Cub Cadet

Professional Shop Manual

LTX Series Riding Tractors

NOTE: These materials are for use by trained technicians who are experienced in the service and repair of outdoor power equipment of the kind described in this publication, and are not intended for use by untrained or inexperienced individuals. These materials are intended to provide supplemental information to assist the trained technician. Untrained or inexperienced individuals should seek the assistance of an experienced and trained professional. Read, understand, and follow all instructions and use common sense when working on power equipment. This includes the contents of the product's Operators Manual, supplied with the equipment. No liability can be accepted for any inaccuracies or omission in this publication, although care has been taken to make it as complete and accurate as possible at the time of publication. However, due to the variety of outdoor power equipment and continuing product changes that occur over time, updates will be made to these instructions from time to time. Therefore, it may be necessary to obtain the latest materials before servicing or repairing a product. The company reserves the right to make changes at any time to this publication without prior notice and without incurring an obligation to make such changes to previously published versions. Instructions, photographs and illustrations used in this publication are for reference use only and may not depict actual model and component parts.

Table of Contents

Chapter 5: Hydro. Drive and brake system

Chapter 6: CVT Drive and brake system

Chapter 7: electrical system

Chapter 8: Cutting Decks and lift shaft

Hydro-gear Appendix

CHAPTER 1: INTRODUCTION

Professional Shop Manual intent

This Manual is intended to provide service dealers with an introduction to the mechanical aspects of the LTX series of tractors.

- Detailed service information about the engine will be provided by the engine manufacturer, in most cases.

Disclaimer: The information contained in this manual is correct at the time of writing. Both the product and the information about the product are subject to change without notice.

About the text format:

NOTE: is used to point out information that is relevant to the procedure, but does not fit as a step in the procedure.

- Bullet points: indicate sub-steps or points.

CAUTION	Caution is used to point out potential danger to the technician, operator, bystanders, or surrounding property.

WARNING	Warning indicates a potentially hazardous situation that, if not avoided, could result in death of serious injury.

DANGER	Danger indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

Disclaimer: This manual is intended for use by trained, professional technicians.

- Common sense in operation and safety is assumed.
- In no event shall MTD or Cub Cadet be liable for poor text interpretation or poor execution of the procedures described in the text.
- If the person using this manual is uncomfortable with any procedures they encounter, they should seek the help of a qualified technician or Cub Cadet Technical Support.

Fasteners

- Most of the fasteners used on these mowers are sized in fractional inches. The engine and transmissions are metric. For this reason, wrench sizes are frequently identified in the text, and measurements are given in U.S. and metric scales.
- If a fastener has a locking feature that has worn, replace the fastener or apply a small amount of releasable thread locking compound such as Loctite® 242 (blue).
- Some fasteners like cotter pins are single-use items that are not to be reused. Other fasteners such as lock washers, retaining rings, and internal cotter pins (hairpin clips) may be reused if they do not show signs of wear or damage. This manual leaves that decision to the judgement of the technician.

CAUTION

- Be prepared in case of emergency:
  - Keep a fire extinguisher nearby
  - Keep a first aid kit nearby
  - Keep emergency contact numbers handy
- Replace any missing or damaged safety labels on shop equipment.
- Replace any missing or damaged safety labels on equipment being serviced.

WARNING

- Grooming and attire:
  - Do not wear loose fitting clothing that may become entangled in equipment.
  - Long hair should be secured to prevent entanglement in equipment.
  - Jewelry is best removed.
- Protective gear: includes, but is not limited to
  - Clear eye protection ..... while working around any machinery
  - Protective gloves ..... where necessary
  - Armored footwear ..... when working around any machinery
  - Hearing protection ..... in noisy environments
  - Chemically resistant gloves ..... when working with chemicals or solvents
  - Respirator ..... when working with chemical or solvents
  - Appropriate tinted eye protection..... when cutting or welding
  - Flame resistant headgear, jacket, chaps . when cutting or welding

CAUTION

- Remember that some hazards have a cumulative effect. A single exposure may cause little or no harm, but continual or repeated exposure may cause very serious harm.
- Clean spills and fix obviously dangerous conditions as soon as they are noticed.
- Lift and support heavy objects safely and securely.
- Be aware of your surroundings and potential hazards that are inherent to all power equipment. All the labels in the world cannot protect a technician from an instant of carelessness.

DANGER

- Exhaust fumes from running engines contain carbon monoxide (CO). Carbon monoxide is a colorless odorless gas that is fatal if inhaled in sufficient quantity. Only run engines in well ventilated areas. If running engines indoors, use an exhaust evacuation system with adequate make-up air ventilated into the shop.

Assembly

Torque specifications may be noted in the part of the text that covers assembly, they may also be summarized in tables along with special instructions regarding locking or lubrication. Whichever method is more appropriate will be used. In many cases, both will be used so that the manual is handy as a quick-reference guide as well as a step-by-step procedure guide that does not require the user to hunt for information.

The level of assembly instructions provided will be determined by the complexity of disassembly/reassembly, and by the potential for unsafe conditions to arise from mistakes made in assembly.

Some instructions may refer to other parts of the manual for subsidiary procedures. This avoids repeating the same procedure two or three times in the manual.

Description of the 900 series

The 900 series is a new tractor platform introduced in the 2009 season. This platform replaces the traditional 600 series tractor. See Figure 1.1.

Figure 1.1

New for the 900 series is:

- New stronger frame
- New hood and grill designs
- A new 42” timed deck
- A new 2 blade 46” deck
- Tighter turning radius

Model and Serial Numbers

The model and serial number tag can be found under the seat. See Figure 1.2.

The serial number is located to the right of the model number as shown above. See Figure 1.2.

Figure 1.2

The model number is 13AX90AR010 The break down of what the character mean is as follows:

1 ..... Cuts grass
....3 ..... Lawn tractor
.....A. ..... Sales level/type of create
.....X. ..... Engine code
.....9. ..... Frame
.....0 ..... Drive system
.....A ..... Hood style
.....R..... Deck (S = 42”, T = 46”, P=50”, R=42” timed deck)
.....056 ..... Customer number

The serial number is 1J078H30003. The serial number reads as follows:

1 ..... Engineering level
..J..... Month of production (J = October)
.....07 ..... Day of the month
.....8 ..... Last digit of the year
.....H..... Plant it was built in (Martin, TN)
.....3 ..... Assembly line number
.....0003 ..... Build number of unit

CHAPTER 2: ENGINE RELATED PARTS

This manual will cover the engine accessories that are manufactured by Cub Cadet.

IMPORTANT: Refer to the engine manufacturer's manual for engine specific service information.

Muffler

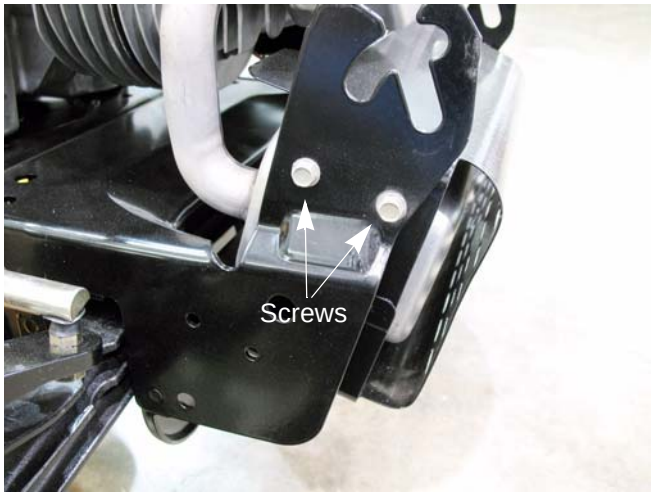

Figure 2.1

Remove the muffler by following these steps:

NOTE: The muffler and the exhaust pipes are welded together. They are replaced as one assembly.

1. Remove the hood and bumper by following the steps described in Chapter 4: Body/Chassis.
2. Remove the two screws on each side that secure the muffler guard bracket. See Figure 2.1.

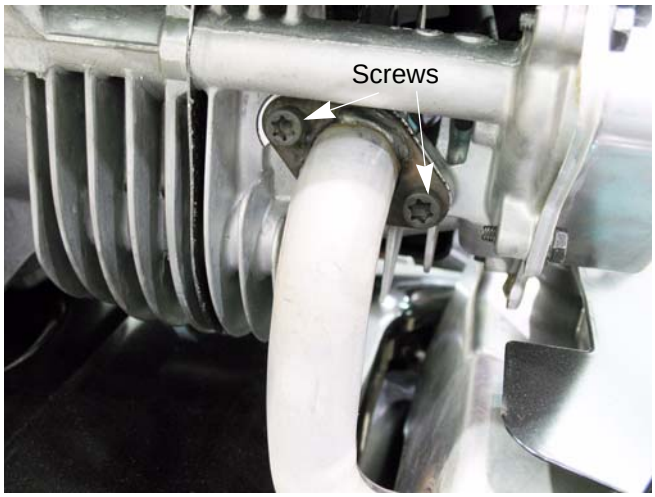

Figure 2.2

3. Disconnect the muffler from the engine:

For single cylinder engines:

- Remove the two screws that secure the exhaust pipe to the cylinder head. See Figure 2.2.

- Remove the screw that fastens the muffler support bracket to the cylinder head. See Figure 2.3.

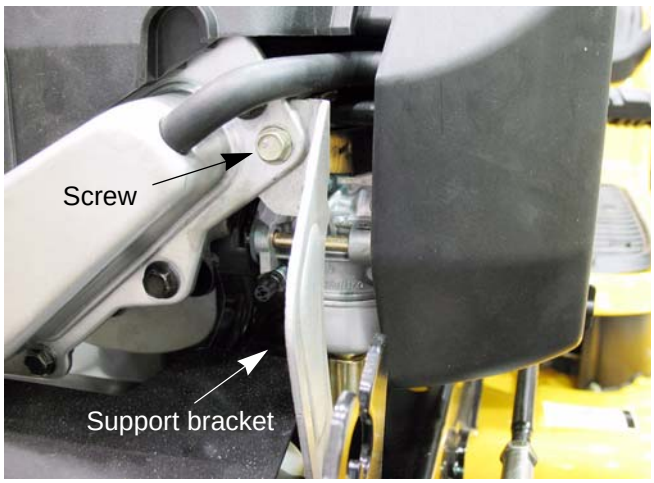

Figure 2.3

For twin cylinder engines:

- Remove the two nuts that secure each exhaust pipe to the cylinder head. See Figure 2.4.

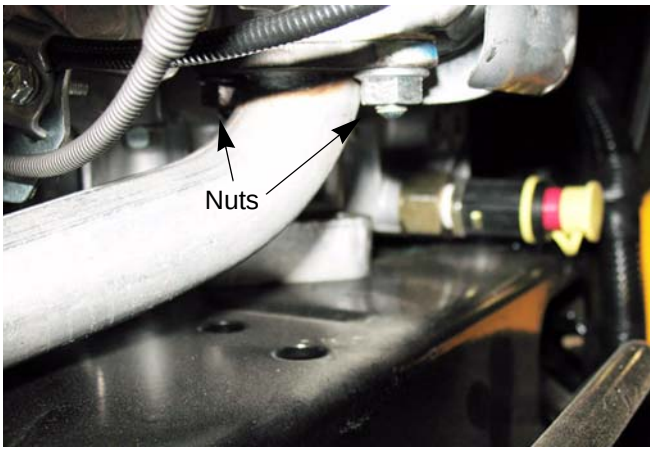

Figure 2.4

Figure 2.5

4. Pull the muffler cover and muffler out together.
5. Rotate the muffler out of the muffler cover. See Figure 2.5.

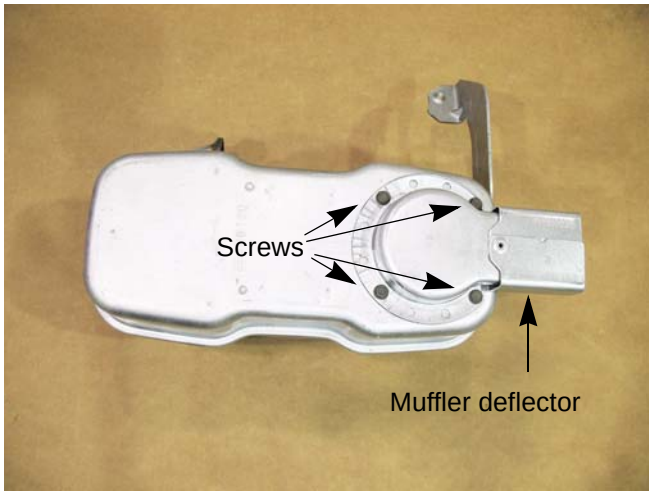

Figure 2.6

6. With the muffler on a work bench, remove the four screws that hold the muffler deflector to the muffler. See Figure 2.6.
7. Install the muffler by following the above steps in reverse order.
8. Test run the tractor before returning to service.

Fuel tank removal/replacement

Remove/replace the fuel tank by following these steps:

> **⚠CAUTION** Gasoline and its vapors are extremely flammable. Use common sense when working around the fuel system.

- Work in a well-ventilated area.
- Allow the engine to cool fully before starting work on the tractor.
- Eliminate any sources of possible ignition from the work area, including but not limited to: heat sources, open flame, potential sparks.
- Clean-up any spilled fuel quickly and properly, disposing of cleaning materials in a way that will not produce a further fire hazard.
- Hold any drained fuel in an approved and safe container.

1. Open the hood.
2. Drain the fuel in the fuel tank into an approved container.

   NOTE: The tank may be drained by mechanical syphon or by disconnecting the fuel line from the fuel filter.
3. Disconnect the fuel tank vent hose from the roll over valve (if equipped).
4. Remove the four screws that secure the fuel tank support rod. See Figure 2.7.
5. Work the fuel tank support bracket off of the tractor
6. Slide the fuel tank out from between the dash and the engine.

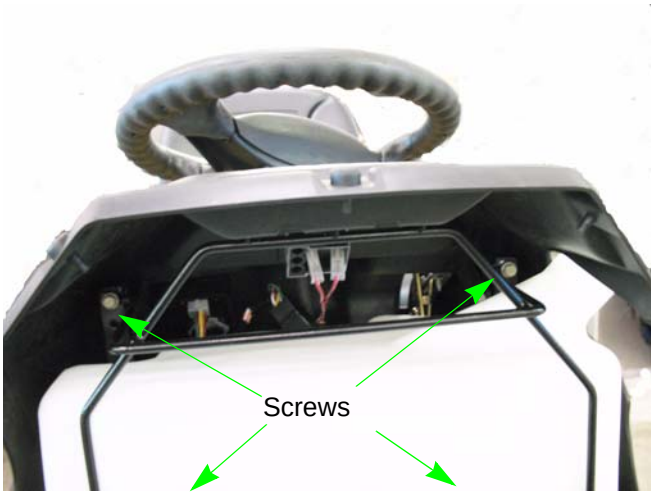

Figure 2.7

7. Remove the fuel line clamp and slide the fuel line off of the fuel tank nipple.

   NOTE: The fuel tank has a barbed fitting. Anytime a fuel line is removed from a barbed fitting it should be replaced because of the damage caused to the fuel line liner.
8. Install the fuel tank by following the above steps in reverse order.
9. Test run the tractor and check for leaks before returning to service.

Fuel Line

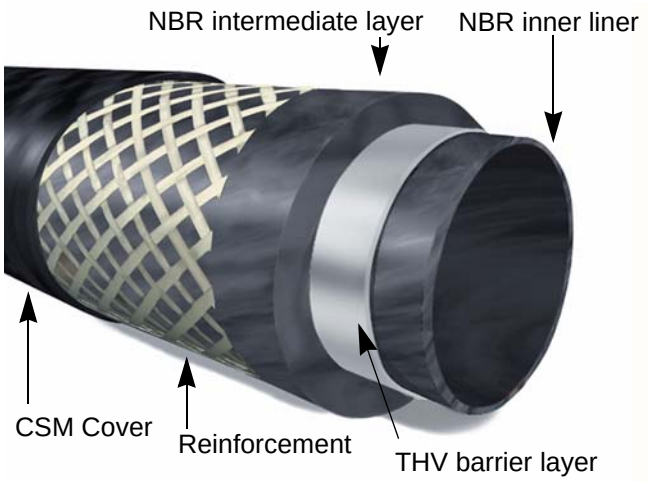

Figure 2.8

Picture courtesy of Avon Automotive

The fuel line used by Cub Cadet is GREENbar™. This is a multi-layer fuel line that meets the current EPA guidelines.

NOTE: This fuel line has a thin inner liner. If a tear forms in this inner liner, fuel can get between the liner and the hose. This will cause the liner to collapse, cutting off the fuel flow.

NOTE: Replace the fuel line only with GREENbar™ 700 series fuel line.

Evaporative (EVAP) emissions system

The EPA has enacted rules that regulate the amount of vapors an engine's fuel system is allowed to vent to the atmosphere. The rules are know as Tier III Emissions Standards. These rules apply to all engines built on or after 1/1/2012. Some of the requirements of tier III emissions include:

- Tethered fuel caps.
- Unvented fuel caps.
- Low permeation (GREENbar^{TM}) fuel line
- Roll over valve vents

The fuel tank has an unvented fuel cap. The fuel tank vents through the roll over valve. The vapors will flow through the vent hose (black hose with a red trace) to the engine. See Figure 2.9.

The EVAP system, from the fuel tank up to the engine connector, is a Cub Cadet system, meaning warranty and parts are handled by Cub Cadet.

The engine side of the system varies by engine manufacturer, but on most engines the vent hose will go to the air intake manifold.

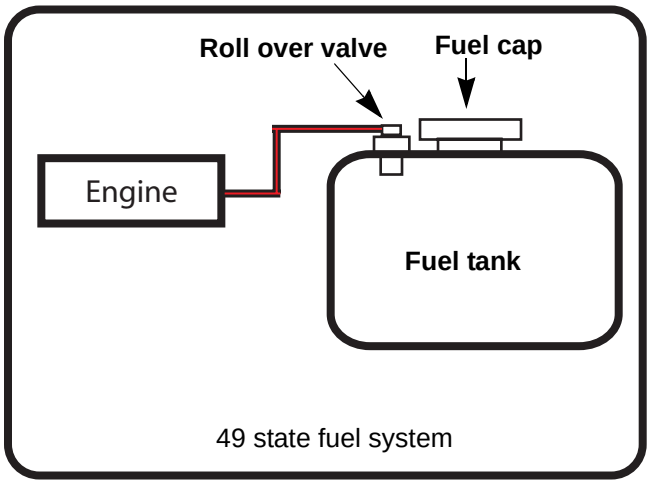

Figure 2.9

NOTE: Units sold in California will have a charcoal canister to further reduce the amount of emissions that escape from the fuel system.

The fuel tank will vent through the charcoal canister. The charcoal in the canister will act as a filter and remove some of the vapors that are venting out of the fuel tank.

A second vent hose connects the canister to the engine. As the engine runs, the vacuum in the intake manifold will draw the vapors out of the charcoal, recharging it. See Figure 2.10.

NOTE: A leak in the vent hose will allow dirt injection into the engine. This will not affect engine performance until the dirt ingestion has cause damage inside the engine.

