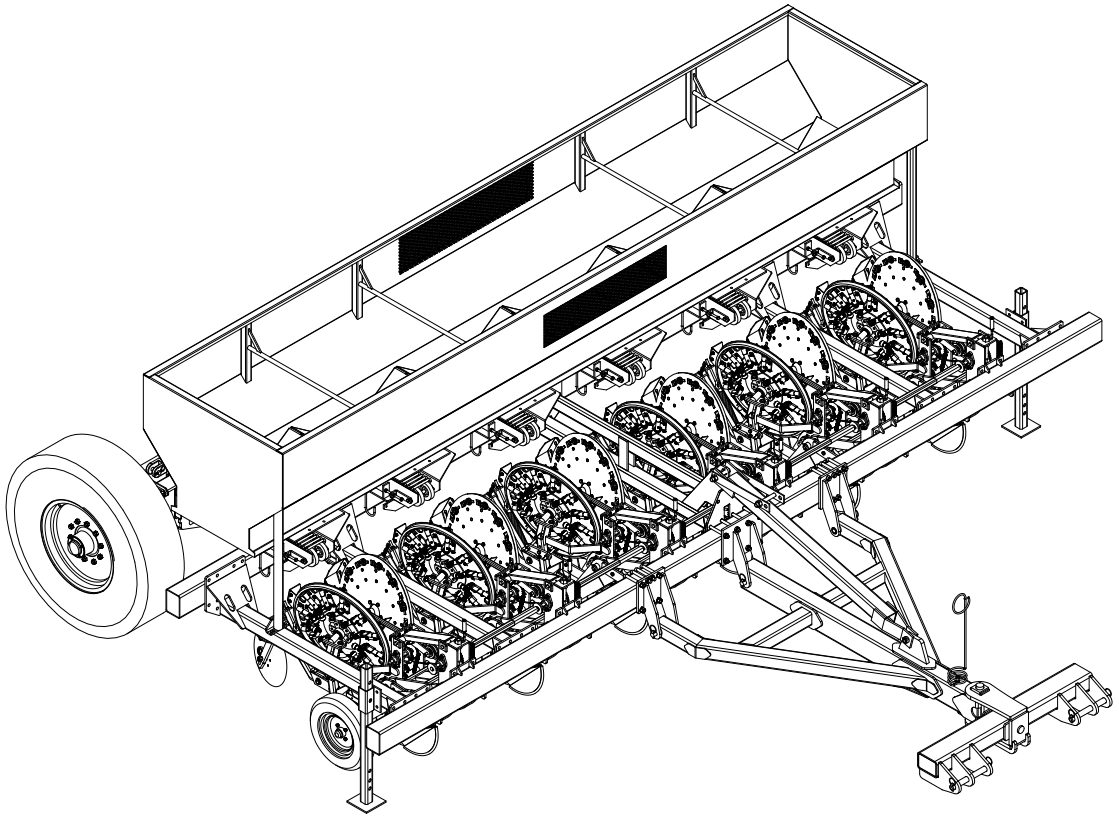
Harriston
INDUSTRIES



CLAMP PLANTER
OPERATOR'S MANUAL 2016

Table of Contents

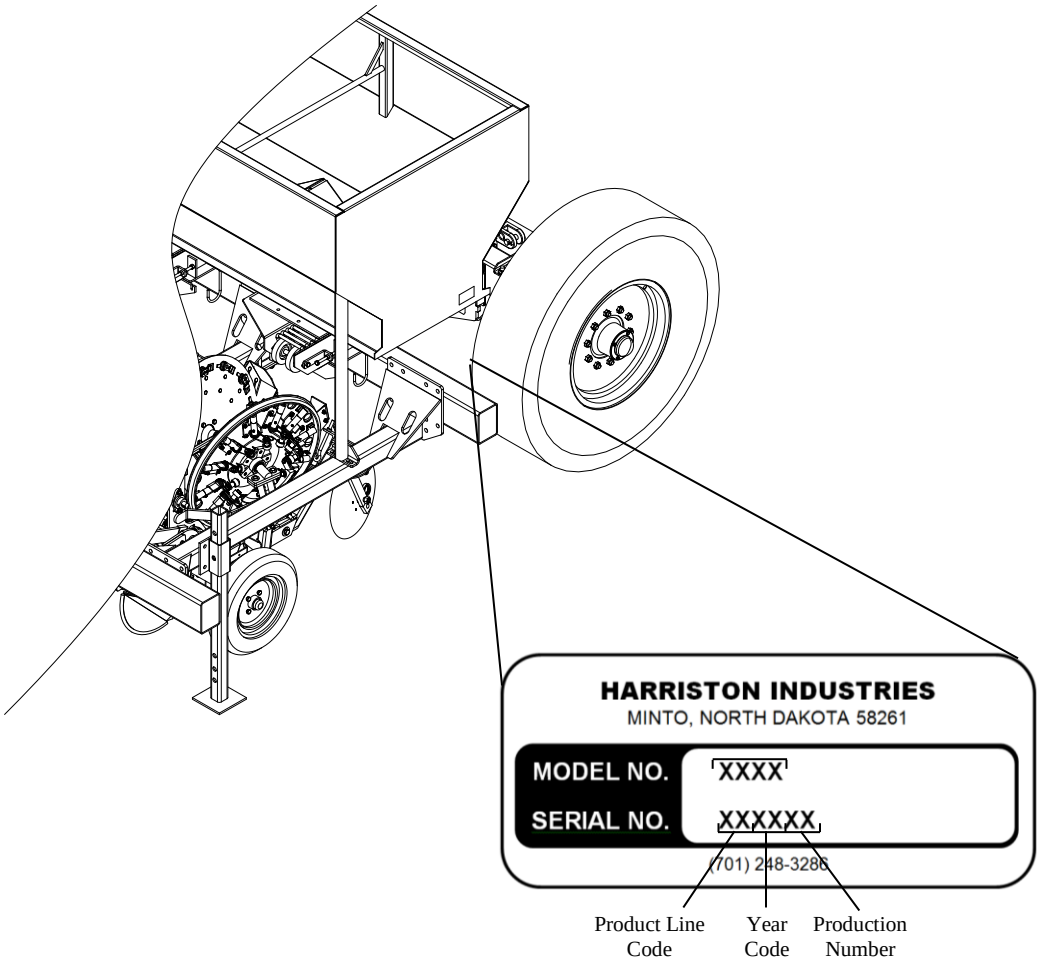
1 INTRODUCTION

Congratulations on your choice of a Harriston Clamp Potato Planter to complement your farming operation. This equipment has been designed and manufactured to meet the needs of a discerning potato industry for the efficient planting of potatoes.

Safe, efficient, and trouble-free operation of your Harriston Planter requires that you and anyone else who will be operating or maintaining the planter read and understand all of the safety, operation, maintenance, and troubleshooting information contained in this Operator's Manual.

This manual covers the 4, 6, and 8 row models. Differences are covered and explained where appropriate.

Keep this manual handy for frequent reference and to pass on to new operators and owners. Call your Harriston dealer or distributor if you need assistance, information, or additional copies of the manual.



OPERATOR ORIENTATION - The directions left (driver's side), right (passenger side), front, and rear, as mentioned throughout the manual, are as seen from the driver's seat and facing in the direction of travel

LIMITED WARRANTY

Harriston Industries, hereinafter called Harriston, extends a Limited Warranty on the products it manufactures to be free from defects in material and workmanship for a period of one (1) year from the date of sale to the original purchaser. Under this Warranty, parts and labor are covered for replacement of warrantable parts or components as determined by Harriston. Exclusions to the warranty include normal wear items and the following parts: tires, planter picks, and accessories installed which are not of Harriston's manufacture. No warranty is extended to paint and regular service items such as lubricants. All warranty work must be done by an authorized Harriston dealer.

The Warranty is void if the product has been subjected to abuse, misuse, misapplication, neglect (including but not limited to improper maintenance), accident, submersion, improper installation, modification (including but not limited to use of unauthorized parts), and improper adjustment or repair. Component parts furnished with Harriston products which are not manufactured by Harriston are not warranted by Harriston, but are warranted according to the manufacturer of the component part.

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED OR IMPLIED WARRANTIES. IMPLIED WARRANTIES INCLUDING THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO A PERIOD OF ONE YEAR. Under no circumstances shall Harriston be obligated for incidental or consequential damages. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state and country to country. Some states and countries do not allow the exclusion or limitation of incidental or consequential damages, so certain limitations or exclusions under this warranty may not apply to you.

It is expressly understood that the liability of Harriston for its products, whether due to breach of warranty, negligence, strict liability, or otherwise, is limited to the furnishing or repair of such replacement parts. Harriston is not liable for any other injury, loss, damage, or expense, whether direct or consequential, including but not limited to loss of use, income, profit, or increased cost of operation.

Any operation prohibited in the Operator's Manual or any other manuals furnished with the product, or any adjustment or assembly procedure not recommended or authorized in the operating or service instructions shall void such warranty.

No one is authorized to modify this warranty or to make additional warranties on behalf of Harriston. Harriston reserves the right to change, modify, or improve its products without obligation to retrofit existing models.

Harriston is not liable for any accidents or damage which may occur from the operation of its equipment. The purchaser assumes all responsibility for proper use, care, maintenance, and safe operation.

This warranty is void if the signed warranty registration form is not returned to Harriston within 30 days of purchase or if serial number has been removed or altered in any way.

Service parts sold and distributed by Harriston carry a 90 day warranty from date of sale.

All warranty claims should be made through the dealer it was purchased from and proof of serial number and purchase date must be provided when the warranty claim is made. All warranty claims must be preauthorized by Harriston.

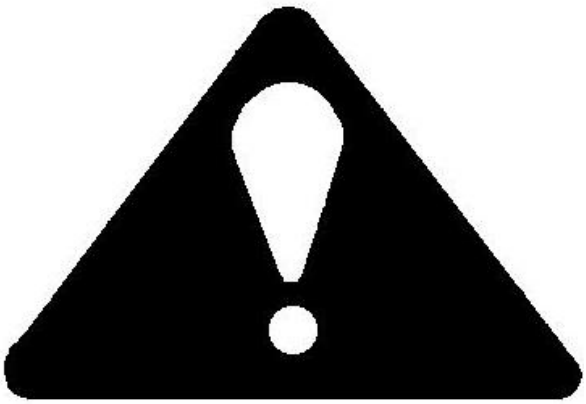
Warranty void if product is not registered

2 SAFETY

SAFETY ALERT SYMBOL

This Safety Alert symbol means **ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!**

The Safety Alert symbol identifies important safety messages on the Harriston Planter and in the manual. When you see this symbol, be alert to the possibility of personal injury or death. Follow the instructions in the safety message.



SIGNAL WORDS:

Note the use of the signal words **DANGER**, **WARNING**, AND **CAUTION** with the safety messages. The appropriate signal word for each message has been selected using the following guidelines:

DANGER - An immediate and specific hazard which WILL result in severe personal injury or death if the proper precautions are not taken.

3 Big Reasons

Accidents Disable and Kill

Accidents Cost

Accidents Can Be Avoided

WARNING - A specific hazard or unsafe practice which COULD result in severe personal injury or death if proper precautions are not taken.

CAUTION - Unsafe practices which could result in personal injury if proper practices are not taken, or as a reminder of good safety

2.1 OPERATING SAFETY

1. Read and understand the Operator's Manual and all safety signs before operating, servicing, adjusting, repairing, unplugging, or filling.
2. Do not allow riders.
3. Install and secure all guards and shields before starting or operating.
4. Keep hands, feet, hair, and clothing away from moving parts.
5. 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 filling.
6. Place all tractor controls in neutral before starting.
7. Operate machine only while seated on the tractor seat.
8. Clear the area of bystanders, especially small children, before starting.
9. Keep all hydraulic lines, fittings, and couplers tight and free of leaks before using.
10. Clean reflectors, slow moving vehicle sign, and lights before transporting.
11. Add extra lights and use pilot vehicle when transporting during times of limited visibility.
12. Use hazard flashers on tractor when transporting.
13. Install safety chain when attaching to tractor.
14. Follow chemical manufacturers' handling and safety instructions exactly when using chemicals with machine.
15. Review safety instructions with all operators annually.

2.2 MAINTENANCE SAFETY

Follow all the operating, maintenance, and safety information in the manual.

Support the machine with blocks or safety stands when changing tires or working beneath it.

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 filling.

Make sure all guards are in place and properly secured when maintenance work is completed.

Never wear ill-fitting, baggy, or frayed clothing when working around or on any of the drive system components.

Before applying pressure to a hydraulic system, make sure all lines, fittings, and couplers are tight and in good condition.

Install safety rod and pin securely in position on hitch cylinder frame before working under frame.

Relieve pressure from hydraulic circuit before servicing or disconnecting from tractor.

Keep hands, feet, hair, and clothing away from moving or rotating parts.

Clear the area of bystanders, especially small children, when carrying out any maintenance and repairs or making adjustments.

Wear appropriate protective gear when contacting chemical handling components on machine.

SAFETY

YOU are responsible for the SAFE operation and maintenance of your Harriston Potato Planter. **YOU** must ensure that you and anyone else who is going to operate, maintain, or work around the Planter be familiar with the operating and maintenance procedures and related SAFETY information contained in this manual. This manual will take you step-by-step through your working day and alerts you to all good safety practices that should be adhered to while operating the planter.

Remember, **YOU** are the key to safety. Good safety practices not only protect you but also the people around you. Make these practices a working part of your safety program. Be certain that **EVERYONE** operating this equipment is familiar with the recommended operating and maintenance procedures and follows all the safety precautions. Most accidents can be prevented. Do not risk injury by ignoring good safety practices.

Planter owners must give operating instructions to operators or employees before allowing them to operate the planter, and at least annually thereafter per OSHA (Occupational Safety and Health Administration) regulation 1928.57.

The most important safety device on this equipment is a SAFE operator. It is the operator's responsibility to read and understand ALL safety and operating instructions in the manual and to follow them. Most accidents can be avoided.

A person who has not read and understood all operating and safety instructions is not qualified to operate the machine. An untrained operator exposes himself and bystanders to possible serious injury or death.

Do not modify the equipment in any way. Unauthorized modification may impair the function and/or safety and could affect the life of the equipment.

Think SAFETY! Work SAFELY!

2.3 GENERAL SAFETY

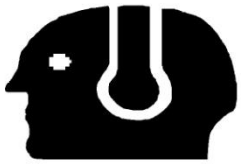
1. Read and understand the Operator's Manual and all safety signs before operating, maintaining, or adjusting the planter.

2. Provide a first-aid kit for use in case of an accident. Store in a highly visible place.

3. Provide a fire extinguisher for use in case of an accident. Store in a highly visible place.

4. Wear appropriate protective gear. This list includes, but is not limited to:
   A hard hat
   Protective shoes with slip resistant soles
   Protective glasses or goggles
   Heavy gloves
   Wet weather gear
   Hearing protection
   Respirator or filter mask

5. Install and secure all guards before starting.
6. Do not allow riders.
7. Wear suitable ear protection for prolonged exposure to excessive noise.



8. 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, or unplugging.
9. Clear the area of people, especially small children, before starting the unit.
10. Review safety related items annually with all personnel who will be operating or maintaining the planter.

2.4 CHEMICAL SAFETY

1. Some agricultural chemicals are among the most toxic substances known to man. Minute quantities can contaminate clothing, machinery, the workplace, and the environment. Follow the chemical manufacturers' instructions exactly. Death can result from their improper use.

2. Misuse, including excessive rates, uneven application, and label violations, can cause injury to crops, livestock, people, and the environment.

3. Do not breathe, touch, or ingest chemicals or the dust. Always wear protective clothing and follow safe handling procedures.

4. Follow the manufacturers' instructions for chemical storage. Avoid unnecessary storage by purchasing only the quantity needed for the crop year.

5. Keep all chemicals out of the reach of children and away from livestock and animals.

6. Store chemicals only in their original containers in a locked area.

7. Check with local authorities regarding the disposal of small quantities of chemicals, chemical containers and wash water.

8. Do not burn the containers or leave them lying in the field or ditches. Take them to your local container disposal site.

9. Wash thoroughly before eating. Use detergent to remove all chemical residue. Rinse carefully and dry with disposable towels.

10. Do not eat in the field where chemicals are being applied.

11. In case of chemical poisoning, get immediate medical attention.

12. Know the Poison Control Emergency telephone number for your area before using agricultural chemicals.

United States – 1-800-222-1222
Alberta – 1-800-332-1414
Manitoba – (204)-787-2591
Ottawa – 1-800-267-1373

13. Thoroughly wash clothing and equipment contaminated by chemicals.

14. Wash the applicators immediately after field work. Dispose of wash water in an environmentally safe manner. Wash water can contaminate the soil or a clean water supply.

2.5 HYDRAULIC SAFETY

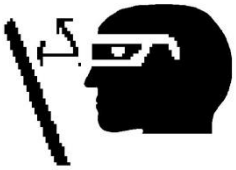
1. Make sure that all components in the hydraulic system are kept in good condition and are clean.

2. Replace any worn, cut, abraded, flattened, or crimped hoses and metal lines.

3. Do not attempt any makeshift repairs to the hydraulic lines, fittings, or hoses by using tape clamps, or cements. The hydraulic system operates under extremely high pressure. Such repairs will fail suddenly and create a hazardous and unsafe condition.

4. Wear proper hand and eye protection when searching for a high-pressure hydraulic leak. Use a piece of wood or cardboard as a backstop instead of hands to isolate and identify a leak.

5. If injured by a concentrated high-pressure stream of hydraulic fluid, seek medical attention immediately. Serious infection or toxic reaction can develop from hydraulic fluid piercing the skin surface.



6. Before applying pressure to the system, make sure all components are tight and that lines, hoses, and couplings are not damaged.

2.6 TRANSPORT SAFETY

1. Make sure you are in compliance with all local regulations regarding transporting equipment on public roads and highways.

2. Make sure the SMV (Slow Moving Vehicle) emblem and all the lights and reflectors that are required by the local highway and transport authorities are in place, are clean, and can be seen clearly by all overtaking and oncoming traffic.

3. Do not allow anyone to ride on the planter or tractor during transport.

4. Do not exceed 20 mph (32 km/h). Reduce speed on rough roads and surfaces.

5. Do not transport with a full seed or fertilizer tank.

2.7 Storage Safety

1. Store away from areas of human activity. Do not permit children to play on or around the stored machine.

2. Make sure the unit is sitting, or blocked up firm and solid and will not tip or sink into a soft area.

3. Cover with a weather - proof tarpaulin and tie down securely.

2.8 Tire Safety

1. Failure to follow proper procedures when mounting a tire on a wheel or rim can produce an explosion which may result in serious injury or death.

2. Do not attempt to mount a tire unless you have the proper equipment and experience to do the job.

3. Have a qualified tire dealer or repair service perform required tire maintenance.

2.9 Assembly Safety

1. Assemble in an area with sufficient space to handle the largest component and access to all sides of machine.

2. Use only lifts, cranes, jacks, and tools, with sufficient capacity for the load.

3. Use two people to handle the large bulky components.

4. Do not allow spectators in the working area.

2.10 Safety Decals

1. Keep safety decals and signs clean and legible at all times.

2. Replace safety decals and signs that are missing or have become illegible.

3. Replaced parts that displayed a safety sign should also display the current sign.

4. Safety decals or signs are available from your Dealer Parts Department.

How to Install Safety Decals:

1. Be sure that the installation area is clean and dry.

2. Decide on the exact position before you remove the backing paper.

3. Remove the smallest portion of the split backing paper.

4. Align the decal over the specified area and carefully press the small portion with the exposed sticky backing in place.

5. Slowly peel back the remaining paper and carefully smooth the remaining portion of the decal in place.

6. Small air pockets can be pierced with a pin and smoothed out using the piece of decal backing paper.

2.11 SIGN-OFF FORM

Harriston Industries follows the general Safety Standards specified by the American Society of Agricultural Engineers (ASAE) and the Occupational Safety and Health Administration (OSHA). Anyone who will be operating and/or maintaining the Potato Planter must read and clearly understand ALL Safety, Operating, and Maintenance information presented in this manual.

Do not operate or allow anyone else to operate this equipment until such information has been reviewed. Annually review this information before the season start-up.

Make these periodic reviews of Safety and Operation a standard practice for all of your equipment. We feel that an untrained operator is unqualified to operate this machine.

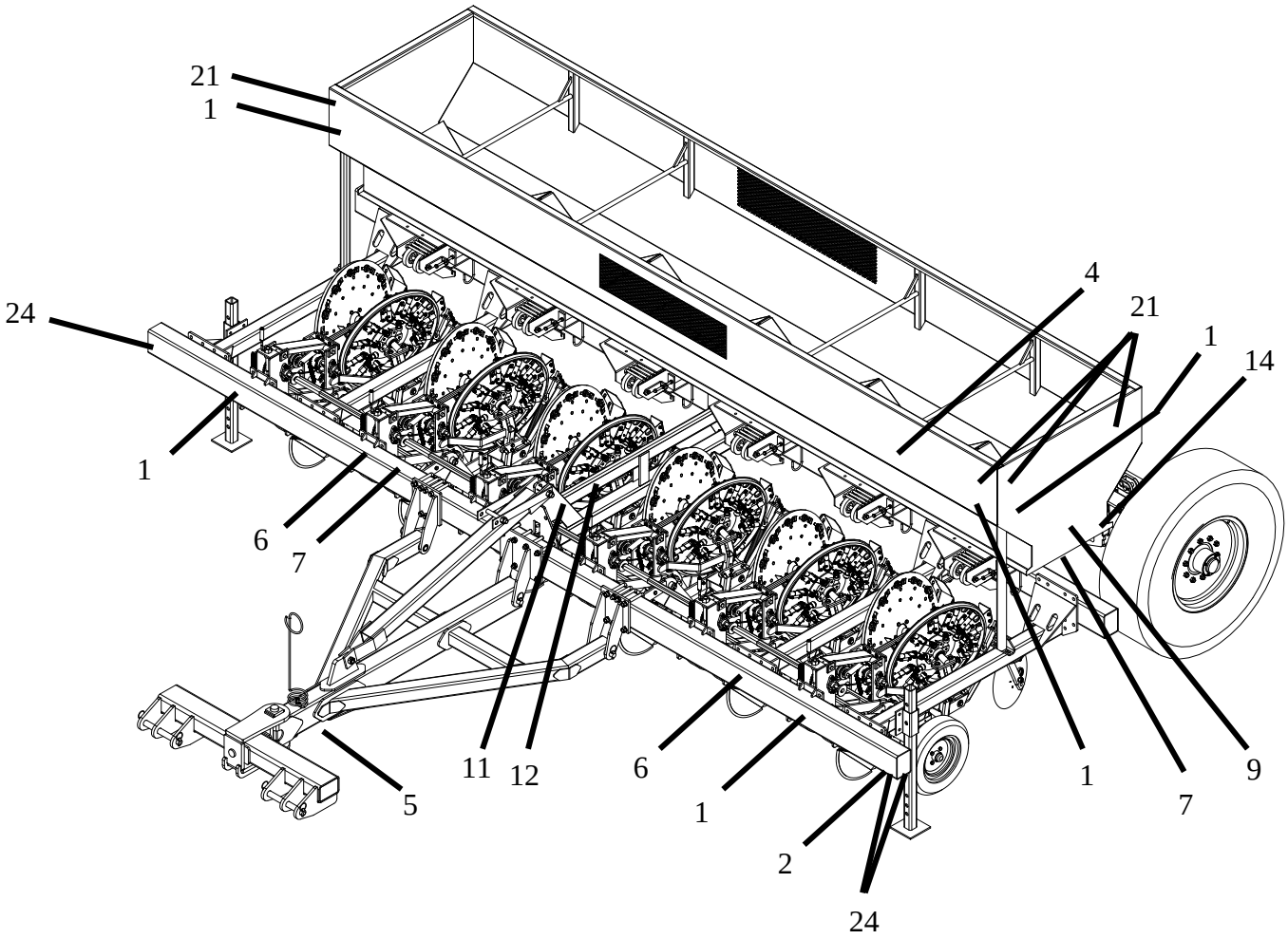
A sign-off sheet is provided for your record keeping to show that all personnel who will be working with the equipment have read and understand the information in the Operator's Manual and have been instructed in the operation of the equipment.

