GOLDAK

Model 777
Leak Detector

Operating Manual

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A. BASIC PRINCIPLES OF LEAK DETECTION

When a fluid under pressure leaks through a small aperture or orifice in a buried pipeline it creates acoustical vibrations, which travel along the pipe and are transmitted through the surrounding medium (such as earth or cement). The strength of these vibrations is greatest at the point where the leak is located and diminishes as the distance from the leak increases.

The Goldak Model 777 Leak Locator detects underground leaks by sensing their acoustic vibrations with a special microphone, by amplifying them electronically, and by making the leak-sound clearly audible on headphones; at the same time, the deflection of the panel meter indicates the relative strength of the leak-sound. Using the Model 777 Leak Locator, therefore, the operator simply traces the leak-sound to the point where its intensity is greatest; this point will be located directly above the subsurface leak.

B. SYSTEM COMPONENTS

- CARRYING CASE
  The Model 777 carrying case is constructed from hi-impact ABS with a foam-lined interior that is custom die-cut to firmly secure all of the unit's components and provide maximum protection for the equipment.

- AMPLIFIER BOX
  The Model 777 amplifier is housed in water tight, metallic control box. The control panel consists of a meter, four control knobs, two jacks, and a mute button; and is powered by 6 "AA" batteries in a single, 9V module. For more detailed instructions see "Amplifier Box" on page (4)

FIGURE 1

- HEADPHONES
  The headphones provided with the Model 777 Leak Locator are high impedance, stereo headphones with a ¼" phone plug. Do not substitute low-impedance devices (such as headphones or ear buds that would be used with portable music players; ipods, mp3 players, etc.)

- MIC PROBE
  The Model 777 Leak Locator comes equipped with a metallic probe-rod, pointed at one end and threaded at the other. The threaded end is screwed into the M-79 microphone, while the pointed end is used for moving direct contact with faucets, meters, or other exposed surfaces of the pipe system. It can also be used for piercing carpets to make direct contact with the concrete slab underneath. When contact is established, the sound vibrations are conducted through the probe-rod into the microphone.

GOODIE BOX CONTENTS:

Contents as follows

- **MICROPHONE**
  The M-79 Microphone is a ultra-sensitive listening device engineered in an aluminum disc-shaped outer housing. With a convenient detachable cable, the M-79 is designed to be versatile, as its size and shape allow it to be used either in head or directly on the ground. On the bottom of the microphone is a threaded hole, which allows for use with either the probe-rod or the bell-resonator.

- **MIC CABLE**
  The 6' Mic cable comes with a ¼" plug on one end, and a custom connector on the other. This cable is used to connect the M-79 microphone to the amplifier box and is detachable for convenience and versatility.

- **BELL RESONATOR**
  The Bell Resonator is a bell shaped PVC unit with a threaded stud protruding from the top, which is screwed into the bottom of the M-79 microphone. The "bell" can be used for gathering sound vibrations from the surface of a slab floor, pavement, asphalt, etc. by focusing these vibrations into the microphone. (Note: it is not necessary to use the bell resonator for this operation as the microphone can be used by itself when acquiring surface readings). Personal preference will ultimately dictate whether or not the bell resonator is used by each individual customer.