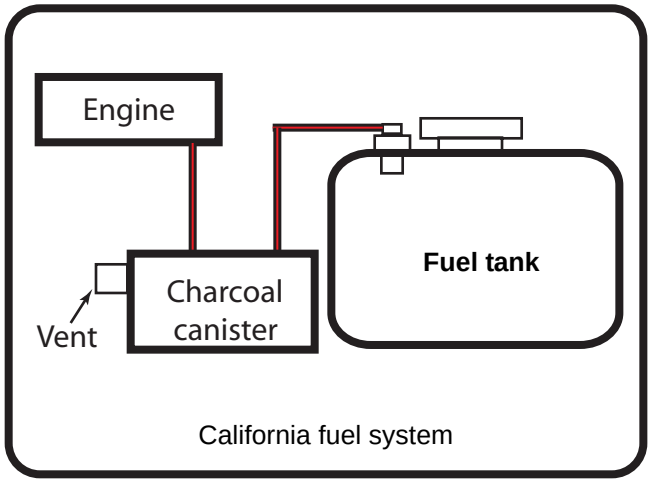

Figure 2.10

Troubleshooting

Symptom	Cause
Engine starts, then dies	A blockage in the vent hose. The roll over valve is stuck closed.
Engine runs rich	Raw gasoline in the charcoal canister (if equipped). A blockage in the line between the charcoal canister (if equipped) and the intake manifold.
Engine runs lean	Wrong fuel cap installed. Leak in the vacuum lines.
Gasoline vapor escaping from the engine	The charcoal canister (if equipped) is saturated. A blockage in the line between the charcoal canister (if equipped) and the intake manifold. Wrong fuel cap installed. Leak in the vacuum lines.

Roll over valve vent

To remove the roll over valve:

1. Open the hood.
2. Disconnect the vent hose. See Figure 2.11.

   NOTE: The vent hose will have a red trace.

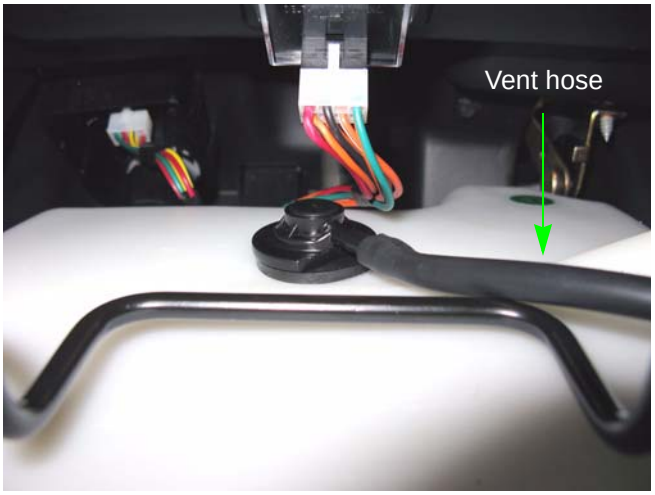

Figure 2.11

3. Gently pry the roll over valve out of the fuel tank. See Figure 2.12.
4. Inspect the rubber grommet, replace if damaged.

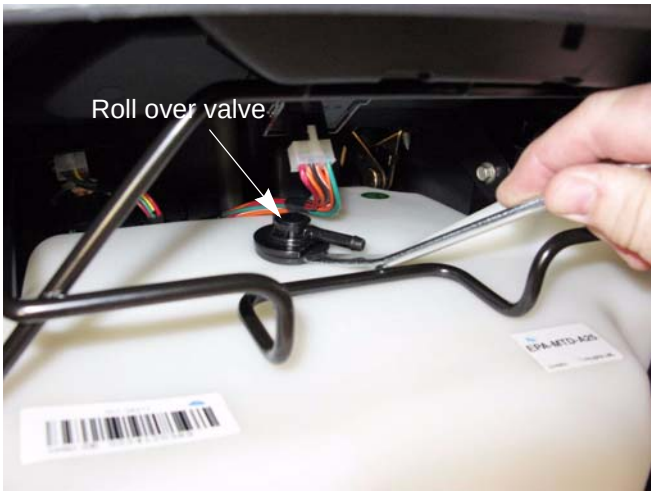

Figure 2.12

To install the roll over valve:

1. With the grommet on the roll over valve, install the roll over valve by pressing it into the opening in the tank.
2. Attach the vent hose to the roll over valve.
3. Test run the engine in a safe area before returning to service.

Testing the roll over valve

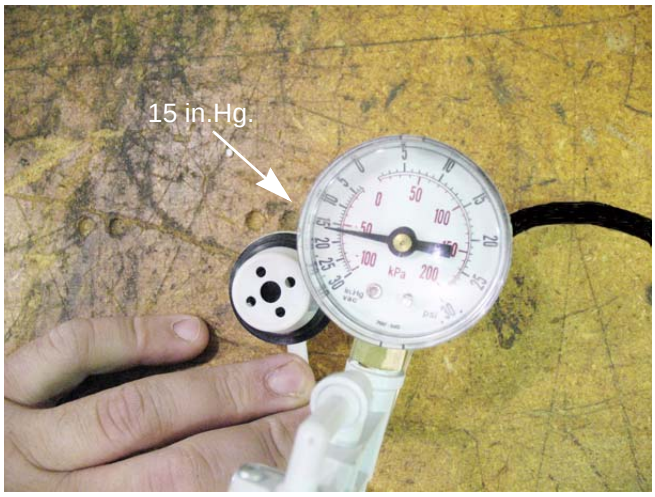

Figure 2.13

The roll over valve vent has two functions. The first function is to vent the tank and the second function is to close off the vent if the tank is inverted.

Test the roll over valve by:

1. Remove the roll over valve by following the steps previously described in this section.
2. Connect a vacuum pump to the roll over valve.
3. Hold the roll over valve in an inverted position.
4. Apply a vacuum to the roll over valve. See Figure 2.13.

NOTE: The roll over valve should hold 15 in.Hg. for 15 seconds.

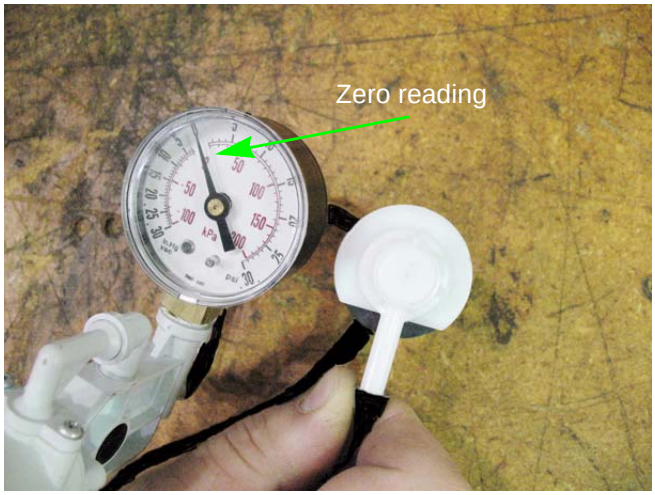

Figure 2.14

5. With the vacuum still applied, turn the roll over valve over. See Figure 2.14.

NOTE: The vacuum should be relieved.

6. If the results do not match what is listed above, replace the roll over valve.

CHAPTER 3A: STEERING

Steering alignment

Figure 3A.1

IMPORTANT: The front tires will have a “TOE-IN” between 1/16” and 1/4” to allow the unit to track properly.

1. Check the tire pressure in the front tires and make certain that they are at approximately 14 PSI. The rear tires should be at 10 PSI.
2. Place the unit on level ground.
3. Lower the deck lift lever to the lowest position.
4. Line up the centering hole in the sector gear with the centering hole in the support plate, and insert a 1/4” Phillips screw driver up through both. See Figure 3A.1.

NOTE: The steering wheel should be in the straight forward position. If it is not, remove the steering wheel and reinstall it so that it is.

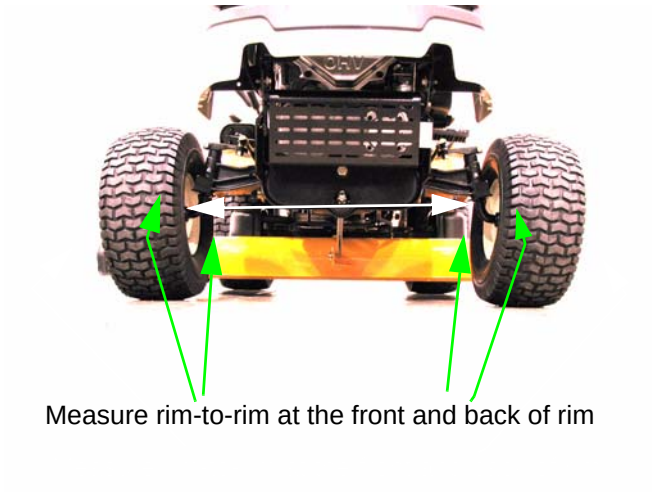

Figure 3A.2

5. In front of the axle, measure the distance horizontally from the inside of the left rim to the inside of the right rim. See Figure 3A.2.
6. From behind the axle, measure the distance horizontally from the inside of the left rim to the inside of the right rim.
7. The measurement taken in front of the axle should be between 1/16” and 5/16” less than the measurement taken behind the axle. If not, perform the following steps:

8. Loosen the jam nut at the rear of the right ball joint that secures the ball joint to the drag link, using a 1/2” wrench and an 11/16” wrench. See Figure 3A.3.
9. Remove the hex nut and lock washer, that secures the right ball joint to the right axle assembly, using a 1/2” wrench and a 9/16 wrench.
10. Remove the right hand ball joint from the right hand drag link.
11. Remove the left hand ball joint performing steps 8, 9 and 10 above.
12. Place the left and right tire assemblies in the straight forward position.
13. Set the toe-in for the rim assemblies to 3/16”.
14. Thread the right hand ball joint onto the right hand drag link until the mounting hole in the right hand axle assembly lines up with the ball joint.

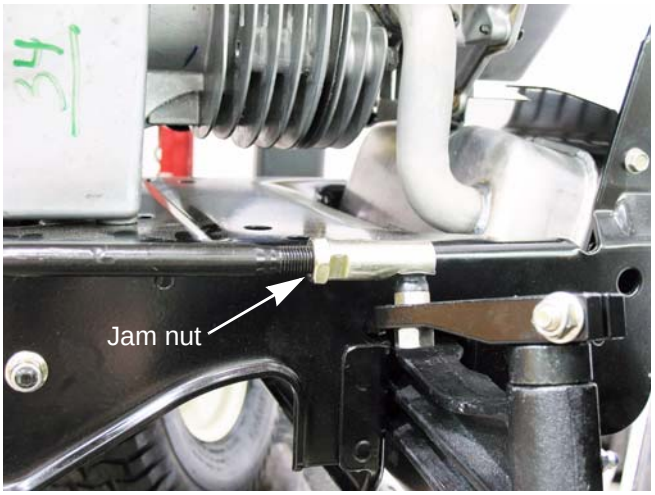

Figure 3A.3

NOTE: Count the number of turns the ball joint was rotated onto the drag link. This number should be within a couple of turns of the left side. If there is more than a couple turns difference, then one or both of the drag links are bent.

15. Secure the right hand ball joint to the right hand axle assembly with the lock washer and nut removed earlier, using a 1/2” wrench and a 9/16” socket
16. Secure the right hand ball joint jam nut to the right hand drag link using a 1/2” wrench and an 11/16” wrench.
17. Install the left hand ball joint using steps 14, 15 and 16.

Axles

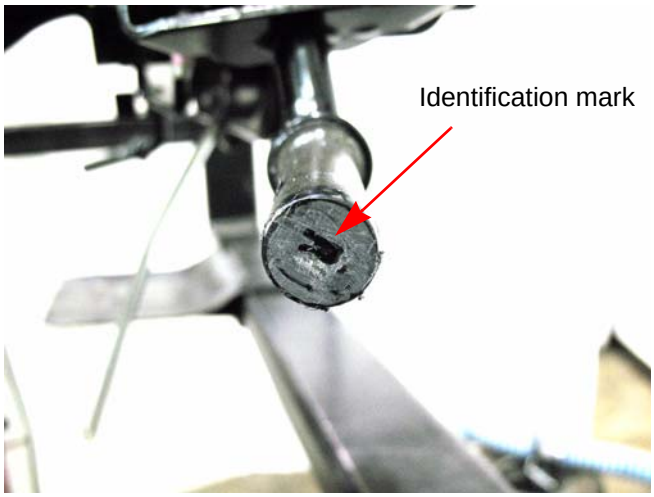

Figure 3A.4

NOTE: The left and right axle have a “L” or a “R” stamped on the end of the shaft for identification. See Figure 3A.4.

1. Jack up the front end of the tractor and securely place on jack stands.
2. Remove the front wheel by popping the hub cap off with a flat head screw driver.

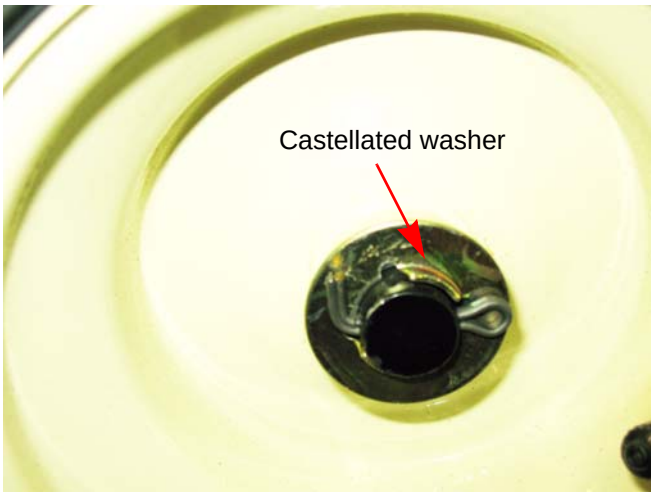

Figure 3A.5

3. Remove the cotter pin and the castellated washer. See Figure 3A.5.

NOTE: When installing the wheel, install a new cotter pin in between the uprights of the castellated washer.

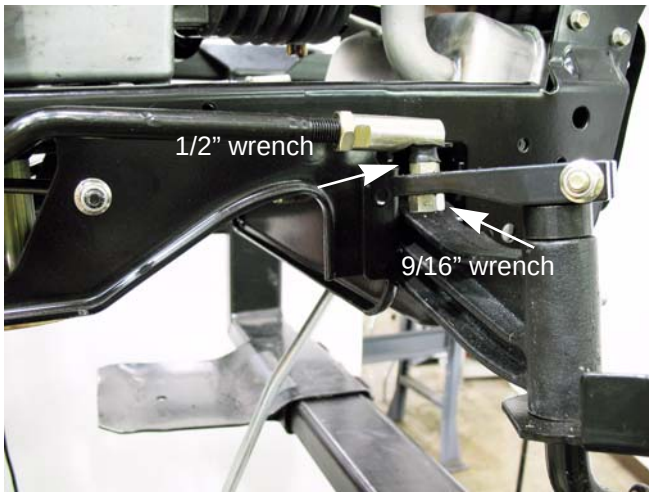

Figure 3A.6

4. Remove the nut holding the drag link to the steering block using a 1/2” and 9/16” wrench. See Figure 3A.6.

5. Support the axle and remove the steering block using two 1/2” wrenches. See Figure 3A.7.

   NOTE: The SLT models do not have a spacer.

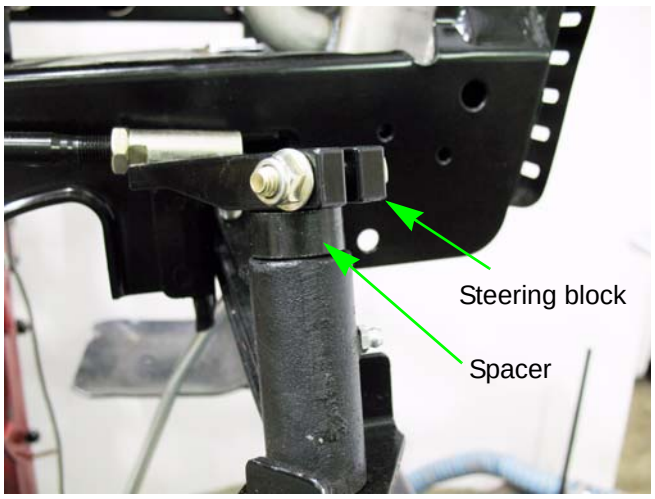

Figure 3A.7

6. Remove the spacer and lower the axle out of the pivot bar.

   NOTE: Starting in the 2010 season, some tractors will be equipped with a stamped pivot bar. These tractors will have plastic bushing where the axle rides inside the pivot bar. See Figure 3A.8.

   NOTE: The procedure to remove this axle is the same as previously described. When installing the axle, install new upper and lower bushings.

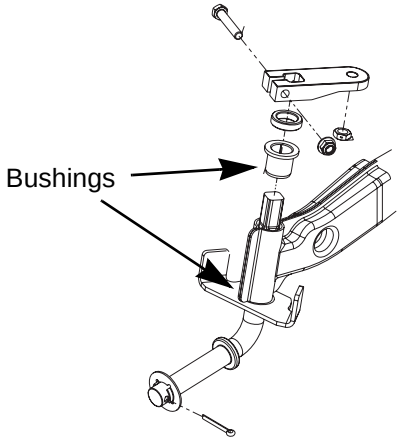

Figure 3A.8

7. Install the axle by following the previous steps in reverse order.
8. Perform a wheel alignment by following the steps described in the steering alignment section of this chapter.
9. Test run the tractor in a safe area before returning it to service.

Sector gear and steering pinion gear

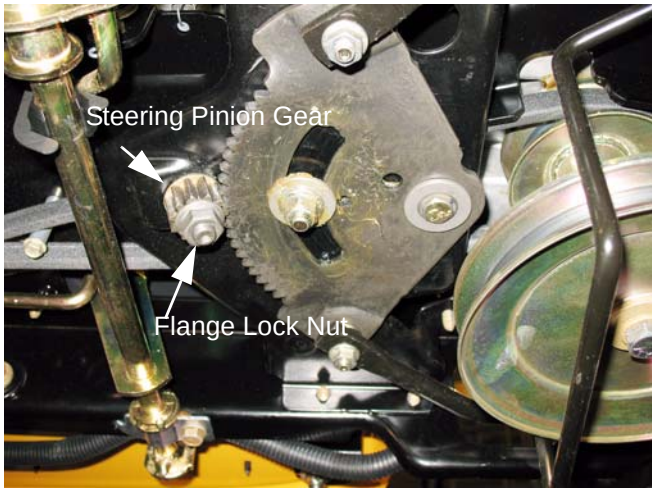

Figure 3A.9

If you are replacing the sector gear or steering pinion gear, check the condition of both gears for any wear or damage. It may be wise to replace both as a set.

1. Remove the cutting deck by following the steps described in Chapter 8: Cutting Decks and Lift Shaft
2. Jack up the front end of the tractor and securely place on jack stands.
3. Remove the flange lock nut securing the steering pinion gear to the steering shaft using an 11/16" socket. See Figure 3A.9.

Figure 3A.10

4. Slide the steering pinion gear off of the steering shaft.
5. Lift up on the steering shaft and remove the washer. See Figure 3A.10.

Figure 3A.11

6. Push the steering shaft up through the frame of the tractor.
7. Remove the hex bushing. See Figure 3A.11.

8. Remove the drag links from the sector gear.
9. Remove the six screws that secure the steering plate to the frame. See Figure 3A.12.

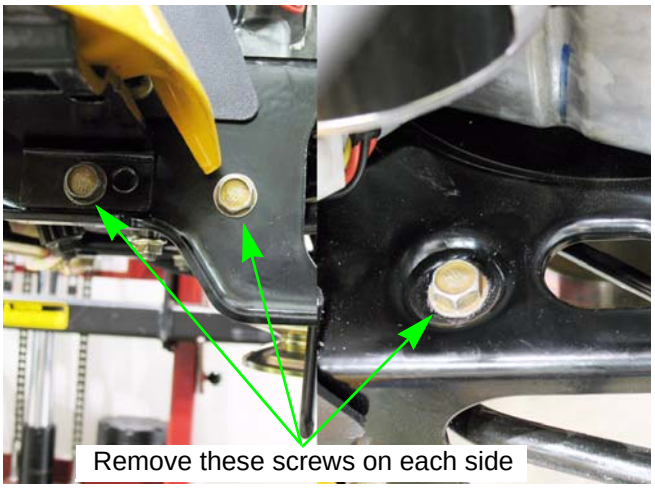

Figure 3A.12

10. Remove the steering plate.
11. Remove the hex cap screw, shoulder spacer and hex nut in the middle of the sector gear using two 9/16” wrenches. See Figure 3A.13.

