Techniques for using the AED-2000L Insect Pest Detection Kit

Introduction

The AED-2000L instrument combined with the SP-1L probe set and accessories has been designed to handle a number of insect pest detection applications.
These include:

- **Termites in wood, trees, and soil**
- **Weevils, beetles, and other larval root feeders**
- **Carpenter ants**
- **Carpenter bees**
- **Red Palm Weevil (palm trees)**
- **Asian & Citrus Longhorned Beetles**
- **Stored grain products**

The sounds that these insects generate include feeding activity, movement, mating calls and warning signals, depending on the species and its habits. Examples of these sounds are included in applications stories on our website at ***www.aeconsulting.com***.

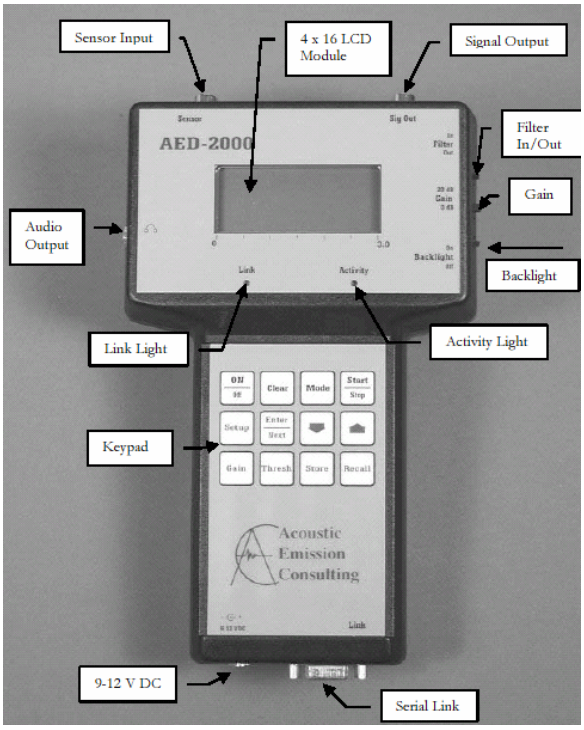
Our objective here is to describe some of the common techniques in using the instrumentation, and to give the user a quick guide to the most effective ways to achieve the goal of finding hidden insect pest infestations. The AED-2000L is a sophisticated tool, yet simple to operate and interpret when properly applied. It is based on ***passive acoustic (emission) detection***, which means that it acts like a microphone, listening in on insect activity.

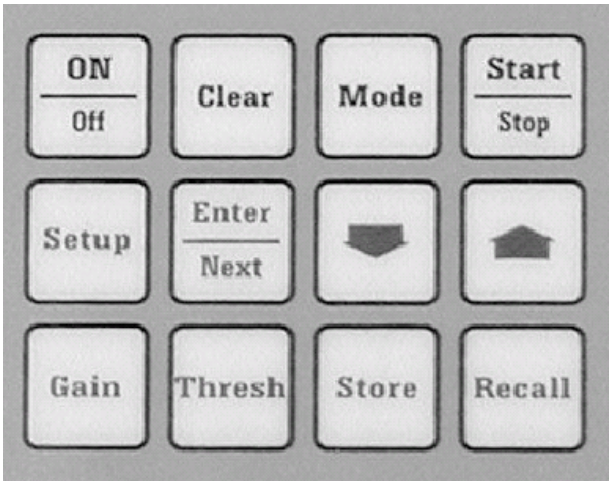
Instrument Settings

The AED-2000L instrument and controls are shown in the photo at the right, and an enlargement of the keypad is shown below. Upon turning the instrument on, the last setup utilized in testing will be automatically recalled. If the batteries have died or been left out of the instrument for awhile, the settings will revert to the default settings. The preferred settings for the most sensitive setup for insect pests using the SP-1L probe are as follows:

- **Gain 40 dB**
- **Threshold 0.5 Volts**

The gain is achieved by using the +20dB rough gain switch on the RH side of the instrument, plus 20 dB of internal gain. If you want to use a less sensitive setting because of background noise, increase the threshold in volts. The easiest way to do this is to go into the run mode, select the "Thresh" key from the keypad, and use the arrow keys to move the threshold up and down as desired. Another way to filter noise is to move the Filter switch on the RH side of the instrument to the "In" position. But this will eliminate all signal content below 25 kHz, and should only be used in extreme noise conditions.





It is a good idea if you are using a particular setup to store that to one of the four storage locations available in memory. Use the "Store" key from the keypad and follow the directions in the manual.

