

# An Evolution in Leak Detection Technology

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Figure 1: Industrial Environment

From seasonal checks of HVAC equipment to periodic maintenance on forklifts and other material handling machinery, every facility relies on an asset management program to stay productive and efficient. Yet too many companies overlook what should be a critical component of any such program: leak detection. The reasons for this lack of attention are many, including too little time, urgency of higher priority tasks and a simple misunderstanding of the true costs of compressed air and gas.

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Additionally, leak detection has historically been a difficult, time-consuming process that requires a considerable investment in internal staff or outside consultants to get the job done. All told, it's easy to see why so many facilities neglect leak detection despite its importance.

Today, a promising alternative to traditional leak detection equipment has emerged in acoustic sound imaging technology. At ITM, a leading provider of test, control and measurement instrumentation, a new generation of advanced devices is making leak detection easier and more effective than ever before. Here, we'll take a closer look at the necessity and challenges of leak detection and how these advanced instruments can help organizations reduce waste, save money and improve operations.

## The Hidden Cost Of Leaks

When compressed air equipment underperforms, the first response is often to invest in a larger compressor. Yet leaks are the #1 issue found in underperforming compressed air systems when equipment is properly sized and installed.

Research reveals that, on average, of 25% of all compressed air produced is lost due to air leaks before it can be used to power equipment. Similarly, the United States Department of Energy (U.S. DoE) reports that the average U.S. plant wastes as much as 20% of its total compressed air production capacity through leaks, and New Zealand's Target Sustainability project estimates that system leaks account for 30 to 50% of a compressed air system's capacity.

To give these numbers context, consider the following: even a single 0.125" (3 mm) leak in a compressed air line can cost as much as \$2,500 annually, per the U.S. DoE. It's also estimated that approximately 40% of global industrial energy loss can be attributed to leaks in compressed air systems, leading to billions of dollars wasted each year.

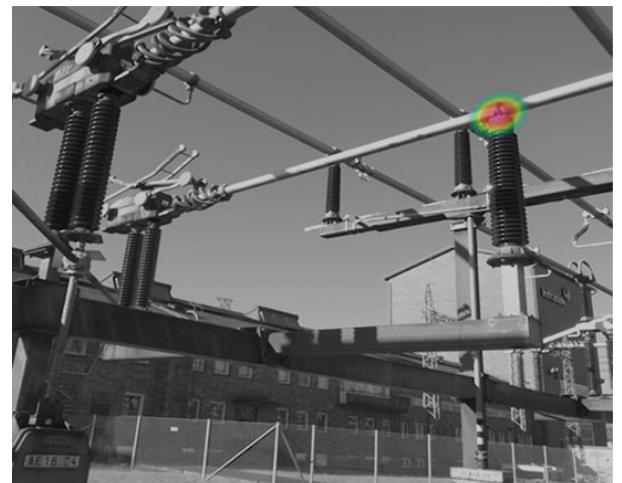


Figure 2: Lithium 4-cell pack with protection circuit.

## Beyond Energy Waste

If the resource waste caused by leaks ended with energy consumption, they would still be a significant concern for production facilities. In reality, however, leaks have a number of far-reaching financial consequences that include all of the following.

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Component damage due to insufficient air supply commonly leads to overspending caused by leaks.

### 1. Increased capital expenditures

Unnecessary investment in more powerful equipment paired with component damage due to insufficient air supply commonly leads to overspending and fails to correct challenges caused by leaks.

### 2. Failure to meet quality standards

Improperly functioning equipment may produce items that fail to meet standards for quality and conformity, resulting in lost product and costly, time-consuming reworks.

### 3. Decreased equipment service life

Without the proper level of compressed air, mechanical equipment may be unable to function as expected, leading to degradation and eventual failure.

### 4. Unplanned downtime

Left unresolved, leaks will eventually cause significant equipment damage that shuts down production. This downtime is often extended by the sourcing and installation of new equipment as well.

### 5. Production delays

When your business depends on meeting client demand within a tight schedule, damage and waste due to leaks can have a significant impact on an organization's ability to produce goods and fulfill orders.

With losses in profits, productivity and even reputation on the line, it's easy to see why leak detection is so critical and should be a key component of every asset management program.



Figure 3: Searching for a leak.

## The Complicated History Of Leak Detection Equipment

Identifying and resolving leaks has always been essential, yet equally challenging. In many cases, simple listening was the most common method of detection. Technicians would identify the sound of hissing air or gas and spray soapy water on the suspected source. If bubbles arose, a leak was confirmed.

While potentially effective, this approach was always problematic for the extensive time required to locate leaks and the operational downtime needed to make hearing them possible. Accessing the leaks was equally difficult, as their common sources – overhead piping, behind equipment and in tight, hard-to-reach areas – made it challenging and even dangerous to get close. This often required scaffolding or other equipment at an additional cost and required techs to risk heights, slippery floors and other hazardous conditions.

