ULTRAPROBE® 2000

INSTRUCTION MANUAL

UE SYSTEMS INC
The ultrasound approach

Rev: 0 92216

NEED HELP???
HAVE QUESTIONS??

AT UE SYSTEMS, WE ARE DEDICATED TO SUPPORTING OUR ULTRAPROBE USERS.

OUR STAFF HAS YEARS OF FIELD EXPERIENCE AND IS STANDING READY TO ASSIST YOU SHOULD YOU NEED US.

WHEREEVER YOU ARE, REMEMBER, WE ARE AS CLOSE AS YOUR PHONE, FAX OR COMPUTER.

CALL: 914-592-1220
FAX: 914-347-2181
Email: info@uesystems.com
Internet: http://www.uesystems.com

Combination Change Instructions

The combination is factory set at --0--0--0

Setting your personal combination:

1. Open the case. Looking at the back of the lock inside the case you will see a change lever. Move this change lever to the middle of the lock in a way that allows it to hook behind the change notch (drawing 1).

2. Set your personal combination, turning the dials to the desired combination (i.e. birthday, phone #, etc.).

3. Move the change lever back to the normal position (drawing 2).

4. To lock, rotate one or more dials. To open, set to your personal combination.

INTERNATIONAL PATENTS PENDING

Your Personal Combination:

SAFETYADVISORY
PLEASE READ BEFORE USING YOUR INSTRUMENT.

WARNING

Improper use of your ultrasonic detector may result in death or serious injury. Observe all safety precautions. Do not attempt to make any repairs or adjustments while the equipment is operating. Be sure to turn off and LOCK OUT all electrical and mechanical sources before performing any corrective maintenance. Always refer to local guidelines for appropriate lockout and maintenance procedures.

SAFETY PRECAUTION: Although your ultrasonic instrument is intended to be used while equipment is operating, the close proximity of hot piping, electrical equipment and rotating parts are all potentially hazardous to the user. Be sure to use extreme caution when using your instrument around energized equipment. Avoid direct contact with hot pipes or parts, any moving parts or electrical connections. Do not attempt to check findings by touching the equipment with your hands or fingers. Be sure to use appropriate lockout procedures when attempting repairs.

Be careful with loose hanging parts such as the wrist strap or headphone cord when inspecting near moving mechanical devices since they may get caught. Don't touch moving parts with the contact probe. This may not only damage the part, but cause personal injury as well.

When inspecting electrical equipment, use caution. High voltage equipment can cause death or severe injury. Do not touch live electrical equipment with your instrument. Use the rubber focusing probe with the scanning module. Consult with your safety director before entering the area and follow all safety procedures. In high voltage areas, keep the instrument close to your body by keeping your elbows bent. Use recommended protective clothing. Do not get close to equipment. Your detector will locate problems at a distance.

When working around high temperature piping, use caution. Use protective clothing and do not attempt to touch any piping or equipment while it is hot. Consult with your safety director before entering the area.

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The ULTRAPROBE 2000 opens the vista of preventative/predictive maintenance as never before. This multifaceted instrument provides testing capability ranging from simplistic forms of leak detection to extremely sophisticated methods of mechanical analysis.

It is a testing laboratory that fits in the palm of your hand.

Before you begin testing, it is advisable to familiarize yourself with the basic components of your kit.

1. METERED PISTOL HOUSING

The main component of the Ultraprobe is its' pistol housing. From back to front, let's examine each part.

A. Meter: This ballistic meter has intensity increments of from 0 to 100. The 50 divisions reflect intensity changes only: the more intense the ultrasonic signal, the higher the reading.

B. Battery Level Light: This red light turns on only when the batteries need recharging.
NOTE: When the trigger on/off switch is pulled to the on position, the red battery light will flicker on and off quickly and the meter will Jump rapidly to indicate that the instrument is working properly.

C. Sensitivity selection (numerically calibrated) Dial: The increments on this dial allow for 500 individual set-points. There are 2 sets of numbers. The outer window reflects the whole digit and reads from 0 to 10. The inside digits are for fine tuning and these smaller gradations are shown as lines which represent 2 divisions each. As the numbers go UP in value, the sensitivity of the instrument also goes up. The maximum sensitivity level is 10, the minimum sensitivity level is 0.0.

On the sensitivity selection switch is a LOCK lever. This allows a user to lock the sensitivity selection and thereby prevent it from being moved inadvertently. To lock the sensitivity selection, rotate the lever clockwise; to release the lock, rotate the lever counter-clockwise.

D. Head Set Jack: This is where you plug in the headset. Be sure to plug it in firmly until it clicks.

TURN THE MAIN HOUSING OF THE ULTRAPROBE 2000 UP-SIDE DOWN AND YOU WILL SEE:

E. Trigger Switch: The Ultraprobe is always "off' until the trigger switch is pressed. To operate, simply press the trigger; to turn the instrument off, release the trigger.

F. Frequency Adjust Dial: There are numbers ranging from 100 kHz down to 20 kHz. These represent the range of frequency selection capable with the Ultraprobe. These frequencies may be "tuned in" when performing mechanical and valve analysis with the contact (stethoscope) probe (refer to description of contact probe). There is also a detented position, labeled "fixed band". This selection automatically locks the circuitry of the Ultraprobe into the peak response of the transducers of either the contact (stethoscope) module or the Trisonic™ Scanning Module. It is an extremely ***narrow band*** response that, when used with the contact (stethoscope) module, reduces most stray unwanted pipe and mechanical noises. In the scanning mode, it provides for extreme sensitivity and is the preferred position in leak detection and electrical inspection activities.

G. Meter Selection: There are three positions for this dial:

1. Log: this selection allows the meter to respond in a real-time, instant, mode. This selection is used when fast, instant meter response is needed, as in leak detection.

2. Lin: this selection, ***linear,*** can be considered a slow response. It eliminates the high and low swings of the meter and averages the response for a more measurable result. This selection is utilized when too rapid a meter response might be confusing to the operator.

3. Aux: this is the ***auxiliary*** position, which is to be used ONLY when a specially adapted instrument is to be interfaced with the Ultraprobe.

H. Recharge Jack: This jack receives the plug from the recharger. The recharger is designed to plug into a standard electrical receptacle.

To charge the UP2000 pistol and the Ultraprobe 2000 WTG-1 (Warble Tone Generator)
There are two wires from the universal recharger (suppose BCH-10) supplied by UE Systems with this ID#28680 UP2000KIT. One is for the Ultraprobe pistol housing and the other is for the Warble Tone Generator.

TO CHARGE THE UP2000 pistol

1. Insert Ultraprobe plug (black) into Ultraprobe 2000 Recharge jack and then plug the recharger into a wall receptacle.
2. Make sure that the LED on the charger is blinking when recharging.
3. The LED remains solid when the battery is charged. The instrument may stay connected to the charger without damaging the battery. Charge time is approximately 4 hours.

4. WARNING: Use the supplied UE Systems recharger (BCH-2) only. Use of unauthorized rechargers will void the warranty and may degrade or damage the battery.