Selecting the "Mode" of operation depends on the the application. If you want to accumulate total hits and counts over a 10-second period, for example:

1. Select the "timed" mode from the "Setup" menu, choose 10 seconds for the countdown time.
2. Select the Hits (Cont) mode by cycling through the "Mode" key selection. When the "Start" key is pressed the unit will begin a 10-second countdown, and hits and counts will be accumulated until time is expired. The value is then available for manual recording or for storing to memory.
3. To store this data to one of 256 memory locations in the AED-2000, press "Store", select "Data", the select "Last Data" (use Enter/Next Key).

The other modes that can be selected are Hits (rate) and RMS. The rate mode outputs the hits and counts on a per second

basis to the LCD display. If you choose the "continuous" selection from the Setup sequence, the unit will acquire data continuously once the Start/Stop button is pressed. Pressing the Start/Stop button again stops the test.

SP-1L Probe

The SP-1L probe and threaded attachments are shown in the photo above:

- **Model DMH-30, 3/4" diam high force magnet**. This is used to attach the probe to threaded bolt heads and large nails, as shown in the photo at top right.
- **Model WG-B6, 6" x 1/4" stainless steel uncoated waveguide**. This is used to make contact with nail heads, for direct insertion in wood and soil. Example in photo at middle right.
- **Model WG-C6, 6" x 1/4" stainless steel rubber coated waveguide**. This is used to make contact directly with finished wood surfaces, with nail heads, and with wallboard. Example in photo at bottom right.

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The function of the attachments is to provide an efficient method of sound coupling from inside the material to the sensor in the probe. These are called "waveguides". A bolt or nail in wood will conduct sound from inside the wood to the surface, where it can be effectively coupled to the probe. In certain cases, such as finished wood products where the surface is hard and smooth, the rubber tipped waveguide can used directly in contact with the wood.

SP-1L probe with DMH-30 magnet used to couple to a 1/2 inch lag bolt screwed into a railroad tie.

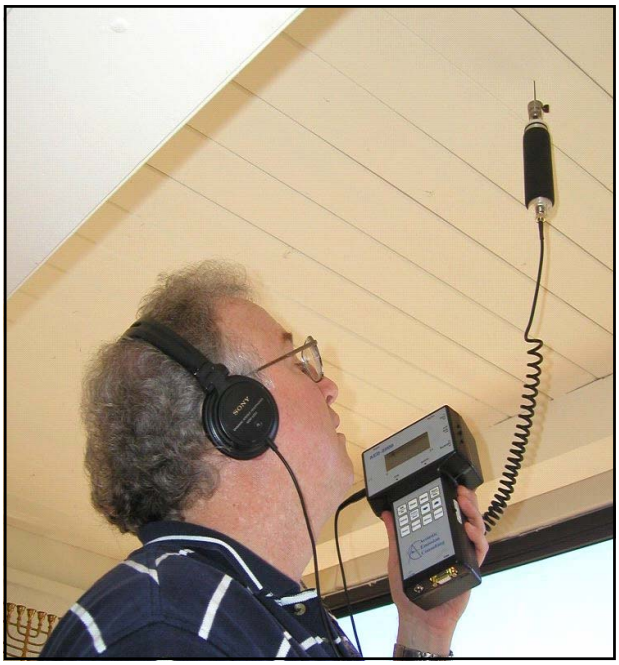
SP-1L probe with uncoated waveguide inserted into nursery pot to monitor black vine weevil larvae feeding on the root system of the plant.

Probing for drywood termite activity on a wood column with rubber- tipped SP-1L probe.

Hands-free coupling of the probe, either by magnetic attachment to a waveguide material, or direct insertion of the bare waveguide into the wood or soil, is going to generally provide a more quiet background for monitoring. But probing by hand with waveguide attachments has the advantage of rapid survey, even if the user has to be mindful of noise he might create himself by movement of the probe at the contact surface. The rubber tipped probe has the advantage of being a less abrasive and more compliant contact surface for use on finished wood, nail heads (natural waveguides) and even wallboard.

Please observe the following recommendations about using the threaded attachments:

- ***Keep the inside surfaces of the threaded areas free of debris and rust***. Particles will cause noise as they are compressed and moved at the interface. Periodically clean these areas with a cotton swap and some alcohol.
- ***Hand tighten the attachments only***. Do not tighten with tools. When using the attachments make sure that the top of the threaded stud on the SP-1L probe is securely bottomed out on the inside of the attachment. If attachments becomes loose during use it will decrease the sensitivity of the probe.
- ***Don't use the rubber tipped probe in soil or on highly abrasive surfaces.*** This probe is coated using a primer (gray) and a thin elastomeric coating (blue). It is subject to tearing if abused, and must eventually be removed and replaced. A common rubber dip coating (Plasti-Dip) can be used to apply a new rubber coat.



