ULTRAPROBE® 2000

Instruction Manual

Safety advisory

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.

Ultraprobe 2000 Kit

Components

Metered Pistol Housing

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

Analog Meter (A)

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.

Battery Level (B)

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.

Sensitivity Dial (C)

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.

Headset Jack (D)

This is where you plug in the headset. Be sure to plug it in firmly until it clicks. Should a tape recorder be utilized, this is where the cord for the tape recorder is inserted. (Use a Miniphone plug). This can also be used as an output for an oscilloscope, engine analyzer or FFT with the use of a UE-MPBNC-2 Miniphone-BNC connector cable and UE DC2 FFT adapter.

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

Trigger Switch (E)

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.

Frequency Adjust Dial (F)

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.

Meter Selection Dial (G)

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 there sponse for a more measurable result. This selection is utilized for monitoring bearings or for mechanical analysis when too rapid a meter response might be confusing to the operator. In this scale the meter indicator may be used to provide a dB (decibel)relationship for applications such as mechanical monitoring and bearing trending.
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.

Recharge Jack

This jack receives the plug from the recharger. The recharger is designed to plug into a standard electrical receptacle. There are two wires from the recharger: one is for the Ultraprobe pistol housing and the other is for the Warble Tone Generator (see TONE GENERATOR for more information).

When recharging:

1. Insert main plug to electrical outlet.
2. Insert Ultraprobe plug (black) into Ultraprobe Recharge jack
3. Insert Tone Generator plug (yellow) into Tone Generator Recharge jack. NOTE: The recharger has two red LED's. Each will illuminate only if it is connected and charging properly.

When to recharge

When the red low level indicator light goes on, recharge the Ultraprobe for 8 hours. If the instrument is not used for a week or more, recharge it for 4 hours. 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.

If a quick charge is necessary, it is advisable to get the Ultraprobe UE-QCH2 QUICK CHARGER. Call the factory for information.

Trisonic™ Scanning Module

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:

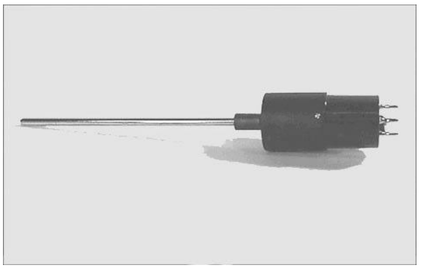
1. Plug in to front end.
2. Select the LOG position on the meter selection dial.
3. For general use position the frequency selection dial to the "fixed-band" mode.
4. Start with the sensitivity selection dial at maximum (10).
5. Start to scan the test area. a. The method of air borne detection is to 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.

Contact (Stethoscope)Module



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. This module can be effectively utilized in practically any environment ranging from airports to broadcasting towers. 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, bearing monitoring, etc., 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 78 cm (31 additional inches) 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 78 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. If a shorter length is desired, omit step 5 and screw "end piece" into "base piece".

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. If a hard hat is to be worn, it is recommended to use
UE Systems' model UE-DHC-2HH Hard Hat Headphones which are specifically designed for hard hat use. For those situations in which it is not possible or difficult to wear the standard headphones described above, UE Systems has two options available:

1. The DHC 1991 Earpiece which loops around the ear,
2. The SA-2000 Speaker Amplifier which is a loud speaker that is compatible with the Ultraprobe headphone output jack.

WTG - 1 Warble Tone Generator (Standard)

The WTG-1 Tone Generator is an ultrasonic transmitter designed to flood an area with ultrasound. It is used for a special type of leak test. When placed inside an empty container or on one side of a test item, it will flood that area with an intense ultrasound that will not penetrate any solid but will flow through any existing fault or void. By scanning with the Trisonic Scanning Module, empty containers such as pipes, tanks, 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 use the WARBLE TONE GENERATOR:

1. Turn Tone Generator on by selecting either "LOW" for a low amplitude signal (usually recommended for small containers) or "HIGH" for high amplitude. In high, the Warble Tone Generator will cover up to 113m^3 (4,000 cubic feet) of unobstructed space. 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 charge the Warble Tone Generator

Follow directions in 1.1-1 RECHARGE JACK

wtg1 warble tone generator (optional)

UE-WTG-2SP Warble Pipe Tone Generator

WTG-2SP Warble Pipetone Generator

This is an option that is used for test conditions where it is not possible to physically place the standard WTG-1 Warble Tone Generator, such as in pipes or in certain heat exchangers or tanks.