C. AMPLIFIER BOX (FIG. 2)

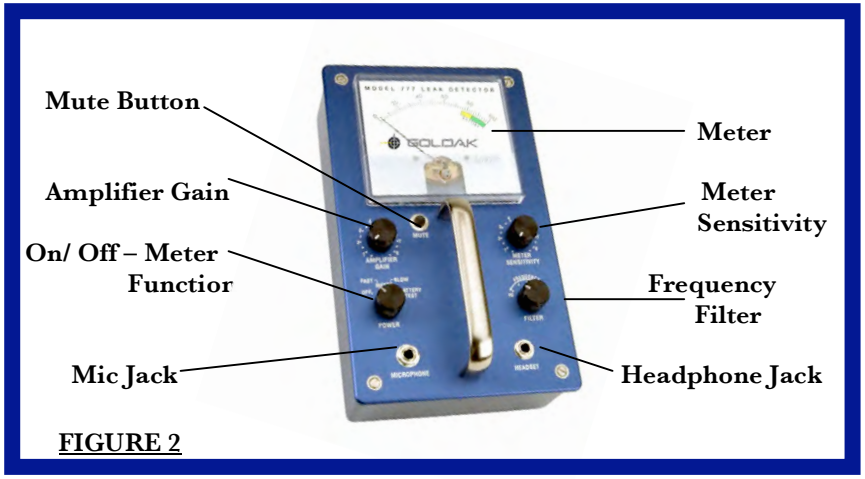

FIGURE 2

- **ON/ OFF – METER FUNCTION SWITCH**
  The lower left-hand knob serves both as an on/ off switch and as a meter-function switch. It is a rotary switch with four positions. Its most counterclockwise position turns the entire instrument off; in any of the other three positions, the instrument is on. Its second and third positions are used for leak-detection operations; in those positions the deflection of the meter-needle indicates the relative strength of the sounds sensed by the microphone and amplified by the circuit. The second position, marked "Fast", enables the meter to respond quickly to all variations in the sound-level, while the third position, marked "Slow", introduces a short time-delay into the meter-response so as to render it insensitive to short ambient noise-impulses. Normally the "Fast" position should be used for leak-detection, but if transient noise-impulses interfere and make it difficult to obtain a clear and steady meter reading, the operator will find

it helpful to switch the knob to "Slow". The fourth position of the knob, marked "Battery Test", is for testing the state of the internal batteries. When the knob is switched to this position, a deflection of the meter-needle into the right-hand area marked "Batt. Good" indicates that the batteries are good; if the meter-needle fails to deflect into this region, the batteries should be replaced (see section F).

- AMPLIFIER GAIN
  The upper left-hand knob, marked "Amplifier Gain", operates as a "volume control", regulating the amount of amplification that is impaired to the sounds sensed by the microphone. Clockwise rotation increases the gain of the entire circuit; counterclockwise rotation decreases the gain. In operation, this knob should be adjusted for a convenient sound-level heard in the headphones.

- METER SENSITIVITY
  The upper right-hand knob, marked "Meter Sensitivity", serves as an additional gain-control for the meter-circuit only. Clockwise rotation increases the meter-sensitivity; counterclockwise rotation decreases the meter-sensitivity. The operator will adjust this knob so as to obtain reference-readings at convenient points on the meter-scale.

- FREQUENCY FILTER
  The lower right-hand knob, marked "Frequency Filter" is a rotary switch with five positions. The setting of this switch determines the width of the audio spectrum, which the amplifier will amplify. In most counterclockwise (toward "Low"), the high-frequency end of the spectrum is progressively truncated to render the response-band and narrow, thereby isolating it more and more into the low-frequency end of the spectrum.

In operation, the knob is switched first to the extreme counterclockwise position ("High"). If ambient noise does not present a problem, the knob is left in that position. If ambient noises interfere and make it difficult to distinguish the leak-sound, the Frequency Filter knob is turned clockwise until a position is found which provides relative suppression of the ambient noise-level while allowing the leak-sounds to be heard.

- MICROPHONE JACK
  The left-hand jack at the bottom of the control panel is the receptacle for the plug at the end of the microphone-cable. The microphone must be plugged in for all operations (Fig. 3).

- HEADPHONE JACK
  The right-hand jack at the bottom of the control panel is the receptacle for the plug at the end of the headphone cable. If the headphones are not plugged in, the instrument will function with a meter-response only. If an audible response is desired in addition to the meter-response, the headphones must be plugged in (Fig. 3). It is recommended that the headphones be used for all operations.

D. LEAK LOCATING PROCEDURE

A leak is located by comparing the relative intensities, which the leak-sound manifests at several different points; the point of greatest intensity is nearest to the leak. To make this comparison, the controls of the amplifier must be initialized at then the operator moves the Leak Locator to a second, third, forth, etc. test point, in each case comparing the intensity of the leak-sound there against its intensity at previous points. The operator will modify the original adjustment of the amplifier's controls only when increased sound-intensities at the subsequent test points necessitate it.

1. EQUIPMENT SET-UP
   Plug both the microphone and the headphones into the amplifier box as shown below.

AMPLIFIER WITH
MICROPHONE AND HEADSET

FIGURE 3

2. ELIMINATE BACKGROUND NOISES
   Before searching for any leak, the operator should first attempt to eliminate as much ambient noise as possible – for example, turn off faucets, motorized appliances, machinery, etc. Ambient noises can be sensed by the microphone and, if excessive in intensity and close in frequency to the leak-sound, can "drown out" the sound of the leak.

