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Section 1
Warranty

Veris Technologies warrants this product to be free of defects in materials and workmanship for a period of one (1) year from the date of delivery to the purchaser. Veris Technologies will repair or replace any product returned to Salina, Kansas, which appears upon inspection to be defective in materials or workmanship. Veris Technologies shall have no obligation under this warranty for the cost of labor, down-time, transportation charges, or for the repair or replacement of any product that has been misused, carelessly handled, modified, or altered.

ALL OTHER WARRANTIES OF ANY KIND, WHETHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE AND ALL CLAIMS FOR CONSEQUENTIAL DAMAGES, ARE SPECIFICALLY DISCLAIMED AND EXCLUDED.

Safety

Look for Safety Symbol
The SAFETY ALERT SYMBOL indicates there is a potential hazard to personal safety involved and extra safety precaution must be taken. When you see this symbol, be alert and carefully read the message that follows it. In addition to design and configuration of equipment, hazard control and accident prevention are dependent upon the awareness, concern, prudence and proper training of personnel involved in the operation, transport, maintenance and storage of equipment.

Be Aware of Signal Words
Signal words designate a degree or level of hazard seriousness.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is limited to the most extreme situations, typically for machine components that, for functional purposes, cannot be guarded.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury, and includes hazards that are exposed when guards are removed. It may also be used to alert against unsafe practices.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
Important! Read the following SAFETY PROCEDURES before operating the Veris system:

• Read and understand all instructions on safety decals

⚠️ WARNING ⚠️

• Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic lines. Use a piece of paper or card-board, NOT BODY PARTS, to check for suspected leaks.
• Wear protective gloves and safety glasses or goggles when working with hydraulic and high-pressure wash systems.
• If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.

⚠️ WARNING ⚠️

• Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the Veris implement.
• Install all transport locks before transporting or working underneath.
• Detach and store implements in an area where children normally do not play. Secure implement by using blocks and supports.

⚠️ CAUTION ⚠️

• Read Operations Manual before operating machine
• Review safety instructions with operators before operating machine and at least annually
• Never stand on or use tire as a step
• Do not tow the implement on public roads without the road-kit light package, or without the proper safety equipment and licensing as required by your State Department of Transportation. Always use safety chain.
• Riders obstruct the operator’s view. They could be struck by foreign objects or thrown from the machine.
• Never allow children to operate equipment.
• To prevent possible electrical shock, or damage to the instrument, do not connect to any power source greater than twelve (12) volts DC.
• Do not grease or oil implement while it is in operation.
• Disk edges are sharp. Be careful when working in this area.
• Disconnect battery ground cable (-) before servicing or adjusting electrical systems or before welding on implement.
• Remove buildup of mud, oil or debris.
• Be very careful when mapping stubble fields with a gasoline engine vehicle. Be prepared if a fire starts.
• Keep a first aid kit and fire extinguisher handy.
Excess speed, especially when turning could cause overturning.

Never pull units faster than 15 km/hr.

Use caution when working on implement. Coulter disks are sharp and may cause cuts.

Don’t allow anyone to climb or ride on implement

The vehicle that pulls the Veris unit thru the field will get hot! There is a chance that this heat can cause field fires in stubble fields.

Don’t lower unit while any part of body is underneath
Keep safety chain installed

Install jack before unhitching; do not drop unit on foot

**FCC NOTE**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at this own expense.
EUROPEAN DECLARATION OF CONFORMITY

Veris Technologies, Inc., located at 601 N. Broadway in Salina Kansas, certifies that the product:

Veris MSP3

is in conformity with the following directive and standards:
Electromagnetic Compatibility 2004/108/EC —December 2004
   EN55022 – Measuring Radiated Emissions

The Technical File is maintained at:

Veris Technologies, Inc.
601 N. Broadway
Salina KS 67401

Date of issue: May 1, 2012
Place of issue: Salina KS USA


Statement of Use

Intended use of the Veris MSP3 model

The Veris MSP3 Soil EC, Organic Matter, and pH Mapping System collects geo-referenced soil electrical conductivity (EC), soil reflectance, and soil pH measurements as it is pulled across a field by a tractor. An electronic device called the Soil EC Surveyor, powered by vehicle’s 12V DC electrical system, generates a small electrical current, which is transferred into the soil through a pair of rolling electrode coulter disks. A second pair of disks measures the drop in voltage which is proportional to the electrical conductivity of soil medium at a given location. Signal response is due primarily to soil texture/grain size and soil salinity. Clay soils and soils with high salinity levels are highly conductive, while coarser soils such as sand do not conduct well. Another electronic device called the OpticMapper controller, powered by vehicle’s 12V DC electrical system, sends power to an optical sensor which has two wavelengths of LEDs and measures the amount of light reflected off the soil surface with a photodiode. The optical sensor is mounted inside a standard row planter, with two discs to cut a furrow in the soil and two depth gauge wheels to keep the sensor at constant depth. Signal response is due to soil color, darker soils are generally higher in Organic Matter; while lighter soils are lower in Organic Matter. A final electronic device called the pH controller, powered by vehicle’s 12V DC electrical and hydraulic system, measures soil pH using two electrodes. The pH controller cycles the pH sampling shoe into the soil, where a soil core is collected and brought up and pressed against the electrodes for a measurement. Once a stable reading is measured, the sampling shoe moves down to collect another soil segment, and the electrodes are washed off. This process is repeated every 20-30 seconds, as long as the operator keeps the system engaged, and ground speed is received. The sampling shoe is controlled by hydraulic solenoids, while the wash jets are powered by two 150 psi pumps. The system records the data on a data recording device such as a laptop computer. Ultimately, the data are displayed in a map format, and variable applications of crop production materials, such as seed, fertilizer and other inputs are variably applied to the zones delineated on the maps. The MSP3 system is designed for use in a farm field, and has no dynamic movement unless vehicle is pulling it, or operator is manually activating switches, so guarding around soil engaging components is not needed and would interfere with field operations. Unit should not be operated when people are present in the field, as coulter disks are sharp and automated movement could cause injury if contact occurs.

Misuse of the Veris MSP3 model

Misuses of the MSP3 model include operation with people in area, and pulling the system at an excessive speed. In field position, this could result in poor data collection and possible tractor overturning at extremely high speeds and sharp turns. In raised position, the chance of overturning is increased, as the center of gravity is higher, so care must be taken to keep speeds under 15 km/hr, and less when turning.

Abnormal use of the Veris MSP3 model

Abnormal use of the MSP3 model includes using it as a cart for carrying equipment, tools, or people. Under no circumstances should anyone ride on the implement. Even though the implement is similar in appearance to a tillage tool, such as a disk harrow, it was not designed for that usage and should never be used for any purpose other than soil data collection.
MSP3 Lifting Points

Below are the recommended lifting points for the unit. Using two straps you can safely lift the unit. Make sure the straps used to lift are rated greater than 1200 lbs. Fork extensions maybe required to lift. Always stay clear when lifting the unit.

Here are the proper lift points for side loading
If lifting from front or back of the unit, use the points shown below.
Section 2
Electronics Overview and Set-up

The MSP3 electronics kit shown below.

![MSP3 electronics kit](image)

Keep all diagnostics and operations manual with system when mapping.

The supplied GPS (Figure 2) is configured to operate with the MSP3 electronics.

The use of any other GPS requires the correct settings. The GPS needs to output only two NEMA strings (GGA and VTG OR RMC). **The system will not run with more than two strings.** The strings need to output at 4800 baud and 1Hz refresh rate.

![GPS](image)
The OpticMapper Controller is mounted on the implement, and can remain on the implement due to weatherproofing.

Figure 3 OpticMapper

Figure 4 OpticMapper/EC Controller

Figure 5 OpticMapper Controller (rear)

OM Com/GPS Input
Serial communication to PC and GPS input with cable #49494

12V Power
Power cord shipped with the unit that connects to the vehicle’s battery

Figure 6 OpticMapper Controller (front)

Optic Power
Delivers power to Optical sensor with cable #46222

On/Off
Turns power to OpticMapper Controller On/Off

3A Fuse

Power Indicator
Indicates when power to the controller is on

EC Signal
Connects to EC wire harness with cable #49457
Electronic Configuration

Soilveiwer – Connect both communication cables from OpticMapper/EC Controller and from the pH Controller to Laptop using the supplied USB to Serial converters. Connect EC signal cable, GPS, and power cords to the OM/EC controller.

Camera Mount – Standard hardware for the MSP3 includes a camera mount. This will allow monitoring of the pH sensor as it samples soil with user supplied camera.
SoilViewer Software Setup

All 2014 models and on require SoilViewer 2.52 or higher.

The Veris SoilViewer software will automatically run the setup once the CD is inserted into the computer. If not the installation can be manually started by double clicking on the setup.exe located on the CD.

Once the CD has begun select the installation directory and click Next.

Next two license agreements will need to be accepted before continuing.

Click Next to continue installation.
The installer will install all necessary components.

Once the installer is completed, click **Next** install the USB drivers.

Veris SoilViewer will now install drivers necessary to operate the included USB-Serial Converter (part #41377). If you do not want to use the included converter than press cancel here, otherwise click **Next**.
Once the computer is restarted the USB to Serial converter cable can be plugged in, Windows will recognize the new hardware.

After the drivers are successfully installed click finish and **Restart** your computer before opening Veris SoilViewer.

Windows will then advice the new hardware is installed and ready to use.
Section 3
Implement Overview and Set-up

Figure 1  MSP3 with EC, OM, and pH sensor modules

⚠️ WARNING

- Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the Veris MSP3.
- Install all transport locks before transporting or working underneath.
- Always use the service stands when working underneath the MSP3.

Figure 2a  Figure 2b
12 Volt Power and Hydraulics Set-up

If the unit has been crated and delivered via closed-van commercial freight, the tongue (if equipped) may need to be installed prior to use. Prior to operating the implement for the first time, it is important to check all fasteners – some may have loosened during shipment. Route cables and hydraulic hoses along tongue and through hose guide. Tie-strap securely. Connect electrical cables to battery. Be careful to attach black cable to negative/ground terminal. DO NOT REVERSE POLARITY.

![Diagram of power and hydraulic connections](image)

Insert hydraulic ends into quick-couplers, being careful to insert the end marked “P” into the tractor extension coupler, and the end marked “T” into the tank or return line coupler; in this configuration, tractor’s hydraulic lever will be secured in raised position. If sampler shoe operates in reverse, simply reverse hydraulic hoses, or secure lever in lowered position. **Note:** Be certain whether tractor or hydraulic power source utilizes open or closed-center hydraulics. Damage to tractor could occur if not set properly. The poppet knob is set ‘up’ for open systems, and ‘down’ for closed-center systems – (see settings below.) Press down and turn knob to lock down—press down, turn and release to allow it to move up to open position.

![Diagram of hydraulic poppet valve](image)

**Figure 3**

**Figure 4**

- pH 12 V Power leads
- pH com cable
- OM 12 V Power leads
- OM com cable
- GPS Input

Open/Closed center hydraulic poppet valve

- Up (out) for open center tractor hydraulics
- Down (in) for closed center tractor hydraulics
Flow control settings:

Open center hydraulic systems

1) Set poppet valve in “up” raised position, this allows flow back to tank
2) Set engine at field rpm
3) Set pH controller to “Manual” and run sampling shoe up and down, timing the cycle time.
4) If sampler raises in approximately 1.5 -2 seconds, leave flow control as is, if not, adjust control arm upward or downward to achieve desired speed.

