AR-99 TROUBLESHOOTING TECHNIQUES

Once you are familiar with the most common faults that occur with the AR-99, you will know how to handle many problems as soon as you hear the symptoms. More often than not applying one or more of the steps described in the last section (Standard Solutions) will be all that is necessary for many faults.

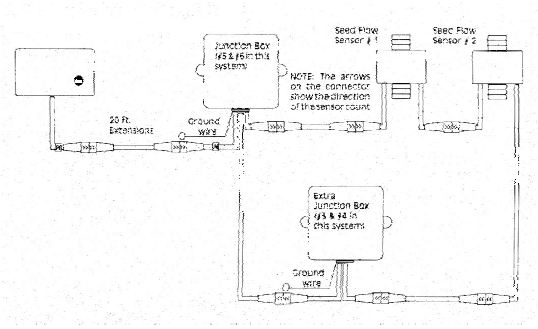
From time to time, problems do arise that require a more aggressive troubleshooting approach. It is extremely important all troubleshooting procedures a conducted in a methodical and accurate manner. This requires that you begin with good information and carry out each step logically, keeping in mind what you have done and being careful not to skip steps.

Initial information about the problem can be very helpful but in some cases the symptoms reported may be incomplete, contradictory or, sometimes, just incorrect. You must evaluate the situation, verify the existing information, and formulate any tests necessary to locate the source of the problem.

Whether you are providing on-site service or telephone support it is important that you approach the process of troubleshooting in a logical and organized way. You will also need a repertoire of tests that will extract the information you need to analyze the problem. This section describes several tests and techniques that will help you collect that information.

> **Note: It is important to understand the difference between testing and troubleshooting. <u>Troubleshooting</u> is a thinking skill; the process of analyzing information to form a theory about the cause of a fault. <u>Testing</u> is the activity of obtaining the information used in the troubleshooting process.**

System Pre-test



Sometimes when a problem arises with the AR-99 the operator observes and reports one or two symptoms that relate to the problem without doing a complete check of the system. Although any correct information can be useful, ideally a complete system check would be better. Under normal conditions the operator should do a System Pre-test each day, prior to using the AR-99 System. The System Pre-test includes the Power-Up Self-Test which runs every time the AR-99 is turned on. If the Power-Up Self-Test passes, the operator then checks to make sure that all sensors alarm with no seed/fertilizer flowing. Next, he checks that all sensors come out of alarm when normal flow is established. Finally, he sets up the Sensitivity Control so that the system will detect plugged runs while at the same time not causing false alarms due to slight changes in operating conditions.

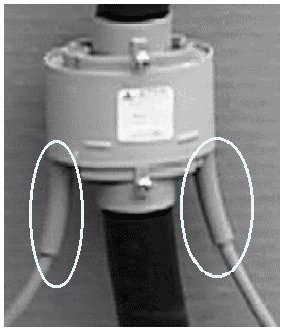
If any part of the system is not operating correctly the problem should reveal itself during the System Pre-test. The only exceptions to this would be problems that are caused by conditions experienced in the field. These may include tractor 12 volt power fluctuations, static electricity, ambient light, temperature, vibration, or mechanical damage to the system.

Power-Up Self-Test

The Monitor Head performs a series of steps called the Power-up Self-Test when the system is initially turned on. First, the Monitor Head attempts to reset all of the Flow Sensors to prepare them for normal operation. While this process is underway the Monitor Head displays the greeting message ‘HI’. Next, the Monitor Head initiates a procedure in which each sensor is detected and counted. As each sensor is counted the number of the sensor appears on the display. The Monitor Head continues this process with each sensor until it reaches the last one in the loop, which is connected back to the Y-cable. When the Monitor Head detects that the last sensor is plugged into the Y-cable the word ‘End’ is displayed. The Monitor Head then switches itself into Seed Scan Mode and begins the normal scanning process.

If the Monitor Head detects a problem with the system during the Power-Up Self-Test, or at any time while operating in Seed Scan Mode, it will display one of two messages: 'HELP' or 'Err'. 'Err' messages are always followed by the number of the sensor that failed to respond correctly.