    NOTE: Note the order the spacers and washer were removed so that they can be installed properly. See Figure 3A.14.

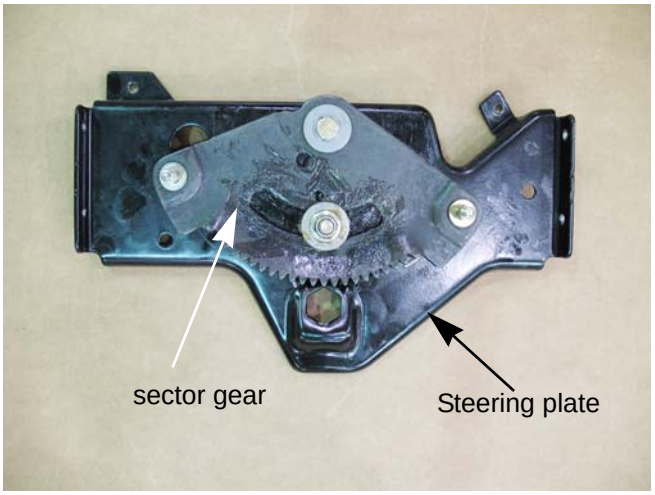

Figure 3A.13

12. Remove the bolt that the sector gear pivots on using two 9/16” wrenches. See Figure 3A.13.

    NOTE: When installing the sector gear, coat the sector gear and the steering plate with a high quality lithium grease.
13. Install the steering and steering pivot gears by following the previous steps in reverse order.
14. Perform a wheel alignment by following the steps described in the steering alignment section of this chapter.
15. Test run the tractor in a safe area before returning it to service.

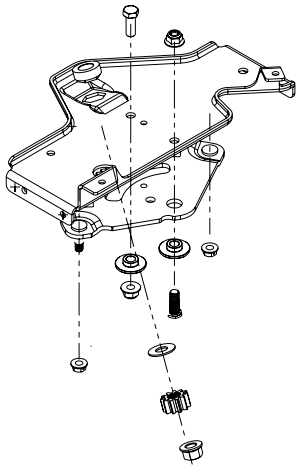

Figure 3A.14

Steering shaft and hex bushing

Figure 3A.15

To remove the steering shaft or to replace the hex bushing:

1. Remove the cutting deck by following the steps described in Chapter 8: Cutting Decks and Lift Shaft
2. Jack up the front end of the tractor and securely place on jack stands.
3. Remove the steering wheel

   3a. Remove the cover from the center of the steering wheel. See Figure 3A.15.

Figure 3A.16

NOTE: The cover can be released by prying-in on the lock-tabs on the under-side of the steering wheel. See Figure 3A.16.

   3b. Remove the bolt that holds the steering wheel to the steering shaft using a 1/2” wrench.

   3c. Lift the steering wheel off of the steering shaft.

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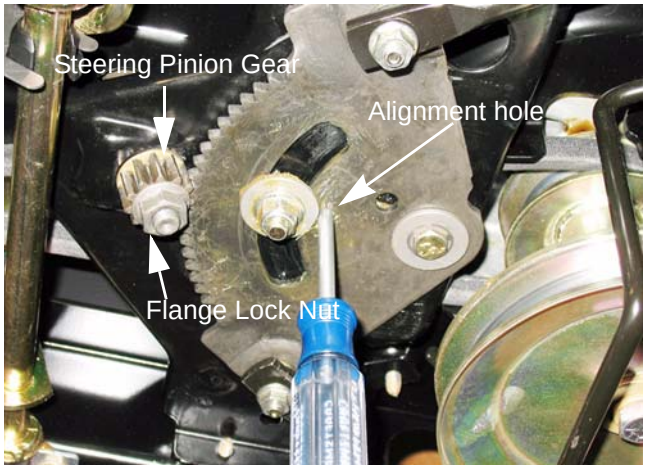


Figure 3A.17

4. Remove the flange lock nut securing the steering pinion gear to the steering shaft using an 11/16” socket. See Figure 3A.17.

NOTE: If the steering shaft rotates while removing the nut, insert a pin punch or a #2 phillips screwdriver into the alignment hole in the sector gear. This will lock the steering shaft in place, allowing the nut to be removed.

5. Slide the steering pinion gear off of the steering shaft.

6. Lift up on the steering shaft and remove the washer. See Figure 3A.18.
7. Push the steering shaft up through the frame of the tractor.

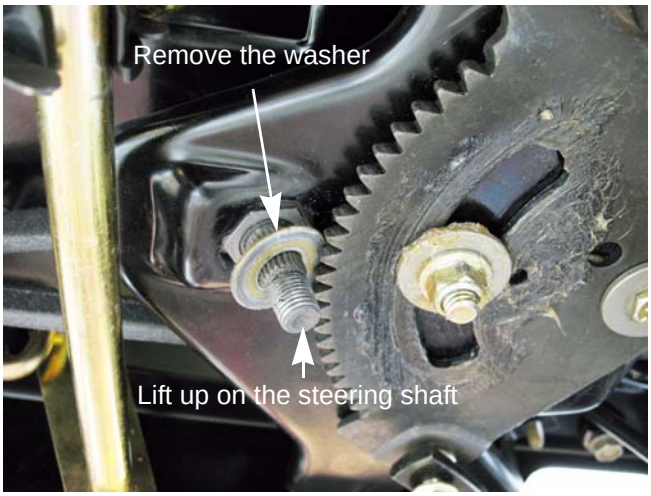


Figure 3A.18

8. Remove the hex bushing. See Figure 3A.11.

   NOTE: Replace the hex bushing every time the steering shaft is removed.
9. Remove the drag links from the sector gear.

Figure 3A.19

10. Remove the six screws that secure the steering plate to the frame. See Figure 3A.12.
11. Remove the steering plate.

    NOTE: The steering shaft will come out with the steering plate..
12. Install the steering shaft by following the above steps in reverse order.
13. Test run the tractor in a safe area before returning it to service.

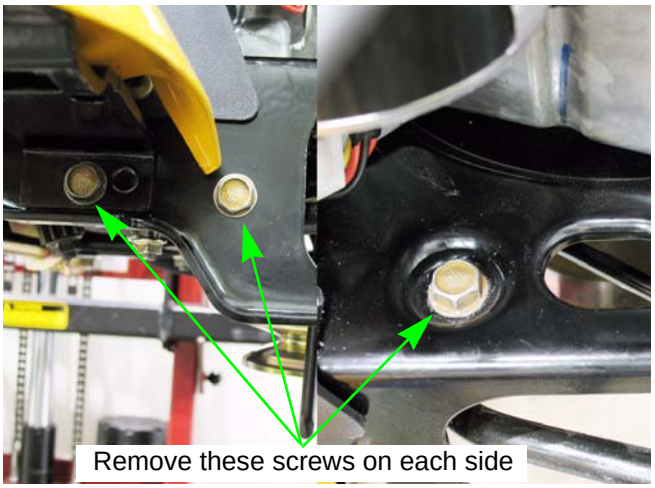


Figure 3A.20

Pivot bar

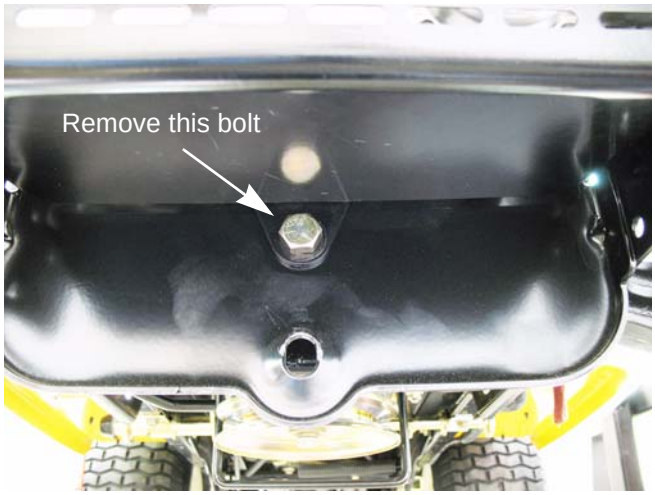


Figure 3A.21

To remove/replace the pivot bar:

1. Jack up the front end of the tractor and securely place on jack stands.
2. Remove the axles by following the procedures described in the axle section of this chapter.
3. Slide the front deck link out of the frame.
4. Support the pivot bar.
5. Remove the pivot bar pivot bolt using two 3/4” wrenches. See Figure 3A.21.

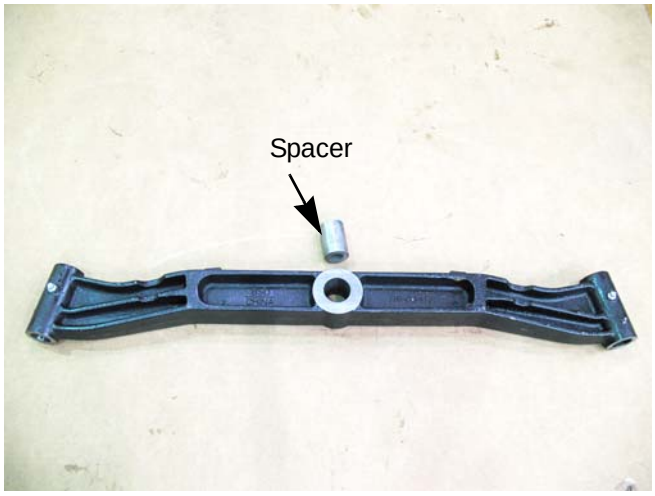


Figure 3A.22

6. Slide the pivot bar out of the frame.

NOTE: There is a spacer in the center of the pivot bar. It must be in place when installing the pivot bar. See Figure 3A.22.

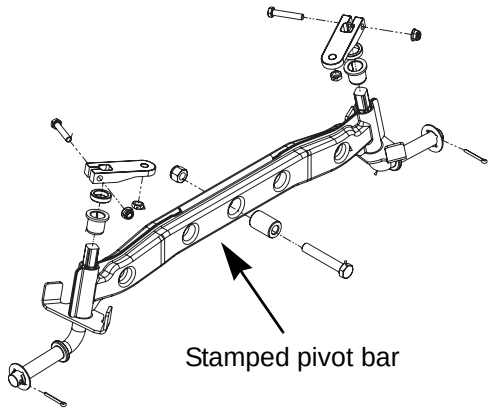


Figure 3A.23

NOTE: Starting in the 2010 season, there will be a stamped pivot bar on some models. The procedure to remove it is the same as the cast iron pivot bar described in the previous steps. See Figure 3A.23.

7. Install the pivot bar by following the previous steps in reverse order.

NOTE: Apply high quality grease to the frame, spacer and the pivot bar.

8. Preform a wheel alignment by following the steps described in the steering alignment section of this chapter.
9. Test run the tractor in a safe area before returning it to service.

CHAPTER 3B: ELECTRONIC POWER STEERING

NOTE: The basic steering system, such as the tie rod ends, drag links axles, etc., is covered in Chapter 3A: Steering.

In 2012, Cub Cadet introduced the Electronic Power Steering (EPS) system on the Cub select models of the LTX series of tractors. The EPS provides an electric assist to the steering wheel.

The EPS is a system consisting of three sub-assemblies: the rubber torsion coupling, the EPS module and the EPS motor & gearbox. They form an assembly that is inserted between the steering shaft and sector gear. The EPS system is treated as one part.

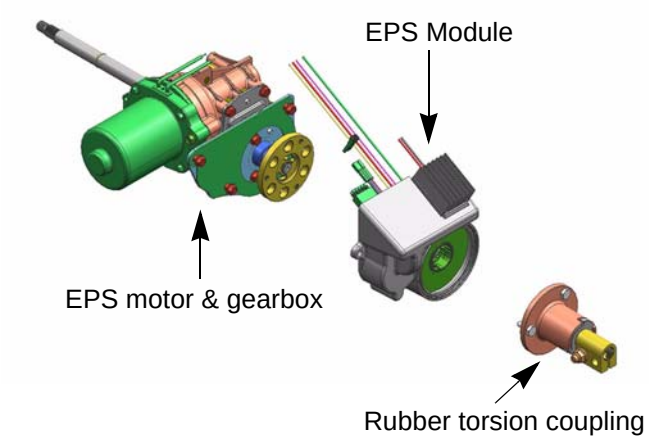


Figure 3B.1

⚠CAUTION DO NOT loosen or separate any of the EPS components.

The module is calibrated to the torsion coupler when the EPS assembly is built at the factory. Once it has been calibrated, it can not be re-calibrated. Any shift between the coupling and the module will result in the EPS auto-steering, which is a very unsafe condition.

NOTE: Auto-steering is a condition were the EPS will turn the wheels to one direction, once the engine is started. This happens because the calibration is off and the EPS thinks there is a steering input when there isn't.

The EPS comes with a 4 year warranty. If there is a failure with the system, replace the entire system as an assembly.

Rubber Torsion Coupling

The steering shaft connects the steering wheel to the EPS system through the rubber torsion coupling. As the steering wheel is turned, it applies force to the coupling. The force causes the torsion coupling to twist or torque. The amount the coupling torques is determined by the amount of force applied to the steering wheel, the more force applied to the steering wheel, the more the coupling twists.

NOTE: The rubber torsion coupling has hard stops built into it. If the force applied to the steering wheel causes the coupling to hit its hard stops, the steering input will transfer through the module into the steering gearbox. This allows manual steering if the EPS system fails.

EPS Module

The EPS module controls the power supplied to the EPS motor. It senses the amount of force that is being applied to the steering wheel by monitoring the torsion coupling. The module will ramp up the power supplied to the EPS motor as the force applied to the steering wheel increases. The EPS motor will reach full power within a couple of degrees of deflection of the torsion coupling.

EPS motor & gearbox

The steering input passes through the torsion coupling and module into the gearbox. The gearbox then passes the input force to the output shaft connected to the steering housing.

The EPS motor assists in turning the input shaft by driving a set of planetary gears. The planetary gears drive a worm shaft. The worm shaft drives a worm gear on the output shaft.

IMPORTANT: DO NOT open or service the steering gearbox.

⚠CAUTION

DO NOT drop or hammer on any of the EPS components.

There is a torque senor that is trapped between the torsion coupling and the EPS module. If this sensor shifts, it can cause an auto-steer condition.

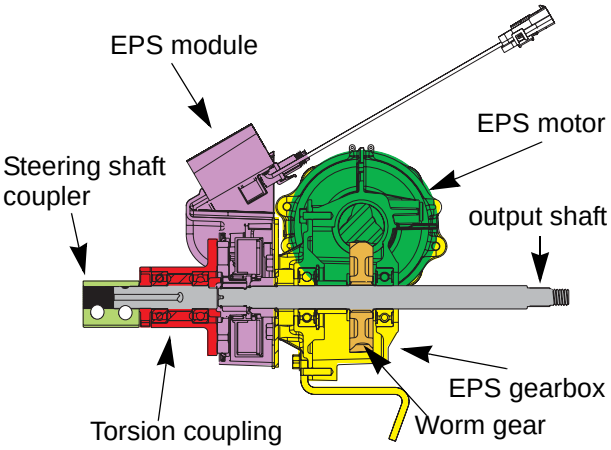


Figure 3B.2

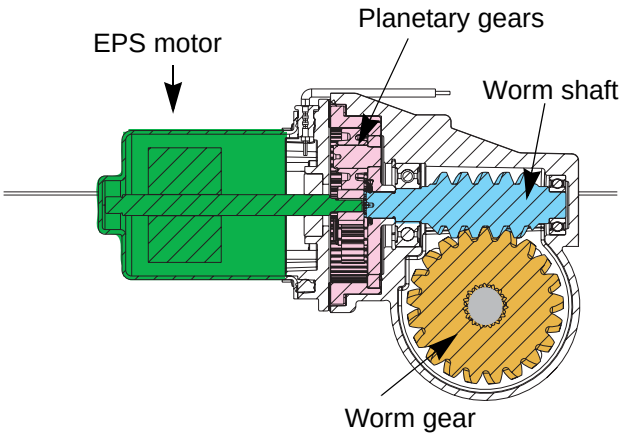


Figure 3B.3

Troubleshooting the EPS (without the 725-05419 EPS tester)

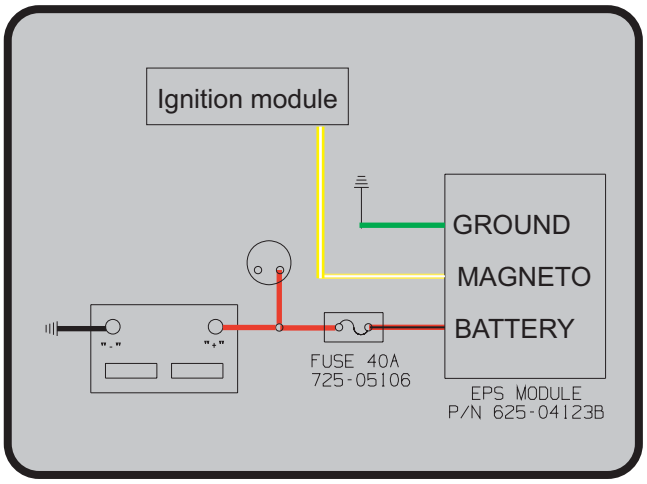


Figure 3B.4

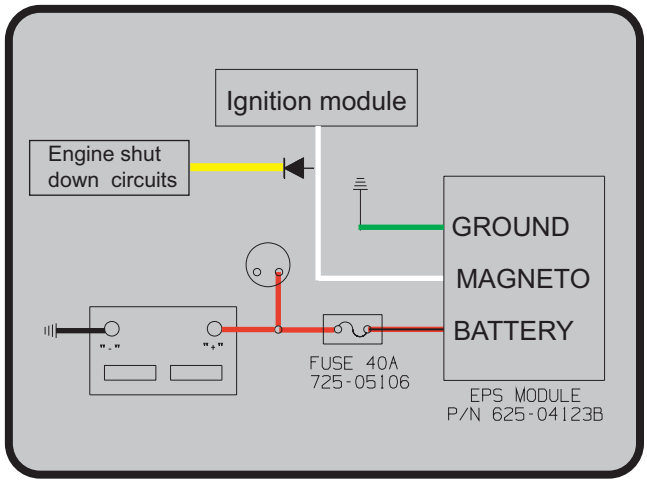


Figure 3B.5

Figure 3B.6

The first step in troubleshooting the EPS system is to understand how it works. See Figure 3B.4.

- A constant 12 volts is supplied by the battery through a 40 amp fuse in the fuse box.
- The EPS is grounded through the green wire.
- The EPS senses the ignition pulses from the ignition module primary windings through the yellow wire with a white trace.

NOTE: On tractors with Kohler engines with a Digital Spark Advance (DSA) ignition, A diode is installed to protect the ignition module from any stray voltage that may come from the engine shut down circuits. A white wire carries a clean spark signal to the EPS to turn it on. See Figure 3B.5.

- Once the EPS determines that the engine is running (by sensing the ignition pulses from the ignition coil) it will turn on.
- The EPS will power the EPS motor as it senses input from the steering wheel.

