



# OPERATOR'S MANUAL



ENVIRONMENTAL  
TILLAGE SYSTEMS



**ENVIRONMENTAL  
TILLAGE SYSTEMS**

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# 1 ETS NEW EQUIPMENT WARRANTY

**1 | Warranty Protection.** *Subject to the further understandings described below, Environmental Tillage Systems, Inc. (“ETS”) warrants that for a period of one (1) year from the startup date if the startup/setup form is completed, signed and returned to ETS. If this form is not returned, warranty period starts from the date of delivery. The delivery of ETS equipment to the retail purchaser of the equipment (“you”), the equipment will (a) be free of material defects in material or workmanship, and (b) function in a manner consistent with any published specifications existing at the time of purchase. This Warranty may be assigned by you during the term of the Warranty to subsequent purchasers of the equipment by written notification to ETS of the new purchaser’s name, address, and telephone number. Upon acceptance of notification by ETS, it will respond in writing to the new equipment owner acknowledging any remaining warranty coverage. If any component of ETS equipment (e.g. guidance systems) are manufactured by third parties, ETS will, if permitted to do so by the component manufacturer, pass the component manufacturer’s warranty on to you. In that case, the component manufacturer’s warranty will be in lieu of any warranty of that component by ETS. If the component manufacturer’s warranty can only be exercised by ETS, ETS’ warranty to you of that component will be identical in breadth and remaining length of the warranty that ETS receives from the component manufacturer. ETS will not provide any additional warranty beyond the manufacturers’ for any components not specially manufactured by ETS. ETS follows an ongoing process of product improvements; any test or research parts/components, if included with the purchase of equipment, are not covered by warranty. These parts will be identified at the time of sale to the customer.*

**a. Extended warranty period for specific items:** ETS will provide a two-year warranty for the following SoilWarrior components – frame, toolbar, hubs, lift arms, hitch/hitch plate, and tilt plates. Hub warranty valid only if gear lube 80w/90 is used. ETS will provide a three-year warranty for the following SoilWarrior components – PWM drive when used with ETS filter system.

**b. No other parts/components are warrantied beyond one year.**

**c. This warranty does not obligate the Company to bear cost of labor in replacement of parts.**

**d. It is the policy of the Company to make improvements without incurring obligations to add them to any unit already sold.**

**2 | Operation and Maintenance of Equipment.** In order to receive full warranty protection, you must utilize your ETS equipment in a manner consistent with direction contained in the Operating Manual or other safety or technical documentation provided by ETS. This Warranty will be voided if you materially modify or alter the equipment in a manner that is not authorized in writing by ETS. Furthermore, this Warranty can be voided if the problem results from your misuse of your ETS equipment, from a failure to maintain your ETS equipment, or for an accident that contributed to the problem. There are parts on your equipment, (e.g. consumable parts such as tillage bits, coulters, fertilizer hoses, application components, etc.) that will wear out and need to be replaced as part of routine maintenance. That replacement will only be covered by this warranty if it is determined that there was a manufacturing defect that caused the part to malfunction or wear out much earlier than it should.

**3 | Disclaimers of Other Warranties.** THIS EXPRESS WARRANTY CONSTITUTES THE ONLY WARRANTY, EXPRESS OR IMPLIED MADE BY ETS WITH RESPECT TO ITS EQUIPMENT OR THE RESULTS OF USE OF ITS EQUIPMENT. ALL IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATIONS, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED. To the extent that State or federal law limits the extent to which implied warranties can be disclaimed, the disclaimer shall be effective to the full extent permitted by law. Furthermore, unless otherwise provided by law, any required implied warranties shall have the same one year term as ETS’ express warranty.

# 1 ETS NEW EQUIPMENT WARRANTY

- 4 | Handling of Warranty Claims.** If you believe that you have a warranty claim, you must promptly either contact ETS, or if you purchased the equipment from an ETS-authorized dealer, contact the dealer about the problem. You must also provide ETS and/or the reseller all information needed to respond to your warranty claim and must reasonably cooperate in the efforts to remedy the problem. Necessary information may include photographs of components of the equipment that you feel are not functioning properly. Warrantable parts must be delivered to ETS for modification or replacement by the Customer at the Customer's expense. If warranty repair work is done at the Customer's location, at the Customer's request, standard ETS field servicing charges for labor and per diem travel charges will be charged to the Customer.

To contact ETS about a warranty issue, call (507) 332-2231 and ask for the Service Manager or write to ETS at 85 Prairie Avenue SW, Faribault, MN, 55021. Make sure that your correspondence informs ETS as to how it can best get in touch with you. If you are contacting ETS because your reseller has been unable to satisfactorily address the warranty problems, please also let ETS know what efforts have been made by your reseller and who your reseller is.

ETS will respond to warranty claims as promptly as reasonably possible. Some of the investigation of warranty claims may be done by telephone or the Internet. If ETS determines that a warranty claim is valid, it will make, or cause to be made, the repairs or replacement of parts or components, necessary to bring your equipment into compliance with this Warranty. However, if ETS determines that within a reasonable time it will be unable to make repairs or replacements that resolve the warranty issues, it can, at its sole discretion, resolve the warranty claim by reimbursing you 100% of purchase price and taking back title of the equipment if within

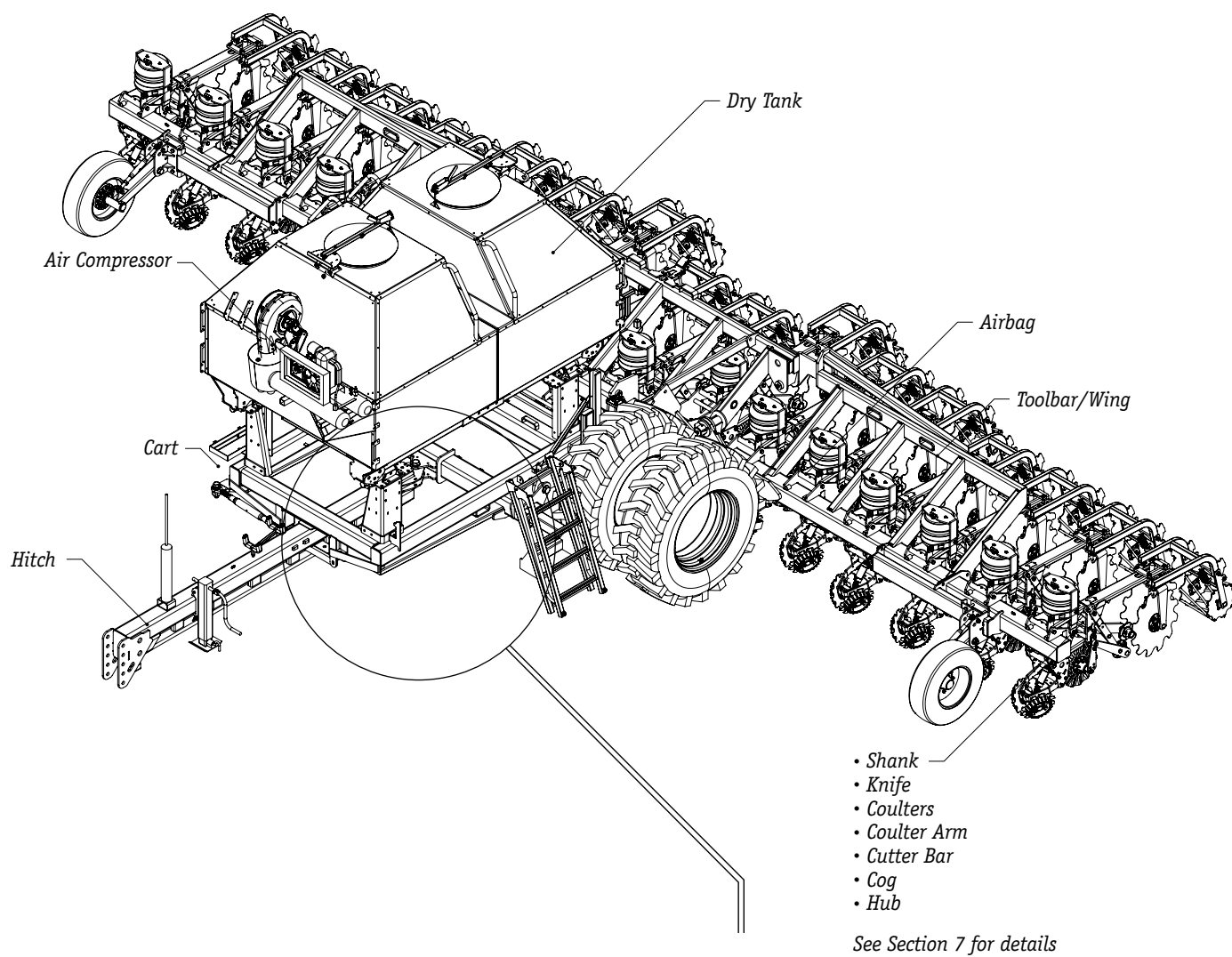
one year of purchase, 50% if within the 2nd year of the warranty, and 33% if within the 3rd year of the warranty. The remedies described in this paragraph constitute your exclusive remedies in the event of a breach of warranty.

- 5 | Limitation of Liability.** IN NO EVENT, BE IT FOR BREACH OF WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, OR ANY OTHER CAUSE OF ACTION SHALL ETS BE LIABLE TO BUYER FOR INCIDENTAL, CONSEQUENTIAL, OR PUNITIVE DAMAGES INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR DELAY DAMAGES, EVEN IF SUCH DAMAGES WERE FORESEEABLE BY , OR KNOWN TO ETS BEFOREHAND. ETS' liability is limited to the cost of repair or replacement of the equipment built by ETS or, at ETS' option, repurchase of the equipment.
- 6 | Warranty Disputes.** If you do not feel that ETS complied with its warranty obligations and are dissatisfied with the answers you are getting from ETS' Service Manager, you can write to ETS' Chief Executive Officer. ETS is proud of the quality of its equipment and will thoroughly evaluate any report of customer dissatisfaction. If your concerns are not addressed to your satisfaction through ETS' follow-up to your letter, any disputes relating to this warranty or the quality or condition of equipment you purchased from ETS must be exclusively resolved in the courts of the State of Minnesota, County of Rice, USA.

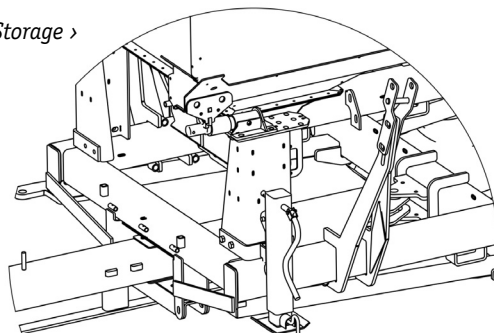
*Please carefully read and follow the Operating Manual that is provided with the equipment you purchased and read and follow any Technical Bulletins or other information you subsequently receive from ETS. If you have any questions about your equipment that you cannot resolve through review of the Operating Manual, feel free to contact ETS' Service Manager. ETS is proud of its commitment to quality and excellent customer service and we want your experience to be positive.*

## 2 SOILWARRIOR® PARTS OVERVIEW

### *SoilWarrior with Dry Nutrient Delivery System*

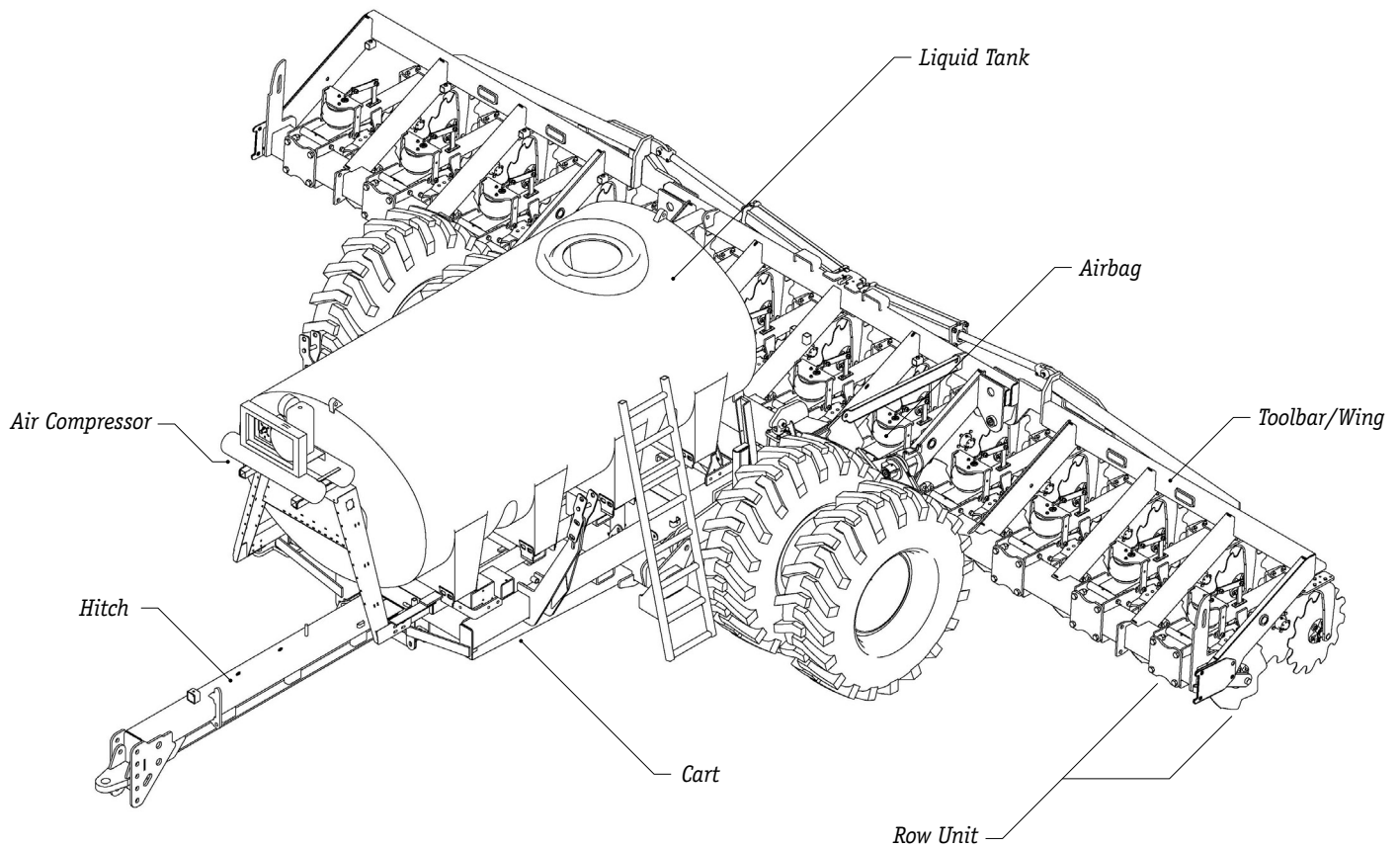


Jack/Jack Storage ›



## 2 SOILWARRIOR® PARTS OVERVIEW

### *SoilWarrior with Liquid Nutrient Delivery System*





# 3 SAFETY LANGUAGE AND LABELS

## 3.1.1 SAFETY LANGUAGE

Before operating or servicing the SoilWarrior®, you must read, understand, and follow the instructions and safety warnings in this manual.

The level of risk is indicated by the following signal words:

<b>IMPORTANT</b> Indicates a situation that could result in damage to the machine or other property.	<b>CAUTION</b> Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.	<b>WARNING</b> Indicates a hazardous situation, which, if not avoided, could result in death or serious injury.	<b>DANGER</b> Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.
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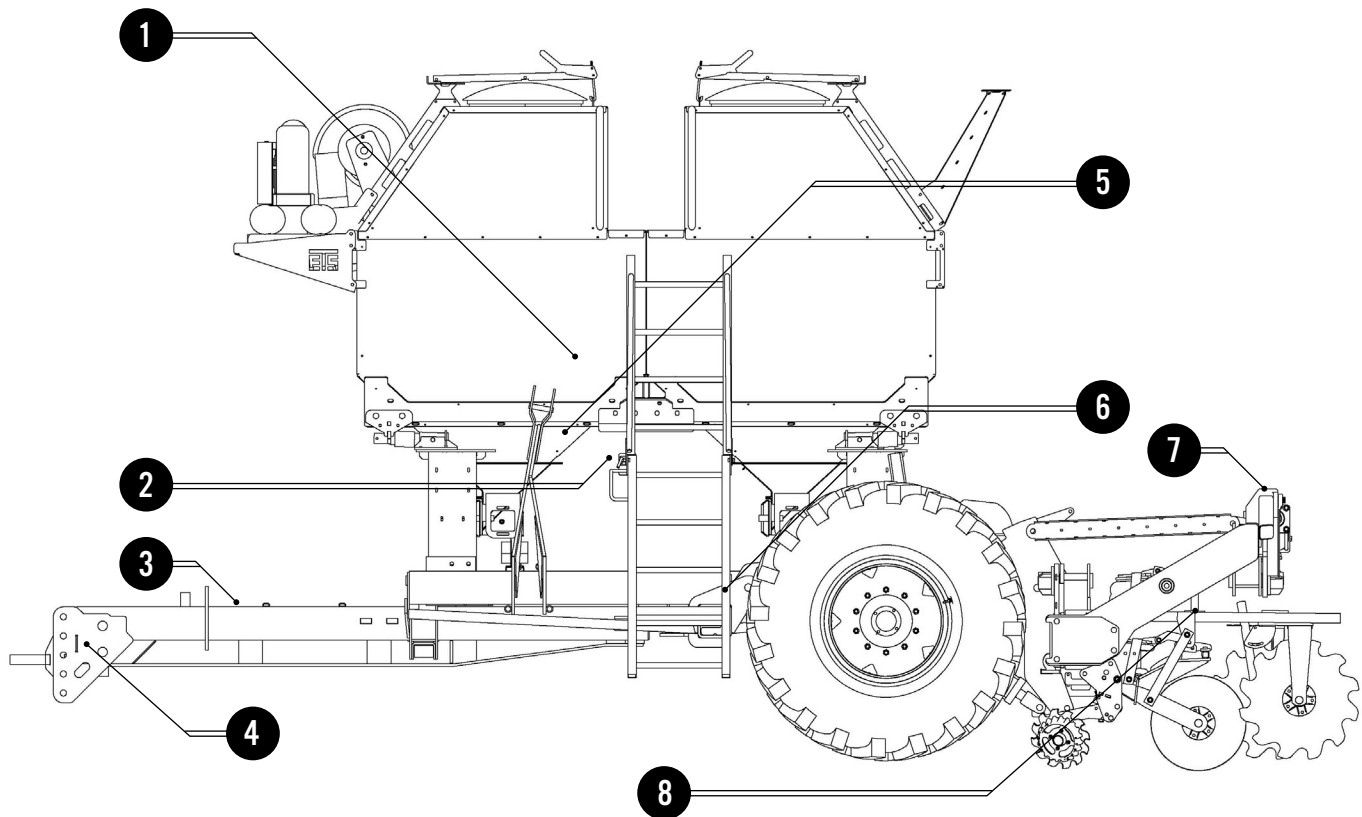


## 3.1.2 SAFETY LANGUAGE: HAZARDS FROM MODIFYING THE SOILWARRIOR®

Before making any modifications, contact ETS and describe the alteration being considered. Altering may void the manufacturer’s warranty and render the machine unsafe for operation.

# 3 SAFETY LANGUAGE AND LABELS

## 3.2 SAFETY LABELS ON THE SOILWARRIOR®



**IMPORTANT**  
**Fold ladder**  
**after**  
**each use**

**1 IMPORTANT**  
Fold ladder after  
each use

**⚠ WARNING**  
  
**Keep off while machine is moving**  
**or mechanism is running.**

**2 WARNING**  
Keep off while the machine is moving  
or mechanism is running.

# 3 SAFETY LANGUAGE AND LABELS



- 3 IMPORTANT**  
Remove jack during field operations



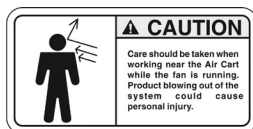
- 4 WARNING**  
Tongue rises rapidly when unhitched from tractor.  
To prevent serious injury or death:  
• Lower implement to ground before unhitching.



- 5 DANGER**  
To prevent Serious Injury or Death From Moving Parts:  
• KEEP AWAY – Moving parts can crush and dismember.  
• Disconnect and lockout power source before adjusting and servicing.