SIGN OFF FORM

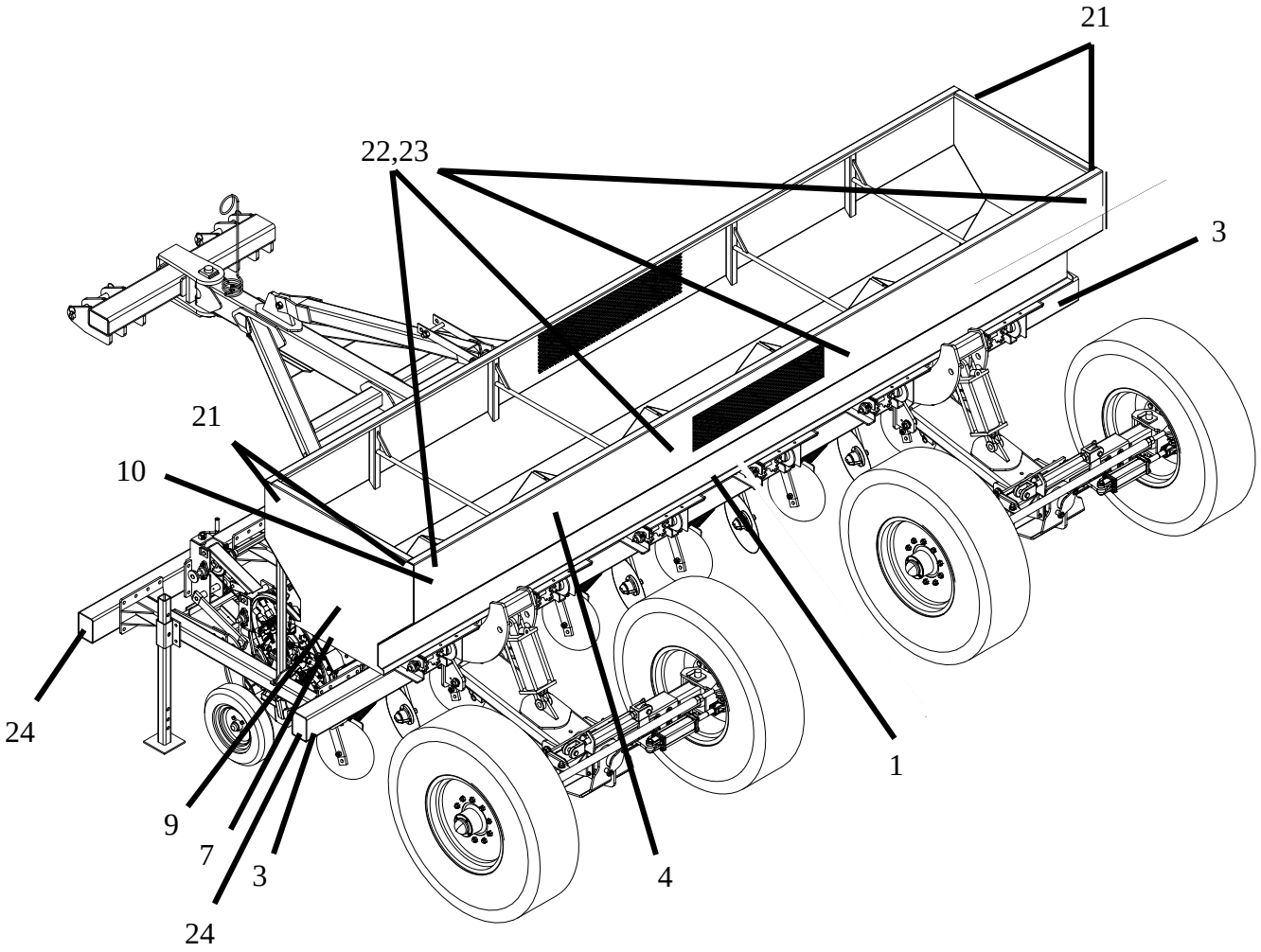
Date	Employees Signature	Employers Signature

3 SAFETY DECAL LOCATIONS

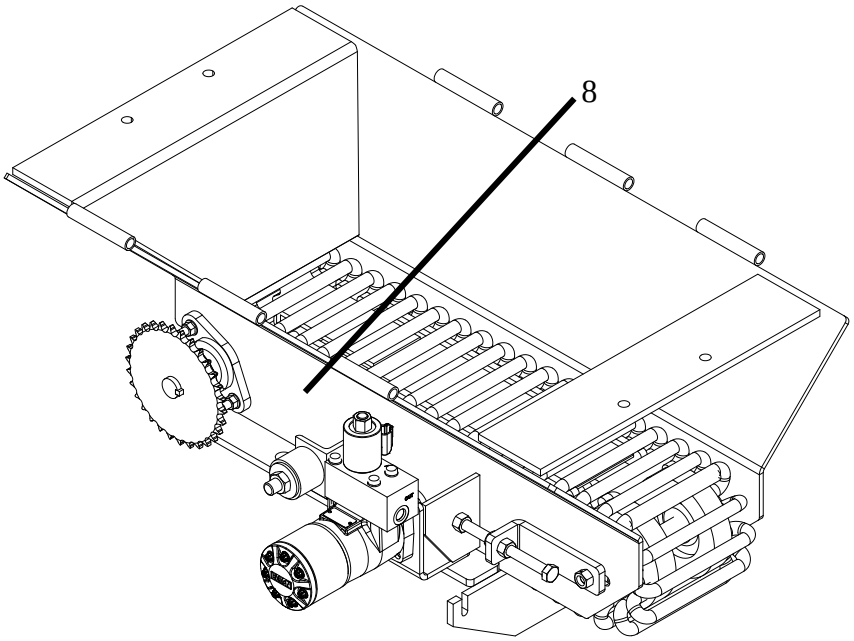
The types of decals and locations on the equipment are shown in the illustration below. Good safety requires that you familiarize yourself with the various safety decals, the type of warning, and the area or particular function related to that area, that requires your SAFETY AWARENESS.

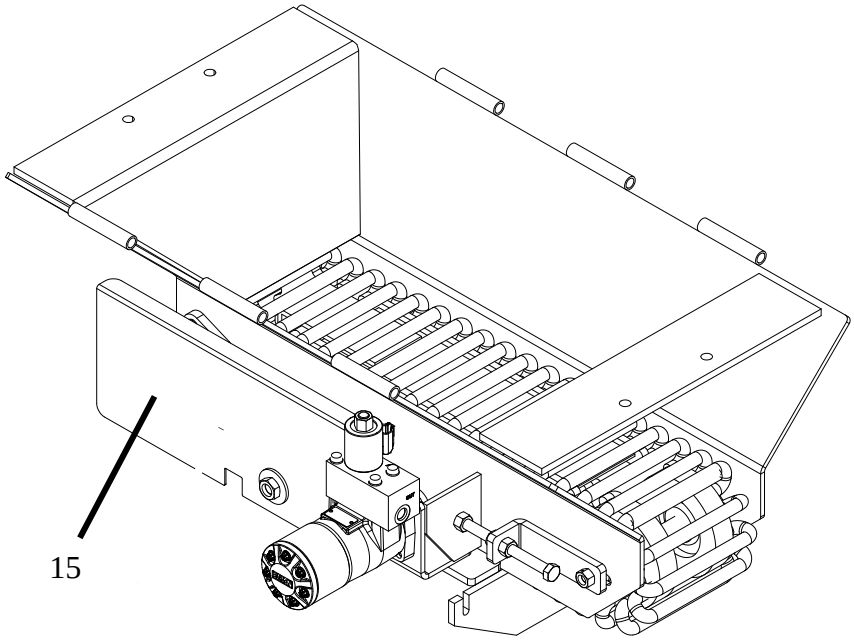


SAFETY DECAL LOCATIONS

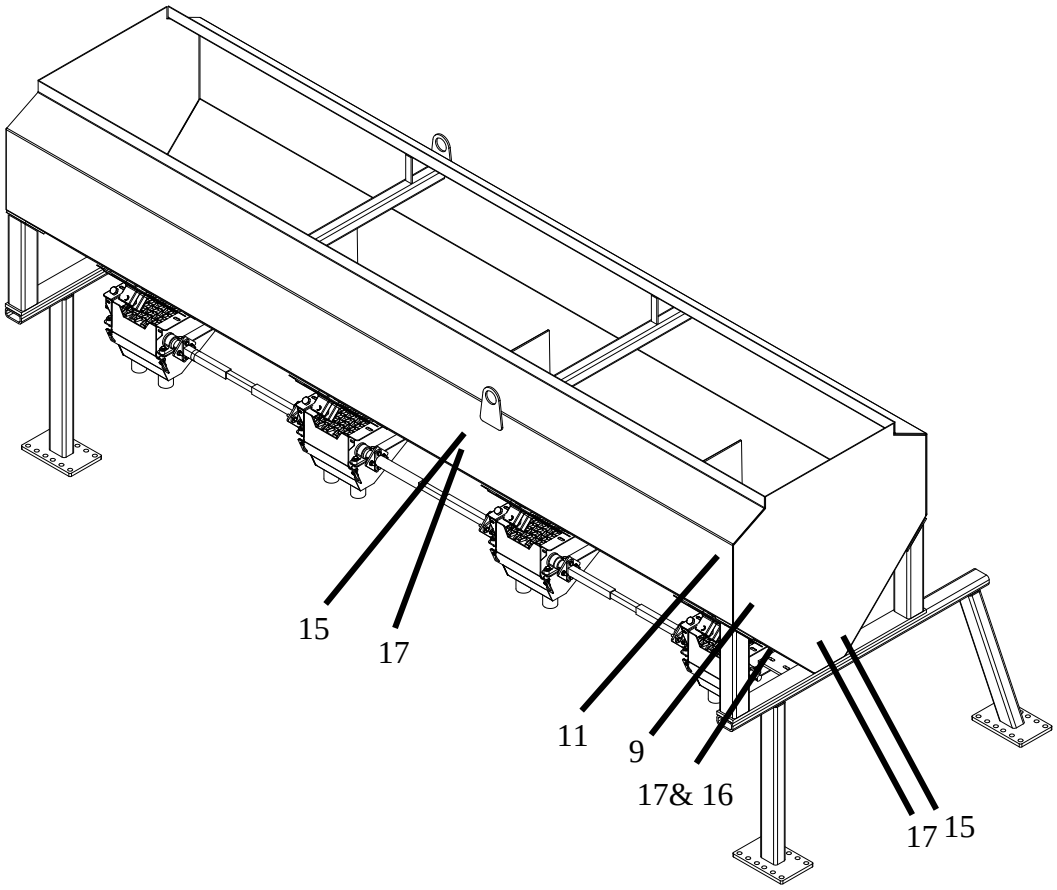


SAFETY DECAL LOCATIONS





SAFETY DECAL LOCATIONS
Fertilizer Attachment



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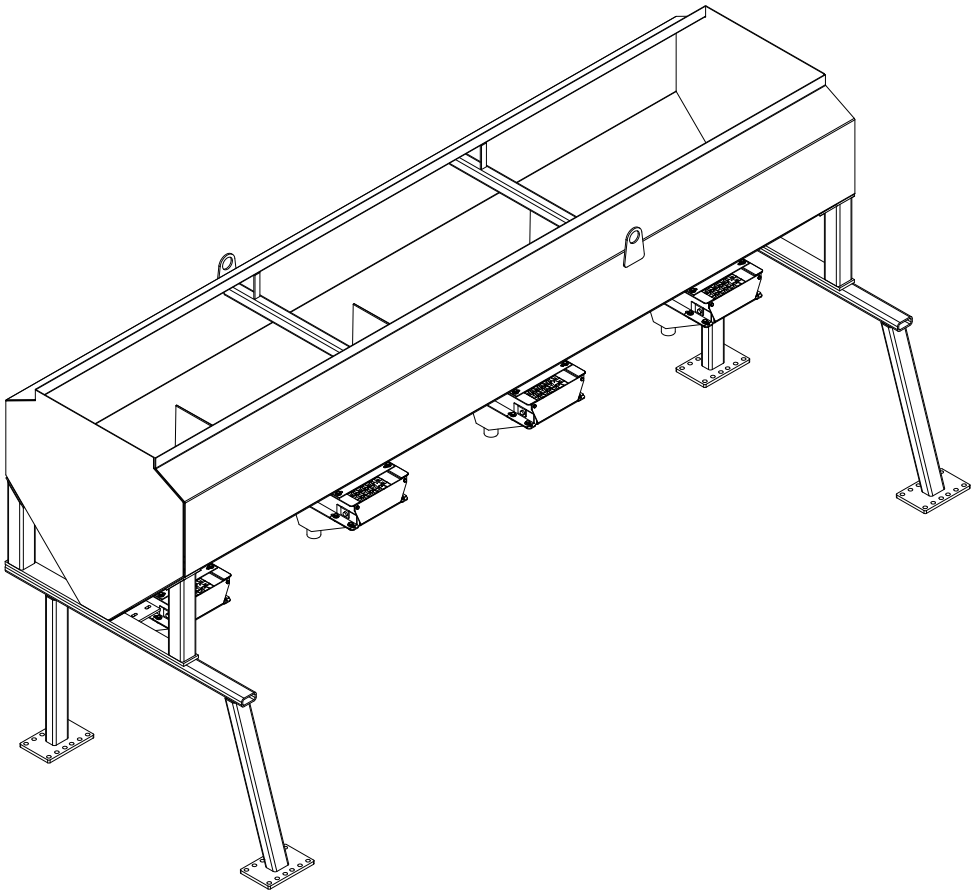

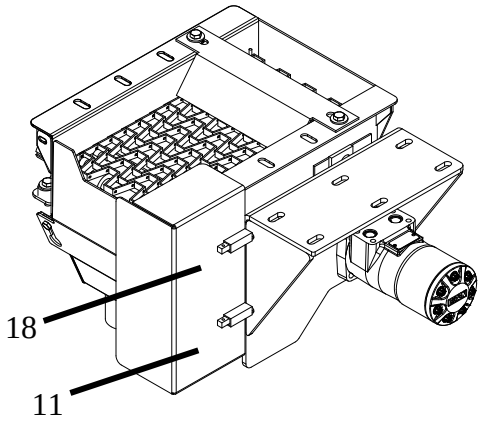

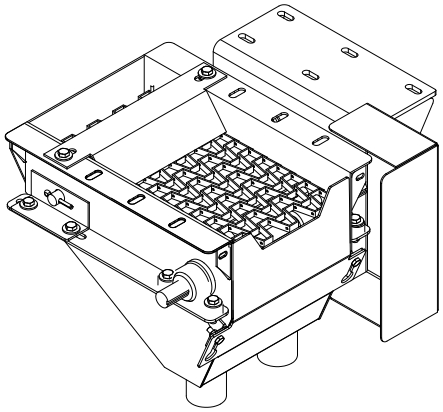

3.1 SAFETY DECALS

The types of decals and locations on the equipment are shown in the illustration below. Good safety requires that you familiarize yourself with the various Safety Decals, the type of warning, and the area or particular function related to that area, that requires your SAFETY AWARENESS.

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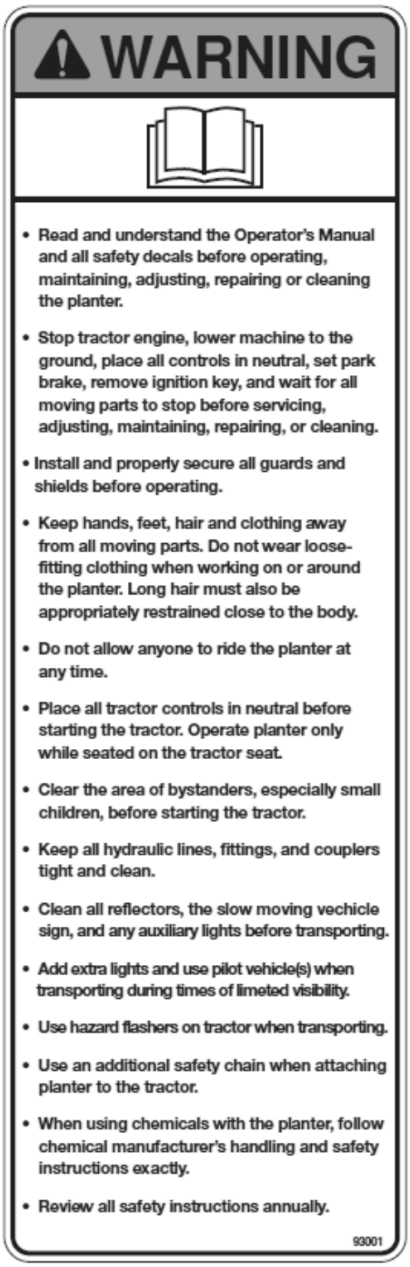

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REMEMBER - If Safety Decals have been damaged, removed, become illegible, or parts replaced without decals, new decals must be applied. New decals are available from your authorized dealer.

The types of decals and locations on the equipment are shown in the illustration below. Good safety requires that you familiarize yourself with the various Safety Decals, the type of warning, and the area, or particular function related to that area, that requires your SAFETY AWARENESS

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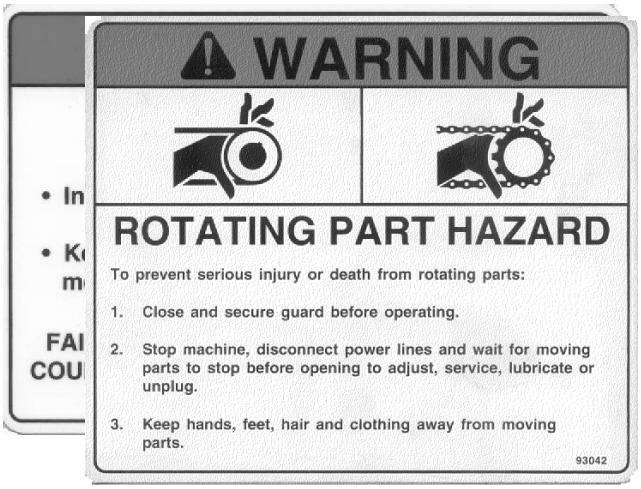

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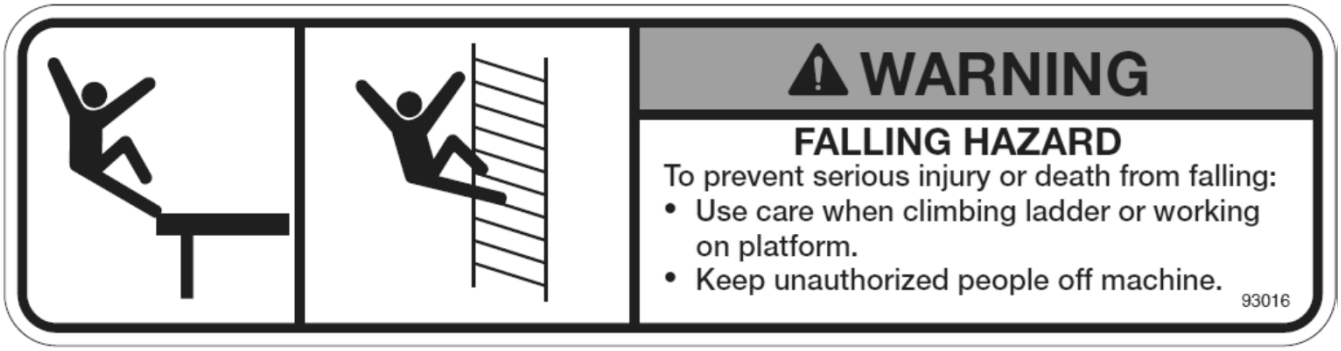

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1	093006	Warning Falling Hazard
2	080021	Decal Yellow Reflector
3	080020	Decal Red Reflector
4	093057	Decal Harriston Large
5	093001	Decal Caution (Hitch)
6	093052	Decal Attention Check Torque
7	093056	Decal Made with Pride
8	093003	Decal Missing Shield
9	093055	Decal Harriston Quality
10	093058	Decal Slow Moving Sign
11	093005	Decal Warning High Pressure
12	093020	Attention Alteration to Hydraulic
13	093016	Decal Warning Falling Hazard Small
14	093009	Serial Number Plate
15	093002	Warning Rotating Parts
16	093004	Danger Toxic Chemical
17	093018	Warning – Empty Seed Tank for Transport
18	093019	Warning – Rotating Parts Hazard
19	093023	Notice : Minimize Corrosion
20	093014	Warning Frame Pinch Point
21	097442	Decal Long Amber
22	097443	Decal Long Blaze Orange
23	097441	Decal Long Red
24	N/A	Decal Short Amber

4 OPERATION

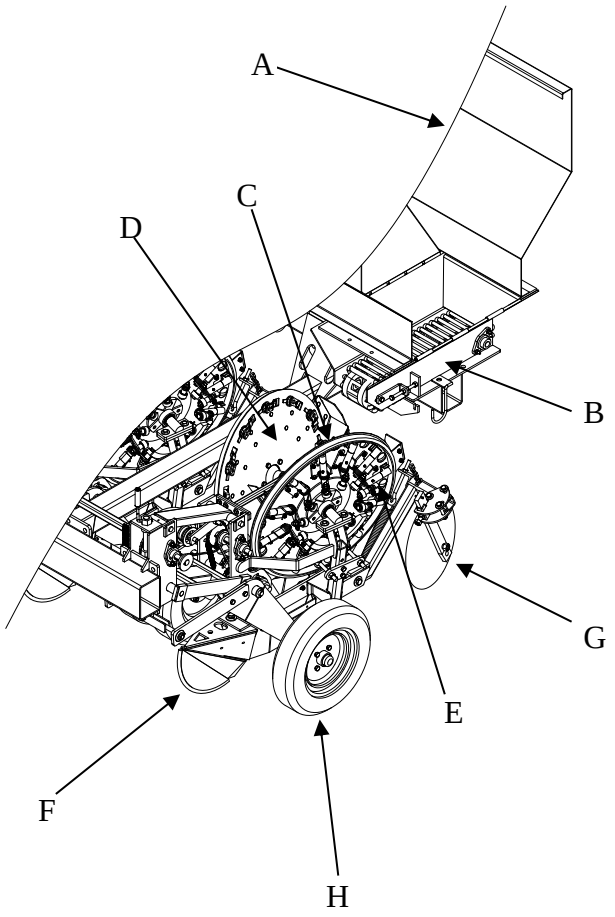
1. Read and understand the Operator's Manual and all safety signs before operating, servicing, adjusting, repairing, unplugging, or filling.
2. Do not allow riders.
3. Install and secure all guards and shields before starting or operating.
4. Keep hands, feet, hair, and clothing away from moving parts.
5. 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 filling.
6. Place all tractor controls in neutral before starting.
7. Operate machine only while seated on the tractor seat.
8. Clear the area of bystanders, especially small children, before starting.
9. Keep all hydraulic lines, fittings, and couplers tight and free of leaks before using.
10. Clean reflectors, SMV, and lights before transporting.
11. Add extra lights and use pilot vehicle when transporting during times of limited visibility.
12. Use hazard flashers on tractor when transporting.
13. Install safety chain when attaching to tractor.
14. Follow chemical manufacturers' handling and safety instructions exactly when using chemicals with machine.
15. Review safety instructions with all operators annually.

4.1 To the New Operator or Owner

Harriston Potato Planters are designed to quickly and efficiently plant potatoes with almost any row spacing and in a variety of seed placement spacings. The hydraulic drive ensures accurate placement of seed at any reasonable speed.

Many features incorporated into this machine are the result of suggestions made by customers like you. Read this manual carefully to learn how to operate the machine safely and to set it to provide maximum field efficiency. By following the operating instructions in conjunction with a good maintenance program, your planter will provide many years of trouble-free service.

4.2 PRINCIPLE COMPONENTS



The Harriston potato planter uses a large hopper (A) to carry cut potatoes over the field for planting. A small hydraulically powered feed chain (B) moves the seed into the seed bowl (C) next to the planting wheels (D). An electrical sensor in the bowl activates the potato chain when more seed is required.

The hydraulic system drive's the planting wheels through a series of chains and sprockets used to set the spacing between each plant. A series of spring-loaded clamps (E) select a potato as it moves through the bowl. As the wheels (D) turn, the clamps are pulled back when they contact a cam on the first portion of the arc. The potato is released and drops into the ground.

The shoe (F) ahead of the planting wheel opens the ground to receive the seed. Discs (G), behind the row unit, close the seedbed and start the hilling process.

Adjustable gauge wheels (H) allow the operator to set the depth of the seed.

Before starting to work, all operators should familiarize themselves with the location and function of the controls on the planter and tractor.

The Harriston Planter is offered with our Harriston drive specifically designed to operate any of our planters.

ALL ELECTRICAL CONNECTIONS MUST BE MADE DIRECTLY TO THE BATTERY WITH 'CLEAN' LEADS. GROUND WIRE MUST BE FREE FROM CORROSION

ANY SYSTEM MALFUNCTIONS CAUSED BY CONNECTION OF ELECTRICAL LEADS TO ANY OTHER POWER SOURCE WILL NOT BE COVERED BY HARRISTON INDUSTRIES

4.3 PRE-START AND BREAK IN

Although there are no operational restrictions on the planter when it is used for the first time, it is recommended that the following mechanical items be checked.

PRE-START INSPECTION

1. Read the Operator's Manual
2. Tighten wheel bolts to 140 ft-lbs (24 N.m) torque
3. Check that tires are inflated to their specified pressure.
4. Check that the hydraulic lines and electrical harness are routed where they will not contact moving parts. Be sure all components are clipped, taped, or tied securely in place.
5. Check that all guards are installed and secured.
6. Tighten all mounting bolts on rear ladder and loading platform if so equipped.
7. Check that all picks are in place and straight. Install or straighten as required.
8. Rotate each seed wheel to be sure that the overrunning clutch and drives are functioning properly. Lubricate or adjust as required.
9. Check that all required nuts and bolts are installed and tightened to their specified torque.
10. Lubricate the machine.

AFTER OPERATING FOR 2 HOURS

1. Re-torque all wheel bolts.
2. Check tire pressure.
3. Re-torque all other fasteners and hardware.
4. Check that no hoses are being pinched, crimped, or are rubbing. Reroute as required.
5. Check that the wiring harness is not being pinched, crimped, or rubbing. Reroute as required.
6. Check the tension and alignment of all drive and feed chains. Adjust as required.
7. Check the condition of the clamps on each wheel. Replace or straighten as required.
8. Lubricate the machine.

AFTER OPERATING FOR 10 HOURS

1. Re-torque all wheel bolts.
2. Re-torque all fasteners and hardware.
3. Check the routing of hydraulic lines and the wiring harness. Reroute as required to prevent pinching, crimping, binding or rubbing.
4. Check the tension and alignment of all drive and conveyor chains. Adjust as required.
5. Check the condition of the clamps on each wheel. Replace or straighten as required.
6. Go to the normal Service and Maintenance schedule.

RE-TORQUE WHEEL BOLTS EVERY 50 HOURS.

4.4 PRE OPERATION CHECKLIST

Efficient and safe operation of the Harriston planter requires that each operator reads and understands the operating procedures and all related safety precautions outlined in this section. A pre-operation checklist is provided for the operator. It is important for both personal safety and maintaining the good mechanical condition of the machine that this checklist is followed.

Before operating the planter and each time thereafter, the following areas should be checked:

1. Lubricate the machine per the schedule outlined in the Maintenance Section.
2. Check the drives for entangled material.
3. Check that the clamps are not broken or bent. Replace or straighten as required.
4. Check the chains and sprockets for proper tension and alignment. Adjust as required.
5. Ensure that all bearings turn freely.
6. Make sure all guards and shields are in place secured, and functioning as designed.
7. Check that all hydraulic fittings and connections are tight and in good condition

4.5 EQUIPMENT MATCHING

The Harriston potato planter was designed to be used on large 2-wheel drive or front wheel assist agricultural tractors. To ensure good field performance, the following list of specifications must be met.:

HYDRAULICS

The towing tractor must be capable of 12 gpm @ 2000 p.s.i. to operate hydraulic drive. Additional
flow must be provided for the following:
Rear Lift (3 gpm)
Markers (2 gpm)
Fertilizer (5 gpm)
Hydraulic Drive (12 gpm)
Air Insecticide (4 gpm)

THREE POINT HITCH

With 2 point semi-mount attaching systems, a Cat III 3 point is recommended.

HORSEPOWER REQUIREMENTS

	Level, Firm Soil	Rolling, Soft Soil	3 Point Lift Cap.
4 Row	90 HP	110 HP	6000 LBS.
4 Row W/ FERT.	110 HP	130 HP	8500 LBS.
6 Row	140 HP	160 HP	8000 LBS.
6 Row W/ FERT.	160 HP	180 HP	11000 LBS.
8 Row	165 HP	200 HP	10000 LBS.

TIRE CONFIGURATION

It is recommended that a tire width be used on the tractor that will allow the tire footprint to fit between the rows being planted. The row spacing of the Planter can be adjusted. Tires that are too wide for the available space will compact the seedbed and affect plant growth.

TRACTOR WEIGHT

By following the recommendations for tractor power, the tractor will have sufficient weight to provide stability for the unit during field operations or transporting. It is also recommended that each tractor be equipped with a full complement set of suitcase weights on the front of the tractor. This will provide the required weight on the front for turning as well as extra traction if equipped with front wheel assist.

ELECTRICAL

Each machine requires a 12 volt 40 amp power supply to operate the Harriston hydraulic drive system. The switch is routed into the cab for easy access during operation.

4.6 HARRISTON HYDRAULIC CONTROL SYSTEM

The hydraulic drive planter is a single series hydraulic system controlled by an electronic pulse width modulated (PWM) control valve. Hydraulic oil flow and pressure is supplied by the tractor. This valve controls how fast the clamp wheels turn, which in turn, determines seed spacing. The system can be operated with an open or closed tractor hydraulic system.