To troubleshoot the EPS assembly:

1 Check the 40 amp fuse in the fuse box. See Figure 3B.6.

NOTE: If the fuse is blown, check for a short in the red wire that goes to the EPS assembly before replacing the fuse.

The technician needs to determine if there is a mechanical bind in the steering system or an EPS issue. The easiest way to rule out a binding steering system is to:

2. Remove the steering pinion gear by following the procedures described in Chapter 3: Steering.
3. Start the engine.
4. Operate the steering wheel.
   - If the steering wheel now moves freely, the issue is downstream of the pinion gear. The most likely suspect would be axles frozen to the pivot bar.
   - If the steering wheel is still hard to operate, isolate the problem to either the EPS assembly or the circuits that go to the EPS assembly.

NOTE: To protect the EPS module, it will turn off if the steering input is held at a hard stop for more than 2 seconds. The EPS will turn back on once the input is released from the hard stop.

NOTE: Before troubleshooting any electrical circuit on a tractor, always make sure the battery is fully charged.

NOTE: The EPS assembly has constant battery power and is not controlled by the ignition switch.

To troubleshoot the EPS assembly:

5. Place the tractor on flat, level ground.
6. Remove any attachments that may be on the tractor.
7. Set the parking brake.
8. Turn the steering wheel so that the wheels are pointing straight forward.
9. With the ignition key in the off position, open the hood.
10. Locate, but do not disconnect, the EPS harness connector underneath the fuel tank. See Figure 3B.7.

Figure 3B.7

11. Check for battery voltage at the red wire:
    - 11a. Set the Digital Multimeter (DMM) to the DC volts scale.
    - 11b. Measure the battery voltage across the battery terminals

NOTE: If the battery voltage is < 12.6 volts, charge the battery before continuing.

- 11c. Connect the black (-) lead of the DMM to the negative post of the battery.
- 11d. Back probe EPS harness connector at the red wire with a black trace, using the red (+) lead of the DMM.

NOTE: The DMM should read battery voltage.

12. Check the ground to the EPS: See Figure 3B.8.
    - 12a. Set the DMM to the DC volts scale.
    - 12b. Connect the red (+) lead to the positive post of the battery.
    - 12c. Back probe EPS harness connector at the green or black wire, using the black (-) lead of the DMM.

NOTE: The DMM should read battery voltage. If it does not, disconnect the EPS harness. If you now have battery voltage at the EPS harness connector (tractor side), there is a short in the EPS assembly. If not, repair the tractor harness.

Figure 3B.8

Figure 3B.9

13. Check the current draw of the EPS assembly.

    13a. Leave the DMM connected to the ground wire on the EPS and the battery.

    13b. Place an amp clamp meter on the red wire with a black trace. See Figure 3B.9.

NOTE: Cut the tape that seals the loom at the EPS connector end of the harness and slide the loom off of the wires to attach the amp clamp.

    13c. Start the tractor.

NOTE: The voltage reading on the DMM should now read over 13 volts. If it does not, repair the charging circuit before proceeding with troubleshooting the EPS system.

    13d. Without sitting on the tractor, turn the steering wheel a quarter turn back and forth. Watching the voltage reading on the DMM and the current reading on the amp clamp while doing this.

NOTE: If the voltage drops below 13 volts and the current draw does not rise above 15 amps, repair the circuit suppling voltage to the EPS before proceeding with troubleshooting the EPS system.

NOTE: If the voltage drops below 13 volts and current draw is more than 15 amps, the problem is inside the EPS assembly and it must be replaced.

13e. Turn off the tractor.

Figure 3B.10

14. Remove the DMM and the amp clamp meter.

15. Check the input from the ignition module.

    15a. Connect the ground lead of an oscilloscope to a good ground on the engine block.

    15b. Back probe the EPS harness connector at the yellow wire with a white trace using the positive (+) lead of the oscilloscope.

    15c. Start the engine.

16. The oscilloscope should show a pulsed signal. The bottom or resting phase of each pulse must be below 5 volts. The peak of each pulse must be over 5 volts. See Figure 3B.10.

17. The pulses must be at 9 Hertz (cycles/second) or higher (engine needs to be >490 RPM).

18. If the resting phase of the pulse is above 5 volts, there is a short in the safety circuit of the tractor that is pulling up the voltage of the ignition module.

NOTE: A voltage spike over 18.5vdc +/- 1.2v @70°F will cause the voltage regulator to shut down. The regulator must be disconnected, then re-connected to reset it.

NOTE: A sustained voltage over 25 volts will damage the EPS module.

IMPORTANT: Loose battery cables or disconnecting jumper cables while the engine is running will create a high voltage spike that will damage the EPS system.

NOTE: If the results are within the specified ranges or if the amperage draw is higher then expected, check for a mechanical bind by:

19. Remove the EPS assembly.
20. Check the steering shaft bushings.

    NOTE: Cocked steering shaft bushing will bind the steering shaft, mimicking a bad EPS. Fix the bushings before condemning the EPS.

21. If nothing is in a bind, replace the EPS assembly.

Troubleshooting the EPS (with the 725-05419 EPS Tester)

To troubleshoot the EPS using the 725-05419 EPS Tester:

1. Connect the red lead of the EPS Tester to the positive post of the battery.
2. Connect the black lead of the EPS Tester to the negative post of the battery.

   NOTE: A green LED and a blue LED should be illuminated. If they are not, the tester is malfunctioning.

   NOTE: If a red LED illuminates when the tester is connected to the EPS, the EPS has a short and has blown the fuse on the tester.

3. Disconnect the EPS harness connector underneath the battery.
4. Plug the EPS Tester into the connector on the EPS assembly.

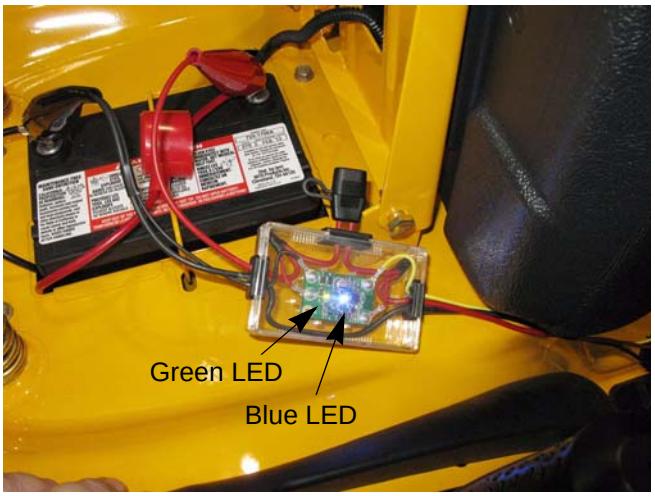


Figure 3B.11

   NOTE: The 725-05419 EPS Tester comes with a jumper harness, to be used on tractors with the battery under the seat, so that the tester can reach the EPS assembly.

5. Start the engine.
6. Operate the steering wheel.

   - If the steering wheel turns easily, the EPS is not the issue. Refer to the previous section to check the tractor's electrical system.
   - If the steering wheel is still hard to turn:

     a. Remove the EPS assembly.

     b. Reconnect the EPS tester to the EPS assembly by following the procedures described in the EPS removal section of this chapter.

     c. Rotate the input shaft of the torsion coupler. If it rotates with minimal effort the EPS is working.

     d. Check for a mechanical bind in the steering system. If it's hard to turn, the EPS is faulty.

EPS motor

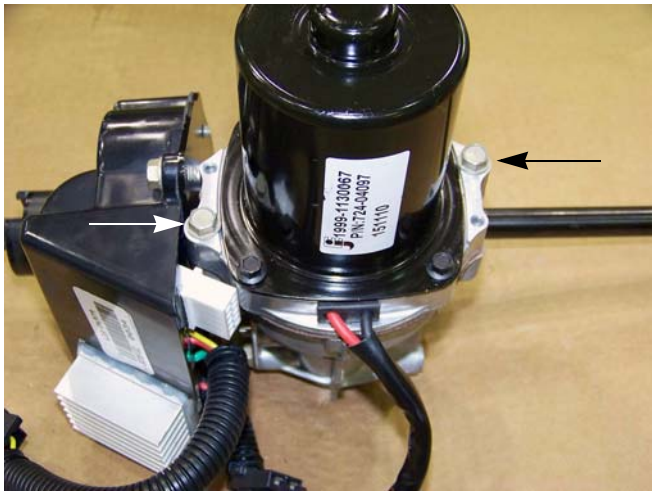


Figure 3B.12

To remove/replace and test the EPS motor:

NOTE: The EPS system has a 4 year warranty. **DO NOT** remove the EPS motor to test it within the warranty period. Outside of the warranty period, the EPS motor can be replaced separately from the EPS assembly.

1 Remove the EPS assembly by following the procedures described in the EPS removal section of this chapter.

2. Disconnect the EPS motor harness from the EPS module.

3. Remove the two screws that secure the motor base to the EPS, indicated by the arrows in Figure 3B.12, using a 3/8” wrench.

4. Lift the motor assembly off of the EPS.

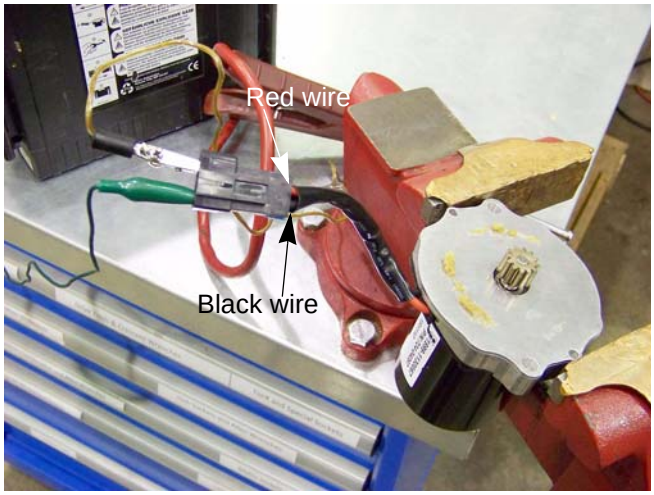


Figure 3B.13

5. Mount the motor in a vise.

NOTE: Position the motor so that the vise jaws clamp the motor base, to prevent damage to the motor.

6. Attach the black wire from the motor to the negative side of a 12 volt power supply capable of producing 40 amps.

NOTE: The tractor’s battery or a jumper box can be used as a power supply.

7. Attach the red wire from the motor to the positive side of the power source.

NOTE: The motor should spin. If it does not, replace the motor.

8. Inspect the EPS motor gasket. If it is damaged, replace it.

   NOTE: Do not use a gasket sealant/adhesive on the EPS motor gasket.

9. Remove the sun gear from the EPS motor.

10. Install the sun gear into the planetary gear set.

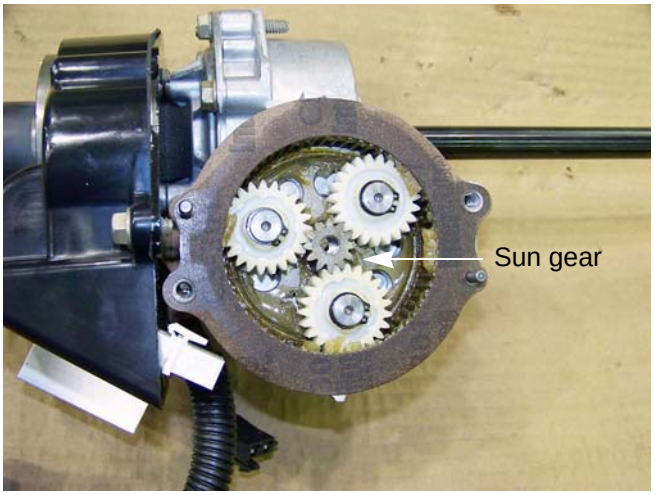


Figure 3B.14

11. Install the EPS motor.

    NOTE: While installing the EPS motor, align the motor pigtail with the EPS motor harness.

12. Install the EPS assembly in the tractor by following the procedures described in the EPS removal section of this chapter, in reverse order.

13. Test run the tractor in a safe area before returning it to service.

    NOTE: Do not put a tractor into service with any safety or control features that are not working properly.

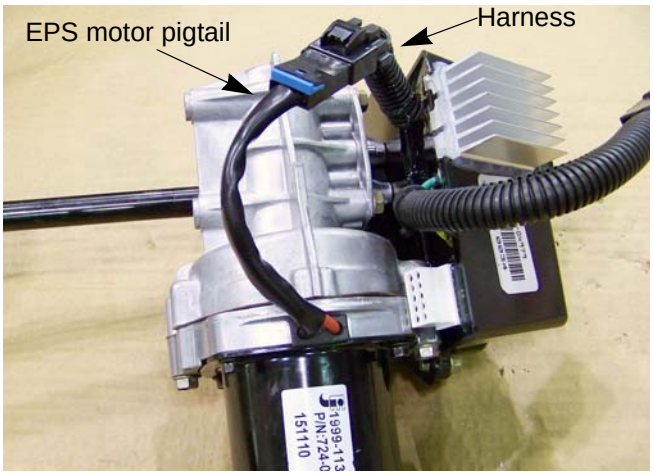


Figure 3B.15

EPS removal/replacement

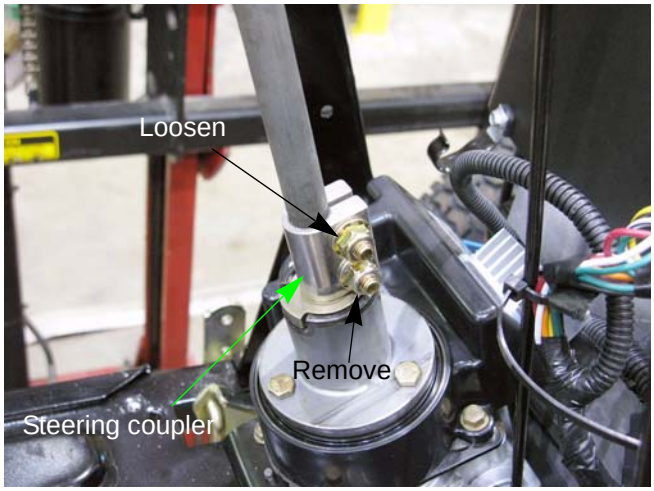


Figure 3B.16

To remove/replace the EPS assembly:

1 Remove the hood, dash and fender by following the procedures described in Chapter 4: Body Panels.

2. Remove the fuel tank by following the procedures described in Chapter 2: Engine Related Parts.

3. Remove the steering pinion gear by following the procedures described in Chapter 3: Steering

4. Disconnect the EPS harness connector.

5. Loosen the top nut and bolt of the steering shaft coupler using a pair of 1/2” wrenches.

6. Remove the lower nut and bolt from the steering shaft coupler. See Figure 3B.16.

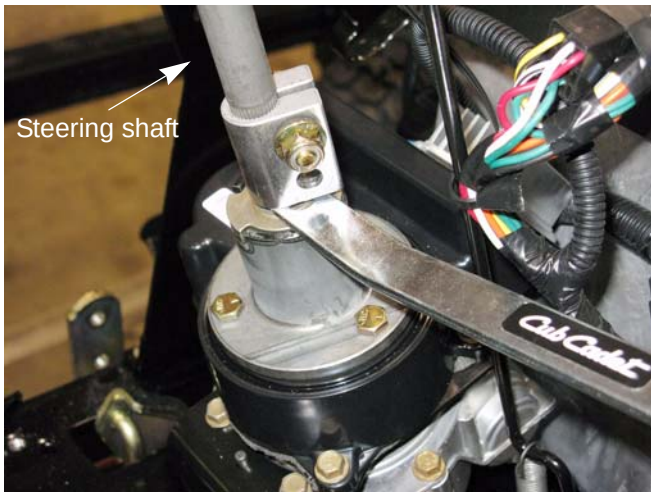


Figure 3B.17

NOTE: It may be necessary to drive the bolt out with a punch.

7. Lift the steering shaft off of the EPS.

NOTE: It will probably be necessary to pry the steering shaft coupler off of the EPS. See Figure 3B.17.

⚠CAUTION DO NOT hammer on any of the EPS components.

Hammering on the EPS components can cause the calibration of the EPS to shift, resulting in an auto-steer condition.

8. Remove the two screws securing the left dash support to the frame using a 3/8” wrench. See Figure 3B.18.
9. Slide the left dash support off of the EPS motor.

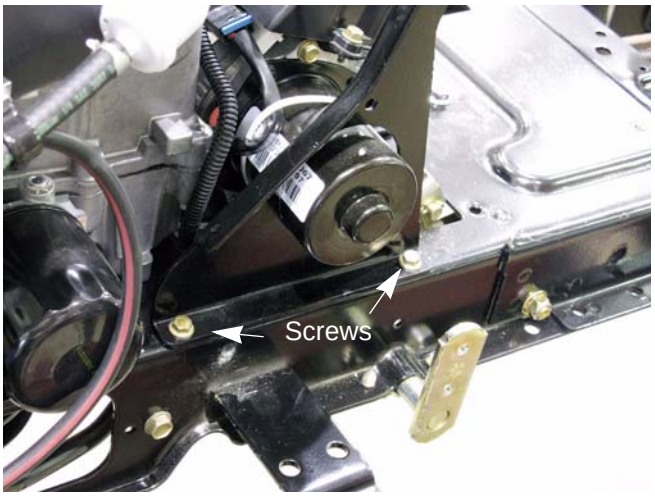


Figure 3B.18

10. Remove the two screws securing the EPS bracket to the frame.
11. Lift the EPS out of the tractor.

    NOTE: The EPS output shaft will pass through a spacer, and a bushing. See Figure 3B.19.
12. Install the EPS by following the previous steps in reverse order.

    NOTE: The washer that goes in-between the pinion gear and the steering housing must be held in place, under the tractor, while inserting the EPS into the steering housing.
13. Test drive the tractor in a safe area before returning it to service.

    NOTE: Do not put a tractor into service with any safety or control features that are not working properly.

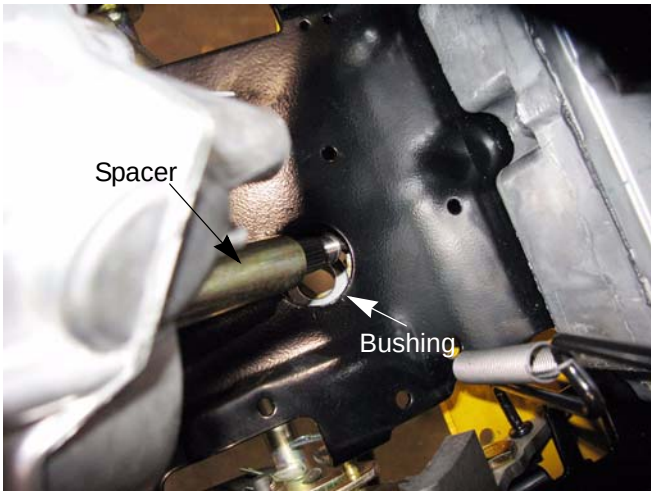


Figure 3B.19

CHAPTER 4: BODY PANELS

What is covered by this chapter

The intent of this chapter is to describe the removal and disassembly of the major body panels on the tractor.

- Hood
- Seat
- Fenders
- Dash panel

Figure 4.1

NOTE: It is not absolutely necessary to remove the mowing deck for any procedures covered in this section. The technician may choose to remove the mowing deck so that it is easier to reach some parts of the tractor.

NOTE: The hood described in this section is the “A” style hood. Other styles may be produced for different markets (e.g.: over-seas) or future style changes. See Figure 4.1.

Hood

Hood removal:

1. The hood is front-hinged. See Figure 4.2.
2. Open the hood by lifting the rear edge to tilt it forward.

Figure 4.2

3. Disconnect the headlight wires. See Figure 4.3.

   NOTE: The ground terminals and power terminals on the headlights are two different sizes. The green wires (ground) fit the larger terminals. The red wires (power) fit the smaller terminals.