WHEN TO RECHARGE: When the red low level indicator light goes on, IMMEDIATELY recharge the Ultraprobe. If the instrument is not used for a week or more, recharge it. If the Ultraprobe is not used for a few days, it can be used without recharging, however, for best results, it is advisable to recharge it as a "booster" for about an hour before using.

TO CHARGE THE Ultraprobe 2000 WTG-1
1. Insert Tone Generator plug (yellow) into Warble Tone Generator Recharge jack and then plug the recharger into a wall receptacle.
2. Make sure that the LED on the charger is blinking when recharging.
3. The LED remains solid when the battery is charged. The instrument may stay connected to the charger without damaging the battery. Charge time is approximately 4 hours.
4. WARNING: Use the supplied UE Systems recharger (BCH-2) only. Use of unauthorized rechargers will void the warranty and may degrade or damage the battery.

2. TRISONIC` SCANNING MODULE

This module is utilized to receive air-borne ultrasound such as the ultrasounds emitted by pressure leaks and electrical discharges. There are three prongs at the rear of the module. For placement, align the prongs with the three corresponding jacks in the front end of the metered pistol housing and plug in.

The Trisonic™ Scanning Module has a phased array of three piezoelectric transducers to pick up the air-borne ultrasound. This phased array focuses the ultrasound on one "hot spot" for directionality and effectively intensifies the signal so that minute ultrasonic emissions may be detected.

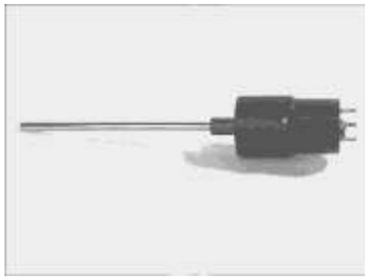
To use the Trisonic Scanning Module:
1. Plug in to front end.
2. Select the LOG position on the meter selection dial.
3. For general use position the frequency selection dial to the "fixed-band" mode.
4. Start with the sensitivity selection dial at maximum (10).
5. Start to scan the test area. a. The method of air borne detection is to go from the "gross to the fine". If there is too much ultrasound in the area, reduce the sensitivity, place the RUBBER FOCUSING PROBE (described below) over the scanning module and proceed to follow the test sound to its' loudest point constantly reducing the sensitivity and following the meter. **RUBBER FOCUSING PROBE:** The Rubber Focusing Probe is a cone-shaped rubber shield. It is used to block out stray ultrasound and to assist in narrowing the field of reception of the Trisonic- Scanning Module. To use, simply slip it over the front of the scanning module or the contact module. NOTE: To prevent damage to the module plugs, always remove the module BEFORE attaching and removing the Rubber focusing Probe.

Trisonic Scanning Module

3. CONTACT (STETHOSCOPE) MODULE

This is the module with the metal rod. This rod is utilized as a "waveguide" in that it is sensitive to ultrasound that is generated internally such as within a pipe, bearing housing, steam trap or wall. Once stimulated by ultrasound, it transfers the signal to a piezoelectric transducer located directly in the module housing. This module is shielded to provide protection from stray RF waves that have a tendency to effect electronic receiving. It is equipped with low noise amplification to allow for a clear, intelligible signal to be received and interpreted.

To use: 1. Align the pins located at the rear of the module with the three jacks in the front end of the Metered Pistol Housing (MPH) and plug in. 2. For detecting leaks in valves, steam traps, etc., position the meter selection dial to LOG. If performing mechanical analysis, select the LIN mode on the meter selection dial. 3. For general use, position the frequency selection dial to "Fixed-Band". For problem solving, i.e. finding a problem sound (refer to section on Mechanical Analysis). 4. Touch test area. 5. As with the scanning module, go from the "gross" to the "fine". Start a maximum sensitivity on the Sensitivity Selection dial and proceed to reduce the sensitivity until a satisfactory sound and meter level is achieved.



Stethoscope Module

At times it may be necessary to utilize the stethoscope probe with the sensitivity level at or near maximum. Occasionally when in this situation stray ultrasound may interfere with clear reception and be confusing. If this occurs, place the RUBBER FOCUSING PROBE over the Stethoscope probe to insulate against the stray ultrasound.

STETHOSCOPE EXTENSION KIT: This consists of three metal rods that will enable a user to reach up to 31 additional inches (78.7 cm) with the Stethoscope Probe. To use: 1. Remove the Stethoscope Module from the Metered Pistol Housing. 2. Unscrew the metal rod in the Stethoscope Module. 3. Look at the thread of the rod you just unscrewed and locate a rod in the kit that has the same size thread - this is the "base piece". 4. Screw the Base Piece into the Stethoscope Module. 5. If all 31" (78.7 cm) are to be utilized, locate the middle piece. (This is the rod with a female fitting at one end) and screw this piece into the base piece. 6. Screw third "end piece" into middle piece. 6a. If a shorter length is desired, omit step 5 and screw "end piece" into "base piece".

4.HEADSET

This heavy duty headset is designed to block out intense sounds often found in industrial environments so that the user may easily hear the sounds received by the ULTRAPROBE. To use, simply plug the headset cord into the headset Jack on the metered pistol housing, and place the headphones over your ears. The **UE-DHC-2HH Hard Hat Headphones** are specifically designed for hard hat use.

5. WTG - 1 WARBLE TONE GENERATOR (Standard)

The WTG-1 Tone Generator is an ultrasonic transmitter designed to flood an area with ultrasound

To use the WARBLE TONE GENERATOR: UE-WTG-1 Warble Tone Generator

1. Turn Tone Generator on by selecting either "LOW" or "HIGH" for high amplitude.

When the Tone Generator is on, a red light (located below the recharge Jack in the front) flickers.

2. Place the Warble Tone Generator within the test item/container and seal or close it. Then scan the suspect areas with the Trisonic Scanning Module in the Ultraprobe and listen for where the "warble" ultrasound penetrates.

As an example, if the item to be tested is the seal around a window, place the Warble Tone Generator on one side of the window, close it and proceed to scan on the opposite side.

To test the condition of the Warble Tone Generator battery, set to the LOW INTENSITY position and listen to the sound through the Ultraprobe in the FIXED BAND mode. A smooth continuous warbling sound should be heard. If a "beeping" is heard instead, then a full recharge of the Warble Tone Generator is indicated.

To charge the Warble Tone Generator:
Follow directions in 1.1-1 RECHARGE JACK (page 2).

ULTRAPROBE APPLICATIONS

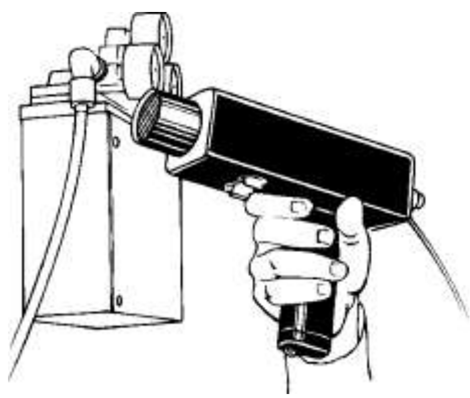
1. LEAK DETECTION

This section will cover airborne leak detection of pressure and vacuum systems. (For information concerned with internal leaks such as in Valves and Steam Traps, refer to the appropriate sections).