4.6.1 PRESSURE-FLOW COMPENSATED SYSTEM

Most new tractors use a pressure flow compensated hydraulic system. Flow is adjusted with the tractor flow control. It is recommended that flow be set to deliver only the gallons per minute (g.p.m.) required to operate the planter at the desired rate and speed, usually 10 g.p.m. is sufficient. Excess flow could damage the planter control system. When planting, the pressure will be the tractor operating system pressure (usually 3000 p.s.i.) plus the pressure required to operate the planter. This varies greatly depending on planter size and configuration.

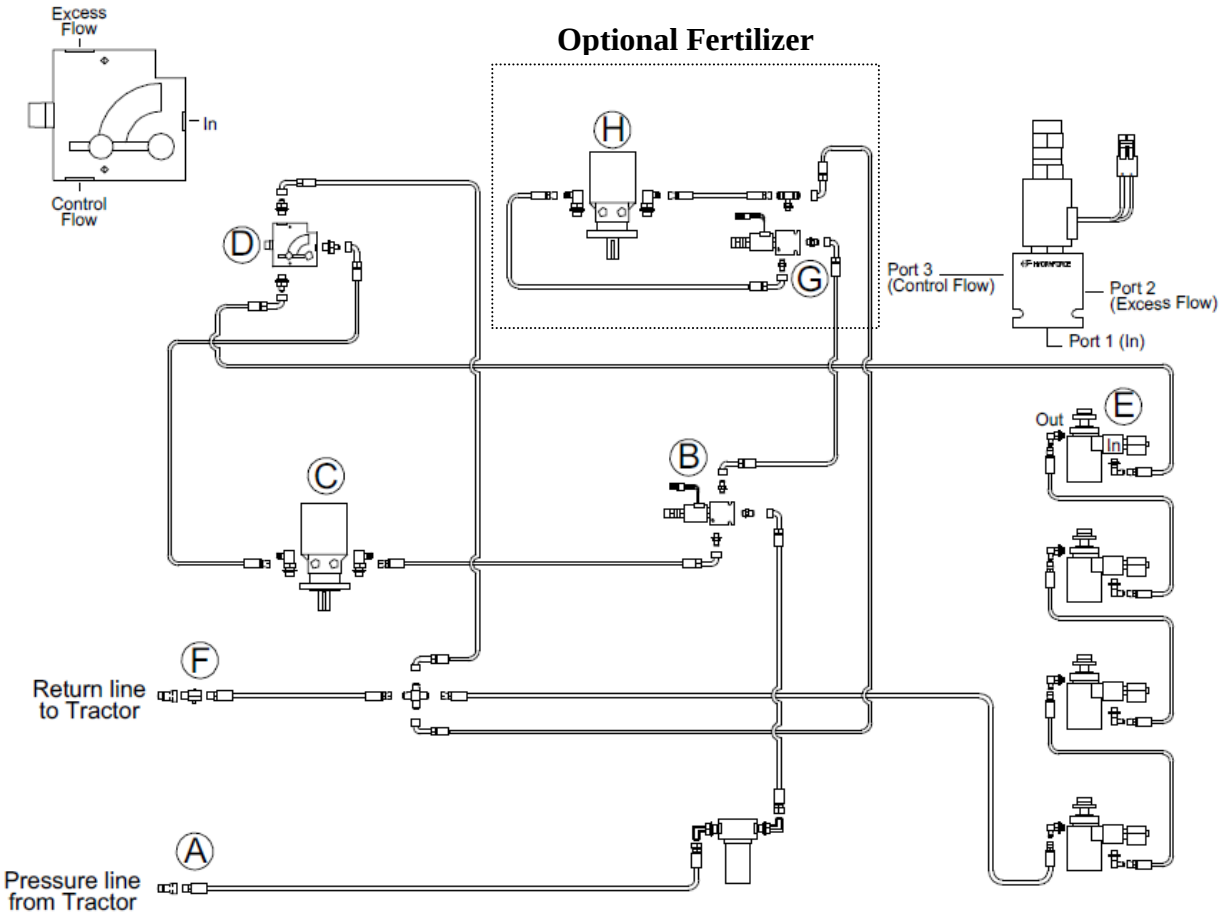
These systems have a very high flow, some in excess of 40 g.p.m. To reduce overheating and possible damage to planter hydraulic system, set the flow to deliver only the g.p.m. to operate the planter. Some compensated hydraulic systems have a pressure-sensing line available as an option. Consult your tractor dealer about this option.

When the planter is not moving, or operating in manual mode, there will be flow and pressure from the tractor (A), but no flow or pressure after the PWM valve (B). When the planter begins to move, (or if you run the planter manually with the radar override), the control console receives a signal from the radar and begins to open the valve. Oil will begin to flow from Port 3 of the valve to the clamp wheel hydraulic motor (C). As the hydraulic motor begins to turn, oil will flow from the motor to the feedbox flow control (D) and on to the feedbox motors (E). Oil returns to the tractor after it flows through the feedbox motors (F). If you have a fertilizer attachment, oil flows from the bypass outlet on the PWM valve for the clamp wheel motor to the PWM valve for the fertilizer attachment (G). It then flows to the fertilizer hydraulic motor (H) & back to the return line to the tractor (F). See Page 24 for more information on motor solenoids / oil flow.

If the feed box motor solenoid is open (potatoes in top height range of sensor), oil will bypass the feedbox motors in the valve block below the solenoid and continue to the other feedbox motors. If the feed box motor solenoid is closed (no potatoes in low height range of sensor), oil will flow through and turn the motor. Any motor that has a closed solenoid will turn as long as the main drive motor is turning. Set the flow control on #2 or #3 when starting. See Page 35 for setting bowl seed level.

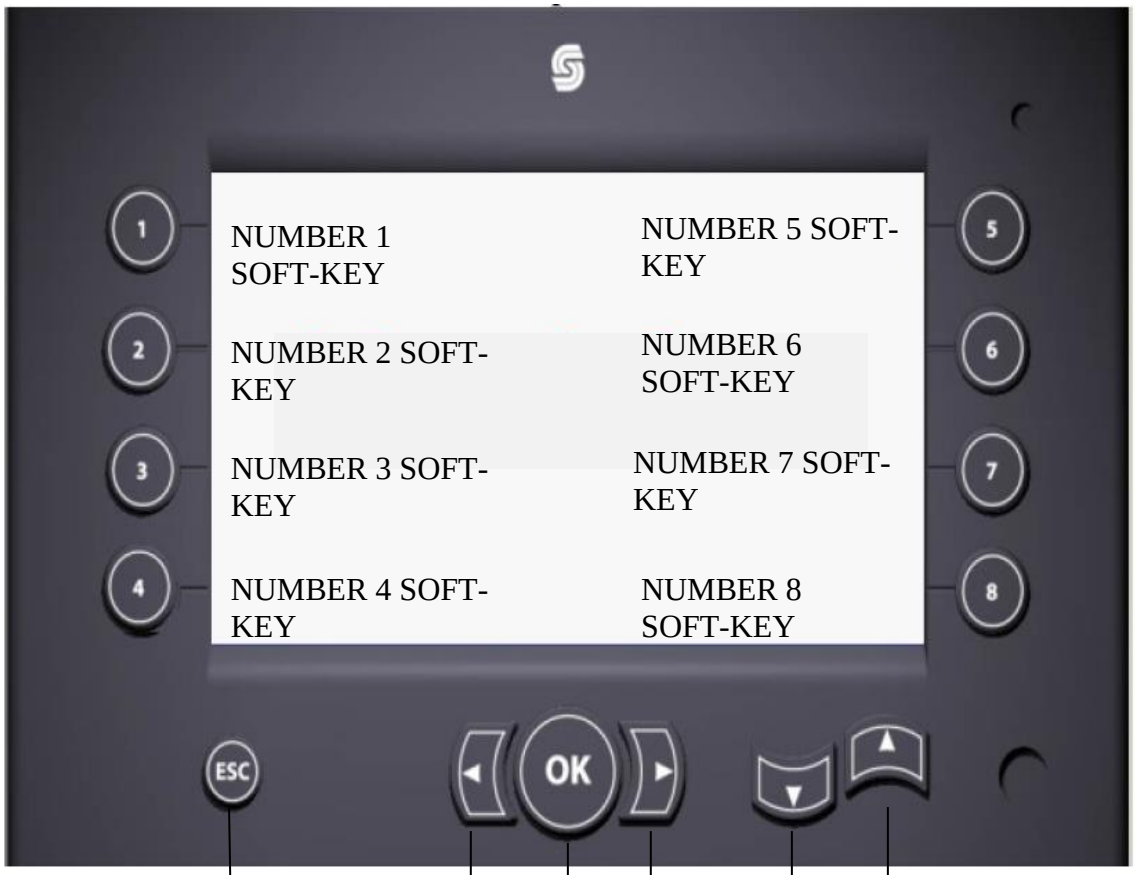
Flow or Gallons Per Minute (G.P.M) is regulated by the tractor flow control. Flow should be set so that sufficient flow is provided to operate planter at the desired planting speed. Usually this will be 12 g.p.m or less. Flow should never be above 12 g.p.m. A check valve is located after the hydraulic tip on the tractor return line to prevent the planter from running in reverse.

4.6.2 Harriston Hydraulic Drive Diagram (with fertilizer)



A—Pressure Line From Tractor
B—Electronic Flow Control (Row Unit Drive)
C—Row Unit Drive Motor
D—Manual Flow Control (Feedbox Drive)
E—Feedbox Drive Motors
F—Return Line to Tractor (w/check valve)
G—Electronic Flow Control (Fertilizer Drive)
H—Fertilizer Drive Motor

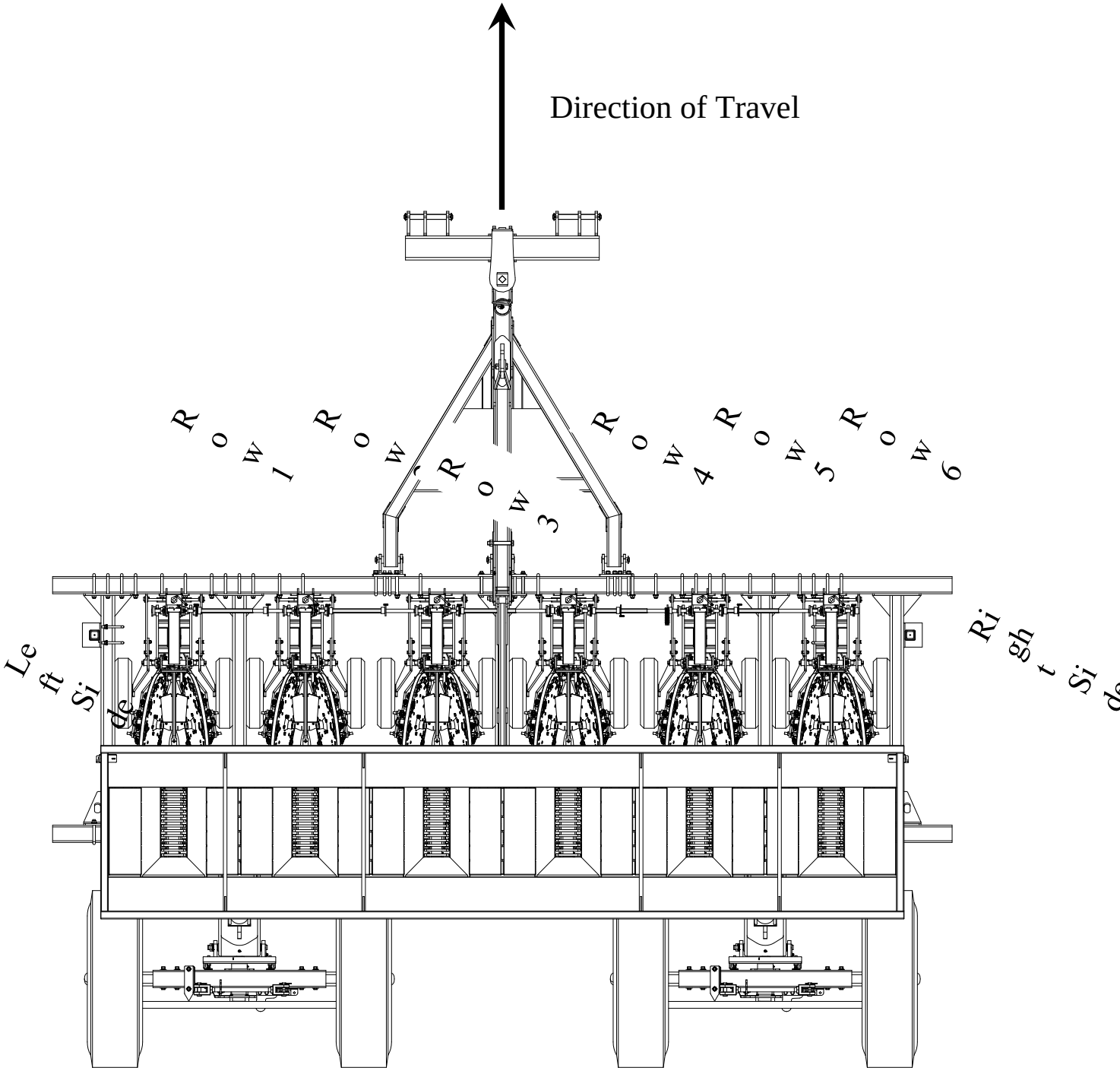
4.6.3 MASTER LIST OF SOFT-KEYS



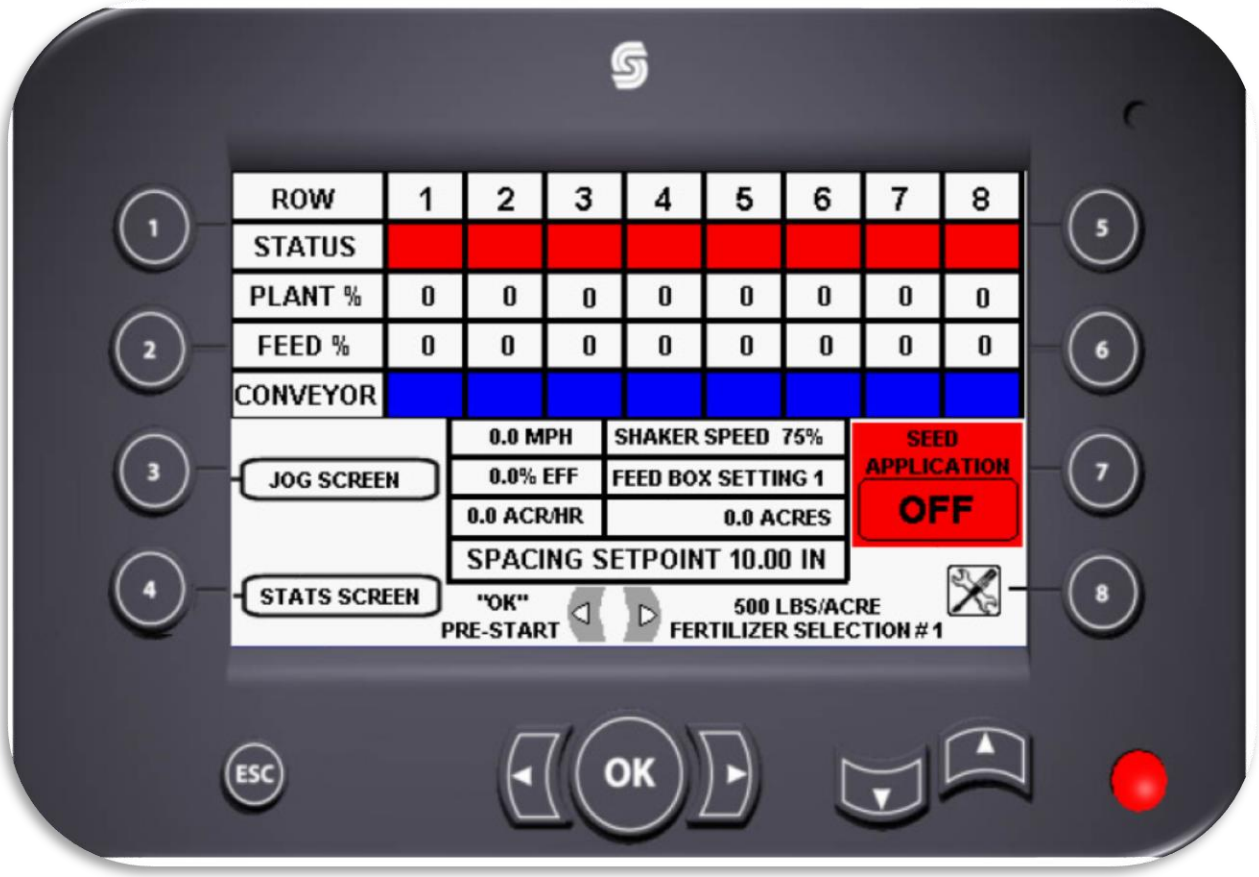
ESC SOFT-KEY
LEFT ARROW SOFT-KEY
OK SOFT-KEY
RIGHT ARROW SOFT-KEY
DOWN ARROW SOFT-KEY
UP ARROW SOFT-KEY

4.6.4 PLANTER VIEW

Row 1 is always orentated on left side of planter when in operation.



4.6.5 MAIN SCREEN



Before the operator starts it is important to remember that if lost anywhere in the computer the ESC soft-key on the monitor always brings the operator back to the main screen.

On this screen the system tracks and displays several important values. The short term planter efficiency for each row that is in use is displayed. With the calculated value the system displays an indicator color. Green indicates good or ok, yellow indicates a warning, and red would be a full out alarm. Underneath the status it shows the short term percentage as well. The feed % shows the percentage of time that the feed chains are running, and conveyor tells when the feed chain is on and when it is off. The blue indicator color means the chain is not running and when it is running it will change to orange. It also shows speed, percent of efficiency, acres per hour, shaker speed percent, feed box setting, acres planted and seed spacing. Also some of the soft-keys are used on this screen as well. The number 3 soft-key takes the operator to the Jog screen. The number 4 soft-key takes the operator to a stats screen. The OK soft-key will start the fertilizer pre-start (if so equipped). The Left and Right soft-keys allows the operator to change the amount of fertilizer between 3 preset amounts. It can be changed on the go. The number 7 soft-key starts all the functions on the planter. And the number 8 soft-key will allow the operator into all the other set up screens outlined in this manual.

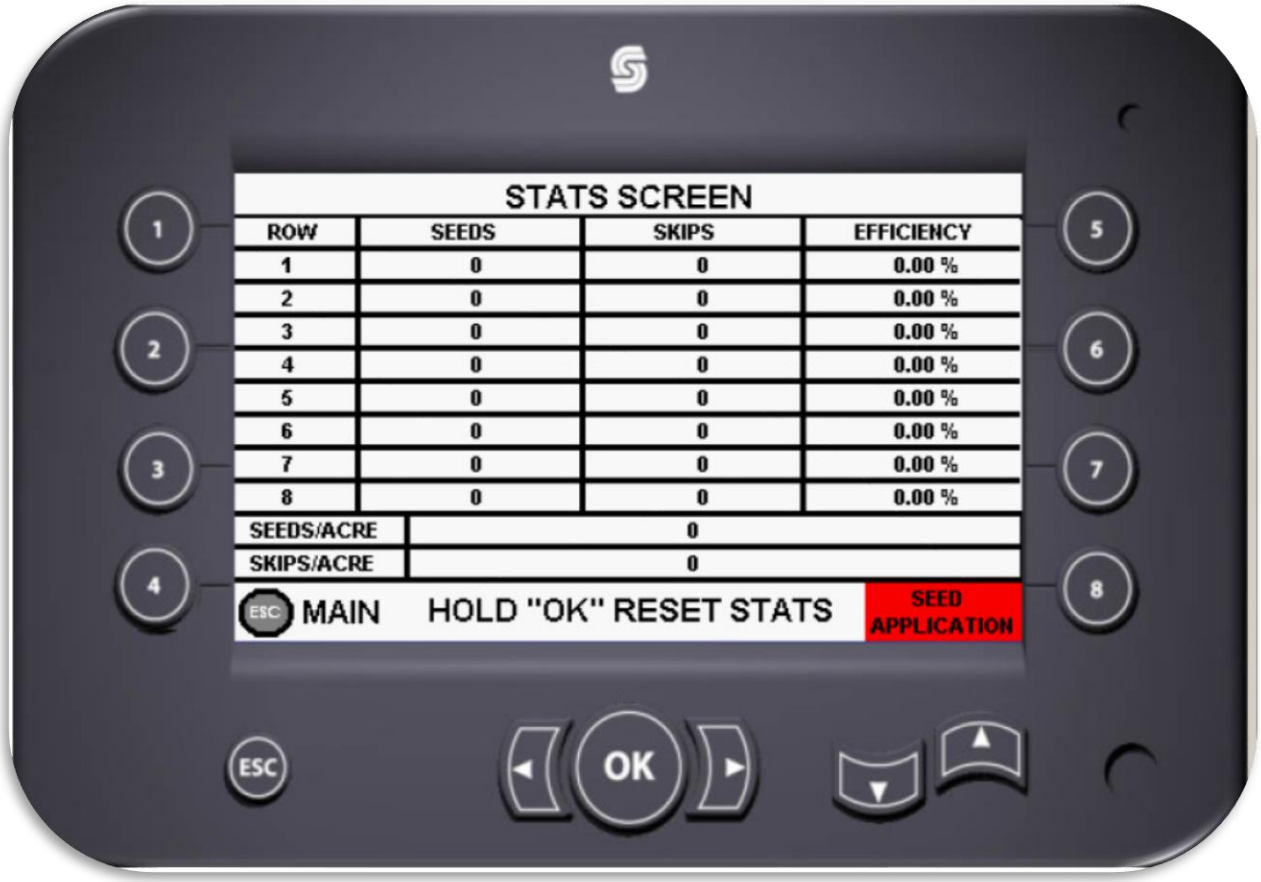
4.6.6 JOG SCREEN

From the main screen, depressing the number 3 soft-key will take the operator to this screen.

This screen allows the operator to fill rows individually in the event there is a malfunction in a single row. If the operator would depress the number 1 soft-key and hold it, only the number 1 feed chain would fill. This would work for soft-keys 1-4. If using a 6 row or an 8 row planter by depressing the OK soft-key the soft-keys 1-4 would change to rows 5 through 8. If the planter has just been filled with seed and there are no seed pieces in the bowl or clamped to the wheels, by depressing the number 5 soft-key the row units and the feed chains would all turn to fill the planter before starting. The number 7 soft-key would start dry fertilizer across all rows. Also, the same goes with the number 8 soft-key if using granular chemical. The up and down soft-keys are for the PWM speed. This is how fast the row unit, fertilizer, and granular would turn, 1 would be the slowest it would move and 10 would be the fastest. The feedbox chains are controlled by a manual flow control valve on the planter near the seed tank on the left side. This has an adjustable rod with settings 1 through 10 to control the speed of the feed chains. After the operator is finished adjusting these functions by depressing the esc key the operator will go back to the main screen.

4.6.7 STATS SCREEN

From the main screen, depressing the 4 soft-key will bring the operator to this screen.



This screen gives the operator a table displaying the stats for each row, total seeds planted, total skips, and efficiency. It also shows total seeds per acre and total skips per acre. By depressing and holding the OK soft-key all stats will reset and the ESC soft-key will bring the operator back to the main screen. Also by depressing the number 5 soft-key on this screen will allow the operator into another stats screen.

STATS SCREEN CONT.

From the main work screen depressing the number 4 soft-key followed by the number 5 soft-key will bring the operator to this screen.

This screen allows the operator to track how many acres the planter has planted. It will keep a running total until the operator resets it by depressing the OK soft-key to reset the counter. Also by depressing the ESC soft-key will bring the operator back to the main work screen.

4.6.8 SETUP SCREEN

From the main screen, depressing the 8 soft-key will bring the operator to this screen.

On this screen the operator can change a number of settings. By depressing the 1 soft-key the operator can choose between standard units or metric units. (Note when metric units are selected everything that was standard will change to metric units.) In the event that your radar would fail, by pressing the number 2 soft-key it will turn the radar override on and allow the operator to plant without radar. To match the desired planting ground speed, the number 3 soft-key will increase the speed and the number 4 soft-key will decrease the speed. Also the operator can use this function to run the planter in place without moving to check planter functions. Remember the speed the operator has chosen in the event of radar failure the operator will have to drive that same speed on the tractor to plant accurately. It should also be displayed on the main screen next to the MPH box. The number 7 soft-key will increase the seed spacing by quarter inch measurements and the number 8 soft-key will decrease seed spacing by quarter inch measurements. By depressing the right soft-key the operator will go into the second setup screen. Also by depressing the OK soft-key it will bring the operator into a password protected screen that will be outlined later in this manual. And the ESC soft-key will bring the operator back to the main screen.

SETUP SCREEN CONT.

From the main screen depress the number 8 soft-key which will bring the operator to setup screen 1. From setup screen 1 depress the right arrow soft-key to bring the operator to this screen.

The number 1 soft-key will increase pounds per acre in preset fertilizer setting 1 by 10 pound increments. By depressing the number 2 soft-key the number will decrease the amount of pounds per acre by 10 pound increments. By depressing and holding any of the numbered soft-keys it will change at a more rapid rate. Also the preset fertilizer settings for 2 and 3 work the same as 1. The granular setting is changed by .1 pounds per acre increments the same as setting the fertilizer settings. The left arrow soft-key will bring the operator to the setup screen 1 and the right arrow soft-key will bring the operator to the next setup screen. The ESC soft-key will bring the operator back to the main screen.

