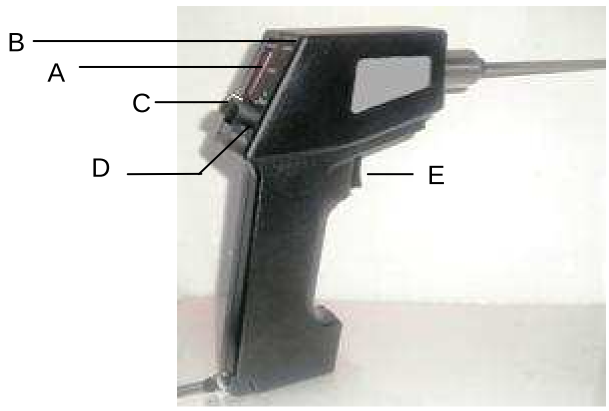
INSTRUCTION MANUAL
ULTRASONIC TRAP TESTER
UTT – 100

The UTT- Ultrasonic Trap Tester is a battery powered instrument that gives visible and audible indication of ultrasonic frequencies. It provides easy, accurate leak detection and mechanical inspection through advanced ultrasonic technology.
Before you begin testing, it is advisable to familiarize yourself with the basic components of your kit.

The UTT-100 consists of 4 main components:

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



A. Bar graph Display: The display consists of a ten segment LED bar graph that will indicate ultrasonic signal strength. A low number of LEDs indicate a low level of ultrasound, conversely more intense ultrasonic signals will display more LEDs.

B. Battery Level Light: This red light turns on only when the batteries need to be replaced.
NOTE: When the trigger On/Off switch is pulled to the On position the Battery Level Light will flicker On and then stay Off. This is normal and has no relation to battery condition.

C. Sensitivity Selection Dial: There are eight (8) sensitivity levels which read out in related decibels of "0" to "70". As the dial is turned to the right instrument's sensitivity *increases*. As the dial is turned to the left, sensitivity *decreases*. A low level ultrasound emission produces low amplitude. For this reason, the instrument should be in a high sensitivity position. **0** is the **high sensitivity** position. 0 is a dB indication of threshold detection for the instrument. For higher amplitude signals, move the sensitivity to the left towards "70".
The dial dB indications, along with the LED indications in the bar graph may be used to establish dB levels. To do this, just add 3 dB for each LED bargraph indication to the dB level set in the sensitivity dial. EX: 0 dB on the sensitivity dial, plus 3 LED bargraph levels = 9dB (0+9). 40 dB on the sensitivity dial plus 4 bar graphs = 52 dB (40+12).

D. Head Set Jack: This is where you plug in the headset. Be sure to plug it in firmly until it clicks.
In case you need to use a tape recorder, this is where its cord is inserted. (Use a miniphone plug).

E. Trigger Switch: This is located on the underside of the UTT100. The Ultrasonic Trap Tester is always "off" until the trigger switch is pressed. To operate, simply press the trigger; to turn the instrument off, release the trigger.

2. CONTACT (STETHOSCOPE) MODULE

This is the module with the metal rod. This rod is utilized as a "wave-guide" that is sensitive to ultrasound 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.
To use the Stethoscope Module:
1. Align the pin located at the rear of the module with the jack in the front end of the Metered Pistol Housing and plug in firmly.
2. Touch test area.
3. This gauge ultrasound detection method goes from "gross to the fine". Start with a maximum sensitivity on the Sensitivity Selection Dial and proceed to reduce the sensitivity until a satisfactory sound and meter level is achieved.

Contact Module

3. 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 UTT. 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 model **UE-DHC-2HH Hard Hat Headphones** which are specifically designed for hard hat use.