What produces ultrasound in a leak? When a gas passes through a restricted orifice under pressure, it is going from a pressurized laminar flow to low pressure turbulent flow. (Fig. 1). The turbulence generates a broad spectrum of sound called "white noise". There are ultrasonic components in this white noise. Since the ultrasound will be loudest by the leak site, the detection of these signals is usually quite simple.

A leak can be in a pressurized system or in a vacuum system. In both instances, the ultrasound will be produced in the manner described above. The only difference between the two is that a vacuum leak will usually generate less ultrasonic amplitude than a pressure leak of the same flow rate. The reason for this is that the turbulence produced by a vacuum leak is occurring within the vacuum chamber while the turbulence of a pressure leak is generated in the atmosphere. (Figs.2/3).

What type of gas leak will be detected ultrasonically? Generally any gas, including air, will produce turbulence when it escapes through a restricted orifice. Unlike gas specific sensors, the Ultraprobe is sound specific. A gas specific sensor is limited to the particular gas it was designed to sense (e.g., helium). The Ultraprobe can sense any type of gas leak since it detects the ultrasound produced by the turbulence of a leak.



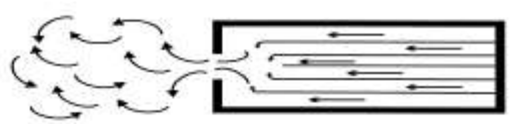


Figure 2 Pressure leak

Figure 3 Vacuum leak

A. HOW TO LOCATE LEAKS

1. Use the TRISONIC SCANNING MODULE.
2. Select the LOG setting on the meter selection dial.
3. Use "fixed-band" position on the Frequency selection dial. If too much background noise is present, try some of the shielding methods listed below.
4. Start off with the sensitivity selection at 10 (Maximum).
5. Begin to scan by pointing the module towards the test area. The procedure is to go from the "gross" to the "fine" - more and more subtle adjustments will be made as the leak is approached.
6. If there is too much ultrasound in the area, reduce the sensitivity setting and continue to scan.
7. If it is difficult to isolate the leak due to competing ultrasound, place the RUBBER FOCUSING PROBE over the scanning module and proceed to scan the test area.
8. Listen for a "rushing" sound while observing the meter.
9. Follow the sound to the loudest point. The meter will show a higher reading as the leak is approached.
10. In order to focus in on the leak, keep reducing the sensitivity setting and move the instrument closer to the suspected leak site until you are able to confirm a leak.

B. TO CONFIRM A LEAK-

Position the Trisonic Scanning Module, or the rubber focusing probe (if it is on the scanning module) close to the suspect leak site and move it, slightly, back and forth, in all directions. If the leak is at this location, the sound will increase and decrease in intensity as you sweep over it. In some instances, it is useful to position the rubber focusing probe directly over the suspect leak site and push down to "seal" it from surrounding sounds. If it is the leak, the rushing sound will continue. If it is not the leak site, the sound will drop off.

C. OVERCOMING DIFFICULTIES

1. Competing Ultrasounds

   If competing ultrasounds make it difficult to isolate a leak, there are two approaches to be taken:

   a. Manipulate the environment. This procedure is fairly straightforward. When possible, turn off the equipment that is producing the competing ultrasound or isolate the area by closing a door or window.

   b. Manipulate the instrument and use shielding techniques. If environmental manipulation is not possible, try to get as close to the test site as possible, and manipulate the instrument so that it is pointing away from the competing ultrasound. Isolate the leak area by reducing the sensitivity of the unit and by pushing the tip of the rubber focusing probe up to the test area, checking a small section at a time. In some extreme instances, when the leak check is difficult in the fixed band mode of the frequency selection dial, try to "tune in" to the leak sound by "tuning out" the problem sound. In this instance adjust the frequency selection dial until the background sound is minimized and then proceed to listen for the leak.

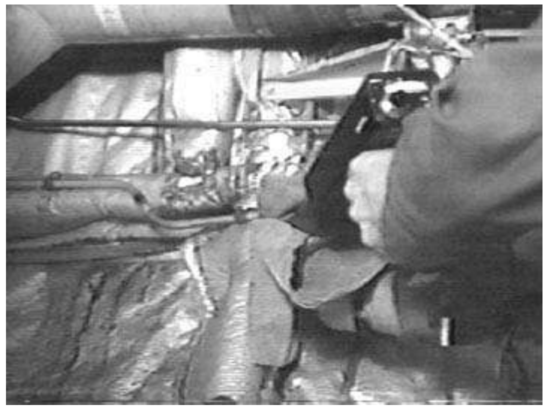
1. SHIELDING TECHNIQUES

Since ultrasound is a high frequency, short wave signal, it can usually be blocked or "shielded". NOTE: When using any method, be sure to follow your plant's or company's safety guidelines. Some common techniques are:

a. Body: place your body between the test area and the competing sounds to act as a barrier

b. Clip Board: Position the clip board close to the leak area and angle it so that it acts as a barrier between the test area and the competing sounds

c. Gloved Hand: (USE CAUTION) using a gloved hand, wrap the hand around the rubber focusing probe tip so that the index finger and the thumb are close to the very end and place the rest of the hand on the test site so that there is a complete barrier of the hand between the test area and the background noise. Move the hand and instrument together over the various test zones.



d. Wipe rag: This is the same method as the "gloved hand" method, only, in addition to the glove, use a wipe rag to wrap around the rubber focusing probe tip. Hold the rag in the gloved hand so that it acts as a "curtain", i.e., there is enough material to cover the test site without blocking the open end of the rubber focusing probe. This is usually the most effective method since it uses three barriers: the rubber focusing probe, the gloved hand and the rag.

e. Barrier: When covering a large area, it is sometimes helpful to use some reflective material, such as a welder’s curtain or a drop cloth, to act as a barrier. Place the material so that it acts as a "wall" between the test area and the competing sounds. Sometimes the barrier is draped from ceiling to floor, at other times, it is hung over railings.

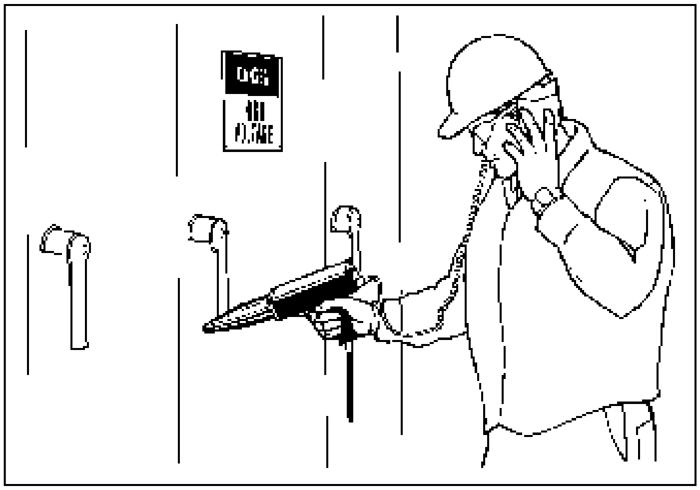
f. FREQUENCY TUNING If there are situations where a signal may be difficult to isolate, it may be helpful to utilize the Frequency Tuning Dial. Point the Ultraprobe toward the test area and gradually adjust the frequency tune dial until the weak signal appears to be clearer and then follow the basic detection methods previously outlined.

