazardous environments or environments that cannot be accessed during machine operation, then we are saving more than just time. This was the turning point for the pharma plant—their AHUs run at 24/7 intervals and could not be serviced while in operation prior to implementing the ultrasound systems. The automated system allows for the regreasing of this equipment during normal operation. This is the ideal time to regrease rather than when machines are shut down.

AUTOMATED ULTRASOUND-AIDED REGREASING APPLICATION PRACTICES WITH REMOTE FEEDBACK

While automation is beneficial for many reasons, it can be further enhanced by being coupled with remote feedback from the single-point greasing product. This provides the best of both worlds; we can not only ensure that the grease gets applied when needed, but we also receive real-time information relating to the component. This gives us even more useful benefits beyond what have been previously discussed, especially in the realm of condition monitoring.

Remote Monitoring with Automated Regreasing

Regreasing events (especially when using an automated system) can be viewed as an inspection point for our condition-monitoring program. We can accurately provide grease when necessary but also track and trend the health of the piece



M-UE Single Point Lubricator features

of equipment that this is tied to. For the pharma plant, this feature resulted in a groundbreaking realization. With less than an hour of friction data, the team was able to determine that the bearings needed lubrication. While the remote grease line was primed, it took over 10cc of grease from the single point lubricator to fill the air gaps in the line. Without the real-time bearing friction provided by the ultrasound device, the original application of a standard time-based frequency calculation would have resulted in the ACH's fan and motor bearings going 10 months without grease due to the air gaps.

One employee shared that he was even able to service a critical bearing from the comfort of his own home.

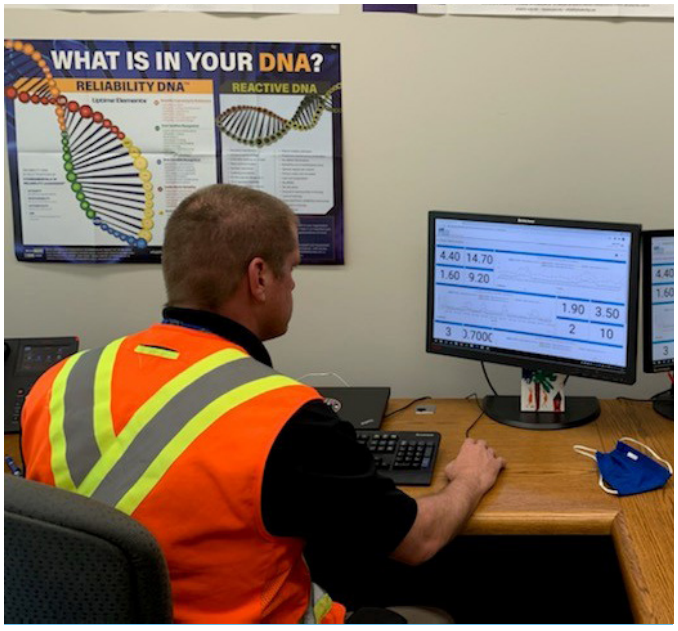
> *"[The OnTrak SmartLube] was extremely easy and very impressive. I was literally putting my son to bed and looked at the message from the system. I logged in from my phone, verified the readings, pushed the "smart assist" button. I monitored for a while and then just forgot about it. Checked next day and voila—back to normal. I'm impressed, this is the future."*
>
> *— Pharmaceutical Plant Team Member*

Further Minimized Workload

In the spirit of reducing manpower required for monitoring and lubricating equipment, this option kills two birds with one stone. Not only are we able to remotely add grease, we also receive useful data on the health of the component it is tied to. This gives us a much greater opportunity to plan and budget manpower effectively to pre-empt problems or address them strategically when they do arise.

Faster Detection on the PF Curve

All machines will eventually fail, but the goal of most maintenance programs is to catch them early and minimize the impact of the failure. By utilizing remote monitoring ultrasonic equipment, we are able to detect failure mechanisms when they are in the incipient stage and extend the failure curve from a sudden, catastrophic failure to a more controlled landing that minimizes downtime and disruption to business.



Employee Uses UE Insights platform to monitor and lubricate bearings remotely.

CONCLUSION

As technology continues to evolve and demands from our equipment continue to rise, it is refreshing to see novel ideas that marry best-practice with practical application. While it will be hard to move fully away from the traditional manual grease gun, there are many options that can be embraced based upon your unique maintenance situation.

With the OnTrak SmartLube system up and running, the pharmaceutical plant has found a reliable and efficient way to ensure the optimal lubrication of their AHU fan and motor bearings. More importantly, this change has empowered them to actively tackle cost overages related to unplanned maintenance and shutdowns. The plant can easily track grease consumption and can tabulate ongoing savings so that everyone involved in the process from leadership to field technicians can understand the benefit and value of optimizing regreasing procedures and adding the ability to remotely monitor and grease these critical machines

The pharmaceutical company has expanded the use of the OnTrak SmartLube across other critical assets and looks forward to engaging in more complex remote bearing analysis, lubrication application and advanced maintenance planning.

If your site is struggling with regreasing frequency, quantity or procedures, seeking out ultrasonic tools and proper training may be the best way to start tackling these issues. Creating procedures to optimize your regreasing with trackable results can be greatly simplified with the help of today's connected and integrated tools.

OnTrak System Gathering Data from Sensors on AHUs

About UE Systems & the OnTrak SmartLube

UE Systems is the world leader in ultrasonic instruments & training solutions for predictive maintenance, reliability, condition monitoring and energy saving program. The OnTrak SmartLube by UE Systems uses the power of remote prescriptive monitoring to give lubrication experts a powerful, accurate and easy-to-use software application to monitor bearing friction and remotely lubricate from anywhere, anytime or any supported device. To learn more about UE Systems and OnTrak SmartLube, please visit UESystems.com/smartlube or UESystems.com.