What You Can't Hear Is What You Need To Hear!

Applications Manual

SoundTrap

Diagnosic Kit – UST-1000k

The **Sound Trap** operates on the principle of detecting high frequency ultrasonic waves which are created by friction from all moving parts, liquids, and gases. These "sounds" reside far above the range of the human ear and tend to be highly directional.

This directional aspect of ultrasonic waves allows one to isolate a suspect signature sound from other background noises and detect its exact location. This sound analysis can be used for efficiently investigating five major areas of repair and preventive maintenance in the automotive, industrial, and trade businesses.

1) Air leaks
Both vacuum and compressed air leaks create an energy packet or wave front which can result in an ultrasonic emission with a differential of 1 psi and/or a hole down to 0.005.
2) Gas and liquid turbulence
Turbulence associated with steam trap and internal valve leaks, cavitation, and blockages in liquid and air/gas lines.
3) Electrical discharge
Electrical discharge associated with insulation breakdown, tracking, corona, and arcing.
4) Mechanical wear
State of mechanical wear in bearing and race assemblies, shafts, and gears (indicating the state of lubrication).
5) Sound generation
Can be used in conjunction with sound generators to detect container cracks and seals, door seals and compartments. (*The Soni-Pod transmitter is matched to Sound Trap's peak response.*)

There exists a need to evaluate mechanical devices and/or systems for the purpose of determining the onset of their failure. When carried to a further degree, through the use of highly calibrated listening devices and specific purpose computer software, it is theoretically possible to predict the approximate, if not exact, time of failure. As a practical matter, the failure of a component within a larger device does not only contain itself to the component, but can also cause devastation to the entire mechanism. Thus, the need to predict such failure is of even more importance. The following description is of one viable methodology to bring about this

general purpose. While there may be other methodologies able to produce the sought after result, the following method is the most up-to-date.

Why Use Ultrasonics?

The Laws of Physics teach us that every object has a resonant frequency inversely proportional to its size. Lets use a comparison of musical instruments to exemplify this principal. The trumpet produces higher notes than the tuba does due to its smaller size. A key to the right side of the piano keyboard produces a higher note than one on the left because the strings attached to it are shorter or smaller in length. As the frequency of sound increases due to the decrease in size of the object producing it, this frequency, at some point, will move beyond the spectrum that can be detected by the human ear. While many published texts place this threshold at 20,000 cycles per second, most people, especially as they grow older, actually are capable of detecting nothing above the 12,000 to 14,000 cycles per second level.

It is commonly known that faults, malfunctions, and/or flaws in mechanical, electrical, and pneumatic devices, as well as manufactured container type objects, start as small defects or leaks. The physical size of these defects is of such relatively small size the sounds that they produce are above the range of human hearing and are not detectable aurally. Most commonly, these faults manifest themselves in the 38,000 to 43,000 cycles per second range. These frequencies fall within the spectrum of frequencies generally referred to as being in the ultrasonic range. It becomes of great utility to be able to hear these ultrasonic emissions from these faults in order to be aware of imminent problems. ***Since these sounds are above the normal level of hearing,*** a device that can transform or convert the ultrasound to an audible level has been produced to answer this need in a cost justifiable manner with high quality results.

To employ the ultrasound methodology in a usable manner, it is imperative the listener be able to have access to an audible sound that bares a resemblance to the natural sound of the defect. That is to say, a mechanical bearing with a defective ball should sound like such. Likewise, a microscopic leak in a compressed air system should sound like a gas leak. **Simply converting the ultrasound frequencies to audible frequencies is not sufficient with regard to rendering a usable signal. It is for this reason the Sound Trap 1000 incorporate a process whereby the audible signal bears a close likeness to the natural incoming**

sample. We call this process **"Sound Signature Technology"** therefore, a gas leak sounds like a gas leak and a defective bearing sounds like one would expect.