2. LOW LEVEL LEAKS

In ultrasonic inspection of leakage, the amplitude of the sound often depends upon the amount of turbulence generated at the leak site. The greater the turbulence, the louder the signal, the less the turbulence, the lower the intensity of the signal. When a leak rate is so low that it produces little, if any turbulence that is "detectable", it is considered "below threshold". If a leak appears to be of this nature:

1. Build up the pressure (if possible) to create greater turbulence.

2. Use the UE-CFM-2 Close Focus Module. Specifically designed for low level leaks, the unique scanning chamber is designed to receive low level signals with reduced signal distortion and provides easier recognition of a low level leak. For more information, call the factory.



CHECK TRANSFORMERS, SWITCHGEARAND OTHER ELECTRICAL APPARATUS

2. ELECTRIC ARC, CORONA, TRACKING DETECTION

There are three basic electrical problems that are detected with the Ultraprobe 2000:

Arcing: An arc occurs when electricity flows through space. Lightning is a good example.

Corona: When voltage on an electrical conductor, such as an antenna or high voltage transmission line exceeds the threshold value, the air around it begins to ionize to form a blue or purple glow.

Tracking: Often referred to as "baby arcing", follows the path of damaged insulation.

Although theoretically the Ultraprobe 2000 can be used in low, medium and high voltage systems, most of the applications tend to be in medium and high voltage systems.

When electricity escapes in high voltage lines or when it "jumps" across a gap in an electrical connection, it disturbs the air molecules around it and generates ultrasound. Most often this sound will be perceived as a crackling or "frying" sound, in other situations it will be heard as a buzzing sound.

Typical applications include: insulators, cable, switchgear, buss bars, relays, contactors, junction boxes. In substations, components such as insulators, transformers and bushings may be tested.

Since ultrasound emissions can be detected by scanning around door seams and air vents, it is possible to detect serious faults such as arcing, tracking and corona on enclosed electrical equipment such as switchgear.

NOTE: When testing electrical equipment, follow all your plant or company safety procedures. When in doubt, ask your supervisor. *Never touch live electrical apparatus with the Ultraprobe.*

The method for detecting electric arc and corona leakage is similar to the procedure outlined in leak detection. Instead of listening for a rushing sound, a user will listen for a crackling or buzzing sound.

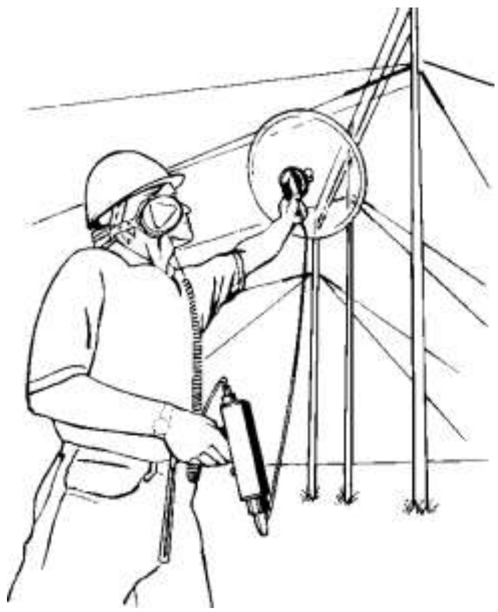
Determining whether a problem exists or not is relatively simple, compare sound quality and sound levels among similar equipment, the problem sound will tend to be quite different.

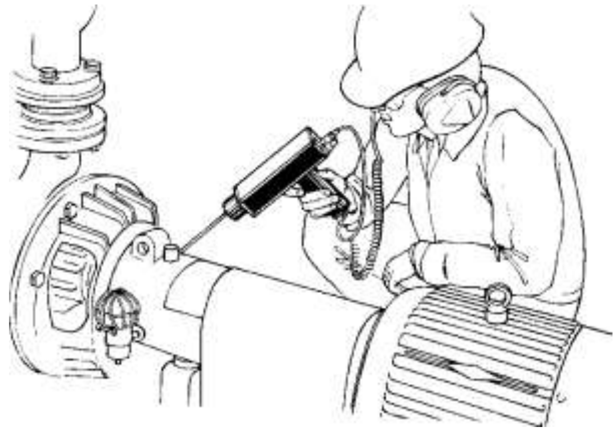
On lower voltage systems, a quick scan of bus bars often will pick up a loose connection. Checking junction boxes can reveal arcing. As with leak detection, the closer one gets to the emission site, the louder the signal.

If power lines are to be inspected and the signal does not appear to be intense enough to be detectable from the ground, use UE Systems, **UWC-2000 Ultrasonic Waveform Concentrator** (a parabolic reflector) which will double the detection distance of the

Ultraprobe and provide pinpoint detection. The UWC-2000 is recommended for those situations in which it may be considered safer to inspect electrical apparatus at a distance. The UWC2000 is extremely directional and will locate the exact site of an electrical discharge.

UWC-2000WAVEFORM CONCENTRATOR DETECTS HIGHVOLTAGE PROBLEMS ATA SAFE DISTANCE





3. MONITORING BEARING WEAR

Ultrasonic inspection and monitoring of bearings is a very reliable method for detecting incipient bearing failure. Ultrasonic warnings appear prior to a rise in temperature or an increase in low frequency vibration levels. Ultrasonic inspection of bearings is useful in recognizing:

a. The beginning of fatigue failure.
b. Brinelling of bearing surfaces.
c. Flooding of or lack of lubricant.

The ultrasonic frequencies detected by the Ultraprobe are reproduced as audible sounds. This "heterodyned" signal can greatly assist a user in determining bearing problems. When listening, it is recommended that a user become familiar with the sounds of a good bearing. A good bearing is heard as a rushing or hissing noise. Crackling or rough sounds indicate a bearing in the failure stage. In certain cases a damaged ball can be heard as a clicking sound whereas a high intensity, uniform rough sound may indicate a damaged race or uniform ball damage. Loud rushing sounds similar to the rushing sound of a good bearing only slightly rougher, can indicate lack of lubrication. Short duration increases in the sound level with "rough" or "scratchy" components indicate a rolling element hitting a "flat" spot and sliding on the bearing surfaces rather than rotating. If this condition is detected, more frequent examinations should be scheduled.

Lack of Lubrication:

To avoid lack of lubrication, note the following:

1. As the lubricant film reduces, the sound level will increase accompanied by a uniform rushing sound will indicate lack of lubrication.
2. When lubricating, add just enough to return the reading to base line.
3. Use caution. Some lubricants will need time to run to uniformly cover the bearing surfaces. Lubricate a little at a time.
   DO NOT OVER-LUBRICATE

Over-Lubrication:

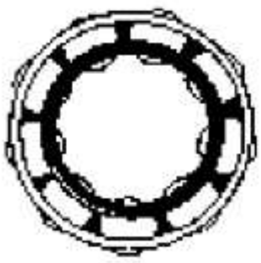
One of the most common causes of bearing failure is over-lubrication. The excess stress of lubricant often breaks bearing seals or causes a build-up of heat which can create stress and deformity.