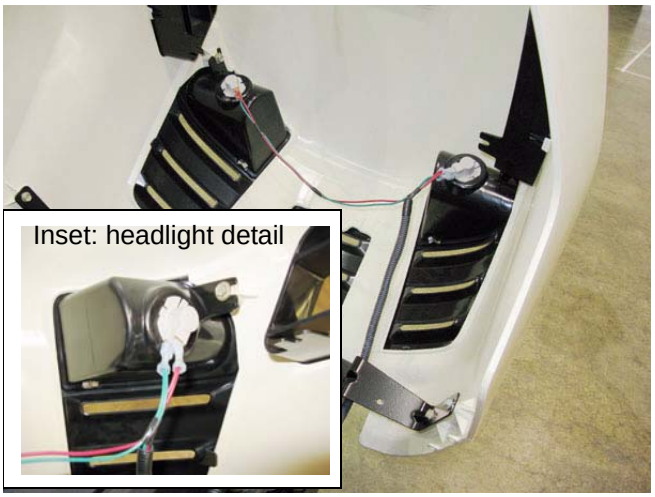


Figure 4.3

4. The hood hinges on a pair of shoulder bolts that fit into slots in the hood bracket.
5. The hinge travel is limited by a tab that fits into a channel in the hood bracket.
6. Open the hood far enough to align the tabs with the slots, then lift the hood off of the tractor. See Figure 4.4.

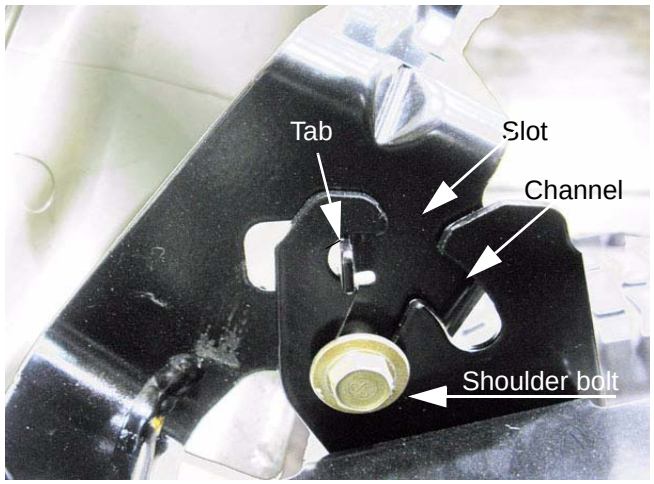


Figure 4.4

Hood components: Headlight removal

Figure 4.5

1. With the spade terminals disconnected, rotate the lamp holder (socket) to release it from the grill assembly. See Figure 4.5.

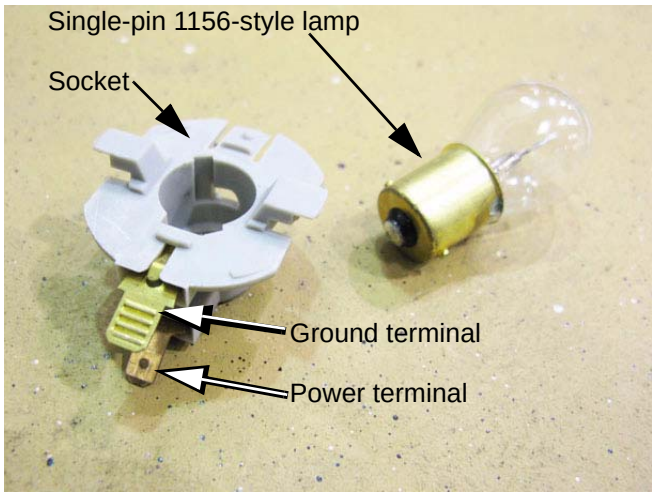


Figure 4.6

2. Rotate the bulb to release it from the socket. See Figure 4.6.
3. Install the replacement lamp following the above steps in reverse order.

Hood components: side vent removal

1. Carefully pry the vent free of the lock tabs. See Figure 4.7.
2. Pull the vent out of the hood assembly.
3. Install the hood side vent by pressing it into the hood side opening until the lock tabs click into place, securing the vent.

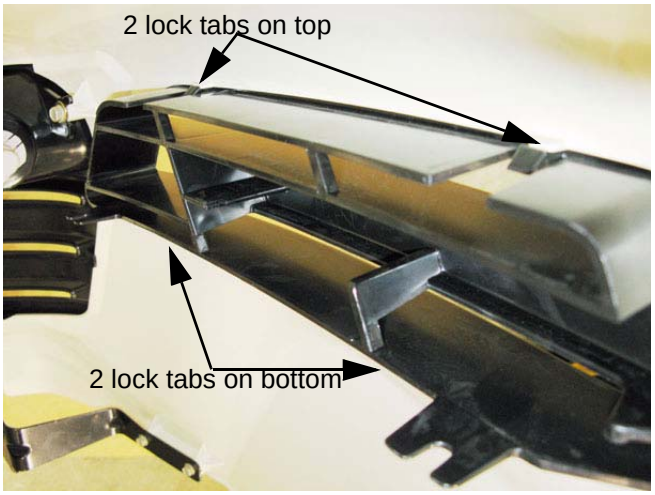


Figure 4.7

Hood components: grill removal

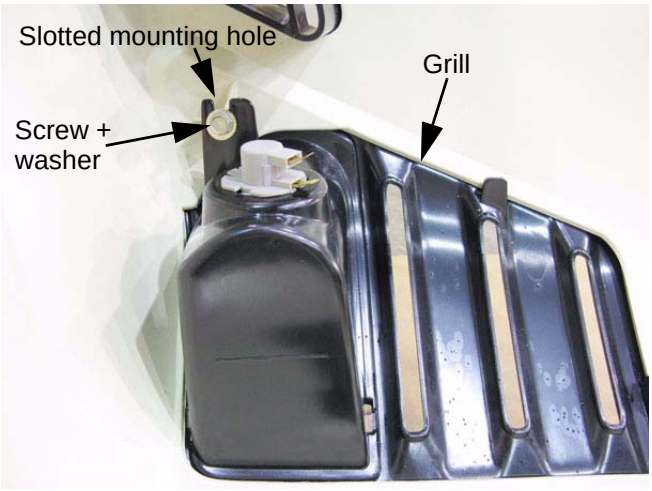


Figure 4.8

1. Remove the hood assembly from the tractor, and place it on a stable work surface.
2. Loosen, but do not remove the screws that hold the upper corners of the grill to the hood using a 3/8” wrench. See Figure 4.8.

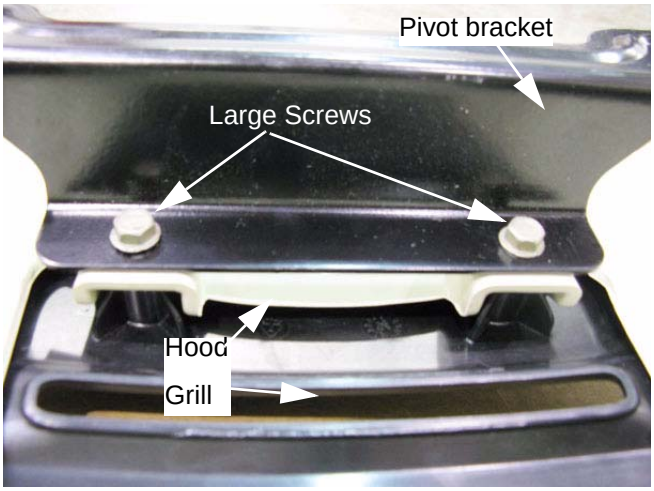


Figure 4.9

3. Remove the two screws that hold the pivot bracket and grill to the hood assembly using a 1/2” wrench. See Figure 4.9.

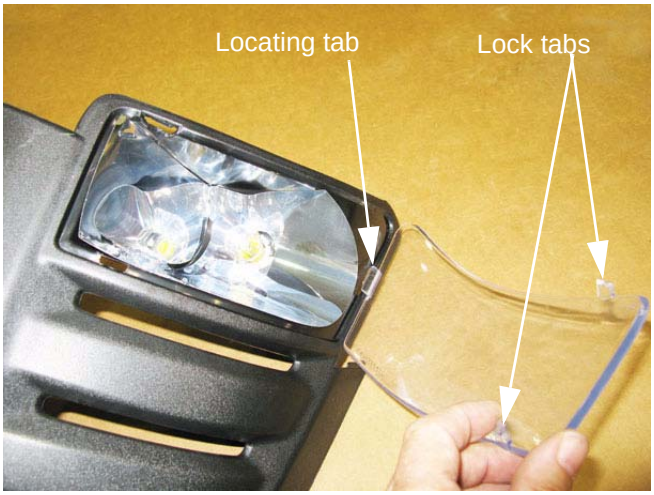


Figure 4.10

4. Once removed, the headlight lens may be removed for cleaning by carefully prying the two lock tabs at the inner edge. See Figure 4.10.

NOTE: The locating tab at the outer edge of each lens has no locking feature.

5. Assemble and install the grill by reversing the steps used to remove it.
   - Tighten the small screws to a torque of 15-35 in-lbs. (1.7-4.0 N-m).
   - Tighten the large screws to a torque of 35-50 in-lbs (4.0-5.7 N-m).

Hood components: pivot bracket removal

1. Remove the four screws that hold the outer arms of the pivot bracket to the hood using a 3/8” wrench. See Figure 4.11.

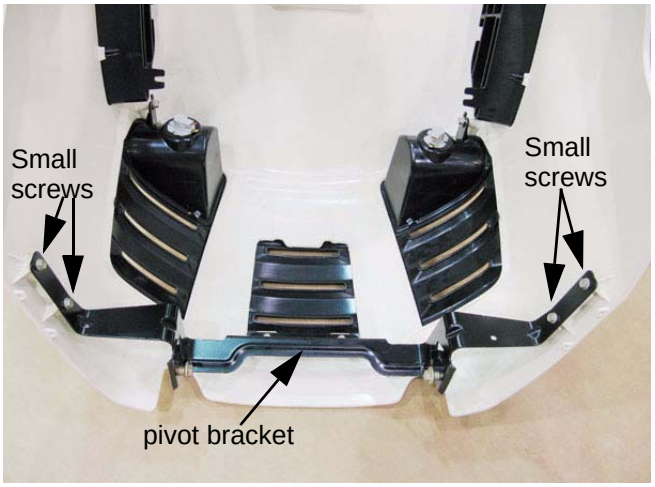


Figure 4.11

2. Remove the two screws that hold the pivot bracket and grill to the hood assembly using a 1/2” wrench. See Figure 4.12.
3. Assemble and install the grill by reversing the steps used to remove it.
   - Tighten the small screws to a torque of 15-35 in-lbs. (1.7-4.0 N-m).
   - Tighten the large screws to a torque of 25-45 in-lbs (2.80-5.1 N-m).

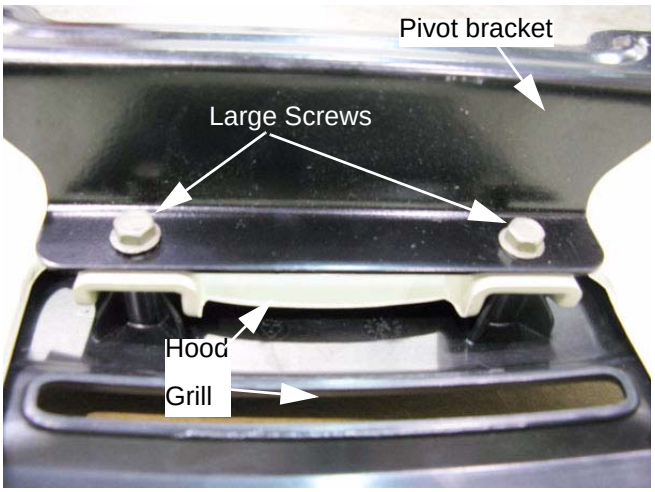


Figure 4.12

Seat and Fenders

CAUTION The battery will be removed in this procedure. Review the Operator's Manual and the Chapter 7: Electrical Systems for important safety information about handling batteries before proceeding.

IMPORTANT: Do not return an unsafe mower to service.

There are four variants of fender used on the Cub Cadet Series 1000 for the model year 2009 and after:

- **Manual PTO** models have two levers on the right fender: one for the deck height control and one for the PTO.
- **Electric PTO** models have one lever on the right fender to control the deck height.
- **CVT-drive** tractors (single-speed transmission + variable speed pulleys) use fenders with a single pedal opening on each side: clutch/brake on the left, drive pedal on the right. In addition, a forward-neutral-reverse lever is on the left fender.
- **Hydrostatic-drive** tractors use fenders with a single pedal opening on the left, and two openings on the right. The clutch/brake pedal is on the left, with two pedals on the right; one to control forward drive, and the other to control reverse drive.

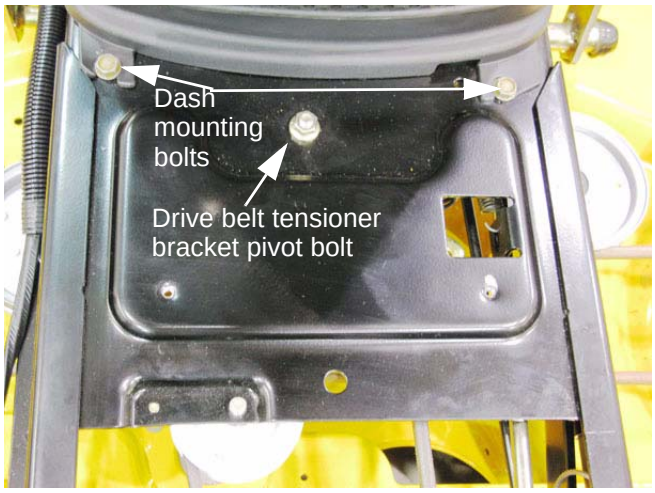


Figure 4.13

NOTE: Removing the fenders provides access to:

- The bolts that hold the base of the dash panel to the frame. See Figure 4.13.
- The nut that holds the drive belt tensioner pivot bracket to the frame.
- The travel stop pin that must be taken-off to remove the control pedal cross-shaft.

Removal procedures for fenders are very similar on all variants. Where necessary, notes will be included to cover slight differences in procedures.

1. Seat removal: It is necessary to remove the seat before removing the fenders, primarily because of the seat safety switch connection.

   1a. Tilt the seat up, and disconnect the negative battery cable. See Figure 4.14.

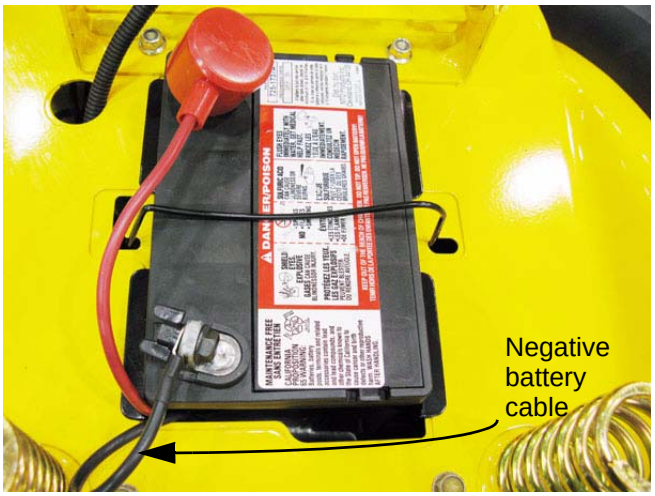


Figure 4.14

NOTE: The seat slides in three “T” slots in the seat bracket. A single bolt threads into one of the forward bosses on the seat base, locking it into the slots. On installation, tighten the bolt to a torque of 60-80 in-lbs. (7-9 N-m).

1b. Remove the locking bolt using a 9/16” wrench. See Figure 4.15.

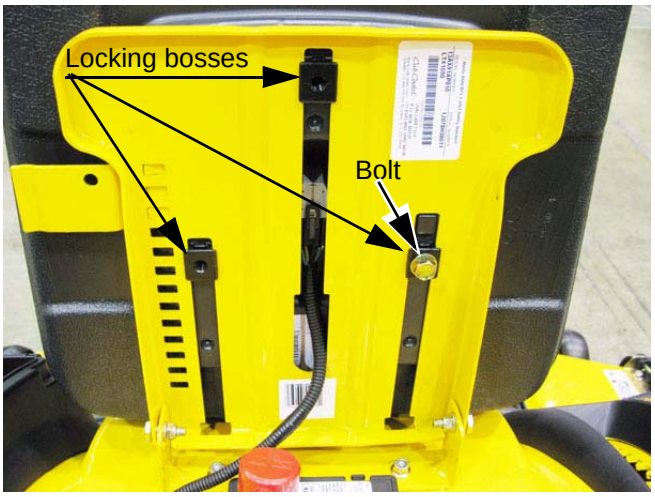


Figure 4.15

1c. Slide the seat forward to the end of its travel, then lift it up to disengage the slide blocks from the “T” slots. See Figure 4.16.

1d. Disconnect the seat safety switch from the harness plug to remove the seat.

1e. Lift the seat off of the tractor.

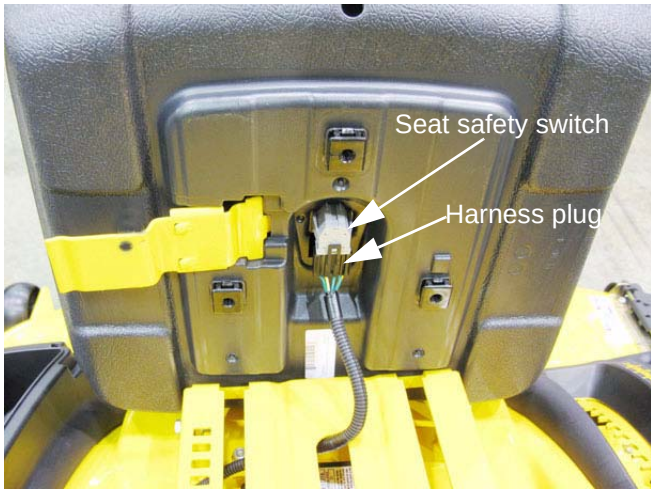


Figure 4.16

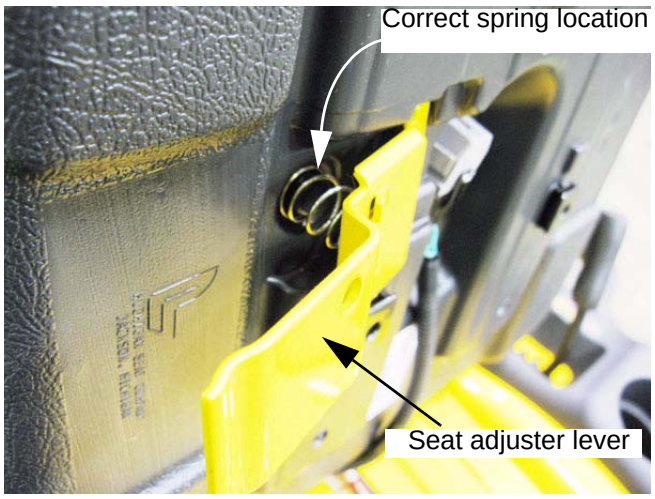


Figure 4.17

1f. The seat adjuster lever and spring will come easily off the bottom of the seat. See Figure 4.17.

- The lever is located by a tab that fits into a slot on the bottom of the seat.
- The spring fits into a toroidal (doughnut shaped) recess in the bottom of the seat.