3. INITIALIZING THE AMPLIFIER'S CONTROLS
   At the first test point, the amplifier is initialized as follows.
   - Turn the "Meter"-Function switch to "Fast".
   - Set the "Frequency Filter" switch at the leftmost ("High") position.
   - Advance the "Amplifier Gain" until the leak-sound is heard clearly on the headphones.
   - Adjust the "Meter Sensitivity" knob so that the meter-needle deflects to "5".

   If ambient noise makes it difficult to distinguish the sound of the leak, switch the "Frequency Filter" knob clockwise repeatedly until a position is found which effectively diminishes or eliminates the ambient noises while allowing the leak-sound to be heard. If necessary, readjust the "Amplifier Gain" and the "Meter Sensitivity".

   If ambient noise-pulses make the meter-needle jump erratically so that it becomes difficult to obtain a steady response, switch the "Meter"-Function knob to "Slow".

4. RE-ADJUSTING THE AMPLIFIER'S CONTROLS
   Once the controls have been initialized for a reference-level at the first test point, they should not be changed thereafter, unless an increase in leak-sound intensity drives the meter-needle beyond a

deflection of "9". In such a case, the operator reduces the "Amplifier Gain" and/or the "Meter Sensitivity" so as to obtain a new reference-level with a meter-deflection of "5". He then compares all subsequent test points against the new reference-level.

5. **IDENTIFY THE LEAKING PIPE**

When a leak occurs in a location where there is more than one pipe-system (for example, where there is a hot-water line and a cold-water line), the operator should first determine which pipeline has to leak. The easiest way to find exposed points in the pipe-system (faucets or hydrants, for example) is to make direct contact with them. To do this, the operator uses the microphone with the probe-rod. He holds the microphone in such fashion that the probe-rod makes firm contact with some part of one of the pipe-structures in question. He then initializes the amplifier's controls for a meter reading of "5". Then, without altering the amplifier's controls, he presses the probe-rod firmly against the second pipe to be tested. If the meter deflects more here, the leak is in the second pipe-system; if the meter deflects less, the leak is in the first pipe-system. (If more than two pipe-systems are present, the same principle applies: the one that gives the loudest leak-sound is one that has the leak.)

DIRECT CONTACT WITH THE PIPE

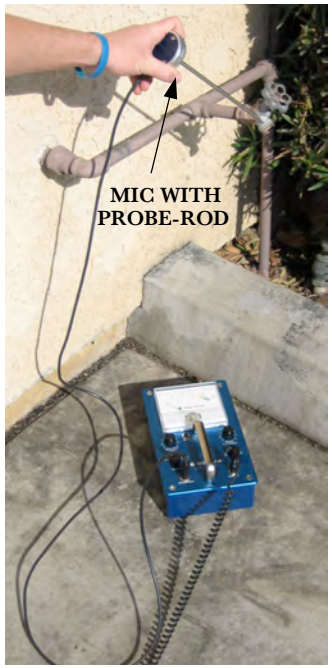

FIGURE 4

DIRECT CONTACT WITH THE PIPE STRUCTURE

FIGURE 5

6. **DETERMINE THE GENERAL LOCATION OF THE LEAK**

When the leaking pipe has been identified. The operator can then begin to "narrow down" the area under which the leak can be. The fastest way to do this is to make direct-contact tests (--see Fig. 4 and Fig. 5) with all exposed points of the leaking pipe. At the first point of direct contact, the amplifier's controls, the operator makes a direct-contact test at a second test point along the pipe. If the meter-deflection is less here than at the first test point, the operator can conclude that he is moving away from the leak. If the response is greater at the second test point, the operator can conclude that he is moving closer to the leak. In the latter case, he should reduce the "Amplifier Gain" and/or "Meter Sensitivity" so as to obtain a new reference-level meter-deflection of "5" and then move on to a third test point. The operator should continue in this fashion to make a direct-contact test at each exposed point of the leaking-system in order to determine at which of them the leak-sound is strongest. Other factors being equal, the leak will lie closest to the one point of loudest response or, if there are two points equally loud and stronger than all other points, midway between them. (Fig 7)