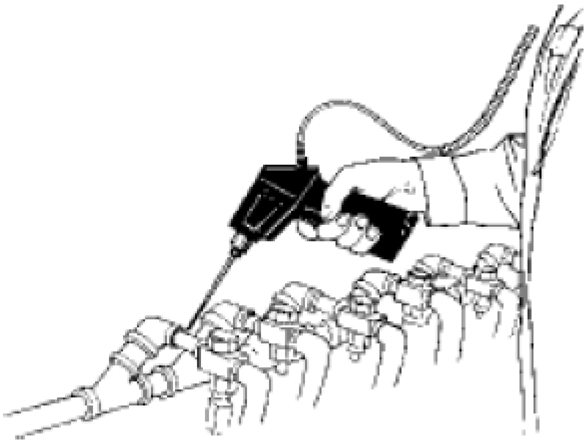
A. For those situations in which it is not possible or it is difficult to wear the standard headphones described above, two options are available:

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 UTT headphone output jack.

SPECIFICATIONS

Construction	Hand held ABS pistol type ultrasonic processor stainless steel, sensor enclosures
Circuitry	SMD/Solid state hybrid heterodyne receiver
Frequency response	20-100 kHz (centered at 28-42 kHz)
Indicator	10 segment LED Bar Graph (red)
Sensitivity selection	8 position precision attenuation
Power	9 volt alkaline battery
Low battery voltage indicator	LED
Headset	Noise isolating type:double headset wired monophonic. Impedance: 16ohms. Over 23 dB noise attenuation. Meets or exceeds ANSI specifications and OSHA standards.
Transmitter	Patented warble tone transmission
Response time	300 m/sec
Ambient operating temperature range	0º - 50ºC
Relative humidity	10 - 95% non-condensing at up to 30ºC
Storage temperature	-18º to 54º C
Dimensions	140 x 25 x 200
Weight	1 kg
Stethoscope (contact) module	Stainless steel plug-in type with 140 mm stainless steel waveguide
Carrying case	Nylon Cordura soft carrying case with die cut foam
Warranty	One year, parts/labour, excluding abuse (details available on request)



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: thermodynamic, mechanical and thermostatic (see Adca training Part 3).

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.

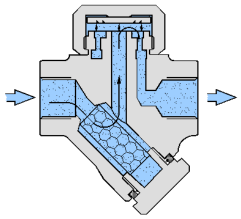
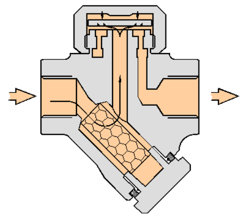
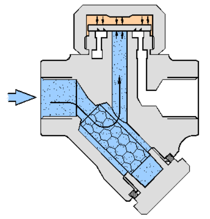
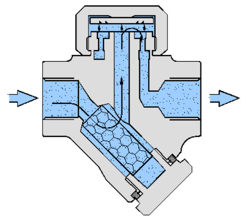
5. Listen for the intermittent or continuous flow operation of the trap. **Intermittent traps** are usually the inverted bucket, thermodynamic (disc) and thermostatic capsule (or bellow under light loads). **Continuous flow** include the float, float and thermostatic and (usually) thermostatic traps -balanced pressure and bimetallic. 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 8; if a high pressure system (above 7 bar) is to be checked, reduce the sensitivity level. (Some experimentation may be necessary to achieve at the most desirable level to be tested.) Check upstream and reduce the sensitivity so that the meter reads about 50% or lower, then touch the trap body downstream and compare readings.

GENERAL STEAM/CONDENSATE/FLASH STEAM CONFIRMATION

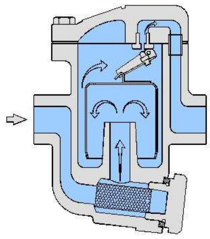
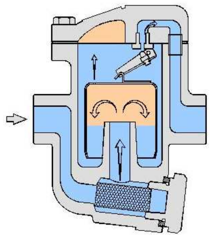
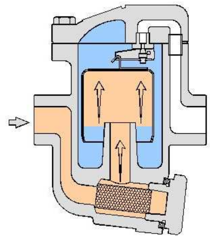
In situations where it may be difficult to determine the sound of steam, flash steam or condensate,
1. touch at the immediate downstream side of the trap and reduce the sensitivity to get a mid-line reading on the meter (about 50%).