Closed center hydraulic systems

1) Set poppet valve in down position. Push down and rotate so that rolled pin locks into closed position. This blocks flow and allows the pump to de-stroke when the directional valve is in the neutral position.
2) Adjust flow control valve to full open position.
3) Set engine at field rpm.
4) Run sampling shoe upward and adjust raise time to approximately 1.5-2 seconds using throttling valve on tractor’s remote coupler

Note: Excessive sampling shoe speed can damage electrodes.

Flow control valve
Adjustment control arm

Figure 5

⚠️ WARNING

- Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic lines. Use a piece of paper or card-board, NOT BODY PARTS, to check for suspected leaks.
- Wear protective gloves and safety glasses or goggles when working with hydraulic and high-pressure wash systems.
- If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.

Flush and fill tanks with tap water; clean any foreign matter out of tank using ball valve clean-out. Set ball valve to open position, allowing water to flow to pumps.
Connecting cables to External controller as shown below:

Figure 7
Remove pH electrodes from individual storage containers. Loosen plastic set screws on electrode holder and insert pH electrodes into electrode holder. Re-tighten set screws finger tight and lock in place with lock nuts. Do not overtighten set screws or electrode damage may occur. Route electrode cables away from sampling mechanisms to prevent damage—tie-strap excess length of cable as needed.

Figure 8
Section 4
Field Operations: SoilViewer: OM and pH System Checks

To acquire data with the MSP3 only EC OM pH- MSP3 can be used. This is the only option that will work with the MSP3. This will allow the user to collect all three sensor readings, or collect only EC and OM if desired.
The EC OM pH-MSP3 Mapping software will automatically detect which ports the Veris OpticMapper /EC Controller and pH Controller are connected to, and begin communicating. If either is not detected, the software will wait 45 seconds for the connection of the electronics and search again; this will repeat until both instruments are connected. If the electronics are not found, unplug the serial or USB cables and reconnect them to the PC. If the connections are still not made, refer to SoilViewer troubleshooting. The conditions for mapping and storing the data are as follows. The user must be going a speed greater than 1 mph, there must be a GPS signal received that includes position and speed (GGA and either VTG or RMC), the OM/EC Comm Light must be green, indicating the PC and OpticMapper with EC Surveyor are communicating properly, and either of the EC values has to be greater than -1.

Before mapping, run the OM system check and pH calibration to ensure everything is operating correctly. pH controller settings can be modified to adjust the wash and cycle times for specific field conditions.

After clicking on EC OM pH- MSP3 the user will be prompted to input the EC file name. All OM and pH files will be named the same as the EC. Files may be appended to by selecting a previously created VSEC file.

![Figure 3](image3.png)

**WARNING**

- Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the Veris MSP3.
- Install all transport locks before transporting or working underneath.
- Always use the service stands when working underneath the MSP3.

![Figure 4 a and b](image4a.png)
The OM System check ensures the optical sensor and controller are functioning properly. By using the light and dark reference block the range of the sensor can be determined. For proper operation the range from the dark to light side for the red and IR readings must be at least 100. If it is not that may indicate a broken wearplate, inadequate power, or damaged sensor. Run the system check before mapping each field to ensure proper operation. The results of the system check are stored in a .inf file specific for each field.

Select OM under the Sensor Checks drop down to start system check.

After clicking the System Check button the following will appear:

Make sure the window is clean and in good condition. (see 4-8) Place the dark side of the reference block under the window, and click continue. The following message will appear.

Turn the reference block over to the light side and place under the window, and click continue. Either of the following messages will appear:
**pH System Check: Calibrating pH electrodes**

Select ISE Calibration from the Sensor Checks drop down menu

![Figure 9](image)

You will be asked if you want to continue the calibration or restore ideal settings.

![Figure 10](image)

You will be asked for the ID of the electrode connected to channel 1. You may want to add an ID name or number to the electrodes, for your own tracking purposes. Insert the name or number then press OK to continue.

![Figure 11](image)

You will be asked to insert electrodes into pH 4 buffer solution.

![Figure 12](image)
The software will prompt for the electrodes to be inserted into pH buffer 4 solution; Slide cup with pH 4 buffer solution onto electrode holder. Press 1 to continue with calibration or 2 to exit. **Tips:** Don’t overfill solution. Cup only needs enough solution to immerse electrode tip and face. Don’t reuse solutions.

The software will read the electrodes for 10 seconds, displaying the output (as it counts seconds):

![Figure 13](image)

The software will display the final pH reading and offer the options to Accept pH 4 buffer readings; Redo pH 4 buffer readings; or Cancel pH electrode calibration. If the readings are satisfactory, press Accept; if the readings are suspect, press Redo to return to re-do pH 4.

![Figure 14](image)

![Figure 15](image)
After accepting the pH 4 buffer readings, the software will prompt for the electrodes to be inserted into pH 7 buffer solution. Remove the pH 4 buffer solution cup from the electrode holder. Rinse the electrodes, electrode holder, and solution cup using the manual wash for at least 10 seconds. Slide the pH buffer 7 solution cup onto the electrode holder.

Press continue to proceed with the calibration. The software will read the electrodes for 10 seconds, displaying the output. After 10 seconds, the software will display the final pH reading and offer the options to Accept pH 7 buffer readings; Redo pH buffer 7 readings; or Cancel pH electrode calibration. If the readings are satisfactory, log pH 7 reading and press continue; if the readings are suspect, press redo to return to pH 7 calibration step.

After accepting the pH 7 buffer readings, the software will determine if each electrode’s response is sufficient to provide suitable readings. A score is displayed for each electrode; the acceptable score range is between 75 and 102. If both electrodes are within this range, the software will display the following screen:

If an ‘X’ is displayed beside one or both electrodes’ scores, this indicates that one or both of the electrodes did not perform well enough for continued reliable use. No calibration settings are changed if calibration is unsuccessful. The electrode(s) responsible for failed calibration should be removed and either cleaned (See section 5-7) or replaced and the calibration procedure repeated.

After calibration is complete, you will have the option to use the calibrated readings or reset to the default parameters. Tip: many operators use the default parameters rather than calibration settings. One reason is this enables readings from one day to be compared to another. It is still important to perform the calibration step at least daily, even if ideal settings are used. The calibration process is important to test electrode quality.
**pH Controller Set-up**

After calibration, you may wish to change the pH Controller default parameters. Select pH Controller Setup from the Options drop down menu.

![Figure 19](image)

The pH sampler settings can be adjusted without exiting the current file. Additionally, a correction can be applied to each electrode’s pH shown on the screen. Occasionally, the pH readings shown on the screen may differ from those expected in the field. If this is the case, the pH shown on the screen can be adjusted up or down with the pH offset 1 and pH offset 2.

The offset is adjustable in 0.5 pH increments up to +/- 2.00 pH. **NOTE:** The instrument DOES NOT apply this offset to the extracted file. Only the readings seen on the screen will be affected.

Sampling time is the duration that the sampler assembly is in the soil. Typically 2 seconds is adequate. In soil conditions that do not produce a firm core, this time may need to be set at 3 seconds in order to allow soil to begin flowing through cutting shoe. If soil conditions result in a very firm core, the sampling time may be reduced to 1 second. Press the up and down arrows to adjust the sample time.
Log time is the longest time in seconds the pH controller will wait for the pH readings to settle. The controller usually cycles before this maximum time is reached. The minimum setting for the log time is 20 seconds. Press the up or down arrows adjust the sample time. *(Tip: use 20 seconds unless there is a special reason to allow a longer wait time)*

Turning on the extra wash option will add 1.5 seconds of cleaning per cycle. The extra wash is performed by automatically stopping the shoe briefly during the cycle. Use this feature if you have noticed the electrodes are not cleaning during the cycle. Put a checkmark in the box to turn the extra wash on and uncheck to turn off the extra wash. *(Tip: water usage will double if extra wash is used)*
Field Operations—EC and OpticMapper

Tools required for Field Operation adjustments
-3/8”, 7/16”, 1/2” 9/16” 3/4” 15/16” wrench
-9/16”, 3/4” 12point socket
-3/8” ratchet
-Ohm meter

Checking Electrical Signal Continuity and Electrode Isolation
It is recommended that you perform the Electrical Signal Continuity and Electrode Isolation test procedure before first field use (see Main
tenance and Service Procedures 2 and 3). While these tests were made at the factory, there is the possibility a problem developed during shipping. Performing these tests on the new implement before it becomes dirty, allows you to get familiar with the process under ideal conditions. It is strongly advised that you perform this test on a routine basis (every 10 hours of data collection) to ensure you are obtaining reliable data. **KEEP OHMMETER, TEST LOAD AND TEST BOX WITH THE MACHINE AT ALL TIMES.**

Setting Operating Depth
Begin field operation by lowering unit into soil. For good electrical conductivity, all coulter electrodes must be in direct contact with moist soil, at all times and in every region of the field. A depth of 1-2” (2.5-5 cm) is recommended. To insure this depth is consistently achieved, 400-600 lbs. (180-275 kg) of additional weight are normally required. Carrying water in the pH wash tank can aid penetration. Also, Veris offers optional weights, or they can be supplied by the customer. Do not adjust the tension on the coulter electrode springs to increase soil contact or penetration. They are pre-set at the factory with the proper tension.

![Figure 21](image1)
![Figure 22](image2)

Depth Sensor
The depth sensor allows the operator to track the mapping depth of the OpticMapper sensor. If the depth is not consistent the data quality can be affected. Figure 23
Adjustable Wing Extensions
This feature allows the re-positioning of the electrodes to fit various bed and crop configurations. Adjustment is made by loosening the jam nuts and set screws located on the lower front of each side of the toolbar, adjusting the toolbar wing extensions, and re-tightening the set screws. Veris suggests setting the toolbars at either the maximum or minimum setting, not at a point in between. A limiter bolt determines full extension, so they cannot extend to the point at which the outside coulters disconnect from the main frame. Important – do not attempt to combine maps in which two different investigative depths are used.

![Figure 24](image)

Figure 24: set screws and jam nuts

**WARNING**
- Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the Veris MSP3.
- Install all transport locks before transporting or working underneath.
- Always use the service stands when working underneath the MSP3.
3-point Adjustment

Turn the top link (Figure 27) to adjust the tilt and level the unit. This is the optimal setting for all fields types. Extending the top link will cause the rear of the unit to move down. Shortening the top link will cause the inverse.

Row Unit Adjustment

Adjust side depth wheels on optical row unit to allow deeper or shallower mapping. Using the Adjusting Tool provided (Figure 28a) move (Figure 28b) backward for deeper depth. Depth wheels should be snug, but freely moving, against the disks. See Section 5-3 for more information.
Adjust spring pressure on row unit as needed. With implement lifted to reduce pressure on springs, move handle forward to reduce spring pressure and back to increase. Additional weight may be required in hard soils. Reduce pressure in rocky conditions to prevent damage to window. (Figure 29)

**WARNING**

Use Service Stands

**Row Cleaner Adjustment**

The row cleaner needs to be adjusted for your conditions, crop changes, and as coulters and openers wear. Ideally, cleaners contact only the trash, and do not disturb the soil.