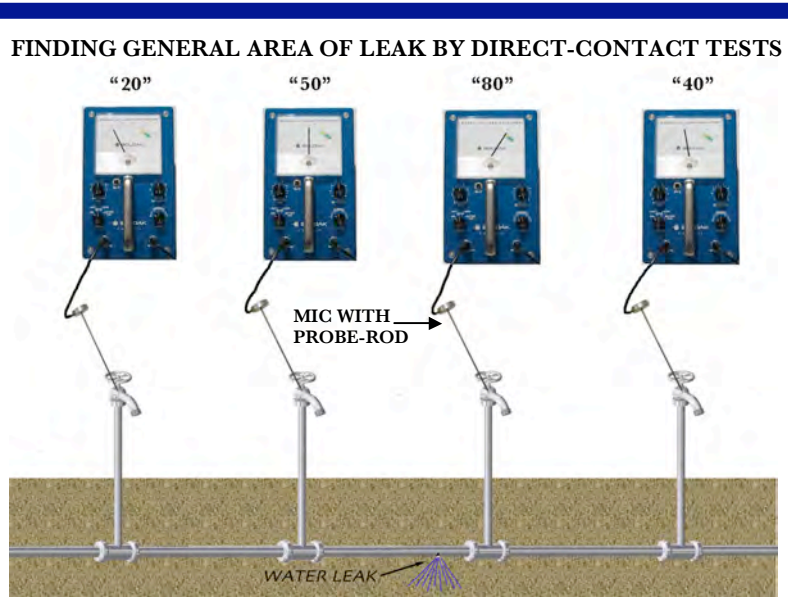

FIGURE 6

Caution – Pipes, which are free to vibrate conduct leak-sounds, better than pipes embedded in earth or concrete. Often, therefore, the judgment of an experienced operator must interpret the significance of the leak-sounds sensed by the microphone.

7. **PINPOINT THE LOCATION OF THE LEAK**

When the location of the leak has been "narrowed down" to a general area by direct contact with the exposed point(s) of loudest response, then the operator can proceed to pinpoint the leak.

a. **Map out the path of the leaking pipe:**

To help insure accuracy in you leak detection. Goldak strongly recommends identifying, marking, and mapping the path of the line determined to be leaking. Especially around or between the areas of the loudest points. On a metallic system this is best accomplished using any of the following Goldak pipe locating models: Triad 2310, 5600-SI, 4400, PB-44, 902, or another reliable pipe locating system. If you do not have a pipe locator available or if the line is non-metallic (plastic, transit, etc.) you will have to roughly guess the path of the line by observing the locations of the exposed parts of the system (meters, hydrants, faucets, etc.) and then

speculate where the expected path might be accordingly.

If the leaking pipe lies under a cement slab, pavement, or a layer of asphalt, the leak can usually be pinpointed by detecting its sound through the overlying medium. If, however, only earth covers the pipe, the leak can be pinpointed by further direct-contact tests with the pipe itself.

SENSING LEAK-SOUNDS THROUGH ASPHALT/CEMENT

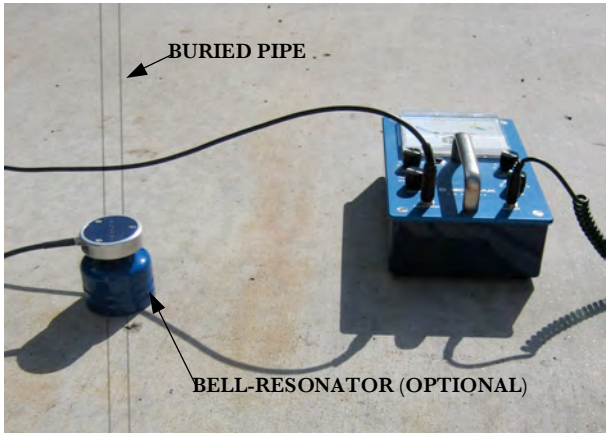

FIGURE 7

b. Sensing the Leak-Sound through the Overlying, Medium:
The leak can be pinpointed by setting the M-79 microphone (with or without the bell-resonator) directly on the cement or asphalt over the marked line of the pipe (Fig. 7) at consecutive test points (Fig. 8). At first test point, the operator initializes the amplifier's controls for a clearly audible sound-response and a meter-deflection

of "5". Then, without altering the amplifier's controls, he should move the microphone a few feet farther along the marked line of the pipe, set it down at a second test point, remove his hand, and observe the deflection of the meter-needle. If

