GARNET

INSTRUMENTS LTD.

MODEL 609 & 610 OPERATIONS MANUAL

❖ GARNET INSTRUMENTS LTD.

MODEL 609 & 610 OPERATIONS MANUAL

TABLE OF CONTENTS

A) OVERVIEW

B) OPTIC OVERFILL PROBE SYSTEM OPERATION

C) SCULLY TESTER OPERATION

D) GARNET 609 FEATURES

E) GARNET 610 FEATURES

F) SCULLY INTELLICHECK™ TROUBLESHOOTING GUIDE

G) SERVICE AND WARRANTY INFORMATION

A) OVERVIEW

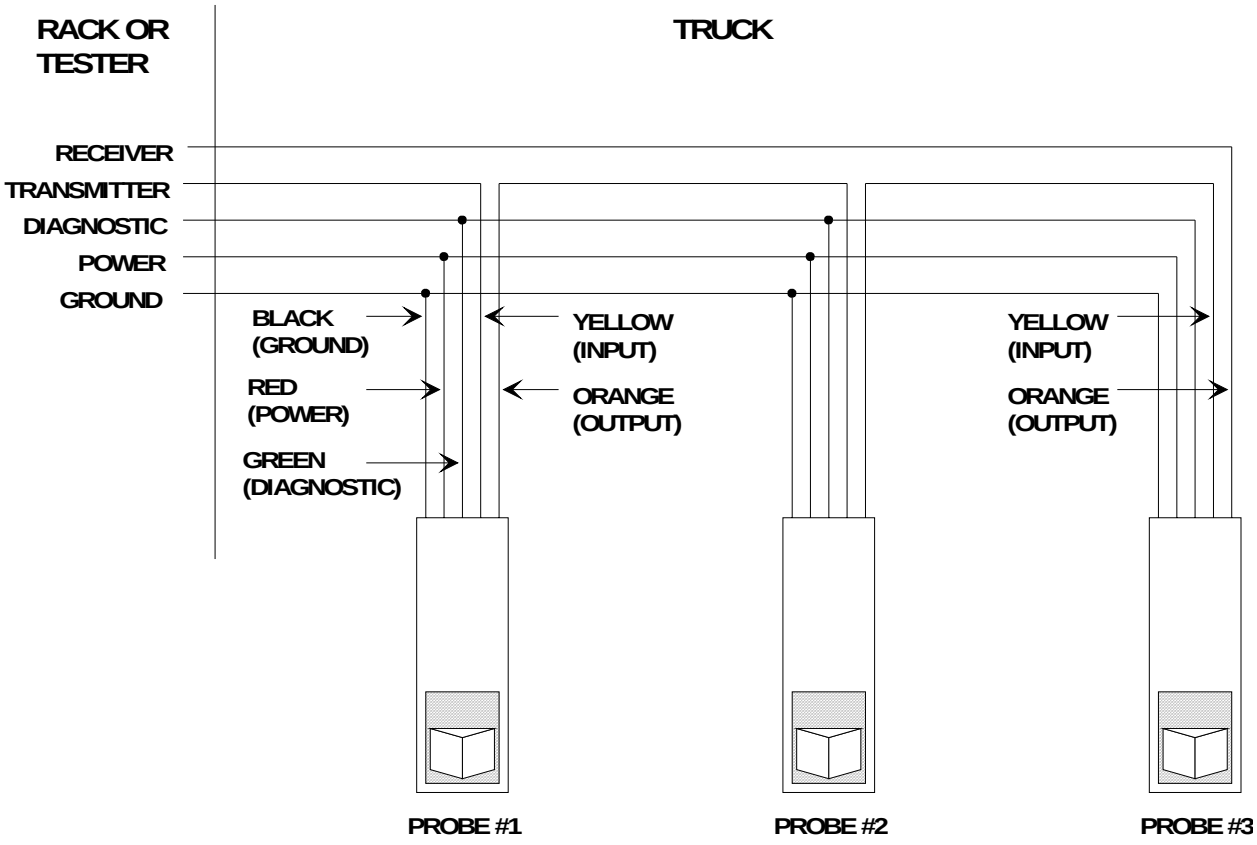
Congratulations on purchasing the Garnet Instruments Model 609 and 610 testers. This equipment represents the state of the art in optic overfill sensor diagnostic equipment. Proper use of this equipment will permit accurate evaluation of sensor operation and rapid determination of the source of faults, resulting in less truck downtime and fewer shop hours spent troubleshooting sensor failures.