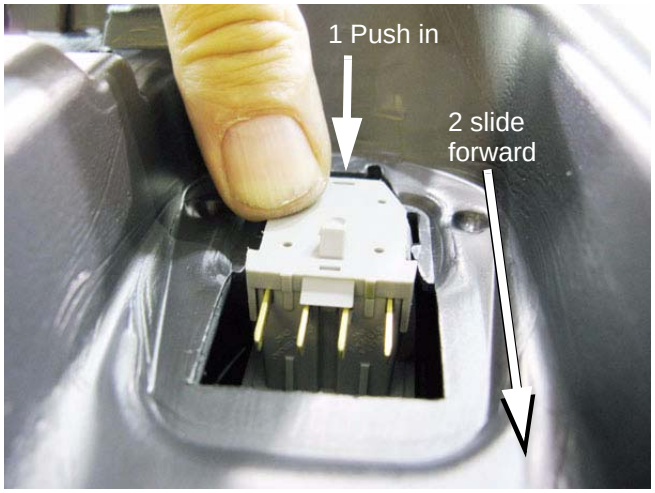


Figure 4.18

1g. To remove the seat safety switch: squeeze the tabs on the side of the switch, and push it into the seat base. See Figure 4.18.

1h. Slide the switch to the wider end of the hole in the seat base, and pull it out.

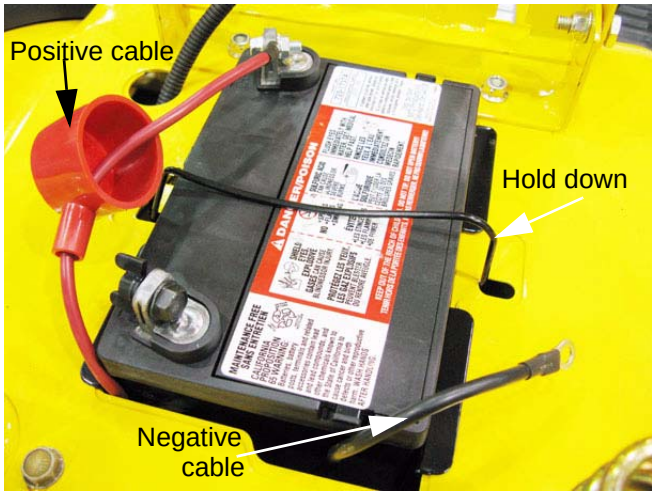


Figure 4.19

2. Remove the battery and tray:

NOTE: Battery tray removal provides easy access to the following service points:

- Fluid check point on hydrostatic transaxles.
- Electrical: Solenoid, main fuse, battery cables
- Drive belt inspection
- Deck lift linkage inspection

2a. Disconnect the positive battery cable from the battery (the negative battery cable was disconnected in an earlier step). See Figure 4.19.

2b. Remove the battery hold-down by prying the end of the hold-down out of the “U” shaped slot.

2c. Lift the battery out of the tractor. See Figure 4.20.

2d. Lift the battery tray out of the tractor.

CAUTION

When reinstalling a battery in this tractor, use only the original type of battery. The negative terminal must go toward the rear of the tractor.

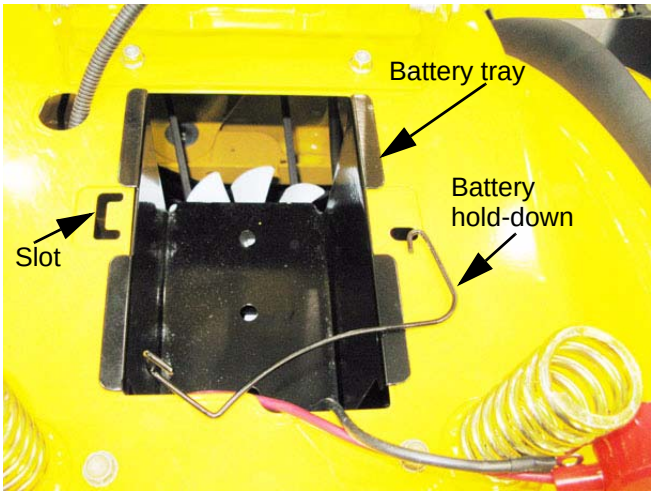


Figure 4.20

NOTE: It is not necessary to remove the seat bracket when removing the fenders.

2e. The seat bracket may be removed using a pair of 1/2” wrenches. See Figure 4.21.

NOTE: Later production units will use self tapping screws instead of a nut and bolt.

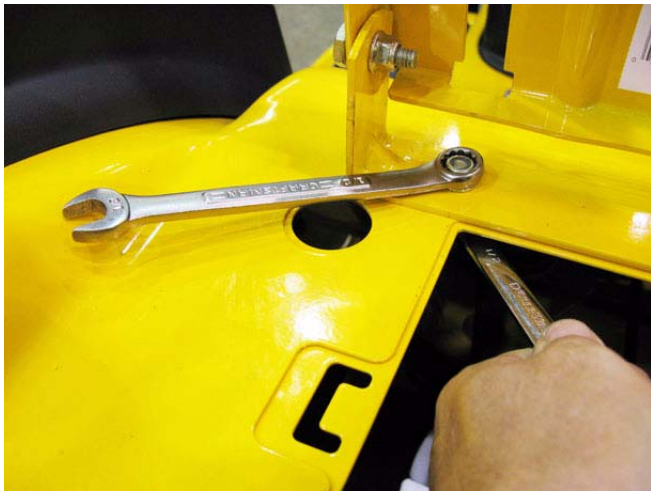


Figure 4.21

3. Remove the grips from the fender-mounted control levers.

3a. Pull the shift knob off of the forward-neutral-reverse lever (on CVT-equipped tractors). See Figure 4.22.

Figure 4.22

Figure 4.23

3b. If the tractor has a deck lift assist spring, remove the deck or lift the mower deck to the highest position and support it with wood blocks. See Figure 4.23.

NOTE: Tractors equipped with the 38” deck and 42” timed-blade R-deck will not have lift assist springs.

Figure 4.24

3c. Unhook and gently release the lift assist spring from the back of the tractor frame. See Figure 4.24.

Figure 4.25

3d. Remove the grips from the deck lift lever and PTO engagement lever (on manual PTO models). See Figure 4.25.

NOTE: A blow-gun with air pressure regulated to less than 25 PSI (1.72 Bars). may be inserted into the small hole at the end of a rubber grip to inflate it slightly, easing removal. See Figure 4.26.

Figure 4.26

4. Remove the rubber foot pads. See Figure 4.27.

Figure 4.27

5. Remove the drive pedals.

   5a. Remove the reverse pad from the drive pedal (hydrostatic drive tractors only). See Figure 4.28.

Figure 4.28

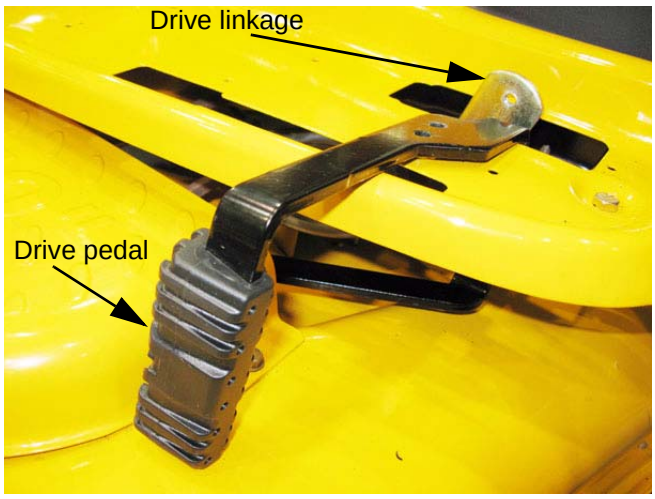


Figure 4.29

5b. Unbolt the drive pedal using a 1/2” wrench, and maneuver it out of the tractor. See Figure 4.29.

5c. Remove the brake pedal using a 1/2” wrench.

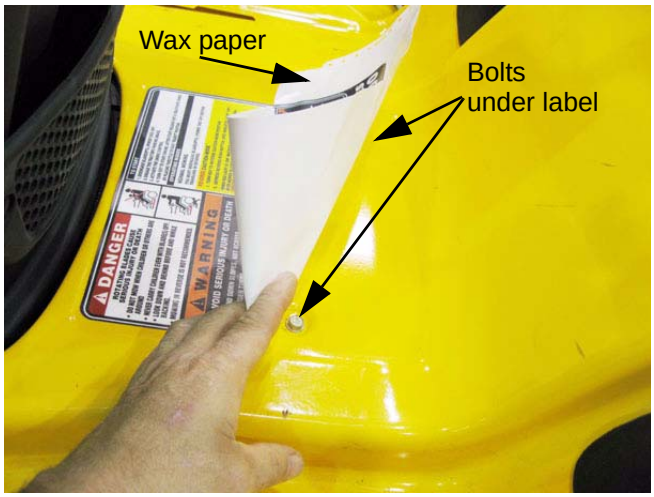


Figure 4.30

6. Remove the fender panel.

6a. Carefully peel-up the large operating instructions label from the floor portion of the fender panel. See Figure 4.30.

- Gentle application of heat will help loosen the adhesive.
- Start at the back: the back edge is closer to the fasteners that are concealed by the label.
- Use wax paper to preserve the adhesive.

6b. Remove the two bolts that are found under the label using a 3/8” wrench.

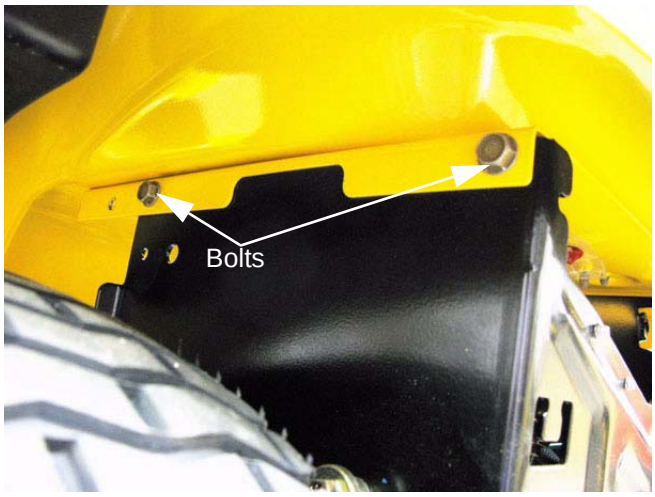


Figure 4.31

6c. Remove the four bolts that hold the fender to the seat-box portion of the frame using a 1/2” wrench. See Figure 4.31.

6d. Remove the nuts and bolts that hold the front edge of each fender to the frame outriggers using a pair of 7/16” wrenches. See Figure 4.32.

6e. Carefully lift the fender assembly off of the tractor.

Figure 4.32

NOTE: On tractors equipped with a Kohler single cylinder engine, the front of the fender mounts to the outrigger using a rubber bushing and steel spacer. See Figure 4.33.

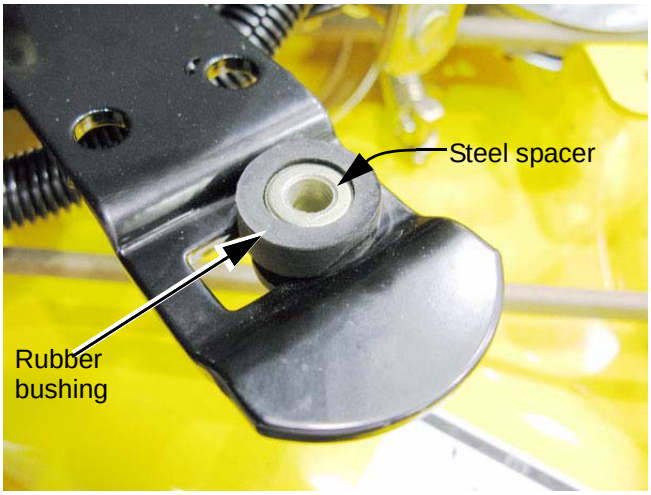


Figure 4.33

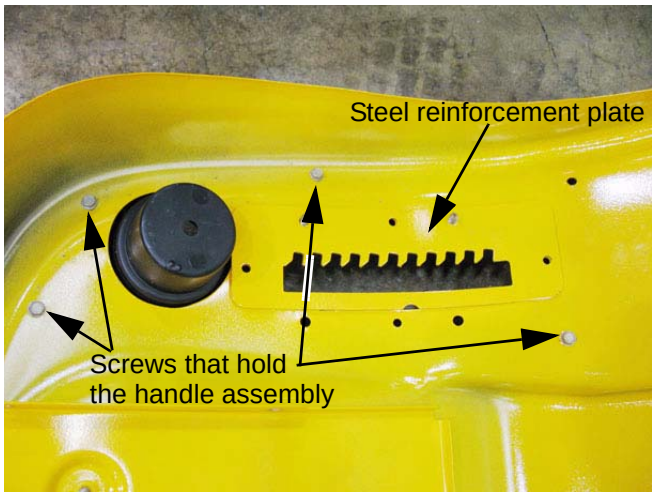


Figure 4.34

NOTE: The handle assemblies can be removed from the rear fenders using a 3/8” wrench, from beneath the fender. See Figure 4.34.

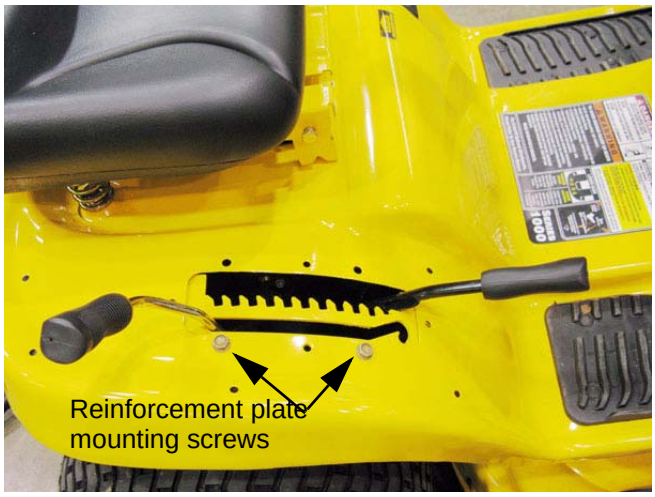


Figure 4.35

NOTE: With the handle assembly removed, the steel reinforcement plate can be unbolted from the top side of the fender using a 3/8” wrench. See Figure 4.35.

Dash Panel

The dash panel may be removed to provide easier access to the cruise-control and drive system linkages, or to replace the dash or dash support brackets.

1. Remove the fenders.
2. Remove the steering wheel:

   2a. Remove the cover from the center of the steering wheel. See Figure 4.36.

Figure 4.36

NOTE: The cover can be released by prying-in on the lock-tabs on the under-side of the steering wheel. See Figure 4.37.

2b. Remove the bolt that holds the steering wheel to the steering shaft using a 1/2” wrench.

2c. Lift the steering wheel off of the shaft.

Figure 4.37

⚠CAUTION

The following steps involve working with gasoline. Gasoline is flammable, and steps should be taken to avoid fire hazard;

- Work in a well-ventilated area.
- Allow the engine to cool fully before starting work on the tractor.
- Eliminate any sources of possible ignition from the work area, including but not limited to: heat sources, open flame, potential sparks.
- Clean-up any spilled fuel quickly and properly, disposing of cleaning materials in a way that will not produce a further fire hazard.
- Hold any drained fuel in an approved and safe container.

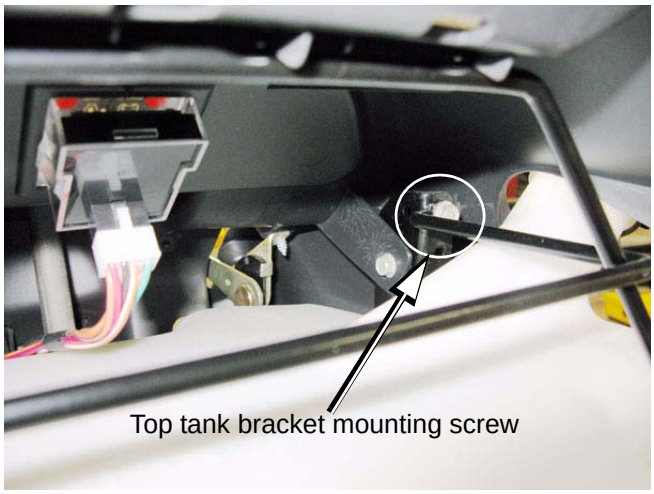


Figure 4.38

3. Remove the fuel tank.

   3a. Drain the fuel tank to a level that will not allow fuel to spill.

NOTE: The tank may be drained by mechanical syphon or by disconnecting the fuel line from the fuel filter.

   3b. Remove the two screws that hold the top of the wire form fuel tank bracket to the dash support brackets using a 3/8” wrench. See Figure 4.38.

Figure 4.39

   3c. Support the fuel tank.

   3d. Remove the two screws that hold the bottom of the wire form bracket to the dash support brackets using a 3/8” wrench.

   3e. Lift the fuel tank and bracket out of the tractor. See Figure 4.39.

Figure 4.40

NOTE: The fuel line may be left connected to the fuel tank, and the fuel tank supported next to the tractor in a position that will not allow fuel to spill. See Figure 4.40.

4. Disconnect the harness plugs from the following electrical devices under the dashboard: See Figure 4.41.
   - Hour meter
   - Key switch
   - RMC module
   - PTO switch, if so equipped

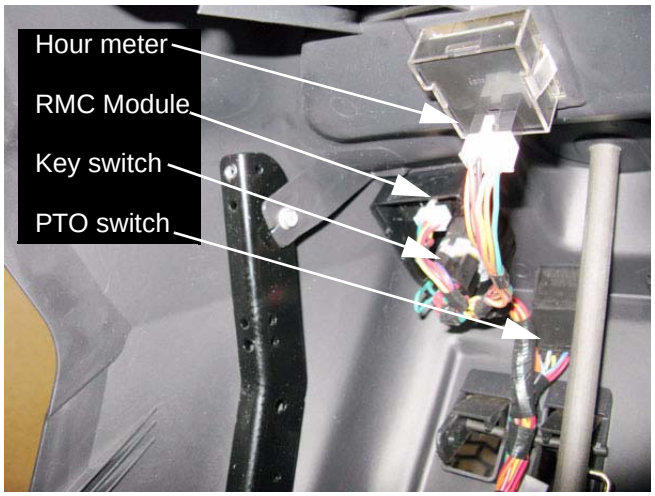


Figure 4.41

5. Use a phillips head screwdriver to remove the throttle control grip. See Figure 4.42.
6. Carefully peel-off the throttle control label.
   - Gentle application of heat will help loosen the adhesive.
   - Use wax paper to preserve the adhesive.

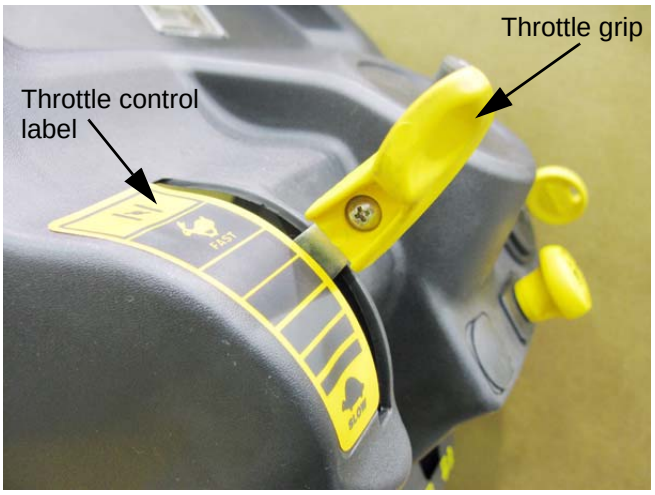


Figure 4.42

7. Remove the two Torx™ head screws that hold the throttle control to the dash panel using a T-27 driver. See Figure 4.43.