PINPOINTING LOCATION OF LEAK UNDER ASPHALT OR CEMENT

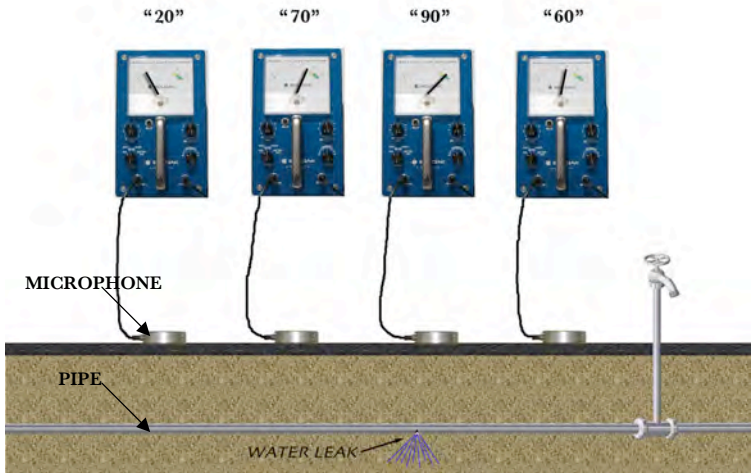

FIGURE 8

the deflection of the meter at the second point is lower than "5", the operator is moving in moving in the wrong direction; he must then reverse the direction of his search. If the meter-deflection at the second test point is higher than "5", the operator is moving closer to the leak; he should continue his search in this direction. If, during this search, the meter-deflection advances beyond "9", the operator should stop and re-initialize the amplifier's controls for a new reference-reading of "5". The operator will continue to test in this fashion along the marked

line of the pipe until he finds a point of strongest response – a point at which the meter-deflection "peaks" to a maximum and from which the meter-deflection falls to lower values on either side. The leak will lie directly beneath this point of peak-response (Fig. 8).

c. Direct Contact with the Pipe:
When no other medium but earth covers the pipe, the leak is pinpointed by making a series of direct-contact tests with the pipe itself along its unexposed length near the area to which the leak had been previously "narrowed down". To make direct-contact tests with the unexposed, a series of holes must be drilled or hammered into the earth so that a metallic rod (a "T"-bar, for example) can be pushed down to touch the pipe.

PINPOINTING LOCATION OF LEAK BY DIRECT-CONTACT TESTS

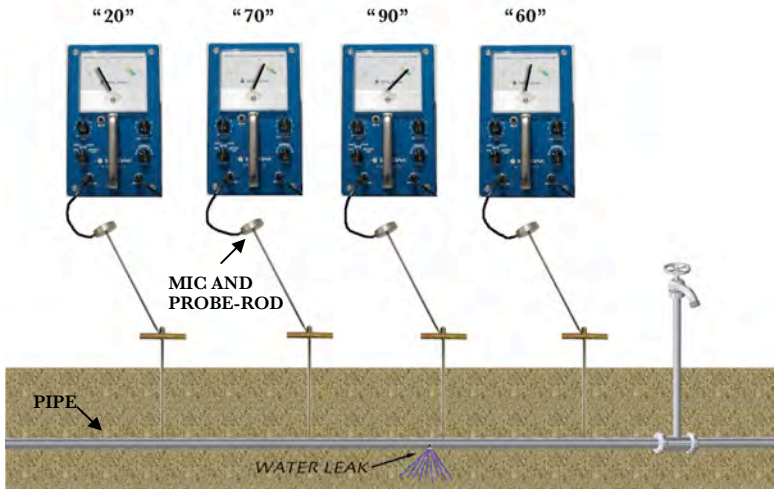

FIGURE 9

The microphone is then use with its probe-rod, and the point of the short probe-rod is pressed firmly against the longer probing rod. (Alternative procedure: the bell-resonator may be used in place of the short probe-rod; the microphone-assembly is then fastened firmly to the long metallic rod by means of the bell-resonator's screw-clamp.) At the first test point the operator initializes the amplifier's controls for a clearly audible sound-response and a meter-deflection of "5". Then a test is a made at a second point, at a third point, etc. in the same fashion as described in the preceding paragraph. The leak will be located at the point of strongest response (Fig. 12).