Using the 'HELP' Message



The 'HELP' message indicates that a serious problem exists in the Monitor Head, cables or one of the Flow Sensors. The message is accompanied by a double beep if the audible alarm is switched on. The 'HELP' message is displayed if the Monitor Head fails to receive important signals back from the sensor loop when it attempts to reset the sensors. The nature of the problem does not allow the Monitor Head to detect exactly where the fault is.

Testing the Monitor Head

It is possible that the fault could be in the Monitor Head itself. To determine this, disconnect the Monitor Head from the extension cable so that there is nothing plugged into the Monitor Head at all. The Monitor Head should display 'Err 1' if it is working correctly.

Testing the First Extension Cable

If the problem is in a cable the cause is most likely a short. A crushed cable or a nicked cable that has absorbed moisture could cause this problem. Moisture in a connector is another possibility. To find out if the fault is in the extension cable, re-connect the extension cable only. The Monitor Head should again display 'Err 1' if the cable is functioning correctly.

Testing the Y-cable

To test the Y-cable re-connect it to the extension cable. Disconnect the sensor loop from both sides of the Y-cable. The Monitor Head should display 'Err 1' if the Y-cable is okay.

During each step, if the problem does not re-appear immediately, wiggle the cables and connectors to determine whether or not the problem is intermittent.

Testing Sensors

To test the sensor loop reconnect cables and sensors one at a time. After connecting the first Flow Sensor the Monitor Head should display 'Err 2' if everything connected is functional. As each Flow Sensor is connected the number will increase by one. Eventually you should find that the Monitor Head will begin to display the 'HELP' message again. Disconnect the last part added and the display should return to an 'Err' message and the number of the next sensor in line.

Testing Larger Systems

With larger systems, if the fault is located near the end of the loop disconnecting and connecting one sensor at a time could take a long time. One method for narrowing down the location of the problem is to reconnect several sensors at a time to see if the 'HELP' message re-appears. A convenient way to do this is to disconnect the extension cables between distribution towers and then re-connect the first tower as a group. If the 'HELP' message does not re-appear, add towers until it does. You can then disconnect individual sensors until the 'HELP' message disappears again. For this test remember to disconnect the last tower from the Y-cable or junction box.

Using 'Err' Messages

During the Power-Up Self-Test, and anytime the AR-99 is operating normally in Seed Scan Mode, the Monitor Head scans through the sensors expecting to receive verification from each one that it is present and operating. If the verification signal is missing the Monitor Head flashes the message 'Err' and the number of that sensor. It also signals the fault with a

double beep from the audible alarm. The Monitor Head repeatedly attempts to communicate with the sensor in question continuing to flash the display and sound the alarm until the problem is corrected. When the problem is corrected the Monitor Head returns to Seed Scan mode.

It is important to understand that the 'Err' message only indicates that the verification signal, which should have been generated by the sensor, was not received. This could mean that a connector is simply unplugged. It could also mean a sensor is faulty, or it could mean that a short or open circuit in the wiring caused the failure. In rare cases a problem with the sensor before or after the indicated sensor could cause this problem.

Swapping Sensors

Often the 'Err' message leads you directly to the source of the problem. If you have a spare Flow Sensor that you know is functional, swap out the Sensor indicated. If the problem goes away you have probably found the fault. One way to confirm this is to plug the faulty sensor into another point in the loop to see if the alarm indicates the new position in the loop. If you do not have a spare sensor just bypass the one in question. If the sensor was faulty the system should begin to operate correctly (although the total number of sensors will be decreased by one).

Bypassing Sensors

If replacing the indicated Sensor does not solve the problem try bypassing that Sensor and the ones on either side of it. Does the system now operate correctly? If so, zero in on the faulty sensor by replacing each of the ones bypassed, one at a time, until the problem reappears.

Other Causes of 'Err' Messages

A noisy or low power supply voltage can also cause intermittent 'Err' messages. Refer to the section below **Using a Multimeter for Testing Power and Continuity** for instructions on how to test the power supply voltage.

Static electricity can also cause 'Err' messages. This would typically only occur while seeding when static is being generated. If all the Standard Solutions relating to this fault have been completed and the problem persists, try to determine if the intermittent message occurs when the implement is stopped.

Intermittent connections and cables may also be the problem. Allow the connectors to see if the problem starts or stops.