To adjust row cleaner loosen bolts, 1, and slide the down stop, 2, to the desired cleaning depth. Forward for deeper cleaning and backward for shallower cleaning.

(Figure 30)
Coulter Adjustment

Adjusting the coulter depth is accomplished by re-mounting the coulter blade in one of the six mounting holes arranged in a staggered pattern in the coulter bracket.

**WARNING**

*Use Service Stands*

Raise unit and lower service stands before working on coulters. Do not attempt to move blade when the current or new position causes it to contact the ground during the adjustment. Be careful around the front end of row units. Row cleaner tines and coulter blades may be sharp.

To adjust coulter depth:
1. Determine the present opener and coulter depths.
2. Note which bracket hole the coulter is presently using.
3. Determine which new hole will position the coulter closer to the 1/4in-above depth. See the table below.
4. Remove the 5/8-11 x 4in bolt, lock washer and nut (A in Figure 31).
5. Move the blade to the new position. Insert the bolt, and tighten on the lock washer and nut.
6. Re-adjust row cleaners, if installed. If a worn coulter cannot be adjusted to satisfactory operating depth, replace coulter.

<table>
<thead>
<tr>
<th>Hole Number</th>
<th>Depth of (new) coulter blade relative to (new) opener blades</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1in (25mm) above</td>
</tr>
<tr>
<td>3</td>
<td>5/8in (16mm) above</td>
</tr>
<tr>
<td>5</td>
<td>1/4in (6mm) above</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3/8in (9.5mm) below</td>
</tr>
<tr>
<td>6</td>
<td>3/4in (19mm) below</td>
</tr>
</tbody>
</table>

Figure 31

Figure 32
Speed
Proper field operating speed depends on field condition. Because of the importance of consistent contact, the unit must not be allowed to bounce over rough fields at high speeds.

Field Condition
Field should be in a uniform state. Mapping after intensive primary tillage is not recommended. The soil must have a minimum of 20% available water, and cannot be frozen. If rocky conditions exist, slow down and make sure rock guards are in place. Also if the field is rocky and/or muddy the optical module will need to be adjusted to make optimum contact with the soil, as well as decreasing the chance for window breakage.

Swath width and Navigation
Setting the swath width and navigation system is at the discretion of the customer. A 50’-75’ (15-23 m) swath works well in most areas. Several methods of navigation are possible: following previous crop rows, swath guidance, or using a field navigation computer. While it is important to map in a consistent pattern, it isn’t absolutely critical that each pass be exactly the same distance from the previous pass.
To help insure the quality of your data, please follow these guidelines:

1. Generate and view maps frequently, especially prior to deleting data from Instrument.

2. View SoilViewer map frequently during data collecting; watch for:
   • Negative readings in the Shallow and Deep or excessive noise in the OpticMapper data.
   • Sensor readings should fluctuate gradually as you drive across the field, relating to soil changes. If readings change erratically, or show values not typical of soil in the area, perform 4-5 below.
   • In SoilViewer, watch for streaks, stripes, unnatural patterns, and missing data points.

3. Perform electrical continuity test on implement wiring:
   • at least once a day during mapping season
   • every 10 hours of mapping
   • after extended periods of non-use
   • after replacing or repairing coulter-electrode components or wiring
   • whenever readings are questionable

4. Perform EC Signal Testing Procedures #2 and #3:
   • at least once a day during mapping season
   • every 10 hours of mapping
   • after extended periods of non-use
   • whenever readings are questionable

5. Perform black/white reference OM System Check and OM Test Load Procedure #1
   • Before mapping every field
   • Whenever readings are questionable

6. Keep all electrical connections dirt and moisture-free

7. Limit speeds in rough or rocky field conditions. This will improve data quality, and will also lengthen the service life of the implement components. NEVER EXCEED 15 M.P.H. FIELD SPEED WHEN MAPPING EC/OM. NEVER EXCEED 7.5 M.P.H. WHEN MAPPING PH.
OM Data Quality

Check depth of sensor – Make a couple of trial passes to make sure the sensor is running at the proper depth. Recommended depth is 2-3 inches. Add weights or adjust down pressure on row unit if needed.

Also make sure the row unit side depth wheels and disks are rotating freely, and are clear of excess mud and crop residue.

Monitoring the window – Observe OM readings at row ends when unit is raised, if they are not within 10% of the initial raised readings, check windows for mud, smearing, and/or window breakage.

Varying Field Conditions – In order to have high data quality the field conditions need to be the same for an entire data set. Any of the following can affect data quality: in-field soil temperature and moisture difference, change in down pressure or depth gauge wheel setting. If conditions change, start a new file.

Figure 33 is an example of how these items can affect data quality.
OpticMapper Wearplate

Below is a comparison of two wearplates. The left is a brand new wearplate, and the right has about 2500 acres on it. Inspect the leading edge, shown below, as the steel wears the window can chip or crack. As this continues to wear it will eventually need replaced.

![Wearplates comparison](image)

Figure 34a & b

Wearplates will wear differently in every type of soil, so check it often. To replace wearplate refer to Procedure # 9
Field Operation—pH Manager

Tools required for Field Operation adjustments
- 3/16” allen wrench
- adjustable wrench: min. 10” (25 cm) length
- 3/4” socket and wrench
- 9/16” socket or wrench
- 15/16” wrench

WARNING

- Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the MSP3.
- Install all transport locks before transporting or working underneath.
- Always use the service stands when working underneath the MSP3.

Figure 35  
Figure 36
Manually Operating Wash and Cycling Functions
After all cables and hydraulic hoses are connected, test power to unit by turning external pH controller power switch to on position. With control switch in manual position, run wash pump briefly. If water does not flow from jets within 10 seconds, disconnect quick couplers to help pumps prime. If water doesn’t spray, but pump is running, see Troubleshooting section for instructions on priming pump. If pumps don’t operate, recheck power cables and connections. If electrical power to Controller is functioning, test hydraulics by locking hydraulic lever in position, and raising and lowering sampler shoe using manual Up/Down switch. Test Raise/Lower functions on main lift cylinder if equipped. Make sure no one is under unit and keep clear of any pinch points.

![Power switch diagram](image)

**Power switch** must be on to operate any function

**Manual-Auto switch:** must be in Automatic mode for mapping; in Manual mode for manual control of washing or sampler shoe position

**Sampler up and down:** raises sampler shoe manually

**Wash:** On when washing manually; **Must be Off for Automatic washing**

Figure 37
Three-point Mounted Units

Raise sampling mechanism to full height. Begin depth adjustment process with shank in center position (pin in one of two center holes). Adjust ratchet jack so that coulters will penetrate 1-2” deep – 21” pin-to-pin is a good starting point. Adjust three-point top link to level unit when in soil.

Begin with a dimension of 21” pin to pin
Initial adjustment of 21”
Adjust tractor or implement top link to level

Figure 38 a,b,c

Operate implement parallel to soil or slightly tipped (up to ½”) forward never allow unit to tip backward --this will decrease shoe penetration.

Figure 39
Once unit is level, lower sampling mechanism completely, drive forward 10-20' (3-6 m) to create soil core. To measure depth of soil core being collected, brush away soil from cutting shoe. Measure from soil surface to top of cutting shoe. This is the depth of sampling. To increase sampling depth, shorten ratchet jack; to decrease sampling depth, lengthen ratchet jack. Re-leveling unit with adjustable top link may be required.

![Sampling depth measurement](image)

**Figure 40**

Note: if MSP is equipped with EC Module and EC data is being collected along with pH data, adjusting the overall height of the unit will affect coulter-electrode depth. If deeper soil sampling is desired, and shortening ratchet jack would result in excessive coulter-electrode depth, remove sampler shank pins and lower shank to lowest setting. If shallower soil sampling is required, and lengthen ratchet jack results in inadequate coulter-electrode depth for EC data collection, raise sampler shank to highest setting.

![Pull adjustment pins](image)

**Figure 41**

Once EC coulter depth and sampling depth are satisfactory, adjust other components in this sequence:

1. Scraper adjustment: in manual mode hydraulically raise the sampling shoe to maximum height. Adjust scraper until cutting shoe clears scraper blade when sampler shank is fully raised.
2. Adjust electrode holder: with sampling mechanism raised completely, adjust electrode holder to provide ½” (1.2 cm) clearance between it and sampling trough.

3. Wash adjustment: Wash brackets should be parallel to sampling trough, with jets directly beside electrode holder, jets should be 1” (2.5 cm) below electrodes; when electrodes are properly aligned.
4. Insert pH electrodes into electrode holder. Finger-tighten plastic screws. Install BNC cover on external controller to keep moisture out of BNC connectors. Leave BNC cover on whenever unit is outdoors.

5. Row cleaner/coulter: Pull MSP forward and check depth of row cleaner and coulter. Cleaner should be clearing residue ahead of sampling shoe, but not gouging into soil.

6. Closing disks (if equipped): Adjust closing disks as needed to properly close trench and bring residue over row-cleaned zone. Do not operate these deeper in soil than necessary.
7. Prox sensor: The prox sensor communicates the position of the sampler assembly to the external controller for automatic cycling functions. Adjust sensor to 1/4"- 3/8" (6-9 mm) gap. Cycle unit manually to insure that this gap is maintained throughout cycling range. Red LED light should light whenever prox sensor is near metal and not light when away from metal. To view LED light, shade ambient light from prox sensor and cycle sampler assembly manually. Be careful to not strike or damage prox sensor face. NOTE: in manual mode, hydraulic cylinder opens and closes completely; in automatic mode cylinder stops as soon as prox sensor clears upper and lower plate. In order for cylinder to set electrode-shoe clearance properly (step 2 above), adjust prox sensor height with sampler shoe completely raised. Adjust the prox sensor so it barely clears the lower part of the sensor plate when sampler is completely raised. It may be necessary to reposition the electrode holder after adjusting prox sensor; see step 2 above.
**pH Shoe Cleaner**

The pH Shoe Cleaner allows the operator to scrape clean the sampling shoe while mapping. The Shoe Cleaner is mounted on the left side of the implement as shown in Figure 49.

![Image](image1.png)

Figure 50 shows removal of the scraper. First remove the retainig clip pin. Then slide out.

![Image](image2.png)

When reinserting the scraper make sure to line up the fins with the slotted hole. (Figure 51)

![Image](image3.png)
**Mapping with SoilViewer**

Attach the pH serial communication cable to an available COM port on your computer. Connect EC signal cable and power cords to ports on rear of OpticMapper/EC Controller, connect the GPS to the GPS in of the OM Comm. cable, then connect the serial output of the OM Comm. to any available COM port on your computer using a standard serial cable. If serial port is not available on PC, then a USB to Serial converter can be used with the OpticMapper with EC Surveyor provided the drivers for the converter are installed and functioning properly.