2. move 15 - 30 cm *downstream* and listen. Flashing steam will show a large drop off in intensity while leaking steam will show little drop off in intensity.

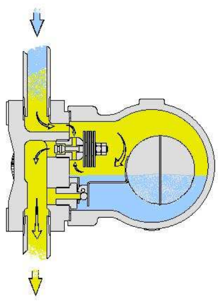
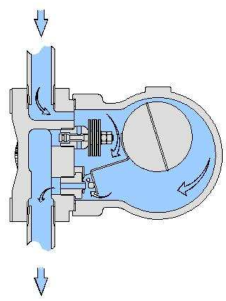
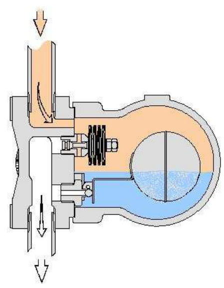
THERMODYNAMIC DISC (DT) traps work on the difference in dynamic response to velocity change in the flow of compressible and incompressible fluids. As steam enters, static pressure above the disc forces it against the valve seat. The static pressure over a large area overcomes the high inlet pressure 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 does in the open position, allowing continuous steam blow through.

INVERTED BUCKET (IB)traps usually 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.

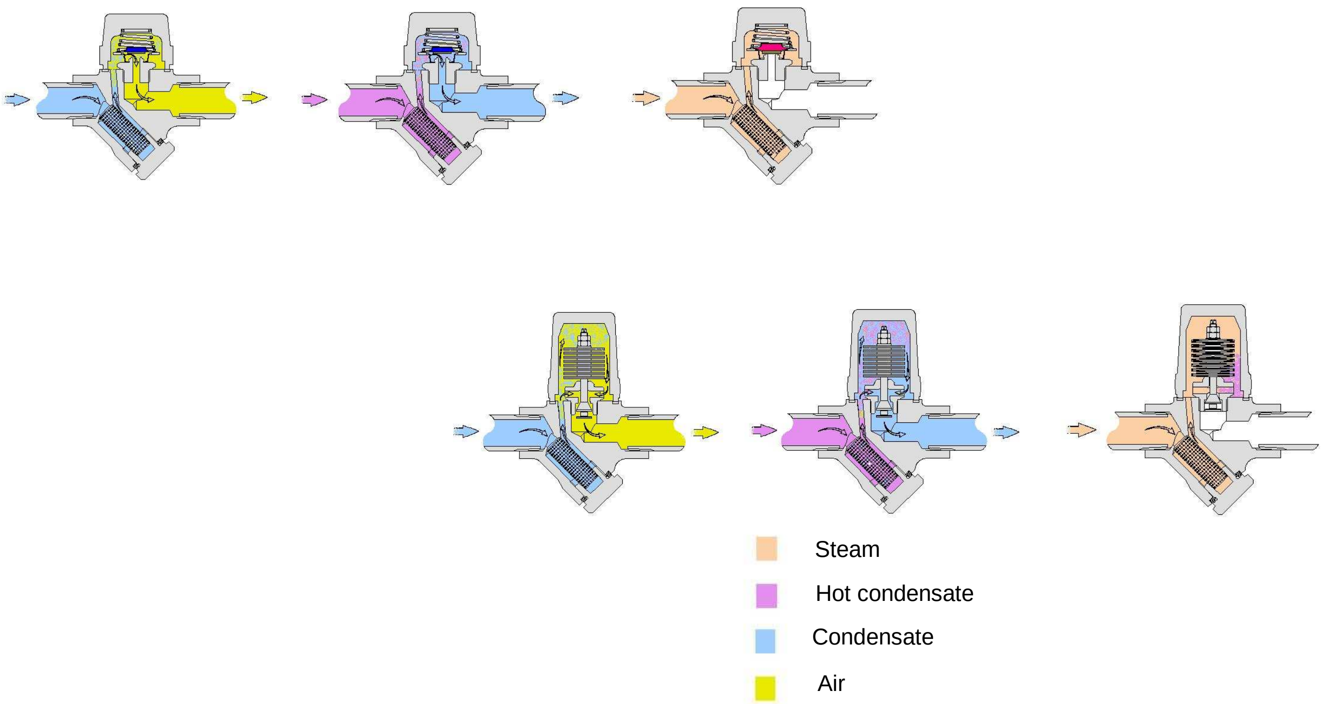
FLOAT AND THERMOSTATIC (FLT) traps normally fail in the "closed" position. A pinhole leak produced in the ball float will cause the float to be weighted down or water hammer will collapse the ball float. Since the trap is totally closed - no sound will be heard. In addition, check the thermostatic element 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 that 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.