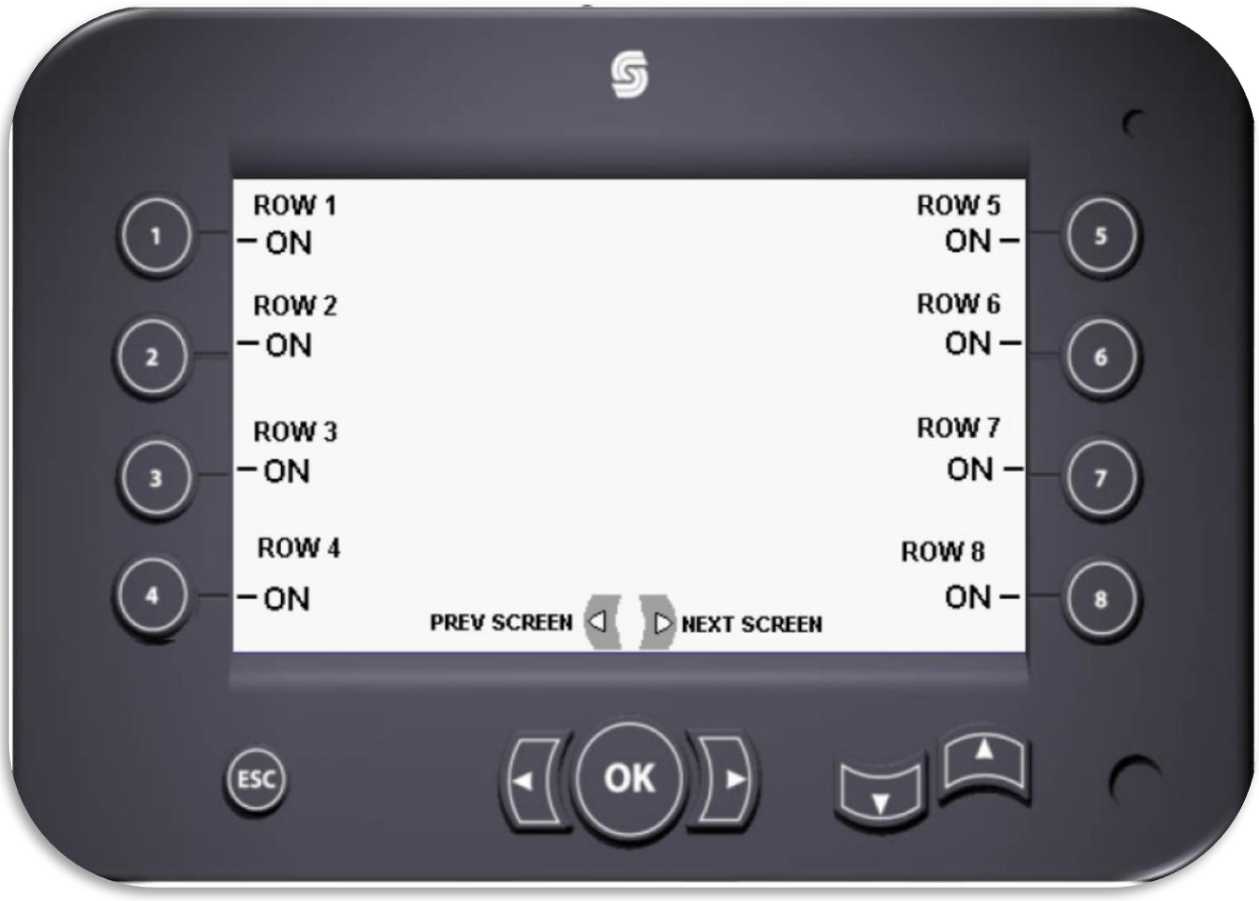
SETUP SCREEN CONT.

From the main screen, depress the number 8 soft-key and the right arrow soft-key twice to bring the operator to this screen.

In this screen the operator can setup the fertilizer pre-start. This engages the fertilizer motor at a given ground speed for a given amount of time. When the ground speed exceeds the set speed or the pre-start timer runs out, the program will take over and operate the planter. When setting this speed the operator will have to be going that speed in order for the motor to turn on. The operator can also set the amount of time it will run in seconds, increasing or decreasing by .1 seconds with a max amount of 15 seconds and low amount of 2 seconds. The left arrow soft-key will bring the operator to the previous screen and the right arrow screen will bring the operator to the next screen. The ESC soft-key will bring the operator back to the main screen.

SETUP SCREEN CONT.

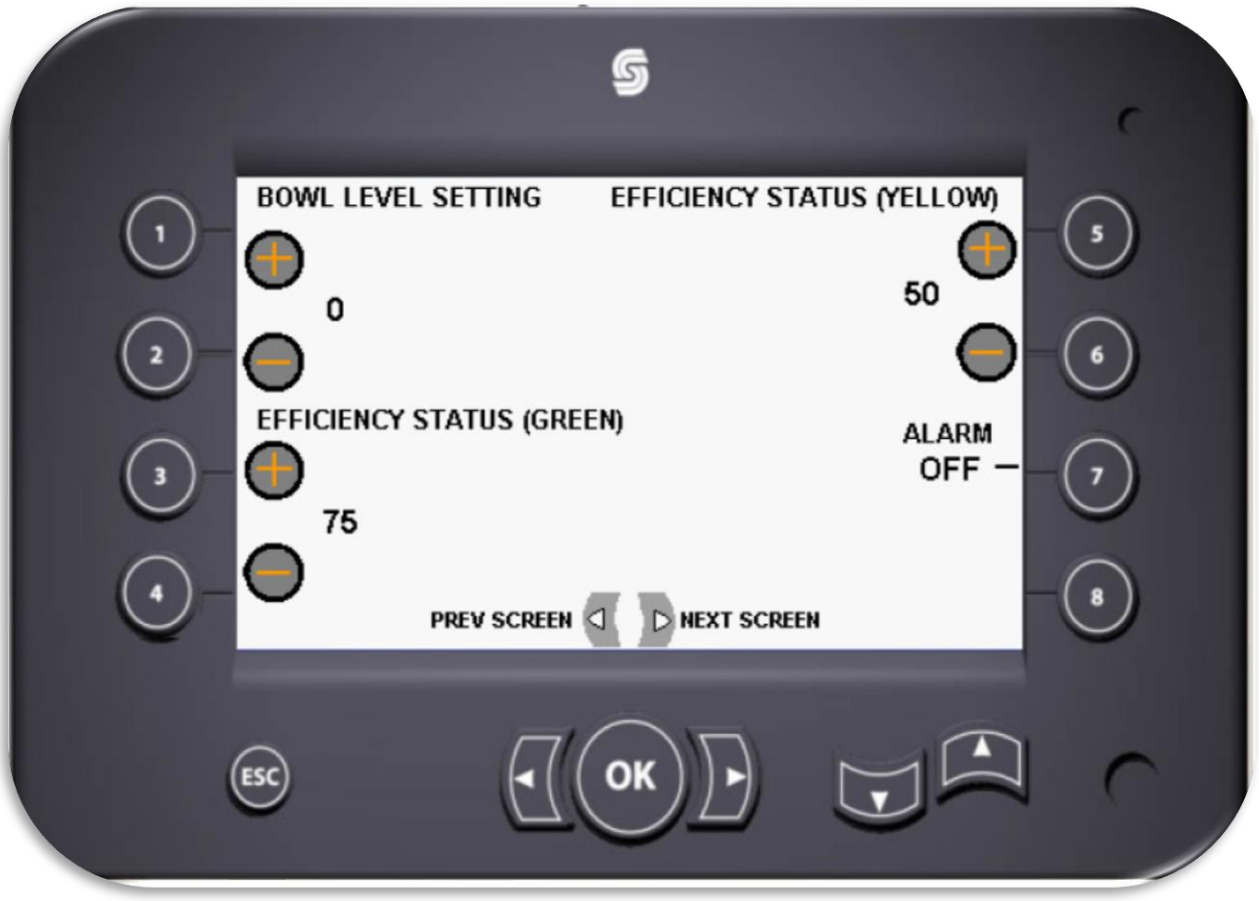
From the main screen, depress the number 8 soft-key and the right arrow soft-key three times to take the operator to this screen.



In this screen it allows the operator to shut any row feedbox off for a given row in any arrangement. To turn rows “OFF” just simply depress any of the numbered soft-keys to turn that matching row off. Now the screen will have changed that row to off to turn it back on depress that soft-key that was pressed earlier. Now this will only turn the feed chain off not the row unit so it will take a little time for the bowl to empty out. The left arrow soft-key will take the operator to the previous screen and the right arrow soft-key will take the operator to the next screen. Depressing the ESC soft-key will take the operator back to the main screen.

SETUP SCREEN CONT.

From the main screen depress the number 8 soft-key and then depress the right arrow soft-key four times which will take the operator to this screen.



In this screen under the heading bowl level setting it is necessary to understand how the bowl ultrasonic sensor works. This sensor gives off a 0-5 volt signal which is automatically ramped between the high and low set points. This signal is filtered in the sensor to eliminate the effects of brief signals such as a potato falling past the sensor. The operator can set the bowl levels in a range of 1-5 from the display. This will correspond to outputs of 1-5 volts. 1 is the lowest bowl level with the least amount of seed pieces in the bowl. 5 is the highest bowl level setting with the most amounts of seed pieces in the bowl. If Level 1 is selected, the feed chain should be turned off if a signal of 1 volt or higher is reached. Level 2 would shut off the feed chains at 2 volts or higher and so forth. Also in this screen the operator can change the efficiency status that would be seen on the main screen for both green and yellow. This is a percent that will be used to monitor the seed spacing as a percent. Operator can also turn the alarm off in the event it is necessary to turn it off.

4.6.9 RADAR CALIBRATION SCREEN

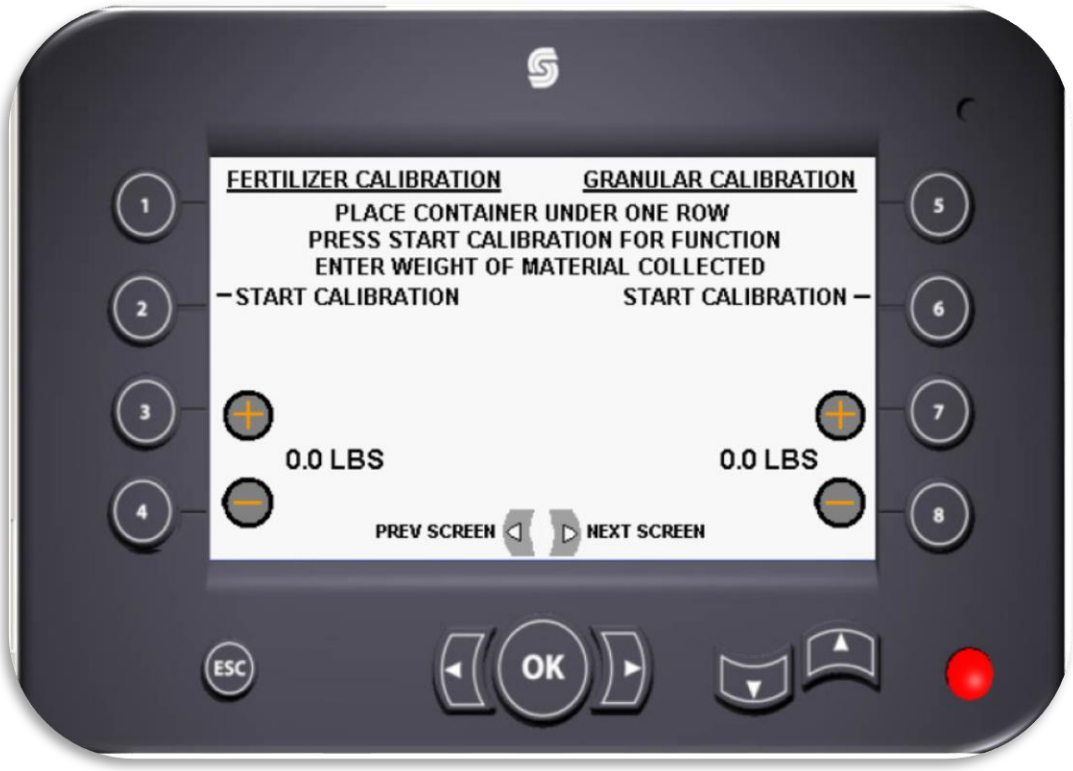
From the main screen depress the number 8 soft-key and then depress the right arrow soft-key five times to take the operator to this screen.

On this screen it may be necessary to recalibrate the radar if the system speed does not match the tractor speed. The very first thing needed to be done is mark out 500 feet. Use something visible like a flag for the beginning and the end. Now with the tractor running on a smooth surface, at an even speed of 3 mph, when the operator reaches the first flag by your rear tire of the tractor depress the number 6 soft-key and this will start the calibration process. Continue to the second flag and when the rear tire of the tractor reaches the same spot as when started depress the number 7 soft-key. This saves the entry number that it calculated and now the operator will be able to see if your speed of the tractor and the monitor are the same. By depressing the ESC soft-key the operator will be taken back to the main screen where the operator will be able to see if the speeds match. If they don't match the operator will need to follow the steps again.

Remember this is a very important step as the computer uses the speed to help calculate your seed spacing.

4.6.10 FERTILIZER/GRANULAR CALIBRATION SCREEN

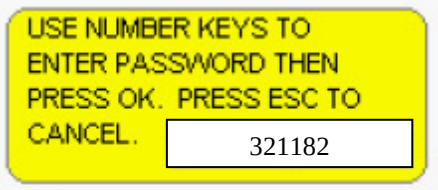
From the main screen depress the number 8 soft-key and then depress the right arrow soft-key six times to get the operator to this screen.



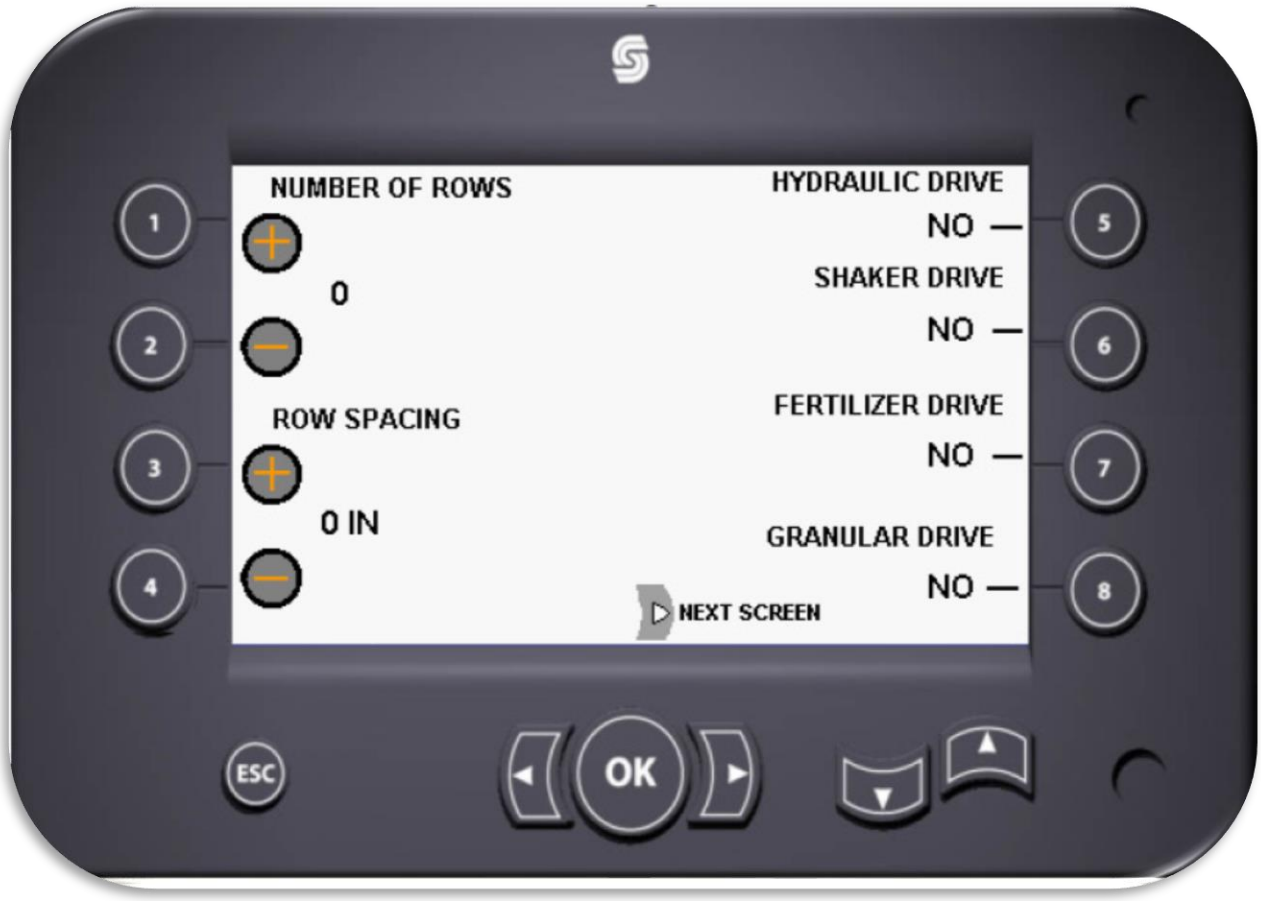
In this screen the operator can calibrate the fertilizer and granular functions on the planter. It is necessary to perform this if the planter is equipped with fertilizer or granular prior to starting planting because it will ensure that the planter is putting on the correct amount. The operator will first start by gathering an accurate scale and 5 gallon buckets for the right amount of rows for the planter. First weigh the buckets on the scale and with a marker write the weight of the bucket on the side you will have to subtract the weight of the bucket to get an accurate weight. Before the operator fills the planter it is important that the fertilizer gates be set at the same height. Take a ½ inch steel plate to set the gates for lower amounts if under 1,000 pounds per acre and a 1 inch steel plate if applying over 1,000 pounds per acre. Once the fertilizer hopper has fertilizer in it and the buckets have been placed under every row the operator will be able to begin. With the tractor hydraulics engaged depress the number 2 soft-key to start the calibration. It will only take a couple of minutes for the computer to do this process since it is done by only turning the shaft a metered amount of revolutions. Once this is finished weigh the buckets individually and subtract the weight of the bucket. If all rows weigh the same, the operator will then enter the amount weighed for only one row by depressing the number 3 soft-key and holding it until it reads the correct amount. If the buckets do not all weigh the same it will be necessary to adjust the fertilizer gate until the same amount (use gate 1 as your control) is collected across all the rows by repeating the steps above. Repeat these steps for the granular calibration also.

4.6.11 TECH SETUP SCREEN

From the main screen depress the number 8 soft-key and then depress the OK soft-key and it will prompt the operator to enter a password that is made up of numbers. The password for the tech setup screen is 321182 once these numbers are entered depress the OK soft-key.



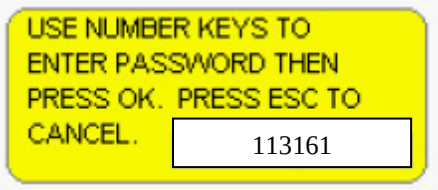
Once all of the above procedure is followed it will take the operator to this screen



This screen allows the operator to change number of rows, change row spacing in inches, turns the drive off, shaker drive off (for use with cup planter only), fertilizer drive off, and granular drive off. This will be programmed prior to receiving the planter.

4.6.12 FACTORY SETUP SCREEN

From the main screen depress the number 8 soft-key and then depress the OK soft-key and it will prompt the operator to enter a password made up of numbers. The password for the factory setup screen is 113161 once these numbers are entered depress the OK soft-key.

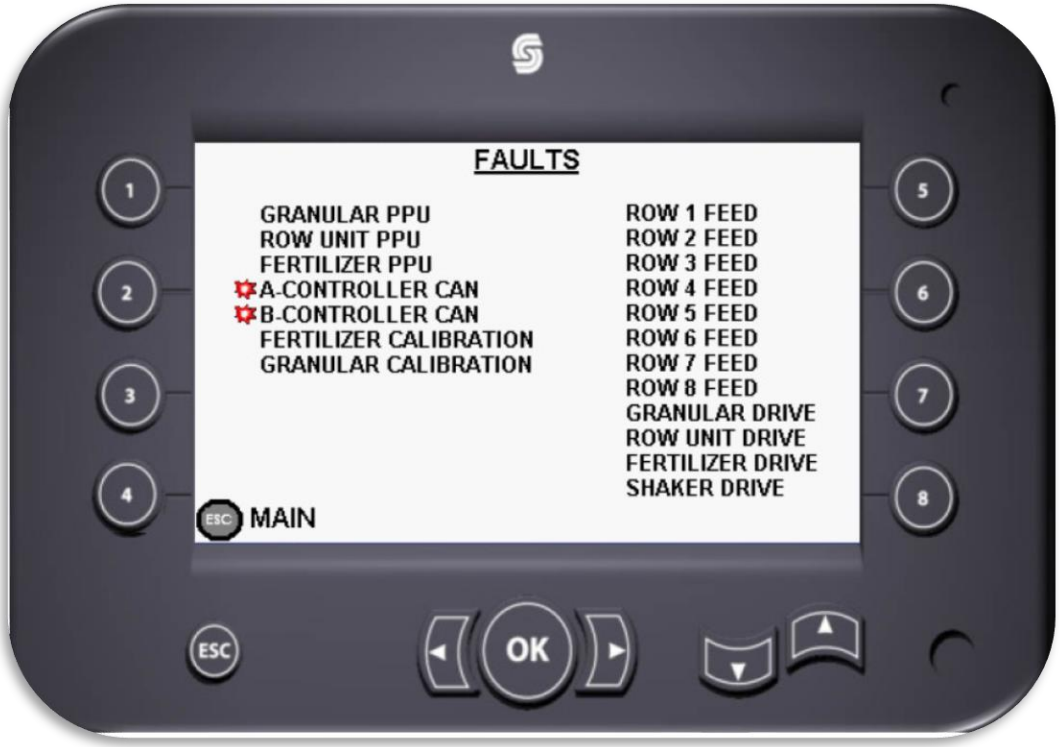


Once all of the above procedure is followed it will take the operator to this screen.

In this screen the operator can change the number of pulses that the motor uses for the main drive, fertilizer drive, and the granular drive. If the planter has Sauer Danfoss motors the pulse count is 35, if it has Eaton brand motors the pulse count is 60. Seeds per revolution are 3.8 for a clamp planter. In any case, this will have been done before the planter was shipped. This will only need to be changed if the motor is replaced with a different pulse count per revolution motor.

4.6.13 Troubleshooting

If the operator sees a red box with an exclamation point flashing in the left hand corner, it means there is something wrong with the system. Depress the number 1 soft-key and it will take the operator to the fault screen.



Troubleshooting Continued

Notice the bullets that have red outlining them; this indicates where the problem would be.

- Granular PPU refers to the motor pick up of that would run the granular part of the planter. Check to see if motor harness is plugged into C13 of the main harness.
- Row Unit PPU refers to the motor pick up that would run the row units on the planter. Check to see if the motor harness is plugged into C9 of the main harness. This alarm can also be triggered if there is no hydraulic flow.
- Fertilizer PPU refers to the motor pick up that would run the fertilizer part of the planter. Check to see if the motor harness is plugged into C11 of the main harness.
- A & B Controller Can refers to the 2 gray controllers located in the middle of the planter in the back. The larger of the 2 controllers plugs into C3 of the main harness and the smaller has C1 & C2 of the main harness plugged into it. If you have a 4 row planter C1 will be the only connection plugged into the smaller controller. Check to make sure this connection is connected.
- Fertilizer Calibration, follow steps outlined on page 37.
- Granular Calibration, follow steps outlined on page 37.
- Row 1 Feed refers to the C7 connection from the harness to the feed box coil on row one. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C7 plug for any damage.
- Row 2 Feed refers to the C6 connection from the harness to the feed box coil on row 2. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C6 plug for any damage.
- Row 3 Feed refers to the C5 connection from the harness to the feed box coil on row 3. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C5 plug for any damage.
- Row 4 Feed refers to the C4 connection from the harness to the feed box coil on row 4. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C4 plug for any damage.
- Row 5 Feed refers to the C41 connection from the harness to the feed box coil on row 5. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C41 plug for any damage.
- Row 6 Feed refers to the C42 connection from the harness to the feed box coil on row 6. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C42 plug for any damage.
- Row 7 Feed refers to the C43 connection from the harness to the feed box coil on row 7. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C43 plug for any damage.
- Row 8 Feed refers to the C44 connection from the harness to the feed box coil on row 8. Check to make sure motor is not jammed or that a rock or stick has not jammed feed chain. Also check the C44 plug for any damage.
- Granular Drive refers to the C12 connection from the harness to the PWM valve that controls the granular motor. Inspect plug for damage.
- Row Unit Drive refers to the C8 connection from the harness to the PWM valve that controls the row unit drive motor. Inspect plug for damage.
- Fertilizer Drive refers to the C10 connection from the harness to the PWM valve that controls the fertilizer motor. Inspect plug for damage
- Shaker Drive refers to the C46 connection from the harness to the PWM valve that controls the shaker motor. Inspect plug for damage.

4.7 SPEED SENSOR (ENCODER) INSTALLATION INSTRUCTIONS

1. Rotate the motor shaft until a (gear/target) tooth is centered in the speed sensor port. If this is not done, the sensor may be damaged during the operation of the motor.

2. Make sure the lock nut and its threads are clean and dry for the proper torque. Position the lock nut against the alignment nut as shown Figure 1.

3. Move the washer and the o-ring up against the speed sensor body threads as shown in Figure 1.

4. By hand, lightly thread the speed sensor body into housing until the sensor touches against the motor (gear/target) tooth. Do not force the sensor against the (gear/target) tooth, damage may occur. Make sure the o-ring or the washer does not touch the housing- see figure 2.

5. Turn the speed sensor body out one quarter turn (CCW) plus the additional amount (CCW) need to make the alignment notches perpendicular to the motor shaft centerline (90° +/-5 degrees from the motor shaft centerline- Figure 4).

6. Maintain the speed sensor body alignment (Figure 4), and tighten the lock nut to 8,5-14 Nm (75-125 lb-in) (torque values are for clean dry threads).

7. Check the speed sensor body for correct alignment (Figure 4), reinstall the sensor if it is not correct.

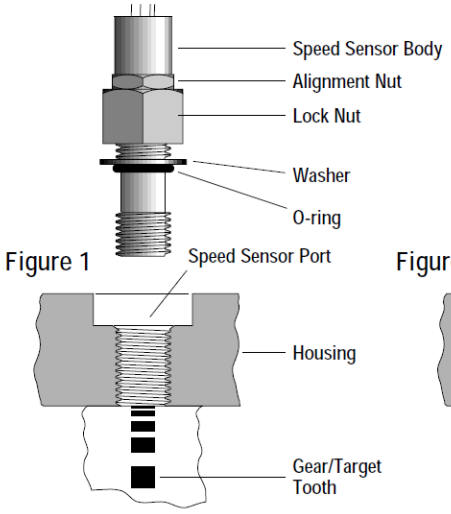


Figure 1

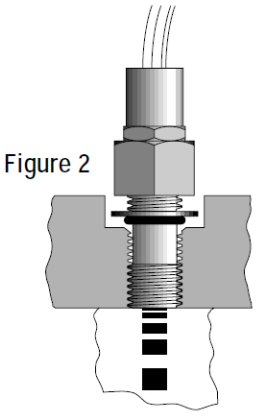


Figure 2

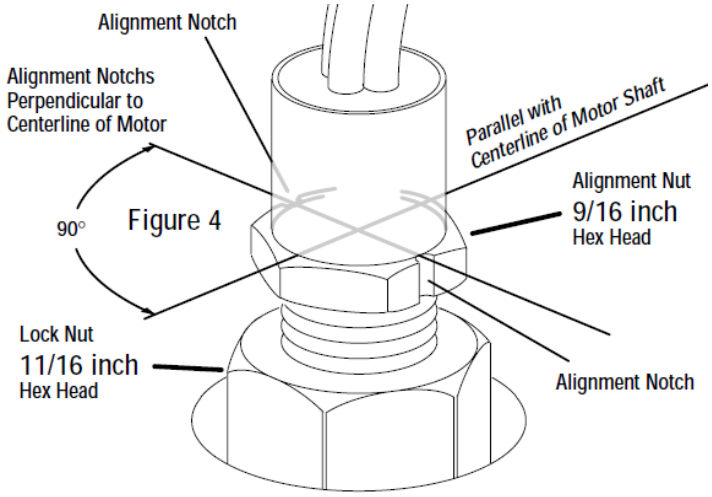


Figure 4

4.8 ATTACHING TRACTOR

When attaching the planter to a tractor, follow this procedure:

1. Clear the area of bystanders, especially small children.

2. Make sure there is enough room and clearance from obstacles to safely back up to the planter.

3. Back up slowly and align the link arms as required for your machine.

4. Two point attachment with Quick Hitch.

   a. Align the claws on the Quick Hitch slightly below the mounting pins on the planter.

   b. Back up until the pins on the planter are above the claws.

   c. Raise the 3-point hitch until the pins "seat" in the claws.

   d. Be sure the retainers are released to hold the pins in the claws.

   e. Adjust the turnbuckle on the top link to position the Quick Hitch frame vertically when the lower lift arms are horizontal.

   f. Set the 3-point hitch in the non-sway position.

   g. Set the lower links on the tractor in the free float position.