1. Features:

a. Threaded Pipe Fitting: The ultrasonic transducer is at this end. When testing, make sure that the transducer is positioned so that it can adequately "flood" the test area. This can be accomplished by screwing the male nipple connection into a threaded hole. The nipple size is 1" NPT.
b. Warble Rate Indicator Lamp (top). This LED will flash to indicate that the unit is on.
c. Variable Intensity Control (top). This dial has whole numbers and decimal numbers. The whole number appears in the window. Maximum output is "10" and minimum output is "0". The dial can be rotated counter clockwise to reduce intensity of output and clockwise to increase intensity output. There is a lock lever located to the right on the variable intensity control dial. Should a specific output intensity be required, the level may be preset and locked into position so that it will not be inadvertently moved during a test. To lock, press the lock lever down. to unlock, push the lock lever up.
d. On/Off Switch (middle). To turn the unit on, push the switch to the left.
e. Recharge Jack (bottom). This receptacle is compatible with the Ultraprobe Tone Generator Battery recharger. To use, follow the instructions for the recharge jack, section 1-H (page 2).
f. LED Indicator Lamp (bottom). This red lamp will glow only if the battery needs to be charged. Should the light glow, charge the battery immediately.
g. Adapters: The adapter kit consists of an acoustical foam rubber shield/sleeve - inside the sleeve is a coupler, 1" female pipe thread to female pipe thread. There are two adapters: one is 3/4" female and the other is 1/2" female that can be screwed on to the coupler. When attached, the adapters can then be screwed on to an appropriate male threaded connection.

Ultraprobe Applications

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.

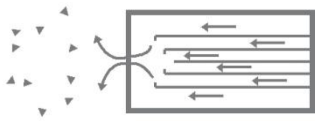


Figure 1: Pressure Leak

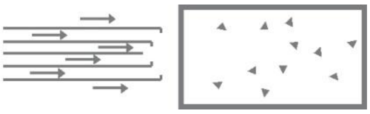


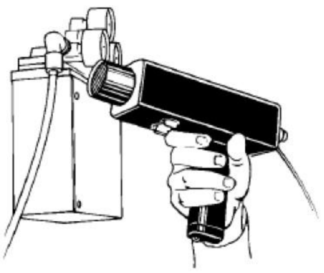
Figure 2: Vacuum Leak

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 (Fig.2).

What type of gas leak will be detected ultrasonically? Generally any gas, including air, will produce a 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. because of its versatility, the Ultraprobe may be utilized in a wide variety of leak detection. Pneumatic systems may be checked, pressurized cables, such as those utilized by telephone companies, may be tested. Air brake systems on railroad cars, trucks, and buses may be checked. Tanks, pipes, housings, casings and tubes are easily tested for leakage by pressurizing them. Vacuum systems, turbine exhausts, vacuum chambers, material handling systems, condensers, oxygen systems can all easily be tested for leakage by listening for the turbulence of the leak.

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.



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.

Overcoming Difficulties

- Competing Ultrasounds If competing ultrasounds make it difficult to isolate a leak, there are two approaches to be taken: Manipulate the environment. This procedure is fairly straightforward. Men possible, turn off the equipment that is producing the competing ultrasound or isolate the area by Closing a door or window.
- 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.

Shielding Techniques

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

1. Body: place your body between the test area and the competing sounds to act as a barrier
2. 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
3. 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.
4. 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.
5. Barrier: When covering a large area, it is sometimes helpful to use some reflective material, such as a welders 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.
6. 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.