While this range of sounds sits at twice the upper frequency of normal human hearing, 20 kHz, the **Sound Trap 1000** uses a technology called heterodyning to convert the ultrasonic range into the audible range. Since this unit is tuned to listen to the ultrasonic range, it is unaffected by everyday sounds such as wind, voices, and traffic which can further mask the technicians ability to listen for a potential problem. The **Sound trap** also incorporates AGC (automatic gain control), which allows one to study ultrasonic sounds associated with the roar of a valve leak or literally the blink of an eye. AGC stops the need for high/low sensitivity switches by allowing the internal circuitry to seek the optimum level of gain for the given situation. This ultimately allows the Sound Trap to be picked up and learned immediately without having to fiddle with knobs or seeking their correct settings.

VO engineering has focused on making the Sound Trap extremely effective yet easy to use, allowing the technician to concentrate on analyzing the problem and not on the operation of the instrument.

Analogous to the advent of night vision for seeing in the dark, the ability to listen beyond the human range allows the ability to diagnose problems before they become catastrophic and allows one to institute smart and cost effective preventative maintenance as opposed to a program of scheduled parts replacement.

By use of the mechanical bearing example, should a ball within the bearing develop a small pit, this small defect will emit ultrasonic evidence of its existence. This ultrasonically emitted indicator goes undetected by the human ear. The defective equipment remains in service and the fault worsens over time. Eventually, the fault will increase to such a size that its resonant frequency descends into the audible range. At this point,

prudent maintenance personnel will repair the fault hopefully before it has caused damage to related equipment and/or systems. The utility of the ultrasound detection products is that had one listened to the initial small fault, it would have sounded like the consequent audible that was emitted by the fully defective device or

object. It is this ability of this instrument that sets it apart from those that lack the ability to convert ultrasonic frequencies into audible frequencies while retaining the same timbre and/or nature of the sound.

SOUND TRAP 1000 OVERVIEW

The Sound Trap 1000 is a unique item of diagnostic test equipment that has achieved outstanding results in reducing downtime and maintenance related costs. Through the detection of ultrasonic sound, the Sound Trap 1000 is used to inspect and check such items as ignition systems, vacuum problems, air brake systems, bearings, gear trains, cam and tappet assemblies, internal combustion engine valving and piston blow-by, gaseous piping and ducting, seals in refrigerated van bodies, air ducts, hydraulic systems, A/C system Freon leaks, and many other components.

Except for their frequencies, ultrasonic waves are exactly the same as their audible counterparts. Audible sound will propagate and compound itself through equipment making it difficult to locate the source even with a stethoscope. Because ultrasonic waves are not as penetrating as those of lower audible frequencies, it is much easier to pinpoint the source of the sound and there is usually less noise interference. Conversation and most background noises are normally absent. Extremely minute sounds can therefore be detected, analyzed, and exactly located.

The Sound Trap 1000 system consists of an ultrasound receiver, ultrasound transmitter, probe attachments, and headphones. **The receiver is sensitive only to ultrasonic energy in the frequency range of 36,000 to 44,000 Hertz.** The energy is amplified by the self-contained circuitry and converted either to sounds, which can be heard through headphones, or intensity reading on an LED display. The ultrasonic transmitter is used with the receiver to check for faulty seals in cabs or trailers, or other non-pressured enclosures.

It is fast and easy to use and takes very little training!

The Sound Trap Set

1. Receiver Easy to use unit incorporating audio feedback and a 10 bar LED indicator for intensity of signal. The receiver has a permanently fixed 2" directional receiver port, 3.5 mm stereo jack port, and a rotary on/off volume control switch.
2. Two Anodized Probes – 12" air probe and a precision length contact probe.
3. Full Sized Headphone set w/ 3.5 mm stereo jack.
4. Carrying case w/ form fitting foam for storage and transportation
5. The Soni-Pod Transmitter for sending out a 40khz pulse for use in testing seal integrity in non-pressurized vessel.
6. Two fresh 9 volt batteries are supplied

Sound Trap Receiver
The Sound Trap is rugged but still a precision instrument. Avoid rough handling.

1. To prolong battery life, make sure unit is turned off when not in use
2. **The unit is not waterproof and should be protected from the elements**
3. The carrying case should be used whenever possible for protection and transportation
4. Performance of the receiver can simply be tested by using the finger method described in step 5 under the operational procedures. If no sound is heard, replace the battery.