**SoilViewer startup display**

![Figure 52](image1)

To acquire EC, OM and pH data select Acquisition

![Figure 53](image2)

**EC** – EC Surveyor connected to PC  
**OM** – OpticMapper and GPS connected to PC  
**pH** – pH controller and GPS connected to PC  
**EC and pH** – EC Surveyor and pH controller connected to PC  
**EC and OM** – EC Surveyor and OpticMapper connected to PC  
**EC OM pH-MSP3** – OpticMapper/EC Controller Surveyor and pH controller connected to PC

**To acquire data with the MSP3 only EC OM pH-MSP3 can be used.** This will allow the user to collect all three sensor readings, or collect only EC and OM if desired.
The EC OM pH-MSP3 Mapping software will automatically detect which ports the Veris OpticMapper/EC Controller and pH Controller are connected to, and begin communicating, provided the power to the OpticMapper and pH is turned on. If either is not detected, the software will wait 45 seconds for the connection of the electronics and search again; this will repeat until both instruments are connected and powered on. If the electronics are not found, unplug the serial or USB cables and reconnect them to the PC and make sure the power to the OpticMapper and pH controllers are turned on. If the connections are still not made, refer to SoilViewer troubleshooting. The conditions for mapping and storing the data are as follows. The user must be going a speed greater than 1 mph, there must be a GPS signal received that includes position and speed (GGA and either VTG or RMC), the OM/EC Comm Light must be green, indicating the PC and OpticMapper with EC Surveyor are communicating properly, and either of the EC values has to be greater than -1.

Before mapping, run the OM system check and pH calibration to ensure everything is operating correctly. pH controller settings can be modified to adjust the wash and cycle times for specific field conditions.

After clicking on EC OM pH- MSP3 the user will be prompted to input the EC file name. All OM and pH files will be named the same as the EC. Files may be appended to by selecting a previously created VSEC file.
Ranges used to map pH values. Each color should have a unique range associated with it. **These are user-defined ranges and can be changed at any time.** If points appear to be missing from the map, it could be that they are out of the ranges selected. pH min and pH max can be used as guidelines for setting up the pH ranges. Up to five divisions can be selected.

GPS status: may read GPS, DGPS, RTK, or None

Ground speed (from GPS) in miles/hour

Status of pH controller; Green means the controller is engaged while Red means it is disengaged and will not automatically cycle

OM/EC Comm. and pH Comm. Lights; when green these indicate there is communication with the controllers.

Control used to change between EC arrays

Shallow (Sh) and Deep (Dp) soil EC readings. If negative, no data is being saved.

Figure 55

Colors for the graphs can be set here, by clicking on the color box and selecting a new color.
From this screen, pressing the Engage key or Enter as you drive forward will initiate the automatic sampling process. **The software requires movement indicated by the GPS receiver in order to cycle.** Speed must be detected within 5 seconds after pressing enter or the system will disengage.

“Cycling” means the sampler assembly is in the process of washing, and lowering for soil sampling. After a core has been collected and is being held against the electrodes, the status text will change to the following:

**Cycling**

The pH readings on the display show what each electrode is reading at every second. The sampler will hold the soil against the electrodes and continue to record pH until the readings settle. The minimum recording time is 7 seconds; the maximum time is determined in the pH settings menu. The pH values that are recorded are the final values at the end of the logging duration. (last reading on the display before the “Cycling” status appears). The final pH value is logged along with the DGPS position where the sample was collected.

If the electrodes take longer than **10 seconds** to settle, a warning will appear that indicates the number of seconds the reading has required to settle. When the maximum log time is reached, the unit initiates a new sample cycle (refer to Controller setup for adjusting the log time).

**Recording...10s**
This time warning is to let the operator know that a measurement cycle is requiring excessive time. While an occasional cycle may exhibit this warning; see the troubleshooting section if this occurs frequently.

The Veris MSP pH Manager uses two electrodes for optimal data quality. If there is a difference of 0.75 or greater between the final electrode readings, the software will beep and the pH readings will flash, informing the operator of the erroneous reading.

To pause the data collection process at any time (but keep the same file), press Engage button. Once the sampling process has completed its cycle, it will disengage and the status text message will indicate disengaged (press Engage to start cycling again). If the system no longer senses a speed signal from the GPS, it will also disengage. NOTE: do not depend on the GPS speed signal for disengagement.

Before inspecting or working around any component of the system, press the Engage key and ensure the engage light is red before exiting the vehicle. Sporadic GPS signals may simulate movement and initiate the cycling process, resulting in possible entanglement and injury.

There are warning signals programmed into the SoilViewer to warn the operator that data are not being recorded, so that corrective action can be taken. If data aren't being recorded, a warning beep will sound from the computer, and the text indicator of the data that is missing information will blink. For example, if the DGPS isn't being received (or the NMEA string containing speed) the Fix indicator text will blink. If EC values are negative, they will also blink.

**pH Data Flags**

Numbered “flags” can be added to the pH data by pressing the Flag key or F2 while the pH Manager is CYCLING or RECORDING. If the key is pressed while the pH Manager is in the RECORDING phase, the flag light will turn bright green:

![Flag (F2)](image)

Figure 59

This means the flag will be recorded with the current data point. If the key is pressed while the pH Manager is in the CYCLING phase, the next point will be flagged and flag light will not turn green until the RECORDING phase is reached. **Tip: Use this function to flag any sample where a problem has occurred, such as a plugged shoe. Open the pH file in a spreadsheet program, locate the points that have been flagged, and delete rows of problem data.**
Customer Collects Optic Mapper and EC Data

Veris quality checks data, calculates terrain derivatives (slope and curvature) and returns a combined filtered ASCII text file and data quality report card

Customer receives monthly bill for 25 cents per acre.

Customer selects sample locations and gets lab results

1) After collecting EC and OM data, customer organizes data into field folders. Each field file will contain all EC and OM files for that field. Multiple files may be included. Any files in the field folder will be combined into one. Files changed or added later will be billed as a new field. Folders need to be zipped (.zip) before emailing.

2) Veris will quality check, and filter data within 2 business days, provided data is routinely sent in by the customer. One ASCII text file containing all data will be returned to the customer. File will be named according to field file. Customer is billed 25 cents per acre. Bills are generated monthly based on the acres filtered in step 2. Customer has up to one year to send in lab data for calibrations.

3) Customer obtains lab samples; existing point sample data may work, or 4-6 point samples should be selected to capture the high and low areas of soil reflectance.

4) Veris will perform proprietary multivariate regression and cross validation then send back final field file in ASCII text format.

Veris returns data via email

Customer emails lab data and filtered field file from step 2 to omdata@verisotech.com

Veris calibrates data to OM, and returns to customer final field (txt) file and calibration report card
File Organization and Submission

Select a field name and put all EC and OM (VSEC or VSOM) files into the field folder. If there is multiple .DAT files for one field they will be combined into one field.txt file. Files must be kept in the .DAT format and folder needs to be zipped before emailing.

Cleaned text file output format (output from step 2)

- **Red** – Soil reflectance value from the red LED source. No units on number; Higher values indicate soil reflected more light, and therefore is a lighter color soil that in general would tend to have less organic matter. Lower values indicate soil reflected less light and is a darker color soil. This is a field relative value.
- **IR** – Soil reflectance value from the IR LED source. No units on number; Higher values indicate soil reflected more light, and therefore is a lighter color soil that in general would tend to have less organic matter. Lower values indicate soil reflected less light and is a darker color soil. This is a field relative value.
- **Altitude** – From GPS Signal in meters
- **Speed** – In MPH
- **Temp** – Photodiode sensor temperature in degrees Celsius * 10
- **IR/Red** – The ratio of the IR to the Red. This is a column used for checking sensor quality, not useful for soil analysis, only to get a relative idea of how the signals varied together.
- **EC S.H.** – EC from 0-1’ in millisiemens per meter. This is a relative value based on the field conditions, higher values indicate finer texture soil, and lower values indicate coarser texture soil.
- **EC D.P.** – EC from 0-3’ in millisiemens per meter. This is a relative value based on the field conditions, higher values indicate finer texture soil, and lower values indicate coarser texture soil.
- **EC Ratio** – Ratio of the Deep to the Shallow, the closer the value is to 1 indicates the topsoil and subsoil have the same EC value indicating a potentially deep soil profile. A value less than 1 indicates topsoil is finer (more clay) texture than subsoil. Values greater than 1 indicate the subsoil is a finer (more clay) texture soil. This can be useful for soil profile information, but rely on EC shallow and Deep for surface soil texture information.
- **Slope** – Terrain slope from the altitude data.
- **Curve** – Terrain Curvature from the altitude data, negative values are convex, while positive values are concave areas.
Data Quality Check and Cleaning

Veris will provide a filtering and quality control check. GPS, Field, and Local outliers will be removed. Data will be checked using proprietary key quality indicators. Veris will return to the customer one .txt file containing all EC and OM Reflectance data in the field folder. File will be named for the field assigned by the customer. Feedback will be provided as necessary.

Calibration and Validation

Customer can provide lab OM data to Veris in either .txt or .shp format. The filtered field file returned to the customer in the previous step needs to be included with the lab data. Veris will calibrate the field to the lab samples, perform a cross-validation, and return a final field file containing all EC, OM reflectance, and OM Calibration data, which will be called (filename)_Cal.txt or (filename)_Cal.shp, along with a calibration report card.

Customer has up to one year from the time the data is billed to get lab samples in for calibration.

Terms and Conditions

Veris will retain data for improving calibrations.

Veris will not share data to any third party without customer permission.

Prices charged will not increase more than 5% in any year or greater than rate of inflation.

Veris will bill monthly. 25 an acre for all data processed; additional charges may apply if data manipulation is required.

If file fails quality check; customer will be notified via email.
Soil EC

Rockshaft pivot points

Each pivot (located at the left and right) contains an upper and lower grease zerk. Due to the limited motion of the rockshaft, these should be lubricated on **20-hour** intervals. This may vary based on the number of times the unit is raised and lowered.

![Figure 1](image1.png)

Electrode coulters Pivot

In all but the most extremely rocky conditions, the coulter electrodes should not flex in the field, thus minimal movement will be realized at the pivot. **80-hour** intervals should be sufficient.
Hubs --Use good quality wheel bearing or lithium grease for lubrication, but we suggest that you grease the hubs sparingly. Over-lubricating the hub will result in pre-mature seal failure, and an excessive amount of grease in the hub cap/commutator. On an interval of 150 hours, 1-2 strokes of grease should be sufficient.

⚠️ WARNING

- Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the Veris MSP3.
- Install all transport locks before transporting or working underneath.
- Always use the service stands when working underneath the MSP3.
OpticMapper Row unit

Setting Sensor Depth
Refer to Figure 7
The “T” handle (1) sets sensing depth by limiting the how high the side depth gauge wheels ride relative to the opener disks. To adjust sensing depth, pull the “T” handle (1) up and back, move it forward or aft, and set it back in a different pair of holes in the scale.
- For shallower sensing, move the “T” handle (1) forward.
- For deeper sensing, move the “T” handle (1) back.

Opener Disc Contact Region
Refer to Figure 8
Opener disc angle and stagger is not adjustable, but disc-to-disc spacing is, and may need attention as discs experience normal wear. Spacers will need to be reset when blades are replaced.
The ideal spacing causes the blades to be in contact for about one inch (4). If you insert two pieces of paper between the blades, they should slide to within zero (touching) to 1.5in (3.8cm) of each other. If zero, the gap between the blades should not be significantly greater than the thickness of two sheets of paper.
If the contact region is significantly larger or there is a large gap, it needs to be adjusted by moving one or more spacer washers.