- 6 FOLD AFTER USE**

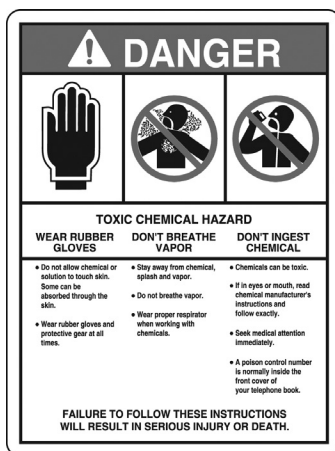
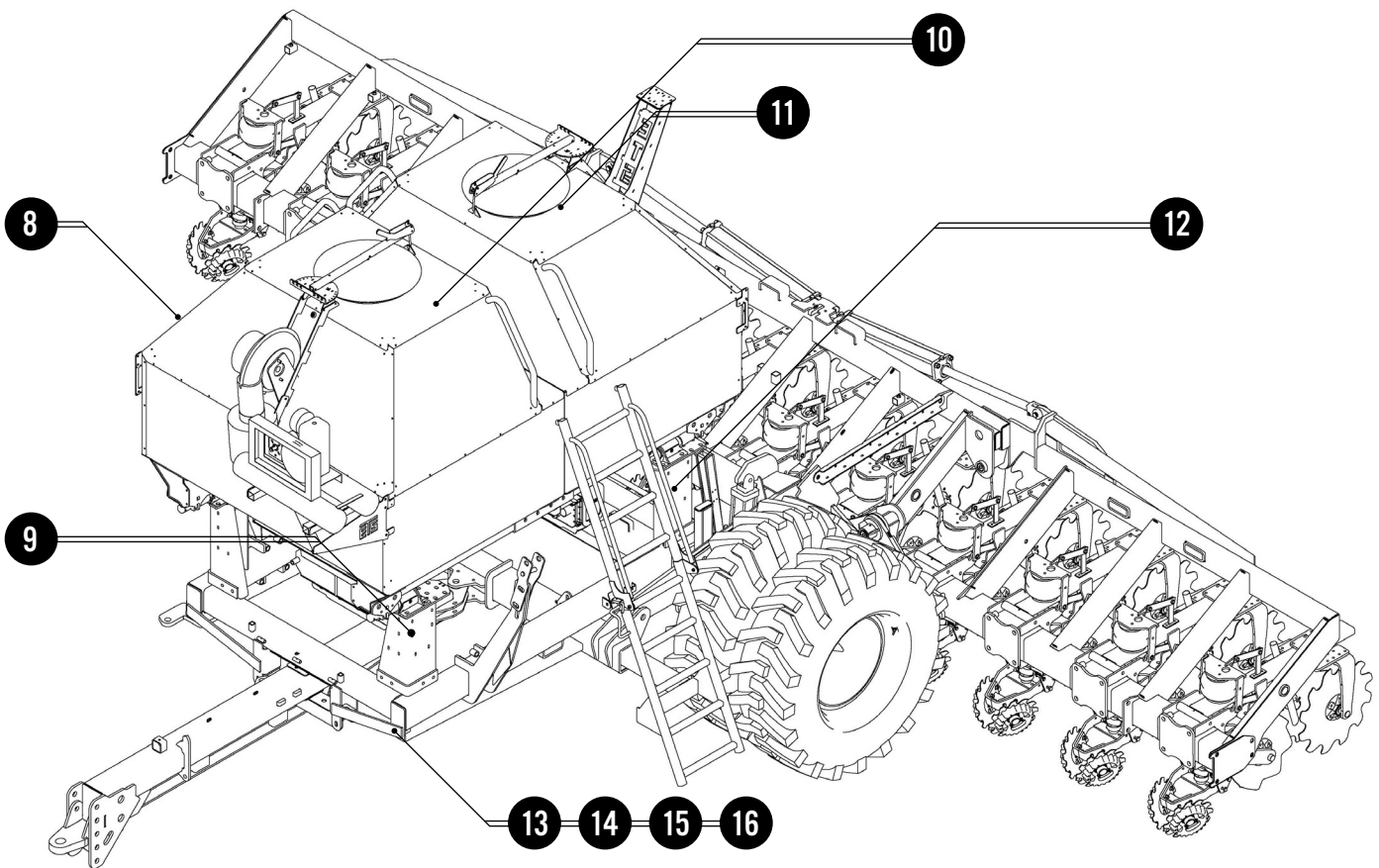


- 7 CAUTION**  
Care should be taken when working near the Air Cart while the fan is running. Product blowing out of the system could cause personal injury.



- 8 WARNING**  
Pinch Point and Crushing Hazard. Depressurize air system and use extreme caution when working on row unit.

# 3 SAFETY LANGUAGE AND LABELS



8

## DANGER

### Toxic Chemical Hazard

#### WEAR RUBBER GLOVES

- Do not allow chemical or solution to touch skin. Some can be absorbed through the skin.
- Wear rubber gloves and protection gear at all times.

#### DON'T BREATHE VAPOR

- Stay away from chemical, splash and vapor.
- Do not breathe vapor.
- Wear proper respirator when working with chemicals.

#### DON'T INGEST CHEMICAL

- Chemicals can be toxic.
- If in eyes or mouth, read chemical manufacturer's instructions and follow exactly.
- Seek medical attention immediately.
- A poison control number is normally inside the front cover of your telephone book.

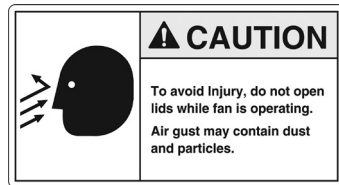
*Failure to follow these instructions will result in serious injury or death.*



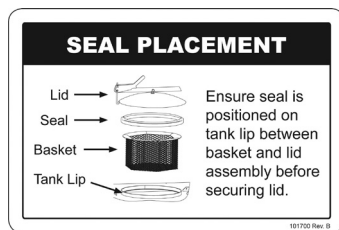
# 3 SAFETY LANGUAGE AND LABELS



- 9 **IMPORTANT**  
Drain Daily



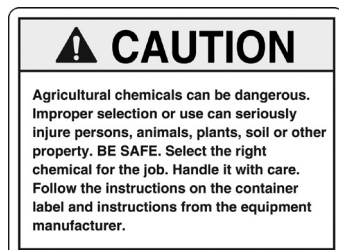
- 10 **CAUTION**  
To avoid injury, do not open lids while fan is operating.  
Air gust may contain dust and particles.



- 11 **SEAL PLACEMENT**  
Ensure seal is positioned on tank lip between basket and lid assembly before securing lid.

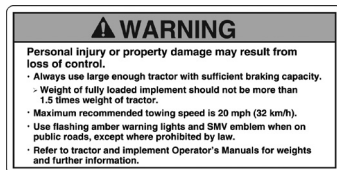


- 12 **DANGER**  
To prevent serious injury or death: Lower unit to ground and depressurize air system before disassembly.



- 13 **CAUTION**  
Agricultural chemicals can be dangerous. Improper selection or use can seriously injure persons, animals, plants, soil or other property. BE SAFE. Select the right chemical for the job. Handle it with care. Follow instructions on the container label and instructions from the equipment manufacturer.

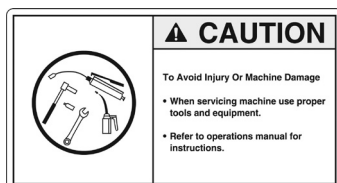
# 3 SAFETY LANGUAGE AND LABELS



## 14 WARNING

Personal injury or property damage may result from loss of control.

- Always use large enough tractor with sufficient braking capacity. Weight of fully loaded implement should not be more than 1.5 times weight of tractor.
- Maximum recommended towing speed is 20 mph (32 km/h).
- Use flashing amber warning lights and SMV emblem when on public roads, except where prohibited by law.
- *Refer to tractor and implement Operator's Manuals for weights and further information.*



## 15 CAUTION

To Avoid Injury Or Machine Damage:

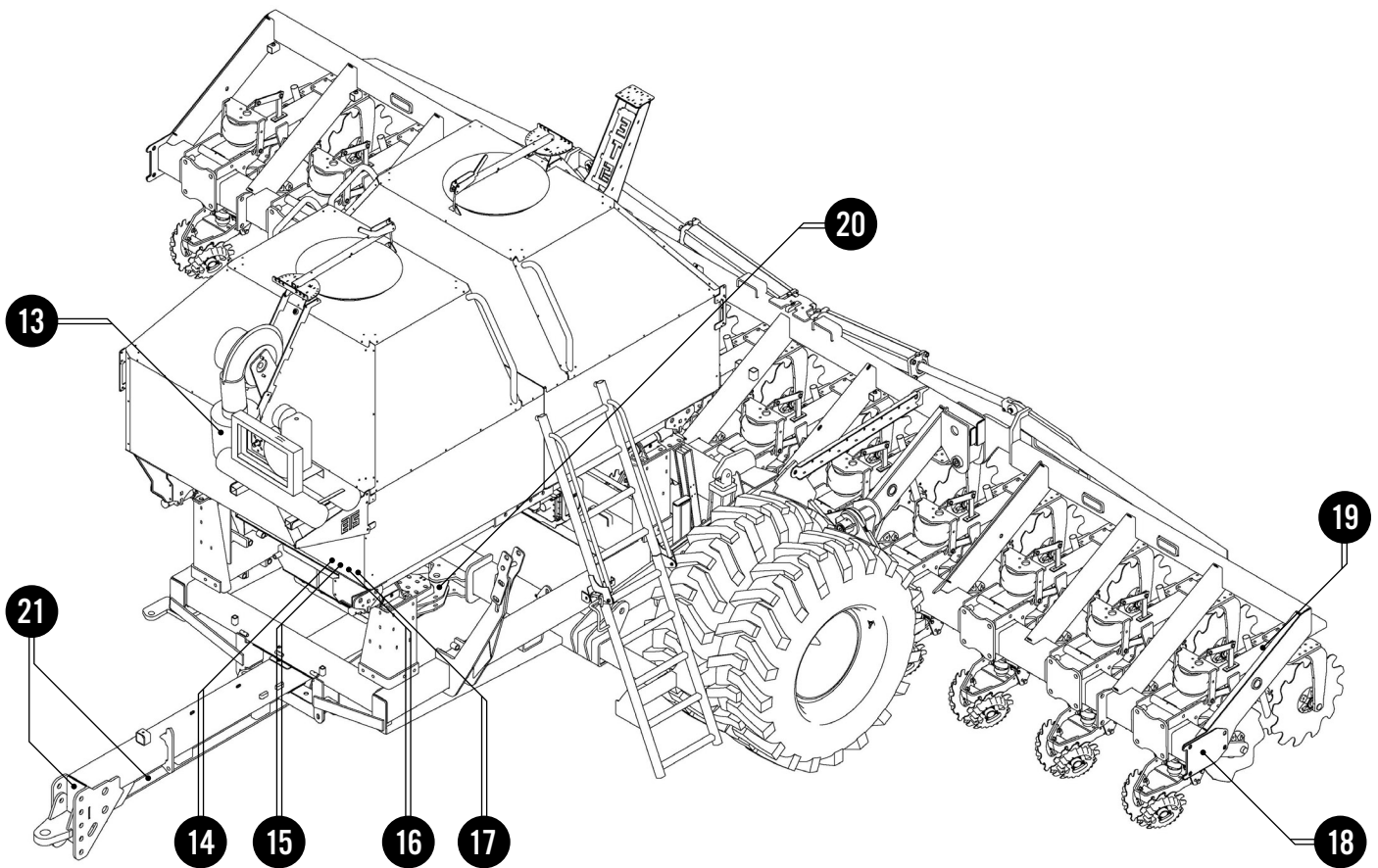
- When servicing machine use proper tools and equipment.
- *Refer to operations manual for instructions.*



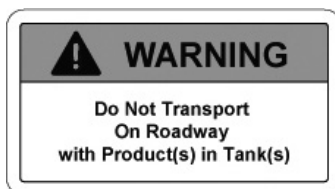
## 16 CAUTION

- 1 | Read Operator's Manual before using machine.
- 2 | Stop tractor engine, lower machine to the ground, place all controls in neutral, set park brake, remove ignition key and wait for all moving parts to stop before servicing, adjusting, repairing, unplugging or fitting.
- 3 | Install and secure all guards before starting.
- 4 | Keep hands, feet, hair and clothing away from moving parts.
- 5 | Do not allow riders.
- 6 | Keep all hydraulic lines, fittings and couplers tight and free of leaks before using.
- 7 | Clean reflectors, SMV and lights before transporting.
- 8 | Install safety locks before transporting or working beneath components.
- 9 | Add extra lights and use pilot vehicle when transporting during times of limited visibility.
- 10 | Use hazard flashers in tractor when transporting.
- 11 | Install safety chain when attaching to tractor.
- 12 | Keep away from overhead electrical lines. Electrocutation can occur without direct contact.
- 13 | Review safety instructions with all operators annually.

# 3 SAFETY LANGUAGE AND LABELS



**13 DANGER**  
High Center of Gravity



**14 WARNING**  
Do Not Transport On Roadway with Product(s) in Tank(s)

# 3 SAFETY LANGUAGE AND LABELS



15

## CAUTION

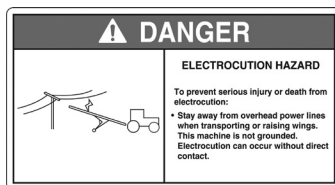
Toolbar **MUST** be fully raised prior to folding.



16

## CAUTION

Toolbar **must** be fully lowered during operation.



17

## DANGER

### Electrocution Hazard

To prevent serious injury or death from electrocution:

- Stay away from overhead power lines when transporting or raising wings. This machine is not grounded. Electrocution can occur without direct contact.



18

## WARNING

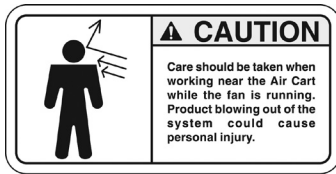
### Overhead Wing Hazard

To prevent serious injury or death:

- Stay away from beneath wings when they are in the raised position or are being lowered.
- Keep others away.



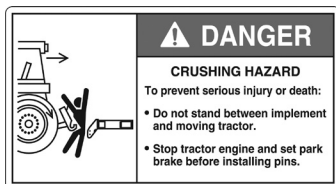
## 3 SAFETY LANGUAGE AND LABELS



- 19 CAUTION**  
Care should be taken when working near the Air Cart while the fan is running. Product blowing out of the system could cause personal injury.



- 20 WARNING**  
**High Pressure Fluid Hazard**  
To prevent serious injury or death:  
• Relieve pressure on system before repairing or adjusting or disconnecting.  
• Wear proper hand and eye protection when searching for leaks. Use wood or cardboard instead of hands.  
• Keep all components in good repair.



- 21 DANGER**  
**Crushing Hazard**  
To prevent serious injury or death:  
• Do not stand between implement and moving tractor.  
• Stop tractor engine and set park brake before installing pins.

### **WARNING**

#### **COLLISION HAZARD**

Know the height, width, and length of the machine. Always be aware of clearances.

#### **SEVERING HAZARD**

Coulters, cogs, and tillage blades can sever digits. Plan a safe lifting and moving procedure before handling.

#### **SAFETY LABELS**

To protect against death or serious injury, all labels must be on the machine and must be legible. If any of these labels are missing or cannot be read, contact ETS for replacements.

## 3.3 LABEL CARE

Keep safety labels clean and legible at all times. Replace safety labels that are missing or have become illegible. If a part is replaced that displayed a safety label, install a safety label on the new part. Safety labels are available upon request.

## 3 SAFETY LANGUAGE AND LABELS

### 3.4 ROAD SAFETY

Transport machine in folded position with no product in the tank(s). Dry fertilizer can pack in the meter bodies resulting in damage to machine components.

SoilWarrior must be towed at 20 MPH (32 km/h) or less.

When unhooking the SoilWarrior, it must be parked on a level surface, with toolbar locked in storage position or field position and row units resting on the ground.

The weight of the tractor must be sufficient to provide a minimum mass ratio of 1.5. See chart to the right.

Select your cart configuration and toolbar configuration from the chart to the right. Add together for approximate machine weight.

Divide SoilWarrior weight by 1.5 to find the minimum tractor weight required.

SoilWarrior Cart Configuration	Component Weight*
--------------------------------	-------------------

4500 D2	13,200 lbs
---------	------------

4500 XX D2	15,700 lbs
------------	------------

4500/5000 D3	16,700 lbs
--------------	------------

Liquid System	11,400 lbs
---------------	------------

Toolbar Configuration	Component Weight*
-----------------------	-------------------

12 row	13,500 lbs
--------	------------

16 row	17,000 lbs
--------	------------

24 row	28,000 lbs
--------	------------

**\*All weights are approximate.**

### 3.5 LIGHTS

It is the responsibility of the customer to know the lighting and the marking requirements of the local highway authorities and to install and maintain the equipment to comply with regulations. Add extra lights when transporting at night or during periods of limited visibility.

#### WARNING

##### COLLISION HAZARD

Failure to use accessory lighting while traveling on public roads may lead to collision.

Install and use accessory lights while traveling on any public road.

Verify all lights function properly before traveling on any public road.

### 3.6 TIRE SAFETY

**IMPORTANT:** Failure to follow proper procedures when mounting a tire on a wheel rim can produce an explosion, which may result in serious injury or death. Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job

safely. Inflating or servicing tires can be dangerous. Whenever possible, trained personnel should be called to service and/or mount tires. Always order and install tires with appropriate capacity ratings to meet the anticipated weight being placed on the equipment.

## 4 PREPARATION FOR THE FIELD

### 4.1.1 TRACTOR NEEDS: HORSEPOWER GUIDELINES

#### *SoilWarrior® N System\**

Machine Configuration	SoilWarrior® N without Knife	SoilWarrior® N with Knife	SoilWarrior® N with Twin Row Attachment
6 row	100 hp +	180 hp+	150 hp +
8 row	130 hp +	240 hp+	200 hp +
12 row	180 hp +	360 hp+	300 hp +
16 row	250 hp +	480 hp+	400 hp +
24 row	450 hp +	600 hp +	550 hp +

The horsepower needed depends on numerous factors such as soil type, terrain, soil moisture level, depth of tillage, tillage type, tracks or tires, and hydraulic motor usage. The ratings listed to the left are only suggestions; actual horsepower requirements may vary.

#### *SoilWarrior® X System\**

Machine Configuration	SoilWarrior® X XS Attachment	SoilWarrior® X XD Attachment
6 row	180 hp+	210 hp +
8 row	240 hp+	300 hp +
12 row	360 hp+	420 hp +
16 row	480 hp+	**
24 row	600 hp +	**

\* The listed Horsepower suggestions are draw bar ratings not PTO ratings.

\*\* For row crop tillage, it is not recommended to operate the XD attachments at more than 12 rows due to the ballast and power requirements.

### 4.1.2 TRACTOR NEEDS: BALLAST

Consult the tractor owner's manual for specific adjustment procedures, tire inflation, wheel spacing, and ballast requirements for the size of SoilWarrior® being operated. Keep in mind that the SoilWarrior will produce negative

drawbar weight when the toolbar is in the raised position without fertilizer in the tank. Drawbar down pressure is affected by fertilizer load and folding toolbar position.

## 4 PREPARATION FOR THE FIELD

### 4.1.3 TRACTOR NEEDS: HYDRAULIC REQUIREMENTS

All systems require 12 volts and at least 30 amps to operate.

#### Hydraulic Requirements

Model	Carts	Toolbar Width (ft)	Row Unit	Number of Rows	Fertilizer System	Liquid Tank Capacity (Gal)	Dry Capacity	Hydraulic Requirements
3100	Standard	10-20	X or N	6, 8	Dry or Liquid	1,250	4 tons/130 bushels	3-5 SCVs
4500	HD or XL	20-45	X	8, 12, 16, 18, 24	Dry or Liquid	1,600 or 2,200	Twin Standard: 8 tons/260 bushels; Twin XL and Triple: 10 tons/320 bushels	4 SCVs
4500	HD or XL	20-45	N	8, 12, 16, 18, 24	Liquid or Dry, NH <sub>3</sub>	1,600 or 2,200	Twin Standard: 8 tons/260 bushels; Twin XL and Triple: 10 tons/320 bushels	4-6 SCVs
5000	XL	60	N	24	Liquid or Dry, NH <sub>3</sub>	2,200	Twin XL and Triple: 10 tons/320 bushels	5-7 SCVs

### 4.1.4 HYDRAULIC FUNCTIONS

Install adapters if tractor does not have ISO hydraulic couplers. The hydraulic requirements vary between units depending on how the unit is equipped. Refer to Section 5 for more information.

The following are options that may be installed on the SoilWarrior®:

- Toolbar Lift
- Toolbar Tilt
- Toolbar Fold with active down force
- Dry Fertilizer Distribution Fan(s)
- Hydraulic Driven Air Compressor Motor
- Liquid Fertilizer Pump
- Hydraulic Dry Fertilizer Variable Rate Drive
- Power beyond return for wing fold relief on 5060 models

A **case drain** is needed for any unit that has a dry fertilizer distribution fan and/or hydraulically-driven air compressor motor. The case drain line typically uses a female flat face quick coupler. Consult the tractor manual to ensure proper connection of the case drain.

#### FLOW SETTINGS

**SCV#1** On John Deere – 10;  
Others at 100% (full flow)

**SCV#2** On John Deere – 6.5;  
Others at about 35%

*Tilt, Inner wing, and Outer wing cylinders are orifice-controlled.*

#### SCV Settings

- The liquid pump, which is determined by the product required.
- Air compressor, which should typically be set at 5 on a John Deere or about 30% of the flow on others.
- Fans, which will be determined by fan RPMs.



## 4 PREPARATION FOR THE FIELD

### 4.1.5 SOILWARRIOR FIELD OPERATION: PREPARATION

- 1 | Once in the field, activate SCV valve for AC/Meter circuit and press AC switch (Red light will activate) on 3 switch box or on the display (if equipped) this will allow the compressor to fill.
- 2 | Unfold, then Tilt the unit to working position.
- 3 | Zero scales if tanks are empty.
- 4 | Setup Rate Controller:
  - Start New Job for tracking acres and product output.
  - Enter your product density in the Rate Controller for each bin.
  - Update the current tank levels in the Rate controller.
  - If first time product is used, complete a catch test calibration in the Rate Controller.
- 5 | Setup Work Parameters, Product name, and Grower, Farm, Field
  - Bin 1 is front bin, bin 2 is rear or middle bin, Bin 3 is rear bin if present.

**NOTE:** If using SoilWarrior ISOBUS Control Module (SWICM), Bin 1 is ISO Tank 0, Bin 2 is 1, and Bin 3 is 2.

- IF liquid or NH3 is being used, set those up in Rate Controller.
  - Enter rates to apply.
  - Or if using a prescription load and select it.
- 6 | Set Airbag pressure to achieve desired depth. Start with 25 psi on X coulter row units, and 45 psi for knives or deep cog set ups.
  - 7 | Record Boundaries and Guidance lines.
    - Drive the boundary recording guidance line. Unit does not have to be in the ground.
    - Create interior headland boundary to alert you when to lift and set down unit.
    - Create long tillage lines/lands on the straightest edge of the field. Setting A and B at the farthest ends.

#### Hydraulic Function

Hydraulic Function	SCV #	Flow Setting
Implement Lift (Green Handle)		
AC/Meter circuit (Gray Handle)		
Wing down Pressure (Blue Handle)		
Cart Steering (Red Handle)		
Blower Fan 1 (Orange Handle)		
Blower Fan 2 (If Equipped)		
Liquid Pump (Yellow Handle) (If Equipped)		

On the above table, please fill in where the hoses get plugged in and what flow rating.