The Model 609 is designed to test Scully or Liberty™ five wire optic overfill sensor probes used on bulk transport trucks, and is compatible with retain systems. It is a dramatically improved version of the Scully sensor tester, and very accurately duplicates the operating conditions encountered at the loading racks. This means that when the 609 indicates a good return, the operator is guaranteed that loading will be permitted.

The Model 610 is a completely new instrument which aids in tracking down the exact location of sensor problems. The 610 is used in conjunction with the 609 or a Scully IntelliCheck™ to probe the signals into and out of each probe to pinpoint faulty component(s).

B) OPTIC OVERFILL PROBE SYSTEM OPERATION

In order to properly understand the advantages of the Garnet equipment and to assist in troubleshooting, it is worthwhile to understand how the Scully and Liberty™ systems function. The diagram below shows a basic three probe hookup (conventional stand alone five wire top sensors only):



During loading, the rack is connected to the probes on the truck via the 7 pin plug and socket. The green diagnostic wire is not used during loading rack operation. The rack supplies approximately 20 volts to the probes via the red power wire. This voltage is constant (not pulsed) and is applied to all probes equally. The rack also transmits a pulse which is approximately 12 volts in amplitude, and about 1 millisecond long. This pulse is repeated every 100 milliseconds (that is, 10 pulses per second). This pulse is connected to the yellow input wire of probe #1. If probe #1 is not wet and is functioning properly, it reproduces this pulse at its orange output wire with an amplitude of about 18 volts. Note that the pulse leaving probe #1 is larger in amplitude than the pulse entering. The pulse from probe #1 is connected to the yellow input wire of probe #2. If probe #2 is dry and working, it reproduces the pulse at its output orange wire with an amplitude of about 18 volts. In this case, since the input pulse is already large in amplitude, the input and output pulses are the same. This process is repeated for probe #3, except that its output is connected back to the rack receiver. The rack analyses this pulse, and if it has the same timing as the transmitted pulse and is at least 14 volts in amplitude, the rack will permit loading. If the pulse is less than 14 volts or non-existent, then the rack will not permit loading.

If any probe is wet or faulty, it does not reproduce the pulse at its output. Since the next probe does not receive a pulse, it does not produce any pulse at its output either, regardless of whether it is wet or dry. Consequently, the rack will not receive any pulse and will not permit loading.

Now at this point it is evident that the rack must receive a larger pulse than it produced in order to permit loading. Consequently, it is impossible to "fool" the rack by connecting the transmitter directly to the receiver, since then the received pulse would be less than 14 volts. Also, the rack cannot be "fooled" by connecting the red power wire to the receiver, since the voltage is steady and not a pulse, so the timing requirement is violated.

The operation of the green diagnostic wire is as follows. If the probe is producing a pulse at its output, it also draws a certain amount of current from the green wire. Any probe that is not producing an output pulse does not draw any current from the green wire. The current drawn by all the probes is added together, measured by the tester, and displayed as a row of compartment lights. One light is illuminated for the amount of current drawn by one probe. Now, if all three probes in our example are working and being fed a pulse, then three compartment lights will be on. If probe #2 quits working, then neither it nor probe #3 will be producing a pulse, so neither will draw any current from the green wire, resulting in only one compartment light being on (from probe #1). Consequently, during troubleshooting, the defective probe should be the one following the last working probe. In this example, only one compartment light is on, so probe #1 is the last working probe, so the fault would be in probe #2.

C) SCULLY TESTER OPERATION

The Scully tester operates by supplying about 11 volts to the red probe wires, and transmitting a pulse with an amplitude of about 10 volts, a pulse width of 1 millisecond, and a pulse repetition rate of 10 milliseconds. In order to illuminate the "return" indicator, it must receive a pulse of about 4 volts amplitude. The green wire diagnostic system functions as described above.

As can be seen, the Scully tester operates the probes under quite different conditions than they are operated at the loading rack. This does not matter too much if the probes are either working perfectly or are completely failed, but it is a real problem if the probes or wiring are only partially degraded. It is entirely possible to have a probe system which will "pass" with the Scully tester but will not be permitted to load at the rack. This is obviously not a desirable situation.

The diagnostic capability of the green wire system also has its limitations. It is possible under certain failure circumstances for a probe to draw *more* current than normal, which can result in more compartment indicators being on than there are probes in the system. In this case the diagnostic system is of no value in determining which probe or wire has failed. Remember, the green wire system does not identify specific probes, but only the total number of operating probes.