Adjusting Disc Contact
Refer to Figure 9
1. Raise the Implement.
2. Remove the side gauge wheels (5) on the row unit in need of adjustment.
3. Remove the bolt (6) retaining the opener disc (7) on one side. Carefully remove the disc. Do not lose the hub components and spacer washers (8)(9).
4. To reduce the spacing between the discs (the normal case), move one spacer washer from the inside (8) to the outside (9) of the disc.
4. Re-assemble and check disk contact.
Side Gauge Wheel Adjustment

Refer to Figure 10 and Figure 11

Disc-to-wheel angle and clearance ideally has the wheel just touching the disk when the wheel is raised to sensing depth (is up against the stop set by the “T” handle. The goal is to have both disks and wheels turn freely, but keep soil and trash from getting between them.

These two adjustments interact with each other. Changing one requires at least checking the other.

In addition to changing the disk angle due to changing depth or new field conditions, these two settings may need attention over time as the disk and wheels wear from normal use. This adjustment will also need to be made if any opener components are replaced.

Refer to Figure 11

For 2in (5.1cm) sensing depth, adjust side gauge wheel angle so wheels contact row unit disks at the bottom of wheel. Check with row units in soil so wheels are held up.

At the same time, keep side gauge wheels close to opener disks so openers do not plug with soil or trash.

Note: Wheels should be out far enough so disks and wheels turn freely.

Refer to Figure 13 on page 5-5

To adjust side gauge wheels:
1. Raise the implement.
2. Loosen hex-head bolt (1). Move wheel and arm out on O-ring bushing.
3. Loosen pivot bolt (2) Turn hex adjuster (2) so Indicator notch (4) is at 5 o’clock to 7 o’clock. Note: Use this as the starting point for adjustment.
4. Move wheel arm in so side gauge wheel contacts row unit disk. Tighten hex-head bolt (1) to clamp arm around bushing and shank.

Refer to Figure 12

5. Check wheel-to-disk contact at 2in (5.2cm) sensing depth. Lift wheel 2in, check contact and release. When let go, wheel should fall freely.

• If wheel does not contact disk at bottom to area where blade leaves contact with soil, move hex adjuster until wheel is angled for proper contact with disk.
• If wheel does not fall freely, loosen hex-head bolt (1) and slide wheel arm out just until wheel and arm move freely. Retighten hex-head bolt (1) according to grade: 1/2in Grade 5 bolt on 25 series, 75 ft-lbs (102 N-m). 1/2in Grade 8 bolt on 25 series, 110 ft-lbs (149 N-m).

6. Keep turning hex adjuster and moving wheel arm until the wheel is adjusted properly. When satisfied, tighten pivot bolt (2) to 110 ft-lbs (149 N-m).

Adjusting Gauge Wheel Scrapers
Refer to Figure 14 (bottom view)
Scrapers are optional, and may be useful in moist or sticky soils that tend to accumulate on gauge wheels and reduce intended sensing depth.

To adjust scrapers:
1. Loosen nut (5).
2. Slide scraper (6) toward gauge wheel (8) until scraper touches tire.
3. Slide scraper (6) away from wheel (8) leaving a 1/8in (3mm) gap at (7).
4. Rotate scraper left and right around bolt, making sure it cannot touch tire if bumped in field. If it can touch tire, back scraper away from wheel until it cannot.
5. Center scraper angle on bolt (5) until gap (7) is constant.
6. Tighten nut (5).

Replacing Row Cleaner

1. Loosen and remove three nuts
2. Now the depth bead wheel and cleaner can be removed and replaced.

WARNING
Use Service Stands
Replacing Opening Disk

1. Make a note of current Disk depth
2. Remove the 5/8-11 x 4in bolt, lock washer and nut
3. Replace disk with new disk.
4. Reinstall disk to proper depth.

WARNING
Use Service Stands

Opening Disk lubrication

The opening disks each have a grease zerk on them (right and left side). Due to the constant rotation, these should be lubricated on 80–hour intervals.

Depth Gauge Wheels lubrication

The depth gauge wheels have and upper and lower grease zerk at each pivot. Due to constant movement, these should be lubricated on 80–hour intervals.
**pH system**

**Clean-up**

If you are going to interrupt your pH mapping for 30 minutes or longer, clean off the electrodes and the electrode holder with the wash wand, heavy soil can be very hard to remove once it has dried.

![Figures 19](image-url)
**WARNING**

- **Antimony is harmful if ingested into your skin, mouth, or lungs**
  - Do not touch antimony electrode tip
  - If grinding or sanding antimony tip wear mask to prevent inhalation
  - Scuff with pad if white film is on Antimony Tip
  - If soaking electrode is needed use pH 4 solution
  - Remove from holder and place in storage in freezing temperatures or when unit will be idle for long periods
  - Keep cover over BNC ports on external controller whether electrodes are attached or unattached

Leave BNC cover on whenever unit is in operation or stored outdoors. Do not allow moisture into BNC connections.
Wash System

If wash water develops algae, flush and fill tanks with tap water; clean any algae or other foreign matter out of tank using clean-out ball valve (right side). Set wash system ball valve (left side) to open position, allowing water to flow to pumps. Clean filter at least once per week of operation. Remove plug and turn on ball valve to clean.

When temperatures are dipping below freezing, prevent freeze damage to the wash system as follows: close ball valve between tank and pumps, open up check diaphragms and drain, disconnect quick couplers and run pumps until empty. If unit is to be left outside for long periods of time over winter, it is advisable to add RV antifreeze to tank and run pumps for a couple of minutes to fill all lines with anti-freeze. Purge system of anti-freeze before collecting any pH data.

• Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the Veris MSP. Disengage automatic cycling function before working around unit. Install all transport locks before transporting or working underneath.
Wear Item Replacement
Inspect cutting shoe for wear and gouges, replace as needed. Knock old shoe off with punch and tap new shoe on, as shown here. **TIP:** *Rotate cutting shoe to prolong wear life.*

![knock worn shoe off from rear](image1)

![tap new shoe on with 2x4](image2)

Figures 24a and 24b

Replace sampling trough liner, scraper cutting edge when wear is apparent.

**WARNING**

*Use Service Stands*

Closing disk Lubrication

The closing disks each have a grease zerk on them (right and left side). Due to the constant rotation, these should be lubricated on 80–hour intervals.

![Closing Disk grease zerks](image3)

Figure 25 Closing Disk grease zerks
Section 6

Service and Troubleshooting Procedures

EC data seem odd—jumpy, negatives, map doesn’t match known or expected soil types
Perform Maintenance and Service Procedures #2-3.

No GPS or DGPS on display
Perform Maintenance and Service Procedure #6

Coulter spring bars breaking:
- reduce ground speed
- order heavy-duty replacement bar (Veris part #31101)

Optical readings seem incorrect:
- check window for mud
- check window for breakage (see Procedure #1)
Procedure #1: OM Signal Testing

Perform this test *daily or every 10 hours of data collection* to ensure you are obtaining reliable data, and whenever EC data is questionable. The purpose of this test is to insure that the instrument is performing properly.

The OpticMapper/EC Controller is shipped with an **Instrument Test Load** (Part No. 46403) that will enable you to quickly check the instrument to ensure that it is functioning properly. To perform this test:

1) Disconnect the optical power cable from the OpticMapper/EC Controller.
2) Connect the test load to the Optical Power port.
3) Switch on the OpticMapper and view display on SoilViewer.
4) The display should show:
   - **Red**: 833 +/-10
   - **IR**: 289+/-10
5) If the readings vary significantly contact Veris service department.
6) Once the test is complete, remove the test load and reinstall the optical power cable.

![OM Signal Test Load](image)

*Figure 1.1 OM Signal Test Load installed*
Procedure #2: EC Signal Testing

Perform this test **daily or every 10 hours of data collection** to ensure you are obtaining reliable data, and whenever EC data is questionable. The purpose of this test is to insure that the instrument is performing properly.

The OpticMapper/EC controller is shipped with an **Instrument Test Load** (Part No. 49492) that will enable you to quickly check the instrument to ensure that it is functioning properly. To perform this test:

- 7) Disconnect the signal cable from the signal terminal on the OpticMapper/EC controller.
- 8) Connect the test load to the signal terminal.
- 9) Switch on the OpticMapper/EC controller and view display in SoilViewer or Data.
- 10) The display should show:
    - Shallow: (2000XA and 3100) **14** (3150) **11**
    - Deep: (2000XA and 3100) **21** (3150) **40**
- 11) If the readings vary significantly (more than one whole number) contact Veris service department.
- 12) Once the test is complete, remove the test load and reinstall the implement signal cable.

Figure 2.1 Signal Test Load installed (SoilViewer display showing proper EC readings for 3150)
Procedure #3: Testing Electrical Continuity

Perform this **test daily or every 10 hours of data collection** to ensure you are obtaining reliable data, and whenever EC data is questionable.

The purpose of this test is to insure that each coulter-electrode has an uninterrupted signal path from the EC Surveyor to the disk blade. Think of each coulter-electrode and its wire path as a ‘channel’. On a 3100 and 3150, there are 6 signal channels that must be clear and isolated from each other (4 on a 2000XA). You will first test the complete pathway for each channel—each coulter-electrode. One easy-to-take reading for each channel tests the cable, wiring harness, and each coulter-electrode and disk blade. If no problems surface during this test, there is no need to test individual components. This test should take only a couple of minutes to perform.

To perform this test, you will need the EC Signal Test Box (part #49708) and an ohmmeter (sometimes referred to as a multi-meter or voltmeter). Make sure the meter is set to ohms, Ω. If a range of ohms is available, choose the lowest setting—ohms rather than kilo or mega ohms. If unfamiliar with ‘ohming-out’ or resistance testing, make a few trial tests before performing the Veris signal test procedure. Touching the meter leads together will display a zero resistance reading, touching two places on the same piece of metal will produce a nearly zero reading, touching nothing will produce an OL (overload or over limit) reading—meaning complete resistance, and no continuity.

![WARNING]

**Use Service Stands**

Remove the signal cable from the EC Surveyor and connect it to the terminal on the test box. If you have hard-wired the signal cable extension into the cab, making it difficult to reach the implement with the cable end, you may want to purchase an extension cable from Veris (part #12269). This cable attaches to the signal cable end and allows you to position the Signal Test Box in close proximity to the coulter-electrodes.
Firmly press one lead of the ohmmeter to the #1 coulter blade edge (left hand, standing behind the unit) and the other lead to the #1 terminal on the test box. Maintain firm pressure on the ohmmeter lead touching the disk blade. A reading of less than 2 ohms is normal. Rotate blade ¼ of a turn back and forth as you view the ohmmeter. Any jump in the readings above 2 ohms indicates a problem.

Continue to check each coulter electrode in succession, left to right. If any coulter electrode exhibits no continuity or resistance higher than 2 ohms, refer to Procedure #4 Diagnosing EC Signal Problems.
Procedure #4: Diagnosing and Correcting EC Signal Problems.

Use this Troubleshooting tree to work through the system, locate the problem, and take corrective action.

Figure 4.1
Coulter Electrode Functions-

Each coulter electrode on the implement is part of a pair, and each pair has a distinct function.

a) Coulters 1 & 6 are the Deep EC receptors. If you are seeing problems only with the “Deep” readings, focus on testing continuity on these two coulter-electrodes.

b) Coulters 2 & 5 are the “charged” coulters that inject the voltage into the soil. If you are getting no (or intermittent) readings on both the “Shallow” and the “Deep” -- continuity to one of these two coulter-electrodes is likely the cause.

c) Coulters 3 & 4 are the “Shallow EC” receptors. Focus on this pair if you see problems in the “Shallow” reading.