Listening to drywood termites in a porch tongue-and groove ceiling. A 1/16" drill bit inserted into the wood is attached with the drill bit adaptor and magnet to the SP-1L probe. This method is also used through drywall.

Using the Drill Bit Adapter

An additional accessory that comes with the SP-1L probe is the drill bit adapter. This is used to attach the SP-1L probe to a 1/16" diameter "jobbers drill bit". Examples of these drill bits have been provided with your kit in 3" and 6" lengths. The drill bits can be used to penetrate wallboard or other barrier materials to establish intimate contact with the underlying wood structure, or may simply be used to provide a hands-free connection to exposed wood structure as shown in the photo above.

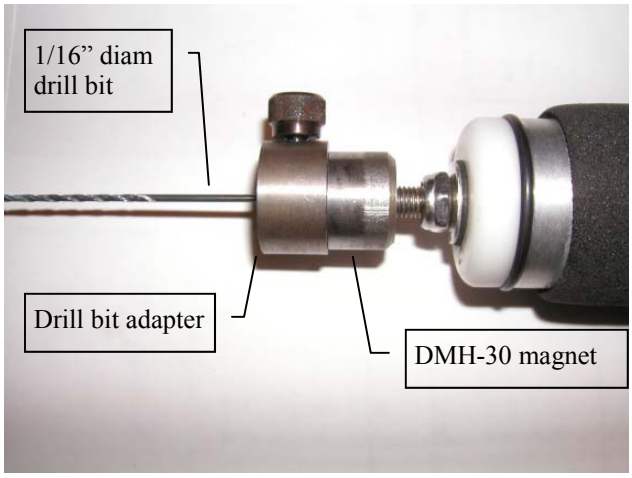
The procedure for using the adapter is simple. Start by threading on the DMH-30 magnet attachment to the SP-1L probe.

- Magnetically couple the adapter to the face of the magnet. Make sure the set screw on the adapter is backed off enough to allow the drill bit

to penetrate through the hole in the adapter to the face of the magnet.

- Using a portable drill, insert the drill bit into the wood material to the depth desired. Remove the drill and expose the free end of the drill bit.
- Insert the SP-1L probe with the adapter onto the free end of the drill bit, making sure to bottom out the end of the drill bit onto the face of the Magnet. Fasten down the set screw on the side of the adapter to secure the assembly.

If mounted horizontally, the weight of the probe will tend to bend the drill bit. It will not break or permanently deform the bit. After monitoring, undo the set screw and remove the SP-1L probe. To remove the adapter from the magnet face, slide it off. Remove the drill bit by reattaching it to the drill chuck and reversing the drill.



Sources of Noise

As with any highly sensitive inspection technique, there are potential sources of noise that can interfere with the objective of monitoring for insect pest signals. These include:

1. Noises induced by handling of the probe or frictional noises at the contact point.
2. Noises introduced from the ambient environment.
3. Electromagnetic signals such as radio frequency transmission in the local area of the inspection.

Handling Noises

The most obvious source of noise that the user will soon adapt to is the handling of the probe. A firm grip on the foam handle and minimizing hand movements will solve this. These are very recognizable through the audio circuit, and are unlikely to be mistaken for insect noises.

- If you are using the coated or uncoated contact probes, the physical nature of the surface being coupled to is also a factor. Remove dirt, debris, and rust from the surface of contact.
- It is not recommended to make surface contact with decayed wood or tree bark. These will give way under the probe pressure, and will continue to create extraneous emission. An inserted waveguide, such as a nail, lag bolt, or drill bit, is a better method for these types of surface conditions.
- Be careful to still the retractable cable between the probe and the instrument. You will notice noise if this is impacting structures, or if the headphone cable is bouncing against it.
- If the probe is inserted into soil, such as a nursery pot or next to tree roots, some time will be needed for the frictional noises of soil movement to cease. Sometimes it is better to use large steel nails or lag bolts and insert them 10-15 mins ahead of the monitoring period. The DMH-30 magnet can be used to couple to these waveguide materials.

Ambient Noises

The SP-1L probe has been designed to minimize pickup of airborne noise from the environment. But there are conditions that will tend to create problems, and these vary with indoor and outdoor locations, and the type of structure under inspection.

Typical outdoor sources of noise background include:

For monitoring trees and bushes—

- Wind rustling leaves, banging branches together.
- Blowing sand.
- Rain or hail.
- Nearby heavy traffic.
- Loud conversation.

For monitoring outdoor building structures—

- Blowing sand or rain impacting the structure.
- Water coursing through pipes in the walls.
- Air conditioning units, compressors and fans operating nearby.
- Nearby heavy traffic.