Now the intention in this manual is not to run down the Scully tester, but to illustrate how the situation can be improved upon with modern technology. The following two sections describe the advantages of the Garnet instruments.

D) GARNET 609 FEATURES

The 609 is similar in concept to the Scully tester but unlike the Scully tester operates the probes under the same conditions as the rack. It powers the red probe wire with about 20 volts and transmits a pulse of about 12 volts amplitude, 1 millisecond pulse width, and a repetition rate of about 100 milliseconds. The receive pulse is analyzed and if the amplitude is less than about 6 volts, the red "FAIL" return indicator will be on. If the received amplitude is between 6 volts and 14 volts, the yellow "POOR" return indicator will be on. If the received amplitude is greater than 14 volts, the green "GOOD" return indicator will be on. This allows the operator to determine exactly what the status of the probe system is, and guarantees that if the 609 gives a "GOOD" return that rack loading will be permitted.

The green wire diagnostic system operates in a similar fashion to the Scully tester except that a different voltage is used which allows better utilization of the batteries in the tester. The 12 volt lantern battery in the Scully tester is only allowed to discharge to about 10 volts before the tester does not give the battery indicator, whereas the 12 volt "C" cell battery pack (which is much cheaper and easier to get than the 12 volt lantern battery) in the 609 can discharge to about 7 volts before the display shuts off. To obtain the 20 volts required to power the probes, the 609 uses a switching power supply to step up the voltage from the batteries. The result of this design is that the performance and operation of the tester remains the same throughout the useful life of the batteries.

The 609 can also be used to evaluate the loading permit status of retain-overfill sensor systems such as the Scully IntelliCheck™, the Liberty™ ROM™, and the Photonic 2000/2100. If the "GOOD" return indicator is on, then loading will be permitted. The green diagnostic wire and the compartment lights do not operate for these systems.

Some of the other unique features of the 609 are:

- Easy to see high intensity LED display.
- Durable, rustproof, weatherproof NEMA 4 rated fibreglass enclosure.
- Durable and attractive Lexan front panel.
- The cord is made from small diameter cable with very tough yet flexible jacketing. The cord is 12 feet long so the tester can be placed on top of the trailer while plugged into the rack receptacle.
- Fast service support.

E) GARNET 610 FEATURES

The 610 is used to inspect the voltage and pulse amplitudes at specific points throughout the sensor system. This allows the operator to determine the exact location of faults without having to disconnect and individually test each probe. It also means that all of the connections and wiring can be tested as well. The 610 must always be used in conjunction with the 609, since the 610 only receives signals, it cannot transmit them. To use the 610, the 609 is plugged into the rack connector, the 610 black test lead is connected to ground (that is, the black sensor wire, or the trailer body if it is connected to the black wire somewhere in the system), and the red test lead is connected to either the red, yellow, or orange sensor wires. The display then indicates if the proper signal levels exist at that point.

The display on the 610 consists of five LEDs. The middle red LED indicates no signal of any kind, and it should always be on whenever the instrument is turned on and not connected to anything. The two LEDs to the right of the middle LED indicate pulse amplitude and are coded the same as the 609: the yellow "POOR" LED indicates a pulse with an amplitude between 6 and 14 volts, and the green "GOOD" LED indicates a pulse with greater than 14 volts amplitude. These LEDs are used when evaluating the signal level on the yellow or orange probe wires. In a properly operating system, all yellow and orange wires should indicate a green "GOOD" LED, except for the first yellow wire coming from the 609, which should indicate a yellow "POOR" LED.

The two LEDs to the left of the middle one indicate voltage amplitude on the red wire. The yellow "POOR" LED indicates a voltage amplitude between 8 and 16 volts, and the "GOOD" green LED indicates greater than 16 volts. All red wire points in the sensor system should indicate "GOOD" if the system is operating properly.

The 610 automatically determines if the incoming signal is a voltage or a pulse, and chooses the correct set of display LEDs accordingly. The display should never have more than one LED on, except for a brief moment when the test lead is first connected.

