

# Detecting Underground Leaks with Ultrasonics

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A 70-acre resort in the Caribbean was losing 23,000 gallons of water a day, but management could not locate the source of the leak in its labyrinthine water system. The complex included a two-story hotel with 40 units, two restaurants, and several villas on the beach. Using state-of-the-art ultrasonic technology, consultants from Ultravision, a Florida-based underground leak detection specialty company, mapped out the entire water system and detected the leak in three days.

"We located the leak on a two-inch galvanized line on the beach," said Ultravision partner and consultant David Baker. "The water was spraying down into the ground so no one noticed it." According to Baker, the resort had four separate piping systems: a rain water cistern supplying fresh water to ice machines and drinking fountains; an osmosis system supplying water to the sinks in the guest rooms; a brackish water system providing water to toilets and showers; and a hot water system (also brackish water).

"Our biggest problem was that all four systems were cross connected. With our portable Ultraprobe, manufactured by UE Systems, Inc., we were able to diagnose all four systems and divide and isolate each one. This enabled us to quickly identify which system was leaking and where," said Baker.

Baker said that many clients do not have

plans of their facility's infrastructure. "So the common first step on most jobs is to energize the piping system with low voltage and use a receiver to plot out the entire system," Baker explained. "Once we have the overall plan of the building or complex, we employ the Ultraprobe's contact probe to take many ultrasonic readings."

"We tune in the ultrasonic instrument to the middle range and move it along the piping system," Baker continued. "It may be necessary to fine tune the equipment after a couple of point-to-point tests. Then we follow the ultrasonic signature of the leak so as to pinpoint its whereabouts. On the Caribbean resort assignment, for example, we inspected about two-thirds of the system before zooming in on the leak that was producing the higher frequency readings."

Some leaks are larger and under higher pressure, some are very small and under very high pressure, others are very large and under low pressure. With the ultrasonic instrument, Baker adjusts the meter at the point of operation and calibrates sounds quite accurately from the low end to the high end.

Baker said there are basically two types of ultrasounds and the trick is to learn how to distinguish the abnormal sounds from the normal ones. Type 1 sounds are high-pitched ultrasounds that give off a

high wavelength. Type 2-type rumbling and grumbling sounds are more likely to occur in a building with a large grotto underneath it where a water leak has produced a large cavern.

"Our ultrasonic instrument is extremely sensitive and is invaluable in helping us scan everything from minute leaks to screamers," said Baker. "By scanning point to point, an inspector can narrow in on the general area of the leak and then zero in on the kitchen rather than a nearby bathroom, for example.

Baker's enthusiasm for ultrasonics is energized with each new assignment.

"Recently we located a leak on a 12-inch water main 16-feet below the ground on a new portion of highway near the beach," reported Baker. "The contractor who installed the roadway had been unable to get his final inspection from the Department of Transportation because the piping system would not hold a hydrostatic pressure test. We came in but could only work late at night because the highway had heavy daytime traffic."

Baker said infrared equipment was used to get a temperature change in portions of the road which directed them to the general location of the problem. Then they used the ultrasonic instrument and, within hours, honed in on a leak on a ductal elbow which was producing a Type 2 sound which was confirmed as an infrared emission.

## What is Airborne Ultrasound?

Ultrasonic instruments are sensitive to sounds beyond the limits of the normal human hearing. Frequency, the number of times a sound wave cycles from trough to crest, is expressed in "cycles per second" and measured in "hertz". One kilohertz (kHz), for example, is one thousand cycles per second. The best human ears can hear noises in the range of 20 hertz to about 20,000 hertz (20kHz). Many ultrasonic portable detectors start at approximately 20 kHz and work upward to sounds as high as 100 kHz. They translate these ultrasound to the range of human hearing. Thus inspectors using the ultrasound instrument can tune-in to and "hear" faults in operating machinery, electric transmission and distribution sys-

tems, as well as leaks in vacuum or pressurized systems.

An ultrasonic detector senses subtle changes in the ultrasonic signature of a component and pinpoints potential sources of failure before they can cause costly damage. The longer wavelengths of lower pitched sounds are gross waves that tend to be very difficult to locate. But higher frequency sounds are short wave signals that are fairly directional in transmission and are localized to the source of emission. For this reason it is possible to use ultrasonic sensors in relatively noisy environments to monitor mechanical and electrical equipment as well as for leakage.

When a fluid (liquid or gas) leaks, it moves from the high pressure side of a

leak through the leak site to the low pressure side where it expands rapidly and produces a turbulent flow. This turbulence has strong ultrasonic components. The intensity of the ultrasonic signal falls off rapidly from the source. For this reason, the exact spot of a leak can be located.

Ultrasonic detection has traditionally been performed with portable instruments. Many of today's lightweight, pistol-shaped ultrasonic tools are battery-powered so technicians can easily move about while operating them. Some instruments feature a frequency adjust dial to provide tuning capability, enabling users to hear the ultrasounds through headphones and gauge their intensity by the definitions on an analog meter.