To avoid over-lubrication:

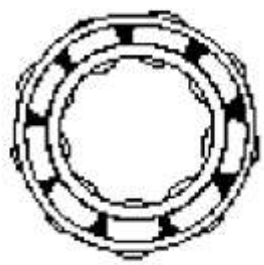
1. Don't lubricate if the base line reading and base line sound quality is maintained.
2. When lubricating, use just enough lubricant to bring the ultrasonic reading to baseline.
3. As mentioned in 3 above, use caution. Some lubricants will need time to uniformly cover the bearing surfaces.

SLOW SPEED BEARINGS

Monitoring slow speed bearings is possible with the Ultraprobe 2000. Due to the sensitivity range and the frequency tuning, it is quite possible to listen to the acoustic quality of bearings. In extremely slow bearings (less than 25 RPM), it is often necessary to disregard the meter and listen to the sound of the bearing. In these extreme situations, the bearings are usually large (1"-2" and up) and greased with high viscosity lubricant. Most often no sound will be heard as the grease will absorb most of the acoustic energy. If a sound is heard, usually a crackling sound, there is some indication of deformity occurring.



PROPER LUBRICATION
REDUCES FRICTION



LACK OF LUBRICATION
INCREASES AMPLITUDE LEVELS

4. GENERAL MECHANICAL TROUBLE SHOOTING

As operating equipment begins to fall due to component wear, breakage or misalignment , sonic and more importantly, ultrasonic shifts occur. The accompanying sound pattern changes can save time and guess work in diagnosing problems if they are adequately monitored. Therefore, an ultrasonic history of key components can prevent unplanned down-time. And just as important, if equipment should begin to fail in the field, the ULTRAPROBE can be extremely useful in trouble shooting problems.

TROUBLE SHOOTING:

1. Use the contact (stethoscope) module.
2. 2. Set desired meter mode.
   a. LIN selection where a slow, averaging meter response is required. Generally this selection is utilized when wide meter swings caused by excessive ultrasonic activity might effect meter interpretation.
   b. LOG selection when instant meter response is desired. This is useful in analyzing certain operating mechanical functions such as valve operation.
3. Touch test area(s): listen through headphones and observe the meter.
4. Adjust sensitivity until mechanical operation of the equipment is heard clearly and the meter can fluctuate,
5. Probe equipment by touching various suspect areas.
6. If competing sounds in equipment being tested present a problem, try to "tune in" to the problem sound by:
   a. Probing equipment until the potential problem sound is heard.
   b. Start probing with Frequency Selection Dial
   c. Adjust Frequency Selection Dial by rotating it (counter-clockwise) slowly until the problem sound is heard more clearly.
7. To focus in on problem sounds, while probing, reduce sensitivity gradually to assist in locating the problem sound at its' loudest point. (This procedure is similar to the method outlined in LEAK LOCATION, i.e., follow the sound to its loudest point.)

MONITORING OPERATING EQUIPMENT In order to understand and keep ahead of potential problems in operating equipment, it is necessary to establish base data and observe shifts in that data. The data can be compiled from meter readings.

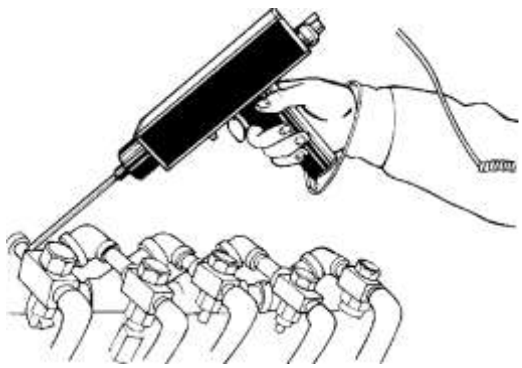
PROCEDURE:

1. Select key locations to be monitored and make permanent reference marks for future inspections.

.

2. Follow steps 1-5 as outlined above in the Trouble Shooting section.
3. Select one (or more) frequency (ies) for each test spot.

4. On a chart note:
   a. Equipment
   b. Location
   c. Date
   d. Meter mode (LIN/LOG)
   e. Frequency selection(s)
   f. Sensitivity level
   g. Meter reading



5. IDENTIFYING FAULTY STEAM TRAPS

An ultrasonic test of steam traps is a positive test. The main advantage to ultrasonic testing is that it isolates the area being tested by eliminating confusing background noises. A user can quickly adjust to recognizing differences among various steam traps, of which there are three basic types: mechanical, thermostatic and thermodynamic. When testing steam traps ultrasonically:

1. Determine what type of trap is on the line. Be familiar with the operation of the trap. Is it intermittent or continuous drain?
2. Try to check whether the trap is in operation (is it hot or cold? Put your hand near, but do not touch the trap, or, better yet, use a non-contact infrared thermometer).
3. Use the contact (stethoscope) module.
4. Set to LOG position in meter mode selection dial.
5. Position Frequency Adjust Dial to about 25 kHz.
6. Try to touch the contact probe towards the discharge side of the trap. Press the trigger and listen.
7. Listen for the intermittent or continuous flow operation of, the trap. Intermittent traps are usually the inverted bucket, thermodynamic (disc) and thermostatic (under light loads). Continuous flow: include the float, float and thermostatic and (usually) thermostatic traps. While testing intermittent traps, listen long enough to gauge the true cycle. In some cases, this may be longer than 30 seconds. Bear in mind that the greater the load that comes to it, the longer period of time it will stay open.

In checking a trap ultrasonically, a continuous rushing sound will often be the key indicator of live steam passing through. There are subtleties for each type of trap that can be noted.

Use the sensitivity levels of the Sensitivity Selection Dial to assist your test. If a low-pressure system is to be checked, adjust the sensitivity UP toward 10; if a high-pressure system (above 100 psi) is to be checked, reduce the sensitivity level. (Some experimentation may be necessary to arrive at the most desirable level to be tested.) Check upstream and reduce the sensitivity so that the meter reads about 50 then touch the trap body downstream and compare readings.

FREQUENCY SELECTION Occasionally it may be necessary to "tune in" to a steam trap. In some systems, specifically float type traps under low or moderate pressure load, a wide orifice will not produce too much ultrasound. If this is the case touch the trap on the downstream side, reduce the frequency, start at 20 kHz and listen for a lower frequency trickling sound of water. For other subtle trap sounds, such as determining the difference of condensate vs. steam sounds, try to listen at FIXED BAND. If this proves difficult, gradually rotate the Frequency Selection Dial down (counterclockwise) until the specific sounds are heard. Steam will have a light, gaseous sound, condensate will have additional overtones to its rushing sound.

GENERAL STEAM/CONDENSATE/FLASH STEAM CONFIRMATION

In instances where it may be difficult to determine the sound of steam, flash steam or condensate,

1. touch at the immediate downstream side of the trap and reduce the sensitivity to get a mid-line reading on the meter ("50").
2. move 6 - 12 inches (15.2-30.5 cm) downstream and listen. Flashing steam will show a large drop off in intensity while leaking steam will show little drop off in intensity.