THERMOSTATIC TRAPS BALANCED PRESSURE (TH) and BIMETALLIC (BM) operate on a difference in temperature between condensate and steam. They build up condensate so that its temperature 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, if 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 pass through. This will be heard as a constant rushing sound.

Detailed illustrated description in Adca Training Part 3.



To identify steam traps it will be kept when possible the same nomenclature used by the client.
It's recommended maintaining the identification by using a tag number (stainless steel tags and hangers available in Valsteam Adca – Fig. 1) without changing current numbers, so we can have accurate data the next time we check that steam traps.

Fig. 1 – Stainless steel tag and hanger

LOCATING FAULTY VALVES

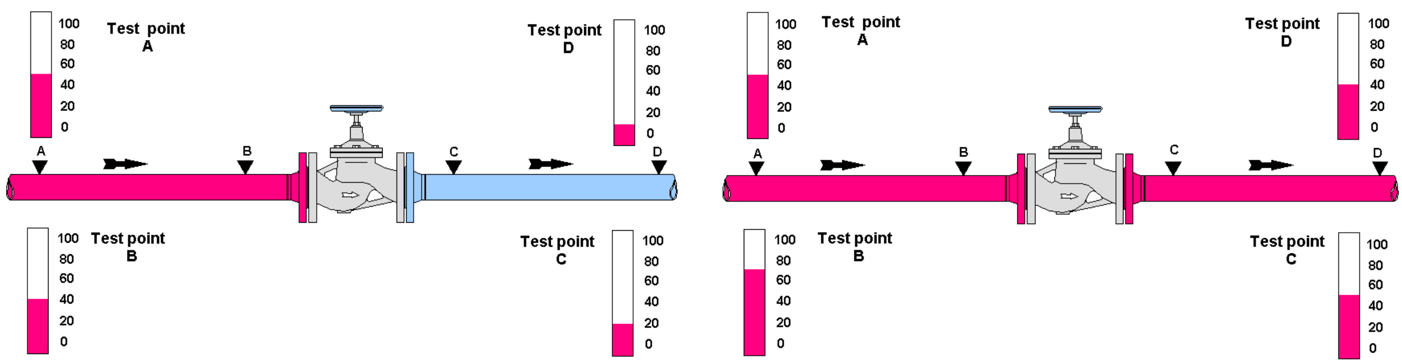
Using the contact (stethoscope) module in the UTT, valves can easily be monitored to determine if a valve is operating properly. As a liquid or gas flows through a pipe, there is little or no turbulence generated except at bends or obstacles. In the case of a leaking valve, the escaping liquid or gas 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: reduce the sensitivity, touch a steam line and listen to the sound quality, then touch a water line. Once you have become familiar with the sound differences, continue your inspection.
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 Fig.2.

PROCEDURE FOR VALVE CHECK:

1. Use stethoscope module.
2. Touch downstream side of valve and listen through headset.
3. When necessary, if there is too much sound, reduce sensitivity.
4. 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.