If the continuity ohm test indicates a problem on a channel, you will need to determine where the interruption is located. Listed below are detailed instructions on how to determine exactly where a continuity or isolation problem is located:

A. Testing Cable and Wiring continuity:

1. Once a high resistance reading on a channel is confirmed, determine whether the problem is in the wiring or in the coulter-electrode. To test all cable and wiring, place one ohmmeter lead in the Test Box terminal pin for that channel and the other on the corresponding coulter wire terminal bolt. Grasp sure-seal connector and move back and forth during this test – vibration from rough fields can weaken the contacts on the sure seal, causing breaks in continuity during operation that might no show up in a static test. Repeat process on all coulter-electrodes.

![Image of testing cable at coulter electrode #3 terminal]

Figure 4.2 Testing cable at coulter electrode #3 terminal

2. If you see <2 ohms on all, test the coulter electrodes as explained in B below.

3. If you see a > 2ohms reading on any channel, separate sure-seal connector and insert one ohmmeter lead in the end of wiring harness and the other lead in the corresponding terminal on the Test Box. If reading is < 2 ohms at that point, the problem is not with the wiring harness or signal cable extension. It is most likely in the terminal connector wire. Check resistance in it by placing one ohmmeter lead on the coulter wire terminal bolt and the other lead in the end of the terminal wire socket. Replace connector wire (PN 14226) as necessary.
Figure 4.3 Testing cable at end of signal cable wiring harness

Figures 4.4 ab. a. Separating sure-seal connector  b. Testing terminal connector wire

4. If there is a >2 ohm reading in the signal cable harness or signal extension cable, visually inspect the wiring harness and cable extension for damage. If a visual inspection doesn’t reveal a problem, you will need to test continuity of the wiring harness and cable. You will need to ohm these cables out individually. Disconnect signal extension cable from implement and insert ohmmeter leads into sockets as shown below.

Figures 4.5 a and b. Checking continuity of signal extension cable with one ohmmeter lead contacting pins in extension cable end, and other lead contacting corresponding test box terminal.
5. To ohm out the wiring harness, disconnect the serial cable extension from the implement and check continuity through the harness as shown in Figures 10a and 10b. While doing so, check the pins and the sockets of the 6-pin connector for corrosion and fit. If necessary spread the pins with a small screwdriver to tighten fit in sockets.

![Image of wiring harness and ohmmeter](image)

Figures 4.6 a and b. Checking continuity of signal harness, with one ohmmeter lead contacting pins in connector and other lead contacting corresponding coulter-electrode.

Note: intermittent electrical problems are difficult to diagnose. Flex wiring and connectors while checking continuity.

B. Testing Coulter-Electrode continuity

1. Place ohmmeter lead on terminal wire bolt and other lead on disk blade. Rotate blade ¼ turn. If readings are consistently above 2 ohms, check for excessive corrosion at the coulter blade mounting bolts, or the terminal located near the coulter pivot. Make sure that high ohm readings are not due to poor contact between blade and ohmmeter lead. Re-test holding lead firmly against edge of blade, removing rust or paint if necessary.

2. If ohms jump over 2 ohms when the blade is rotated, and you were careful to maintain good contact between the lead and the blade, the problem is likely inside the hub. Because electrical signals cannot be sent consistently through the coulter bearing, Veris has designed a more reliable path for the EC signal to travel. A special hub with a spring plunger presses against the spindle of the coulter, serving as a commutator. Shown below is a cut-away view of the hubcap and plunger assembly. When ohm readings jump during blade rotation, it is due to the greased rollers on the bearing making intermittent and inconsistent contact. See Maintenance and Service procedure #5: Spring Plunger adjustment and replacement on adjusting and replacing spring plungers.
C. Testing Coulter-Electrode isolation

If continuity tests show no excessive resistance on any channel, yet erratic soil EC readings continue, or if EC readings do not drop to $-1$ when unit is out of the soil, it is possible that the channels are not isolated. This could be the result of a pinched wiring cable, causing channels to short out. Or, one of the coulter-electrodes is no longer insulated properly from the frame or adjacent coulter-electrodes.

1. If EC readings do not drop to $-1$ when unit is raised, disconnect signal cable extension from implement. If readings don’t drop to $-1$, the problem is with the signal cable extension. If readings show $-1$, re-insert the signal cable extension into the implement. Disconnect the sure-seal terminal connector wire from each coulter electrode. If readings don’t drop to $-1$, the problem is with the wiring harness. If this is the case, you should replace the wiring harness. If readings do drop, re-insert the signal cable extension into the implement. The problem is with one or more of the coulter-electrodes. Proceed as follows:
2. Inspect nylon insulation slides under coulter-electrode mounting brackets. These nylon insulators may become worn or brittle, or may slip out from under mounting bracket. Repair and replace as necessary. Make sure that all electrode coulter U-bolts are properly tightened to clamp mounting bracket and insulation tightly to frame.

3. Disconnect signal cable from instrument or front of frame. Check to see that no metal part of the any coulter electrode is in contact with the implement frame. This may be by visual inspection or by connecting one lead of an ohmmeter to the individual coulter electrode, and the other to a grounded fastener on the frame. If the coulter electrode is properly isolated, no reading will be obtained. Make sure that all electrode coulter clamp bolts are properly tightened to prevent lateral movement of the coulter electrode.

4. Wet soil on the toolbar could be a pathway for the EC signal to short. Test coulter-to-coulter and coulter-to-frame isolation by checking resistance between coulter-electrodes. Any continuity from one coulter to another is not acceptable. Remove buildup of wet soil, especially if it bridges across insulation slides. It may be necessary to remove coulter mounting brackets and clean toolbar, if problem persists.
Procedure #5 Spring Plunger adjustment and replacement

The spring plungers are located in the center of each coulter electrode hub cap, and are vital to maintain good continuity through the coulter hub bearings. They are factory preset, and should not need routine adjustment. If a continuity test shows abnormally high resistance, the plungers should be checked. This may be performed in the following manner:

1) Check coulter hub bearing preload by grasping coulter blade and pushing from side to side. If there is any noticeable movement, bearing preload is incorrect, or bearings are failing -- and this can damage the spring plunger; see procedure #7 for adjustment or replacement.
2) Remove the 3/8" allen head set screw.
3) Remove the plunger by turning counter-clockwise.
4) Depress the spring loaded tip on a hard surface to determine if plunger has adequate tension and can move freely.
5) If the plunger will not move freely, replace. Coat the threads with di-electric silicone grease before installation.
6) If the plunger appears to be in good working order, reinstall in the hub, and adjust until it bottoms against the spindle end. Rotate 1/2 turn backward to allow adequate clearance. Improper adjustment will result in premature failure (too little tolerance) or poor continuity (too much tolerance). See Figure 5.1 below to view proper clearance.
7) Reinstall locking set screw and tighten firmly on top of plunger. The top of the setscrew should be even with the face of the hub. If not, remove and adjust the plunger inward or outward as necessary.
8) Re-test coulter electrode continuity

Figure 5.1

In some cases, you may have to remove the hub cap to service the spring plunger, if the plunger is rusted in the cap, or if the readings are still unsatisfactory with the new plunger installed.
Procedure:

1) Remove hub cap by turning **clockwise** with a pipe wrench or large adjustable wrench – these caps have left hand thread to prevent loosening during field rotation.

2) If plunger is frozen in cap, remove allen head set screw on top of plunger and apply penetrating oil on both sides of plunger. Let this stand for a few minutes and try to remove. If it will not back out with allen wrench, lock vise grips on the inside portion and turn out through inside of hub.

3) Clean all hub cap surfaces, install new o-ring, coat plunger and set screw with di-electric grease and install as outlined above.

4) At the same time, inspect the end of the spindle. Over time the plunger will wear a slight depression in the spindle face. This is common, and more noticeable on high acreage units, or units that have been operated at high field speeds. If the depression is 1/6” or more, carefully grind the face of the spindle. Cover the bearing with a cloth or towel to prevent grinding dust from entering the hub and bearings.

5) Re-install hub cap and tighten firmly. You may have to re-set the plunger to compensate for the reduced length on the newly ground spindle. Re-adjust as outlined above.

**Note:** If you are still unable to obtain favorable resistance readings, check for excessive corrosion at the coulter blade mounting bolts, or the terminal located near the coulter pivot. It may be necessary to grind the spindle end smooth, if a dimple has developed.

**All EC models, 2014 and on, have a carbide insert on the spindle making grinding unnecessary.**
Procedure #6: Diagnosing GPS-related problems

If you do not see a GPS, DGPS, or RTK on SoilViewer screen, you do not have GPS coming in, and no data will be recorded.

Fix | Speed
---|---
No GPS | 0
DGPS | 6.5

Figure 6.1 (No GPS)  
Figure 6.2 (With DGPS fix)

Insure your GPS receiver is powered and outputting only two NMEA strings GGA, and either VTG or RMC at a 1hz rate; 4800 baud, 8 data bits, no parity, 1 stop bit. Verify that your GPS cable is sending GPS data through pin 2, pin 5 is ground, and no other pins have signal or power on them. The most common issue is hz rate. If the GPS has been used for lightbar guidance it may have been set to a 5 or 10 hz rate. It will need to be changed to 1 hz in order for the OpticMapper/EC controller to accept it.

Shown below is a Troubleshooting tree for diagnosing GPS signal problems. It is not meant to replace your GPS receiver user manual—it merely shows how to determine if your receiver is sending the GPS signal that the EC Surveyor needs.

Figure 6.3
If it becomes necessary to send GPS data into your PC, you will use a program called HyperTerminal. This program is in all Windows software. It is designed to record serial data streaming into a serial or USB port on the computer. The purpose of this is two-fold: 1) it verifies whether your GPS and cables are delivering the proper messages, and 2) it give Veris Technologies support personnel a GPS data file to test.

Here’s how to use HyperTerminal

1. Plug the GPS output cable into the laptop serial input (or USB-serial hub); no null modem is needed
2. Verify in Device Manager which Com port the GPS is connected to (Start—Settings—Control Panel—System—Hardware—Device Manager—Ports
3. Start the “HyperTerminal” program under “Accessories” in Windows.

4. Give your HyperTerminal session a name such as gps trial when the program prompts you for the name of your connection and then hit “OK”.

Figure 6.4

Figure 6.5
5. The program will then ask you for a phone number. Instead of entering a phone number, specify the proper serial port number. For example, if Com 1 of the laptop is being used, specify “Direct to Com 1” under “connect using:” at the bottom of the entry area.

Figure 6.6

6. HyperTerminal will then display a configuration menu where you can specify 4800 bits per second, 8 data bits, no parity, 1 stop bit and no flow control.

Figure 6.7
7. At this point, upon clicking ok, legible strings of GPS data should begin appearing on the laptop screen. Here’s an example of a typical set of strings:

$GPGGA,191528.00,3851.0333,N,09737.2342,W,2,08,1.3,372.7,M,27.3,M,10.0,0100*69
$GPRMC,191528.00,A,3851.0333,N,09737.2342,W,0.1,0.0,090998,6.3,E*48

8. If GPS data doesn’t appear, recheck the port and configuration settings to make sure they are correct. If the data won’t appear correctly in HyperTerminal, consult your GPS supplier to see what adjustments (connectors or software) are necessary to bring the signal into a computer.