INVERTED BUCKET TRAPS normally fail in the open position because the trap loses its prime. This condition means a complete blow-through, not a partial loss. The trap will no longer operate intermittently. Aside from a continuous rushing sound, another clue for steam blow-through is the sound of the bucket clanging against the side of the trap.

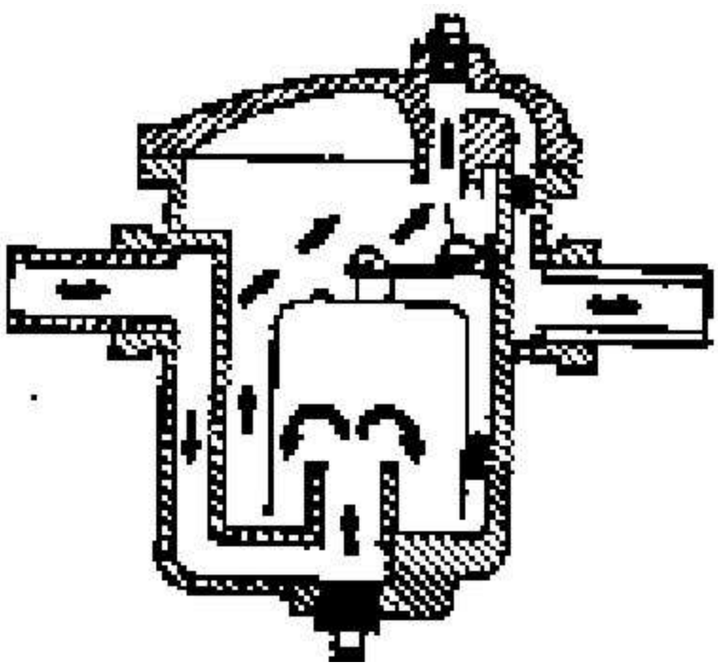
A FLOAT AND THERMOSTATIC trap normally fails in the "closed" position. A pinhole leak produced in the ball float will cause the float to be weighted down or water hammer will collapse the ball float. Since the trap is totally closed - no sound will be heard. In addition, check the thermostatic element in the float and thermostatic trap. If the trap is operating correctly, this element is usually quiet; if a rushing sound is heard, this will indicate either steam or gas is blowing through the air vent. This indicates that the vent has failed in the open position and is wasting energy.

THERMODYNAMIC (DISC) traps work on the difference in dynamic response to velocity change in the flow of compressible and incompressible fluids. As steam enters, static pressure above the disc forces the disc against the valve seat. The static pressure over a large area overcomes the high inlet pressure of the steam. As the steam starts to condense, the pressure against the disc lessens and the trap cycles. A good disc trap should cycle (hold-discharge-hold) 4-10 times per minute. When it fails, it usually fails in the open position, allowing continuous blow through of steam.

THERMOSTATIC TRAPS (bellows & bimetallic) operate on a difference in temperature between condensate and steam. They build up condensate so that the temperature of condensate drops down to a certain level below saturation temperature in order for the trap to open. By backing up condensate, the trap will tend to modulate open or closed depending on load.

In a bellows trap, should the bellows become compressed by water hammer, it will not function properly. The occurrence of a leak will prevent the balanced pressure action of these traps. When either condition occurs, the trap will fail in its natural position either opened or closed. If the trap fails closed, condensate will back up and no sound will be heard. If the trap fails open, a continuous rushing of live steam will be heard.

With bimetallic traps, as the bimetallic plates set due to the heat they sense and the cooling effect on the plates, they may not set properly which will prevent the plates from closing completely and allow steam to piss through. This will be heard as a constant rushing sound.



NOTE: A complimentary Steam Trap Trouble Shooting Guide is available. Contact UE Systems directly by phone or fax.

CHECKINGVALVE LEAKAGE/ BLOCKAGE WITH THE ULTRAPROBE

6. TESTING VALVES
Utilizing the contact (stethoscope) module in the Ultraprobe, valves can easily be monitored to determine if a valve is operating properly. As a liquid or gas flows through a pipe, there is little or no turbulence generated except at bends or obstacles. In the case of a leaking valve, the escaping liquid or gas will move from a high to a low-pressure area, creating turbulence on the low pressure or "downstream" side. This produces a white noise. The ultrasonic component of this "white noise" is much stronger than the audible component. If a valve is leaking internally, the ultrasonic emissions generated at the orifice site will be heard and noted on the meter. The sounds of a leaking valve seat will vary depending upon the density of the liquid or gas. In some instances it will be heard as a subtle crackling sound, at other times as a loud rushing sound. Sound quality depends on fluid viscosity and internal pipe pressure differentials. As an example, water flowing under low to mid pressures may be easily recognized as water. However, water under high pressure rushing through a partially open valve may sound very much like steam. To discriminate: 1. reduce the sensitivity until the meter reads about mid-line. 2. change the frequency down to about 20-25 kHz and listen.

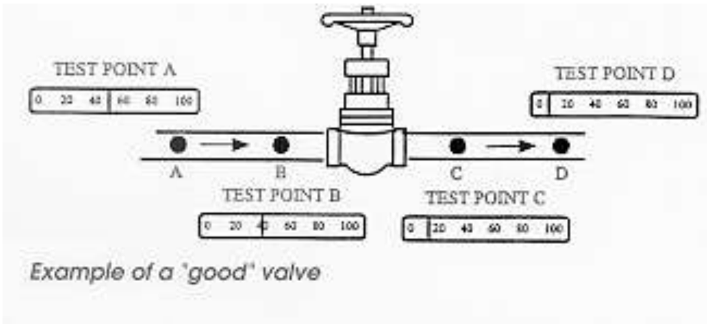
A properly seated valve will generate no sound. In some high pressure situations, the ultrasound generated within the system will be so intense that surface waves will travel from other valves or parts of the system and make it difficult to diagnose valve leakage. In this case it is still possible to diagnose valve blow-through by comparing sonic intensity differences by reducing the sensitivity and touching just upstream of the valve, at the valve seat and just downstream of the valve (see "Confirming Valve Leakage In Noisy Pipe Systems", page 22).

PROCEDURE FOR VALVE CHECK:
1. Use stethoscope module.
2. Select LIN in meter mode dial.
3. Touch downstream side of valve and listen through headset.
4. Start test in FIXED BAND on Frequency Selection dial. If the sound appears weak or confusing, change the frequency. As an example, try to test at 40 kHz, then sweep down in frequency to 20 kHz.
5. When necessary, if there is too much sound, reduce sensitivity.
6. For comparative readings, usually in high pressure systems:
   a. Touch upstream side and reduce sensitivity to minimize any sound (usually bring the meter to a mid-line "50" reading).
   b. Touch valve seat and/or downstream side.
   c. Compare sonic differentials. If the valve is leaking, the sound level on the seat or downstream side will be equal to or louder than the upstream side.
7. In some instances, such as in noisy background or low viscosity fluids, it will be helpful to adjust the frequency to adequately interpret valve sounds. To do this:
   a. Touch upstream of the valve and gradually rotate Frequency Select Dial until the stray signals are minimized or until the desired fluid flow is heard clearly.
   b. Touch the upstream side, valve seat, downstream sides (as described above) and compare differences.