E. NOTES AND SUGGESTIONS

1. **There is a characteristic hissing sound generally associated with all water-leaks. The success that an operator will have in locating a leak depends largely on his recognizing this characteristic sound of leakage and distinguishing it from ambient noises. To familiarize himself with the characteristic leak-sound, the operator can screw the probe-rod into the microphone, hold the point of the probe-rod against a pipe near a faucet slightly so that water trickles forth, listen with the headphones, and adjust the amplifier's controls to appropriate settings.**

2. **When using the model 777 Leak Locator, the headphones should be kept at a distance from the microphone. If the headphones are brought near the microphone, acoustic feedback through the air (from headphones to microphone) will set the high-gain circuit into squealing or howling oscillations. If, however, the headphones are fitted snugly over the ears and the microphone is kept at arm's length, this problem will not occur.**

3. **The strength of the acoustic vibrations set up by a leak depends on several factors:**
   a. **on the pressure in the line (--the high the pressure, the stronger the vibrations);**
   b. **on the size of the leak-aperture (--generally stronger vibrations occur when the orifice is small, weaker vibrations when the orifice is large);**
   c. **on viscosity of the fluid;**
   d. **on the presence or absence of reasoning cavities around the leak or excavated by the leak;**
   e. **on the freedom with which the pipe can vibrate (--see note of caution on p.)**

Moreover the strength of the acoustic vibrations at the point where the operator is testing depends not only on the above factors but also on the distance between the leak and the test point.

4. **The primary indication on which the operator should rely for locating a leak is the response obtained from direct-contact tests with the pipe itself. The response obtained through cement, asphalt, or the like is secondary and should be used only to confirm or to define more precisely the location previously determined by direct contact with the pipe.**

5. **Although the Model 777 Leak Locator is recommended primarily for water leaks, it is often possible to detect gas-leaks under good pressure and, under appropriate circumstances, to detect gas-leaks in low-pressure mains. It is necessary, however, to make direct contact with the pipe in all the tests.**

6. **Capacity of mains:**

2"	.16 gal. per ft.		24"	23.50 gal. per ft.
6"	1.47 gal. per ft.		30"	36.72 gal. per ft.
8"	2.61 gal. per ft.		36"	52.88 gal. per ft.
12"	5.88 gal. per ft.		48"	94.00 gal. per ft.
18"	13.22 gal. per ft.		60"	146.88 gal. per ft.

7. **Water wasted at 40 pounds pressure:**
   - **a 1/32" leak wastes 170 gallons a day**
   - **a 1/16" leak wastes 970 gallons a day**
   - **a 1/8" leak wastes 3600 gallons a day**

F. MAINTENANCE

- **BATTERY REPLACEMENT**

  The batteries in the Model 777 amplifier should be replaced whenever the battery test meter reading fails to deflect into the area marked "Batt. Good" (--see section C, on p. 5).

  To replace the battery, remove the four screws on the sides of the amplifier-housing and open up the housing. Then remove the two screws that hold the battery bracket against the backside of the front panel. Unsnap the battery-connector and remove the battery pack. Replace the batteries with standard "AA" batteries. Then replace the battery pack with the battery bracket and reassemble the housing,

- **PERFORMANCE TEST**

  A simple way to determine that the Model 777 Leak Locator is functioning properly is to plug the microphone and headphones in, to turn the instrument on with "Amplifier Gain" advanced, and to place a wristwatch against the probe-out or on the metallic housing of the microphone. The mechanical movement of the watch should be easily audible on the headphones.

G. TECHNICAL ASSISTANCE AND SERVICING

Should the Model 777 Leak Locating System or any of the accessories require repair or servicing aside from normal product maintenance, we suggest that you contact the factory at the following address:

GOLDAK INC.
547 West Arden Avenue
Glendale, CA 91203
Phone: 818-240-2667
Fax: 818-244-6818
E-mail: sales@goldak.com
Website: www.goldak.com

We will inform you of any local repair stations in your area, or advise you to ship the instrument directly to the factory. If you ship product, we suggest you:

a) Pack the instrument carefully and securely

b) Include any accessory items normally used with the instrument

c) Include a note with the instrument stating the nature of the problem(s) you have encountered in using the instrument.

d) Include a contact name, telephone number & fax number