## 4 PREPARATION FOR THE FIELD

### 4.1.6 SOILWARRIOR FIELD OPERATION: IN-FIELD APPLICATION

- 1 |** Lineup your first pass.
- 2 |** Check the 3-switch box ensuring Scales, Fold, and AC are lit red.
  - If the machine is equipped with an integrated switchbox ensure that the Fold and AC boxes are green.
- 3 |** Set Hydraulics on Tractor:
  - SCV 1 = Raise and lower function for tillage
  - SCV 2 = Detent forward applying downforce to the wings (set to Constant)
  - SCV 3 = Detent forward for Cart steering if available, (set to Constant)  
*IF no cart steering this SCV will run the AC and Product Meter drives*
  - SCV 4 = Detent forward to run the AC and Product Meter drives or Liquid pump  
*May be the Product Fan if no cart steering (set to Constant)*
  - SCV 5 = Detent forward to operate Product Fan (set to Constant)
- 4 |** Set Transmission on Tractor to achieve desired speed. (Between 7 and 9 MPH)
- 5 |** Set Throttle to Maximum RPM
- 6 |** Turn on Product Master Switch (foot switch or button on display)
- 7 |** Turn on Guidance
- 8 |** Lower unit to Ground while driving forward and start applying product
- 9 |** Verify Application Rates on Rate controller
- 10 |** Verify tractor speed
- 11 |** Using Air Pressure regulators in Cab set pressure to achieve desired tillage depth
- 12 |** Monitor scales, Rate output and acres to ensure accuracy  
Lbs/Acre= Total Applied from Scale head/Acres covered (Found on Rate Controller)

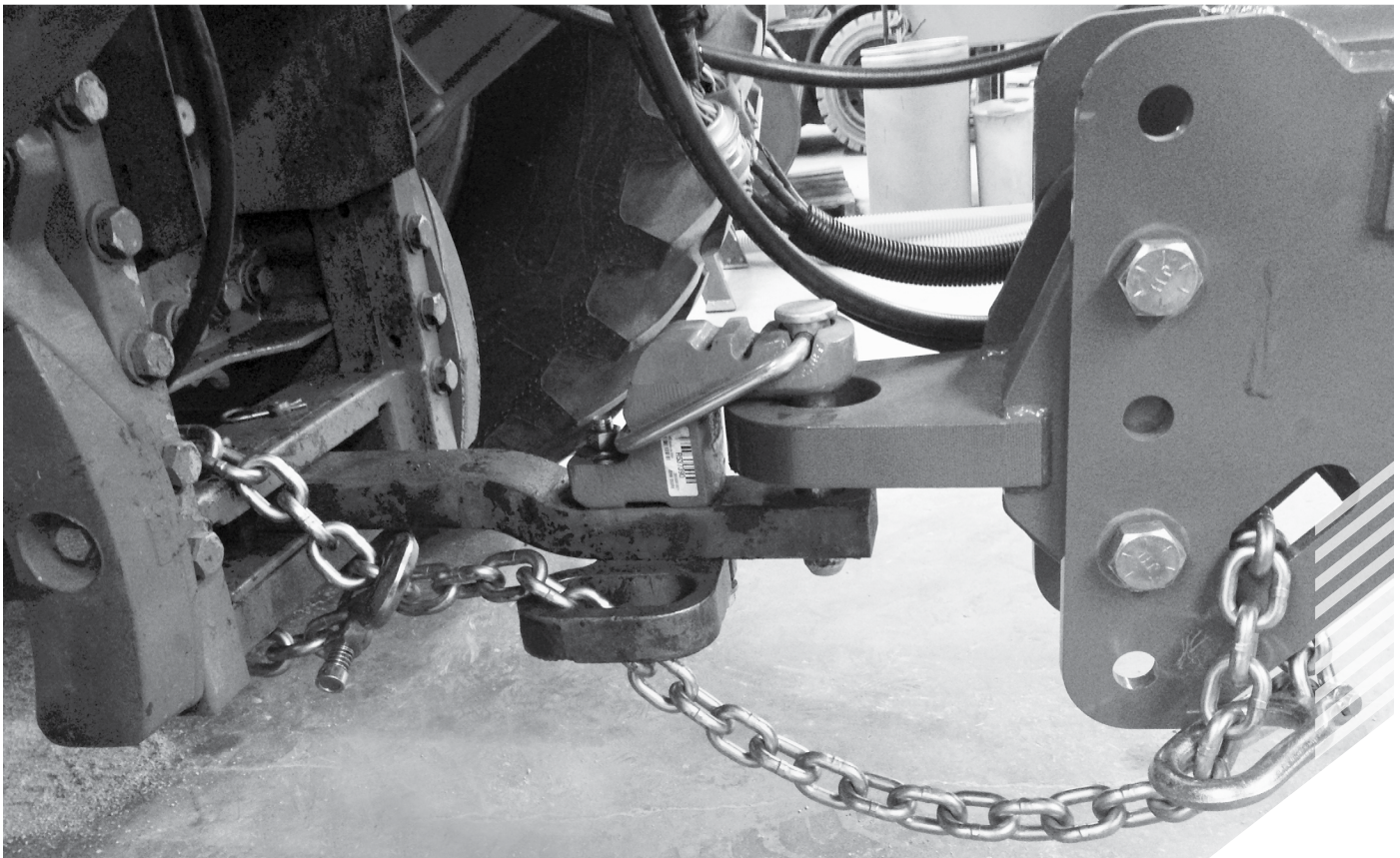
## 5 CONNECTION/DISCONNECTION

### 5.1 CONNECT UNIT TO TRACTOR

- 1 | Back tractor up to the SoilWarrior®.
- 2 | Adjust hitch height as needed with the jack so that the hitch is between the drawbar and hammer strap. Adjust the hitch point to assure the cart is level when connected to tractor.
- 3 | Install drawbar pin and lock in position.
- 4 | Inspect the safety chain for damage and wear. Replace damaged or worn safety chain before using machine.
- 5 | Route safety chain through chain support. Wrap chain around drawbar support as shown. Hook chain and engage hook safety lock.
- 6 | Retract the jack so it is not touching the ground or pavement.
- 7 | Place jack in storage position on unit.

**NOTE:** The tractor tire will contact the jack when left in the lifting position. Severe damage will result if not removed.

**NOTE:** Service videos can be found on the SoilWarrior YouTube channel - Service & Maintenance playlist.



Proper connection of unit to tractor.

## 5 CONNECTION/DISCONNECTION

### 5.2 CONNECT HYDRAULIC HOSES

It is suggested to set the tractor SCV flow rate to a **low setting** and the detent to a middle range when first operating each function so that you start each function at a slow rate.

See chart below for connection instructions.

Function	SCV Number	Hose ID Color & Hydra Grip Combo
Toolbar Lift	1	Green – Green & Black Hydra Grip
Toolbar Tilt	2	Blue – Blue & Black Hydra Grip
Toolbar Fold	2	Blue – Blue & Black Hydra Grip
Cart Steering (if used)	3 – if using John Deere Active Implement Guidance TBD by operator if using any other guidance system	Red – Red & Black Hydra Grip
Hydraulic PWM Drive and Hydraulic Air Compressor	4**	Gray – Gray & Black Hydra Grip
Dry Fertilizer Delivery Fan 1	5	Yellow – Yellow & Gray
Dry Fertilizer Delivery Fan 2 (if equipped)	6	Orange – Orange & Gray
Liquid Fertilizer Hydraulic Pump	6 (if available)	Yellow – Yellow & Black Hydra Grip

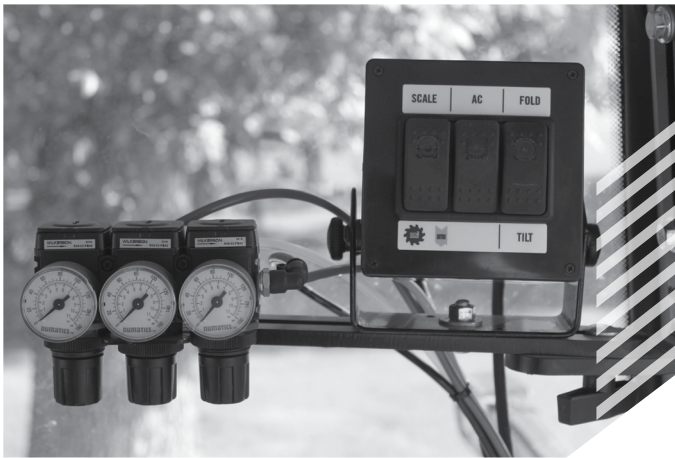
\*\* When using the Power Beyond port, a flow control valve and shutoff valve must be used to control the flow to the hydraulic drives and air compressor.

## 5 CONNECTION/DISCONNECTION

### 5.3 INSTALL AIR REGULATORS AND MONITOR

Each SoilWarrior® is equipped with a monitor and regulator mount bracket. The bracket is universal and should work with any type of tractor.

Install the monitor per each system's guidelines as recommended in the owner's manual. These systems are compatible with ETS SWICM. For other units not listed contact ETS Sales:



*Typical installation of regulators and switch boxes.*

- **Raven Viper® 4, Raven Viper® 4+, and Raven CR12™**
  - Document/VRA up to 10 products
- **Raven CR7™**
  - Document/VRA up to 5 products
- **John Deere GreenStar™ 3 2630**
  - Document/VRA up to 4 products (single RCM only)
- **John Deere Gen 4 Displays (CommandCenter™ 4100/4600 and 4240/4640)**
  - Document/VRA 5 products (single RCM only)
- **CNH Pro 700/New Holland IntelliView™ Plus IV**
  - Document/VRA up to 6 products (single RCM only)
- **AGCO NT01**
- **AGCO C3000**
- **Topcon X30 and X35**
- **Ag Leader InCommand® 800 and 1200**
- **Ag Leader Integra**
- **Trimble TMX-2050™ and GFX-750™**
- **Mueller Touch800® and Touch1200®**
- **AgJunction Outback MAX™**
- **Outback Guidance Outback REBEL**

### 5.4 DISCONNECT FROM TRACTOR

- 1 | Make sure wings are folded in fully. Engage Tilt lock and Lift lock. Install wing lock pins, or wing chocks so wings can not drift open.
- 2 | Park machine on a hard, level surface. Shut off tractor and remove key from the ignition.
- 3 | Disconnect cab air lines and cab electrical connections. Remove SoilWarrior hydraulic hoses from tractor SCVs.
- 4 | Remove safety chain from tractor drawbar support.
- 5 | Remove jack from storage position and install on jack mount. Install jack lock pin.
- 6 | Pull pin to extend lower half of jack to the lowest hole the pin will engage in. Extend jack using handle until the weight of the SoilWarrior is off the drawbar.
- 7 | Remove pin and slowly pull tractor away from SoilWarrior.



#### DANGER

Prior to disconnecting, make sure the SoilWarrior® is in a fully folded position or parking stands are in contact with the ground. Keep people away from the unit.

If these precautions are not followed, the tongue of the SoilWarrior® may rise rapidly during disconnection causing serious injury or death.



# 6 TRANSPORTATION TO FIELD

Once the unit is connected to the tractor, it should be transported in the folded position to the field with no fertilizer in the tank(s). If weight is needed to assist in the transfer of weight to the hitch, it is acceptable to carry up to 2,000 lbs of product in tank(s.) Do not unfold the unit until reaching the field.

**NOTE:** Transport machine in folded position with no fertilizer in the tank(s).

## 6.1 SWITCH BOX FUNCTIONS FOR 2000-5000 SERIES

### **Fold**

This switch allows you to unfold and fold the toolbar. It also enables the lift wheel, inner wings, and outer wing switches.

### **Working**

This function allows the machine to run the lift and wing wheels together in field operation.

### **Inner wing**

This switch folds the inner wing.

### **Outer wing**

This switch folds the outer wing.

### **Center raise main**

This switch raises and lowers the center toolbar in the fold section.

### **Tilt**

This switch tilts the toolbar in the fold section.

### **Scales**

This switch turns on the scales with a dry system.

### **Hyd drives/AC**

This switch turns on the power to operate the fertilizer drives and air compressor.

### **Spare**

This switch can be utilized for an extra function if needed.

### **Outer Wing bypass**

This is used during the unfolding to bypass the pressure relief.

### **Right inner wing**

This switch allows the operator to hold the right inner wing while folding or unfolding.

### **Left inner wing**

This switch allows the operator to hold the left inner wing while folding or unfolding.

To balance the lift of the wing wheels and the main frame, adjust the flow valves on the block on the front left side of the cart. There is a valve for the center main and the wing wheels. By turning the valves in or out, it restricts the flow to the main or the wing wheels. The valve for the center main restricts the flow down and is full flow up. The valve for the wing wheels restricts the flow up and full flow down.



# 6 IN-FIELD OPERATIONS

## 6.2 UNFOLD WINGS ON 3000–4500 SERIES

- 1 | Remove both fold lock wing pins.
- 2 | Disengage lift lock. If unable to pull lever into disengaged position, the toolbar needs to be raised. Pull back on SCV #1 to lift the toolbar. Toolbar will rise. Disengage lift lock.

**NOTE:** If you have to push forward on SCV #1 to raise the toolbar, your hoses are reversed. Switch the hoses on SCV #1 to the opposite ports.

- 3 | Disengage Tilt Lock valve.
- 4 | Activate the Fold circuit switch.

- 5 | Activate SCV #2 forward to fold out wings.

**NOTE:** If you have to pull back on SCV #2 to fold out wings, your hoses are reversed. Switch the hoses on SCV #2 to the opposite ports.

- 6 | Deactivate the Fold circuit switch. Activate the Tilt switch.
- 7 | Activate SCV #2 forward to fully tilt toolbar into working position.
- 8 | Activate SCV #1 forward to lower the toolbar.

## 6.3 FOLD WINGS ON 3000–4500 SERIES

To fold the unit, reverse the steps listed in Section 6.2.

## 6.4 UNFOLD WINGS ON 5000 SERIES

- 1 | Remove both fold lock wing pins.
- 2 | Disengage lift lock. If unable to pull lever into disengaged position, the center toolbar may need to be raised. Activate the center raise main switch and pull back on SCV#1 to raise the toolbar.

**NOTE:** If you have to push forward on SCV #1 to raise the toolbar, your hoses are reversed. Switch the hoses on SCV #1 to the opposite ports.

- 3 | Disengage Tilt Lock valve.
- 4 | Activate Fold circuit switch.
- 5 | Activate the Inner Wing switch. Activate SCV #2 forward to unfold the inner wings completely.

**NOTE:** If you have to pull back on SCV #2 to unfold wings, your hoses are reversed. Switch the hoses on SCV #2 to the opposite ports.

- 6 | Deactivate the Inner Wing switch.
- 7 | Activate the Outer Wing switch. Activate SCV #2 forward to unfold the outer wings completely. If the outer wings do not cycle, depress the Outer Wing Bypass switch while activating SCV #2 forward. This allows full hydraulic pressure to the outer wing cylinders.
- 8 | Deactivate the Outer Wing switch. Activate the Wing Wheel switch. Extend the wing wheels completely by activating SCV #1 forward.
- 9 | Deactivate the Fold switch. Activate the Working switch. Activate SCV #1 to fully tilt toolbar into working position.

**NOTE:** Keep tractor RPM above 1700 when folding or unfolding 5000 series toolbar.

## 6 IN-FIELD OPERATIONS

### 6.5 FOLD WINGS ON 5000 SERIES

To fold the unit, reverse the steps listed in Section 6.4.

#### 6.6.1 PROPER HITCH AND CART POSITION

**The hitch is set properly when:**

- The cart frame is level with the ground or positioned at a slight upward angle. If not set properly, adjust the hitch point position (see Section 6.7.1.)
- The toolbar and row units are level to a slightly downward angle. This can be adjusted by the Toolbar Tilt.
- There is approximately 20 inches between the bottom of the toolbar and the ground. This is especially important when using zone cleaners.



# 6 IN-FIELD OPERATIONS

## 6.6.2 HITCH AND CART POSITION: HITCH ADJUSTMENT

- 1 | Place tractor transmission in park, stop engine, and remove key.
- 2 | Chock the tires.
- 3 | Lower the toolbar to the ground to eliminate negative drawbar weight. Set air pressure above 5 psi on row unit regulators and zone cleaner air pressure at 0 psi (if installed).
- 4 | Remove jack from storage position and install jack on jack mount.
- 5 | Install the pin into holes through the jack and mounting plate. Install clip on pin. Release drop leg. No more than three holes should be exposed on the drop leg.
- 6 | Extend the jack to remove weight from the hitch.
- 7 | Remove the hitch bolts and lock nuts from the hitch point.
- 8 | Raise or lower the hitch using the jack to align four holes in the hitch.
- 9 | Reinstall the bolts and lock nuts from the hitch point.

**NOTE:** Moving the hitch point one hole position changes 4 inches of elevation at the front of the hitch. Inverting the hitch point changes the elevation 2 inches.

- 10 | Retract the jack and the drop leg.
- 11 | Remove the jack from the jack mount and place in storage position.
- 12 | Load tank with product. Re-check the toolbar.
- 13 | Re-check the row unit operating position.
- 14 | Repeat hitch adjustment if necessary.

**NOTE:** Consider making any test passes of the unit in the field at an angle to where you plan to do your final tillage.



Distance between the bottom of the toolbar and ground

## 7 ROW UNIT SETTINGS

Before operating the unit in the field and after the first day of operation, inspect the unit for any loose or missing fasteners, damaged components, missing shields or guards, and hose leaks or loose fittings. Repair, tighten, or replace these items as needed.

**IMPORTANT:** *SoilWarrior® row units are not designed to penetrate ground that is very dry and extremely hard (more than 400 pounds on a penetrometer).*

*Damage from field operation in frozen ground or from sharp turns will void the machine's warranty.*

### 7.1 GENERAL INFORMATION ABOUT AIR SYSTEMS

The SoilWarrior® N and SoilWarrior X require air pressure for operation. The unit may be equipped with an on-board compressor (hydraulic or electrically-driven) or an air hose connected to the tractor compressor. These will pressurize the row unit air system. Pressure to the air bags is regulated from 5–70 psi for the SoilWarrior X deep till, 5–40 psi for SoilWarrior X standard till and 5–80 psi for the SoilWarrior N by a pilot regulator mounted in the tractor cab. The gauge on the cart and the cab regulators may have a pressure difference of up to 10 psi depending on the installation. The gauge on the cart indicates the pressure in the row unit airbag. When operating at higher pressures and the relief valve discharges, the system pressure must drop to less than 30 psi before the relief valve resets.

Be sure to have the correct relief valve installed depending upon the row unit and the tillage attachment installed.

Air bags on each row unit provide positive and uniform down pressure.

# 7 ROW UNIT SETTINGS

## 7.2.1 SOIL WARRIOR® X: OVERVIEW AND OPERATING PROCEDURES

The SoilWarrior X can be used in both phases of crop production. Primary deep tillage (XD) and standard depth tillage (XS) by switching the coulters setup on each row unit.

The XD tillage system provides deep primary tillage up to 12 inches deep and 12 inches wide, while incorporating fertilizer into the zone. The soil is fractured wider than the loose dirt may show at the surface depending upon soil conditions.

The XS tillage system provides up to 6 inches of depth in a 12-inch-wide zone. The coulters setup can be used as a 6" deep primary tillage tool or to refresh zones before planting. A twin row attachment can be used to widen the tilled zone to 15 inches.

**NOTE:** Deep tillage with XD is recommended to be done at speeds of less than 7.5 mph. Operating speed will be determined by terrain, soil type, moisture, residue, and tractor horsepower.

An optional adjustable gauge wheel is available to operate in front of the coulters on each row unit to assist in maintaining uniform depth. Moving the gauge wheels to one of the three positions regulates the running depth of the coulters. If equipped, the tilt of the toolbar will also affect the depth. On non-tilting toolbar units, the hitch position of the unit in relationship to the tractor's drawbar height will also affect the tillage depth.

**NOTE:** The SoilWarrior X row unit uses a gauge wheel to control the depth, and the containment coulters are free floating. In certain conditions, the gauge wheel may be removed. ETS has kits available for the removal of the gauge wheel.

Two 25-inch free-floating containment coulters operate behind the tillage system on each row unit and folds soil into a berm. The containment coulters are adjustable so the operator can produce the type of soil berm that is right for their operation.

**NOTE:** Zone height and width vary on soil types, residue type and amount, speed, and moisture levels.

If equipped with a nutrient delivery system, product is placed behind the tillage system. Nutrients are blended throughout the zone.

Shallow tillage is recommended to be done at speeds above 5 mph. A higher speed creates more soil movement and generally produces a better seedbed. The best speed will be determined by terrain, soil type, soil moisture, residue amount, tractor horsepower, and operator experience.