   IF YOUR TRACTOR IS NOT EQUIPPED WITH A QUICK HITCH, IT WILL BE NECESSARY TO INSTALL THE MOUNTING PINS THROUGH EACH BALL ON THE 3-POINT HITCH. BE SURE TO INSTALL THE RETAINER ON EACH PIN.

5. Connect the hydraulic circuits.

6. Route the electrical control console into the cab. Route the electrical cord over the hitch and secure in position with clips, tape, or plastic ties. Be sure the wire doesn't dangle and contact the ground or become pinched. Allow enough slack for turning.

7. Mount the Harriston console in tractor. Be sure the console location does not interfere with other controls.

   CONNECT THE POWER CABLE DIRECTLY TO THE TRACTOR BATTERY. DO NOT CONNECT TO TRACTOR CONVENIENCE OUTLETS. HARRISTON WILL NOT BE RESPONSIBLE FOR ANY CONSOLE MALFUNCTIONS IF CONNECTED TO A CONVENIENCE OUTLET.

8. Connect the console cable (tractor) to the product (planter) cable.

9. Program or check the program numbers in the console.

10. Start the tractor and raise the machine.

11. Remove the pins from frame stands. Raise the stands into storage position and reinstall the pins.

12. Raise and lower machine a couple of times to be sure hydraulic hoses and wires are secured properly and are not binding or pinching.

13. Check rear lift wheels for function and operation.

4.9 Daily inspection

The planter should be thoroughly inspected at the start of each working day to ensure that all parts and systems are in good condition and working properly. If this inspection is not done, minor problems could result in poor planting performance in the field.

These items should be checked at the start of each day:

Note: It is recommended that each planting wheel and drive wheel be rotated by hand to get an accurate check of the components

PLANTING COMPONENTS:

a. Bent or broken clamps on each wheel.
b. Clamp arm springs.
c. Free movement of each cam roller.
d. Position and condition of each cam.
e. Over running clutch and chain
f. Rotate wheels by hand to ensure wheels are free to rotate.

HYDRAULIC SYSTEM:

a. Routing and condition of all components
b. Tighten or repair all leaking components.
c. Make sure all electrical connections are tight.

HYDRAULIC DRIVE:

a. Ground or GPS Radar is secured in position
b. Drive motor and chain turn smooth.

GROUND ENGAGING COMPONENTS:

a. Wear on lower shoe of the furrow opener.
b. Damaged closing disc or worn bearings.
c. Damaged opening disc or worn bearings if equipped with fertilizer attachment.

ELECTRICAL SYSTEM:

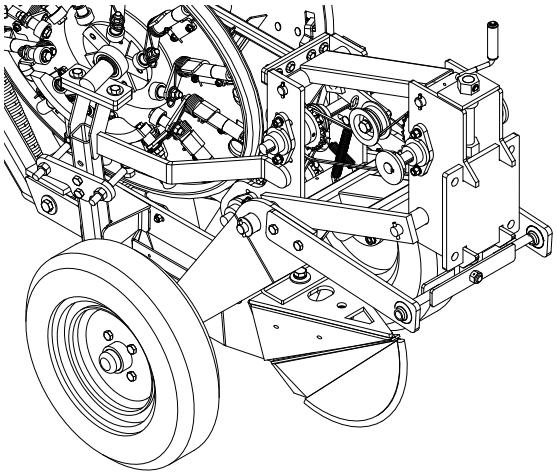
a. Damage to wiring harness components.
b. Damage to connections at solenoids.
c. Function of seed bowl sensors and seed sensors.
d. Condition of switch on electrical box
e. Power connections.

It is very important to ensure good field performance that the operator corrects each problem found during the inspection before starting to work. Little problems won't become big problems, and the machine will perform as expected.

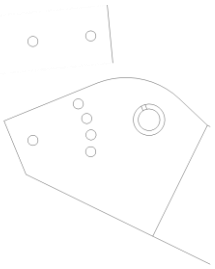
4.10 Machine Settings

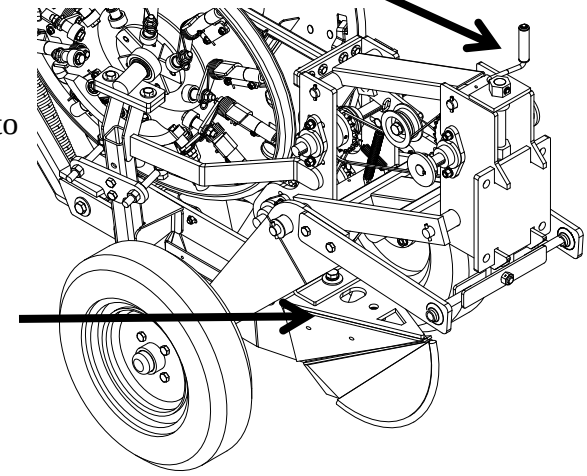
During the machine inspection that the operator should do at the start of each working day, it is his responsibility to check each machine setting to ensure that they are appropriately set for the operating conditions. The following adjustments should be checked:

4.10.1 Gauge Wheels



Each row is equipped with a set of gauge wheels to control planting depth. The two gauge wheels carry part of the weight of the planting shoe as the machine moves through the field. All irregular seedbed conditions are evened out by the wheels. A variety of holes are provided to adjust gauge wheels.





The height of the gauge wheels are set by the adjusting cranks on the front of the row unit frame. Turn clockwise to raise and counter-clockwise to lower. Repeat with other gauge wheel assemblies. Always operate all gauge wheels at the same depth.

The gauge wheels are also adjustable on the gauge wheel itself. Adjust here as needed, to avoid having adjusting cranks to low.

****Failure to adjust the gauge wheel side plates for large depth changes can result in bending the depth screw or other depth control components****

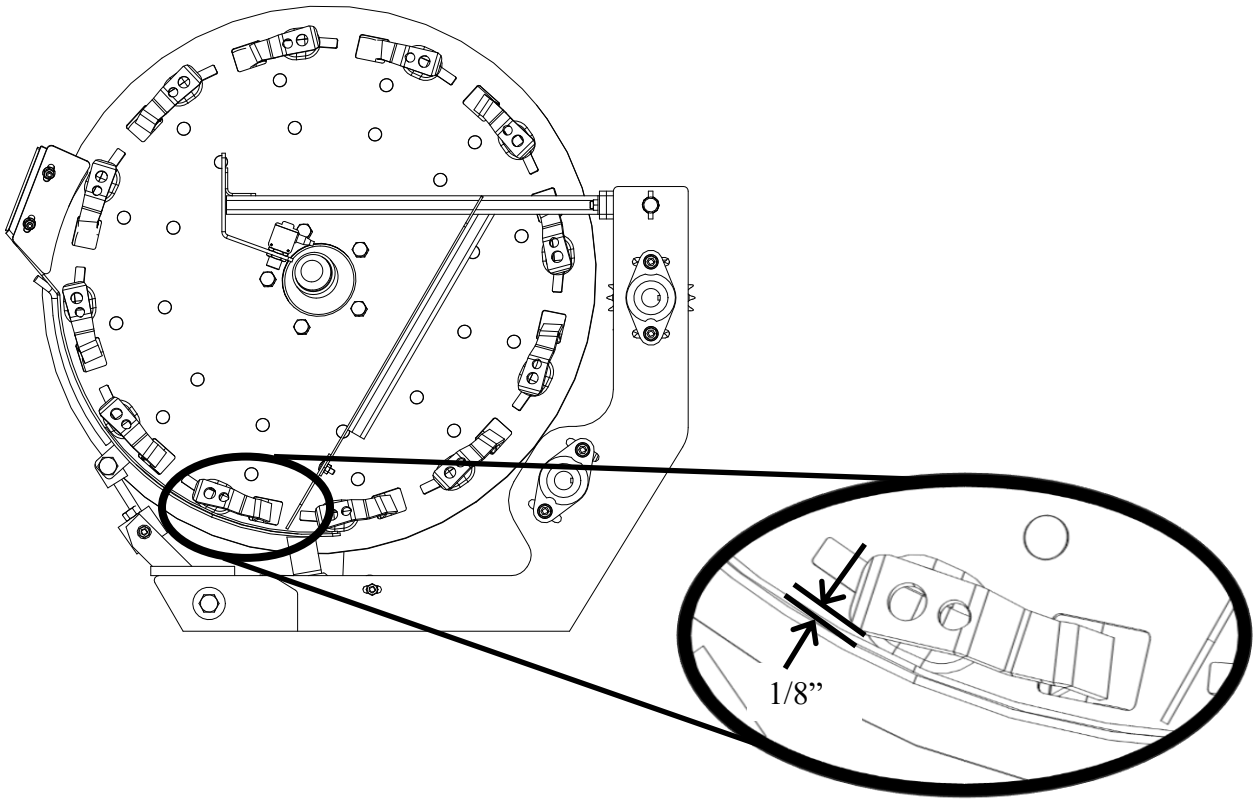
4.10.2 Clamp Wheel/Seed Bowl Clearance

Clearance is provided between the clamp wheel and the seed bowl to:

a. Allow seed piece alignment to ensure proper clamping.

b. Provide some clearance as the seed moves along the seed bowl.

c. Prevent contact and /or damage the seed bowl and clamp.



4.10.3 CLAMP WHEEL CAM

Each clamp wheel is equipped with a cam mounted on the machine frame that contacts the spring loaded clamp trip arm. The cam is located on the lower segment of the clamp wheel arc.

As the clamp wheel rotates, the trip arm roller should contact the cam at the 3:15 position. This cam contact point will open the clamp away from the wheel, allowing the seed to drop in front of seed bowl for planting.

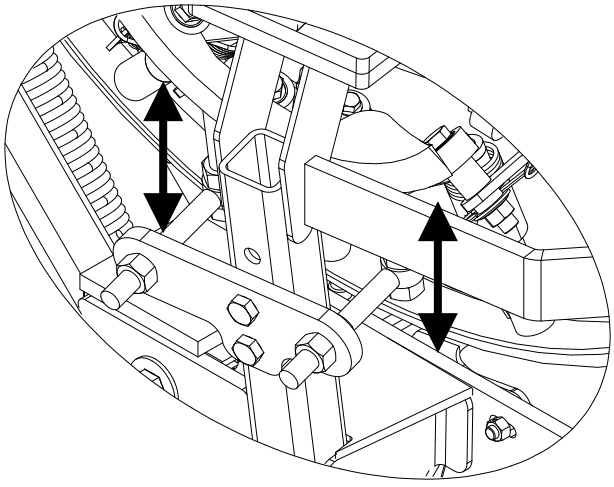
It is very important that the cam and roller are aligned to give a dynamic release and clamping action by the clamp arms. Each clamp assembly must have a spring to provide the force to close the clamp arm to line up the next seed for clamping.

CLAMP WHEEL CAM ADJUSTMENT

As the clamp wheel turns, the roller on the end of the trip arms contacts the adjustable cam. The cam should contact the rollers at the 4:00 position to release seed piece and 8:00 position to clamp the next seed. All new planters come pre-set from factory with a clamp opening of 3" at the drop point and 2" ¼ at the grabbing position. The drop point should not need to be adjusted, but should always open the clamp at least ¼ more than the grab point.

To adjust the cam for alignment with the roller movement, follow this procedure:

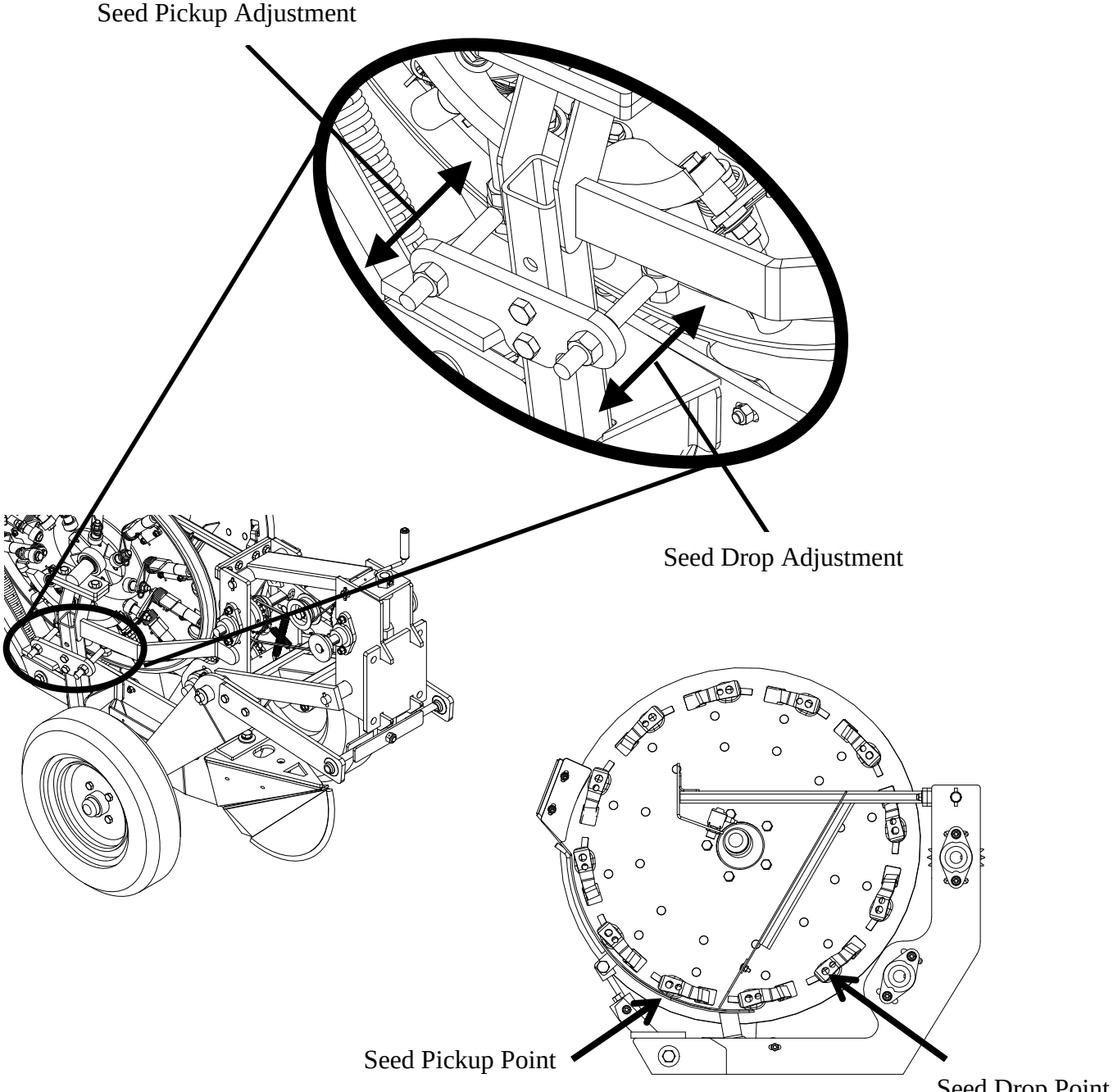
1. Loosen the cam mounting bolts on the front and rear of the cam, with 15/16 wrench.
2. Adjust cam to the required position.
3. Rotate the clamp wheel to check roller alignment and clamp arm movement on each clamp assembly.
4. Ensure the rollers ride on the cam. Adjust the cam vertically if needed.
5. Tighten the mounting bolts.



To adjust the cam for seed pick up, follow this procedure:

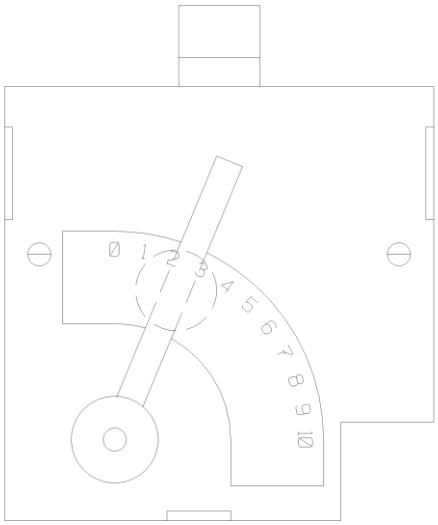
1. Loosen the rear bolt with 15/16 wrench, move the cam in or out for larger or smaller seed. See Seed Drop Adjustment in figure below.
2. Tighten the bolts.
3. Check clamp arm opening at grabbing point. The roller should be riding on the peak of the cam.
4. Rotate the wheel by hand to ensure seed is being picked up by clamps. ****Failure to do so can cause the row unit to jam and cause major damage to planting components****

NOTE: If seed is not being released from the clamp arms, the drop point will need to be adjusted. The drop point should always be adjusted to open the clamp arm atleast ¼" more than the pickup point.



4.10.4 Feedbox Chain Speed

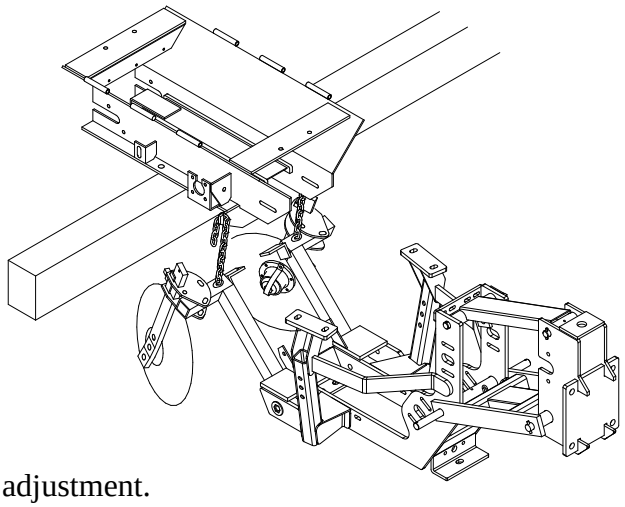
A manual flow control is used for allowing fine adjustment of the seed bowl levels. The factory setting is between 2 and 3. Keep feed chain as slow as possible to maintain accurate picking. If the planter is not producing large number of skips, seed volume is adequate. Too much seed is almost always more of a problem as opposed to too little seed.



Flow Control (Feedbox Chain)

4.10.5 Planter Shoe Depth Rear

The planter shoe is suspended at the rear by a set of chains attached to the arms of the closing discs. Each chain should have a slight amount of slack when the shoe is in its planting position.
This will allow the shoe to float as required when planting and lift the row unit for turning and transporting. Adjust the length of the chain at its frame attaching point by fastening to another link. Always keep the lengths the same on each row unit.



4.10.6 Closing Disc Adjustments

Each closing disc can be adjusted in a vertical direction and spaced from the center of the row. Use these features when adjusting:

A. VERTICAL

1. 3 holes are located in the disc shank for tilt adjustment.

2. A setscrew is located through the mounting frame of the shank that is used to raise or lower the shank/disc assembly. Tighten the setscrew to its specified torque after adjusting.

3. The disc clamp is slotted for changing disc angle. This angle determines the size of the hill. All clamps should be set at the same angle.

B. ROW SPACING

The disc frame assembly is attached to the row unit frame crossmember. Loosen the mounting clamps and slide the assembly to its required position. Tighten mounting clamps.

Important
Maintain Closing Discs on all row units at the same setting to obtain consistent planting results

C. POSITION

The closing discs are held in position when planting with a tension spring between the disc assembly and the row unit frame.

The tension is set with the eyebolt on the top and should be set so the spring is snug when the row unit is out of the ground.

4.10.7 Seed Bowl Volume

Each seed bowl is equipped with a senor to control the seed depth in the bowl. Seed depth levels can be adjusted from the Harriston drive display. See page 35. The seed depth should be adjusted to be as low as possible with minimal skips. If the bowl level is too high excessive doubles and skips may occur due to the seed not being able to move freely to line up with the clamp arm. The manual flow control to the feedboxes should be adjusted to keep the feed chains moving slowly with only brief periods of stopping.

NOTE: Use flow control for fine adjustments

Ultrasonic Bowl Level Sensor

An ultrasonic bowl level sensor is used to analyze the height of seed within the seed bowl. Figure 5 shows the sensor. These sensors are teachable to learn the height range that is required to be viewed for this application. They will come taught from the factory, and should not need any further adjustment. **ANY MODIFICATIONS TO THE WIRING MAY HAVE ADVERSE EFFECTS TO THE SENSOR AND WILL VOID ANY WARRANTY**. The sensors are able to function with 12-24V applied. Better resolution will occur at higher voltages. For the application of sensing bowl height a voltage of 24 V is required, and will be supplied using a 12 to 24 V power inverter. The sensor has three lights on the back of the sensor. During normal operation the light will be yellow if no seed is visible in the sensing window. When seed becomes visible in the sensing window the light will turn green, and a red light will turn on. The red light will become brighter as the seed comes closer to the sensor.

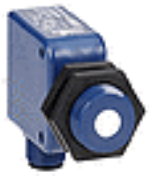


Fig. 1: Ultrasonic Seed Bowl Height Sensor

The following items must work together:

a. The sensor must have an unobstructed view of the bowl. The sensor can be moved on its mounts to change the fill level in the bowl.
b. The hydraulic motor runs at a speed determined by the volume of oil flowing through the circuit. Normally, a 3 g.p.m. (11 Lpm) flow rate provides the optimum feed rate. Use the flow control on the planter to set the flow rate.

A high flow rate will increase the speed of the feeding chain and require excess cycling of the system. A low flow rate will require the chains to constantly move. If it is too low, there will not be enough seed supplied for consistent planting.

Major seed height adjustments should be done in the Harriston Drive program. Minor adjustments should be made using the manual flow controls.

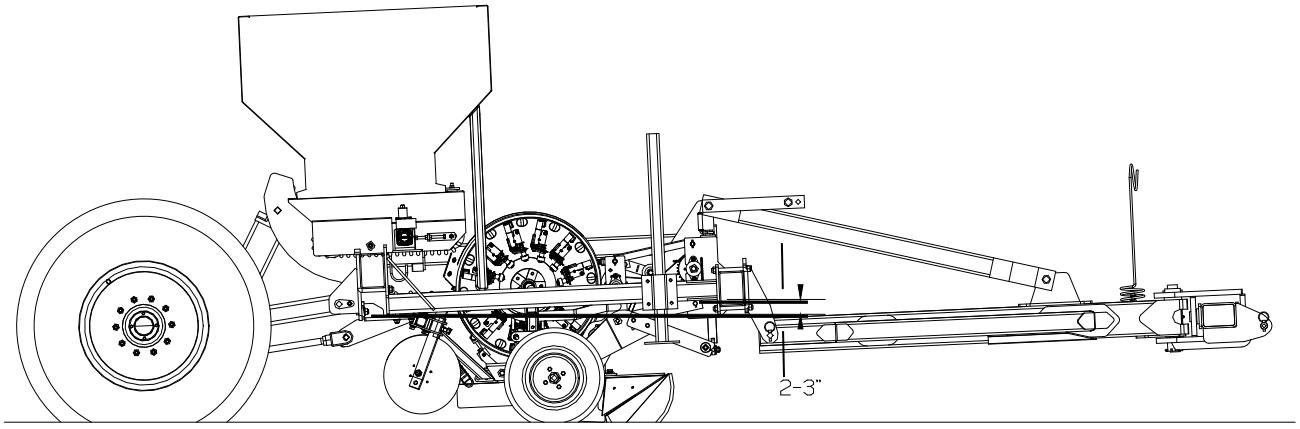
4.10.8 Field Operation

When operating the machine in the field, follow this procedure:

1. Clear the area of bystanders, especially small children, before starting.
2. Check that components, systems, and the machine are set appropriately for the operating conditions.
3. Transport the machine to the field. See Safety Section on Page 3
4. After arriving at the field, fill the hopper with seed. Seed cutters must be adjusted to properly cut a given seed size.

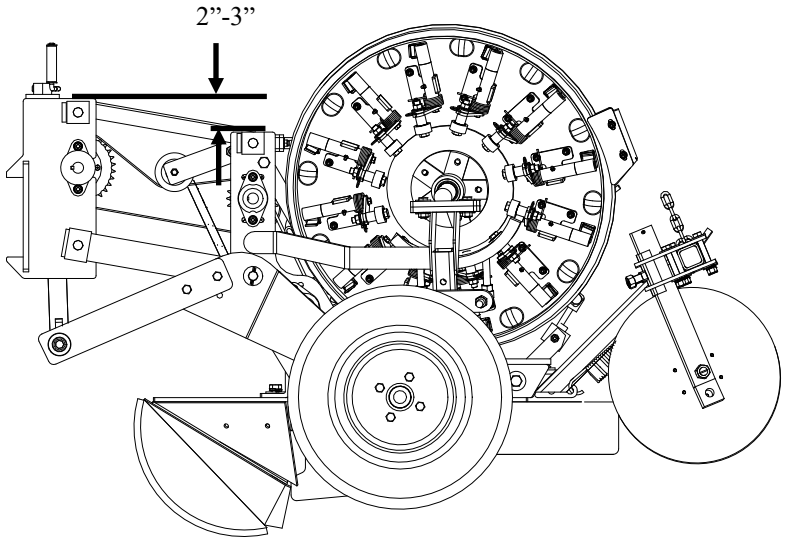
> **NOTE**
>
> **IT IS NOT RECOMMENDED THAT THE MACHINE BE TRANSPORTED WHEN THE HOPPER IS FILLED. THE EXTRA LOAD ON THE MACHINE CAN CAUSE ADVERSE HANDLING CHARACTERISTICS AND LEAD TO STRUCTURAL FAILURES AT FASTER SPEEDS.**

5. Fill the pesticide hoppers if your machine is equipped with that option.
6. Move the vehicles or equipment away from the working area.
7. Align the machine with the edge of the field if just starting or with the previously planted row.
8. Lower the machine to the ground.
9. Lower tractor 3-point hitch until crossmembers are 2 -3” higher in the front.
10. Drive approximately 30 feet in typical ground conditions and check planting depth. Adjust gauge wheel to desired depth (see page 45).



Machine Settings – Continued

11. After seed depth is obtained, observe angle of shoe linkages. Linkage should be approximately 2” to 3” lower in the rear when planting. This will allow the gauge wheels to carry only the weight of the row unit and float over obstructions if any are encountered. The trailing action of the parallel linkage results in a more consistent planting depth.