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The advent of ultrasonic leak detection offered an improvement in the process, relying on sound identification outside the range of human hearing. Still, challenges remain. Getting close enough to the source of a leak remains challenging, and considerable amounts of time are required to scan specific areas. Additionally, a great deal of training is required to successfully operate these compressed air leak detectors and interpret results in a way that can be useful to maintenance staff. This demands a considerable internal investment in training and equipment or costly fees for third-party specialists to perform periodic checks.

The result? For many companies, leak detection is not included as part of a regular maintenance program due to expense, downtime and required technician effort. Inspections are often neglected, allowing what may initially be minor problems to grow over time to significant profit losses, added maintenance efforts and even catastrophic system failures.

# The Solution To Leak Detection Challenges: Acoustic Sound Imaging Technology

Building on the advances of ultrasonic leak detection, acoustic sound imaging further improves the process by creating a 2-part image based on sound waves and photographs or videos of the facility. Doing so transforms these waves into visual images that allow techs to rapidly identify leaks and their source at surprising speeds.

## 1. Interpreting Ultrasounds

The term sound itself simply describes vibrations that take the form of an acoustic wave and spread throughout a medium, such as solid surfaces, liquids or gasses like the air around us. The human ear is capable of picking up frequencies between 20 Hz and 20 kHz, but a far larger spectrum of sounds exists that may be observed using devices like ultrasonic leak detectors. The full range of sound includes infrasonic, or sounds up to 20 Hz, acoustic, or sounds between 20 Hz and 20 kHz and ultrasonic, or sounds from 20 kHz to 2 MHz.

Ultrasonic sounds, or ultrasounds, produce high-frequency sound waves beyond those that human hearing is capable of detecting. Because they rise above the frequencies produced by everyday operational sounds like running equipment, it's possible to detect ultrasounds even when the production floor operates at full capacity. These sound waves are also highly directional, making it possible to determine where they originate and thus, where leaks occur.



Figure 4: Detecting leaks using the full array microphones.

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In contrast, acoustic sound imaging technology relies on large numbers of highly sensitive, low-power microphones arranged in an array.

Traditional ultrasonic compressed air leak detectors typically rely on a single microphone and identify sounds only in a narrow band, frequently at 30, 35 or 40 kHz. In contrast, acoustic sound imaging technology relies on large numbers of highly sensitive, low-power microphones arranged in an array. These microphones listen across a far broader range, reaching as low as 2 kHz and as high as 52 kHz. This includes the 20 to 30 kHz range, where most operational noise drops out and ultrasounds produced by leaks are more easily isolated. Sound signals are also highly directional within this range, further standing out from typical operational noise. With a greater number of microphones in an array, devices are also able to perform more accurate detection over greater distances – just as a camera sensor with a higher number of megapixels produces a more detailed image. Overall, this delivers optimal differentiation of sound at the longest distances possible.

## 2. Diverse Applications across Industries

Just as the challenges of leaks affect a diverse range of industries, the applications of acoustic sound imaging technology are equally diverse. These industrial imagers have been most quickly adopted by businesses that rely on compressed air, where leaks yield costly consequences for productivity and equipment. In addition to addressing all of the challenges of compressed air leaks, acoustic sound imaging technology can quickly resolve nitrogen, natural gas, ammonia and other pressurized gas leaks. Doing so helps prevent the loss of costly substances, like argon, and avoid health and safety issues related to toxic materials.

Identifying partial discharge presents another valuable use for acoustic sound imaging. When 2 wires fail to connect properly, an arc forms that releases electricity in small sparks. Corona may also be detected through small cracks in ceramic and other insulation materials, enabling users to identify wasted energy and potential safety hazards.



Figure 5: Leak detected.

### Other common applications include

- Vacuum system leak detection
- Outdoor leak detection
- Design
- Acoustic localization
- Mechanical troubleshooting
- Upset condition identification and alarming
- Scientific research
- Building acoustics planning
- Sound abatement
- Refrigerant gas leaks
- Duct leaks

As an evolving technology, acoustic sound imaging does face some limitations. A clear line of sight is needed to identify leaks, as the imager cannot detect sound waves through solid surfaces such as equipment panels and walls. Additionally, an acoustic sound imaging device will not take the place of a sniffer or other gas-identifying tool. While these industrial imagers are capable of identifying partial discharge, or electrical coronas, some applications may require more sensitivity than is available at this time.

## Understanding The Benefits Of Acoustic Sound Imaging Technology

As a relatively new technology, it's not uncommon for businesses to be unfamiliar with acoustic sound imaging. This means that even if existing leak detection protocols fail to deliver expected results, reluctance around adopting new methodology persists. However, seeing these imagers in action frequently turns product testers into regular users. After taking a closer look at the technology's benefits, it's easy to see why.

### 1. Minimal Training

New users are often surprised to learn they can begin scanning a facility for leaks just seconds after powering up an acoustic sound imaging device. There's no need for additional components, headphones and other parts – these imagers are ready for use right out of the box.