9. If the signal appears correctly on HyperTerminal and it shows that the required strings are being output, highlight a page of strings, copy and paste into Word or Wordpad before exiting HyperTerminal.

10. Retry the unit with the Veris instrument. If it still doesn’t work, please email the page of GPS strings from HyperTerminal to Support@veristech.com, along with your contact information.
Procedure #7: Bearing Repair and Replacement

The coulter electrode hubs operate in a significantly harsh environment, and annual inspection is of utmost importance. The double-lip seals are designed to keep grease in, and contaminates out, but they are the cause of practically all hub failures. It is advisable to disassemble, clean and repair annually. To perform this maintenance, do the following:

1) Remove hub cap by turning in a clockwise direction (left-hand thread prevents loosening in operation).
2) Remove cotter pin, castle nut, thrust washer, and remove hub.
3) Remove outer bearing and knock out inner bearing and both races (cups).
4) Veris recommends that you purchase our Coulter Hub Repair Kit (PN 32641) that includes new bearings, races, seal, o-ring and cotter pin.
5) Thoroughly wash hub in solvent and dry.
6) Spindle end may need grinding—see spring plunger replacement Procedure #5.
7) Reassemble and adjust bearing pre-load by fully tightening spindle nut, then backing off until you can turn the hub fairly easily with one hand—normally this involves backing off 1-2 slots on the castle nut, and inserting cotter pin. Excessive pre-load may cause plugging in extremely loose soil conditions, and excessive endplay may damage the spring plunger. Hub should have no side play when assembled, but should turn with little resistance. Drive round end of cotter pin firmly into nut, and bend upper portion of cotter pin upward and trim of excess length of both top and bottom with cutting pliers. **Do not bend cotter pin over the end of spindle as it will interfere with spring plunger.**
8) Fill hub via grease zerk until grease pushes through outer bearing.
9) Install hub cap by threading counter-clockwise on the hub. Check to make sure that hub still rotates freely. If not, the cotter pin may be too long, and is contacting hubcap—remove cap and check cotter pin length.
10) Adjust spring plunger clearance as mentioned in Procedure #5.

Figure 7.1
Procedure #8 SoilViewer Troubleshooting

OpticMapper or pH controller is not found
Check to ensure the com which the EC Surveyor/OpticMapper is connected to is present under the device manager. To get to the device manager go to Start → Settings → Control Panel → System Click on the Hardware tab and then click on the device manager button. Click on the “+” sign next to Ports and make sure the port is listed here. In this case a USB to serial converter is being used and the port is listed as USB Serial Port (COM33)

![Device Manager](image)

Figure 8.1

If the port is not listed here, then unplug and replug the USB – Serial converter cable and ensure the power is on to the EC surveyor. If USB – Serial port is still unavailable then reinstall the drivers following the manufactures instructions for driver installation.
Procedure #9: Optical Wear plate and Side Wear plate replacement

1. Remove the bolts attaching the optical sensor assembly to the row unit.

2. Remove the hex screws attaching the side plates to the optical sensor.

3. To remove wear plate, unscrew the hex bolts on the top of the optical sensor as shown in figure 9.2

4. Now to replace the wear plate, ensure the O-ring is seated in the o-ring groove as shown in figure 9.3.

5. Install the wear plate and side plates, then mount the assembly back to the row unit.

⚠️ WARNING
Use Service Stands

Figure 9.1

Figure 9.2

Figure 9.3
Procedure #10 pH Module

1. Unit doesn’t cycle when “Engage” button is clicked

- check to be sure that external controller is in Automatic mode. If it isn’t, this screen will appear:

- follow troubleshooting flow chart below and see related Procedures in Maintenance and Procedure Section

![Troubleshooting Flow Chart]

Figure 10.3
2. Functions Aren’t Working in Manual Mode

- follow troubleshooting flow chart below and see related procedures in Maintenance and Service Procedure Section.

**Problem: Unit doesn’t cycle in manual mode**

- press “1” to disengage, turn external controller to Manual and check prox sensor adjustment (see Procedure #14 in Maintenance and Service Procedure Section.)
- check DGPS signal
- if status of sampler shows “Cycling” for long periods, set sampler shank to shallower position. In hard soil, sampler shoe may not be able to penetrate to the depth needed to move plate off prox sensor. (see Procedure #14 in Maintenance and Service Procedure Section.)
3. **Wash system malfunctioning: no water being pumped**
   - Are there at least 10 gallons of water in tank?
   - Are pumps running? If not, check electrical connections and 12 volt power to them.
   - Check pressure switch on pump—wiggle wire, disconnect and reconnect; direct wire if needed.
   - Is filter plugged?
   - Is ball valve open?
   - Disconnect quick couplers to help pumps prime.

4. **pH readings seem erroneous or won’t calibrate**
   - Use pH simulator to test External Controller and Veris instrument. Re-test with pH simulator set to High Impedance.

   **Figure 10.5**

   - Use pH simulator to test external controller and Veris instrument.
   - On/Off key (Turn pH simulator OFF when test is completed)
   - Attach to each BNC port to test each circuit.
   - Press Select button to toggle from 4 to 7 to 10. Light above pH value will light. View Veris display to confirm these readings at each simulator setting:
     - 4 should read -2, 7 should read .6, and 10 should read 3.9.
     - (Note: the simulator is designed for glass electrodes; for antimony the readings are those listed above)

   - Check for moisture around BNC connectors and for proper installation and fit of the BNC cover over BNC connections (if the pH simulator readings are not close to the default settings, blow compressed air into BNC ports on external control module).

5. **Sampling shoe plugging**
   - Verify if shoe is plugged: wash electrodes to create a wet sample in the shoe; in manual mode lower sampler to full depth and drive forward; if soil in the sampling trough is now dry, fresh soil has entered and the shoe isn’t plugged.
   - To clean plugged shoe, raise implement, lower shoe manually to maximum depth, and drive forward at high rate of speed as you lower the implement completely; if it doesn’t clear, clean manually (put transport locks in before working under unit).
   - Clean cutting shoe thoroughly, especially if it has dried mud in it.
   - Check cutting shoe and scraper for wear; replace as needed.
   - Check scraper adjustment by manually raising and lowering sampler assembly. Does scraper completely clean the cutting shoe face? See Field Operation section for proper adjustment.
   - Adjust row cleaner to clear residue more completely.
   - Adjust firming wheel down to firm soil.
   - Lower sampling depth to engage soil with better coring properties.

6. **pH readings are repeatedly >.5 different or are slow to settle,**
   - Check shoe for sample quality. If only a small amount of soil is present, reduce field speed to retain adequate core. If crop residue is present, adjust cleaning disks to reduce crop residue in sampling area.
7. **pH electrodes are not being cleaned of soil adequately**
   - check wash system in manual mode—are both pumps operating properly?
   - check alignment of wash jets
   - check wash function operation while in automatic mode
   - increase wash time in Controller set-up menu; this can be done either by selecting the extra wash option, by extending the cycle time to 3 seconds—or both.

8. **Too many pH points are rejected**
   - check electrodes and wash system for adequate cleaning
   - recalibrate the electrodes

10. **Electronic controller not functioning:**
    remove metal plate covering external controller and inspect the LED lights for following functions:

![Figure 10.6](image)

<table>
<thead>
<tr>
<th>LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Main board power (Red)</td>
</tr>
<tr>
<td>D2</td>
<td>Fuse F2 (Green)</td>
</tr>
<tr>
<td>D3</td>
<td>Fuse F1 (Green)</td>
</tr>
<tr>
<td>D4</td>
<td>Water pumps relay coil (Red)</td>
</tr>
<tr>
<td>D5</td>
<td>Water pumps relay contact (Green)</td>
</tr>
<tr>
<td>D6</td>
<td>Up solenoid relay contact (Green)</td>
</tr>
<tr>
<td>D7</td>
<td>Up solenoid relay coil (Red)</td>
</tr>
<tr>
<td>D8</td>
<td>Down solenoid relay contact (Green)</td>
</tr>
<tr>
<td>D9</td>
<td>Down solenoid relay coil (Red)</td>
</tr>
<tr>
<td>D10</td>
<td>5V power 1 (Green)</td>
</tr>
<tr>
<td>D11</td>
<td>5V power 2 (Green)</td>
</tr>
</tbody>
</table>

**OVERVIEW**

When the power is turned on and the pH controller is in automatic mode, LEDs D1, D2, D3, D10, and D11 will light up. When the controller is switched to manual mode, LEDs D4 and D5 will light if the wash switch is turned on; LEDs D6 and D7 will light if the manual control hydraulic switch is in the up position (raising sampler shoe); and LEDs D8 and D9 will light if the manual control hydraulic switch is in the down position (lowering sampler shoe).

*Power is turned on but no LEDs are lit...*

- Turn off pH controller.
- Check fuse at battery connection.
- Check all plugs for a secure fit and check cables for damage before turning on pH controller.

*Power is turned on but only LED D1 is lit...*

- Turn off pH controller.
- Remove cover from pH controller.
Replace fuse F2 with supplied cylindrical fuse. Part #8496
Check all power connections and check cables for damage before turning on pH controller.

Power is turned on but only LEDs D1 and D2 are lit...

- Turn off pH controller.
- Remove cover from pH controller.
- Replace fuse F1 with supplied miniature fuse. Part #22611
- Check all power connections and check cables for damage before turning on pH controller.

In manual mode, red LED (D4, D7, or D9) lights but green LED (D5, D6, D8) does not light when switch is thrown for wash or hydraulics up/down...
- Relay supplying power to the water pumps or up/down solenoid is not receiving power
- The relay or another component on the board may be damaged and the pH controller needs to be returned for repair. Contact Veris service department (785) 825-1978

In manual mode, red LED and green LED light when switch is thrown for wash or hydraulics up/down but water is not sprayed or the sampling shoe does not move...
- The relay supplying power to the water pumps or up/down solenoid is functioning normally.
- Ensure that all pumps and solenoids are connected.
- See Section 2 above and follow troubleshooting flowchart.

11. No GPS or DGPS on display
Perform Maintenance and Service Procedure #6.

12. Data status (green LED) light not lit
- check GPS status: must have GPS, DGPS, or RTK
- check EC status: EC values must be positive
- Unit must be moving to send data out port
Procedure #11: Checking External Controller Power

The Veris pH module requires a minimum of 12 volts at all times. 12 volts at the battery terminals is NOT sufficient power for the system to function, due to the significant current draw when the pumps and solenoids are engaged. Reduced voltage can be caused by corroded or dirty terminals, and an inadequately charged battery or failure in the charging system. Because there is often a voltage drop found in tractor power ports, you should hook the pH module power cables directly to the battery. TIP: if automatic cycling is erratic, disconnect wash pump power from pH external controller. If system cycles normally, the cause is most likely due to inadequate electric power.

If the Veris electrical system is not functioning properly, the Troubleshooting flowcharts will direct you through the most logical steps to identify the cause of the problem. If the problem persists, you will likely need to check the power inside the External Controller in order to isolate power system problems. An overview of this procedure is shown in Figure11.1.

1. Inspect LED's on External Controller circuit board.
   Remove metal plate covering external controller and inspect the fuse LED lights, as shown in Figure 11.2. If the green LED for its fuse is lit, the fuse is working.
2. Turn off power to External Controller, remove clear lid and remove and replace any fuse that has failed.