**IMPORTANT:** Max airbag pressure  
X Deep row unit configuration 70 psi  
X Standard row unit configuration 40 psi.

**IMPORTANT:** Maximum tillage speed is 10 mph.



# 7 ROW UNIT SETTINGS

## 7.2.2 SOIL WARRIOR® X: CONVERT FROM DEEP TO STANDARD TILLAGE

**NOTE:** The hardware from the deep tillage system is used on the shallow tillage system.

**NOTE:** For row unit spacing less than 30 inches, lock up pins may aid in servicing the unit.

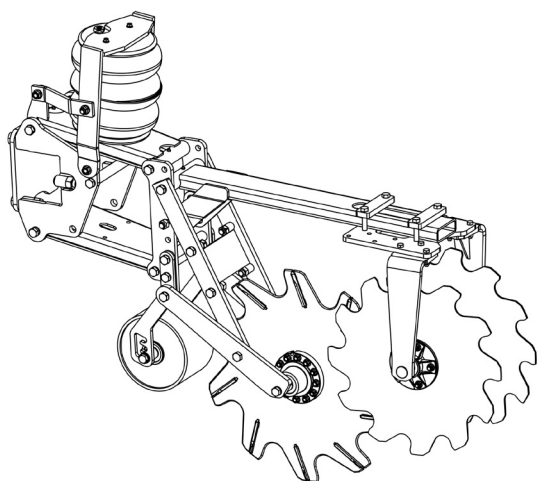
- 1 | Lower the toolbar and tilt the toolbar down so the cog wheels are on the ground, but the row unit is in the fully-raised position.
- 2 | Relieve all down-force air pressure from the row units.
- 3 | Place tractor transmission in park, stop engine, and remove key. Chock the tires.
- 4 | Position the cog wheel so that coulters are in contact with the ground, and remove the  $\frac{3}{4}$  x 2 $\frac{1}{4}$  inch fine thread bolt (7) and washer from the lower cog wheel arms on both sides of the cog wheel. The cog wheel and hub will sit in between the arms after the bolts are removed.
- 5 | Start the tractor and raise the toolbar to the fully-raised position to engage the toolbar lift locks. Tilt the toolbar to allow access to the row units. Remove chocks.
- 6 | Place tractor transmission in park, stop engine, and remove key.
- 7 | Loosen but do not remove upper bolts (4). They support the trailing arm for the containment coulters assembly.
- 8 | Remove the four straight cutter bar bolts (5).
- 9 | Remove the lower arms (8).
- 10 | Move spacer pin to bottom position.
- 11 | Position left shallow tillage coulters on row unit with the front hole of the coulters arm into the second hole up from the bottom of the rear parallel link. The cog wheel arm was in the bottom hole. Be sure to install bolts so nuts are to the inside of row unit.
- 12 | Install left shallow coulters arm.
- 13 | Install right shallow tillage coulters arm.
- 14 | Install angled cutter bar. Flange nuts cannot be used in this position.
- 15 | Install wavy coulters on each of the shallow tillage arms. Use flange top lock nuts with the nut to the hub side.
- 16 | Tighten bolts and nuts in the following sequence and to the specified torque:
  - (2) – 375 foot-pounds of torque
  - (4) – 270 foot-pounds of torque
  - (3) – 375 foot-pounds of torque
- 17 | Loosen and remove the bolts on the left containment coulters arm bottom plate. Move the containment coulters arm to the desired position. For shallow tillage, the left containment coulters arm must be in the forward position. The inside edge of the coulters should clear the outside of the shallow tillage coulters arms by a minimum of  $\frac{1}{2}$  inch.
- 18 | Be sure that the  $\frac{3}{4}$  x 11 inch (11) bolt is in the correct position for shallow tillage.

**NOTE:** Do not over tighten the  $\frac{3}{4}$  inch top lock nuts and 11 inch bolt. Must be able to rotate after tightening.

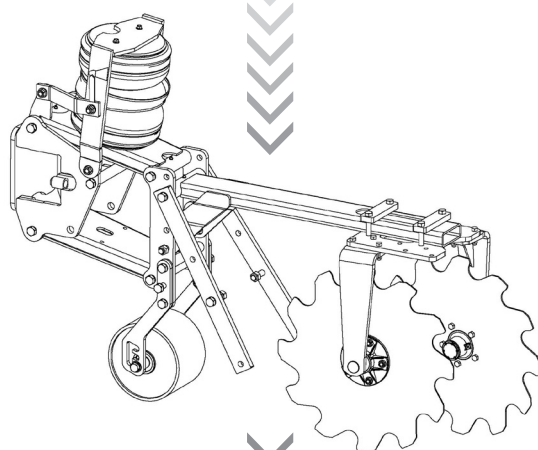
**NOTE:** Service videos can be found on the SoilWarrior YouTube channel - Service & Maintenance playlist.



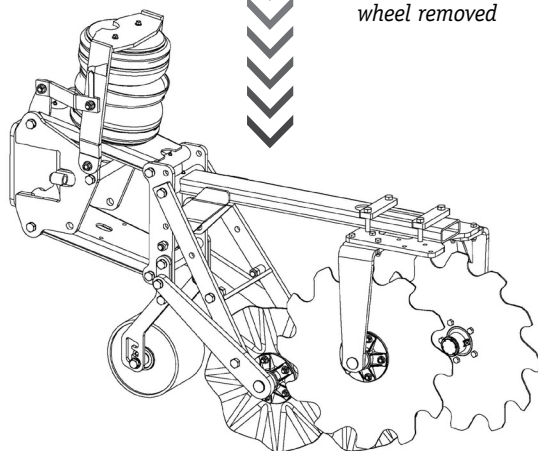
# 7 ROW UNIT SETTINGS



*XD System*

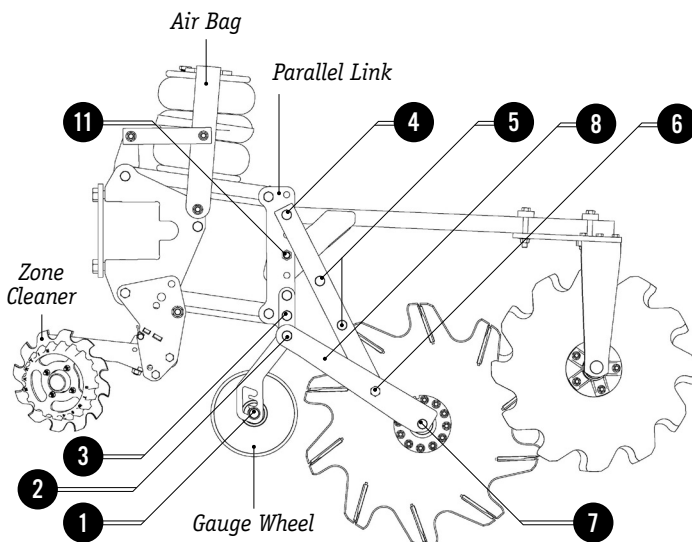


*XD System with cog wheel removed*



*XS System*

## *XD Row Unit*



# 7 ROW UNIT SETTINGS

## 7.2.3 SOIL WARRIOR® X: CONVERT FROM STANDARD TO DEEP TILLAGE

**NOTE:** The hardware from the deep tillage system is used on the shallow tillage system.

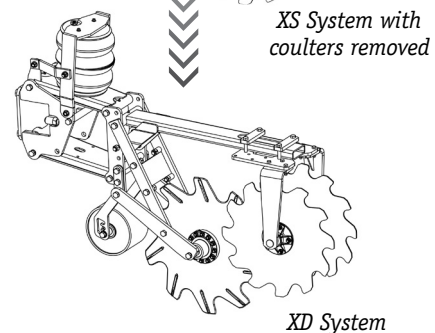
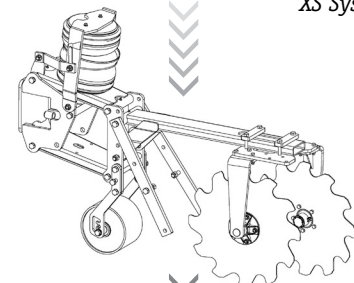
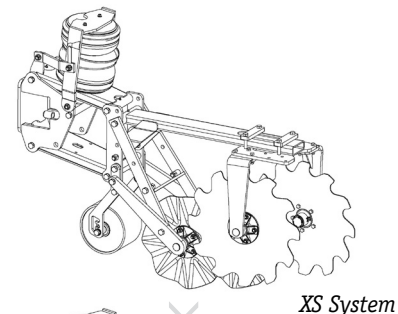
**NOTE:** For row unit spacing less than 30 inches, lock up pins may aid in servicing the unit.

- 1 | Fully unfold and lower the toolbar onto the lift stop and tilt the toolbar to allow access to the row units and set the toolbar lift lock.
- 2 | Relieve all down-force air pressure from the row units.
- 3 | Place tractor transmission in park, stop engine, and remove key. Chock tires.
- 4 | Loosen but do not remove upper bolts (4) on the upper coulters arm on each side of the row unit. They support the trailing arm for the containment coulters assembly.
- 5 | Remove the wavy coulters on both arms.
- 6 | Remove angled cutter bar.
- 7 | Remove the two lower arms.
- 8 | Install lower arm in bottom hole.
- 9 | Install straight cutter bar.
- 10 | Position the cog wheel and hub to allow the installation of the lower cog wheel arm hardware on both sides of the cog wheel hub.
- 11 | Tighten bolts and nuts in the following sequence and to the specified torque:
  - (1) – 375 foot-pounds of torque
  - (2) – 375 foot-pounds of torque
  - (7) – 375 foot-pounds of torque
  - (5) – 270 foot-pounds of torque
  - (3) – 375 foot-pounds of torque
  - (4) – 375 foot-pounds of torque
- 12 | Loosen and remove the bolts on the left containment coulters arm bottom plate. Move the containment coulters arm to the desired position. For deep tillage, the left containment coulters arm must be in the rear position for row spacing greater than 22 inches. For spacing of 20 inches, the left containment coulters

arm must be in the center position. The inside edge of the coulters should clear the outside of the shallow tillage coulters arms by a minimum of ½ inch.

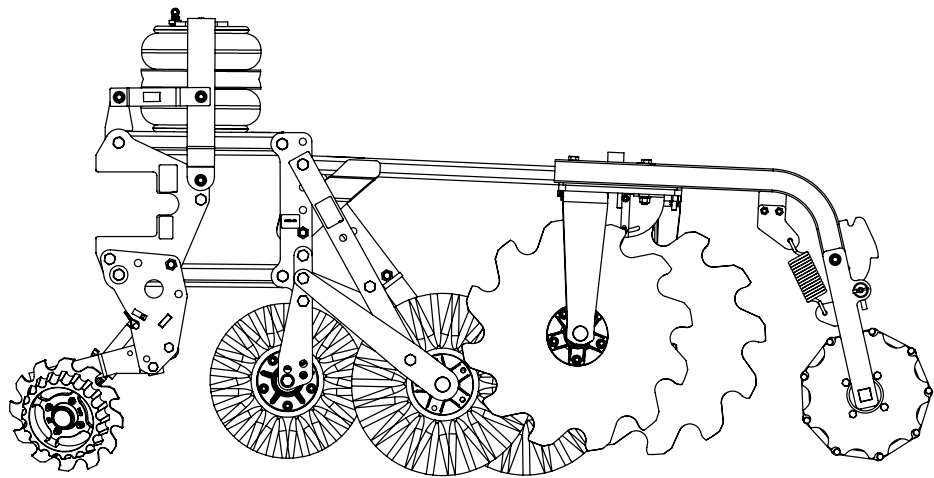
- 13 | The pressure relief on the toolbar regulator valve must be changed. Remove the shallow tillage 40 pound relief valve and install the deep tillage 70 pound relief valve.
- 14 | Be sure that the ¾ x 11 inch bolt is in the correct position for deep tillage.

**NOTE:** The ¾ inch top lock nuts must not be over tightened. The 11 inch bolt must be able to rotate after tightening.



# 7 ROW UNIT SETTINGS

*XS Row Unit*



## 7.2.4 SOIL WARRIOR® X: GAUGE WHEEL ADJUSTMENT

- 1 | Raise the toolbar to the fully raised position in order to set the toolbar lift lock and tilt the toolbar to allow access to the row units.
- 2 | Engage the toolbar lift and tilt lock.
- 3 | Place tractor transmission in park, stop engine, and remove key. Chock tires.
- 4 | Loosen but do not remove bolts on each side of the gauge wheel.
- 5 | Move the gauge wheel to desired position (see table).
- 6 | Tighten bolts to 375 foot-pounds of torque.
- 7 | Repeat steps for remaining row units.

Gauge Wheel Position	Shallow Tillage Depth	Deep Tillage Depth
Bottom Slot	3 inch	10 inch
Center Slot	4 inch	11 inch
Top Slot	5 inch	12 inch

*The table lists approximate depths and may vary depending upon tilt pitch of toolbar, hitch position, row unit air pressure, and soil type. Values are based on 20-inch diameter coulter and 30-inch diameter cog wheel.*

# 7 ROW UNIT SETTINGS

## 7.2.5 SOIL WARRIOR® X: STARTING FIELD OPERATION WITH DEEP TILLAGE SETUP

**NOTE:** Primary deep tillage should be done with the containment coulters trailing arm adjustment bolt in the top slot.

- 1 | Adjust the gauge wheels to the desired position.
- 2 | Adjust containment coulters to desired setting. When positioned to desired setting, there should be approximately 9 inches between the containment coulters at the narrowest position.
  - In wet soil, opening coulters at least 10 inches allows soil to flow through.
  - In dry soil, narrowing coulters to 8 inches creates a taller berm in the zone.
  - Soil berms will vary according to soil type and moisture, so the operator must monitor performance and adjust coulters for conditions.

**NOTE:** For best performance, the containment coulters must be rotating at all times.

- 3 | Start with row unit down pressure of about 50 psi.
- 4 | Load fertilizer system. Adjust and calibrate per instructions in Section 8.
- 5 | Once in the field, lower the row units and bring the tractor speed up to approximately 4 mph.
- 6 | Check the running depth after driving about 200 feet in the field at the suggested operating speed. Upon stopping, the position of the row units, toolbar, and cart will change from the true operating position. If possible have an assistant watch from a safe position during operation to assure correct operation set-up (see Section 6.7). If equipped, use the camera mounted below the toolbar to watch the row units at operating speeds.
- 7 | The zones should be about 7 – 12 inches deep in the center of the zone and mounded to create a berm up to 5 inches high and 12 inches wide.
- 8 | If the gauge wheel is pressed firmly against the soil and the cog wheel is firmly in the ground, the machine is set properly. If the gauge wheel is not turning and isn't contacting the soil, increase the air pressure by increments of 5 psi until firmly in contact with the soil. Adjustments must be made while moving.

- 9 | If the gauge wheel is sliding or pressed into the soil 1 inch or more, reduce the air pressure by 5 psi until the desired gauge wheel operation is achieved.
- 10 | If 70 psi cannot be reached or if the pressure exceeds 70 psi, check the relief valve on the remote controlled regulator on the cart.

**NOTE:** If the gauge wheel is in contact with the soil the majority of the time, periodically leaving the soil is acceptable. Check in average soils; avoid field headlands when setting the pressures. Monitor this throughout the fields.

Never exceed 70 psi of down pressure with the deep tillage system. Most field conditions require 40-50 psi.

For best results, run a SoilWarrior® XD at speeds less than 7.5 mph.

**IMPORTANT:** In rocky conditions, adjust the air system pressure as low as possible to keep the desired tillage depth. Damage from field operation in frozen ground or from sharp turns will void any and all warranties.

**IMPORTANT:** Max airbag pressure 70 psi.

**IMPORTANT:** Maximum tillage speed is 10 mph.

# 7 ROW UNIT SETTINGS

## 7.2.6 SOIL WARRIOR® X: STARTING FIELD OPERATION WITH STANDARD TILLAGE SETUP

**NOTE:** *Shallow tillage should be done with the containment coulters trailing arm adjustment bolt in the bottom slot. This bolt must be able to rotate after tightening.*

- 1 | Adjust gauge wheels to desired position.
- 2 | Adjust containment coulters to desired setting. When position to desired setting, there should be approximately 9 inches between the containment coulters at the narrowest position.
  - In wet soil, opening coulters at least 10 inches allows soil to flow through.
  - In dry soil, narrowing coulters to 8 inches creates a taller berm in the zone.
  - Soil berms will vary according to soil type and moisture, so the operator must monitor performance and adjust coulters for conditions.

**NOTE:** *For best performance, ensure containment coulters are rotating at all times.*

- 3 | Start with a down pressure of 20 psi when conditioning a fall zone. Start with a down pressure of 25 psi when establishing a new zone in the spring.
- 4 | Load fertilizer system. Adjust and calibrate per instructions in Section 8.
- 5 | Once in the field, lower the row units and bring the tractor speed up to approximately 6 mph.
- 6 | Check the running depth after driving about 200 feet in the field at the suggested operating speed. Upon stopping, be aware that the position of the row units, toolbar, and cart will change from the true operating position. If possible have an assistant watch from a safe position during operation to assure correct operation set up (see Section 7.1). If equipped, you should have your toolbar-mounted camera adjusted so you can watch the row units at operating speeds.
- 7 | The zones should be about 3–5 inches deep and mounded to create a berm up to 5 inches high and 12 inches wide.
- 8 | If the gauge wheel is pressed firmly against the soil and the wavy coulters are firmly in the ground with

the left and the right wavy coulters operating at the same depth, the machine is set properly.

If the gauge wheel does not turn or is not firmly on the ground, increase the air pressure by 5 psi and drive about 200 feet. Check the operating depth again.

- 9 | If 40 psi cannot be reached or if the pressure exceeds 40 psi, check the relief valve on the remote controlled regulator on the cart.

**NOTE:** *If the gauge wheel is in contact with the soil the majority of the time, periodically leaving the soil is acceptable.*

*Check in average soils; avoid field headlands when setting the pressures. Monitor this throughout the fields.*

*Never exceed 40 psi of down pressure with the shallow tillage system. Most field conditions require 10-30 psi.*

*For best results, run a SoilWarrior® with coulters at speeds above 5 mph. Higher speeds require greater down force.*

*If equipped with a tilting toolbar, the toolbar can be tilted down to provide more depth of the right coulters. The toolbar can be tilted up to provide more depth of the left coulters. Ideal operating position is with both coulters operating at the same depth.*

*Planting can be done into the SoilWarrior® zones once the top of the berm dries off. In conditions where soil moisture is lower and weather is hot and dry, plant as soon as possible after zoning to produce good seed-to-soil contact and retain moisture in the zones.*

*In dry conditions, do not get too far ahead of the planter with SoilWarrior®.*

**IMPORTANT:** *Damage from field operation in frozen ground or from sharp turns will void any and all warranties.*

**IMPORTANT:** *Max airbag pressure 40 psi.*

**IMPORTANT:** *Maximum tillage speed is 10 mph.*

# 7 ROW UNIT SETTINGS

## 7.2.7 SOIL WARRIOR® X: DEPTH ADJUSTMENTS

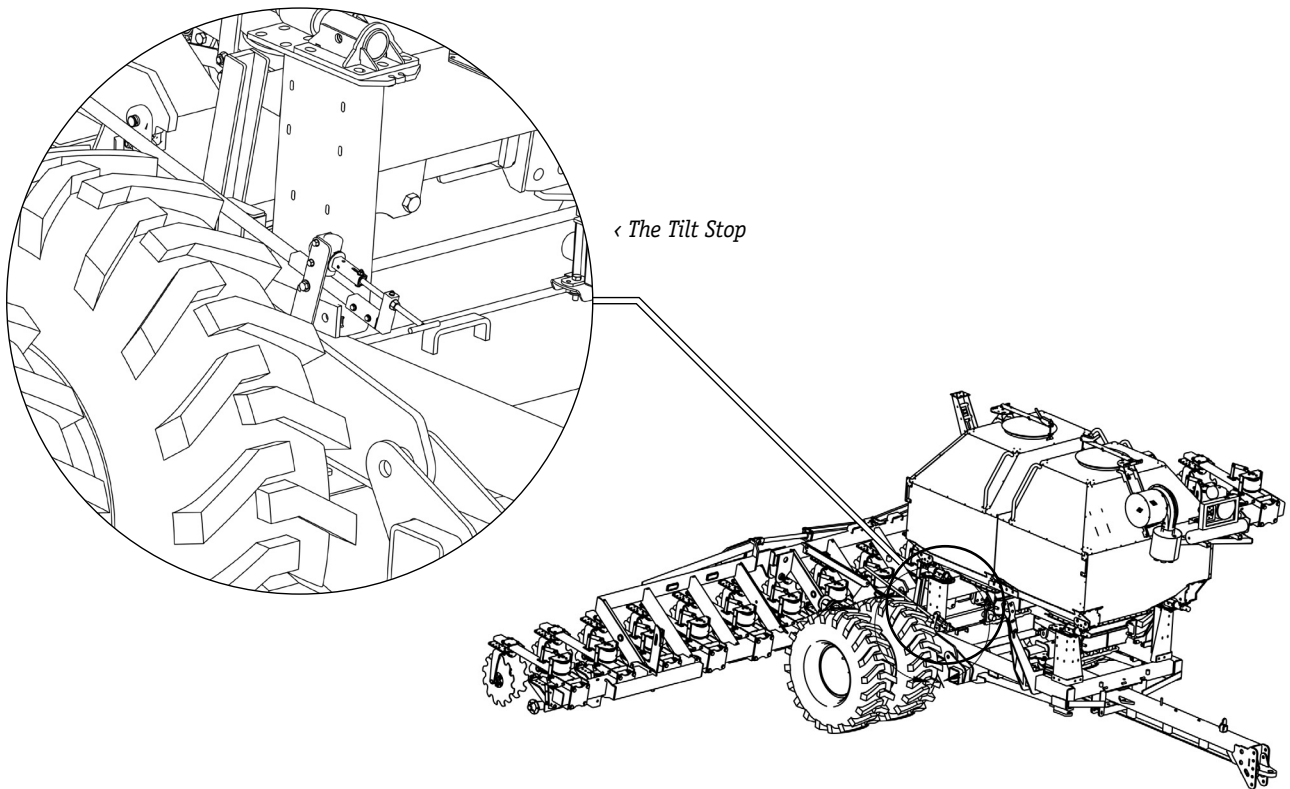
- 1 |** Adjust the toolbar tilt so that the toolbar is parallel and level with the ground at operating depth.

If equipped with a tilting toolbar, the back of the toolbar can be tilted down to provide more depth of the cog wheel. Adjust the tilt with the toolbar tilt stop on the right side of the machine and the tilt hydraulics.

- Clockwise rotation of the adjustment assembly will raise the back of the toolbar up.
- Counter clockwise will lower the back of the toolbar down.
- Cycle the toolbar tilt hydraulics to reset the tilt stop after the adjustment. When raising the back of the toolbar, tilt the toolbar up slightly before adjusting the toolbar tilt stop.

- 2 |** If not equipped with a tilting toolbar, adjust the position of the hitch.

**NOTE:** After adjusting the toolbar tilt or the hitch position, ensure that the parallel links of the row units are close to parallel. If the parallel links are above parallel, you are at risk of damage to the row unit in the event of an obstacle in the field.





# 7 ROW UNIT SETTINGS

## 7.2.8 SOIL WARRIOR® X: COULTER ADJUSTMENTS (DEEP AND STANDARD)

- 1 | For gauge wheel adjustment, raise the machine out of the ground and engage the lift and tilt locks. Be sure that the locks are properly secured.
- 2 | To build a narrower berm, containment coulters can be adjusted with a slight camber. Place a shim on the outer two bolts of each containment coulters.
- 3 | Adjust the gauge wheel to the desired position (refer to Section 7.2.3 for depth reference and adjustment procedure).
- 4 | Lower the machine into the ground, operate for a distance of 200 feet, and check the zone depth.
- 5 | If the berm is lower than desired, adjust the containment coulters at a sharper angle so they roll soil in a tighter pattern. If the berm is taller than desired, straighten the coulters with the main coulters so less soil is rolled into the berm. Piling of residue and soil occurs if the containment coulters are set too tight for the conditions.

