

---

# Ultrasonic Testing for the Maintenance of Buildings & Facilities

by CTRL Systems, Inc.

The cost of maintaining buildings and facilities is growing. A company's ability to keep a clean, safe, and long-lasting building at minimal costs can provide the company with a competitive advantage. As technology becomes more sophisticated, its implementation is often more costly. However, ultrasound diagnostics, one of the most sophisticated technologies on the market today, is easy to use and cost effective. An ultrasonic receiver such as the UL101, manufactured by CTRL Systems, Inc., is used to listen to ultrasonic noises.

Ultrasound is created in many different ways including friction, high & low speed vibration, impact, electrical arcing, and turbulence (gas and liquid). The normal range of human hearing is between 20 Hz and 20,000 Hz. Ultrasonic waves emitted at the 40,000 Hz level are ideal for listening for both acoustical and non-acoustical sound. The UL101 receiver is centered on 40,000 Hz, ignoring all other ambient noise, to provide a sixth sense to the facility maintenance staff. This sixth sense can be used for acoustical sounds such as locating and pinpointing leaks, electrical arcing, and corona discharge. It can also be used to indicate the condition of equipment by listening for non-acoustical sounds such as the vibration through metal of bearings and gears, internal leaks, and other mechanical components.

The following list includes some practical applications for using the UL101 for facility maintenance.

**Mechanical Systems** - When equipment or machinery is failing mechanically, the human audible failure noises propagate throughout the machinery and the surrounding area. By the time these noises become noticeable (human audible frequency range) the component is usually badly damaged. Use of a stethoscope, broom handle or screw driver held tight to the component and to the ear is helpful for diagnosis, but this technique simply amplifies the human audible noise present. Also, the audible noise radiates throughout the structure and generally sounds the same no matter where it is heard.

Because of the physical nature of ultrasound, the UL101 allows tracing of the noise to the source. For example, a single bearing can be monitored for scratches on the race by touching the solid probe of the UL101 to the bearing's case. The condition of the bearing can be assessed, even if it is located in close proximity to other moving parts or ambient noise. Besides bearing and gears, moving parts can be monitored for alignment and proper lubrication.

**HVAC Testing, Refrigeration and Air Conditioning** – The UL101 can be used to listen to any ultrasonic noises. An obvious rushing sound is an indication of a strong leak to atmosphere. This can be traced to its source to identify the nature of the sound and repairs needed. All joints from the compressor outward should be checked closely.

The filter/dryer can be tested using the UL101 and UT2000 in combination by follows: open the housing and remove the filter cores. Insert the transmitter (that has been turned on) into the housing. Close it and bolt it down. Use the UL101 at all brazed joints and the shell casing to search for the loudest transmitter noise. The intensity of the noise increases when a leak is present. After any leaks are found and repaired, test again to confirm that the repair is complete.

**Compressed Gas, Freon, Air and Natural Gas Plumbing** - Many buildings have systems involving compressed air, oxygen and natural gas, often with several secondary systems. The UL101 will find leaks in such systems without closing down the system in question or inconveniencing a tenant. Pressure leaks to atmosphere can easily be detected 15 to 20 feet away and then pinpointed to within a 1/4" area. The UL101 complements and enhances the capabilities of both soapsuds and "sniffers". To identify minute leaks, leaks that soapsuds won't indicate, the UL101 would be used in conjunction with the soapsuds. A distinctive ultrasonic crackling or snapping noise is detected when a leak is present; this is caused by the soap bubbles breaking. This technique is effective even when air movement (such as on a rooftop) or gas saturation makes a "sniffer" ineffective. Air conditioning refrigerant leaks as small as 1/2 (one-half) ounce per year can be located with the UL101.

**Pneumatic Control Systems** - These use various operating controls such as thermostats and shutter-stats with low pressure compressed air in the range of 15 PSI. If the pneumatic tubing or control devices in the system leak enough air to drop below minimum operating pressure the controls will cease to function. For instance, a thermostat will be unable to call for more heat, etc. Using the UL101, each room having such a control can be easily scanned from the doorway to detect a leaking thermostat, etc. For a complete system inspection, start at the compressor (checking internally, too, for unloader valve leaks, etc.) and check each joint going outward. The UL101 finds leaks not possible to identify with soapsuds alone.

**Steam Systems** - The UL101 will pay for itself in a short time when finding leaks of just 1/16 inch in a 100 psi steam system. Just one such leak may cost over \$2000 a year in steam generation costs. The UL101 will locate the source of high or low-pressure steam leaks. The leak is found by moving the receiver in a wide arc. When the receiver picks up the leak, the operator will be able to quickly isolate its location.

**Steam Traps** - Steam traps block steam vapor and pass condensate out of the system. Two types of malfunctions can occur. A steam trap regularly opens and closes. A trap stuck open creates an expensive waste of steam. A trap stuck closed keeps the heating element or power device from receiving steam and making it non-functional. The UL101 can be used to listen to the operation of the trap. The PowerBeam 300 can be used to listen to traps that are out of reach. If there is sound all the time, the trap is stuck open. If there is no sound, the trap is stuck closed. The UL101 eliminates the mess and uncertainty of conventional testing methods such as listening with a screwdriver or using hot melt crayons.

**Steam Condensers** - The UL101 can be used to scan the tube ends of the condensers. Water jackets should be fully drained so as to have access. The steam side of the condenser needs to be isolated and pressurized with air to between 2 and 4 PSI using existing compressed air supplies.

**Elevators & Escalators** - This equipment is often hydraulically operated. The UL101 will quickly detect valve malfunctions and internal system oil leaks. It also enables the technician to check bearings for condition and proper lubrication.

**Vacuum Condensers** - Air leaking into a large vacuum condenser of turbo generators can greatly increase costs. These leaks are almost impossible to find by conventional methods. Since the UL101 is sensitive to the ultrasonic sound generated by a vacuum leak, it can readily find these leaks. This eliminates using shaving cream or other time consuming and messy techniques.

**Humidity Control** - Live steam is often discharged into a forced air-heating duct to maintain proper humidity levels. The technician can easily determine if a discharge valve is operating properly by using the UL101.

**Electrical Systems** - Any system involving high voltages, over 1000 volts, as in large buildings or power sub-stations, is subject to corona discharge problems. Individual insulators leaking corona discharge to ground can be easily identified. These waste expensive power and interfere with radio, TV and telephone equipment. The UL101 can be used to rapidly and safely locate the exact point of trouble. The UL101 can also detect the arcing from motor slip rings and brushes.

**Weather Stripping** - Deteriorated weather stripping, seals, and insulation can greatly increase the cost of heating and air conditioning. To check such a conditions use the UT200 Transmitter on the inside of the suspected room and the UL101 on the outside. Place the UT2000 Transmitter (turned on) in the room and it will pressurize the room with ultrasound, without disturbing the occupants. The UL101 is used outside to detect ultrasound escaping that indicates a leak.

The UL101 utilizes the properties of ultrasound to dramatically improve the speed and accuracy of component condition assessment and leak detection. With the UL101, pinpointing the source of ultrasound and understanding it's meaning usually takes only a few seconds to a minute. This enables you to make smart, proactive, and corrective decisions before catastrophic failures occur. It also enables you to find failed components that have gone unnoticed but are very costly.

Even in extremely noisy environments, this powerful device allows you to isolate and to differentiate current and potential defects prior to their becoming recognizable to the human ear. This versatile diagnostic device is perfect for facility maintenance, management, and safety.