Additionally, the user-friendly point-and-shoot design requires no training. While it is possible to fine-tune settings to specific facility and testing requirements, most users are best served by preset operating parameters and can begin locating leaks in minutes.

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Users were able to identify 2 leaks in just 5 minutes with acoustic sound imaging technology.

### 2. Speed

After rigorous in-field testing, Fluke, a manufacturer of acoustic sound imaging devices, compared the time required to find a leak with traditional ultrasonic leak detection methods and acoustic sound imagers. When using ultrasonic leak detection equipment, even highly trained professionals spent extensive time scanning, pinpointing leaks, interpreting results and preparing reporting. Overall, it took approximately 20 minutes to locate a single leak.

In contrast, new users were able to identify 2 leaks in just 5 minutes with acoustic sound imaging technology. These imagers make it possible to scan large areas in a single pass and identify multiple leaks in a single image, even if the user has never done so before.

### 3. Safety

Thanks to a wider range of sound wave transmission via advanced microphone arrays, users avoid many of the dangers associated with ultrasonic leak detection. There's no need to enter areas with dangerous conditions or scale equipment to reach components in ceilings and other elevated locations. It also eliminates the need for spraying soapy water and creating slip hazards every time leak detection is performed, keeping maintenance techs and production workers safer on the job.

#### 4. Reduced Labor

What once took several techs days or even weeks to complete may now be done in a fraction of the time by a single individual. This ensures that maintenance techs are available to attend to other critical issues, such as equipment breakdowns or safety concerns while conducting leak detection.

Users also notice streamlined reporting processes that further simplify maintenance. With no need for extensive interpretation and translation, users can provide techs with easy-to-understand, highly accurate visuals that let them get to work right away. It's also possible to confirm the success of repairs on the spot to ensure the job is done right.

#### 5. Improved Maintenance Programs

Leak detection shouldn't be a company's last priority. With acoustic sound imaging technology, it's easy to make these checks part of a scheduled maintenance program. Doing so allows techs to identify problems before they stymie productivity, increase capital expenditures, create safety hazards and more.

The more detailed information provided by acoustic sound imaging technology also makes it easier to organize and prioritize maintenance. A fast scan reveals which leaks are most serious and where most problems are located so you can identify where attention is needed most.

### Acoustic Sound Imaging From Leading Brands

Always on the cutting-edge of instrumentation, ITM is proud to offer acoustic sound imaging devices from Fluke, FLIR and SDT Ultrasound Solutions. With a variety of advanced technologies and intuitive, user-friendly features, these devices make it simple to revolutionize your company's leak detection equipment.

#### Fluke ii900 & ii910 Series Acoustic Imagers

Fluke ii900 & ii910 Series Acoustic Imagers detect compressed air, vacuum system leaks, and electrical partial discharge (PD) quickly and easily with Fluke's range of acoustic imaging cameras and industrial scopes that offer simplified workflows and advanced efficiency and accuracy. Moreover, expedite inspections and make crucial predictive maintenance decisions with their innovative imaging technology. Some key features include:

- Leak volume and cost indication on the go
- CO<sub>2</sub> emission reporting
- SoundSight™ technology
- Acoustic imaging: Blended live SoundMap™ with visual image
- 7" (177.8 mm) 1280 x 800 LCD with capacitive touchscreen



Figure 6: Fluke ii900 & ii910 Series Acoustic Imagers

#### FLIR Si124 Series Industrial Acoustic Imaging Cameras

The FLIR Si124 and Si124-LD industrial acoustic imaging cameras are designed to provide exceptional capabilities for detecting and visualizing ultrasound in a variety of applications. These imagers make it easy to upload, store and backup data, create reports and perform deep analysis with FLIR Acoustic Camera Viewer cloud analytics. The lightweight design is easy to transport and the display ensures a clear view even in bright outdoor light. Other features include:

- Detects a 0.0011 CFM leak from 9.8' (3 m) or 0.0018 CFM from 32.8' (10 m)
- 2 to 31 kHz frequency range
- 328' (100 m) maximum operating range
- Wi-Fi connectivity
- 32 GB internal storage, 8 GB USB external storage



Figure 7: FLIR Industrial Acoustic Imaging Cameras

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## SDT SonaVu Acoustic Imaging Cameras

SonaVu , equipped with SDT Ultrasound technology, is an acoustic imaging camera designed to enhance condition monitoring. It specializes in identifying airborne ultrasound sources through its array of 112 exceptionally sensitive ultrasound sensors. This innovative device generates visual representations that highlight defects, simplifying the task of operators in locating the root causes of ultrasound emissions.

- 112 Digital MEMS Microphones
- Sample Rate 96,000 Sample per Second
- 5-inch Touch Screen
- Including Distance Range Sensor
- Adjustable Lighting



Figure 8: SDT SonaVu Acoustic Imaging Cameras

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