**NOTE:** All gauge wheels on a machine should be set at the same operating depth. You may want to operate the row units deeper if conditions allow removing additional compaction from the tramlines.

**NOTE:** Be sure that the cog wheel arm is not in contact with the ground so that it does not drag residue along and create piles. Adjust one or two rows at a time to ensure desired depth is achieved prior to repositioning all the rows. Throughout the adjustment process, verify the toolbar and hitch maintain proper positioning. One way to verify this is to make sure the containment coulters maintain ground contact. Also, be sure that the toolbar is not tilted too far forward or the hitch position is so low that the containment coulters are not in contact with the ground.

Containment coulters mix and roll churning soil into a berm behind the cog wheel or the shallow tillage system.

### In Deep Tillage Configuration:

Soil should be mounded about 2-5 inches above unworked ground and 12 inches wide with a flat top and no uneven ridges or trenches on the sides for seedbed preparations. For the deep tillage system with the cog wheel, they need to be set to contain the lumps, chunks of soil, and the fertilizer.

### In Standard Tillage Configuration:

Soil should be mounded about 2-5 inches above unworked ground and 12 inches wide with a flat top and no uneven ridges or trenches on the sides for seedbed preparations. If the berm is lower than desired, adjust the containment coulters at a sharper angle so they roll soil in a tighter pattern. If the berm is taller than desired, straighten the coulters with the main coulters so less soil is rolled into the berm. Piling of residue and soil occurs if the coulters are set too tight for conditions. For the shallow tillage system, the coulters need to be set to contain the lumps, chunks of soil, and the fertilizer.

# 7 ROW UNIT SETTINGS

## 7.2.9 STANDARD TILLAGE CONTAINMENT COULTER ADJUSTMENT

See Section 7.3.5, #2 for proper containment coulters set up.

The containment coulters can be moved forward and backward as needed. By moving them forward, more of the

soil is lifted by the coulters. This reduces the amount of black dirt in between the tilled zone. Moving them rearward allows more room from the rear of the working coulters and the containment coulters.

## 7.3.1 SOIL WARRIOR® N: OVERVIEW AND OPERATING PROCEDURES

The SoilWarrior N can be used in both fall and spring. Depth adjustments can be made in one inch increments up to a depth of 6 inches with coulters-only and 10 inches with knife.

Unlike the SoilWarrior X row unit, the tillage coulters of the SoilWarrior N is linked together with the containment coulters. The containment coulters serve as the depth control device.

The bottom of the tillage coulters stays parallel with the bottom of the containment coulters throughout the 19 inches of vertical travel, thus creating an accurate control method throughout the range of travel. The amount of down pressure is controlled through the standard air bag assemblies that are mounted on each row unit.

The containment coulters can be angled independently and positioned behind the tillage coulters to create the best zone for your soil type and condition.

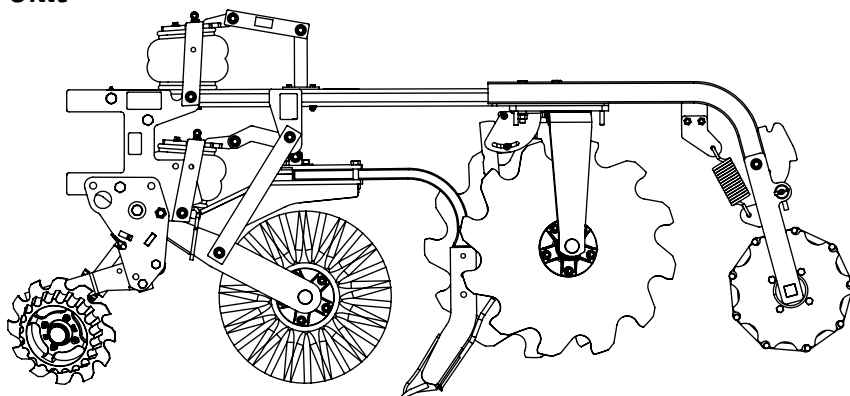
The wavy coulters cut, fluff, and condition the soil into zones that are 8 inches wide with the coulters-only attachment (12 inches with the shank and knife attachment), and up to 5 inches above the unworked ground.

**NOTE:** Zone height and width vary depending on soil types, residue type and amount, speed, and moisture levels. Shallow tillage is recommended to be done at speeds above 5 mph. A higher speed creates more soil movement and generally produces a more functional soil berm and better seedbed. The best speed will be determined by terrain, soil type, soil moisture, residue amount, tractor horsepower, and operator experience.

**IMPORTANT:** Max airbag pressure N Rowunit 80 psi.

**IMPORTANT:** Maximum tillage speed is 10 mph.

### N Row Unit

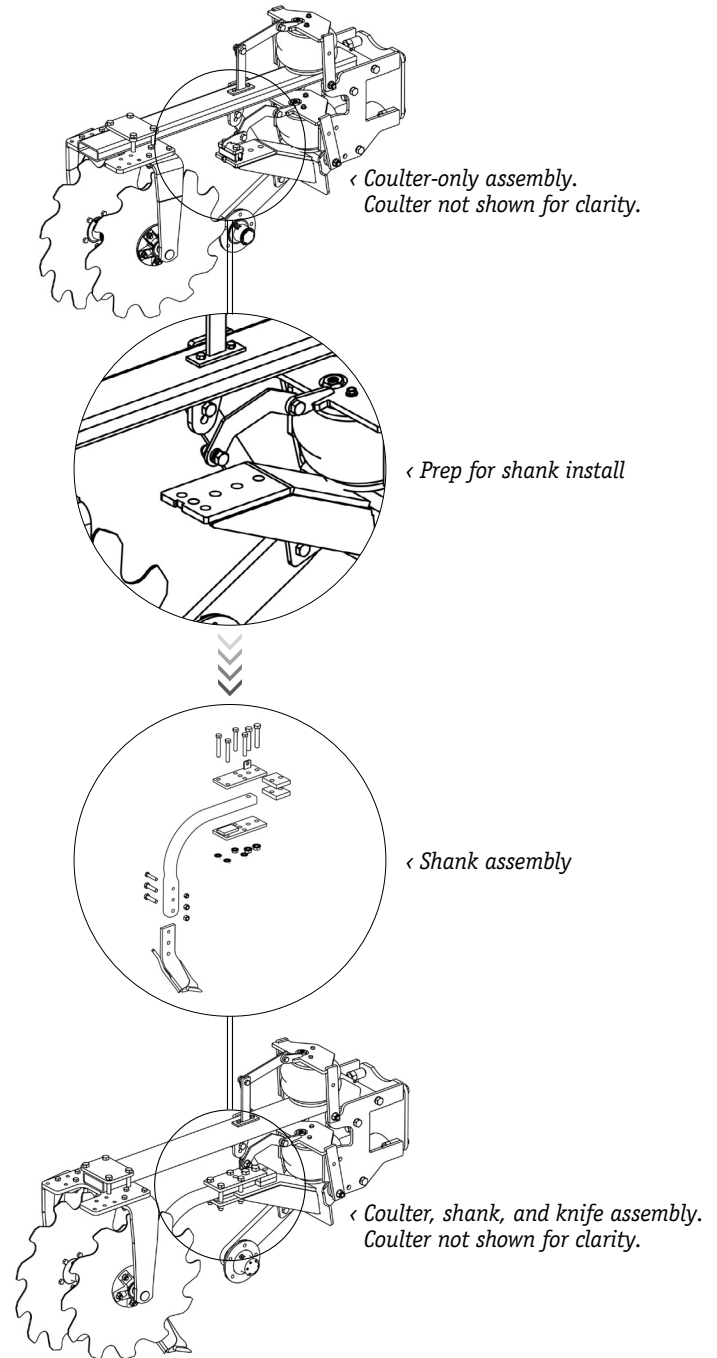


# 7 ROW UNIT SETTINGS

## 7.3.2 SOIL WARRIOR N: CONVERT FROM COULTER-ONLY TO SHANK-AND-KNIFE TILLAGE

- 1 | Fully unfold and lower the toolbar onto the lift stop and tilt the toolbar to allow access to the row units and set the toolbar lift lock.
- 2 | Relieve all down force air pressure.
- 3 | Place tractor transmission in park, stop engine, and remove key.
- 4 | Loosen (do not remove) the bolts and flange nuts on the top plate of the containment couler assembly. Reposition the containment couler assembly to a position approximately 2 inches from the end of the containment couler tube. Re-tighten the four bolts evenly.
- 5 | Loosen the two outer bolts of the containment couler arms and remove the inner bolt and nut.
- 6 | Set the containment coulers about 10 inches apart at the narrowest point. This is needed to allow proper flow of soil and residue through the containment coulers.
- 7 | Remove the two bolts on the air bag equalizer mount bracket and remove the spacer.
- 8 | Install the shank front mounting bolt washer and top lock flange nut.
- 9 | Reinstall the air bag equalizer mount bracket.
- 10 | Center the knife and shank to the center of the tillage couler and tighten.
- 11 | When using shank extension kit, position containment couler assembly closer to the end of the containment couler tube.
- 12 | Set the fertilizer delivery tube about 1.5 inches behind the shank. Allow clearance for the NH3 or liquid tube if equipped.

### SoilWarrior® N



# 7 ROW UNIT SETTINGS

## 7.3.3 SOIL WARRIOR N: STARTING FIELD OPERATION

- 1 | Position the containment coulters arm so that the containment coulters are 10 inches apart. A containment coulters that is set at too severe of an angle will create a trenching action on the containment coulters.
  - In wet soil, straighten coulters to allow the soil to flow through.
  - In drier soil conditions, narrow them to allow the soil to stand up taller in the zone.
  - The berm will change from soil type and moisture so it is up to the operator to monitor their performance and adjust the coulters to best suit the existing conditions.

**NOTE:** For best performance, the containment coulters must be rotating at all times.

- 2 | For coulters-only, start with a down pressure of 40 psi when conditioning a fall zone and 50 psi when establishing a new zone in the spring.
- 3 | For shank and knife tillage, start with a down pressure of 50 psi when conditioning a fall zone and 60 psi when establishing a new zone in the spring.
- 4 | Load fertilizer system. Adjust and calibrate per instructions in Section 8.
- 5 | Once in the field, lower the row units and bring the tractor speed up to approximately 6 mph.
- 6 | Check the running depth after driving about 200 feet in the field at the suggested operating speed. Upon stopping, be aware that the position of the row units, toolbar, and cart will change. If possible have an assistant watch from a safe position during operation to assure correct operational settings. If equipped, you should have your toolbar-mounted camera adjusted so you can watch the row units at operating speeds.

- 7 | With coulters-only tillage, zones should be about 3–5 inches deep and mounded to create a berm about up to 5 inches high and 9 inches wide. Using the shank and knife assembly, zones should be up to 9 inches deep and mounded to create a berm about 2–5 inches high and 12 inches wide.

**NOTE:** The containment coulters should be in the soil less than 2 inches. Excess depth is not recommended.

- 8 | If the containment coulters do not turn or is not firmly in the ground, increase the air pressure by 5 psi and drive about 200 feet. Check the operating depth again.

**NOTE:** Air pressure should never exceed 80 psi. Most field conditions require 40 to 70 psi.

- 9 | If equipped with a tilting toolbar, the toolbar can be tilted down to provide more depth of the tillage coulters. The toolbar can be tilted up to provide less depth of the tillage coulters. Ideal operating position is when the desired coulters tillage is reached and the containment coulters are engaged preferably at 1.5 inches and no more than 3 inches. Refer to Section 7.2.6 for correct depth adjustment procedures.
- 10 | Adjust the tilt of the toolbar with the toolbar tilt stop on the right side of the machine and the tilt hydraulics. Clockwise rotation of the adjustment assembly will tilt the toolbar up. Counter clockwise will tilt the toolbar down. Cycle the toolbar tilt hydraulics to reset the tilt stop. When wanting to tilt the toolbar up, you must tilt the toolbar up slightly before adjusting the toolbar tilt stop. If not equipped with a tilting toolbar, adjust the position of the hitch.

# 7 ROW UNIT SETTINGS

**NOTE:** If you adjust the depth link arm, be sure to adjust the fertilizer delivery tube to assure proper alignment. Moving the depth link arm will either position the fertilizer delivery tube into the coulter or too far away from the desired position. The desired position of the delivery tube is approximately 1.5 inches away from the coulter in the raised position.

All row units on a machine should be set to the same operating depth. In the event of coulter diameter wear, adjust the link arm to a lower position to reach the desired tillage depth as with a new 20 inch coulter.

It is suggested to replace the 20 inch tillage coulter when it reaches a diameter of 17 inches.

- 11 |** To adjust zone depth after air pressure adjustments have been made, changing the link arm position up or down. One position will change the depth the 1 inch.
- 12 |** When the operating depth is correct, check the size and shape of the soil berm. Soil should be mounded up to 5 inches above unworked ground. If the berm is lower, adjust the containment coulters at a sharper angle so they roll soil in a tighter pattern. If the berm is too tall, adjust the containment coulters straighter with the wavy coulters so less soil is rolled into the berm. Piling of residue and soil occurs if the containment coulters are set too tight for the conditions. As a suggestion, adjust one or two rows out of the tramlines first and test to see what the best setup for the conditions is.

**NOTE:** The containment coulters can also be adjusted with a slight camber by placing a ½ inch hardened flat washer on the inside bolt where the containment coulter arm attaches to the lower mount plate. Place the washer between the lower mount plate and the containment coulter arm. This will allow for more soil and residue to slough through the containment coulters. This will create a zone approximately 12" in width. Be sure to check for clearance on all coulters and coulter arms after making adjustments.

**NOTE:** Planting can be done into the SoilWarrior® N zones once the top of the berm dries off. In conditions where soil moisture is lower and weather is hot and dry, plant as soon as possible after zoning to produce good seed-to-soil contact and retain moisture in the zones.

In dry conditions, do not get too far ahead of the planter with SoilWarrior N.

**OPERATOR'S NOTE:** SoilWarrior N row units are not meant to penetrate ground that is very dry and extremely hard (more than 400 pounds on a Soil Compaction Tester.)

The same holds true in extremely moist conditions. If the gauge wheels are balling up with soil and the containment coulters are throwing chunks of soil, wait for drier conditions.

**IMPORTANT:** Damage from field operation in frozen ground or from sharp turns will void any and all warranties.

**IMPORTANT:** Max airbag pressure N Rowunit 80 psi.

**IMPORTANT:** Maximum tillage speed is 10 mph.

# 7 ROW UNIT SETTINGS

## 7.4 ACCESSORIES

**Wing Wheels:** Your SoilWarrior toolbar may be equipped with wheels on the toolbar wings. These wheels should have slight pressure against the ground on level terrain. Wing wheels should be set so they run between existing rows to reduce wear from stubble.

To adjust wing wheels: Loosen jam nut on the turnbuckle. Rotate turnbuckle clockwise to raise wing wheel. Rotate turnbuckle counterclockwise to lower wing wheel. Tighten jam nut for field operation.

**Zone Cleaners:** Your SoilWarrior may be equipped with zone cleaners on each row unit. These are designed to skim across the surface and move crop residue between the rows. This helps create a cleaner, more uniform zone. Zone cleaner pressure is provided either by an airbag or an air cylinder. Air cylinders also provide automatic zone cleaner lift if equipped.

**Air bag zone cleaners:** When beginning field operation start the zone cleaner air bag pressure at 5 lbs. Maximum air pressure is 100 psi. As you are setting row units for tillage depth, also check zone cleaners for proper movement of residue. Zone cleaners should be moving all residue to the side but leaving soil intact. If your zone cleaners are moving soil, reduce air pressure. If zone cleaners are not needed, lower air pressure to 0 psi and install lock up pins on each row.

**Air cylinder zone cleaners:** When beginning field operation start the zone cleaner air cylinder pressure at 5 lbs. Maximum air pressure is 100 psi. As you are setting row units for tillage depth, also check zone cleaners for proper movement of residue. Zone cleaners should be moving all residue to the side but leaving soil intact. If your zone cleaners are moving soil, reduce air pressure. If zone cleaners are not needed, use auxiliary driver to automatically lift zone cleaners.

If zone cleaners are not providing a clean enough zone, the depth bands can be removed to increase aggressiveness.

To remove depth bands: Remove nuts on 4 carriage bolts holding depth band to blade. Remove depth band and reinstall nuts to hold zone cleaner blade on hub.

**Rolling Basket:** Your SoilWarrior may be equipped with rolling baskets on each row unit. Rolling baskets provide smoothing and/or shaping of the soil zone. Available basket types are round bar and berm builder.

**Round Bar Baskets:** These are designed to create a smooth, uniform seed bed behind the row unit. To engage, lift toolbar up and allow rolling basket to hang down. Install pin to lock rolling basket in engaged position. Install lynch pin to secure pin. Spring pressure will keep the rolling basket engaged with the soil. To disengage rolling baskets, remove pin and lift rolling basket up to storage position. Install pin to lock rolling basket in disengaged position.

**Berm Builder:** These are designed to create a smooth, uniform seed bed behind the row unit. Flat bars can be installed in different positions to shape the zone into the berm of your choice. To engage, lift toolbar up and allow rolling basket to hang down. Install pin to lock rolling basket in engaged position. Spring pressure will keep the rolling basket engaged with the soil. To disengage rolling baskets, remove pin and lift rolling basket up to storage position. Install pin to lock rolling basket in disengaged position. To adjust berm height, remove two nuts and bolts holding flat bar on. Adjust flat bar to desired height. For the highest berm possible, remove flat bar from rolling basket.

**Lead Coulters:** Optional lead coulters bolt on in the same way gauge wheels bolt on to the row unit. Lead coulters use a 17" 13 wave coulters to cut in the center of the zone, helping to create a more consistent zone depth and texture. Lead coulters are available for XS row units.

# 8 NUTRIENT DELIVERY SYSTEMS

ETS nutrient delivery systems include dry (granular) fertilizer, liquid (non-suspension) fertilizer, and NH<sub>3</sub>.

The ETS dry fertilizer systems are a pressurized tank system. Each tank is manufactured to meet the requirements of the method of metering. The metering system has the ability

to accurately apply a wide variety of materials to meet the desired rate of delivery and placement.

The maximum weight will vary based on the product density.

## ETS Cart, Fertilizer Systems, and Capacities

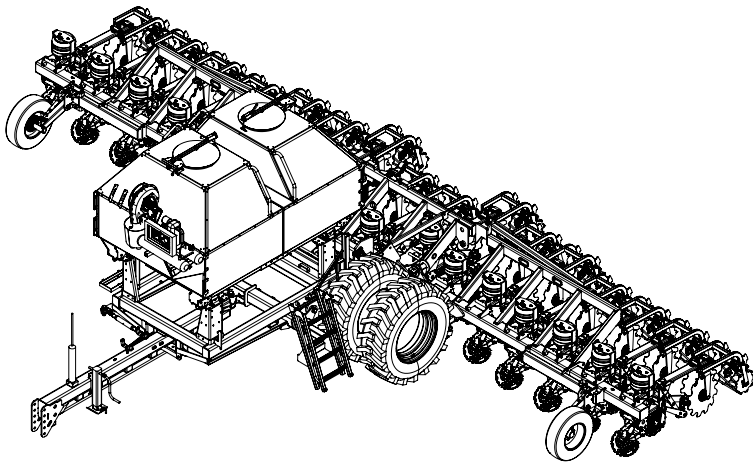
DRY GRANULAR FERTILIZER					
ETS CART	No. of Tank(s)	Capacity (cubic ft.)	Capacity per Tank (cubic ft.)	Capacity (bushels)	Capacity (lbs.) <i>Based on product density 58 lbs per cubic ft.</i>
Standard	1	160	160	130	9,280
HD	2	320	160	260	18,560
XL	2	400	200	320	23,200
	3	415	160-75-160	334	24,070

LIQUID FERTILIZER			
ETS CART	Liquid Tank	Capacity (gallons)	Capacity (lbs.) <i>Based on weight of UAN 28</i>
Standard	1	1,250	13,350
HD	1	1,600	17,100
	1	2,200	23,500
	2	300 each	6,200
	1	2,200	23,500

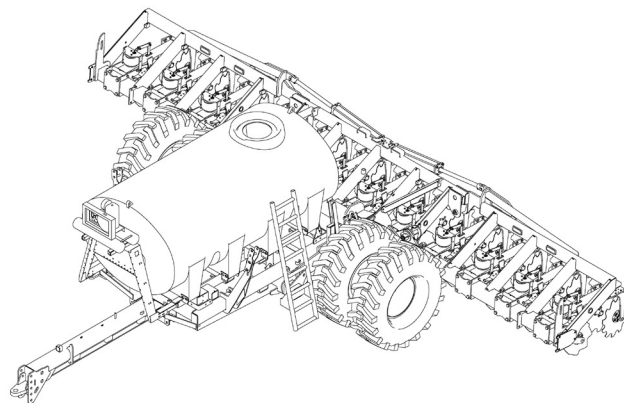


## 8 NUTRIENT DELIVERY SYSTEMS

### *Dry Granular System*



### *Liquid Fertilizer System*



### *Product Density Using the Dry Fertilizer System*

Product	Analysis	Density ft <sup>3</sup> approx.
DAP	18-46-00	59
MAP	11-52-00	58
Soft Rock Phosphate	0-05-0	78
Potash	0-0-60	65
Potassium Sulfate	0-0-50	80
Ammonium Sulfate	21-0-0-26S	58
Urea	46-0-0	46
ESN	44-0-0	46
Soybeans		47.5
Rye		45

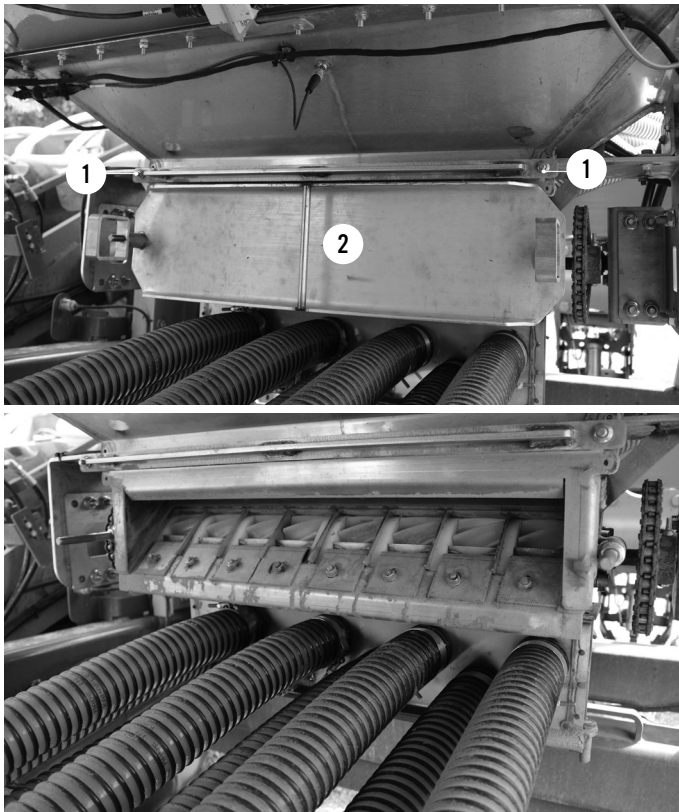
It is important to test each load for density. Computer generated densities from the fertilizer plant may not be accurate enough for SoilWarrior's precise metering system.