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. Utilize LIQUID LEAK AMPLIFIER. This patented method incorporates a UE Systems product called LIQUID LEAK AMPLIFIER, or LLA for short. LLA is a uniquely formulated liquid substance that has special chemical properties. Used as an ultra sonic "bubble test, a small amount of LLA is poured over a suspected leak site. It produces a thin film through which the escaping gas will pass. When it comes in contact with a low flow of gas, it quickly forms a large number of small "soda-like" bubbles that burst as soon as they form. This bursting effect produces an ultrasonic shock wave that is heard as a crackling sound in the headphones. In many instances the bubbles will not be seen, but they will be heard. This method is capable of obtaining successful leak checks in systems with leaks as low as 1 xl0-6 ml/ sec.

   NOTE: The low surface tension of the LLA is the reason small bubbles form. This can be negatively changed by contamination of the leak site with another leak fluid, which can block LLA or cause large bubbles to form. If contaminated, clean the leak site with water, solvent or alcohol (checks with plant regulations before selecting a decontaminating cleaning agent).

3. 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.

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. Ultrasonic testing is often used at voltages exceeding 2,000 volts, especially in enclosed switchgear. 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 without taking the switchgear off line to perform an infrared scan. However, it is recommended that both tests be used with enclosed 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. In some instances, as in trying to locate the source of radio/TV interference or in substations, the general area of disturbance may be located with a gross detector such as a transistor radio or a wide-band interference locator. Once the general area has been located, the scanning module of the Ultraprobe is utilized with a general scan of the area. The sensitivity is reduced if the signal is too strong to follow. When this occurs, reduce the sensitivity to get a mid-line reading on the meter and continue following the sound until the loudest point is located. Determining whether a problem exists or not is relatively simple. By comparing 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.

CHECK TRANSFORMERS, SWITCHGEARAND OTHER ELECTRICAL APPARATUS

Monitoring Bearing Wear

Ultrasonic inspection and monitoring of bearings is by far the most reliable method for detecting incipient bearing failure. The ultrasonic warning appears 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.

In ball bearings, as the metal in the raceway, roller or ball bearing begins to fatigue, a subtle deformation begins to occur. This deforming of the metal will produce an increase in the emission of ultrasonic sound waves. Changes in amplitude of from 12 to 50 times the original reading is indication of incipient bearing failure. When a reading exceeds any previous reading by 12 dB, it can be assumed that the bearing has entered the beginning of the failure mode.

This information was originally discovered through experimentation performed by NASA on ball bearings. In tests performed while monitoring bearings at frequencies ranging from 24 through 50 kHz, they found that the changes in amplitude indicate incipient (the onset of) bearing failure before any other indicators including heat and vibration changes. An ultrasonic system based on detection and analysis of modulations of bearing resonance frequencies can provide subtle detection capability; whereas conventional methods are incapable of detecting very slight faults. As a ball passes over a pit or fault in the race surface, it produces an impact. A structural resonance of one of the bearing components vibrates or "rings" by this repetitive impact. The sound produced is observed as an increase in amplitude in the monitored ultrasonic frequencies of the bearing. Brinelling of bearing surfaces will produce a similar increase in amplitude due to the flattening process as the balls get out of round.

These flat spots also produce a repetitive ringing that is detected as an increase in amplitude of monitored frequencies.

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.

Detecting Bearing Failure

There are two basic procedures of testing for bearing problems:
COMPARATIVE AND HISTORICAL. The comparative method involves testing two or more similar bearings and "comparing" potential differences. Historical testing requires monitoring a specific bearing over a period of time to establish its history. By analyzing bearing history, wear patterns at particular ultrasonic frequencies become obvious which allows for early detection and correction of bearing problems.