Probes
Both the air and contact probe are precision parts and have been designed to optimize the response of the **Sound Trap 1000** receiver when needed. The 12" air probe serves to extend reach or to facilitate in isolating a leak among multiple suspect areas. Do not modify the probes in any way and never use the probes for other than described in this manual.

AGC (Automatic Gain Control) Simply said, there's no need for turning knobs for pulse width or pressing buttons for sensitivity levels. The Sound trap adjusts the incoming signal while comparing to an internal reference point to adjust the gain. Therefore you only need to use the volume and proximity sensing to see whether you are closing in on the problem.

Batteries and replacement
Both the Sound Trap receiver and Soni-Pod transmitter use one 9 volt battery each. Zinc or Alkaline are preferred. To replace the battery in the receiver, the protective rubber boot has to be removed first. The rubber boot is easier to remove when warm because it is more flexible. To remove, push the bottom edge of the boot off of the inner enclosure and pull enclosure out. Please observe polarity. Replace boot in reverse manner. When replacing the Soni-Pod battery, be careful not to strain or pinch wires. **Always remove battery during a period of long storage.** And please dispose of batteries in a way dictated by your local laws.

Receiver and Transmitter Port openings
The port openings of the receiver and transmitter contain the heart of the **Sound Trap's** operation, a precision transducer. During use, guard against any foreign matter from entering these areas

Calibration
The **Sound Trap** has been optimally tuned at our factory and should require no re-calibration during its life under normal conditions.

LED Bar Graph
The LED display allows one to zero in on a steady state source of ultrasonic sound as in locating an air or vacuum leak or using the Soni-Pod transmitter. Simply watch for a rise or drop in the bar levels to locate the source of problem. Please see para. - **Using LED graph for locating leaks**

Soni-Pod Transmitter
The transmitter emits a warble output centered at 40Khz. This output cannot be heard by the human ear. If the red indicator is on the unit is emitting.

Replacement Parts

Parts	**Reason**	**Part No.**
Air Probe	Nicks, gouges, bent tube	100B109H01
Contact Probe	gouges, length change	100B108H01

For all other parts call factory.

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OPERATING INSTRUCTIONS

The Sound Trap ultrasonic detector is a simple to use tool. No Calibration or training is required. Follow the following steps

Basic Operational Procedures

Note: Please read all safety precautions before proceeding. As with all situations involving the diagnosis of a problem, be aware of your surroundings (moving machine parts, electrical hazards, etc).

1) Put headphones on while being aware of the headphone cord location.
2) Plug the headphone jack into the receptacle located on the face of the panel.
3) Thread either the air probe or contact probe into the receiver port. Refer to the typical scanning section for optimum probe choice.
4) Turn the rotary knob clockwise to "on" and watch for the LED bar to settle to the bottom position. Turn up the volume until you can just hear the background noise (hiss). **Please Note,** Increasing the volume does not increase the units detection sensitivity. Setting the volume control too high can lead to operator fatigue.
5) When using the air probe, point the probe in the direction of your free hand while lightly rubbing your forefinger and thumb together 2+ ft away. The response should be the sound of sandpaper on wood. You can vary the distance and increase/decrease the level of volume accordingly. While performing this function, become familiar with the directional sensitivity of the probe while sweeping the probe past your fingers at various distances. If using the contact probe, adjust the sensitivity while lightly rubbing your finger along the tip of the rod.

Typical Scanning Methods/Tips

The Sound Trap 1000 provides information in two ways: qualitative, through the ability to “hear” the signature ultra-sounds produced by various types of equipment and the ability to see the feedback level on a graduated LED bar readout.

The air and contact probes are used to optimize the response depending on the type of inspection. The air probe is best used for detecting ultrasounds associated with a pressure leak or an electrical corona while the contact probe is best to detect the ultrasounds generated from within a casing such as in a gear, bearing, pump, valve, or steam trap housing.