CONFIRMING VALVE LEAKAGE IN NOISY PIPE SYSTEMS

Occasionally in high pressure systems, stray signals occur from valves that are close by or from pipes (or conduits) feeding into a common pipe that is near the down stream side of a valve. This flow may produce false leak signals. In order to determine if the loud signal on the downstream side is coming from a valve leak or from some other source:

1. Move close to the suspected source (i.e., the conduit or the other valve).
2. Touch at the upstream side of the suspected source.
3. Reduce sensitivity until the meter displays a mid-line ("50") reading.
4. Touch at short intervals (such as every 6 - 12 inches (15-30.5 cm) and note the meter changes.
5. If the sound level decreases as you move towards the test valve, it indicates that the valve is not leaking.
6. If the sound level increases as you approach the test valve, it is an indication of a leak in the valve.



7. MISCELLANEOUS PROBLEM AREAS
A. UNDERGROUND LEAKS

Underground leak detection depends upon the amount of ultrasound generated by the particular leak. Some slow leaks will emit very little ultrasound. Compounding the problem is the fact that earth will tend to insulate ultrasound. In addition, loose soil will absorb more ultrasound than firm soil. If the leak is close to the surface and is gross in nature, it will be quickly detected. The more subtle leaks can also be detected but with some additional effort. In some instances it will be necessary to build up pressure in the line to generate greater flow and more ultrasound. In other cases it will be necessary to drain the pipe area in question, isolate the area by valving it off and inject a gas (air or nitrogen) to generate ultrasound through the leak site. This latter method has proven very successful. It is also possible to inject a test gas into the test area of the pipe without draining it. As the pressurized gas moves through the liquid into the leak site, it produces a crackling sound which may be detected.

PROCEDURE:
1. Use contact (stethoscope) module.
2. Adjust meter selection to LOG
3. Start Frequency Selection at 20kHz.
4. Touch surface over ground, DO NOT JAM probe to ground. Jamming can cause probe damage,
   - 4a. In some instances it will be necessary to get close to the "source" of the leak. In this situation, use a thin, sturdy metal rod and drive it down close to, but not touching, the pipe.
   - 4b. Touch the contact probe to the metal rod and listen for the leak sound.
   - 4c. This should be repeated approximately every 5-10 feet until the leak sound is heard.
   - 4d. To locate the leak area, gradually position the rod until the leak sound is heard at its loudest point. An alternative to this is to use a flat metal disc or coin and drop it on the test area. Touch the disc and listen at 20 kHz. This is useful when testing concrete or asphalt to eliminate scratching sounds caused by slight movements of the stethoscope module on these surfaces.

B. LEAKAGE BEHIND WALLS
1. Look for water or steam markings such as discoloration, spots in wall or ceiling, etc.
2. If steam, feel for warm spots in wall or ceiling.
3. Test area using steps 1-3 as outlined on page 22, section "A", "Procedure".
4. Listen for leak sounds. The louder the signal the closer you are to the leak site.

C. BLOCKAGE IN PIPES

If total blockage occurs in piping, there will be no sound since there will be no flow at the blocked site.

PROCEDURE:
1. Use steps 1-2 as outlined in VALVE TESTING.
2. Use 40 kHz or Fixed Band
3. Use the Tone Test method:
    a. Make sure the downstream side of the pipe is clear of fluids.
    b. Place a Tone Generator in the downstream side facing upstream.
    c. At set intervals, touch along pipe with contact probe and listen for a drop off of the ultrasonic signal from the Tone Generator.

PARTIAL BLOCKAGE:
When partial blockage exists, a condition similar to that of a by-passing valve is produced. The partial blockage will generate ultrasonic signals (often produced by turbulence just down stream). If a partial blockage is suspected, a section of piping should be inspected at various intervals. The ultrasound generated within the piping will be greatest at the site of the partial blockage.

PROCEDURE:

1. Use procedures 1-3 as outlined in VALVE TESTING.
2. Listen for an increase in ultrasound created by the turbulence of partial blockage.

D. FLOW DIRECTION

Flow in piping increases in intensity as it passes through a restriction or a bend in the piping. As flow travels upstream, there is an increase in turbulence and therefore the intensity of the ultrasonic element of that turbulence at the flow restriction. In testing flow direction, the ultrasonic levels will have greater intensity in the DOWN-STREAM side than in the UPSTREAM side.

PROCEDURE:

1. Use stethoscope mode.
2. Select LOG in Meter Selection Dial.
3. Start test in FIXED BAND mode. If it is difficult hearing the flow signal, adjust Frequency Selection Dial to 40 kHz or to 25 kHz for higher viscosity fluids.
4. Begin test at 10 (maximum) sensitivity level.
5. Locate a bend in the pipe system (preferably 60, or more).
6. Touch one side of bend and note meter level.
7. Touch other side of bend and note meter level.
8. The side with the higher (louder) reading should be the downstream side.

NOTE: Should it be difficult to observe a sound differential, reduce sensitivity and test as described until a sonic difference is recognized.

ULTRASOUND TECHNOLOGY The technology of ultrasound is concerned with sound waves that occur above human perception. The average threshold of human perception is 16,500 Hertz. Although the highest sounds some humans are capable of hearing is 21,000 Hertz, ultrasound technology is usually concerned with frequencies from 20,000 Hertz and up. Another way of stating 20,000 Hertz is 20 kHz, or KILOHERTZ. One kilohertz is 1,000 Hertz.

Since ultrasound is a high frequency , it is a short wave signal. Its' properties are different from audible or low frequency sounds. A low frequency sound requires less acoustic energy to travel the same distance as high frequency sound. (Fig. A)

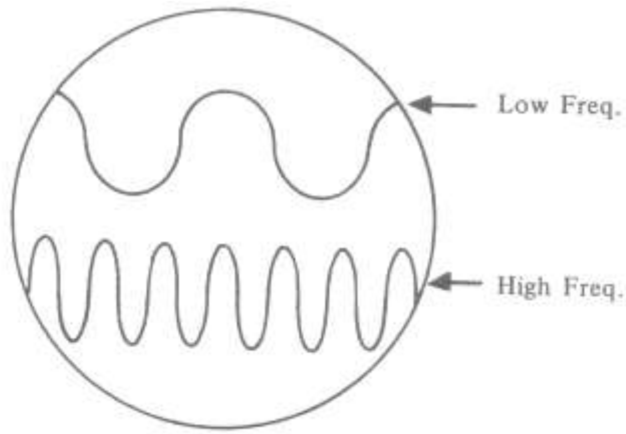


FIGURE A

The ultrasound technology utilized by the Ultraprobe is generally referred to as airborne ultrasound. Airborne ultrasound is concerned with the transmission and reception of ultrasound through the atmosphere without the need of sound conductive (interface) gels. It can and does incorporate methods of receiving signals generated through one or more media via wave-guides.

There are ultrasonic components in practically all forms of friction. As an example, if you were to rub your thumb and forefinger together, you will generate a signal in the ultrasonic range. Although you might be able to very faintly hear the audible tones of this friction, with the Ultraprobe it will sound extremely loud.