For Comparative Test

1. Use contact (stethoscope) module.
2. Select a "test spot" on the bearing housing and mark it for future reference by marking it with a center punch or with dye or by epoxy bonding a washer to the spot. Touch that spot with the contact module. In ultrasonic sensing, the more mediums or materials ultrasound has to travel through, the less accurate the reading will be. Therefore, be sure the contact probe is actually touching the bearing housing. If this is difficult, touch a grease fitting or touch as close to the bearing as possible.
3. Approach the bearings at the same angle, touching the same area on the bearing housing.
4. Reduce sensitivity) until the meter reads 20 (if unsure of this procedure, refer to SENSITIVITY SELECTION DIAL (See page 6
5. Listen to bearing sound through headphones to hear the "quality" of the signal for proper interpretation. (Refer to page 17 for discussion of audio interpretation.)
6. Select same type bearings under similar load conditions and same rotational speed.
7. Compare differences of meter reading and sound quality.

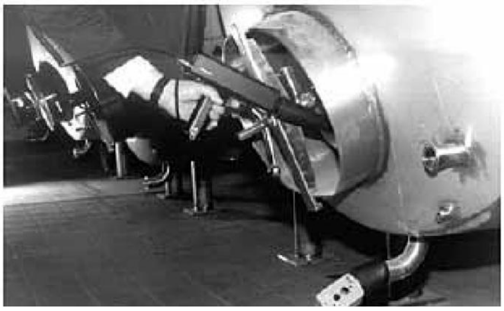
Procedure for Bearing History (Historical)

There are two methods to historically "trend" a bearing. The first is a very common, field proven method called the "SIMPLE" method. The other provides greater flexibility in terms of decibel selection and trending analysis. It is referred to as the "ATTENUATOR TRANSFER CURVE method. Before starting with either of the two HISTORICAL methods for monitoring bearings, the COMPARATIVE method must be used to determine a baseline.

Simple Method

1. Use basic procedure as outlined above in steps 1-7.
2. Note frequency, meter reading, and sensitivity selection on your Reference Chart 1 (page 25).
3. Compare this reading with previous (or future readings). On all future readings, adjust level to the original level recorded in the Reference Chart.

   a. If the meter reading has moved from the original 20 mark up to or past 100, there has been a 12 dB increase (increments of 20 on the meter in the linear mode is about 3 decibels. e.g.: 20-40=3 dB, 40-60=3db, etc.). NOTE: Increase of 12 dB or greater indicates the bearing has entered the incipient failure mode.
   b. Lack of lubrication is usually indicated by an 8 dB increase over baseline. It is usually heard as a loud rushing sound. If lack of lubrication is suspected, after lubricating, re-test. If readings do not go back to original levels and remain high, consider bearing is on the way to the failure mode and recheck frequently.



Attenuator Transfer Curve

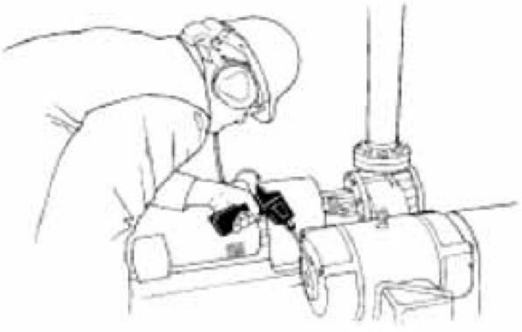
(SAMPLE DO NOT USE WITH YOUR INSTRUMENT)

In order to use this method, refer to the ATTENUATOR TRANSFER CURVE which is supplied for each instrument There are two curves. Use the curve marked STETHOSCOPE MODULE.
On the curve, the vertical axis numbers indicate various SENSITIVITY levels, while the horizontal axis displays DECIBELS. By following where the curve lines intersect on the chart it is possible to obtain decibel changes from one reading to the next.

1. Use the basic procedure as described in the Comparative test (steps 1-7.)
2. Note, meter reading, and sensitivity selection on your Reference Chart. NOTE: in this method, the meter reading is going to be your most consistent reading. For this reason, select a meter reading that provides the majority of users comfort and ease when listening to the sound quality through the headphones)
3. On subsequent readings, adjust the sensitivity dial until the meter reads exactly as noted in the baseline reading.
4. Note the new sensitivity reading on the chart.
5. Refer to the Attenuator Transfer Curve and locate the decibel level for the current reading.
6. Note the decibel level for the baseline reading.
7. Subtract the original decibel reading from the current reading and you will have the decibel change from the baseline reading to the present reading.
8. If this level exceeds 8 dB, it may indicate a lack of lubrication, if the reading exceeds 12 dB, it may indicate the onset of the failure mode.