Using the Sensor Scan Test

The Sensor Scan Test is initiated by holding in the Seed Count button while turning on power to the Monitor Head. This test continuously scans the sensor loop checking for the required signals from each sensor in sequence. Faulty sensors can be detected using the Sensor Scan Test and the test can also be used to check cables for intermittent operation. As the system scans through the sequence cables and sensors are wiggled to see if the Monitor Head detects incorrect signals due to intermittent faults.

While in the Sensor Scan Test mode the Monitor Head does not alarm on no-flow conditions. If a fault is detected the display will stop counting and flash the number of the sensor currently being tested. The audible beep will sound about once per second. Even if the fault is corrected the Monitor Head will continue to flash the number and sound the alarm. The Monitor Head must be powered down and restarted to re-initiate the test. If the sensor detects flow through it while this test is in progress it will respond as if it is a faulty sensor as well.

Testing for Sensor Ground Straps

Although Sensor Ground Straps are not recommended on new installations of the AR-99, some systems in the field may still have them connected. A quick way to determine whether any ground straps are still connected on an implement is

to remove the ground fuse at the Monitor Head. If any of the straps are still present the Monitor Head will continue to operate because it receives its ground connection through the sensor loop. If no sensor grounds are connected the Monitor Head display and LEDs will no longer be illuminated indicating the loss of power.

Using a Multimeter for Testing Power and Continuity

A multimeter can be an effective tool in testing for some faults on the AR-99 system. Typical multimeters will measure voltage, current and resistance over a wide range of values. Analog multimeters (shown on the right below) use electromechanical meter movements that point to a value on a scale. This type of meter may be satisfactory for many of the measurement you wish to make but analog meters have some disadvantages compared to digital meters. Analog meters tend to be more fragile and may affect the circuit you are measuring, causing them to be less accurate than digital meters. The range to be measured must be set manually on most analog meters and, if set incorrectly, could result in damage to the meter itself. Digital meters tend to be equipped with more features, including automatic ranging features. They are also more rugged and easy to read the measurements.

Figure 28. Two Different Types of Meters

Whether you are using a digital or analog meter, always consider what you are trying to measure *before* connecting the meter to the circuit. Never connect the meter leads to a live circuit if it is set on a resistance range. When measuring voltage with a meter with manually set ranges always begin with the highest voltage range and work down until you have reasonable resolution. It is unlikely that you will ever need to measure current while troubleshooting the AR-99.

If you require more information on how to use a meter obtain the user manual for your meter and read it carefully. You may also be able to obtain information on how to use a meter from a local electronics supplier such as Radio Shack.

Testing Power Supply Voltage at the Monitor Head

Although it is customary to describe the battery voltage as being +12 volt power, automotive batteries are nominally 14.2 volts. If the charging system of the tractor is working properly battery voltage should normally be over 14 volts and less than 14.5 volts. Although the battery voltage may drop temporarily while cranking the engine, once the engine is running the charging system should bring it back to over 14 volts within a short period of time. Battery voltage may drop slightly when the tractor is not running, especially if any significant current has been drawn by accessories. Since the AR-99 is only used when the tractor is running the voltage available should always be at least 14.2 volts.

Figure 29. The In-line Fuse Holder

Power supply voltage decreases over the distance it travels through the sensor cables. The AR-99 requires a minimum of 14.2 volts at the Monitor Head to ensure that the voltage supplied to sensors at the farthest point in the loop will always be sufficient to operate them reliably. This is especially true of AR-99 systems using a large number of sensors. If the battery voltage drops below about 14 volts it could cause the Monitor Head to produce 'HELP' or 'Err' messages. It could also cause false blockage alarms. If the voltage drops lower than about 8 volts the Monitor Head itself will probably not operate at all.

Set your meter so that it can measure 14 volts with the highest possible resolution your meter provides. Make your first measurement with the key switch on but without the tractor running. Measure the voltage from the red wire (+12 volt power) to the black wire (chassis ground) at the in-line fuse holder on the Monitor Head power cable. Check both the incoming side (ignition circuit) of the fuses, and the out-going side (Monitor Head). In both cases the voltage should be at least 14 volts DC and it should be stable. If you measure about 14 volts on the incoming side but not on the outgoing side one or both of the fuses are probably blown.

If the voltage is less than 14 volts you may have a weak tractor battery or the charging system may not be charging up your battery while running.