The use of the 610 can best be illustrated by an example. Suppose we have a 5 compartment B-train (3 lead, 2 pup) trailer come into the shop with a complaint of being unable to load. Plugging in the 609 indicates no return and all 8 compartment lights are flashing. Remove the cover of the first probe (in this case it is at the front of the lead trailer) and connect the 610 black lead to ground and the 610 red lead to the red sensor wire. The display indicates "GOOD" voltage, so we know that the probe is getting power. Connecting the 610 red lead to the yellow sensor wire indicates "POOR" pulse, which is correct since this is the yellow wire connected directly to the 609. Connecting the lead to the orange sensor wire indicates "GOOD" pulse, which is also correct. Now we proceed to the next probe and remove its cover. Checking the red probe wire indicates "GOOD" voltage and the yellow probe wire indicates "GOOD" pulse, so we know that the wiring up to this point is OK. Checking the orange sensor wire also indicates a "GOOD" pulse, so we proceed to the third probe and repeat the procedure. All three wires check out OK. Now remove the cover on the fourth probe, which is the first one on the pup. Checking the red wire indicates "GOOD" voltage, but the yellow wire indicates "NO SIGNAL". The problem must be in the wiring between the last probe on the lead and the first on the pup. Pull the plug between the trailers and check the signals coming out of the plug. Here we find a "NO SIGNAL" on the yellow/orange pins,

so we take the plug apart and find that some of the wires are broken inside the housing. We also note that the green wire is shorting to ground, which explains why all 8 compartment lights were flashing. Checking the exposed end of the yellow wire indicates "GOOD" pulse, so we know that the problem has been determined. Repairing the plug and reconnecting it then shows a "GOOD" return and five compartment lights on the 609. Congratulations, everyone in the shop now thinks you are a genius.

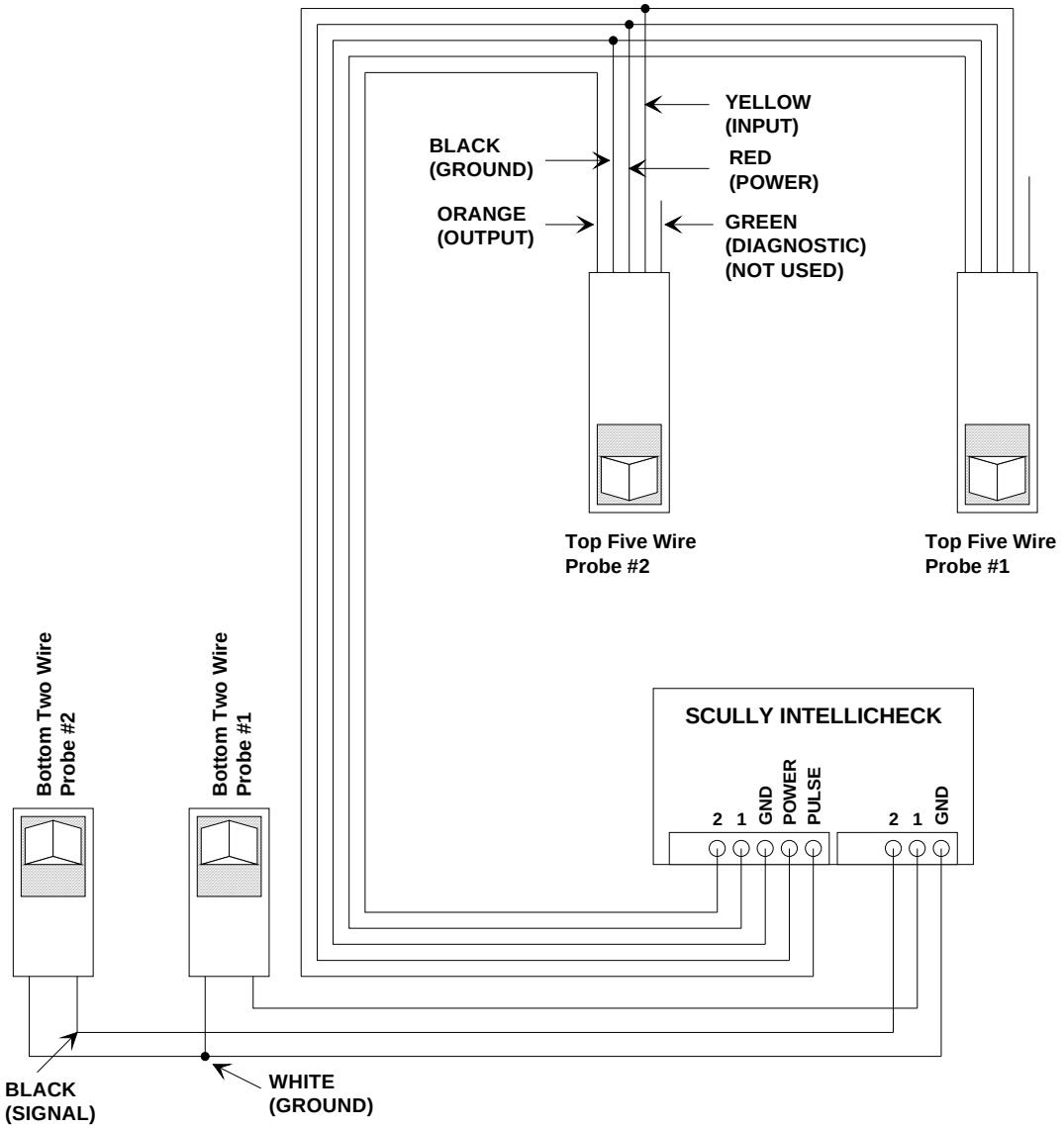
Notice that we always checked the red wire first. This is because if the probe is not getting power, it will not work regardless of whether it is good or not. If the voltage checks OK up to a point and is then bad, the cause would be a poor wiring connection in the black ground or red power wires. If the voltage is bad everywhere, the cause would be a defective probe drawing too much current or a short to ground somewhere along the red wire. In this case, it is necessary to start disconnecting the red wire at the last probe and work back to the first probe until the voltage returns. Check in the vicinity of the point where disconnecting the red wire brought back the voltage.