MECHANICAL MALFUNCTIONS

At right shows a typical use to inspect a potential wheel bearing problem with the Sound Trap. In this case the air probe is used since the wheel is being turned while listening for the sound of the bearings. The tip of the probe is kept 2-3 inches from the inspection area. Response can sometimes be optimized by removing the wheel and using the contact probe to touch the stationary center hub. Inner and outer bearing sounds can be isolated by contacting the inner and outer side of the spindle. The Sound Trap is very useful in monitoring the state of the bearings, rotors, and armature in a motor housing such as pictured on the right. Because the housing encloses the moving parts, monitoring with the Sound Trap is best used by making contact with the outside housing with the contact probe. All sound waves conduct best thru materials such as metal and the contact probe will optimize the listening response. The contact probe is also used for investigating Fuel injectors and “top over coil” in the same manner. Touch the tip of the metal probe to the surface area being tested. Correct operation sounds one way. Malfunction sounds another way. You will easily hear the difference.

ELECTRICAL CORONA DISCHARGE

The Sound Trap can detect electrical coronas due to insulation breakdown or other.

At right is a typical application using the Sound Trap to inspect possible electrical and corona discharge associated with power switch and breaker boxes. As with all potentially dangerous situations, use caution. Only use the air probe when inspecting electrical conditions and keep a safe distance between the air probe tip and the metal panel surfaces. The Sound Trap is highly sensitive to picking up the voltage breakdowns described. The resultant ultrasonic sound has been described as sounding like “frying bacon.”

PRESSURIZED LEAKS

Applications for pressurized type inspections are endless including: compressed air or gas of any kind, air brake systems, pipes/lines, steam systems, water lines, manifolds, and likewise all vacuum systems. **Note:** Ultrasonic detection relies on detecting the sounds associated with the turbulence of the fluid or gas exiting a hole or orifice under a differential pressure. It is independent of the type of gas or fluid.

The Sound Trap will readily detect air and vacuum leaks typically caused by bad gaskets, cracks in pipes, and worn valve seats (right).

As with all new inspection technologies nothing substitutes for the importance of practice in listening to the differences between good and bad components in their real life "ultrasonic" application.

NON-PRESSURIZED LEAKS

Non-pressurized vessels or containers cannot generate ultrasonic sounds. The supplied Soni-Pod is used to broadcast an ultrasonic noise which is optimized to the frequency response of the Sound Trap receiver. Some examples are: pin hole leaks, tanks, HVAC, seals, windshields, weatherstripping, and whole house integrity.

1. Turn on the Soni-Pod and place in the enclosed environment to be evaluated. The Soni-Pod will fill the interior with a piecing warble sound. **Note:** Since the output is in the ultrasonic range, you will not hear it without the Sound Trap receiver.
2. Walk around the exterior of the enclosed environment while sweeping the receiver around the suspect areas. Compromised areas will be revealed by the change in tone and intensity both audibly and visibly by watching the changes on the LED bar graph.

USING LED GRAPH FOR LOCATING LEAKS

Please note that the volume control is independent of the bar graph intensity during an inspection. Depending on the amount of ultrasonic signature being detected, You can use both the level of intensity on the LED graph and the audible amount of sound through the headphones. As you get closer to the problem decrease the volume. As the sound get louder, repeat the process until you have pinpointed the location.

While scanning in a side to side pattern with the receiver, watch the level of the LED graph.

Keep the receiver pointing in the direction of the highest bar.

Please note that depending on the level of ultrasonic sounds being detected, With minute leaks, the LED bar graph may not move up from the first position. In this situation, use the audible signal as discussed above.

AUTOMOTIVE AND FLEET MAINTENANCE
APPLICATIONS

ENGINE MECHANICAL: Finding vacuum leaks are now easy! Just listen and you will hear the leak. You will hear a hissing noise as soon as you point the Sound Trap 1000 unit under the hood. This finds the leaks that the "smoke machines" misses due to the swing door leak principle. Place the hollow probe on the unit and listen and watch the LED's and you can pinpoint the location of the leak fast and easy. **Use the hollow probe.**

Find that engine noise. The Sound Trap 1000 detector will locate those engine noises and let you find where they are truly coming from. Ultrasound does not transfer within engine components due to the directional characteristics of ultrasound. **Use the solid contact probe**.

ELECTRICAL SYSTEMS: Separations in high-tension spark plug wire conductors can be quickly identified from the corona discharge "snapping" sound emitted. The same applies to arcing within electrical motors and accessories. Also, listen to connection points for the "snapping" or "frying bacon" sound, this is a sound a poor connection makes under electrical load. Circuits are best tested under operation and full load.