When using the ATTENUATOR TRANSFER CURVE method, there are three warning levels that have been established. They vary somewhat from the SIMPLE method, but provide more information.
The three levels are:

a. 8 dB : Pre-Failure, Lack of Lubrication
b. 16 dB : Failure Stage
c. 35-50 dB: Catastrophic Failure



a. **Pre-Failure:** This is the earliest stage of failure. The bearing may have developed hairline cracks or microscopic spalls that are not visible to the human eye. This also signals a need to lubricate.
b. **Failure Stage:** At this stage, visible flaws develop along with a marked rise in acoustic energy and the temperature of the bearing begins to rise. It is at this stage that the bearing should be replaced or more frequent monitoring should occur.
c. **Catastrophic Stage:** here, rapid failure is imminent. The sound level is so intense as to be audible and the temperature of the bearing has risen enough to overheat the bearing. This is a highly dangerous stage since the bearing clearances increase and can cause additional friction/rubbing within a machine causing potential damage to other components.

It is important to consider two elements of potential failure. One is lack of lubrication while the other is over lubrication.
Normal bearing loads causes an elastic deformation of the elements in the contact area which give a smooth elliptical stress distribution. But bearing surfaces are not perfectly smooth. For this reason, the actual stress distribution in the contact area will be affected by a random surface roughness. In the presence of a lubricant film on a bearing surface, there is a dampening effect on the stress distribution and the acoustic energy produced will be low. Should lubrication be reduced to a point where the stress distribution is no longer present, the normal rough spots will make contact with the race surfaces and increase the acoustic energy. These normal microscopic disuniformities will begin to produce wear and the possibilities of small fissures may develop which contributes to the "Pre-Failure" condition. Therefore, aside from normal wear, the fatigue or service life of a bearing is strongly influenced by the relative film thickness provided by an appropriate lubricant.

Lack of Lubrication

To avoid lack of lubrication, note the following:

1. As the lubricant film reduces, the sound level will increase. A rise of about 8 dB over baseline 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, 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.

On most other slow speed bearings, it is possible to set a base line and monitor as described. It is suggested that the Attenuator Transfer Curve method be used since the sensitivity will usually have to be higher than normal.

FFT INTERFACE

The Ultraprobe may be interfaced with FFT's via the UE-MP-BNC-2 Miniphone to BNC connector or the UE DC2 FFT Adapter. The Miniphone plug is inserted into the headphone jack of the Ultraprobe and the BNC connector is attached to the analog-in connector of the FFT. Using the heterodyned - converted low frequency signal, the FFT will be able to receive the ultrasonic information detected from the Ultraprobe. In this instance it can be used to monitor and trend low speed bearings. It can also extend the use of the FFT to record all types of mechanical information such as leaking valves, cavitation, gear wear, etc.

Proper Lubrication
Reduces Friction

Lack of Lubrication Increases
amplitude levels

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. Touch test area(s): listen through headphones and observe the meter.
3. Adjust sensitivity until mechanical operation of the equipment is heard clearly and the meter can fluctuate
4. Probe equipment by touching various suspect areas.
5. 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, chart recordings and even tape recordings (for chart recording it will be necessary to have your Ultraprobe converted at the factory).