## 8 NUTRIENT DELIVERY SYSTEMS

### 8.1.1 DRY SYSTEM: INSPECT AND SERVICE METER ROLLS

Take the time to inspect the meter rolls throughout the season, or if the desired rate is not being achieved. If the tank is empty, open up the clean-out door and inspect the meter rolls. If there is product in the tank and the meter rolls need inspection or service, use the following procedure to stop the flow of fertilizer.

- 1 | Place tractor in park, shut off engine, and remove key.
- 2 | Remove two  $\frac{5}{16}$  inch flange nuts (1) from the slide gate slot access T-bar.
- 3 | Insert fertilizer shutoff slide gate completely into the slot behind the T-bar. The angle bracket on the gate must be upward.
- 4 | Remove meter roll access door (2).
  - Some dry fertilizer will spill out when door is removed.
  - Use the meter calibration bag to catch the fertilizer, if desired.
- 5 | Remove the collector bottom (3) insert and the rear access door (4) on the meter body to ensure there is no blockage.
- 6 | Inspect the meter rolls for possible replacement, plugging, or blockage.
  - Use the manual override function of the Pulse-Width Modulation (PWM) to rotate the meter roll.
  - Rotate the meter rolls 360° during inspection to check all flutes.
- 7 | Meter shaft should turn with minimal resistance.
- 8 | Check all foam seals and reinstall all meter doors so that the seals make firm contact. Replace foam seals if signs of wear or deterioration.
- 9 | Reinstall the meter access door.
- 10 | Remove the fertilizer shutoff slide gate.
- 11 | Reinstall the slide gate slot access T-bar.



TOP: Meter roll with access door attached  
BOTTOM: Meter roll rear access door removed



TOP: Meter roll with rear access door removed  
BOTTOM: Meter roll collector bottom insert

# 8 NUTRIENT DELIVERY SYSTEMS

## 8.1.2 DRY SYSTEM: MOUNTED SCALE HEAD CALIBRATION

*This is a condensed excerpt from the Weigh-Tronix Manual. See manual for more information.*

- 1 | From the **G/N** mode, Press and hold **Hold/Menu** key until three beeps are heard then release.
- 2 | **Set.Pas** will be displayed.
- 3 | Use the numeric entry procedure to enter the password 640.

### NUMERIC ENTRY PROCEDURE



Press this key to enter a value on the screen and increment the value being entered.



Press this key to decrement the numeric value being entered.



Press this key to move the numeric entry cursor one position to the right.

- 4 | When 640 is programmed press **Print/Select** key.
- 5 | Press **Print/Select** key once more... CONFIG is displayed.
- 6 | Press **Print/Select** key again.
- 7 | Press **RM** or **M+** key to select number and **Hold Menu** key to move on to next number.
- 8 | Configuration Code Number (CCN) to put in is 09200.
- 9 | When all numbers have been added press **Print Select** - CONFIG will be displayed
- 10 | Press **G/N** key twice.
- 11 | Screen will say busy and reset system.
- 12 | Press **Zero Clear** to clear weight and reset scale.

**NOTE:** For integrated scales refer SoilWarrior ISOBUS Control Module Quick Start Guide.

Enter 640 by using **RM** and **M+** key to enter numbers and **Hold Menu** key to go to next number.



Weigh-Tronix 640XL scale display

## 8 NUTRIENT DELIVERY SYSTEMS

### 8.1.3 DRY SYSTEM: REMOTE SCALE HEAD DISPLAY DRY FERTILIZER ONLY CALIBRATION

The remote display mount on the machine lets the operator view scale weights, zero/tare scales, and complete catch test calibrations.

#### To view scale weights:

- 1 | Select the ESC button to turn the screen on.
- 2 | Use the arrow button to navigate the main screen to select Scales, then press ok.
- 3 | Use the arrow keys to toggle between the different products.

#### To Zero/Tare a tank:

- 1 | Select the ESC button to turn the screen on.
- 2 | Use the arrow button to navigate the main screen to select Scales, then press ok.
- 3 | Use the arrow keys to toggle between the different products.
- 4 | On the bottom of the screen select the corresponding button under the Zero.

**NOTE:** Ensure the tank is completely empty before selecting Zero.

#### To Perform Catch Test Calibration:

- 1 | Select the ESC button to turn the screen on.
- 2 | Use the arrow button to navigate the main screen to select Rate Calibration, then press ok.
- 3 | Toggle to the product you want to calibrate be using the arrow button.
- 4 | Once the correct product is listed on the screen select the button below Calibrate.
- 5 | A warning will be displayed notifying you that the meter will turn, and product will be dispensed, select ok.
- 6 | Select the sections that will need to be calibrated, then select next.



- 7 | Catch test Summary will be the next page, on this page the Test Speed, Rate, and Desired Weight can all be modified by selecting the button under EDIT. Once selected a black box will appear over the value you want to modify.
- 8 | Select ok on the value you want to modify and using the arrow button input your in-field conditions.

#### Example:

DTest Speed: 7  
Rate: 250 lbs/ac

- 9 | Set the desired weight to 25 lbs.
- 10 | Once those 3 values are set select the button under Next to proceed.
- 11 | If product has not been discharged from the meter yet, select the button under PRIME to fill the meter rolls. This will cause product to flow out of the meter.
- 12 | Once the meter is primed, select the button under Start to run the catch test.
- 13 | Once the test is completed weigh the catch test bag and enter the weight from the scale into the remote monitor and press ok.
- 14 | Repeat the process until the weight in the catch bag is within a half-pound of the Desired weight.

# 8 NUTRIENT DELIVERY SYSTEMS

## 8.1.4 DRY SYSTEM: CALIBRATION PRE-FILL RECOMMENDATIONS

The fertilizer delivery system must be calibrated at the start of the season and when changing products. Use the following recommendations to calibrate the fertilizer application rates.

- 1 |** Use a flexible tube approximately 24 inches long and with the diameter of the tenders fill an auger. This allows an effective way to transfer product from the tender to SoilWarrior's® dry tanks.
  - SoilWarrior's dry tank is approximately 12 feet to the top of the tank. Be sure the tender's auger has 14 feet of vertical and horizontal length from the tender's rear bumper to reach each tank with the flexible tube attached to the auger.
- 2 |** Position the tender at about a 10 degree angle to the toolbar to reduce possible interference with the toolbar wing wheel assemblies.
- 3 |** Ensure the tank's fill screens are in place.
  - Debris in the system can make it difficult to operate.
  - Let the fertilizer supplier know that the product is going through a fluted metering roll system and that they need to take caution in the quality of the product. Ask the supplier to minimize the amount of fine particles as best as they can.
  - If possible, request screens with holes of less than 1 inch diameter within their system. If not available, be sure that the fertilizer tender and SoilWarrior have screens in them.



## 8 NUTRIENT DELIVERY SYSTEMS

### 8.1.5 DRY SYSTEM: LOADING FERTILIZER

- 1 | Connect the SoilWarrior® to the tractor (see *Section 5.1, Transportation*).
- 2 | Unfold the machine.
- 3 | Place tractor transmission in park, stop engine, and remove key.
- 4 | Fold the ladder up to access the fertilizer tank.
  - Ensure the folding ladder latch is engaged so that the ladder does not fold down while climbing to the tanks.
  - If the machine is equipped with a folding toolbar, fold down the ladder after each use and before folding the toolbar. The ladder and row units can be damaged if this is not done prior to folding the toolbar for transport.
- 5 | Open tank lids.
  - For safety, do not lift the lids vertically, but swing them to the side to access the tanks. Follow the arrows on the lid mounts.
- 6 | Insert flex tube in a tank.
  - Be sure that the tank screens are in place and clear of obstructions.
- 7 | Fill each tank with product, and record weight after each filling.
- 8 | Stop the flow to the tender's auger in time to clear the auger of product for transport.
- 9 | Wipe off the rubber seals on top of tanks to assure a good seal.
  - Make sure the seals are seated correctly on the tank before closing lid.
  - Ensure lid is centered on seal and seated correctly. Improperly installing seals will allow air to escape, causing an incorrect fertilizer application rate.
- 10 | Carefully climb down the ladder, and then fold down and secure the ladder in place.
- 11 | Move the tender away from the machine.





# 8 NUTRIENT DELIVERY SYSTEMS

## 8.1.6 DRY SYSTEM: PWM BLOCK

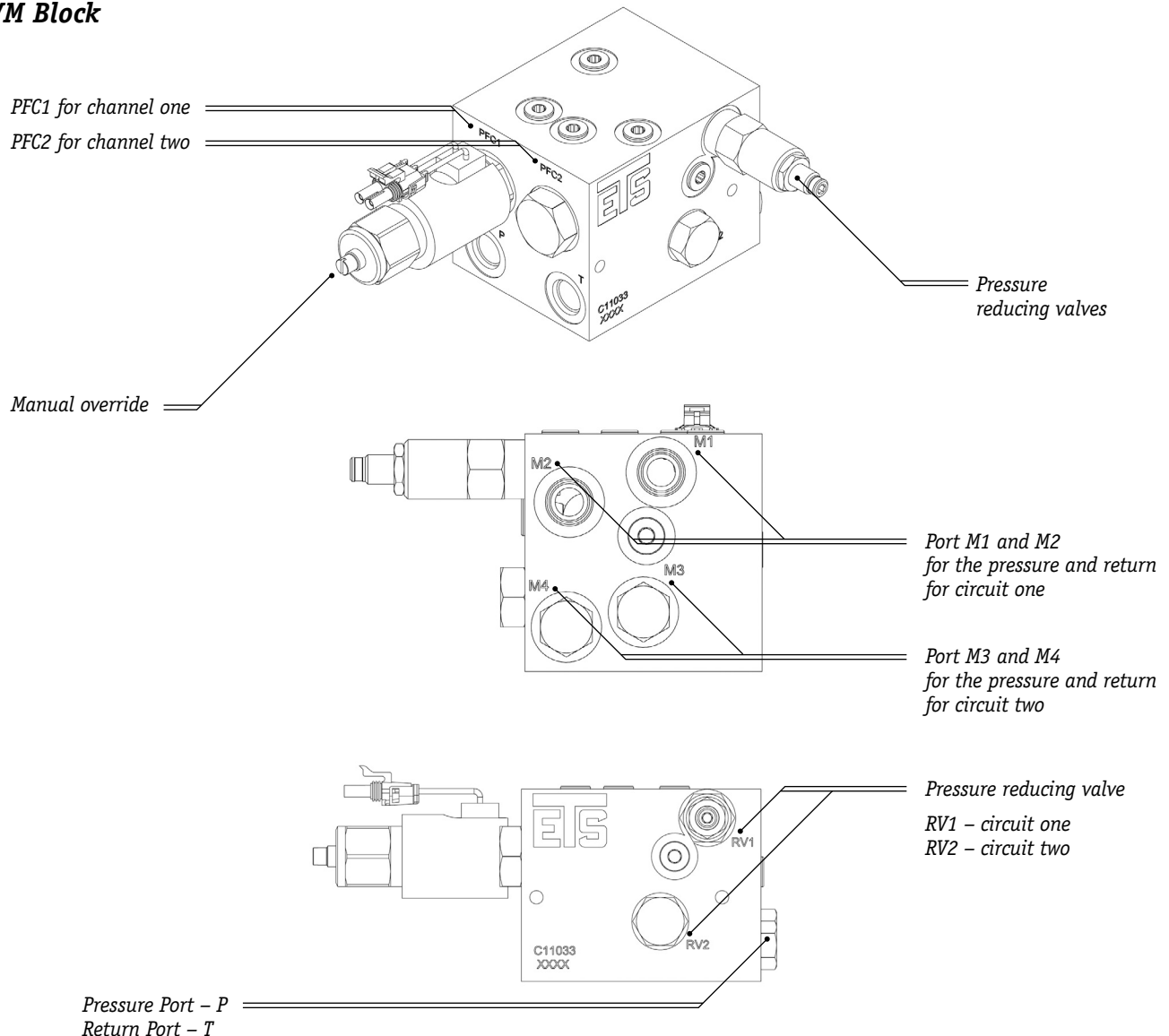
The PWM block controls hydraulic flow to the fertilizer drive motors.

When setting the hydraulic flow to this valve at the tractor, set the constant flow to approximately 20% flow on most tractors, or 5.0 on a John Deere tractor. During calibration, you may need to adjust the flow slightly. It is advised that you don't send more than 40%, or 6.5 (John Deere), flow to this valve.

The T port of this valve has a check valve to prevent reverse flow in the system. DO NOT remove the check valve. Fluid flow in reverse will damage the solenoids.

Most ETS units will have the Air Compressor (AC) connected to the Return Port T to operate the hydraulic motor on the AC. This reduces the required SCVs of the tractor. Refer to Section 5.2 for correct connections.

### PWM Block



## 8 NUTRIENT DELIVERY SYSTEMS

### 8.1.7 DRY SYSTEM: PWM MANUAL OVERRIDE

Use manual override to clean and service meter rolls. Turning the screw on the proportional flow control (PFC) manual override clockwise opens the valve to provide flow to the meter drive motors. The further turned, the faster the motor will rotate. When service is complete, rotate the PFC manual override screw counterclockwise to its end stop to assure the manual override is deactivated.

**NOTE:** If manual override is not completely deactivated, it will affect performance.

### 8.1.8 DRY SYSTEM: PWM PRESSURE REDUCTION VALVE ADJUSTMENT

Adjustable hydraulic pressure reduction valves are located on each circuit of the PWM (RV1 and RV2.) Valves may need to be adjusted due to inconsistent meter roll shaft rotation. These valves protect meter rolls from damage.

**Factory settings:**

- 8-run meter bodies = 5 turns in (clockwise from the fully retracted end stop)
- 12-run meter bodies = 7 turns in (clockwise from the fully retracted end stop)

Before making adjustments, check the system for a plugged run or meter roll. Inconsistent shaft rotation may be caused by drag of fertilizer within the system. Adjust by turning pressure reduction valve inward one turn at a time.

Making more than 2 turns may indicate another factor is affecting the shaft rotation. Turning up the flow from the tractor will not correct the inconsistent shaft rotation issue.

**NOTE:** When switching from heavy density to lighter density fertilizer, reset the pressure reduction valve to factory settings.

**NOTE:** Drive motors are connected to the meter rolls via a 1/4" grade 5 bolts with a lock nut. It is recommended to change this bolt at the start of each season.

### 8.1.9 DRY SYSTEM: SHAFT SPEED SENSOR

The shaft speed sensor is mounted on the opposite side of the meter roll drive motor. This sensing technology will alert you if there is a problem and the drive has stopped operating. All ETS systems can also be outfitted with

electronic fertilizer run block systems to alert you to a flow issue. *Run block system information is in Section 8.1.16, Dry System: PDC Run Block System.*

## 8 NUTRIENT DELIVERY SYSTEMS

### 8.1.10 DRY SYSTEM: HYDRAULIC FLOW

#### The hydraulic flow of most ETS dry fertilizer systems:

SCV pressure from tractor. (Set the flow rate at about 20% flow or 6.0 on a John Deere).



Through the non-bypass filter.



PWM block – P port.



Up to two circuits per block to control drive motors. If you have three tanks, a second PWM will be mounted on the rear tank. The T line from PWM one will go to the P port of this block. The T line will then go to the AC.



Return from block is out of port T.



Most systems, this line will go to the AC in port.



Through the AC and then back to the return SCV of the tractor.

**IMPORTANT:** As with any hydraulic motor circuit, always put the tractor engine in idle and move the SCV to the float position whenever you shut the flow off. This reduces the possibility of a seal issue with the motors and PWM. Be sure that the case drain line is connected to the appropriate port on the tractor which has zero back pressure.

**IMPORTANT:** All ETS AC systems have a case drain. Be sure that the case drain line is connected to the appropriate port on the tractor which has zero back pressure.

**IMPORTANT:** If you connect the case drain line to a SCV or power beyond return, the motor seals will fail. This type of damage voids warranty.

### 8.1.11 DRY SYSTEM: CALIBRATION SETTINGS AND METER ROLL SELECTION

#### Cubic Feet per Revolution (CFR) Settings for Ag Leader and John Deere Systems

No. of Rolls	Roll Size 7	Roll Size 10
1	0.005	0.006
2	0.009	0.013
3	0.014	0.019
4	0.018	0.026
6	0.028	0.039
8	0.037	0.051
12	0.055	0.077

For calibrating other dry fertilizer systems, refer to system manual.

**NOTE:** Prior to filling with fertilizer, be sure to operate the drives with the monitor and assure PWM calibration process has been completed. Refer to monitor operator manual for process.

**NOTE:** To obtain calibration value for a SWICM or JD 2000 rate control, multiply the value from the table by density of the product you are applying.

# 8 NUTRIENT DELIVERY SYSTEMS

## ETS Dry Fertilizer Meter Roll Selection *(all values are per tank)*

Meter Roll Size	Meter Roll Width	Shim Usage (quantity)	Rate Per Acre Range	Slider Usage	Chain Reduction Usage Required
7	1.75 in.	(2) .625	25–175 lbs*	50 lbs/ft <sup>3</sup>	Less than 75 lbs/acre
10	2.5 in.	(1) .50	75–400 lbs*	Always	Less than 125 lbs/acre

\* Actual rate ranges will vary with product density and speed.

**NOTE:** Slider usage for #10 meter roll will be for most products other than large granule and seed.

## 8.1.12 DRY SYSTEM: PREPARING TO CALIBRATE

- 1 | Fill tank(s) with fertilizer.
- 2 | Remove the collector bottom insert and check for fertilizer flow on the tank to be calibrated by using the manual override procedure (Section 8.1.6).
- 3 | Before attempting meter bag calibration, prime each meter body and set the hydraulic flow of the tractor and the control system.
- 4 | Attach meter calibration bag by tightening the cord of the bag around to the bottom of the collector.
- 5 | Calibrate the meter's delivery rate by collecting at least 20 pounds of fertilizer into the meter calibration bag and weighing it. Because larger volume aids in calibration accuracy, be certain to collect a large enough sample.
- 6 | It is important to know the density of each blend or product in the bins. With the use of the fertilizer density meter and scale in the toolbox, determine the density of the product at each point of calibration.

**NOTE:** Remove collector bottom insert evenly to prevent damage.

The density that is supplied on your bill of lading is sometimes inaccurate. To minimize the misapplication of your product, it is advised to check each time you calibrate or change blends or product.

- 7 | It's now time to calibrate the drive system according to the appropriate system user manual.

**NOTE:** When calibration is finished, place the collector bottoms back in original location.



Meter calibration bag attached to collector bottom

## 8 NUTRIENT DELIVERY SYSTEMS

### 8.1.13 DRY SYSTEM: BEST PRACTICES WHEN CALIBRATING

- When priming meters, watch to ensure product is flowing from all open runs before starting calibration procedure.
- Perform calibration procedures at least twice to improve accuracy.
- If the CFR values differ from chart, make sure product is flowing from all open runs on meter body.

- When calibration is complete, save it in your monitoring system. Compare that information to your scale weight — this will ensure calibration is accurate.

If inaccurate, adjust the pounds of product density to correct. Do not adjust CFR.

**NOTE:** When changing product density, be sure to adjust to match the applied blend.

### 8.1.14 DRY SYSTEM: TROUBLESHOOTING FERTILIZER FLOW

If product rates are inaccurate use these steps to troubleshoot:

#### 1 | Check product delivery to each row.

- a. Check for air flow to each row. If no air flow, check for plugged lines.
- b. Check all drive components, meter motor mount, motor leaks, chains, and shear bolts for proper tightness. Pull gently on meter shaft RPM sensor. If it is loose tighten set screws and check electrical connections to ensure accurate readings to the computer.
- c. Activate the PFC manual override. Turn off after 15 seconds. Walk by each row to determine the flow of product to each row. If a row does not have flow, inspect meter roll.
- d. Pull forward ten feet and repeat test for each tank.
- e. If a flow issue is determined on a meter body, open the back of each meter body to assure product flow is even across all runs and that the flow is clear to the 2.5 inch hose.
- f. Tapping on the tank with a rubber hammer may break loose any bridged material and correct flow issues
- g. With the rear door open, rotate the meter with the manual override to determine if product is flowing freely into and out of each meter roll.
- h. If product flow is not achieved by rotating the meter rolls, open the meter door.

#### 2 | Inspect meter roll flow.

- a. Remove two  $\frac{5}{16}$  inch flange nuts from the slide gate slot access.
- b. Insert fertilizer shutoff slide gate completely into slot. The angle on fertilizer shutoff slide gate must be upward. If facing down, the meter roll access door cannot be removed.
- c. Remove meter roll access door to gain access to the meter rolls. Use the meter calibration bag to catch fertilizer that may spill.