12. Raise or lower 3-point hitch and rear cylinders to obtain proper angle on shoe linkage while maintaining planter frame angle. Adjust rear cylinder and 3-point lever stop accordingly.
13. Lower the marker if your machine is so equipped. The sequencing valve supplied with the optional marker controls its operation.
    a. To operate the markers, connect the hose to give the following sequences:
    b. Move the hydraulic lever to the “raise” position to raise both markers.
    c. Move the lever to the “lower” position to lower one marker.
    d. Move the lever to the “raise” position to raise the marker.
    e. Move the lever to the “lower” position to lower the other marker.
    f. To lower both markers, move the hydraulic lever to the “lower” position / momentarily to the “raise” position, and then back to the “lower” position. Both markers will be lowered.
    g. Move the hydraulic lever to the “raise” position to raise both markers. The valve will then return to its normal sequencing cycle.
    h. Raise or lower markers as required for operation and transporting.

14. Engage hydraulic lever for planter hydraulic system.
15. Put power switch on Harriston console to "ON"
    i. To preload clamp arms and bowl:
    b. Follow instructions on page 28

Machine Settings – Continued

16. Planter clamp wheels will turn when radar senses movement.
17. Recommended planting speed is 3.5 to 6.5 mph to obtain the most consistent planter performance depending on seed spacing.
18. Slow down at the end of the round and depress the Master switch before turning. Raise the machine and the marker as the shoes cross into the headland area.
19. Swing wide to minimize excess frame loads while turning. When using duals on tractor with front stabilizer wheels, be sure duals do not contact stabilizer wheel when making turns.
20. Lower machine to pre-set depth and lower the markers.
21. Before quitting, empty out seed bowls. To do this turn off all rows using the planting monitor. Then use the radar override to empty the remaining seed.

4.11 Operating Hints

Start the flow control valve at the #3 setting.

Start the hydraulic speed control (rabbit and turtle) on the tractor at just under half speed.
If there is not enough oil flow, the console will show row unit ppu alarm.

Always connect the power source directly to the battery.

The frame should be 2 to 3 inches higher in the front and set high enough so the parallel linkage is lower in back by 2 to 3 inches.

Keep the potato level in the bowl as low as possible.

If seed pieces are planted too shallow, reduce speed and/or check gauge wheel depth.

Do not use the hydraulic system to operate other equipment.

If all feeds do not run, this does not indicate an electrical problem.

SEED SIZE AND VARIETY

Wide variations in the size and shape of your seed will result in poor planter performance. Although the machine can handle cut or whole seed, it has difficulty handling both at the same time because the operational settings change.

Time spent to ensure consistent seed size and type pays rich dividends in planter accuracy, consistency and faster planting.

TIRE SPACING

Normally the tire spacing on the rear of the machine is set at twice the row spacing. For example: 36" rows require 72" tire spacing. However, when your machine is equipped with mono rib tires, it is recommended that the tire spacing be set to match the tire spacing of the tractor to be used during the first cultivating pass. If the spacing is not the same, the tractor will be difficult to control and keep in the center of the rows.

4.12 Transporting

1. Make sure you are in compliance with all local regulations regarding transporting equipment on public roads and highways.

1. Make sure the SMV (Slow Moving Vehicle) emblem and all the lights and reflectors that are required by the local highway and transport authorities are in place, are clean, and can be seen clearly by all overtaking and oncoming traffic.
2. Do not allow anyone to ride on the Planter or tractor during transport.
3. Do not exceed 20 mph (32 km/h). Reduce speed on rough roads and surfaces.
4. Do not transport with tank(s) loaded.

When transporting the machine, review and follow these instructions

1. Be sure all bystanders are clear of the machine.
2. Ensure that the machine is securely attached to the tractor and all retainer pins are installed.
3. Raise the machine and install the transport lock before transporting.
4. Clean the SMV emblem and all lights and reflectors before starting.
5. Be sure that all lights required by the local highway authorities are in place, clean and functioning so they can be seen by oncoming and overtaking traffic.
6. If transporting during times of limited visibility or dusk, install extra lights or use pilot vehicles.
7. Always use hazard flashers on the tractor when transporting unless prohibited by law.
8. Watch through the expanded metal grill on the hopper for overtaking traffic. Keep to the right and yield the right of way to allow faster traffic to pass. Drive on the road shoulder, if permitted by law.
9. Do not allow riders on the machine.
10. Do not transport when the machine is loaded.
11. Never exceed a safe travel speed.
12. Always shift to a lower gear when going down hills to use the engine as a retarding force.
13. Apply the brakes carefully to prevent jackknifing.
14. Never disengage tractor drive train and coast down hills. Always keep tractor in gear.
15. Never tow the machine faster than 20 mph (32 km/h). The ratio of the tractor weight to the planter weight plays an important role in defining acceptable travel speed.

4.13 Storage

4.13.1 PLACING IN STORAGE

At the end of the planting season, the machine should be thoroughly inspected and prepared for storage. Repair or replace any worn or damaged components to prevent unnecessary down time at the beginning of the next season. Follow this procedure:

1. Thoroughly wash the machine using a pressure washer to remove all dirt, mud, debris, or residue. During the final rinse, add a good disinfectant to the pressure washer tank to disinfect the machine.

> **NOTE**
> DO NOT point high pressure directly on wire connections, encoders or sensors.
> If planter is equipped with fertilizer attachment, wash with a solution of 10% Vinegar / 90% Water

2. If a disinfectant is not used, fungus and mildew will grow during the storage period and could contaminate next year's crop.

3. Inspect the following components:

Soil Engaging Components:

a. Check for worn or damaged planting shoes. Look for signs of wear on front of lower shoe. If wear is detected, rebuild or replace planting shoe.

b. Check closing discs for damaged or worn bearings. Replace disc or bearings as required.

c. Check opening discs for damage or worn bearings (for machines with optional fertilizer attachment). Replace disc or bearings as required.

Planting Components:

a. Check all clamp arms for bent or broken clamp. Straighten or replace as required.

b. Check clamp arms for damaged or broken springs. Replace as required.

c. Lubricate clamp arm pivot. Use SAE multi-purpose high temputure grease or SAE multi-purpose lithium based grease. Work pivot arm several times to get lubricant into the bushing.

d. Rotate all clamp wheels and lubricate each clamp arm bushing.

e. Check Cam Bearing for damage.

f. Check all clamp arm cams for damage, wear, or misalignment. Repair as required.

g. Lubricate over-running clutch at the front of each row unit.

h. Inspect and lubricate the roller chain on row unit drive. Replace damaged or worn roller chain as required.

i. Repack gauge wheels on each row unit. Replace bearings with damaged seals.

j. Lubricate all grease points. (see Maintenance Section).

Electrical System:

a. Check the wiring harness and all wiring for damaged or worn areas. Check for cracked or worn insulation. Replace any components that have come in contact with moving parts and route to prevent damage in the future.

b. Check all seed bowl sensors for proper operation. Repair or replace any damaged or malfunctioning switches or wiring harness.

c. Check all hydraulic solenoids for loose or damaged wires. Repair or replace as required.

4. Make a list of all parts needed for repairs and order them immediately. Repairs can then be done when time permits to prevent unnecessary down time at the start of next season.

5. Lubricate all grease points to remove any water residue from the washing and prevent rusting during the storage period. Rotate all moving parts to distribute lubricant to all surfaces.

6. Coat each roller chain with a good quality chain lubricant to prevent rusting. Rotate the chain slowly by hand to cover all surfaces.

7. Apply a light coat of grease on the shafts where the sprockets slide on the transmission driving shaft and on the clamp wheel over running clutch shaft.

8. Remove material that has become entangled in any drives.

9. Touch up all paint nicks and scratches to prevent rusting.

10. Move the machine to its storage area.

11. Select an area that is dry, level, and free of debris.

12. Place planks or blocks under the hitch pole on the pull-type model.

13. Unhook the machine from the tractor (see page 43).

14. Place all wiring harness and hydraulic line components in a safe place on the hitch to prevent damage and keep clean during the storage period.

15. If the machine cannot be stored inside, cover with a waterproof tarpaulin and tie securely in place.

16. Store out of the way of human activity.

17. Do not allow children to play around stored unit.

4.13.2 Removing From Storage

When removing from storage and preparing to use, follow this procedure:

1. Clear the area of bystanders, especially small children.
2. Remove the tarpaulin from the machine if it was covered.
3. Attach the tractor to the machine (See Page 43).
4. Check:
    a. Tire pressure. Add as required.
    b. Re-torque all wheel bolts.
    c. Re-torque all hardware.
    d. Routing and securing of all hydraulic lines and wiring harness. Adjust as required.
5. Rotate all components and systems by hand to see that none are seized. Loosen any seized components with penetrating oil before starting.
6. Lubricate all grease points, roller chains, and shaft surfaces with sliding sprockets.
7. Review and follow all items on the Pre-Operation Checklist and Daily Inspection before starting.

5 SERVICE AND MAINTENANCE

1. Follow all the operating, maintenance, and safety information in the manual.
2. Support the machine with blocks or safety stands when changing tires or working beneath it.
3. 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 filling.
4. Make sure all guards are in place and properly secured when maintenance work is completed.
5. Never wear ill-fitting, baggy, or frayed clothing when working around or on any of the drive system components.
6. Before applying pressure to a hydraulic system, make sure all lines, fittings, and couplers are tight and in good condition.
7. Install safety rod and pin securely in position on hitch cylinder frame before working under frame. Make sure safety rod is unhooked before resuming operation.
8. Relieve pressure from hydraulic circuit before servicing or disconnecting from tractor.
9. Keep hands, feet, hair, and clothing away from moving or rotating parts.
10. Clear the area of bystanders, especially small children, when carrying out any maintenance and repairs or making any adjustments.
11. Wear appropriate protective gear when contacting chemical handling components on machine.

5.1 Service

5.1.1 FLUIDS AND LUBRICANTS

Grease
Use an SAE multi-purpose high temperature grease for all applications Also acceptable is an SAE multi-purpose lithium based grease.

Roller Chain Lubricant
Use WD-40, LPS-2, or equivalent to coat roller chains and bushings to prevent rusting or seizing.

Storing Lubricants
Your machine can operate at top efficiency only if clean lubricants are used. Use clean containers to handle all lubricants. Store them in an area protected from dust, moisture, and other contaminants.

When pressure washing, do not directly spray the side (seal) of the bearing. This will damage the seal and reduce the life of the bearing.

5.1.2 GREASING

Use the Maintenance Checklist provided to keep a record of all scheduled maintenance.

1. Use only a hand-held grease gun for all greasing. Air powered greasing systems can damage the seals on bearings and lead to early bearing failure.

IMPORTANT

Over-greasing can damage bearing seals. A damaged seal will lead to early bearing failure. Replace all bearings with damaged seals immediately.

2. Wipe grease fitting with a clean cloth before greasing, to avoid injecting dirt and grit.
3. Replace and repair broken fittings immediately.
4. If a fitting will not take grease, remove and clean thoroughly. Also clean lubricant passageway. Replace fitting if necessary.

SEALED BEARINGS

Sealed bearings are used at several locations on this machine. All sealed bearings are lubricated at the factory and the seals retain the grease inside the bearing and prevent dirt and other contaminants from getting inside. The life of the sealed is virtually limitless provided it is not damaged in any way. When sealed bearings are greased, the grease is introduced next to the outer face of the seal. When a hand held grease gun is used, the grease slips in next to the seal without damaging it. An air powered greasing system will inject the grease so fast that it is no uncommon for them to damage a seal. Once the seal is damaged, the factory installed grease comes out and the bearing runs dry. Seizing will then occur in a short time.

Should you notice that a seal is damaged, replace the bearing immediately to prevent problems at a later time.

SEALED BEARINGS

Occasional greasing of sealed bearings is required to remove moisture and contaminants from the space next to the seals. It is not recommended that sealed bearings on the machine be greased any oftener than once every season after the machine is washed and then only give them one shot. More frequent lubrication runs the risk of damaging the seals and causing bearing failure. The exception to this rule is at the beginning and end of the season. At those times, each bearing should be given only one shot of grease to remove moisture or water next to the seal that can accumulate during washing or storage.

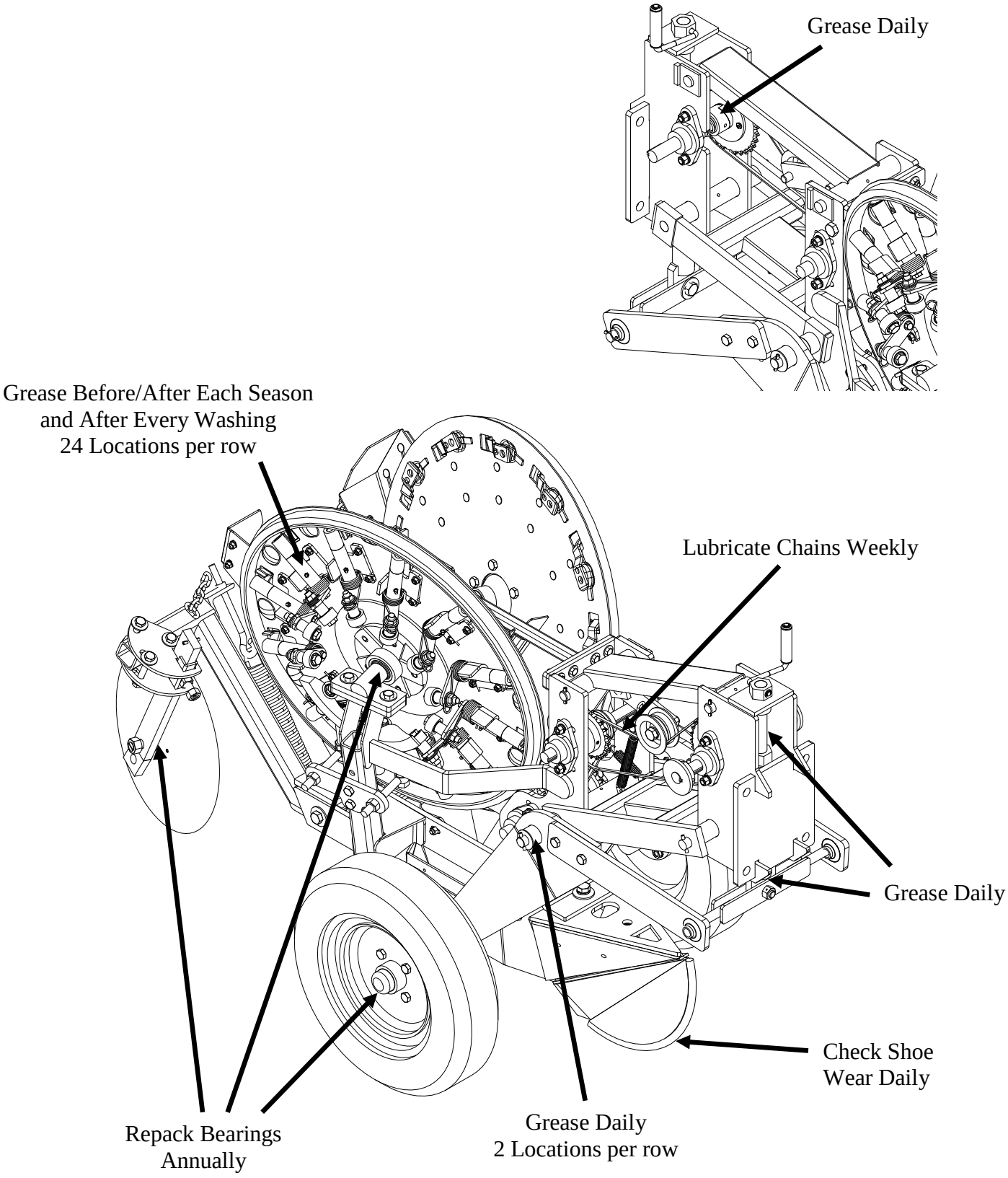
ROLLER CHAINS

Check all chains daily for tension. Lubricate chains every 20 hours of operation. Tighten chains so there is approximately 1/4 to 1/2" of slack on the side of the chain opposite the tightener or so that you can slide the chain back and forth with your fingers on one of the sprockets. DO NOT over tighten. Replace all shields after servicing chains.

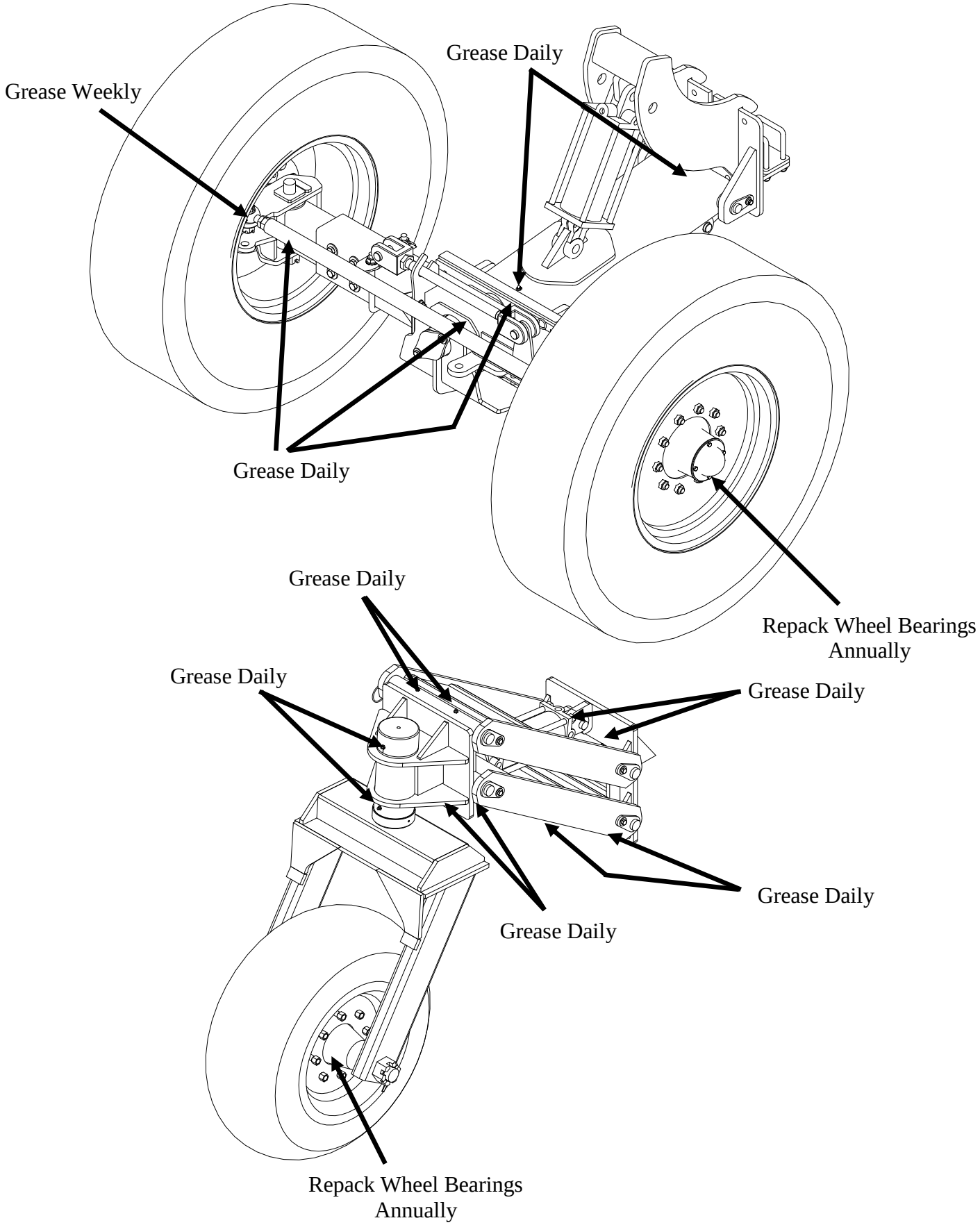
Action Code L = Lubricate R = Repack
CL = Clean D = Disinfect

Hours **Maintenance** Serviced By																	
L Gauge Wheels																	
L Walking Beam																	
L Over-Running Clutch																	
L Rear Wheel Pivots																	
Annually																	
L Roller Chains																	
L Clamp Wheel Drive Chain																	
L Feeding System Drive Chain																	
L Hydraulic Drive Roller Chain																	
R Rear Wheel Bearings																	
R Gauge Wheel Bearings																	
R Clamp\ Wheel Hubs																	
CL & D Machine																	

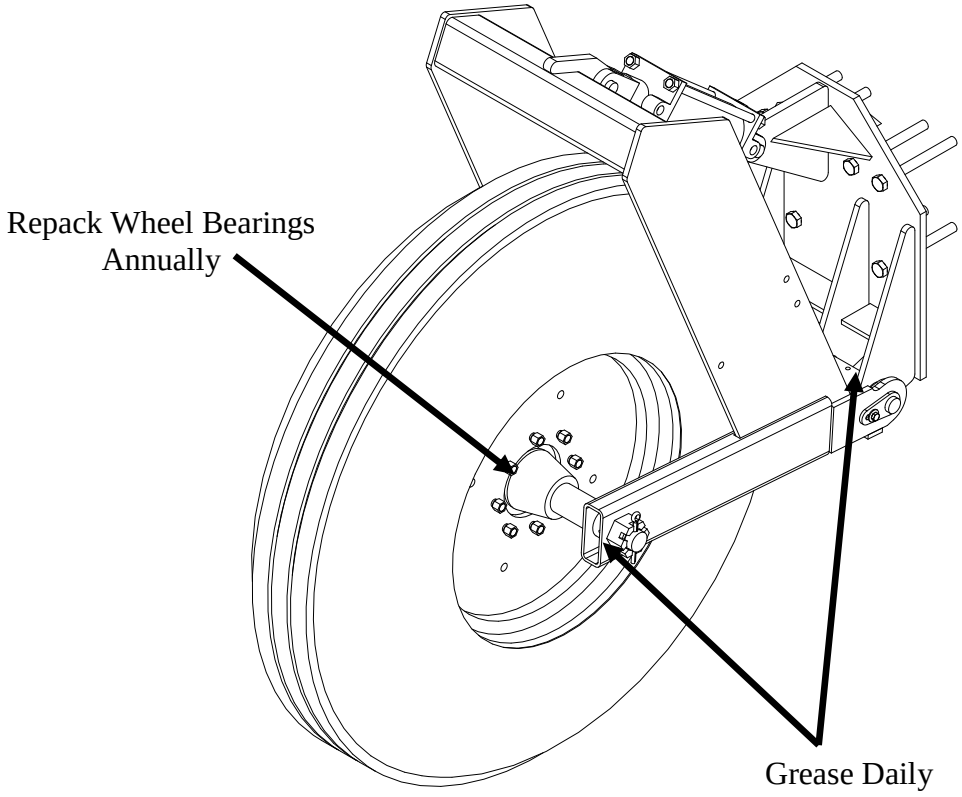
5.1.3 SERVICE INTERVALS

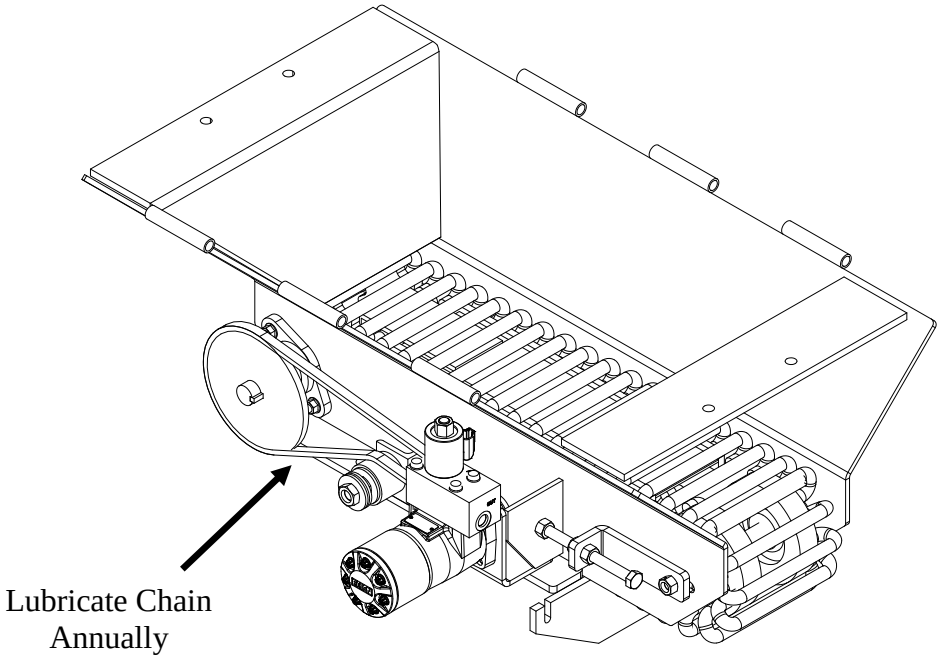


SERVICE INTERVALS CONT.



SERVICE INTERVALS CONT.





5.2 Maintenance

5.2.1 CLAMP WHEEL DRIVE SPROCKET

Each clamp wheel is driven by a sprocket that mates with a roller chain on the circumference of the wheel. To check and adjust the clearance, follow this procedure:

a. Checking clearance
Hold the clamp wheel in a stationary position and turn the drive sprocket by hand. The teeth on the sprocket should move approximately 1/16 inch (1.5 mm) to have proper clearance.

Less clearance or movement can introduce vibration into the clamp wheel, and will cause uneven plant spacing.

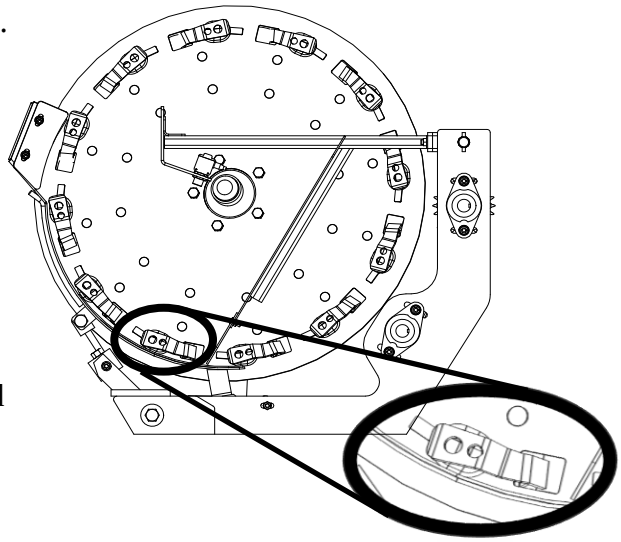
b. Adjusting clearance

Loosen the bearing mount bolts on the sprocket shaft. Move bearing and shaft to the required position. Tighten the bearing bolts to their specified torque.