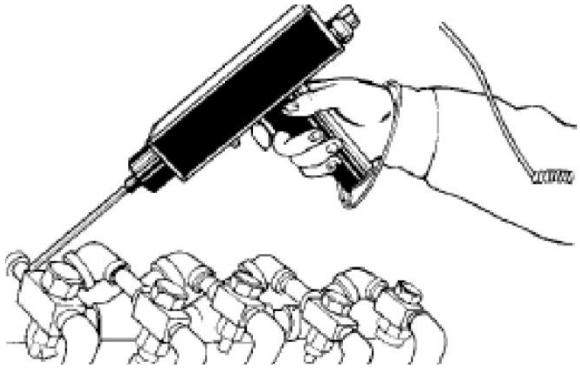
Procedure:

1. Select key locations to be monitored and make permanent reference marks for future testing by either marking with a center-punch or with paint or epoxy bond a washer to note the spot.
2. Follow steps 1-5 as outlined above in the Trouble Shooting section.
3. On a chart note:

    a. Equipment
    b. Location
    c. Date
    d. Meter Mode (LIN / LOG)
    e. Frequency
    f. Sensitivity level
    g. Meter reading

NOTE: In diagnosing any type of mechanical equipment, it is important to understand how that equipment operates. Being able to interpret sonic changes is dependent on a basic understanding of the operations of the particular equipment being tested. As an example, in some reciprocal compressors, the diagnosis of a valve problem in the inlet manifold is dependent on recognizing the distinctive clicking sound of a good valve vs. the muffled click of a valve in a "blow-by" mode.

In gearboxes, before missing gear teeth may be detected as an abnormal click, the normal sounds of gears must be understood. In pumps, certain pumps will have surges which may confuse inexperienced operators by the constant shifting of the meter readings. The surge pattern must be observed before a lower, consistent meter reading can be recognized as the true meter reading.



Locating 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. Try to touch the contact probe towards the discharge side of the trap. Press the trigger and listen.
5. 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 (UP2000 only)

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.

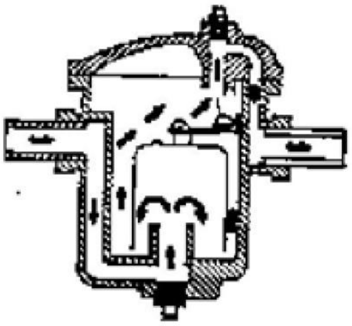
General Steam/Condensate/Flash Steam Confirmation

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 15-30 cm (6 - 12 inches) 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

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

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)

Thermodynamic 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.

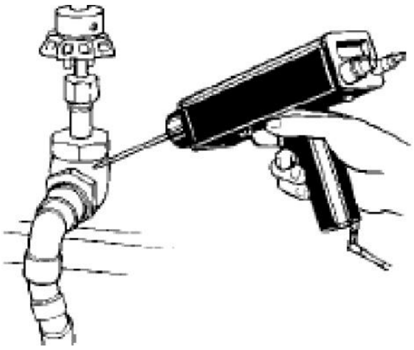
Thermostatic Traps

(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.

Locating Faulty 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 26).

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.

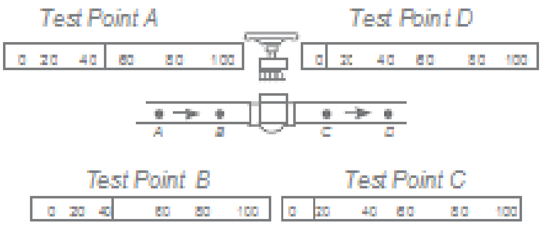
To do this:

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 downstream 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.



Example of a 'good' valve

Miscellaneous Problem Areas

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. Touch surface over ground, DO NOT JAM probe to ground. Jamming can cause probe damage,

   a. 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.
   b. Touch the contact probe to the metal rod and listen for the leak sound.
   c. This should be repeated approximately every meter until the leak sound is heard.
   d. 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.

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 26, section "A", "Procedure".
4. Listen for leak sounds. The louder the signal the closer you are to the leak site.

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 downstream). 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.

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 DOWNSTREAM 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)

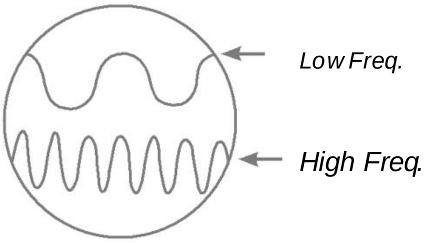


Figure A

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.