The 610 is also compatible with the Scully IntelliCheck™ system for troubleshooting the five wire top probes and two wire bottom/top probes. The IntelliCheck™ uses different voltages and pulse amplitudes than the conventional rack, and the 610 incorporates a switch to change the operation of the 610 to properly determine IntelliCheck™ signal levels. All of the probe yellow wires are connected together in this system, and the orange wires are individually brought back to the monitor. All yellow wires should give a "POOR" pulse indication, and all orange wires should show a "GOOD" pulse. All red wires should show a "GOOD" voltage. Note that the IntelliCheck™ is quite sensitive to incoming voltage, so before testing the probes ensure that the truck voltage is at least 12.0 volts, and no more than 16.0 volts. (If this is a problem, Garnet offers a power conditioner which guarantees proper voltage despite variations in the truck electrical system.) The next section is a complete troubleshooting guide for the IntelliCheck™.

Some of the other features of the 610 are:

- Easy to see high intensity LED display.
- Durable, rustproof, weatherproof NEMA 4 rated ABS / polycarbonate enclosure.
- Durable and attractive Lexan front panel.
- Powered by inexpensive, easy to obtain "C" cells.
- Fast service support.

F) SCULLY INTELLICHECK™ TROUBLESHOOTING GUIDE



The above diagram shows the basic wiring diagram of a retain/overfill IntelliCheck™ system. The major wiring differences between this and the conventional system for the five wire probes are that all yellow input wires are connected together, and all orange wires are brought back individually. Consequently, if one probe is defective, the other probes should still operate.

During fault conditions such as open or shorted connections or probe failures, the red power, yellow pulse, and black signal wires are turned on and off once per second. This will result in the indicators on the 610 flashing at the same rate between NO SIGNAL and one of the other indicators. It is normal for the 610 PULSE indicators to flash briefly during on - off flashing of the POWER indicators. Once the fault is cleared, the IntelliCheck™ may take up to 15 seconds to stop this cycling.

To help troubleshoot this system, we have included a table showing the relationship between a number of fault conditions in wiring and probes and the response of the IntelliCheck™. The various 610 indicators are shown as well. Note that this table assumes that the IntelliCheck™ control unit is functioning properly. The 610 must be in the "IntelliCheck" mode.