Continue to measure this voltage and start the tractor. The voltage should increase somewhat but it should not exceed about 14.5 volts. If the voltage goes much higher than that you may have a faulty regulator circuit on your tractor. The voltage should remain constant while the tractor is running. If turning on lights or other accessories drops the battery voltage below 14 volts you may have a problem with the tractor electrical system.

Testing Voltage in the Sensor Loop

To facilitate testing battery voltage, and other signals, at any point in the sensor loop a special 'break-out' cable can be obtained from Agtron. This cable can be inserted into the sensor loop at any connector. It provides access to the cable conductors via a terminal block. To test the worst-case power supply voltage you should insert the break-out cable into the middle of the sensor loop. (The reason for this is that power and ground are connected to the loop from both ends. In a system with 120 sensors the lowest possible voltage would occur between sensor #60 and sensor #61.) Measure the voltage from the white wire to the black wire. It should be at least 8 volts.

Figure 30. The Breakout Cable used for Testing Voltage & Continuity

In rare cases a faulty electrical system on the tractor, or the presence of some other electronic devices, can create electrical noise on the battery voltage supply. A standard multimeter measuring voltage cannot detect electrical noise unless it is changing very slowly. If random faults with the AR-99 persist after all the **Standard Solutions** have been performed on the system it may be necessary to obtain more sophisticated test equipment to test the battery voltage for noise.

Testing for Continuity

A multimeter can be used to check wiring for short circuits (a connection that isn't supposed to be there) and open circuits (a lack of a connection where there

should be one). Some meters are equipped with a continuity setting that produces a beep as long as continuity (low resistance) exists between the meter leads. These meters will normally display a very low number (almost zero) when continuity exists. Other meters use the resistance setting and may or may not have an audible indicator.

When checking for continuity resistance should be very low, in the order of 0 to a few ohms. On the AR-99, if you measure more than 50 ohms through a wire or connector it probably is faulty.

Continuity checks can be used:

- to be sure that fuses are still functional
- to make sure power wiring is connected all the way from the fuse block to the battery (disconnect the wire from the battery terminal while doing this)
- to make sure ground wiring is connected all the way from the fuse block to the chassis
- to make sure extension cables are connected from connector to connector to make sure optional sensor wiring is functional. When the complete sensor loop is connected, each conductor should be continuous throughout the loop, with the exception of the yellow wire.

Continuity and resistance measurements can also be used to detect short circuits. For example, extension cables have several conductors. None of these conductors should be connected to any other conductor. With the cable disconnected at both ends you can measure from pin to pin in the connector. In all cases the resistance measured should be extremely high (virtually infinite).

Never measure continuity of power wiring if that wiring still connected to the battery. You could damage your meter.

The breakout cable shown above can be used for measuring both continuity and shorts. Continuity through one or more cables connected together can be accomplished using two breakout cables.

Measure continuity from end to end by connecting one meter lead to each end of the cable. Intermittents can be found by wiggling the cable while doing this test. If you are checking continuity of several cables with Flow Sensors connected in line, all the wires should show continuity except the yellow wire.

Using the Display Self-Test

The Display Self-Test does a quick check of the display and LEDs in the Monitor Head. If any segments do not light up during this test you may have a malfunction in the Monitor Head. This test also allows you to check the operation of the Sensitivity control. As the control is turned clockwise the speed of the display should increase. Dirty or dead spots in the Sensitivity control will cause the sequence to stop or change speeds abruptly. If any of these tests fail the Monitor Head should be returned to Agtron for replacement.

Testing for Sensor Buildup

A quick test to determine whether seed treatments may be causing false blockages can be done if translucent tubes are being used. If the treatment has built up to the point where you cannot see through the tubing there is a good chance that the treatment buildup is interfering with the infrared detector inside the flow sensor.

Testing for Moisture in Connectors

Although moisture in connectors is rarely a problem with the AR-99 a quick and simple test can be performed to be sure. With the connector disconnected simply blow into its open end. Any moisture present will be forced back out of the connector and you should be able to feel it spray back in your face.

Testing Individual Sensors

An individual Flow Sensor can be easily and quickly checked by plugging it directly into the Monitor Head cable. The Monitor Head should indicate 'Err 2' if it detects the presence of the sensor. If the sensor is faulty it could cause a 'Err 1' or a 'HELP' message.