**NOTE:** Reposition slide gate if fertilizer continues to flow.

- d. Clear all fertilizer from meter rolls. Gently try to spin individual meter rolls with a tool to ensure the keyway is not sheared.
- e. Rotate meters with PFC. Inspect the meter body and collector bottom to assure there is not a blockage.
- f. Re-install components and remove slide gate to prepare for operation.

**NOTE:** Inconsistent meter roll shaft rotation may be caused by using application rates below specification (see chart in Section 8.1.10).

# 8 NUTRIENT DELIVERY SYSTEMS

## 8.1.15 DRY SYSTEM: FAN SPEED AND WATER COLUMN SETTINGS

The fan speed sensor is located within the fan screen. The speed sensor output has two pulses per revolution. Use this when setting up the monitor.

The chart below illustrates suggested RPM settings for field operation. Most monitors have the ability to read a fan speed sensor. Some systems can only read one sensor. If your unit has only one sensor and two fans, be sure to match the water column of the fan that does not have a sensor to the fan with a sensor.

**NOTE:** Matching the hydraulic flow between the two fans does not assure the same fan water column or RPM.

**IMPORTANT:** The  $\frac{3}{4}$  inch hydraulic lines are for the fan(s). When operating the fertilizer fan, be sure to have the SCV lever in the forward position. This is necessary for two reasons:

- 1) When you shutoff the fan, the flow must go to float to stop flow to the fan to minimize the fluid hammer of stopping the hydraulic flow.
- 2) All functions of the SoilWarrior® are designed so that in field operations of the SCV, the levers go forward.

If the tractor has two hydraulic pumps, connect the fans to the pump with higher capacity.

**NOTE:** Each fan requires approximately 13 GPM.

Start the fans at an SCV flow of less than 50% (6.0 John Deere). The fan should rotate clockwise. The overrun valve on the fan hydraulic circuit prevents the fan motor from running backward.

**NOTE:** Do not remove the check valve from the fan hydraulic circuit. Removing will damage the fan.

Periodically check fan blades and screen are clean of debris. Remove any debris. Debris build-up may cause fan to vibrate excessively.

### POTENTIAL CAUSES OF FLOW PROBLEMS

- Pelletized Lime
- Spring blends of urea and AMS
- Rate/acre
- Fines
- Liquid additives
- Poultry litter
- Fan speed
- Water in lines
- Doors not tight
- Lid not locked
- Road travel
- CFR value incorrect
- Wet product
- Running without fan on or low fan speed
- Plugged fertilizer hoses

### Fan Speeds and Water Column Settings

Unit	Fan Speed (RPM)	Water Column (without product) in H <sub>2</sub> O	Water Column (with product)
less than/equal to 6 row units & PlotWarrior	less than 3,000	less than 17	less than 20
less than/equal to 12 row units	less than 4,500	less than 20	less than 30
greater than 16 row units	greater than 4,500	less than 25	less than 35



## 8 NUTRIENT DELIVERY SYSTEMS

### 8.1.16 DRY SYSTEM: FERTILIZER TUBE PLACEMENT FOR DRY OR LIQUID FERTILIZER

ETS offers 6 tillage attachments with the two row units offered. See chart for proper fertilizer tube placement.

#### Fertilizer Tube Placement

Row Unit	Attachment	Placement
SOILWARRIOR® X	XD – Cog Wheel	2 inches behind cog wheel
	XS – Dual Coulter	Fertilizer tube as forward as possible
	XS TR – Dual Coulter with Twin Row option	Fertilizer tube as forward as possible
SOILWARRIOR® N	Coulter only	2 inches behind coulter
	Coulter with Shank and Knife	2 inches behind the NH3 or liquid hoses if installed. 2 inches behind the shank.
	Twin Till	Fertilizer tube as forward as possible

**NOTE:** In some conditions, the use of a 6–8 inch tube extension may be added to place the fertilizer deeper into the zone. The use of this extension tube will concentrate the fertilizer more in to a band in the soil.

### 8.1.17 DRY SYSTEM: PDC RUN BLOCK SYSTEM

The SoilWarrior® dry fertilizer system can be equipped with a flow blockage system. ETS uses the Intelliag PDC system from DICKEY-john, as well as VISUM from J. Assy. Both systems will monitor the flow of fertilizer to each row after the diffuser.

If DICKEY-john is installed, at startup, you will need to program the PDC to match your monitor. Below is a condensed process for initial setup. Refer to the DICKEY-john manual for full configuration details.

- 1 | Set speed to manual at 6 mph. This does not control drives, so the system only needs a manual speed entered. With some systems, you can select CAN speed if you have a GPS speed available.
- 2 | Set the system to monitor the correct number of rows.
- 3 | Use the sensor detect mode to assure each row is detected.
- 4 | Turn each row to be monitored on to blockage instead of population count.
- 5 | Default rate is set to 2 particles per second. When applying a rate less than 50 lbs. per acre, set the rate to 1 particle per 5 seconds.

If VISUM is installed from the factory, verify that the monitor is detecting all sensors by following the steps below.

- 1 | Turn on the VISUM display in the cab.
- 2 | Wake up the sensors by shaking the fertilizer hoses.
- 3 | Select the gear button until F1 is displayed on the monitor, then select the power button.
- 4 | LS will be displayed. It will then list all the sensors that are connected and awake.
- 5 | Once all sensors are listed, you are ready for field operation.

# 8 NUTRIENT DELIVERY SYSTEMS

## 8.2.1 LIQUID SYSTEM: INSPECT AND SERVICE SYSTEM

When using the unit for tillage only, remove nozzles and plug to prevent lines from filling with debris.

Flush out system with water. Clean screens and control panel. Wash machine to prevent corrosion of valves and hydraulic fittings.

If storing for winter months, run RV anti-freeze through the lines to protect from freezing.

- 8 row machines require 6 gallons
- 12 and 16 row machines require 12 gallons
- 24 row machines require 15 gallons



## 8.2.2 LIQUID SYSTEM: OPERATION

- 1 | Make sure there is liquid product in the tank before operating.
- 2 | Make sure the product supply valve is open to allow flow to the pump.
- 3 | Check pressure gauge for pump pressure.
- 4 | On each pump, there is an output tee in place with a  $\frac{1}{4}$  turn valve in the agitation line. Make sure this valve is not completely closed — it will need to be adjusted when setting line pressure.
- 5 | On front of panel, make sure that all drains are closed and that all system lines are connected correctly.
- 6 | Turn on hydraulic pump. The pump should not exceed 15 percent flow. Watch the hydraulic pump pressure gauge. Start the system at 30 psi. Pressure is regulated by hydraulic flow and bypass valve setting.
- 7 | Use water to flush and test the system prior to use. ETS recommends running between 15–30 psi line pressures.
- 8 | If line pressure is less than 15 psi, increase hydraulic pump speed.

**NOTE:** Closing the agitation valve in small increments will cause more product to flow into the valves.

# 8 NUTRIENT DELIVERY SYSTEMS

## 8.2.3 LIQUID SYSTEM: NOZZLE SELECTION AND MONITORING SYSTEM

### Nozzle Selection \*

Nozzle No.	PSI	GPM per Nozzle in Water	Recommended Visagage II Ball Size	4 MPH	6 MPH	8 MPH	10 MPH	12 MPH
4	10	0.20	Black Plastic	9.9	6.6	5.0	4.0	3.3
	20	0.28	Blue Plastic	13.9	9.2	6.9	5.5	4.6
	30	0.35	Blue Plastic	17.3	11.6	8.7	6.9	5.8
6	10	0.30	Blue Plastic	14.9	9.9	7.4	5.9	5.0
	20	0.42	Blue Glass	20.8	13.9	10.4	8.3	6.9
	30	0.52	Blue Glass	25.7	17.2	12.9	10.3	8.6
8	10	0.40	Blue Plastic	19.8	13.2	9.9	7.9	6.6
	20	0.57	Blue Glass	28.2	18.8	14.1	11.3	9.4
	30	0.69	Blue Glass	34.2	22.8	17.1	13.7	11.4
10	10	0.50	Blue Glass	24.8	16.5	12.4	9.9	8.3
	20	0.71	Blue Glass	35.1	23.4	17.6	14.1	11.7
	30	0.87	S.S. Ball	43.1	28.7	21.5	17.2	14.4
15	10	0.75	Blue Glass	37.1	24.8	18.6	14.9	12.4
	20	1.06	S.S. Ball	52.5	35.0	26.2	21.0	17.5
	30	1.30	S.S. Ball	64.4	42.9	32.2	25.7	21.5
20	10	1.00	S.S. Ball	49.5	33.0	24.8	19.8	16.5
	20	1.41	S.S. Ball	69.8	46.5	34.9	27.9	23.3
	30	1.73	S.S. Ball	85.6	57.1	42.8	34.3	28.5
30	10	1.50	S.S. Ball	74.3	49.5	37.1	29.7	24.8
	20	2.12	S.S. Ball	104.9	70.0	52.5	42.0	35.0
	30	2.60	S.S. Ball	128.7	85.8	64.4	51.5	42.9
40	10	2.00	S.S. Ball	99.0	66.0	49.5	39.6	33.0
	20	2.83	S.S. Ball	140.1	93.4	70.0	56.0	46.7
	30	3.46	Out of Range	171.3	114.2	85.6	68.5	57.1

\* TeeJet nozzles and CDS John Blue VisaGage monitoring balls are standard on ETS liquid systems. Operators who choose to use other brands should refer to the manufacturer's information for proper sizing and usage. Copies of TeeJet and CDS John Blue VisaGage operating materials are provided with each unit.

\* Gallons per acre of water – 30" spacing

## 8 NUTRIENT DELIVERY SYSTEMS

Since all calculations are based on spraying water, which weighs 8.34 lbs per USA gallon (1 kilogram per liter) conversion factors must be used when spraying liquids that are heavier or lighter than water. To determine the proper size nozzle for the liquid to be sprayed, first multiply the desired GPM or GPA of liquid by the water rate conversion factor. Then use the new converted GPM or GPA rate to select the proper size nozzle.

### **Example:**

Desired application rate is 20 GPA of 28% N.  
Determine the correct nozzle size as follows:

- ›  $GPA \text{ (liquid other than water)} \times \text{Conversion Factor} = GPA$
- ›  $20 \text{ GPA (28\%)} \times 1.13 = 22.6 \text{ GPA (water)}$

Users should choose a nozzle size that will supply 22.6 GPA of water at the desired pressure and speed.  
The recommended pressure range is 15–30 psi.

*To calculate product application rate, find desired rate and speed in the Nozzle Selection chart. Multiply GPA in water by the conversion factor listed below. Below are conversion factors for some common liquid fertilizers. If your specific product or product mix is not listed, please contact your product supplier for the appropriate conversion factor.*

Product	Weight/ Gallon	Specific Gravity	Conversion Factor
Water	8.34 lbs	1.00	1.00
28%	10.65 lbs	1.28	1.13
32%	11.06 lbs	1.32	1.15
10-34-00	11.4 lbs	1.37	1.17

\*If the product you are applying is not listed, please contact your product supplier for proper conversion factors.

# 9 MAINTENANCE

## 9.1.1 DAILY SOILWARRIOR MAINTENANCE

- 1 |** Grease cart frame, meter roll bearings, tilt pins, wing pins, row units, and zone cleaners.
- 2 |** Open air compressor drain valve to remove water. (If temperatures are below freezing it is recommended to do this multiple times per day to prevent freezing.)
- 3 |** Spread Ceplattyn adhesive grease on hitch and cart frame slide plates.
- 4 |** Check for hydraulic leaks on any hoses or components.
- 5 |** Open meter roll inspection doors and check meter rolls for grinding or free rotation on the shaft. Inspect foam seals on inspection doors for leaks or deterioration of the foam.
- 6 |** Inspect hitch, cart frame, lift arm, and toolbar for loose or damaged hardware and components.
- 7 |** Inspect row units for loose or damaged hardware and components.
- 8 |** Inspect safety devices for proper function.
- 9 |** Inspect field and safety lighting for proper function.
- 10 |** Inspect electrical components for any loose or pinched wiring.

## 9.1.2 CART STEERING

Cart steering uses the tractor hydraulic system to turn the front of the SoilWarrior to keep zones perfectly spaced.

Daily Maintenance: Inspect all cart steering components including hydraulic cylinder, hoses, wiring, and sensors. Keep all slide plates well lubed with Ceplattyn adhesive grease to ensure smooth operation.

# 9 MAINTENANCE

## 9.1.3 ROUTINE MAINTENANCE: LUBRICATION

The SoilWarrior® is designed so the grease fittings are accessible while the machine is in the transport position. Verify that the toolbar raise/lower locks and the toolbar tilt locks are engaged before entering the area under or behind the machine.

There is not a grease label by all five grease fittings on the SoilWarrior® X row units. Remember to lube the five points on the SoilWarrior® X row unit. The SoilWarrior® N row unit has two points, which are labeled.

Lubricate all grease fittings every 250 acres on units 12 rows and smaller and 500 acres on units 16 rows and larger.

**NOTE:** Service videos can be found on the SoilWarrior YouTube channel - Service & Maintenance playlist.

## 9.1.4 ROUTINE MAINTENANCE: FERTILIZER FAN DRIVE MOTOR SEAL INSPECTION

Remove one fertilizer air tube from bin and check for an oily residue inside air tube. If an oily residue is present, this indicates that the fan drive motor seal is leaking and must be repaired or replaced.

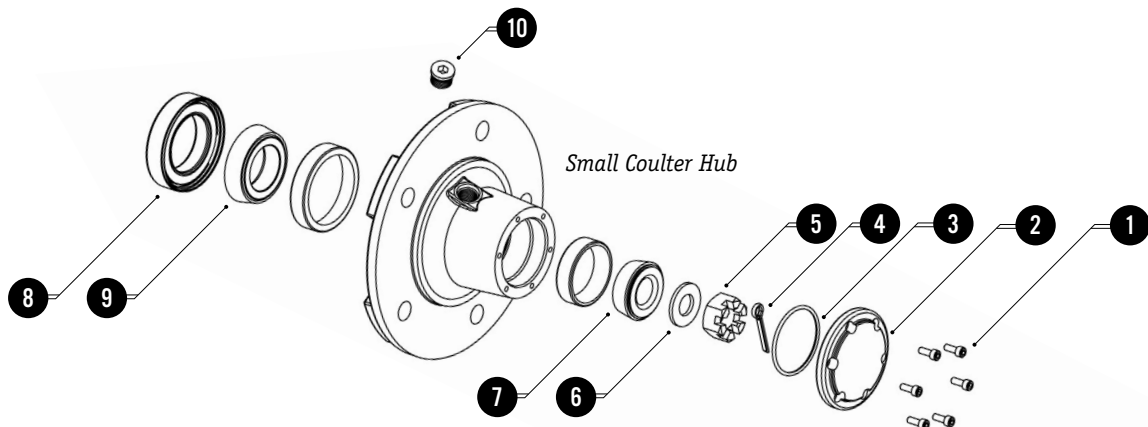
## 9.1.5 ROUTINE MAINTENANCE: SERVICE REMOTE-CONTROLLED REGULATOR

- 1 | Place tractor transmission in park, stop engine, and remove key. Chock tires.
- 2 | Relieve the air pressure from the row unit down force system.
- 3 | Remove regulator cap.
- 4 | Remove o-ring, spring, U-cup seal, and piston.
- 5 | Clean and inspect spring, piston, and piston o-ring. Use a cotton swab to clean the regulator.
- 6 | Lubricate piston and o-rings with Parker O-Lube (in toolbox). Lightly lube; too much can create sticking issues.
- 7 | Remove snap ring from bottom of regulator.
- 8 | Remove cover under the snap ring which contains the bottom piston.
- 9 | Remove the top piston, bottom piston, and o-rings. Clean and lube with Parker O-Lube. Be sure to clean the interior of piston. Lightly lube; too much can create sticking issues.
- 10 | Assemble regulator.



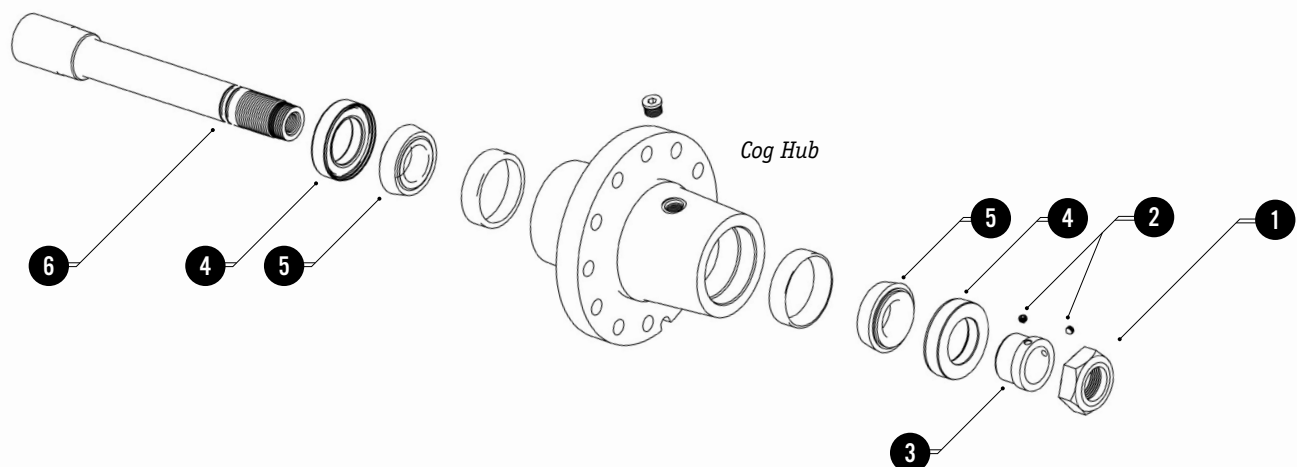
## 9.1.6 ROUTINE MAINTENANCE: STANDARD TILLAGE AND CONTAINMENT COULTER HUB BEARING AND SEAL REPLACEMENT

- 1 |** Unfold and lower toolbar.
- 2 |** Tilt onto the lift and tilt locks.
- 3 |** Place tractor transmission in park, stop engine, and remove key.
- 4 |** Relieve air pressure from the row unit down force system.
- 5 |** Remove bolts, nuts, and coulters from hub.
- 6 |** Remove six  $\frac{8}{32} \times \frac{1}{2}$  inch socket head bolts (1) and hub cap from hub (2).
- 7 |** Inspect the o-ring (3) on the hub cap for quality.
- 8 |** Remove the spindle cotter pin (4), castle nut (5), washer, (6) and outer bearing (7).
- 9 |** Remove hub from spindle. The hub will come off the spindle relatively hard due to the oil seal.
- 10 |** Remove the seal (8) and inner bearing (9) from hub. Discard the seal.
- 11 |** Clean and inspect bearings, bearing cups, hub, and spindle.
  - Replace any parts that are damaged or worn.
  - If a bearing or bearing cup must be replaced, replace both bearings and bearing cups.
  - Do not install a new bearing in a used bearing cup.
  - Use a press and correct size drivers to remove and install bearing cups in hub.
- 12 |** Install inner bearing (9).
- 13 |** Install new seal (8) with flat side facing up, away from the hub with a press and seal installation tool. This tool is available for purchase from ETS. Lubricate seal surfaces before installing in hub and onto shaft.
- 14 |** Place hub on spindle.
- 15 |** Add two ounces of 75–90 Gear Lube into hub.
- 16 |** Install outer bearing (7), washer (6), and castle nut (5).
- 17 |** Tighten castle nut to 50 foot-pounds of torque. Rotate hub several times.
- 18 |** Loosen castle nut  $\frac{1}{2}$  turn, then tighten to 140 inch-pounds of torque.
  - Tighten castle nut if necessary to align hole in spindle and install cotter pin.
  - Bend open end of cotter pin.
  - Be sure that the cotter pin does not interfere with the hub cap.
- 19 |** Install new o-ring on hub cap. Apply anti-seize to hubcap face.
- 20 |** Apply small amount of Loctite 243 on six socket head cap screws. Install screws and torque to 40 in/lbs.
- 21 |** Remove plug (10). Rotate the bottom of the plug hole to a 3 o'clock position. Check fluid level. Add if necessary.
- 22 |** Install plug. Rotate hub and check for free movement. The hub may rotate hard due to the type of seal and torque specs.
- 23 |** Install coulters, bolts, and nuts to the hub side.