Typical indoor sources of noise background include:

- Loud conversation.
- Water coursing through pipes in the walls.
- Ultrasonic transmitters designed to eliminate pests (unplug them!).

Most of these sources of noise can be controlled while inspections are being performed, with the exception of the weather.

Electromagnetic Sources

Although these are likely to be rare, be aware that certain types of commercial alarm systems, nearby AM transmitters, and some electronic appliances can create electromagnetic noise that may be picked up through the probe. If you hear a low frequency hum that varies with intensity as the probe is moved around, this type of noise background may be present.

Detecting Insect Pests

As we have discussed, the use of the AED-2000L instrument and SP-1L probe may be used differently depending on the application. The sounds created by insects or larvae feeding on wood structures will be "pops and snaps" of different intensities. For **larvae** there will be an intelligent pattern to the feeding, with longer tearing and snapping sounds at intermittent intervals. These will generally be in the range of every 5-10 seconds, depending on how many larvae are feeding and how far the probe is from the source of the activity. For **termites** there may be several different kinds of sounds heard:

- ***Active feeding is characterized by random pops and snaps of different intensities***. Activity rates can vary from a few hits every few seconds, to over 100 per second in very active areas. There is no doubt when you are near an active feeding area.
- ***Soldier termites may engage in a warning action called "head banging", which is a periodic, staccato burst of sound***. It is very distinctive, and can be heard over long distances in wood. It is generally not audible if the filter is set to the "In" position on the AED-2000L, since this setting eliminates lower frequency sounds such as head banging. Predicting whether you will here this sound is not definite. It depends on the ratio of soldiers to workers in the area being monitored, and whether your actions cause them to take alarm. With subterranean termite species we have monitored here in California, we have heard head banging at some time in just about every situation—in trees, in soil with cellulose debris, and in homes. One of the unique aspects of this sound is that it can be monitored through wallboard by direct contact with the rubber-tipped probe. This is not true for the feeding activity, which requires direct contact with the wood, or with a waveguide penetrating the wood (nail, drill bit, etc.).

- ***Swarming activity may also be heard*** if many winged bodies are beating and impacting against the wood.

Termite Monitoring Strategies

The approach to monitoring will depend on the structure to be inspected, its mass, size, and location.

Trees are being actively monitored by the USDA Southern Regional Research Center (SRRC) in New Orleans, LA. Lag bolts (3/8" to 1/2" diam x 3-4" long) are inserted into each tree to be monitored, and are coupled with the DMH-30 magnet attachment. The lag bolts are left in place to provide a future monitoring location. The bolts are inserted near the bottom of the tree, since the Formosan termite infestations come from underground. In a study conducted in 2002, over 90% of trees that had been chemically treated for termite infestations were shown to still have acoustic activity. The treatments had not been very effective in eliminating the termite colonies.

Middleton Pest Control of Orlando, FL is making use of the AED-2000L for both drywood and subterranean termite inspection in homes and commercial structures. They use the rubber-tipped waveguide for external probing of finished wood structure, such as door and window frames. They also gave us the idea for developing the drill bit adapter. Middleton's approach to drywood termite treatment is to use a tool called the Resistograph (http://www.rjmcontracting.com/) to drill into wood, both exposed and behind drywall, to locate the termite galleries. They then locally treat the infestation with a foaming injection system. The AED-2000L is both an important time saver in terms of locating the termite infestation, but also is an important verification tool to track the elimination of the termite colony.

The distance over which detection may occur depends on the mass of the structure and the efficiency of sound coupling. The sound of termite feeding can be picked up from distances up to 3-4 ft away in a typical 2x4 stud. This distance will be reduced if the structure is more massive, such as a railroad tie in an outdoor garden, e.g. Sound travels preferentially along the principal fiber direction in wood, and is attenuated more quickly perpendicular to the wood grain. A waveguide such as a nail, a drill bit, or a lag bolt will give the best coupling efficiency between the wood and the SP-1L probe. Since termite feeding sounds have an appreciable dynamic range of 30 dB or more (a linear factor of over 30x in amplitude), the larger amplitude signals will survive a longer distance than the smaller amplitude signals. When probing from the surface, the number and intensity of signals will increase the closer to the primary feeding area. This strategy can be used to provide a starting point for localized treatment with approved termiticides.

Termite head banging has been monitored by dry contact on wallboard several feet away from where the activity is occurring. How far away this might eventually be found to be detectable has not yet been determined.

Other Applications

The AED-2000L can also be used for some other applications in home inspection:

- Finding water leaks from pipes and fixtures. Use the RMS mode on the instrument.
- Finding dry rot in wood. Even minor damage will produce emission when the waveguide probe is pressed against the surface.