The Sound Trap 1000K unit is also great at locating short circuits. Shorts give off a "frying" or "snapping" sound also. As you are checking for shorts or connection problems, do not forget to wiggle the wiring! Those electrical problems will now call out to you. Save Time!
Use the hollow probe for this test.

AIR CONDITIONING SYSTEMS: Locate those hard to find Freon leaks with the Sound Trap 1000 unit. You can use the Sound Trap 1000K unit one of three ways to find the problem.
Use the hollow probe for this test.

1. Since most A/C systems come into the shop without Freon in them, just pressurize the system with Nitrogen to about 150 to 250 psi and then listen for the leak using the hollow probe. This is the most preferred method and will prevent the problems with the "swing door leak" issue. This method is also great for the evaporator leaks inside the car.
   On those super slow leaks, while the systems is under pressure (250psi) spray a soap solution on the A/C components and lines and you will here the bubbles as they escape and pop from the system. Most of the time, you can hear them from more than 3 feet away!
2. You can also pull a vacuum on the system and listen for ultrasound air sucking into the system.
3. **Place the flexible hose onto the transmitter and inject ultrasound into the A/C system.** You can inject the sound into the service port into the system. The short ultrasound wave will escape were the leak is occurring. The ultrasound wave is so short that it will escape from on opening 1/20th the thickness of a human hair! This method is how most large commercial companies in the industrial setting find A/C leaks.

IGNITION SYSTEMS: Listen to today's ignition systems. You can hear the coils and plugs firing. This is by far the best and quickest method for diagnosing Coil Over Plug (COP) systems. It also works great on Distributorless Ignition Systems (DIS). You will hear the snapping of the plugs firing in the headset. After some experience testing ignition systems, you can tell if you have a plug or wire problem by the sound alone. When checking DIS systems make sure you listen at both ends of the wire if you can. **Use the solid probe for this test.**
Listen at both ends of the plug wire to determine problem area.

INJECTORS: Place the solid probe onto the injector to test and listen while the engine is running. You can hear the injector working plus hear the fuel flow. You may also want to shut the engine off and listen to make sure that the injector is not leaking fuel past the injector nozzles. If fuel is flowing, it will create a rushing noise in the headset. A good clean injector will make a sharp ringing clicking tone, while a dirty injector will have a muffled clicking tone.
Use the solid probe for this test.

AIR BRAKE SYSTEM: A Sound Trap1000 detector can help locate leaks quickly in both vacuum assisted and air brake systems. In many cases leaks can be detected from a considerable distance. After building up full pressure (Air Brakes) , a casual sweep of the vehicle from one end to the other using the receiver can often locate the leak. Use of the headphones will also reduce noise interference from the shop. If the first sweep does not locate the leak, trace out the entire air system piping at close range (1-2 feet) with the receiver. Once the general area of the leak has been determined, the receiver probe is very useful to pinpoint the exact location of the leak. For effectiveness, be sure that pressure is maintained in the brake system during the entire search. If no leaks are discovered, check the air horn, windshield wiper and other air-actuated equipment. Leaks in these accessories can produce abnormal gauge drop**. Use hollow probe for this test.**

TIRES: Sweep the tire and find the leaks. For heavy trucks, many mechanics check tires for adequate pressure by striking the tire with a hammer and noting the rebound and sound. However, this procedure doesn't find leaks. A sweep with the Sound Trap 1000 receiver will locate even the smallest of leaks. The receiver normally finds leaks of sufficient magnitude before they cause downtime on the highway. The detection of even one leak may save the cost of original investment in the equipment. Savings realized by preventing the loss of a tire (on duals, a second tire), possible damage to the driveline components, and road service costs to replace the tire can be significant. In addition, you can put a soap solution on tires and listen for the bubbles to pop**. Use the hollow probe or use the receiver open.**

LEAKING VALVES: Leaking intake valves can be checked for defects by using the Sound Trap 1000 receiver and headphones with the engine running. All valves would emit a sound in a very close meter and sound pattern when the probe is placed on the intake manifold opposite the intake port. A suspected valve can then be positively checked, with the engine off, by bringing that particular cylinder to full compression and placing the probe on the valve stem. The "hiss" of escaping gas across the valve seat will be distinctly audible on the leaking valve. Using the same procedure can check exhaust valves, however, signal intensity will be much greater. **Use the solid contact probe for this test.**