3. Check voltage with a digital voltmeter at power supply connection
All functions must be engaged during this test. In manual mode turn on wash pumps and cycle sampler shoe hydraulics while holding voltmeter leads on power supply connector shown in Figure 3. Keep moisture from entering External Controller. It may be necessary to reposition the spray nozzles or shield the overspray from the Controller. It is critical that the pumps are under full load (pumping water through the nozzles) during this test. Be careful to not let your fingers or voltmeter leads touch any other component inside the External Controller.
If voltage at power connector drops below 12 volts during this test:
   a) clean battery terminals
   b) check disconnect contacts
   c) hook power leads directly to battery—not through tractor power port
   d) charge battery

4. Check voltage at power cable (Figure 11.4). If 12V at cable but not on circuit board—call Veris Service Dept.

Figure 11.4: Using voltmeter to check voltage at power supply cable
Procedure #12: Troubleshooting Sampler Cylinder Hydraulics

The Veris pH module uses electro-hydraulics to perform the cycling functions. If the sampling shoe hydraulic cylinder is not functioning properly, the cause of the problem must be traced to either the electronic or the hydraulic side. This procedure will guide you through the steps necessary to identify the problem when the sampler cylinder in manual mode is not moving or only moves in one direction. An overview of this procedure is shown in Figure 12.1.

![Flowchart for trouble-shooting sampler hydraulics.](image)

1. **If cylinder doesn’t move at all in manual mode, check hydraulic flow.** Does main lift cylinder function? If not, check tractor hydraulic lever position. If necessary, check flow with pressure gauge.

2. **Inspect LED’s on External Controller circuit board.** Remove metal plate covering external controller and inspect the solenoid LED lights, as shown in Figure 12.2. Do not remove clear lid at this time. The LED’s on the UP circuit should light when the sampler up-down switch is raised and the LED’s on the down circuit should light when the manual up-down switch is lowered. If the four LED’s on the solenoid circuit do not light in that sequence, see Procedure #11 to test power inside External Controller.
3. **Test voltage coming out of External Controller to solenoids.** Disconnect the weather-pack connectors in line from Controller to the solenoids. Using a digital voltmeter set to read voltage, insert leads into connector coming from Controller. Activate manual raise-lower switch and read voltage. (Figure 12.3) Voltage should be 12 volts.

Figure 12.2 External Controller circuit board (metal cover removed)

Figure 12.3 Testing voltage on power leads to solenoid.
4. **Test continuity of coil.** With voltmeter set to ohms (resistance), insert both leads into the weatherpack connector leading to each solenoid. Start at the jumper wire (at first connection from external controller) and move to connector at solenoid. This tests the continuity of the signal through the coil. You should have continuity if the coil is working. Test both solenoids.

![Testing continuity of solenoid coil](image1)

Figure 12.4 Testing continuity of solenoid coil (at weather-pack connector on jumper-wire).

5. **Determine if coil is energizing.** (This test integrates the previous two steps—if you have 12 volts going to the coil and the coil is functioning (has continuity), the coil should energize.) Touch a small screwdriver or other metal object to the coil as shown in Figure 12.5, and activate manual raise/lower switch. When the coil energizes it will hold the metal magnetically. If one coil doesn’t energize, swap coils to determine whether it’s a bad coil or power problem.

![Using screwdriver to test energizing of coils](image2)

Figure 12.5: Using screwdriver to test energizing of coils.

6. **Clean solenoid valve.** If coils energize and the cylinder doesn’t move, there must be contamination in the solenoid cartridge. Remove and clean thoroughly with compressed air—be careful not to damage or lose O-rings.

Additional Tips…

If your system is equipped with lift hydraulics, you can swap coils or valves to verify the failed part, before ordering a replacement.

If sampler shoe moves in reverse direction, disconnect solenoid wires (from external controller) and reverse.
Procedure #13: Troubleshooting Communication Problem

Communication between the Veris Instrument and the External Controller is required for the system to initialize (sampler cylinder moves to neutral), and function. A communication failure between these components may be expressed as INIT ERR (initialization error) or COMM ERR (communication error). Follow flow chart below to address problems in their logical sequence.

Figure 13.1 Flowchart for testing communication between PC and External Controller

MAKE SURE POWER CABLE IS DISCONNECTED BEFORE ATTEMPTING ANY OF THE FOLLOWING STEPS

1. **Look for obvious damage to cable.** Unplug the communication cable from the external Controller. Check the pins in each side of the connector--gently press on each pin (2 in each connector) with a screwdriver or something similar to check for loose or broken pins. See Figure 13.2.
2. Testing continuity on communication cable.
   a) Unplug the communication cable from the PC.
   b) Bring both ends of the communication cable close enough together to reach with a voltmeter.
   c) Set your voltmeter to resistance (or continuity). Check continuity between the following pins:

<table>
<thead>
<tr>
<th>4 pin connector</th>
<th>Serial connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

   (you will need to insert a solid-conductor wire or paper clip attached to a wire into the sockets of the serial connector unless your voltmeter leads are very small)

Figure 13.3 9 pin serial connector (left) and 4 pin round connector (right)
3. Testing continuity from the circuit board through the communication cable
   a) Remove the steel cover and unscrew the plastic lid from the external Controller.
   b) Look for the brown Molex 3-pin connector circled in Figure 13.4. The color sequence
      (left->right) should be white-green-black. CAREFULLY wiggle each wire to check for
      a loose connection.
   c) Check continuity between the following pins:

   Figure 13.4 Brown Molex connector on circuit board (POWER MUST BE DISCONNECTED
      BEFORE TESTING)

   d) Check continuity from brown Molex connector to 9 pin serial connector; this tests
      continuity from the circuit board to the PC. (Figure 13.5)

<table>
<thead>
<tr>
<th>Molex Connector</th>
<th>4-pin connector</th>
<th>9 pin serial connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Green</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Black</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

   Figure 13.5 Testing continuity from Molex connector to serial connector
4. Testing that the external controller is receiving/acknowledging the command sent to it by the PC.

a) Turn on the external pH Controller.

b) Open up a HyperTerminal session on a PC:
   Click Start►Programs►Accessories►Communications►HyperTerminal. A new session of Hyper Terminal should open. In the box labeled “Connect using___” you will need to select the Com port you will be using.
   (on Windows 2000 and older: Under the Call menu, click Disconnect.)
   Under the File menu, click Properties.
   Click the Configure… button.
   Change the settings to:
   Bits per second: 9600
   Data Bits: 8
   Parity: None
   Stop bits: 1
   Flow Control: None
   Click OK on both boxes.
   Under the File menu, click Save As…
   enter 9600 for the file name and click OK.
   (on Windows 2000 and older: Under the Call menu, click Connect.)

c) Plug the serial cable from the external controller into the PC’s serial port. The data in Hyper Terminal should be similar to this:

   7E -237 -285 3A
   7E -237 -285 3A

   The important piece of information here is the first two characters. They tell you the “state” of the controller. You should see 7E if you just turned on the controller, in which the controller is waiting for a certain command from the Instrument. When you see the “INIT ERR” message on the Instrument’s screen, it is receiving this state from the controller.
5. **Testing that the instrument is sending the proper command to the external controller.**
   
a) Connect the PC to the PC using a serial cable (you will need a null modem and may need a gender changer). Turn on the PC and enter data acquisition. The data in Hyper Terminal should look like this
   
   $\text{U\&\text{U\&\text{C}}}$
   
   The important letter above is the 'U', but the data coming up should match this character-for-character. The 'U' is the letter the pH Controller is looking for. Press the engage (1) key on the PC. The data in Hyper Terminal should change to:
   
   $\text{N\&\text{N\&\text{e}}}$
   
   Again, the important letter is the second letter, this time 'N'. Pressing the (1) key will toggle this from 'U' to 'N'. Depending on settings in your controller, there may be slight variations in the specific characters. The main issue is whether or not any characters are transmitted.

b) Exit data acquisition. Connect the external pH Controller to the PC using the Controller's cable. Go back to data acquisition in the PC. If everything is working properly, the pH readings should be something other than "-1.00" and the message will read "1 TO START" or "INIT ERR". Wait 10 seconds, disconnect the external pH controller's serial cable from the PC, and connect it to the PC's serial port. The data coming in from the external pH controller will be the same as in 3> above if the message read "INIT ERR", but will look something like this if the message read "1 TO START":
   
   7F -236 -284 39
   7F -236 -285 3A
   
   If the message has changed, everything is working properly. If it has not, the message being sent from the PC to the external Controller is not being received.

To summarize, the external pH Controller sends a report starting with ‘7E’ until it receives the command "$\text{U\&\text{C}}$" from the PC. When the external Controller receives this command, the reports will start with ‘7F’. At this point, the external controller waits for a command starting with ‘$\text{N}$’ or ‘$\text{G}$’ from the PC to initialize its position and start cycling. If the external controller never receives the ‘$\text{U\&\text{C}}$’ command, it stays in the ‘7E’ state and will not cycle.
Procedure #14: Troubleshooting Prox Sensor

The prox sensor, located on the left of the sampler shoe parallel linkage arm, is critical to the machine’s function. It informs the external controller of the sampler’s position, which allows the controller to move the sampler to the next position in the sampling/measuring sequence. If the prox sensor is not functioning properly, the entire operation will be affected. The problem may be with the Prox sensor itself or with its adjustment. Follow flow chart below to address problems in their logical sequence.

Figure 14.1.

1. **Inspect LED light on prox sensor.** Red LED light should light whenever prox sensor is near metal and not light when away from metal (Figure 14.2). This sequence indicates to the external controller the status of the shoe: whether the shoe is down and needs to come up for pH measuring, or it’s up and needs to go down for the next sample, etc. To view LED light, shade ambient light from prox sensor and cycle sampler assembly manually. Be careful to not strike or damage prox sensor face. KEEP HANDS CLEAR OF CYCLING MECHANISM.

Figures 14.2a and b. Prox sensor and LED light
2. **Adjust prox sensor gap if needed.** Adjust sensor to 1/4” - 3/8” (6-9 mm) gap (Figure 14.3). Cycle unit manually to insure that this gap is maintained throughout cycling range.

![1/4 to 3/8" gap (6-9 mm)](image)

**Figure 14.3 Prox sensor gap**

3. **Adjust prox sensor height if needed.** Loosen bolt holding prox sensor arm and rotate to change height of prox sensor (Figure 14.4). Adjust prox sensor height with sampler shoe completely raised. Adjust the prox sensor so it barely clears the lower part of the sensor plate when sampler is completely raised. It may be necessary to reposition the electrode holder and/or sampler shoe after adjusting prox sensor. If sampler shoe is unable to penetrate hard soil, the prox sensor may not be able to clear the top of the plate. If that happens, the sampler will appear to have locked in the down position—when in reality it just isn’t able to clear the metal plate. In that case, the external controller has not received the message from the prox sensor to move to the next step in the sequence—raising the shoe for pH measurement.

![Pivot bolt for adjusting prox sensor arm](image)

**Figure 14.4 Pivot bolt for adjusting prox sensor arm**
4. **Check voltage to prox sensor if needed.** Disconnect sure-seal connector from external controller to prox sensor. Check for 12V voltage on socket #1 and pin #3 from external controller, with power to external controller turned on (Figure 14.5). Do not short across voltmeter leads.

![Figure 14.5 Checking voltage to prox sensor](image-url)