5.2.2 Clamp Wheel to Seed Bowl Clearance

The machine is designed to have a tapered clearance between the seed bowl and the clamp wheel. This clearance provides a self-cleaning action, eliminates contact damage, and reduces drag on the seed piece. To set or adjust this clearance, follow this procedure:

1. Clear the area of bystanders, especially small children.
2. Raise the machine and place safety stands under the front frame.
3. Loosen the four bolts attaching the seed bowl to the row unit frame.
4. Move the bowl to the desired position.
5. The clearance at the bottom should be 1/8 to 3/16 inches (3 to 4.5 mm).
6. The clearance at the top front of the seed bowl should be 3/8 inch (9 mm).
7. The clearance between the bowl and the clamp arm should be 1/8 inch to ¼ inch.
8. Measure the clearance dimensions carefully before tightening mounting bolts.
9. Tighten mounting bolts to their specified torque levels.
10. Remove safety stands.



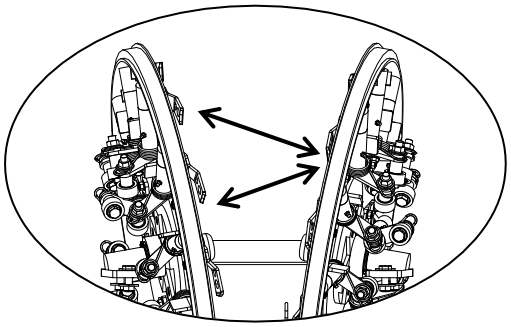
WARNING

Always support frame with safety stands before working under machine.

5.2.3 Retiming clamp wheels

The clamp wheels are designed to drop seed pieces into the planting shoe in an alternating sequence. To maintain proper seed spacing, the dimensions between the clamp arms on the facing clamping wheel must be equal. Should wear, mechanical damage or repairs change this dimension, retime the clamp wheels by following this procedure:

1. Clear the area of bystanders, especially small children.
2. Raise the machine and place safety stands under the front frame.
3. Measure the distance between the clamp arms to see if they are centered between the two arms on the opposite wheel.
4. If not equal:
    a. Loosen the bearing mounting bolts on the clamp drive sprocket shaft.
    b. Slide the drive shaft back until the driving sprocket clears the wheel.
    c. Rotate the clamp wheel until the measurement between the arms are equal. Timing notches on wheel can be used as a guide.
    d. Slide the drive shaft back into place and secure bearings in place.
    e. Check the arms to ensure they are properly spaced.
    f. Repeat procedure if not properly spaced.



5.2.4 ROW UNIT SHEAR BOLTS

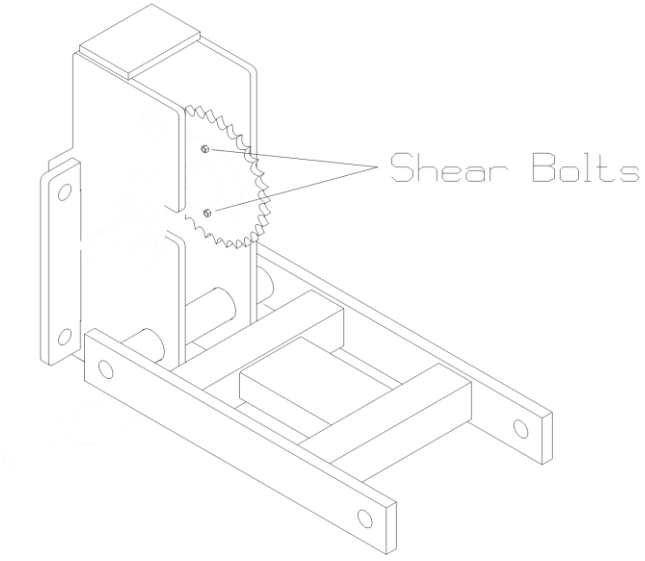
The drive of each row unit is protected by shear bolts on the driving sprocket should the picker wheel jam. To replace shear bolts, follow this procedure:

1. Clear the area of bystanders, especially small children.

2. Place all controls in neutral, stop engine, set the park brake, and remove ignition key.

3. Carefully remove remaining shear bolt using a hammer and punch if necessary. Do not enlarge holes.

4. Install new shear bolts (2 required and tighten).



5.2.5 Hydraulics

Daily:

1. Check indicator on hydraulic filter. Replace element when indicator is in red zone.

2. Check hydraulic hoses for pinching, fraying, etc. Replace any damaged hoses.

3. Check for leaking fittings, couplers, or cylinders. Replace, repair as needed.

4. Check hydraulic control valve for any visible damage. Repair as necessary.

IMPORTANT
Whenever replacing hydraulic hoses and coupling or uncoupling hoses to tractor, be sure hoses are clean to prevent contamination.

5.2.6 ROLLER CHAIN TENSION

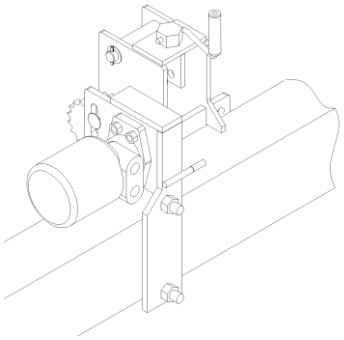
The machine has several roller chains that are used to transmit power. To adjust the tension of these chains, follow this procedure:

5.2.7 HYDRAULIC DRIVE CHAIN

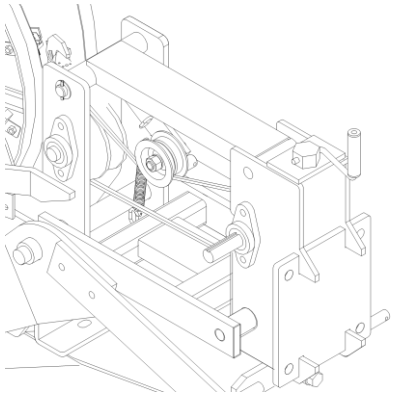
1. The hydraulic drive chain tension is set by the idler sprocket.

2. Loosen the nut on the sprocket and slide or tap to the required position. Tighten until the long span is snug.

3. Tighten the nut on the idler sprocket.



5.2.8 Clamp Wheel Drive Chain



1. The clamp wheels on a row unit are driven by a single chain.

2. The chain tension is set with a spring loaded idler.

3. Normal spring tension will give 1/8 inch (3mm) spacing between the coils.

4. This will keep the chain on the long span snug.

5. Check the springs on other row units as required.

5.2.9 Feedbox Roller Chain Drive

1. Each feed chain is driven by a hydraulic motor through a roller chain.

2. Loosen the nut securing the idler sprocket.

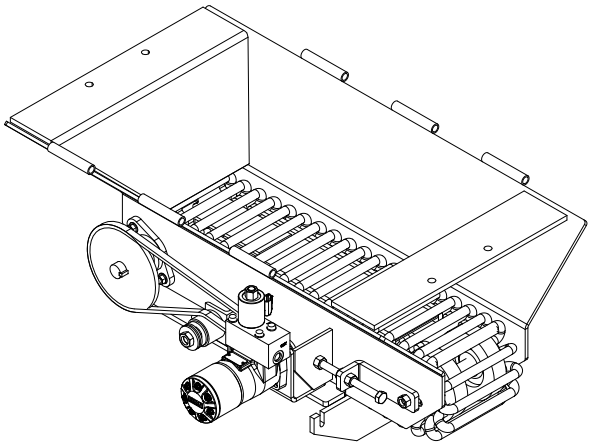
3. Slide or tap the idler into its required position.

4. The chain on the long span should be snug. Do not overtighten.

5. Tighten the idler bolt to its specified torque.

6. Repeat on the other row units as required.

5.2.10 Feed Chain Tension



The feed chain moves cuttings from the hopper into the seed bowls for planting. To adjust the tension, follow this procedure:

1. Loosen the chain idler bolts on both sides of the feed chain.

2. Adjust until there is approximately 1 inch (25 mm) of sag on the loose (bottom) side of the chain.

3. Tighten the chain idler bolts to their specified torque.

4. Adjust tension on the other feed chains as required.

5.2.11 Operation of Feedbox Motor Control Solenoid

On Harriston planters, the feedbox providing seed to the planter bowl is controlled by an electric solenoid mounted on a hydraulic motor. Oil for the hydraulic motor flows from the return side of the planter clamp wheel drive motor. Oil flow is regulated by a manual flow control. An electric switch in the feed bowl provides 12 V.D.C. to the solenoid for control of oil flow for each individual feedbox. When the seed bowl is being filled, the electric switch is closed, which sends current to the solenoid. The solenoid closes the by-pass line in the motor manifold, which directs oil to the hydraulic motor.

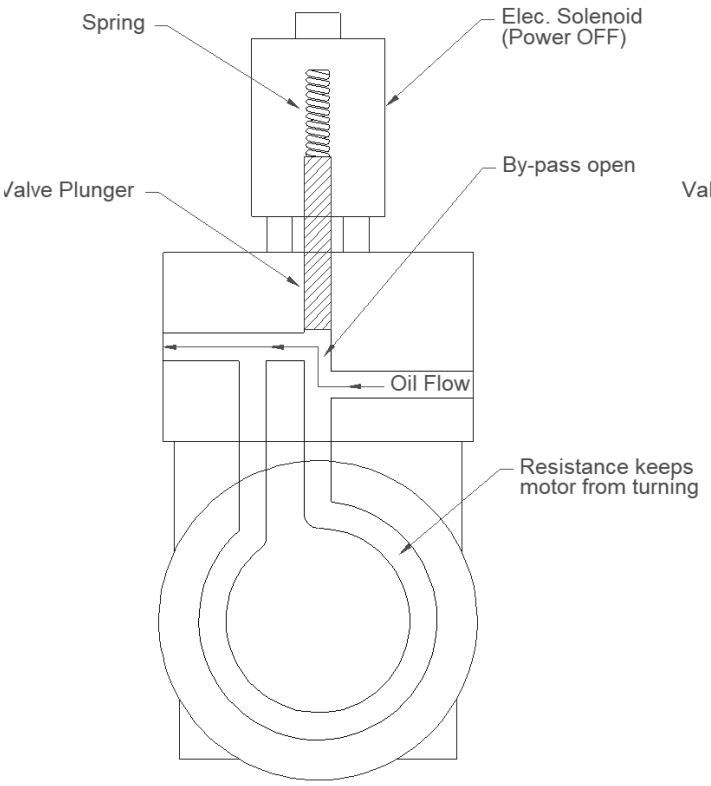


Fig. 1

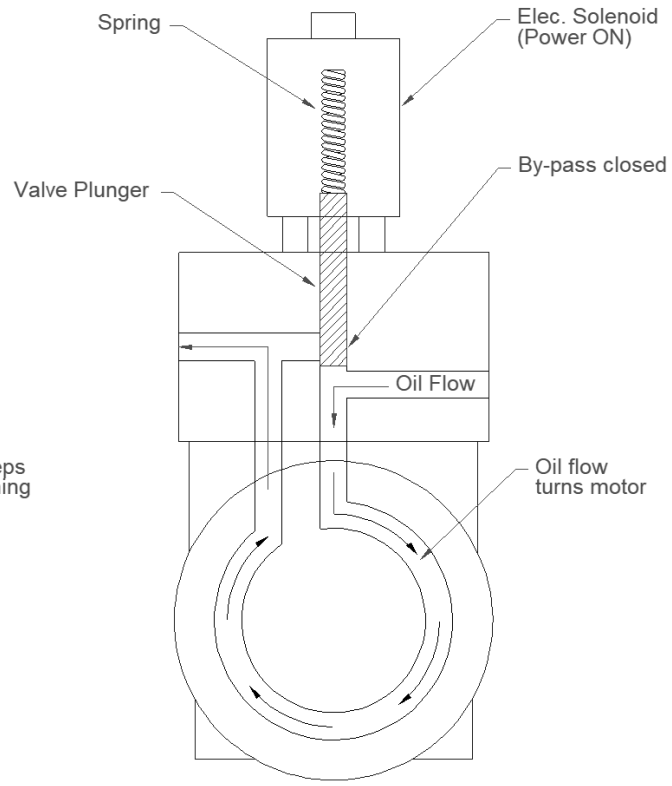


Fig. 2

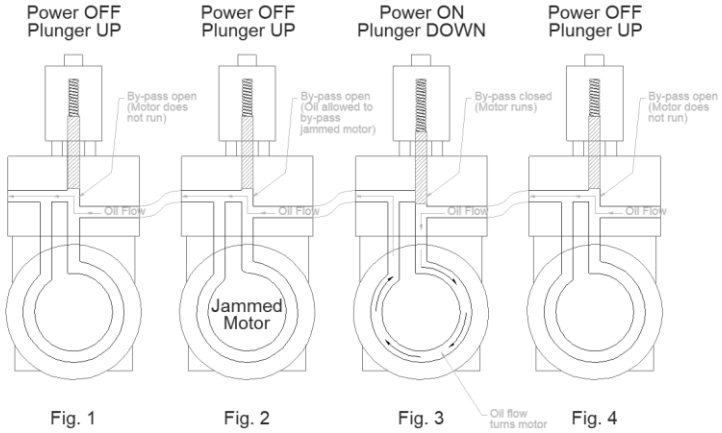
In Figure 1, electric current is off, the by-pass is open, which diverts hydraulic oil away from motor; therefore the motor does not run.
In Figure 2, Electric current activates magnetic solenoid. The solenoid closes the by-pass and directs oil flow to the hydraulic motor (motor runs).

All feedbox motors are connected in a hydraulic series, which means hydraulic oil flows from one motor to the next. Oil flow is the same regardless of how many motors are in the circuit. As the number of motors (rows) increase, oil pressure increases proportionally. Example: one motor requires 150 P.S.I., 4 motors require 600 P.S.I. Motors that are operating require pressure. Motors that are not operating (because solenoid has opened by-pass) will not increase pressure. Pressure will continuously vary, depending upon how many motors are operating at any given time. Because all motors are connected in a series, if one stalls because of a jammed feed chain, all motors will stall because oil flow will be blocked.

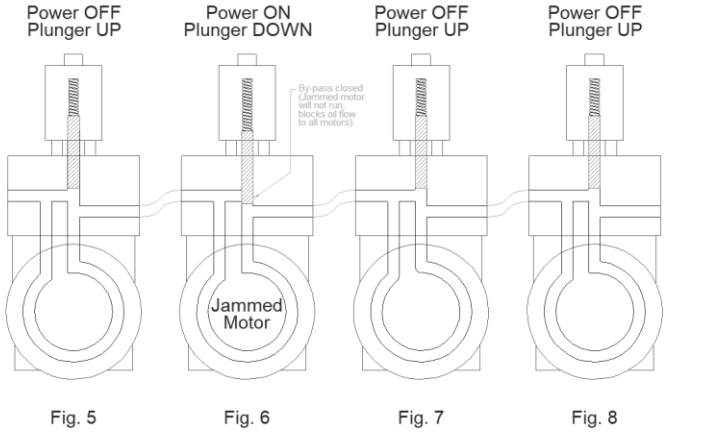
5.2.12 Feedbox Motor Testing

If a piece of seed or foreign material jams one feedbox motor, oil flow will be stopped, therefore all motors will stop. To determine which motor is jammed, follow this procedure:

1. Turn feed chain switch **OFF** on switchbox in cab.
2. Disconnect power wires (white) from all feedbox solenoids. Leave ground wire connected.
3. Turn feedbox chain switch **ON**.
4. Starting at one end of the planter, disconnect one bowl switch wire (blue) and connect it to feedbox solenoid. If feedbox runs, it is NOT the jammed motor. Disconnect the power wire and move on to the next feedbox solenoid.
5. Repeat step 4 until you encounter a motor that **DOES NOT** run when you connect the power wire. This is the jammed motor. Oil will not flow through a jammed motor. Refer to the diagrams below to visualize how the oil flow is directed by the solenoids.
6. Place all controls in NEUTRAL, stop engine, place tractor in PARK, remove key.
7. Remove the object that is causing the problem.
8. Repeat step 4 to check feedbox that was jammed. If it functions now, reconnect all other feedbox solenoids and continue planting.



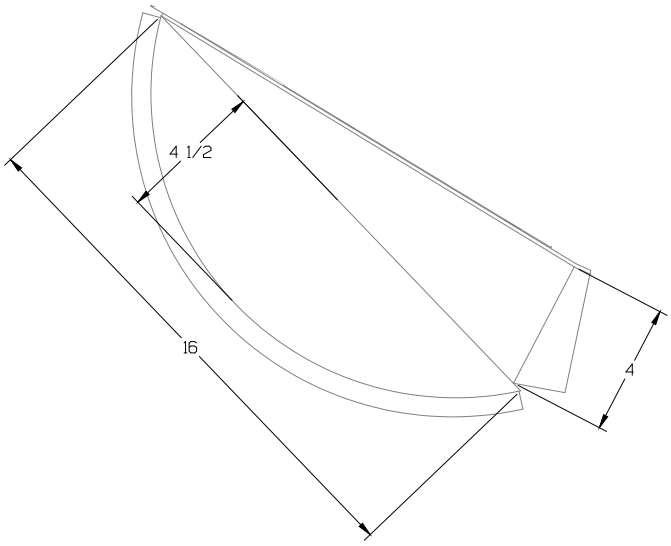
In Figures 1-4 above, Figure 2 is jammed. Power is connected to solenoid on Figure 3, which makes motor run. Oil can flow past jammed motor in Figure 2. Every motor that is not jammed will run when power is present at solenoid.

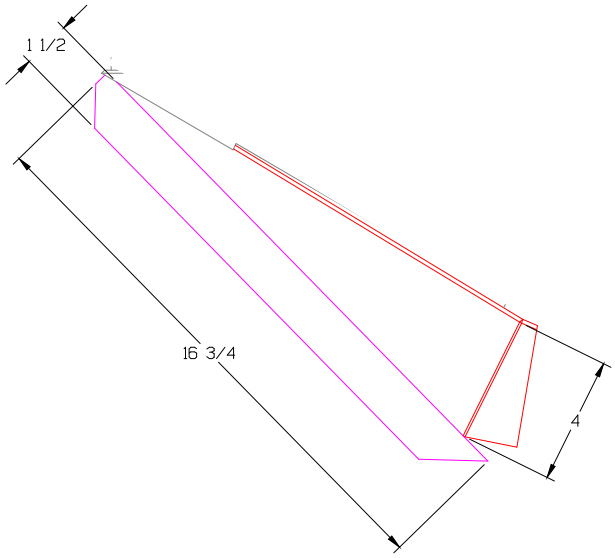


In Figures 5-8, Figure 6 is jammed. Power is connected to solenoid on Figure 6. Plunger is pushed down, attempting to force oil through the motor. Motor does not run. Because the motor is jammed, oil cannot flow through it.

5.2.13 Rebuilding Shoes

If you wish to build up worn planter shoes, the following figures show the approximate dimensions of new shoes.





5.2.14 Walking Beam Tracking/Adjustment

In order for the planter to follow the tractor properly the walking beams need to be adjusted properly. To properly adjust the walking beam:

1. Empty the seed / fertilizer tanks prior to adjusting tire toe and walking beams.
2. Position planter on smooth firm surface.
3. The tires need to have an 1/8" toe in on the tires for the walking beam to be straight
    a. Tires measure an 1/8" closer in the front than the rear.
4. In figure 1 measure the center of the tires on the front side and the backside to determine the position of the tire as shown on A.
5. Loosen the jam nut on both sides of the tie rod (B). Adjust the tie rod so the tires are 1/8" closer in the front than the rear.
6. After adjusting, retighten jam nuts on both sides of the tie rod.
7. Loosen the four bolts in Figure 2 (C). Use a square and a tape measure to center the walking beam on both sides (F). Tighten or loosen one side at a time to get desired measurement.
8. After adjusting retighten bolts to recommended torque, move planter 100' and recheck all measurements.

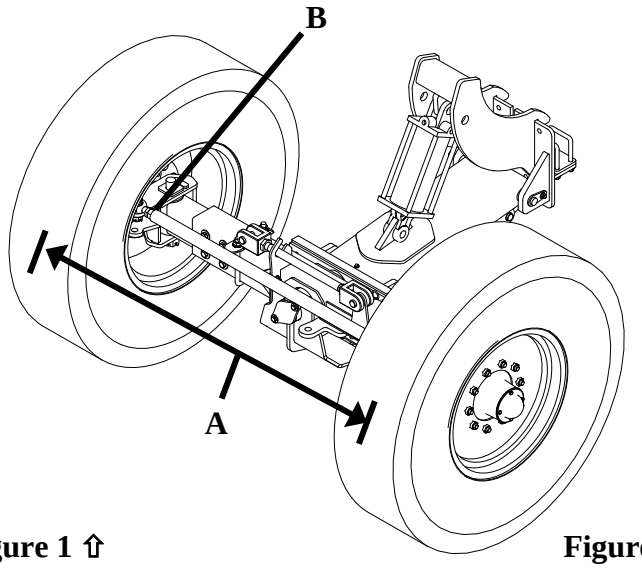
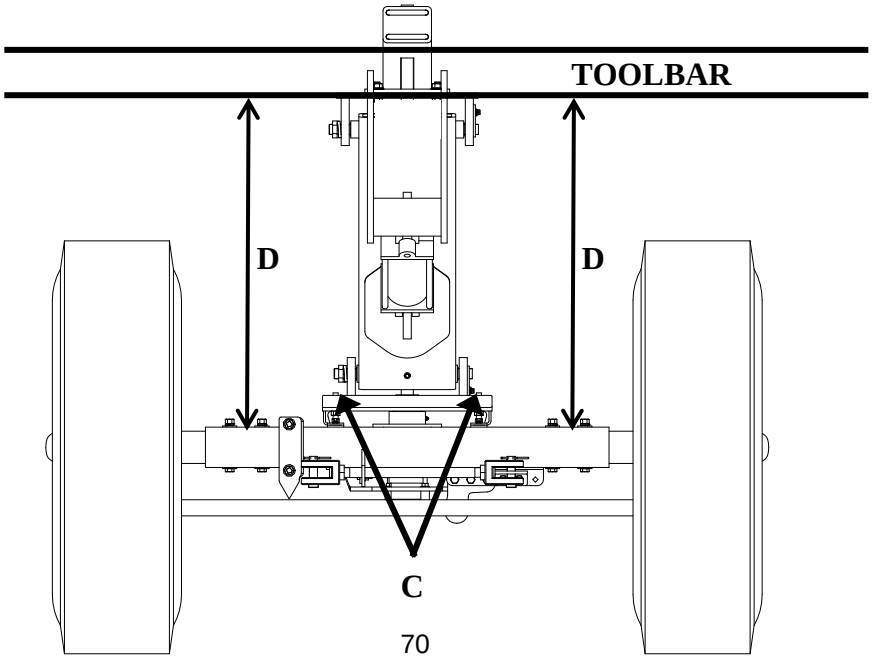


Figure 1 ⇧

Figure 2 ⇩

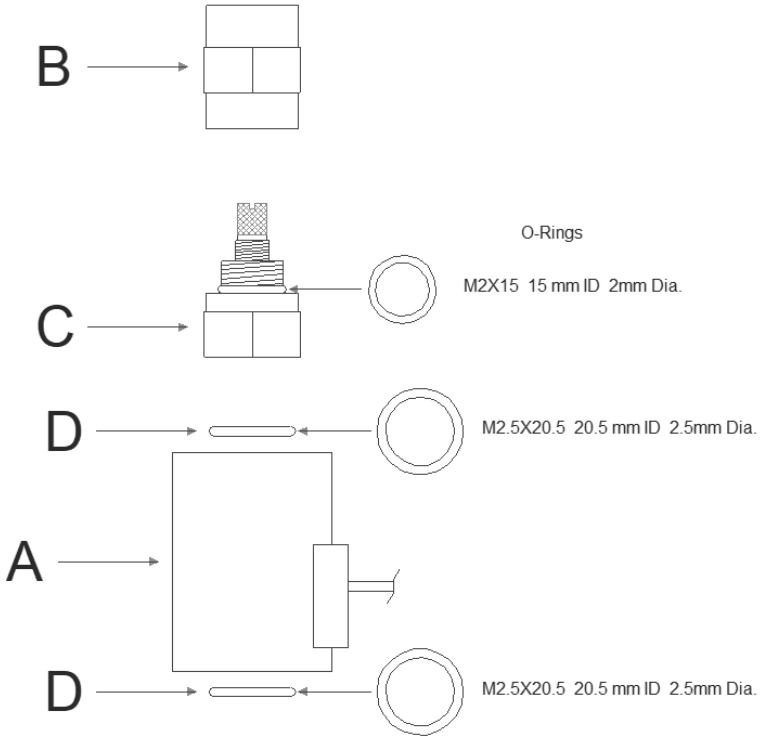


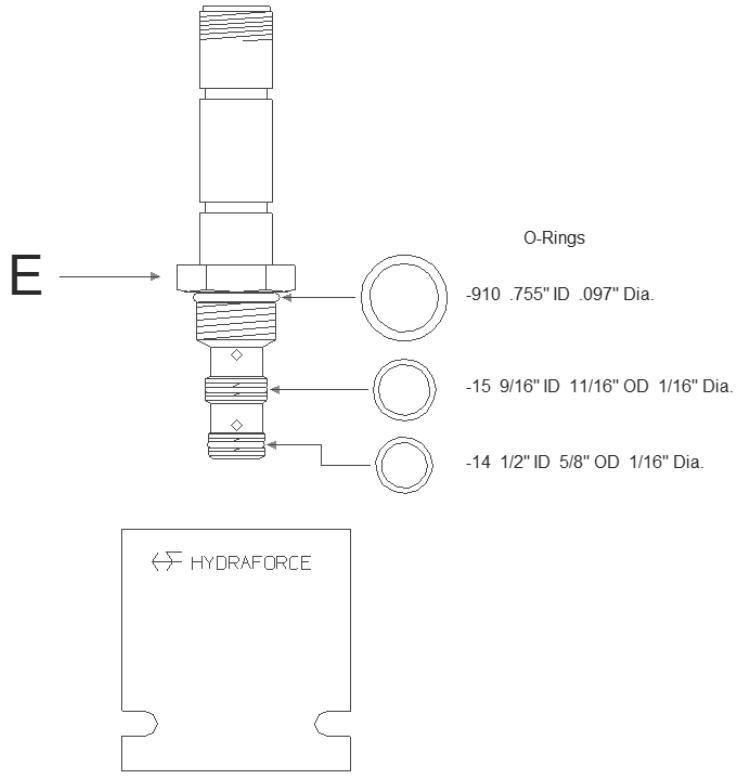
5.2.15 Servicing Pulse Width Modulating (PWM) Valve

If an oil leak develops in a PWM valve, there are O-Rings that can be replaced. Tolerances on the valve are very close. Any contamination, no matter how small, may cause the valve to malfunction. Follow these steps closely to disassemble/clean the valve. **DO NOT ATTEMPT IN FIELD**

1. Place all controls in NEUTRAL, stop engine, place tractor in PARK, remove key.
2. Clean area near valve. Wipe/use compressed air.
3. Remove valve from planter. Plug all hose connections or wrap tape over connections to prevent contamination.
4. Find a clean area to disassemble. Place the valve in a vise or clamp with the solenoid (A) in a horizontal position.
5. Lay out a clean cloth to place parts on.
6. Remove Top Cap nut (B), Secondary Cap (C), O-Rings (D), and electric solenoid from solenoid valve stem.
7. Using a 1-1/8" wrench, loosen solenoid valve stem (E).
8. Place solenoid valve stem on clean cloth.
9. Using compressed air, blow through valve body cavity. Clean all disassembled parts with compressed air. It is not recommended the parts be cleaned with solvent. This could make the parts dry & difficult to reassemble.
10. Replace damaged O-Rings.
11. Valve reassembly: Using clean hydraulic oil, lubricate valve body cavity and piston spool. **CAREFULLY** thread spool into valve body.
12. Tighten Valve Stem with 1-1/8” wrench.
13. **CAREFULLY** re-install electric solenoid, O-rings, secondary cap, and top cap.
14. Re-install valve on planter, making sure no contamination enters system.