## 9.1.7 ROUTINE MAINTENANCE: COG WHEEL HUB BEARING AND SEAL REPLACEMENT

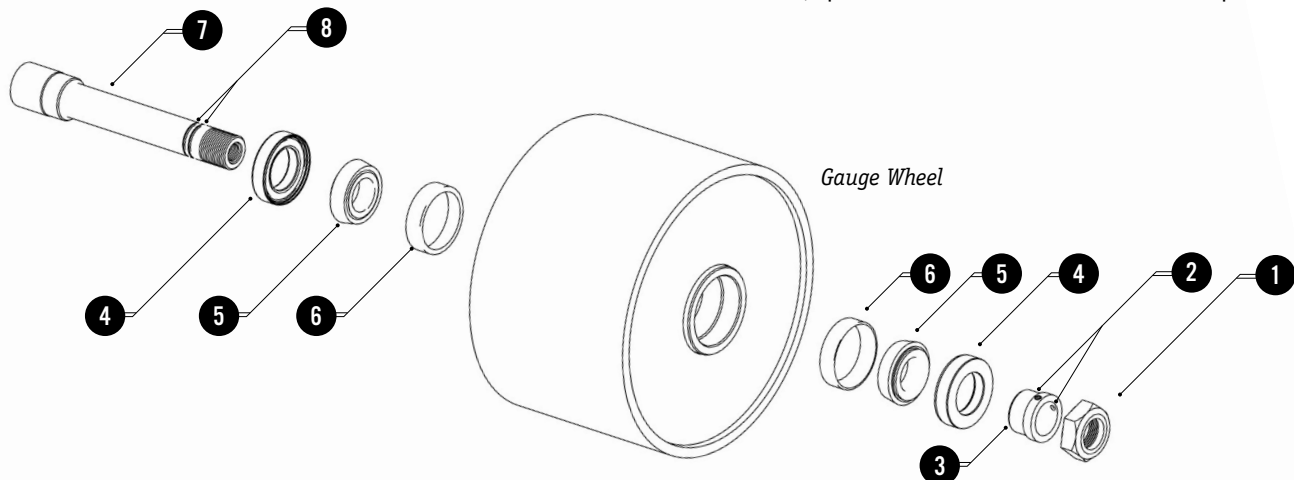
- 1** | Unfold and fully lower machine to the lift locks and tilt the toolbar until the tilt cylinders bottom out before performing service.
- 2** | Place tractor transmission in park, stop engine, and remove key. Chock tires.
- 3** | Relieve air pressure from the row unit down force system.
- 4** | Remove two bolts from the spindle of the deep tillage hub assembly located on the lower arms. An assistant must be firmly holding the cog wheel and hub assembly prior to the removal of the bolts.
- 5** | Place the cog wheel and deep tillage hub assembly on a bench.
- 6** | Remove twelve bolts, nuts, and cog wheel from hub.
- 7** | Remove lock nut (1).
- 8** | Loosen two set screws (2) and collar (3).
- 9** | Remove oil seals (4), bearings (5), and spindle (6) from hub.
- 10** | Clean and inspect bearings, bearing cups, hub, and spindle.
- 11** | Replace any parts that are damaged or worn.
- 12** | If a bearing or bearing cup must be replaced, replace both bearings and bearing cups. Do not install a new bearing in a used bearing cup. Use a press and correct size drivers to remove and install bearing cups in hub.
- 13** | Install bearing on long side of hub.
- 14** | Install new seal (4) with flat side facing up, away from the hub face with a press and seal installation tool. This tool is available for purchase from ETS.
- 15** | Turn hub over and install bearing on short side of hub.
- 16** | Lubricate seals and o-ring surfaces before installing in hub and onto shaft. Install new seal with flat side facing up, away from the hub face with a press and seal installation tool.
- 17** | Install spindle with new o-rings (8) into short end of hub.
- 18** | Install seal collar (3) until collar seats in seal.
- 19** | Install lock nut (1) and tighten to 100 foot-pounds of torque.
- 20** | Back lock nut (1) off  $\frac{1}{8}$  turn.
- 21** | Tighten two set screws (2).
- 22** | Remove oil plug (7) and add 6 ounces of 75-90 Gear Lube. Check amount by placing hub horizontal and filling until fluid flows out. Install oil plugs. Rotate shaft and check for free movement.
- 23** | Place cog wheel on hub with the nut of the hub spindle on the right side of the cog wheel in its direction of travel.
- 24** | Install bolts and nuts. Place the nuts on the hub side so the bolt goes through the cog wheel and into the hub. Be certain disk is installed in the correct direction of travel.
- 25** | Position cog wheel with hub to the lower cog wheel arm and install two bolts.



# 9 MAINTENANCE

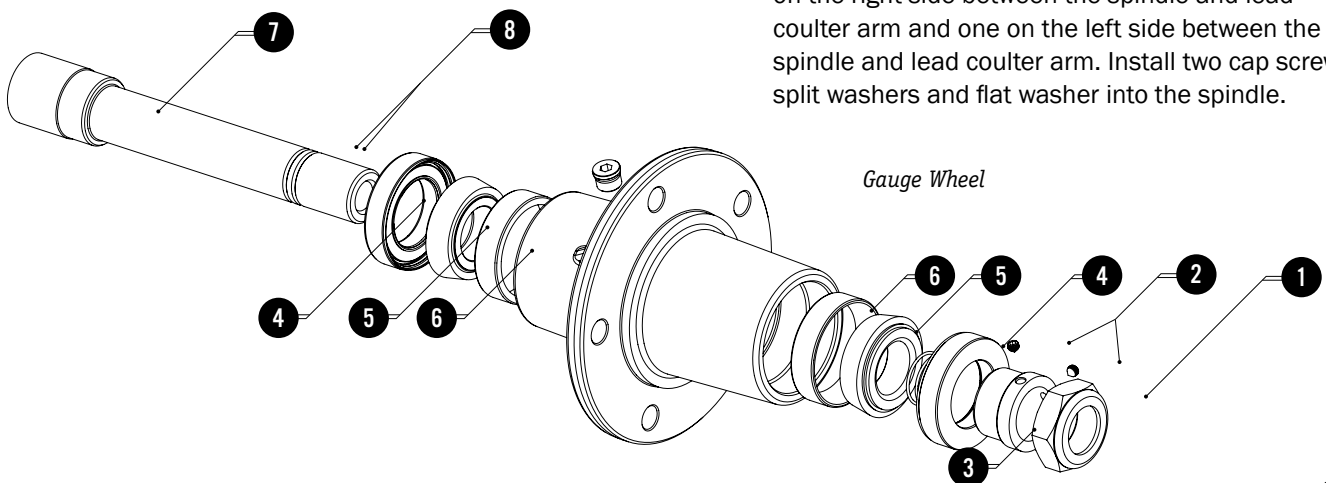
## 9.1.8 ROUTINE MAINTENANCE: GAUGE WHEEL BEARING REPLACEMENT

- 1 |** Unfold and fully lower machine to the lift locks and tilt the toolbar until the tilt cylinders bottom out before performing service.
- 2 |** Place tractor transmission in park, stop engine and remove key. Chock tires.
- 3 |** Relieve air pressure from the row unit down force system.
- 4 |** Support the gauge wheel and remove two mounting bolts. Be sure to note the washer placement. There are two flat washers on the right side between the spindle and gauge wheel arm and one on the left side between the spindle and gauge wheel arm.
- 5 |** Place the gauge wheel on a bench.
- 6 |** Remove lock nut (1), loosen two set screws (2) and collar (3).
- 7 |** Remove oil seals, bearings and spindle (7) from gauge wheel.
- 8 |** Clean and inspect bearings cones (5), bearing cups (6), hub and spindle.
- 9 |** Replace any parts that are damaged or worn.
- 10 |** If a bearing or bearing cup must be replaced, replace both bearings and bearing cups. Do not install a new bearing in a used bearing cup. Use a press and correct size drivers to remove and install bearing cups in hub.
- 11 |** Install bearing cone in bearing cup.
- 12 |** Install new oil seal (4) with flat side facing up on first side, with a press and seal installation tool.
- 13 |** Lubricate seal surfaces before installing shaft.
- 14 |** Install spindle with new o-ring (8) installed on spindle into gauge wheel. Be sure that the portion of the shaft that seats to the seal is started.
- 15 |** Place the gauge wheel on end with the threaded portion of the spindle up. Add about 6 ounces of gear lube through the space between the spindle and the oil seal. There are plugs in the gauge wheel assembly to add or check the oil level.
- 16 |** Install bearing on side two. Install new oil seal with flat side facing up, with a press and seal installation tool.
- 17 |** Install bearing collar (3) until it seats in seal.
- 18 |** Install lock nut (1) and torque to 100 foot-pounds.
- 19 |** Back lock nut off  $\frac{1}{8}$  turn.
- 20 |** Tighten two bearing seat set screws (2).
- 21 |** Rotate gauge wheel and check for free movement. The gauge wheel may turn hard due to the type of oil seal and torque specs used.
- 22 |** Install gauge wheel onto the row unit. Be sure to support the gauge wheel. Place the nut side of the spindle to the right. Be sure to note the washer placement. There are two flat washers on the right side between the spindle and gauge wheel arm and one on the left side between the spindle and gauge wheel arm. Install two cap screws, split washers and flat washer into the spindle.



## 9.1.9 ROUTINE MAINTENANCE: LEAD COULTER HUB BEARING REPLACEMENT

- 1 |** Unfold and fully lower machine to the lift locks and tilt the toolbar until the tilt cylinders bottom out before performing service.
- 2 |** Place tractor transmission in park, stop engine and remove key. Chock tires.
- 3 |** Relieve air pressure from the row unit down force system.
- 4 |** Support the lead coultter assembly and remove two mounting bolts. Be sure to note the washer placement. There are two flat washers on the right side between the spindle and lead coultter arm and one on the left side between the spindle and lead coultter arm.
- 5 |** Place the lead coultter hub on a bench.
- 6 |** Remove lead coultter from lead coultter hub.
- 7 |** Remove lock nut (1), loosen two set screws (2) and collar (3).
- 8 |** Remove oil seals, bearings and spindle (7) from lead coultter hub.
- 9 |** Clean and inspect bearings cones (5), bearing cups (6), hub and spindle.
- 10 |** Replace any parts that are damaged or worn.
- 11 |** If a bearing or bearing cup must be replaced, replace both bearings and bearing cups. Do not install a new bearing in a used bearing cup. Use a press and correct size drivers to remove and install bearing cups in hub.
- 12 |** Install bearing cone in bearing cup.
- 13 |** Install new oil seal (4) with flat side facing up on first side, with a press and seal installation tool.
- 14 |** Lubricate seal surfaces before installing shaft.
- 15 |** Install spindle with new o-rings (8) installed on spindle into lead coultter hub. Be sure that the portion of the shaft that seats to the seal is started.
- 16 |** Place lead coultter hub on end with the threaded portion of the spindle up. Add about 6 ounces of gear lube through the space between the spindle and the oil seal. There is a plug in the lead coultter hub to add or check the oil level.
- 17 |** Install bearing on side two. Lubricate oil seal. Install new oil seal with flat side facing up, with a press and seal installation tool.
- 18 |** Install bearing collar (3) until it seats in seal.
- 19 |** Install lock nut (1) and torque to 100 foot-pounds. Rotate hub several times.
- 20 |** Back lock nut off  $\frac{1}{8}$  turn.
- 21 |** Tighten two bearing seat set screws (2).
- 22 |** Rotate lead coultter hub and check for free movement. The lead coultter hub may turn hard due to the type of oil seal and torque specs used.
- 23 |** Install lead coultter on lead coultter hub.
- 24 |** Install lead coultter assembly onto the row unit. Be sure to support the lead coultter assembly. Place the nut side of the spindle to the right. Be sure to note the washer placement. There are two flat washers on the right side between the spindle and lead coultter arm and one on the left side between the spindle and lead coultter arm. Install two cap screws, split washers and flat washer into the spindle.



## 9.1.10 ROUTINE MAINTENANCE: COG WHEEL TILLAGE BIT REPLACEMENT

Cog wheels and tillage bits need to be replaced periodically.

Replace tillage bits when the broad end of the bit is worn off and the tip is the same width as the cog wheel. Bits wear differently depending on where they are located. There will be more wear in bits located on tramlines.

Cog wheels should be replaced when they no longer hold bits.

**IMPORTANT:** Always wear gloves and safety glasses when removing and installing bits.

**NOTE:** Service videos can be found on the SoilWarrior YouTube channel - Service & Maintenance playlist.

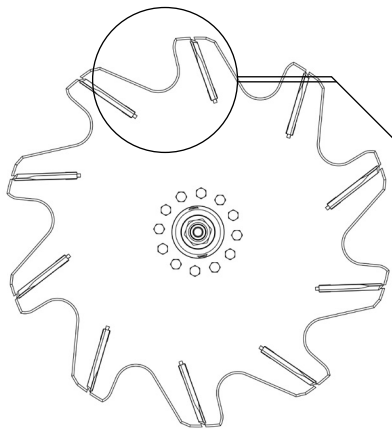
### Bit Removal

The best way to remove the tillage bits is to cut them off with a cutting wheel on an angle grinder.

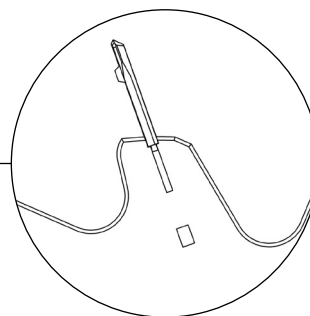
- 1 | Raise the toolbar and secure the safety locks.
- 2 | With a cutting disk on an angle grinder, cut the bit above the square slot on the cog. Repeat on the other side.
- 3 | Once both sides of the tillage bit have been cut off, the remainder of the bit can be driven off with a hammer.

### Bit Replacement

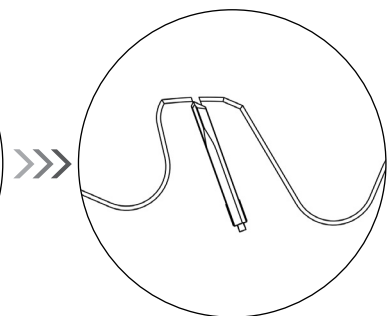
- 1 | Position the bit so the angled side points toward the long angle of the cog and the square edge points toward the short edge of the cog.
- 2 | Position the retaining tab over the bit slot in the cog.
- 3 | Start the bit in the cog wheel with a brass or lead hammer. (Steel hammers may generate sparks and chips).
- 4 | Strike the bit until it bottoms out in the slot and the retaining tab snaps into the square hole.



Cog Wheel with Tillage Bits



Installing Bit



Bit Installed

# 9 MAINTENANCE

## 9.2.1 PRE-SEASON MAINTENANCE: COULTER HUB LUBRICANT LEVEL

- 1 | Clean the area around the plug (1) on the coulters or tillage hub.
- 2 | Remove the plug and rotate the hub so the hole is at the 3 o'clock position.
- 3 | Check the quality and quantity of lubricant in the hub.
- 4 | Add 75–90 Gear Lube as needed until lubricant is present with the hub hole at the 3 o'clock position.
- 5 | Install and tighten plug.

## 9.2.2 PRE-SEASON MAINTENANCE: PRE-LOAD HUB ADJUSTMENT

In addition to checking the fluid level of each hub, check the hub for pre-load. Loosen nut one turn, then set using torque specs. Unlike hubs with grease, the hub pre-load of an oil bath hub is slightly higher.

**Check the hub pre-load by using the following procedure:**

- 1 | Put on an abrasion-resistant glove.
- 2 | Grab the upper part of the coulters about 2 o'clock and with a firm action, give the coulters a fling downward.
- 3 | If the coulters rotate more than 1.5 revolutions, the pre-load is too loose. If the hub rotates less than  $\frac{3}{4}$  of a rotation, the hub pre-load is too tight.

- 4 | If the pre-load is out of the rotational test complete the following:
  - Remove the 6 screws on the hub cap.
  - Remove the cotter pin retaining the castle nut.
  - Loosen or tighten the castle nut to allow the hub to be adjusted to fit the rotation test criteria.

- 5 | Retest the hub pre-load as listed above.
- 6 | Re-install the cotter pin, hub cap and screws.
- 7 | Re-fill with lube to correct level.

Keep in mind that when the hub cap is removed, all the oil will run out. After re-installation of the cotter pin and the hub cap, re-fill the hub.



## 9.2.3 ATTACHING AND DETACHING WING SECTIONS ON 4500 SERIES UNIT

Detachable wing sections can be removed to match the tillage system to your tractor.

- 1 | Position the SoilWarrior® and tractor so that you have room to move forward at least 50 feet.
- 2 | Be sure that the area you are on is firm enough that the detachable wings do not sink into the soil.
- 3 | With the toolbar in transport position and the row unit air pressure at zero, position the detachable wing row units over center as if they were at the top of their up travel.
- 4 | Insert the row unit lockup pins in the holes below the lower parallel link on each wing row unit on the SoilWarrior X.
- 5 | Unfold the toolbar and tilt the toolbar to a horizontal position. Turn the tilt stop rod completely out to allow the toolbar to tilt into the needed profile.
- 6 | Raise the toolbar to the fully-raised position and engage the toolbar lift locks.
- 7 | Insert the parking stands in the mounts on each wing section using the pins and clips supplied.
- 8 | Disconnect all the fertilizer placement lines that supply the wings from the main fertilizer system, and place the supply lines that were disconnected on the wing and secure.
- 9 | Disconnect the row unit airline that supplies the row units on the wings, and cap or connect the air supply line to the appropriate connection.
- 10 | Assure all the hardware and supply lines for the detachable wings are clear of the main section, and secure the removed hardware and fasteners for storage.
- 12 | Slowly lower the toolbar until the detachable wing's front and rear parking stands are in contact with the ground.
- 13 | Loosen and remove the 1 inch bolts and nuts on the wing plates.

- 14 | Raise the SoilWarrior toolbar. Drive the unit forward until it is clear of the detached wings.

- 15 | Position the detached wings and row units in a safe area for storage. Some toolbar sections have pallet fork pockets to aide in the transport of the detached wing and row units.

For installing the wings, position the wing section close to the unit for easy alignment and reverse the previous steps.

For dry fertilizer systems, ensure that the internal block-out plates are installed or removed on the affected rows. This depends on the application. For example, rows not in use must have internal block plates installed on the affected meter rolls and caps installed onto the air distribution lines not being used.

Air distribution lines must be removed from the fan distributor and caps placed on both sides of each run on both collector bottoms. Caps should also be placed on the empty fan distributor openings. To add lines back into the system, reverse the process.

**NOTE:** *If adding lines into the fertilizer distribution system, make certain the internal block-out plates are removed on the respective runs.*

The fan outlets must match the meter runs used. In the event that an airline from the fan to the meter collector bottom is left connected and the meter block-off plate is installed, fertilizer will be siphoned through the meter rolls of the connected meter runs when the unit is stopped and the fan is running.

For liquid fertilizer systems, be sure to cap the disconnected section or reconnect the lines on the wings that were attached.

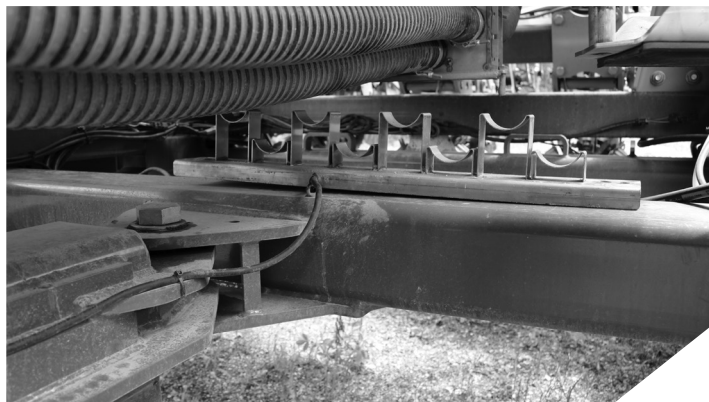
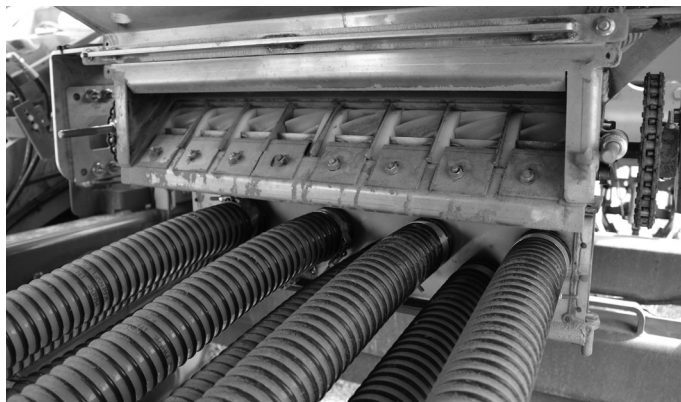
# 9 MAINTENANCE

## 9.3 END OF SEASON MAINTENANCE: CLEANING OUT THE DRY FERTILIZER METER BODY SYSTEM

- 1 | Empty tanks of all products.
- 2 | Place tractor transmission in park, stop engine, and remove key. Chock tires.
- 3 | Remove the front meter roll access door. Consider doing this in the field.
- 4 | Remove all meter roll block-off plates and the T-bar for the block-off shield.
- 5 | Remove all capped-off runs and hoses from the rear of each meter body.
- 6 | Remove the collector bottom insert.
- 7 | Use pressure washer to clean system components. Do not direct spray directly at bearings or seals.
- 8 | Start at the top of the tank and wash downward, both on the inside and outside of the tanks. Be sure to wash with a pressure washer all areas of the tanks, meter rolls, and meter body. ETS recommends a triple rinse of the tank.
- 9 | Do not direct the pressure washer at the bearing seals and the application rate sensor. Apply ample amounts of WD-40 to the meter body and rolls after the system has dried.
- 10 | Re-install all components.



**INSPECT UNIT FOR WORN PARTS. ORDER AND INSTALL BEFORE NEXT USE.**



TOP: Meter roll with access door attached  
BOTTOM: Meter roll rear access door removed

TOP: Meter roll with access door removed  
BOTTOM: Meter roll collector bottom insert

## 9.4 WINTERIZING

When using the unit for tillage only, remove nozzles and plug to prevent lines from filling with debris.

Flush system with water. Clean screens and control panel. Wash machine to prevent corrosion of valves and hydraulic fittings. Fill machine with proper amount of RV antifreeze. Run solution pump until antifreeze comes out of all nozzles.

If storing for winter months, run RV antifreeze through the lines to protect from freezing.

- 8 row machines require 6 gallons
- 12 and 16 row machines require 12 gallons
- 24 row machines require 15 gallons

# 10 STORAGE

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- 1 |** Thoroughly clean all fertilizer from the machine.
- 2 |** Flush the fertilizer tubes, liquid pumps, liquid plumbing, and meter bodies with clean water.
- 3 |** Liquid pumps and plumbing must be winterized to prevent freezing. Damage from frozen fluids will void any and all warranties.
- 4 |** Use a pressure washer to thoroughly clean the unit.
- 5 |** Leaving fertilizer in the meter body will cause severe rust and damage to its assembly. Wash completely and apply ample amounts of WD-40.
- 6 |** Check the oil level in all of the hubs after each season. Add oil if needed.
- 7 |** Remove and clean the air filter on the air compressor.
- 8 |** Tighten any loose nuts and bolts.
- 9 |** Grease all fittings.
- 10 |** Inspect hydraulic components, such as pins and cotter keys, hose condition, cylinder and hose leaks, repairing any leaks or damaged hoses.
- 11 |** Engage all safety lockouts including lift locks, tilt lock, wing pins, etc.
- 12 |** Store the machine inside a building so it is not affected by weather.
- 13 |** Inspect unit for worn parts. Order and install before next use.
- 14 |** Change air compressor oil if needed.





ENVIRONMENTAL  
TILLAGE SYSTEMS