COOLING SYSTEM: The presence of air in the cooling systems can cause hot spots, resulting in burned liners and heads in a very short time. Since all cooling systems are under pressure, coolant must go out in order to allow the air to get in. Aeration detection equipment gives the signal that air is in the system, but not the location of the leak. Using the Sound Trap 1000 receiver in suspect areas, such as the head gasket, the water pump, and injectors, will usually detect the exact source of the leak. The "bubbling" of air in the cooling system is very noisy and usually enables the exact problem to be determined. By detecting an unsuspected trouble point unnecessary labor can be eliminated. All such tests should be conducted while the engine is idling. Internal leaks may also be pinpointed immediately after shutoff when internal pressure is at its highest point. Headphones should be used for this test.

EXHAUST SYSTEMS: With the engine idling, pulsation in the exhaust system can be detected with the receiver. Leak points normally give off much louder and sharper sound. Headphones are essential for this procedure.

WHEEL BEARINGS: A ball or roller bearing that is in good condition and adequately lubricated normally produces a soft "whirring" sound via the earphones. Lack of lubrication introduces scraping sounds. Flat spots or nicks cause a grafting or clicking noise, depending on the speed of the rotation and the degree of damage.

For the best result, the probe should touch the spindle while spinning the wheel. **Use the solid probe for best results. You can also use the receiver open and just point at the suspect bearing.**

DRIVE TRAIN BEARING AND GEARS: By using the receiver with headphones, it is possible to determine which gear or bearing in a drive is faulty. This should be done by allowing the drive train to run with the wheels off the ground. The receiver and headphones are the search combination to discover the point of greatest noise generation. **Use the solid probe for this test.**

HYDRAULIC SYSTEMS: Partially blocked or bypassing valves in high-pressure hydraulic systems can be difficult and costly to find with conventional methods. Since hydraulic systems employ very high pressures, the intensity of the ultrasonic sound given off by an internal leak is extremely high and easily detected by the Sound Trap 1000 receiver. **Use the hollow or solid probe for this test.**

BODY WEATHER-STRIPPING, SEALS, FUEL TANKS: The Sound Trap 1000 transmitter, placed inside a vehicle, fuel tank or any enclosure, can easily locate leaks in weather-stripping, seals, or the structure itself.

This is extremely useful for inspecting fuel transporters and storage tanks and will save many hours of downtime and labor.

The Sound Trap 1000 detector will become one of the most valuable tools in your maintenance diagnostic and repair operation.

TECHNICAL SPECIFICATIONS

Dimensions:	Width: 4.0”
	Depth: 1.5”
	Length: 6.0”
Weight:	3 lbs.
Housing:	Chemical Resistant ABS w/ Protective rubber boot
Battery Life:	Approx. 20 hrs.
Power Requirement:	Standard 9-Volt
Power Consumption:	26 mA, typical
Frequency Response:	36,000Hz-44,000Hz
Circuitry:	Solid State
Headphones:	Full-Sized Noise Attenuating
Headphone Connector:	3.5m phone plug
Operating temp. Range:	10 to +60 degrees Celsius

Safety Precautions

While the Sound Trap allows you to focus on diagnosing a problem in a fast and effective manner, Never lose focus of your surroundings.

1. Always remember the Sound Trap and probes are an extention of your hand. Keep the probes and hands a safe distance from moving parts and electrical areas.
2. Never over reach or de-stabilize your footing while using the SoundTrap
3. Stand a proper distance from electrical and moving parts
4. Always be aware of headphone cord when near moving parts
5. Never use the air or contact probe as a lever, pry bar, or other unintended purposes
6. Never use the contact probe for diagnosing electrical problems
7. Wearing headphones hinders ones ability to listen to your surroundings

The entire Visual Optics staff is committed to our customers, so we want to hear from you. Our facility is located at 105 Sunset Rd, Wynnewood, OK 73098 - Contact us at: 405-665-9000

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