Servicing Pulse Width Modulating (PWM) Valve - Continued

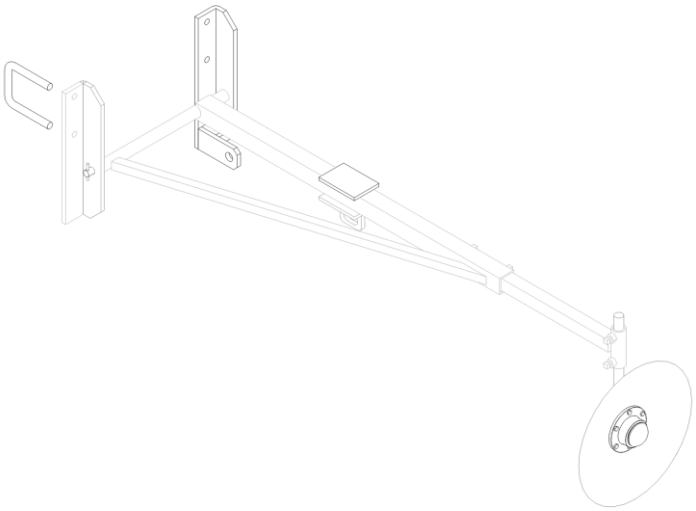




6 Optional Equipment

Optional equipment is available from your dealer or the factory. It can be part of the machine at the time of purchase or installed in the field. Optional equipment includes:

6.1 Row Markers



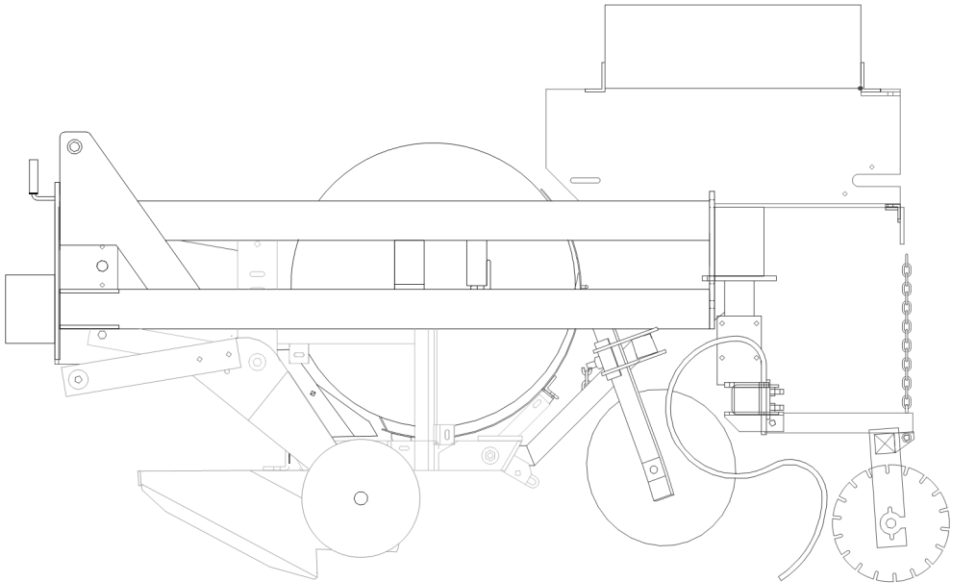
Row markers are used by the operator to define the required spacing when making the next pass.

1. They are mounted on the outside frame behind the frame stand.

2. Be sure the mounting bolts are tightened to their specified torque.

3. Route the hydraulic hoses along the frame and secure with clips or plastic ties to prevent damage.

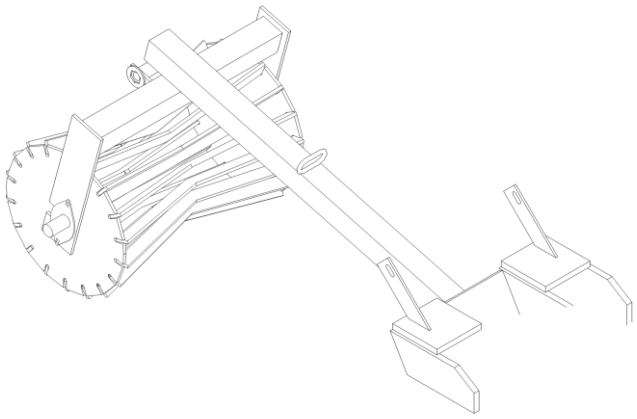
4. Connect the hoses to the sequencing valve that comes with the package. It allows the markers to operate with only one hydraulic circuit.



6.2 Packer Wheels

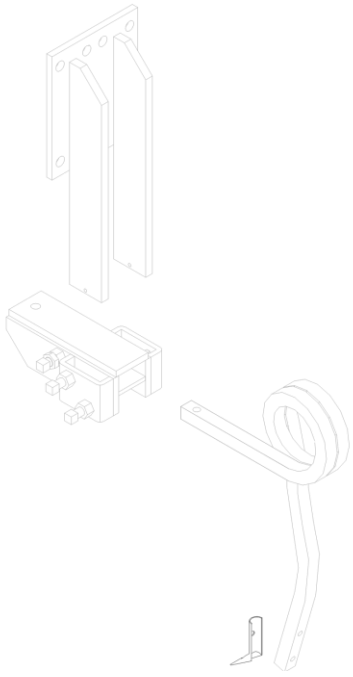
Packer wheels are mounted behind closing discs to help form and compact the rows. The roller floats behind the discs and is suspended on an adjustable chain.

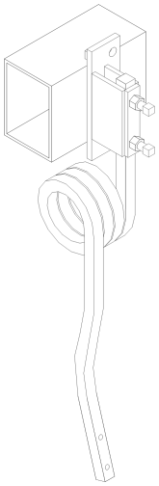
The use of packer wheels improves germination in loose dry soil conditions.



6.3 Horizontal Coil Ripper Shank

This ripper shank is used to break up the tractor tire track. It mounts on the front of the planter frame directly behind the tractor tire.



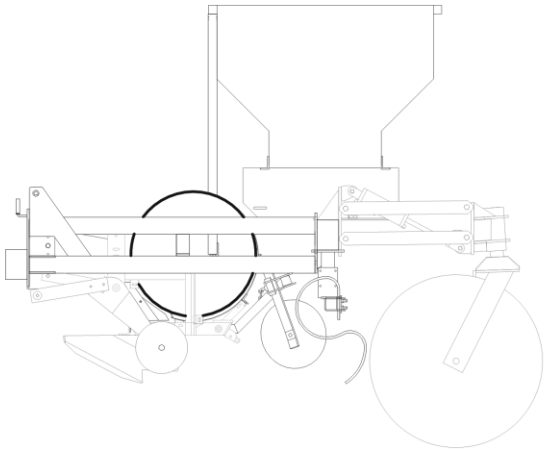


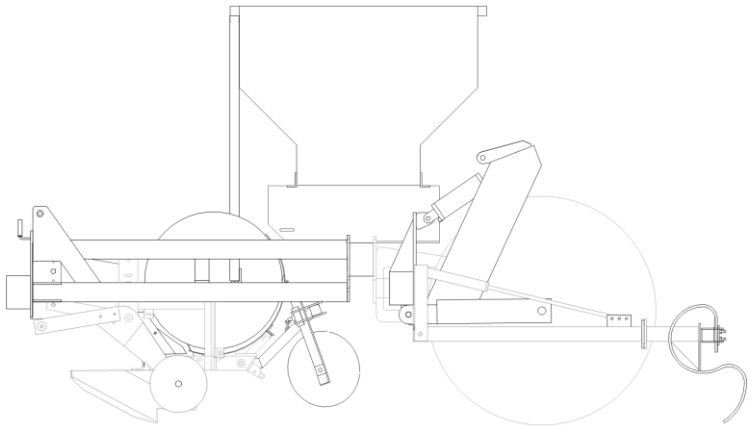
6.4 Trash Shank

In soil with heavy trash conditions, a toolbar mounted 1” flex coil shank can be used in front of each row unit. They are attached with an adjustable bracket.

6.5 Rear Ripper

This S-Tine is used to break up the tire track or break up the ground between all the rows.





7 Troubleshooting

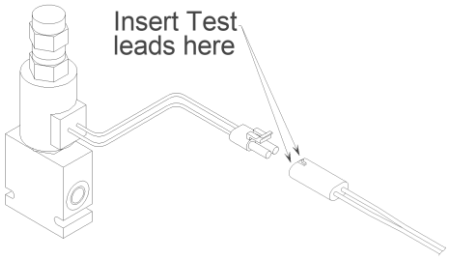
If you encounter a problem that is difficult to solve, even after having read through this trouble shooting section, please call your local dealer or the factory. Before you call, please have this Operator's Manual and the serial number from your planter ready.

7.1 Operating the Planter with a Failed Radar.

If your radar fails, you can set the monitor to manually override the control system. You may then run the planter, but you will need to travel at the manually programmed speed to plant with any degree of accuracy. Use the best means available to you to determine your ground speed.

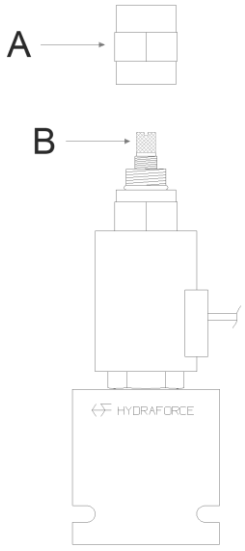
7.2 Testing PWM valves/wires.

If you have 2 or more channels setup on the planter & they all fail, the chances of the problem being caused by an individual PWM valve is slim, because the fertilizer channel will still run if the planter (seed) channel fails. Check for proper oil flow or wiring harness damage. Channel 1(seed) and the feedbox motors are plumbed hydraulically in series, so if the channel 1 valve fails, it will not allow oil to flow through to the feedbox motors & neither Channel 1 or the feedboxes will operate. Therefore, if the seed channel & the feedboxes fail, you have a problem with channel 1 (seed) PWM valve or valve wire. If channel 2 (fertilizer) fails, there is a problem with the channel 2 valve or wire.



If a channel stops, stop the planter, put hydraulic system in neutral, turn tractor off, & inspect all planter systems for an obstruction in the metering systems. If no obvious problems are found, follow these steps to test individual PWM valves and lead wires.

1. Turn power on to the console (leave the planter off).
2. Use a voltage meter to check the voltage between the two lines on the wire connector leading to the valve. There should be 11.6 to 12.6 volts. If this voltage cannot be maintained, check wiring harness for breaks or a loose connection.
3. If a reading of 12 volts is found, continue on with step 4.
4. From the main workscreen on the console, depress the number 8 soft-key and turn the radar override on.
5. Set the radar override to on & the manual ground speed to 4.0 (refer to page 31 For more information on Ground Speed setup).
6. Return to the main work screen on the console.
7. Remove the top cap on the faulty channel PWM valve (A)
8. Have an assistant depress the number 7 soft –key to start the planter.



⚠ WARNING

STAY CLEAR OF THE CLAMP WHEELS TO AVOID ENTANGLEMENT.
All necessary precautions must be taken to ensure user safety. Failure to practice all necessary caution may result in serious injury or death.

9. With a flat blade screwdriver, turn the manual adjusting screw (B) in (clockwise) a maximum of 4-1/4 turns or until you reach a dead stop.
10. If the channel runs, you have a faulty valve. Replace valve. If it does not run, shut the planter off & disconnect the drive motor (remove shear bolts on channel 1 or chains on channels 2-4).
11. Try running the planter again. If motor runs, stop the planter, put hydraulic system in neutral, turn tractor off, & inspect all planter systems again for an obstruction in the metering systems.
12. Re-configure your ground speed override to off.
13. Turn on channels that were previously turned off.

7.3 Testing Encoders/wires.

Perform the following steps to test an encoder.

1. Unplug the wire connector leading to the encoder to be checked.
2. With the planter & the hydraulic system off, turn power on to the console.
3. Using a voltage tester, touch test leads to the RED & BLACK wires on the wire connector. There should be 11.6 to 12.6 volts. If this voltage cannot be maintained, check wiring harness for breaks or a loose connection.
4. If a reading of 12 volts is found, inspect the lead wires going across the planter. If no damage is found, replace the encoder.

7.4 Machine Troubleshooting

PROBLEM	CAUSE	SOLUTION
All hydraulic feedbox drives do not run	Hydraulic lever on tractor in neutral position.	Place hydraulic lever in work position.
NOTE: this will not indicate an electrical problem	Hydraulic hose not connected.	Plug hose into tractor
NOTE: Hydraulic feed is equipped with a one way check valve to prevent system from running in reverse	Operator is attempting to operate hydraulic drive in reverse.	Run hydraulic drive in proper direction.
	One way check valve malfunctioning	Replace check valve. (Valve is located behind hydraulic coupler on inlet line).
	Malfunctioning hydraulic coupler.	Check coupler for foreign object, replace if necessary
	Malfunctioning tractor hydraulic coupler	Plug couplers into another valve if available, check with tractor dealer.
	Hydraulic flow control set too low or shut off.	Increase hydraulic flow
	Main wire harness is broken/unplugged	Repair broken wire. Plug wire harness back in
One seed feedbox drive does not run, all others O.K.	Malfunctioning bowl level control switch.	Clean the face of the sensor
		If unit doesn't run while in "ON" position, replace switch
	Object wedged in feed chain	Remove wedged object
	Malfunctioning hydraulic motor	Replace hydraulic motor
	Broken drive chain	Repair or replace chain
	Malfunctioning solenoid valve on hydraulic motor	Replace solenoid
One seed feedbox drive runs continuously, all others normal	(No power at switch). Broken or unplugged wire between junction box and row unit switch	Plug wire back in. Repair broken wire. Correct problem that broke wire.
	(Power at sensor). Bad sensor	Replace sensor
	(Power at switch, no power at solenoid). Broken wire between junction box and solenoid.	Repair broken wire, correct problem that broke wire.
	Dirty sensor	Clean the face of the sensor

MACHINE TROUBLESHOOTING CONT.

PROBLEM	CAUSE	SOLUTION
All hydraulic drives do not run	Defective ON/OFF switch	Replace switch
NOTE: When checking for electrical problems, it is suggested that a continuity tester and test light be used.	Fuse blown	Replace fuse. Check for cause of blown fuse
	Main wire harness is broken/unplugged	Repair broken wire. Plug wire harness back in
Planter has too many misses, empty clamp arms	Bent or broken clamp arms	Replace clamp arms. Find the reason for damaged clamp arms.
	Cams not set properly for seed size	Adjust cam pick up point
	Planting speed too slow	Increase planting speed
	Seed cutter not set properly	Readjust seed cutter
Planter picking up too many doubles	Bent clamp arms	Replace arms. Determine cause of bending to prevent further damage.
	Seed cut too small	Readjust seed cutter
	Cams not set properly for seed size	Adjust cam pick up point
	Too much seed in the bowl	Reduce level of seed in the bowl. See page35.
Planter wheel carry seed around that is not on clamps	Planting speed too fast	Slow down planting speed
	Too much seed in the bowls	Reduce level of seed in the bowl. See page 35.
Feed chains constantly overfill the seed bowl	Feed chain running too fast	Slow down feed chain
	Bowl level set too high	Reduce level of seed in the bowl. See page 35.
One or more clamp arms not opening	Missing Cam Roller	Replace cam roller
	Broken arm, misadjusted cam	Replace clamp arm
	Misadjusted Cam	Adjust cam
	Broken Spring	Replace clamp assembly spring

MACHINE TROUBLESHOOTING CONT.

PROBLEM	CAUSE	SOLUTION
One or more clamp arms not closing	Broken clamp arm spring	Replace spring
	Damaged clamp arm	Replace clamp arm
	Foreign object wedged behind clamp arm	Remove object
Soil plugging between gauge wheels and planter shoe	Too much debris in field	Rework field if possible
Uneven planting depth	Front of planter frame too low	Lift planter hitch slightly
	Field conditions too soft	Rework field to improve seedbed
One row unit not planting all, other normal	Broken shear bolts	Replace shear bolts See page 64.
Poor seed placement.	Planting too fast	Try planting at lower speeds
	Worn planter shoe	Rebuild or replace shoe
	Closing discs are set too deep	Set closing discs to a shallower position
Seed piece depth uneven	Closing discs set too close together	Readjust closing discs
	Closing disc angle too steep	Readjust closing discs
	Front of planter frame is too low	Raise front of planter slightly

7.4.1 HARRISTON DRIVE CONTROL SYSTEM TROUBLE SHOOTING

PROBLEM	CAUSE	SOLUTION
Console will not turn on	Console not connected to 12V.	Console must be connected to 12V. Console must be connected directly to battery. **Do not** connect to convenience outlet in tractor.
	Broken wire.	Check all connections. Repair broken wire.
	Poor or corroded connection	Clean connection. Always coat electrical connections with dielectric grease Replace corroded wire.
	Blown fuse	Find cause of blown fuse. Replace fuse.
Console comes on momentarily, no display	Poor battery connections	Clean / repair connections as needed.
	Weak tractor battery	Console must have 12 V. D.C. Charge or replace battery as needed.
Console turns on, no response from planter	No hydraulic flow	Be sure tractor hydraulics are on. Check for hydraulic flow. Hoses must be plugged into tractor correctly (check-valve is on inlet hose).
	Main cable or valve wire disconnected	Check all wire connections.
	Console not properly programmed	Check all program numbers.
	Console wires not connected to battery.	Console must be connected directly to battery. Do not connect to convenience outlet in tractor.
Console works with radar override on, not when radar override is off	Radar disconnected	Connect radar cable
	Radar not properly mounted	Radar must have clear view

HARRISTON CONTROL SYSTEM TROUBLE SHOOTING

PROBLEM	CAUSE	SOLUTION
Planter runs properly in test speed, does not respond to forward movement	Radar disconnected	Check radar cable.
	Defective radar	Replace radar.
	Defective interface cable (when using tractor radar)	Repair or replace interface cable.
Console speed does not read the same as tractor speed, seed spacing does not match rate chart	Incorrect Ground Speed Calibration number	See programming section (page 36) for help calibrating Ground Speed Calibration value.
Planter runs correctly in manual - starts, stops, or does not hold constant speed in "Auto"	Encoder improperly seated	See instructions for properly seating encoder. Page 42.
	Defective encoder	Replace encoder
	Defective PWM Valve	Replace valve
Console does not maintain constant speed in field	Poor connection on radar cable	Check/clean connection on radar cable.
	Radar incorrectly mounted	Radar must be mounted clear of obstructions
	Defective or incorrect radar interface cable from tractor radar	Contact Harriston Industries for correct interface cable.
	Defective radar	Replace radar.
System does not respond to increase in field speed	Tractor oil flow set too low	Increase tractor oil flow approx. 10%.
Planter does not stop completely when tractor stops, does not correlate with ground speed when slowing down	Tractor oil flow set too high	Reduce oil flow from tractor in approx. 10% increments until problem is corrected. Oil flow should be set at a Max. of 10 G.P.M.
	PWM Valve defective	Replace PWM Valve.
Planter creeps when stopped.	Tractor hydraulic flow set too high	Reduce hydraulic flow from tractor.
	Defective hydraulic valve	Replace hydraulic valve.

HARRISTON DRIVE CONTROL SYSTEM TROUBLE SHOOTING

PROBLEM	CAUSE	SOLUTION
Planter creeps when Master Switch is off (Tractor standing still)	Tractor oil flow set too high	Reduce tractor oil flow by approx. 10%
	Defective PWM Valve	See section on servicing PWM Valve (page 71) or replace defective valve
Planter drive does not work or works incorrectly after rain or period of non-use	Loose or corroded wire connections	Disconnect and clean all connections with electrical contact cleaner. Coat all connections with dielectric grease. Reconnect & tighten all connections
	Moisture has entered damaged wiring cable	Locate damaged cable, repair or replace as required. Coat all connections with dielectric grease.
Planter will not stay at target rate when speed increases	Hydraulic oil flow too low	Increase Hydraulic oil flow in 10% increments until planter stays at target rate at desired planting speed. **Do not** set higher than 10 G.P.M..
Alarm sounds	One or more rows not planting	Correct planting problem Check seed level Check feed chain Check row unit drive
	Monitor eye(s) dirty	Clean eye(s)

Harriston Service Department
1-800-437-8205

8 Shipping and Assembly

If the machine is shipped by truck, certain components are removed to bring the unit to the legal transport width. Although the machine is heavy, it is not difficult to handle by following this procedure:

1. Clear the area of bystanders.

2. Spread the forks on the forklift as wide as possible to match the frame clearance points.

3. Drive the forklift to the machine and slide the forks under the frame but away from moving parts. Do not lift on any of the row units or drives.

4. Attach a couple of chains or slings between the frame and mast to prevent tipping.

5. Lift slightly to tighten the chains.

6. If using a crane or hoist, attach chains to frame at 3 or 4 locations to prevent tipping.

7. Lift slightly to tighten the chain.

8. Loosen and release all machine tie-downs.

9. Slowly raise the machine to lift it slightly above the truck bed.

10. Be sure the unit is balanced before moving.

11. Raise the machine until the truck bed is cleared.

CAUTION

1. Keep bystanders away.

2. Use a forklift, crane, or hoist with adequate lift capacity and stability to handle the machine.

3. Securely chain the frame to the lifting device before moving.

4. Use 2 men when handling the machine.

12. Back slowly always and carefully move to the assembly area. Carry close to the ground when moving to minimize the tendency to tip.

13. Lower the machine to the ground at the assembly site but do not unhook until the rear wheels are mounted.

ASSEMBLY

1. Open the crate and cartons containing the attaching components and mounting hardware.

2. Determine the machine row spacing required.

3. Mark the center of the frame and measure toward each end to establish the positions for the rear wheels.

4. Install the rear wheels and tighten the U-bolts to their specified torque.

5. Be sure the frame stands are pinned in their supporting position.

6. Lower the machine to the ground and remove chains or slings.

7. Tighten all U-bolts to their specified torque.

8. Install the rear platform and ladder and tighten mounting bolts to their specified torque.

9. Install optional equipment as required. The Harriston potato planter uses hydraulic drive to transmit power to a series of clamps that select and meter seed for planting. It is a simple and reliable system that requires minimal maintenance.

9 SPECIFICATIONS

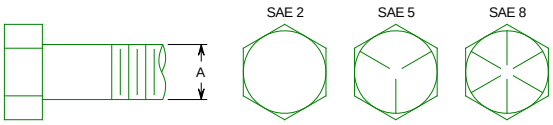
9.1 Bolt Torque

CHECKING BOLT TORQUE

The tables shown below give correct torque values for various bolts and capscrews. Tighten all bolts to the torques specified in chart unless otherwise noted. Check tightness of bolts periodically, using bolt torque chart as a guide. Replace hardware with the same strength bolt.

ENGLISH TORQUE SPECIFICATIONS

Bolt Diameter	Bolt Torque SAE 2		SAE 5		SAE 8	
"A"	N.m.	(lb-ft)	N.m.	(lb-ft)	N.m.	(lb-ft)
1/4"	8	(6)	12	(9)	17	(12)
5/16"	13	(10)	25	(19)	36	(27)
3/8"	27	(20)	45	(33)	63	(45)
7/16"	41	(30)	72	(53)	100	(75)
1/2"	61	(45)	110	(80)	155	(115)
9/16"	95	(70)	155	(115)	220	(165)
5/8"	128	(95)	215	(160)	305	(220)
3/4"	225	(165)	390	(290)	540	(400)
7/8"	230	(170)	570	(420)	880	(650)
1"	345	(225)	850	(630)	1320	(970)



Torque figures indicated above are valid for non-greased or non-oiled threads and heads unless otherwise specified. Therefore, do not grease or oil bolts or capscrews unless otherwise specified in this manual. When using locking elements, increase torque values by 5%.

* Torque value for bolts and capscrews are identified by their head markings.

9.2 Hydraulic Fitting Torque

TIGHTENING FLARE TYPE TUBE FITTINGS *

1. Check flare and flare seat for defects that might cause leakage.
2. Align tube with fitting before tightening.
3. Lubricate connection and hand tighten swivel nut until snug.
4. To prevent twisting the tube(s), use two wrenches. Place one wrench on the connector body and with the second tighten the swivel nut to the torque shown.

Tube Size OD	Nut Size Across Flats	Torque Value*		Recommended Turns to tighten (After finger tight)	
(Inch)	(Inch)	(N.m.)	(lb-ft)	(Flats)	(Turns)
3/16	7/16	8	6	1	1/6
1/4	9/16	12	9	1	1/6
5/16	5/8	16	12	1	1/6
3/8	11/16	24	18	1	1/6
1/2	7/8	46	34	1	1/6
5/8	1	62	46	1	1/6
3/4	1-1/4	102	75	3/4	1/8
7/8	1-3/8	122	90	3/4	1/8

* The torque values shown are based on lubricated connections as in reassembly.

9.3 Mechanical

		4 Row	6 Row	8 Row
Height	Without Hopper Ext. With Hopper Ext.	7’ 8” (2.3m) 8’ 8” (2.6m)	7’ 8” (2.3m) 8’ 8” (2.6m)	7’ 8” (2.3m) 8’ 8” (2.6m)
Width		16’ 8” (5.0m)	21’ 8” (6.6m)	36” Rows 25’ 4” (7.8m) 40” Rows 28’ 0” (8.5m)
Length	Pull Type Front to Rear In Field Position	18’ 0” (5.5m)	18’ 0” (5.5m)	19’ 2” (5.8m)
Weight	Empty (Estimated)	7,600 lbs. (3455 kg)	11,900 lbs. (5409 kg)	15,600 lbs. (7090 kg)
Seed Capacity (without ext.)		70 cwt.	112 cwt.	150 cwt.
Recommended Tractor H.P. (Minimum)		90	130	160
Tires (Gauge Wheel)		4.80 x 4.00 x 8” 50 psi (345 kPa)	4.80 x 4.00 x 8” 50 psi (345 kPa)	4.80 x 4.00 x 8” 50 psi (345 kPa)
Seed Spacing		Hydraulic Drive	Hydraulic Drive	Hydraulic Drive
Planting Capacity		Up to 7 acres/hour (2.8 ha/hour)	Up to 12 acres/hour (4.8 ha/hour)	Up to 16 acres/hour (6.5 ha/hour)
Planting Speed		4 to 6.5 mph (6 to 11 km/h) recommended speed		

****SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE****

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