FIVE WIRE PROBE INTELLICHECK FAULT TABLE

FAULT CONDITION	INTELLICHECK COMPARTMENT DISPLAY	610 ON RED	610 ON YELLOW	610 ON ORANGE
NORMAL	ALL OFF	GOOD VOLTAGE	POOR PULSE	GOOD PULSE
YELLOW TO GROUND SHORT	ALL ON STEADY	GOOD VOLTAGE FLASHING	NO SIGNAL	NO SIGNAL ON ALL
ORANGE TO GROUND SHORT	INDIVIDUAL INDICATOR FLASHING FAST	GOOD VOLTAGE FLASHING	POOR PULSE FLASHING	GOOD PULSE FLASHING ON OTHERS, NO SIGNAL ON SHORTED ONE
RED TO GROUND SHORT	ALL ON STEADY	NO SIGNAL	POOR PULSE FLASHING	NO SIGNAL ON ALL
YELLOW TO ORANGE SHORT	ALL ON STEADY	GOOD VOLTAGE FLASHING	NO SIGNAL	NO SIGNAL ON ALL
RED TO YELLOW SHORT	ALL ON STEADY	POOR VOLTAGE FLASHING	POOR VOLTAGE FLASHING	POOR PULSE FLASHING
RED TO ORANGE SHORT	ALL ON STEADY	POOR PULSE FLASHING	POOR PULSE FLASHING	NO SIGNAL ON OTHERS, POOR PULSE FLASHING ON SHORTED ONE
ORANGE TO ORANGE SHORT	ALL OFF	GOOD VOLTAGE	POOR PULSE	GOOD PULSE
ALL YELLOWS DISCONNECTED	ALL ON STEADY	GOOD VOLTAGE FLASHING	POOR PULSE FLASHING AT UNIT	NO SIGNAL ON ALL
ALL REDS DISCONNECTED	MAY FLASH OR BE ON STEADY	GOOD VOLTAGE FLASHING AT UNIT	POOR PULSE FLASHING	NO SIGNAL ON ALL
ORANGE DISCONNECTED	INDIVIDUAL INDICATOR FLASHING SLOW	GOOD VOLTAGE FLASHING	POOR PULSE FLASHING	GOOD PULSE FLASHING ON ALL ORANGE WIRES CONNECTED TO PROBES

TWO WIRE PROBE INTELLICHECK FAULT TABLE

FAULT CONDITION	INTELLICHECK COMPARTMENT DISPLAY	610 ON BLACK
NORMAL	ALL OFF	GOOD PULSE
BLACK TO GROUND SHORT	INDIVIDUAL INDICATOR FLASHING FAST	NO SIGNAL
BLACK DISCONNECTED	INDIVIDUAL INDICATOR FLASHING SLOW	GOOD VOLTAGE FLASHING AT UNIT, NO SIGNAL AT PROBE
PROBE IN FLUID	INDIVIDUAL INDICATOR ON STEADY	GOOD VOLTAGE FLASHING

Note that in the case of the five wire probes, there are a number of different fault conditions which cannot be distinguished by observing the IntelliCheck™ indicators alone. For example, a red wire short to ground cannot be distinguished from a yellow short to ground, or a yellow to orange short, or a red to yellow short, etc. With the 610 and the chart, it is possible to gain additional information to assist in tracking down the fault, thus speeding the troubleshooting process considerably. In the case of an ambiguous result, such as between a yellow to ground short and a yellow to orange short, disconnect all the orange wires from the probes and the IntelliCheck™ unit, then recheck the signals again to isolate the fault.

In the case of an open circuit, trace the signal from the point where the signal exists with the 610 until the signal stops; that must be the fault location.

A faulty five wire probe will show up as having a flashing POOR PULSE at its yellow wire, a flashing GOOD VOLTAGE at its red wire, and NO SIGNAL or POOR PULSE at its orange wire.

G) SERVICE AND WARRANTY INFORMATION

The 609 and 610 are guaranteed against defects in material or workmanship for two years from the date of purchase, with the exception of the cord or leads, which are guaranteed for one year. This guarantee covers everything except for the 609 plug and the batteries. The plug used is an industry standard plug, but since Garnet doesn't make it and it can be subjected to a wide range of use and abuse, Garnet is unable to guarantee it. The guarantee is void if the instrument has been obviously abused (such as being dragged behind a truck) or obviously tampered with.

If you do have a warranty claim or if the instruments need to be serviced, Garnet can be contacted as follows:

Garnet Instruments Ltd.
288 Kaska Road
Sherwood Park, Alberta
Canada T8A 4G7
tstalker@garnetinstruments.com

Garnet endeavors to ship out a repaired or replacement instrument within two business days of receiving the defective instrument.

Before sending defective equipment in for service, a few items should be checked:

- Is the unit really defective, or is it your equipment? Verify the instruments with equipment that you **know** is functioning properly.
- If the display is off, check the batteries inside the instruments. Are they dead? Are they making contact with the battery holder? Are they all in the right way around?
- Check the plug (609) or clips (610) for damage or corrosion. These items can be replaced quite easily by the user.
- Check the cord (609) for damage. The cord is connected with a terminal block and can be replaced by a local electrical service technician without too much difficulty.

The 609 operates on 8 "C" alkaline cells, and the 610 operates on 4 "C" alkaline cells. These cells are readily available. Regular carbon zinc cells can be used, but they will have significantly shorter battery life. The 609 should operate for 50 to 60 hours on a set of alkaline cells, and the 610 should operate for over 200 hours.