CONFIRMING VALVE LEAKAGE IN NOISY PIPE SYSTEMS (Fig.2)

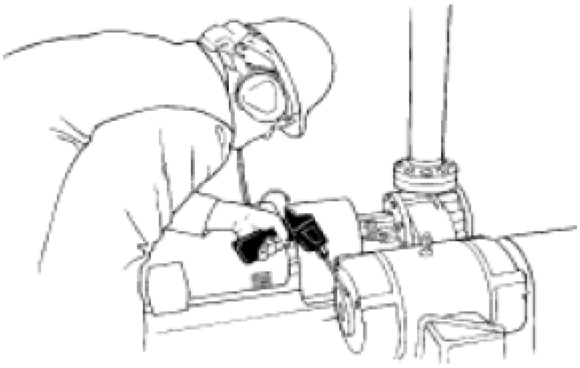
Occasionally in high pressure systems, stray signals occur from valves that are close by or from pipes (or conduits) feeding into a common pipe that is near the down stream side of a valve. This flow may produce false leak signals.
In order to determine if the loud signal on the downstream side is coming 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 15 - 30 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 "good valve" **Example of leaking valve**

Fig. 2

DETECTING 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 metal's deforming will produce an increase in the emission of ultrasonic sound waves.
Changes in amplitude 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 UTT 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 indicates 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

COMPARATIVE TESTING - The comparative method involves testing two or more similar bearings and "comparing" potential differences.

FOR COMPARATIVE TEST
1. Use contact (stethoscope) module.
2. Select a "test spot" on the bearing housing. 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 (if unsure of this procedure, refer to SENSITIVITY SELECTION DIAL)
5. Listen to bearing sound through headphones to hear the "quality" of the signal for proper interpretation.
6. Select same type of bearings under similar load conditions and same rotational speed.
7. Compare differences of meter reading and sound quality.

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. In case lubrication is 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 non-uniformities 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.

SLOW SPEED BEARINGS

Monitoring slow speed bearings is possible with the UTT100. 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 (25 – 50 mm 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.

GENERAL MECHANICAL TROUBLE SHOOTING

As operating equipment begins to fail due to component wear breakage or misalignment, sonic and more important, ultrasonic shifts occur. The accompanying sound pattern changes can save time and guess work in diagnosing problems if they are correctly 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 UTT 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 clearly heard.
4. Probe equipment by touching various suspect areas.
5. To focus on problematic sounds, while probing, reduce sensitivity gradually to assist in locating the problematic sound at its loudest point.

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)

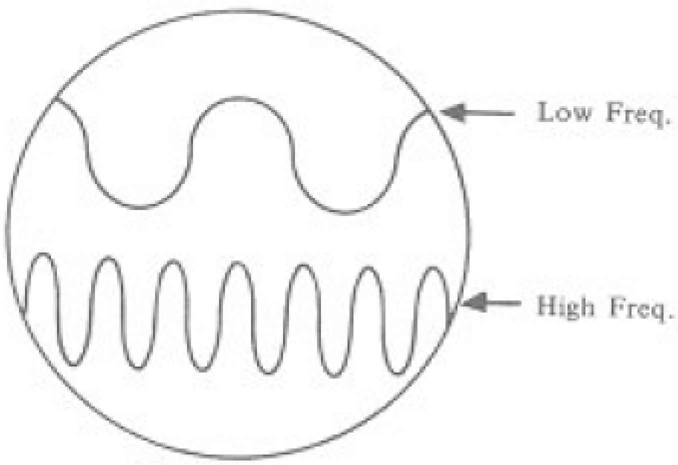


FIGURE A

The ultrasound technology utilized by the UTT 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 hear very faintly the audible tones of this friction, with the UTT it will sound extremely loud.
The reason for this loudness is that the UTT 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, it offers a fast, accurate method of locating minute as well as gross leaks. Since it 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.

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 have 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, be cautious. Use protective clothing and do not attempt to touch any piping or equipment while it is hot.
Advice with your safety director before entering the area.