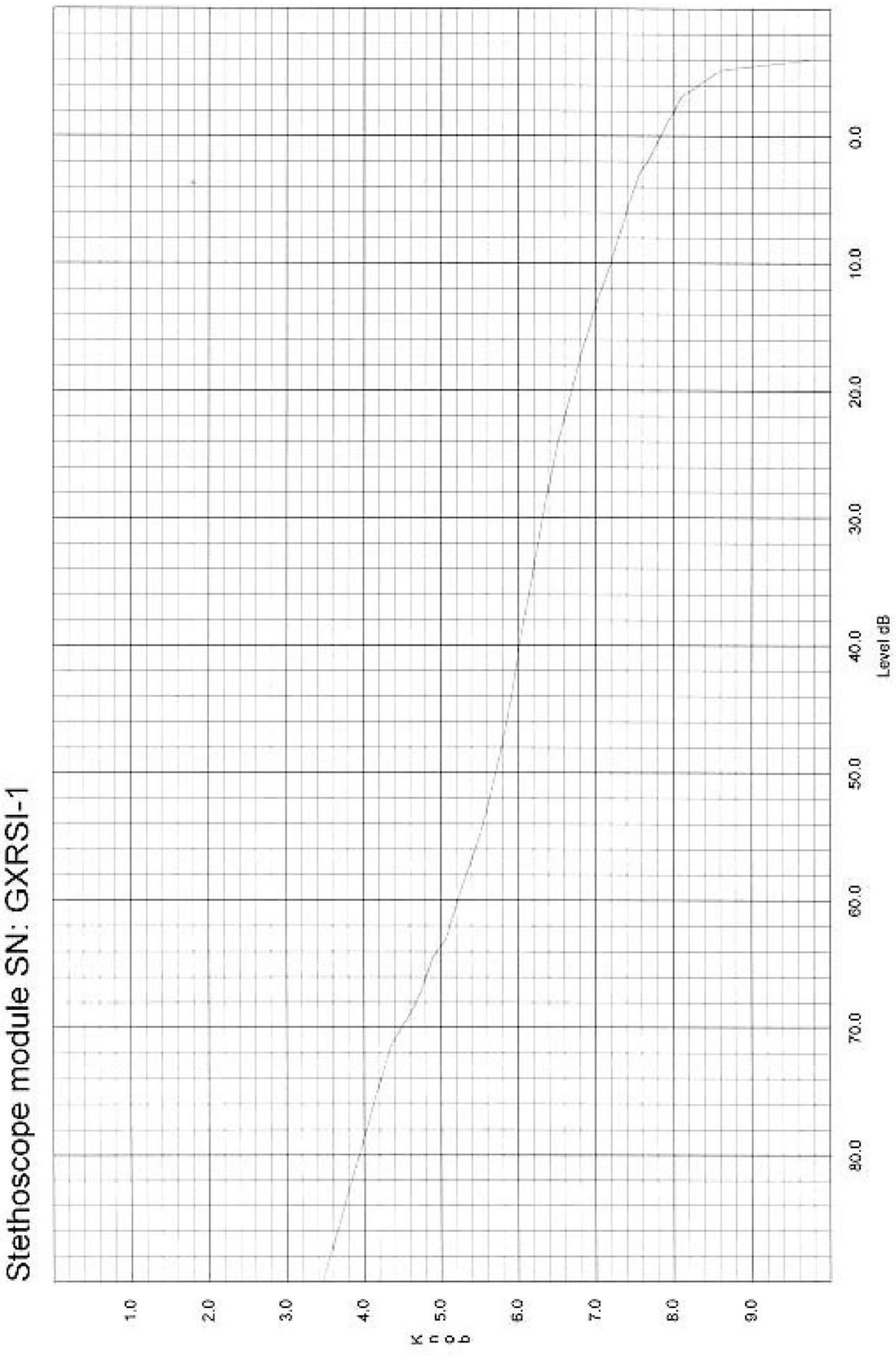
The reason for the loudness is that the Ultraprobe converts the ultrasonic signal into an audible range and then amplifies it. Due to the comparative low amplitude nature of ultrasound, amplification is a very important feature. Although there are obvious audible sounds emitted by most operating equipment, 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.

