

## Applications of Ultrasound in Industry

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Ultrasound seems like some type of a superpower a comic book hero might have, but you might be surprised to find out that you can put ultrasound to work for you in troubleshooting, monitoring, and evaluating the equipment in your facility. From steam traps to electric motors, ultrasound data can be a powerful tool for your predictive maintenance program.

## What is Ultrasound?

**Ultrasound** refers to sound waves that are at such an ultra-high frequency that they are beyond the normal range of human hearing. Many different phenomena in electrical and mechanical systems emit ultrasounds that can aid a trained technician in detecting and diagnosing problems such as vacuum leaks or under lubricated bearings.

## How Ultrasound Works

Ultrasound equipment detects sounds within ultra-high frequency ranges and transforms those sounds to a form that can be interpreted by a technician. Many times ultrasound is plotted to show how intensity measured in dB varies across frequencies, allowing a particular frequency to become the focus of ultrasound investigation.

Filters that are part of the ultrasound equipment allow a technician to tune out other sounds that are not related to the investigation or troubleshooting process. And because sound is directional it is possible to pinpoint the exact location of a particular ultrasound source.

In addition to visual plots of intensity versus frequency, some types of ultrasound equipment can transform ultrasounds into a range that can be detected by human hearing. In such situations, a technician can wear a set of headphones to essentially “hear” the sounds and learn to recognize sounds for different electromechanical conditions.

## Why Ultrasound Works

So here is where things get interesting: when most industrial machines begin to approach a failure mode, the onset of the defect behind that failure mode results in high-frequency sounds being emitted. These sounds are usually the result of one of three things:

- Increased friction (e.g., a bearing that is about to fail)
- Impacting (e.g., cavitation in a hydraulic pump)
- Turbulence (e.g., a vacuum leak, the effect of electrical discharge on air)

Each of these phenomena (friction, impact, turbulence) has its own ultrasound signature that is detectable with the right equipment in the hands of a trained technician.

## Applications for Ultrasound

Here is a list with some of the more common applications for ultrasound in an industrial setting:

- Valve bypass
- Vacuum leak detection
- Leak surveys
- Compressed air leak management
- Complex gearbox fault analysis
- Slow-speed bearing monitoring and analysis
- Monitoring the condition of bearings
- On-condition lubrication of bearings
- Cavitation detection in pumps
- Steam trap testing
- Steam systems management

- Tightness testing of non-pressurized volume
- Electrical systems inspection
- Heat exchanger (shell and tube) testing
- Detect tank and pipe wall thickness
- Evaluate fluid flow

Let's take a look at some of these in more detail, beginning with ultrasound for bearing inspection and lubrication.

## **Bearing Inspection and Lubrication**

Identifiable ultrasound profiles are generated by friction from bearings that are either about to fail or suffering from lubrication issues (and that can be over or under lubricated). The ultrasound profile is directly related to the amount of friction involved. Bearings that are functioning correctly have a very different sound profile from those that are experiencing problems --- and this is something that a trained ultrasound technician will recognize. Not only does ultrasound detect problems, it can also be used as a tool to optimize the amount of lubricant used on a bearing.

## **Leak Detection and Leak Surveys**

When gases leak under pressure (either out of a system, in the case of a pressurized system, or into a system, in the case of a vacuum) they are going to create a turbulent flow. Ultrasound not only picks up on the presence of that turbulent flow, but allows the technicians to use its intensity and directionality to locate the source of the leak even in noisy environments. Ultrasound can also be used as part of a compressed air leak survey to locate leaks, aid in developing a cost estimation for the leaks, and provide key information about your facility's carbon footprint.

## **Steam Trap and Valve Inspection**

Ultrasound can also be used to inspect steam traps and valves. Both steam trap and valve operation can be investigated in just about any environment. For a valve, it is as simple as determining whether you are picking up the sound of turbulent flow. When you consider how many steam traps and individual

valves there are in your plant floor, it makes sense that a quick, efficient means of inspection is important.

## Electrical Inspection

Mechanical issues are not the only type of phenomena that can generate identifiable ultrasound profiles: certain electrical issues have high-frequency sounds associated with them, also. These include ...

- Arcing
- Corona
- Partial discharge or tracking
- Mechanical vibrations from transformers

In all of these phenomena, high-frequency sounds are generated because the electrical ionization involved disturbs nearby air molecules. While some electrical equipment produces a steady hum, that is far different from the types of ultrasound generated by factors such as arcing or corona.

## Ultrasound and Predictive Maintenance

**Ultrasound is a powerful tool** for PdM (**Predictive Maintenance**). Here are a few examples of the benefits your facility will reap if you make ultrasound a part of your PdM program:

- Enhance the accuracy and effectiveness of **lubrication programs**
- Monitor the condition of bearings
- Monitor valves, boilers, steam traps, condensers, and heat exchangers
- Detect and eliminate of costly leaks
- Detect potentially dangerous electrical issues
- **Extend the useful life** of assets and equipment.
- **Increase reliability**

And when used as **part of PdM** and **Asset Condition Maintenance**, ultrasound will help you stop problems before they develop into catastrophic, costly failures through the **data that it provides**.

## **Benefits of Ultrasound in an Industrial Environment**

Here are some key reasons why ultrasound works so well in industrial environments:

- It is easy to learn and easy to use
- It is non-contact
- It cannot cause damage to your equipment and assets
- It can be performed while the system is online
- It is very versatile (i.e., can be used for mechanical and electrical systems)
- Used correctly, it can pinpoint the location of problems
- It is a quick and effective means of inspection and ongoing monitoring

## **HECO Knows Ultrasound**

At HECO, our Predictive Service Group (HECO PSG) provides on-site maintenance and reliability services for industrial facilities like yours. PSG can help you set up and run your PdM programs (PdM) and perform the necessary corrective actions that are revealed by data. Our team of engineers and technicians are both knowledgeable and experienced in a wide variety of equipment and technologies -- including ultrasound. In fact, we have a certified ultrasound technician for both air leak and steam trap surveys on staff. If you are ready to harness the potential of ultrasound for your facility, give us a call!