The reason for the loudness is that the Ultraprobe converts the ultrasonic signal into an audible range and then amplifies it. Due to the comparative low amplitude nature of ultrasound, amplification is a very important feature.

Although there are obvious audible sounds emitted by most operating equipment, it is the ultrasonic elements of the acoustic emissions that are generally the most important. For preventative maintenance, many times an individual will listen to a bearing through some simple type of audio pick-up to determine bearing wear. Since that individual is hearing ONLY the audio elements of the signal, the results of that type of diagnosis will be quite gross. The subtleties of change within the ultrasonic range will not be perceived and therefore omitted. When a bearing is perceived as being bad in the audio range it is in need of immediate replacement. Ultrasound offers a predictable diagnostic capacity. When changes begin to occur in- the ultrasonic range, there is still time to plan appropriate maintenance. In the area of leak detection, ultrasound offers a fast, accurate method of locating minute as well as gross leaks. Since ultrasound is a short wave signal, the ultrasonic elements of a leak will be loudest and most clearly perceived at the leak site. In loud factory type environments, this aspect of ultrasound makes it even more useful.

Most ambient sounds in a factory will block out the low frequency elements of a leak and thereby render audible leak inspection useless. Since the Ultraprobe is not capable of responding to low frequency sounds, it will hear only the ultrasonic elements of a leak. By scanning the test area, a user may quickly spot a leak.

Electrical discharges such as arcing, tracking and corona have strong ultrasonic components that may be readily detected. As with generic leak detection, these potential problems can be detected in noisy plant environments with the Ultraprobe.

REFERENCE CHART 1

TYPE OF TEST: **Mechanical: (describe)** ____________________
Electrical: (describe) ____________________
Leak: (describe ____________________

Diagram of Equipment (if needed)

Equipment Name:
____
____

Location:
____
____
____

TEST POINT I.D. (E.G.: BEARING NUMBER, INSULATOR TAG, TRAP TAG, ETC.)

DATE	MODULE USED (Contact Scanning)	ACCESSORY USED	FREQUENCY SETTING	SENSITIVITY SETTING	METER (Lin Mode)	BASELINE METER (Lin)	ACTION TO TAKE	ACTION TAKEN BY: WORK ORDER#

14 Hayes Street
Elmsford, NY 10523
PH: 914-592-1220

ULTRAPROBE 2000

FREQUENCY SELECTION CHART*

(Feel free to add your own applications and frequencies)

	FIXED BAND	20 kHz	25 kHz	30 kHz	40 kHz	50 kHz	60 kHz	80 kHz	100kHz	SUGGESTED** METER MODE	MODULE SELECTION
STEAM TRAPS	X		X		X					Log	Stethoscope
VALVES		X			X					Log	Stethoscope
COMPRESSORS (valves)	X		X		X					Log	Stethoscope
BEARINGS	X			X						Lin	Stethoscope
PRESSURE/ VACUUM LEAKS	X				X					Log	Scanner
ELECTRICAL (Arcs, Tracking, Corona)	X				X					Log	Scanner
GEAR BOXES		X	X							Log/Lin	Stethoscope
PUMPS (CAVITATION)	X	X	X							Log	Stethoscope
PIPING SYSTEMS (Underground)	X	X			X					Log	Stethoscope
CONDENSER TUBES	X				X					Log	Scanner
HEAT EXCHANGERS (Tone Method)	X									Log	Scanner

*Use this chart as a guideline. It is only to be used as a suggested starting point. Individual situations may dictate different frequency settings. **Use Lin for measuring, Log for detecting.

SPECIFICATIONS FOR UE MODEL ULTRAPROBE 2000 ULTRASONIC INSPECTION SYSTEM
FACTORY MUTUAL INTRINSICALLY SAFE RATING EXPLANATION

The Ultraprobe 2000 is to be considered intrinsically safe for use in Class 1, Division 1, Groups A, B, C, & D only when it has the appropriate "Factory Mutual System Approved" logo and label affixed to the bottom rear panel of the instrument. **NOTE:** If the Ultraprobe 2000 has been modified to interface with a chart recorder, the Factory Mutual approval does not apply. An intrinsically safe Ultraprobe 2000 is an instrument in which any spark or thermal effect, produced either normally or in specified fault conditions, is incapable, under the test conditions prescribed in article 500 of the national Electrical Code, NFPA-70 of causing ignition of a specified mixture of flammable or combustible material in air.

There are a few necessary precautions to take, which will ensure that your instrument remains intrinsically safe. The precautions are as follows: (1) Do not recharge the instrument (metered pistol housing or warbling tone generator) in a hazardous location. (2) Substitution of any components in the instrument will void the Factory Mutual Approval. (3)Only the UE BPA-1 or BPA-2 battery pack can be utilized to power the instrument. This battery pack is located in the pistol handle and is changeable in the field. Check with factory for correct style pack before replacing. **NOTE:** Failure to comply with the above will void the intrinsically safe rating.

CONSTRUCTION: Hand held metered pistol type made with anodized aluminum and ABS plastic.

CIRCUITRY: Solid state heterodyne receiver with temperature compensation.

FREQUENCY RESPONSE: Detect ultrasonic frequencies between 20 kHz and 100 kHz, continuously variable. Frequencies are converted to 100 Hz to 3 kHz audio.

PROBES: **Scanning module: plug-in type** consisting of a phased array of multiple transducers for airborne ultrasound. This probe is shielded against RF interference.
Rubber focusing probe (flexible) slips over scanning module to concentrate conical directivity and to shield reception of stray ultrasound. Also fits over stethoscope module to shield against high ambient ultrasound while unit is at maximum sensitivity.
Stethoscope module: Plug-in type, insulated probe with RE shielding: 5 1/2" long chrome plated brass probe tip, conically shaped for uniform surface contact. Probe tip is interchangeable.
Stethoscope extension kit: 3 piece, segmented to increase stethoscope contact range 20" and 31".

HEADSET: Noise isolating type: double headset wired monophonic. Impedence, 16 ohms.

INDICATORS: **Ballistic output meter:** linear calibration scale of 0-100 for logging relative measurements. Meter is accurate ± 3% throughout entire scale.
Low level battery LED indicator for main housing internal power supply.

BATTERIES: Self contained NiMH rechargeable.

FEATURES: **Frequency tuning adjustment dial:** scale 20-100 kHz with "fixed band" position for ultra narrow frequency response.
Bi-modal meter switch for logarithmic and linear meter scale adjustments.
Precision 10-turn adjustment dial with numerically calibrated sensitivity increments for finite gain adjustment.
Spring loaded trigger switch.

OVER-ALL SIZE: Complete kit is housed in a Zero Halliburton aluminum carrying case: 14" x 18"x5" (35.6x45.7xl2.7 cm)

WEIGHT Pistol unit: 2 lbs. (.75 kg).

Complete kit including carrying case: 13 lbs. (4.9 kg)

UE Systems, Inc. 14 Hayes Street, Elmsford, NY 10523 • 1-800-223-1325 • 914-592-1220
Fax: 914-347-2181• http://www.uesystems.com • email: info@uesystems.com