ATTENUATOR TRANSFER CURVE

SAMPLE ONLY DO NOT USE WITH YOUR INSTRUMENT



Type of Test:	Mechanical: (describe)______________________ Electrial: (describe)________________________ Leak: (describe)____________________________
Diagram of Equipment (if needed)	

Equipment Name:
____
____

Location:
____
____
____

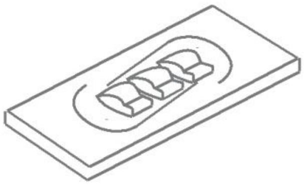
Test Point I.D. (E.G.; Bearing Number, Insulator Tag, Trap Tag, Etc.)								
Date	Module Used (contact Scanning)	Accessory Used	Frequency Setting	Sensitivity Setting	Meter (L in Mode)	Baseline dB Gain	Action To Take	Action Taken By: Work

	Fixed Band	20 kHz	25 kHz	30 kHz	40 kHz	50 kHz	60 kHz	80 kHz	100 kHz	Suggested* Meter mode *	Module Selection
Steam Traps	X		X		X					LOG	Stethoscope
Valves		X			X					LOG	Stethoscope
Compressor (valves)	X		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

Instructions for setting combination on carrying case

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 so that it hooks behind the change notch (picture 1).
2. Now set your personal combination by turning the dials to the desired combination (i.e. birthday, phone no. etc.)
3. Move the change lever back to the normal position (picture 2).
4. To lock, rotate one or more dials. To open the lock, set your personal combination. International patents pending.



1.
2.

UP2000 Specifications

Construction	Hand-held metered pistol type made with aluminum and ABS plastic
Circuitry	Solid State heterodyne receiver with temperature compentsation
Frequency Response	Ultraschallfrequenzen zwischen 20kHz und 100 kHz, stufenlos einstellbar Frequenzen werden auf 50 kHz bis 3 kHz Audio moduliert Frequency Detect ultrasonic frequencies between 20kHz and 100 kHz, continuously variable Frequencies are converted to 50 kHz to 3 kHz audio
Probes	**Scanning Module** patented Trisonic 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 RF shielding; 11.4cm long stainless steel probe tip, conically shaped for uniform surface contact. Stethoscope Extension Kit: 3-piece, segmented metal rods to increase stethoscope contact range for 50.8 cm and 76.2 cm.
Transmitter	Patented warble tone transmission
Headset	Noise isolating type: Double headset wired monophonic Impedance 16 ohms. Over 23 dB of noise attenuation. Meets or exceeds ANSI specifications and OSHA standards. For hard hat use.
Indicators	Ballistic ouput meter; linear calibration scale of 0-100 for logging relative measurements. Meter is accurate 1% throughout entire scale. Low level Battery LED indicator for main housing internal power supply.
Battery	Self containd NIMH rechargeable. RECHARGING SYSTEM: Standard 110V. Also available in 220V.
Features	**Frequency Tuning Adjustment Dial:** 20-100kHz with (fixed band) position for ultra-narrow frequency response. **Bi-Modal Meter Switch** for logarithmic and linear meter scale adjustments. **Optional Auxillary Mode** selection for chart recorder output: 0-50mV. **Sensitivity Control** Precision 10-turn adjustment dial with numerically calibrated sensitivity increments for finite gain adjustment **Spring loaded trigger switch**
Overall Size	Complete kit in Zero Halliburton aluminum carrying case: 47x37x17 cm Pistol unit: 0.9kg Complete carrying case: 6.4kg
Sensitivity	Detects 0.1 mm diameter leak @ 0.3 bar at a distance of 15 m.
Threshold*	1 x 10^{-2} std. cc/sec bis 1 x 10^{-3} std. cc/sec
Waranty	1-Year parts/labor standard, 5 years with completed warranty registration card.
Display Modes	Logarithmic and Linear

*depends on leak configuration

** specify Ex rating if needed at time or order

Need further support?
Want information regarding products or training?
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