Figure 4.43

Figure 4.44

8. If the tractor has a separate choke cable, disconnect it from the engine.
9. Remove the locking clip that holds the cruise control / parking brake rod to the engagement lever assembly. See Figure 4.44.

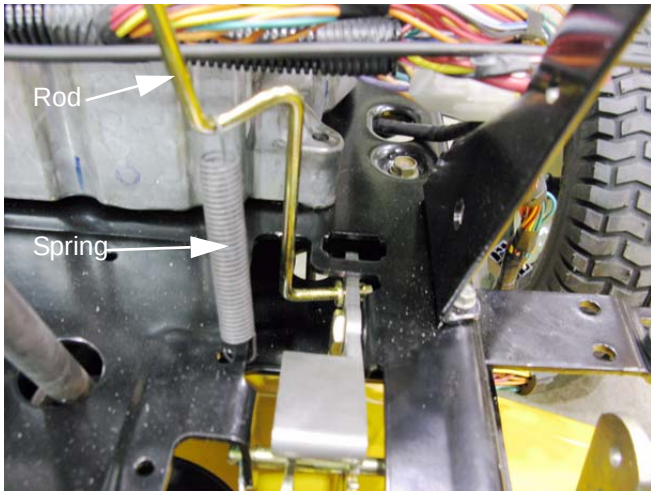


Figure 4.45

10. Disengage the rod from the lever assembly.

NOTE: The rod is kept in slight tension by a light spring that hooks between the frame and the step in the middle of the rod. See Figure 4.45.

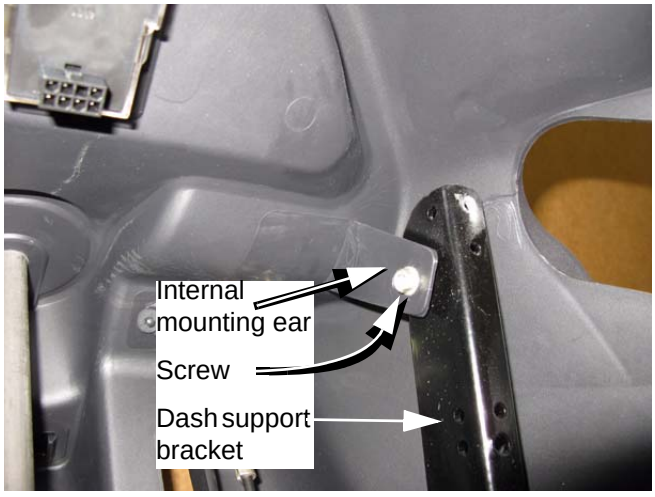


Figure 4.46

11. Remove the screws that hold the inside mounting ears of the dash panel to the dash support brackets using a 3/8” wrench. See Figure 4.46.

12. Remove the four screws that hold the base of the dash panel to the frame using a T-40 driver and a 1/2” wrench. See Figure 4.47.

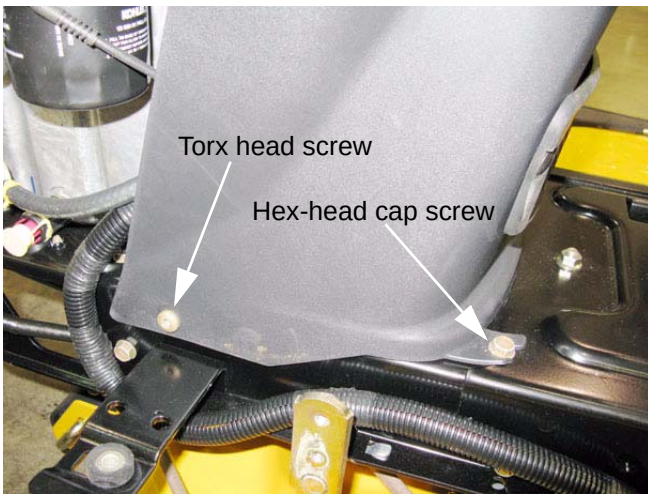


Figure 4.47

NOTE: On tractors equipped with electronic power steering: See Figure 4.48.

- Remove the screw that holds the EPS motor cover to the left side of the dash using a 3/8” wrench.
- Pull the EPS motor cover off of the barbed fastener.

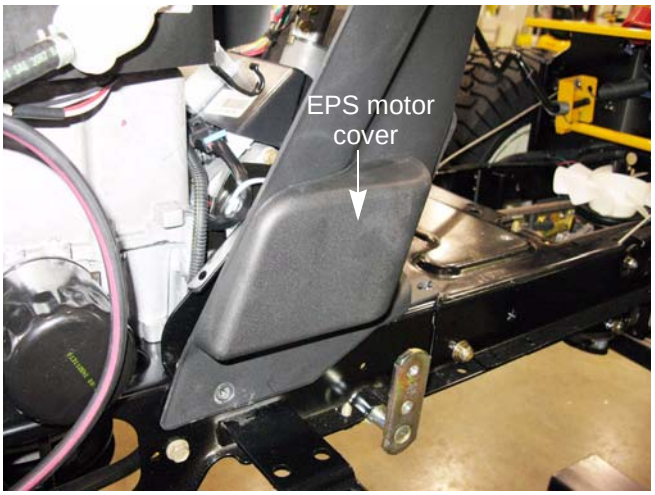


Figure 4.48

13. Lift the dash panel off of the tractor. See Figure 4.49.
14. Assembly notes:
    - Assemble tractor by reversing the disassembly process.
    - Tighten fasteners to a torque of 20-22 in-lbs. (2.25-2.50 N-m).
    - Test all tractor controls and features before returning the tractor to service.

Figure 4.49

CHAPTER 5: HYDRO. DRIVE AND BRAKE SYSTEM

About this chapter

The drive and brake systems for the Cub Cadet Series 1000 tractor are combined. Two reasons for this:

- The brake on the Series 1000 tractor is supplied with the transaxle. On hydrostatic-drive tractors, the brake comes from Hydro-Gear.
- The brake pedal applies the brake and disengages the drive system. Both systems share common linkage.

The hydrostatic transaxle used in the Cub Cadet Series 1000 is a Hydro-Gear model 311-0510. LTX and SLTX transaxles are similar except that the SLTX transaxles have 4-lug wheel mount hubs in place of a double -D axle.

NOTE: A training video BLN-51763 covers this transaxle.

NOTE: The complete Hydro-Gear Service and Repair manual, BLN-51260 is included as an addendum to this manual, with the permission of and thanks to Hydro-Gear.

If the tractor has drive system problems within the warranty period, the Cub Cadet service dealer has the following responsibilities:

- Eliminate any external causes for drive system problems, before removing the transmission from the tractor.
- External problems would include, but are not limited to: belt, linkage, low fluid, or brake issues.
- Look for signs of over-use or abuse. Transaxles that fail because of over use or abuse are not warrantable. They are to be repaired or replaced at the customer’s expense.
- If the problem is internal, the transmission is to be removed, repaired, and reinstalled unless the cost of repair exceeds 70% of the price of a new replacement transaxle.
- If Hydro-Gear transaxle is replaced under warranty, the original transaxle will be called-back for evaluation and vendor recovery.
- Warranty Claims will be denied, returned, or adjusted if the returned transaxle does not meet Cub Cadet’s replacement criteria.
- If the dealer has questions regarding transaxle replacement, they should call Cub Cadet Service, using the dealer only line, before proceeding.

Externally repairable drive system problems

Most of the problems listed in this section will result in a customer complaint of low power or low ground speed, sometimes accompanied by growling or similar noises from the transaxle. If the tractor is difficult to push, check the brakes and the hydraulic bypass.

1. Engine performance:

   1a. Find the specified engine RPM for the tractor (3,375-3,525 RPM for the Cub Cadet Series 1000).

   1b. Check the engine with a tachometer to confirm that it maintains the specified RPM under normal load. See Figure 5.1.

   1c. Correct engine performance problems before trying to diagnose drive system problems.

2. Check the tires: Confirm that the correct size tires are on the tractor.

   Smaller rear tires will yield lower ground speed. Under-filled tires will put additional load on the drive system.

   - LTX 1040 Series has 20” x 8” rear tires.
   - LTX 1050 Series has 20” x 10” rear tires.
   - SLTX 1050 Series has 22” x 9.5” rear tires.

Figure 5.1

3. Check the hydro. bypass linkage: See Figure 5.2.

   3a. If the tractor does not drive with as much speed or power as normal:

   - Confirm that the transmission release rod is fully engaged (pushed-in).
   - When the transmission release rod is fully engaged, confirm that the bypass arm on the side of the transaxle moves freely.
   - If the bypass arm is not releasing fully, the variable displacement pump will cavitate, or pump air. The air bubbles will produce a growling noise as they go through the system.

   3b. If the tractor is difficult to push:

   - Confirm that the Transmission Release Rod is disengaged (pulled-out and hooked).
   - Confirm that the Transmission Release Rod and spring are moving the bypass arm correctly. It takes about 5 lbs. (2.3 Kg.) force to move the bypass arm fully into the release position.
   - If the bypass linkage is working correctly, confirm that the brakes are releasing fully.

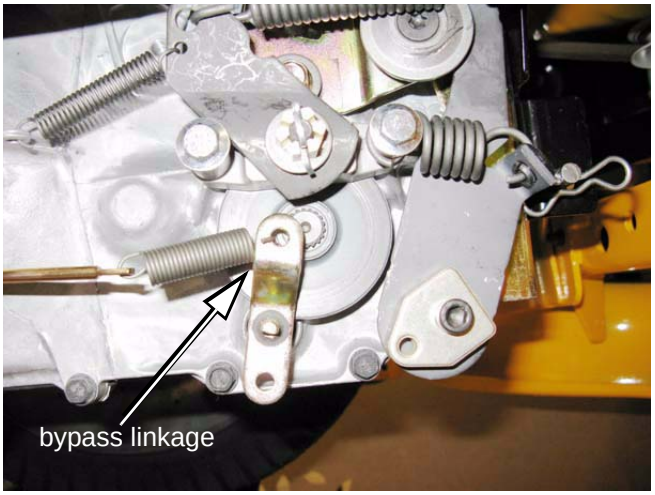


Figure 5.2

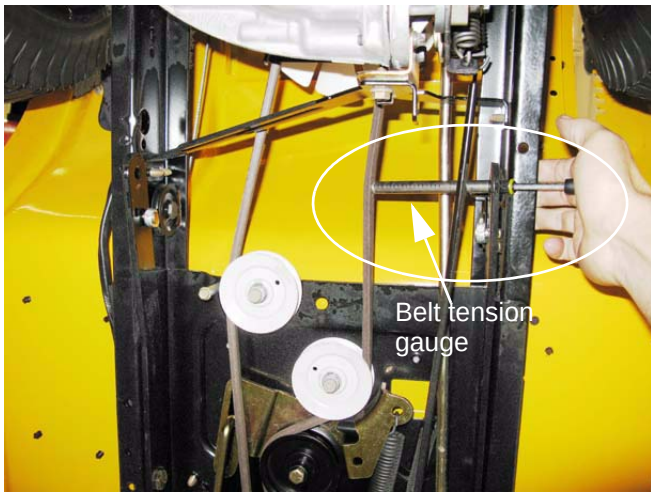


Figure 5.3

4. Check the brakes: See Figure 5.3.

4a. The brake linkage applies the brakes and disengages the drive belt. Confirm that both parts of the linkage are moving properly.

- When the brake pedal is released, the transmission drive belt should be under tension. It should take about 3 lbs (1.36 Kg.) of force at the center of the longest span of the belt to move the belt 1/2” (1.3 cm) inward.
- If the belt is not tensioning properly, the drive will slip. Some belt noise may be present, but the transmission itself will not make much noise.
- Accelerated belt wear, and the presence of black belt residue, are cause to check the belt tensioner linkage.
- If the brake is dragging, the transmission is likely to make growling noises and run hot.
- The rotor may be discolored from heat.

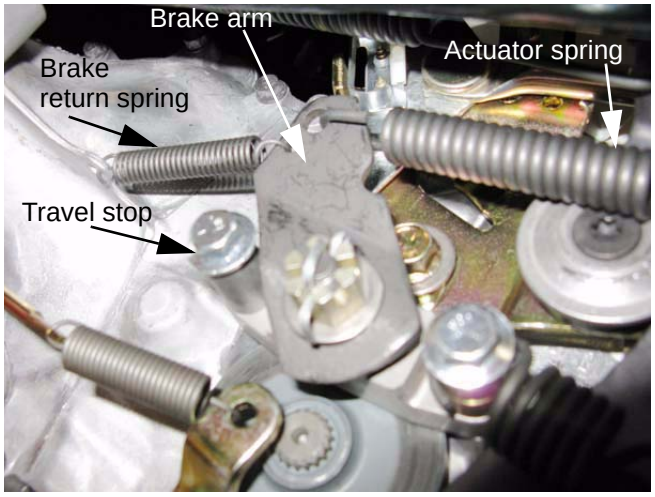


Figure 5.4

4b. If the linkage is working properly, but the brakes seem to be dragging, check the caliper. See Figure 5.4.

- When the brakes are released, it should be possible to wiggle the brake rotor within the caliper.
- If the rotor is tight in the caliper, check the caliper adjustment.

Check the operation of the caliper to confirm that it is not stuck.

- When the brake pedal is released, the brake arm on the caliper should fall completely back against the stop.

4c. Operator error: See Figure 5.5.

- If the customer complains of symptoms similar to a brake / clutch linkage problem, yet no mechanical problem is present, check the customer.

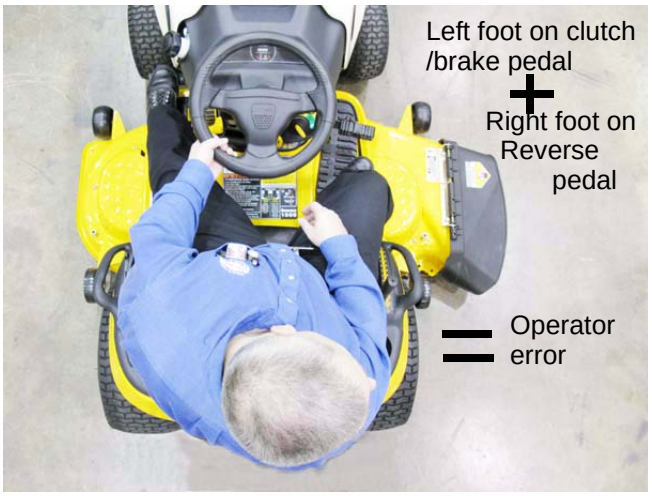


Figure 5.5

5. Check the drive belt. See Figure 5.6.

- In normal use, drive belts typically last for years without problems.
- If the belt fails prematurely, identify and correct the cause of the belt failure before returning the tractor to service.

5a. Look-up the part number for the belt, and confirm that the correct OEM belt is on the tractor.

5b. Check the belt routing.

5c. Check the brake/clutch linkage and belt tensioning pulleys.

5d. Check for foreign objects jammed against the belt.

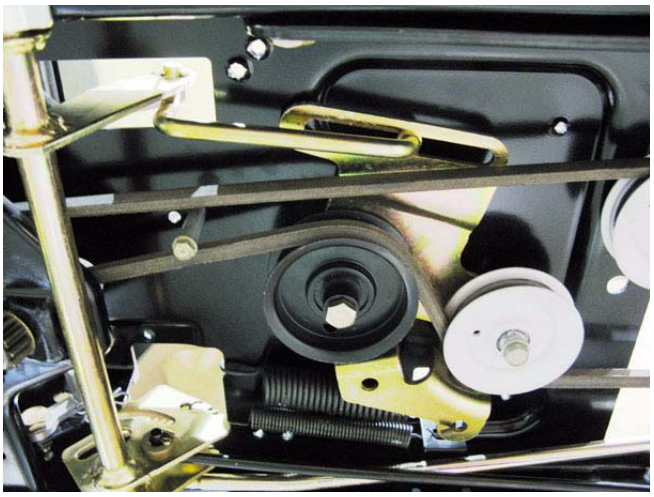


Figure 5.6

5e. Check for missing or out-of-place belt guides. See the belt replacement section of this chapter.

5f. Check the engine crankshaft and transaxle input pulleys.

Confirm that the sheaves are not spread-out, causing a loose belt fit.

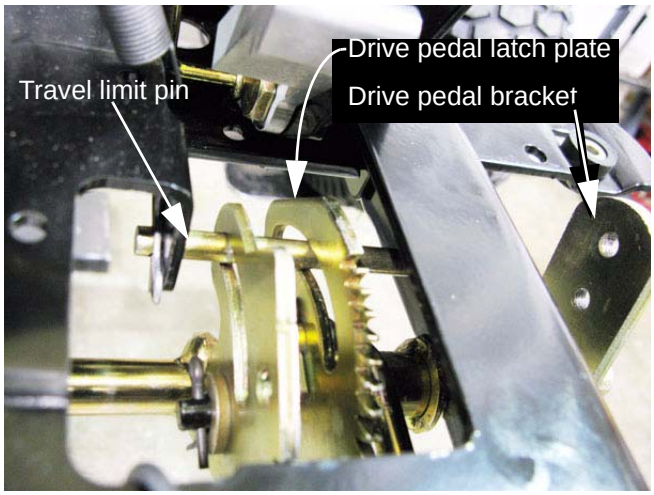


Figure 5.7

6. Check the drive control linkage. See Figure 5.7.

6a. The travel limit pin fits into the curved slot in the drive pedal latch plate. The pedal bracket should have enough travel for the pin to hit both ends of the curved slot when the pedal is moved through the full range of its travel.

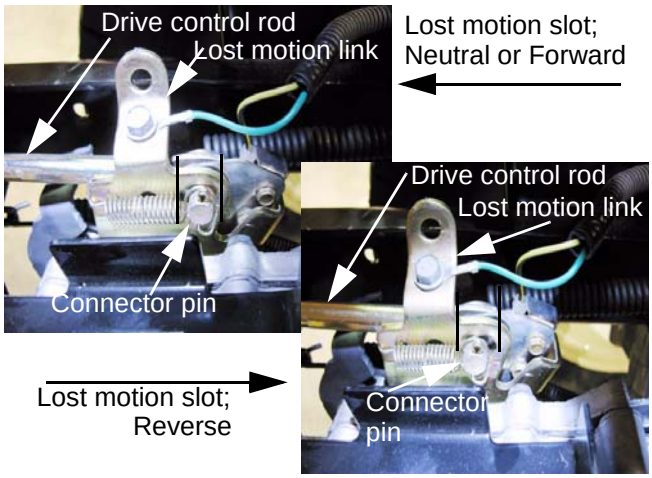


Figure 5.8

6b. Some lost motion is built into the linkage so that there is a “dead” range as the pedal moves from neutral to reverse. See Figure 5.8.

- This dead spot allows the reverse safety switch to act before the tractor actually begins to move backward.
- It is normal to have 1-1/8” play at the Forward pedal or 1” play at the Reverse pedal in this dead range.

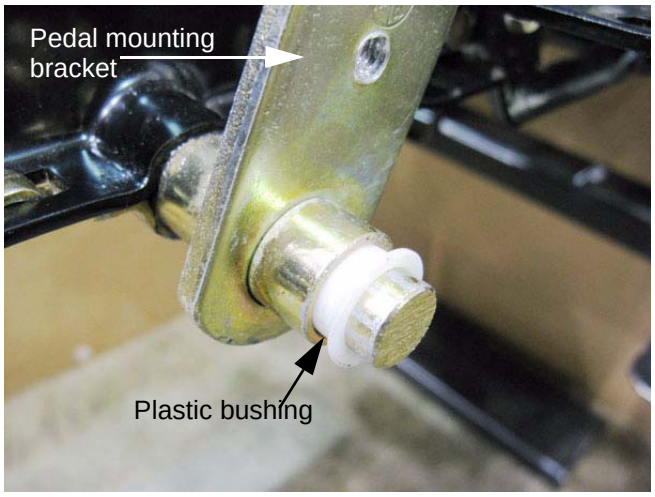


Figure 5.9

6c. The most likely causes for additional lost motion that would effect the ground speed of tractor are: See Figure 5.9.

- The drive pedal itself being loose on the bracket.
- Worn plastic bushings between the drive pedal bracket and the brake cross-shaft.

6d. If the tractor makes drive noise or creeps while the pedal is in neutral, but seems to have lost speed in just one direction (forward or reverse):

- The rod connecting the pedal bracket to the arm on the transaxle may be bent, changing its effective length. See Figure 5.10.
- The transaxle neutral control may be out of adjustment. See the Neutral control adjustment section of this chapter.

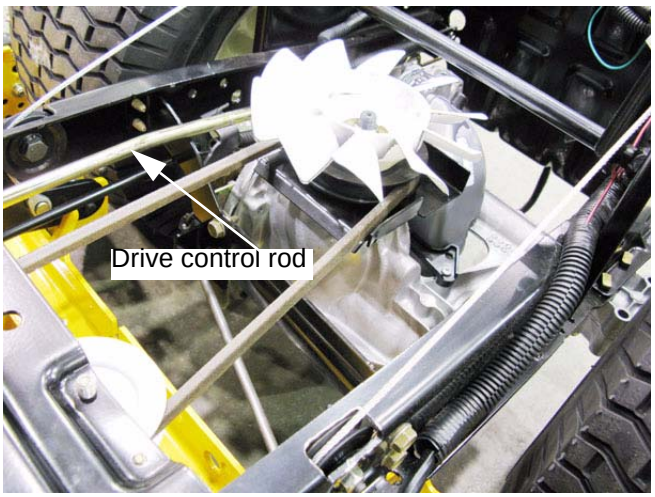


Figure 5.10

7. Check the fluid:

- Unless the fluid gets contaminated, it should last for many years with no fluid service.
- Check the level and condition of the fluid: It should be no more than 1-1/4” (3.175 cm) down from the top of the casting. The fluid level is generally near the bottom of the threads in the plug hole.
- Check at the socket-head plug on the casting, NOT the plastic expansion tank. Remove the plug using a 1/4” allen wrench.
  See Figure 5.11.
- The transaxle should contain 20W-50 motor oil having a minimum API classification of SL.

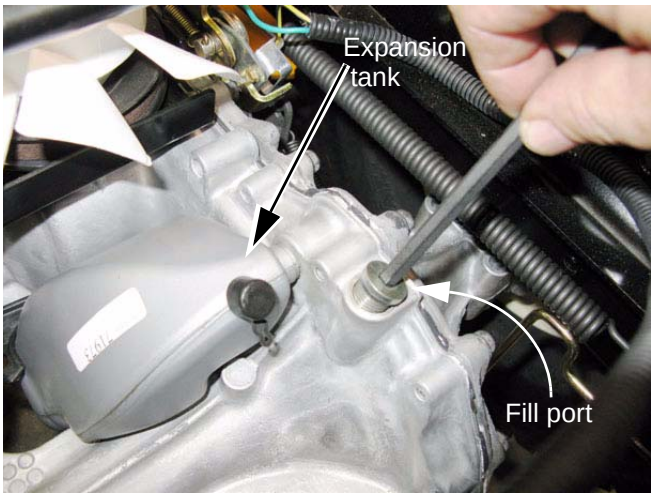


Figure 5.11

- If there is any reason to suspect that the fluid is contaminated, replace the fluid and monitor performance. A second fluid change after a brief period of operation may be necessary to remove all contaminants.
- If the fluid is low, there is probably a leak that needs to be found and repaired.
- If the fluid is too full, it will drain into the catch tank

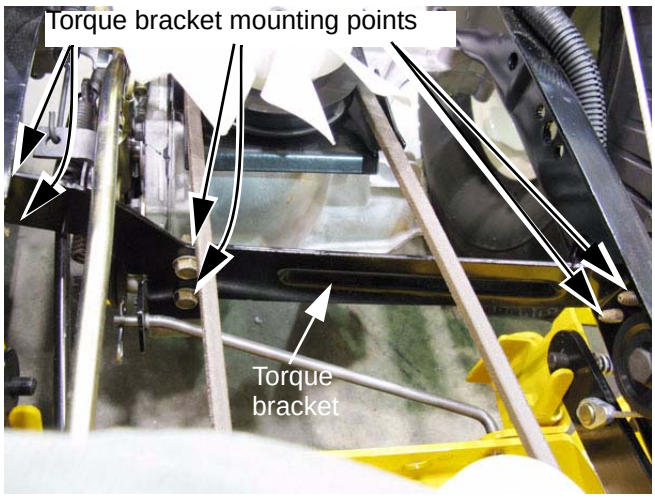


Figure 5.12

8. Transaxle mounting:

   8a. The primary symptoms of a transaxle that is loose in the frame are that it will lose drive or throw-off the drive belt in reverse.

   8b. Check the torque bracket and the axle mounting points at the frame. See Figure 5.12.

9. Eliminate heat factors

   - As hydrostatic transaxles wear, they will begin to lose drive power when they get hot.
   - Heat is the enemy of transaxle performance and longevity.
   - If the cooling fan is damaged, replace it.
   - Clean any mud and debris from the transaxle so that it can shed heat properly.
   - DO NOT clean the transaxle (or any part of the tractor) with a pressure washer.
   - Do not direct hose water at line pressure at the transaxle or any bearings on the tractor.

NOTE: It is possible to inject water past seals, contaminating fluid and ruining bearings.

Indications that a transaxle is not warrantable

Anything that would indicate misuse, abuse, neglect, accident, improper maintenance, alteration, vandalism, theft, fire, water or damage because of other peril or natural disaster will render the transaxle non-warrantable even though it is within the normal warranty period.

Typical indicators of a void warranty would be:

- The normal warranty is for 3 years or 120 hours, whichever comes first. Beyond 120 hours of use, the tractor is out of warranty
- Abnormally high wear indicators for the age of the tractor (usually consistent with high hours of usage). As an example, if the tires are completely worn-out on a tractor that is 6-months old, it is reasonable to think it has been used pretty heavily even if the hour meter has been unplugged.
- Bent axle, broken housing, or other obvious signs of impact damage
- Contaminated fluid or low fluid
- Damage to the cooling fan
- Enough dirt or debris on the transaxle to prevent the it from cooling properly
- Indication that the tractor has been over-loaded.

Brake adjustment

1. Test the operation of the brakes

   1a. Disengage the transmission release rod by pulling it out and hooking it.

   1b. Set the parking brake by depressing the brake/clutch pedal and pushing-down on the parking brake/cruise control lever. See Figure 5.13.

   1c. Attempt to push the tractor. If it can be pushed by hand without skidding a rear wheel, check and adjust the brakes.

   1d. Release the parking brake.

   1e. Attempt to push the tractor again. If it cannot be pushed with reasonable effort, check and adjust the brakes and the hydro bypass (controlled by the transmission release rod).

Figure 5.13

2. Visually inspect the linkage to confirm that it functions properly. See Figure 5.14.

   - Beneath the floor panel, on the right side of the tractor there are two semi-circular latch plates.
   - The outer latch plate rotates with the drive control pedals. The inner latch plate rotates with the clutch/brake pedal.

   2a. With the clutch/brake pedal fully released:

   - The travel limit pin should be resting against the front of the curved slot. See Figure 5.14.

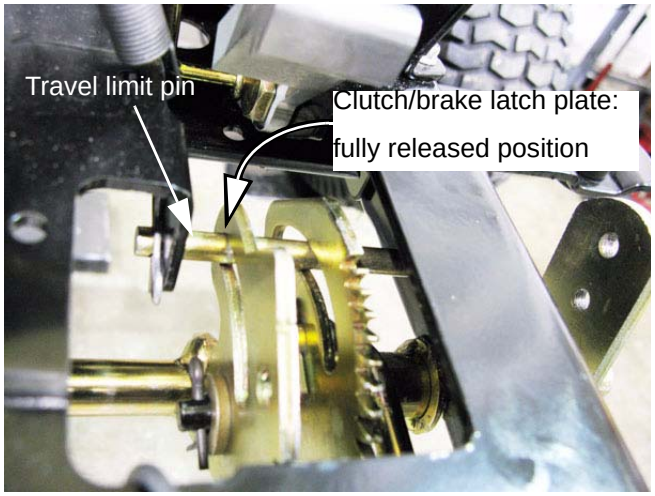


Figure 5.14

   - The rod that connects the clutch/brake latch plate to the heavy brake actuator spring should be slack. See Figure 5.15.
   - The light brake pull-off spring should be holding the brake arm back against the stop.

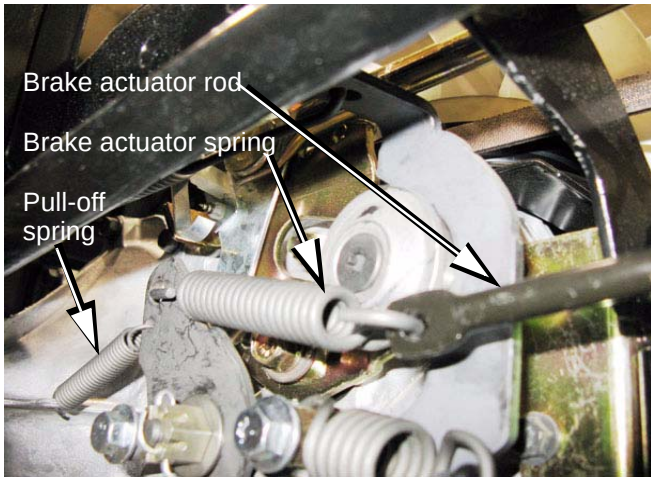


Figure 5.15

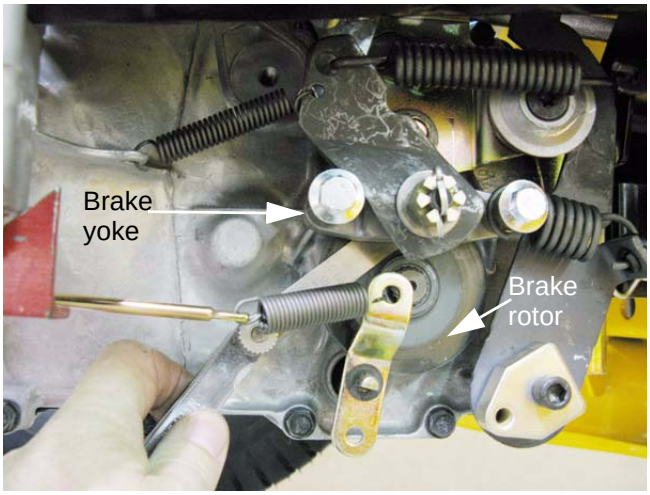


Figure 5.16

2b. Check the gap between the brake rotor and the brake pads.

- There is a fixed pad in the transaxle housing.
- There is a moving pad in the brake caliper.
- Wiggle the brake rotor slightly, and attempt to insert a 0.015” (0.38mm) feeler gauge between the rotor and either pad.

2c. Adjust the gap, if necessary, so that the feeler gauge slips between the pad and the rotor with light pressure. See Figure 5.16.

- If adjustment is necessary, remove and discard the cotter pin that locks the adjusting nut.
- Turn the nut to adjust the gap.
- Apply and release the brake pedal, then re-check the gap.
- If the gap is consistent, install a new cotter pin to secure the adjustment nut.

2d. If the brake seems to be sticking, or the rotor is discolored from dragging, remove the brake yoke for repair or replacement.

2e. Confirm that the drive belt is under tension when the brake is released.

2f. Set the brake. The drive belt should be slack.

2g. Re-test the operation of the brakes before returning the tractor to service.

NOTE: The hydrostatic transaxle creates it’s own braking force from the hydraulic pressure in the hydraulic motor. The brake is used more as a parking brake than a service brake. Properly adjusted brakes generally show little wear over the life of the tractor.

Neutral control adjustment

NOTE: Neutral control rarely goes out of adjustment on its own. If it needs adjustment, check for damaged linkage or signs of tampering.

CAUTION

The tractor engine and drive system must be operated to complete this procedure. Confirm that no hazards will be incurred by running the engine or operating the drive system:

- Work in a well vented area to prevent carbon monoxide poisoning or asphyxiation.
- Be careful to avoid contact with hot parts or moving parts.

1. Loosen the wheel bolt or lug nuts on the right rear wheel of the tractor.
2. Lift and safely support the rear of the tractor.
3. Remove the right rear wheel:
   - LTX tractor drive wheels fit on a “Double-D” axle, and can be removed using a 1/2” wrench.
   - SLTX tractor drive wheels are hub mounted. Remove the lug nuts using a 3/4” wrench.
4. bypass the seat safety switch. See Figure 5.17.

   4a. Remove the seat from the tractor.

   4b. Disconnect the seat safety switch.

   NOTE: This procedure is described in Chapter 4: Body Panels.

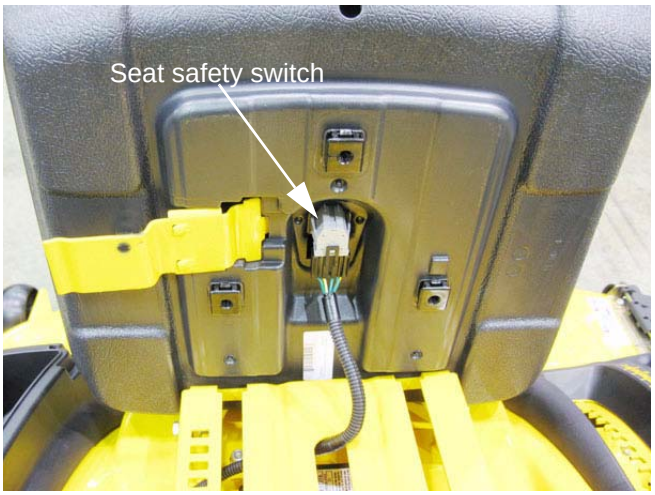


Figure 5.17

5. Confirm that the linkage is in the neutral position: The roller on the control arm must be centered in the “elbow” of the control cam. See Figure 5.18.
   - If the roller is not centered in the elbow of the control cam, identify and correct the problem before proceeding.

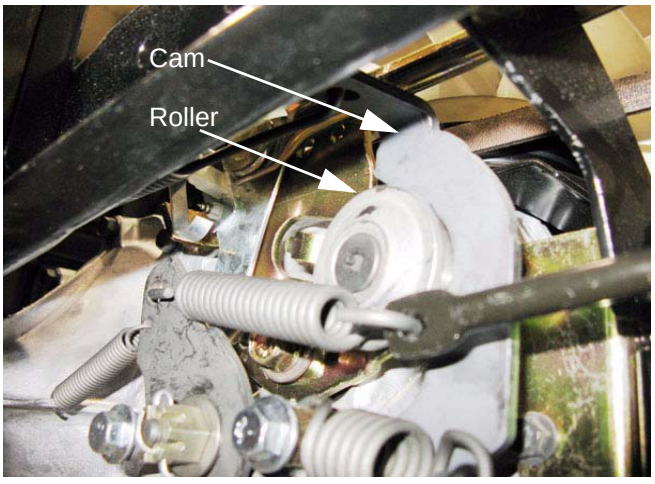


Figure 5.18

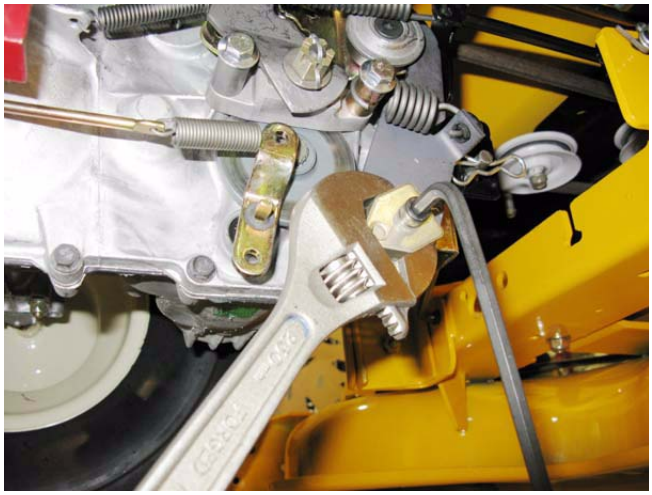


Figure 5.19

6. Loosen the socket head cap screw that locks the adjusting puck using a 1/4” allen wrench.
7. Have a 1-1/8” wrench handy, or size an adjustable wrench to fit the adjusting puck. See Figure 5.19.
8. Start the engine and advance throttle to maximum RPM.
9. Set the adjusting puck so that neither wheel rotates. The brake rotor should also be stationary.
10. Lock the adjusting puck, then confirm that the wheels and brake rotor are still motionless.
11. Turn the engine off.
12. Reinstall the seat, reconnecting the seat switch.
13. Reinstall the rear wheel:

Double-D axle

13a. Lubricate the axle with anti-seize compound before positioning the wheel on LTX models.

13b. Apply thread locking compound such as Loctite 242™ (blue) to the threads of the wheel bolt.

13c. Install the bolt and belleville washer so that the inside diameter contact area of the washer is against the bolt head and the outside diameter contact area is against the wheel.

Hub

13d. Position the wheel on the hub and secure it with four lugs.

14. Lower the tractor to the ground.

14a. Tighten the bolt to a torque of 12-15 ft-lbs. (16-20 N-m).

14b. Tighten the lugs on the SLTX tractors to a torque of 30-42 ft-lbs. (41-57 N-m).

15. Test the drive system and all safety features before returning the unit to service.

Linkage: pedal shaft

Description: The Clutch/brake pedal and the drive control pedal operate on two concentric shafts.

- The clutch/brake shaft runs the full width of the tractor.
- The drive control shaft is tubular, and pivots on the clutch/brake shaft.
- Each shaft has a toothed latch plate. The latch plates are next to each other.
- The cruise control/park brake lever operates a common pawl that engages the latch plate of whichever pedal is applied. See Figure 5.20.

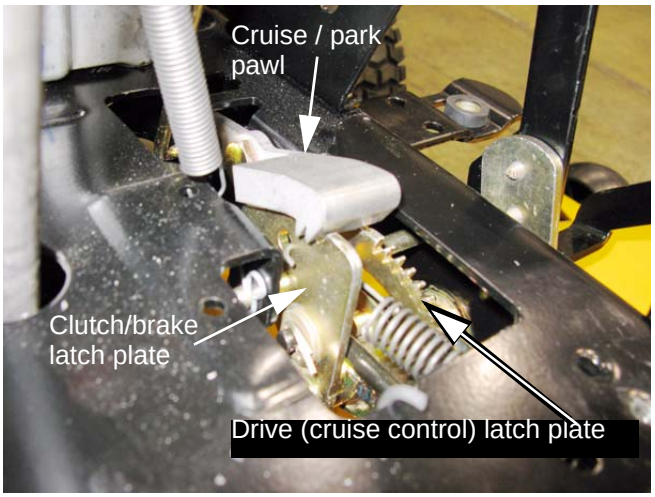


Figure 5.20

- A travel limit pin passes through curved slots in both of the latch plates. The pin is blocked into place by the fenders. See Figure 5.21.

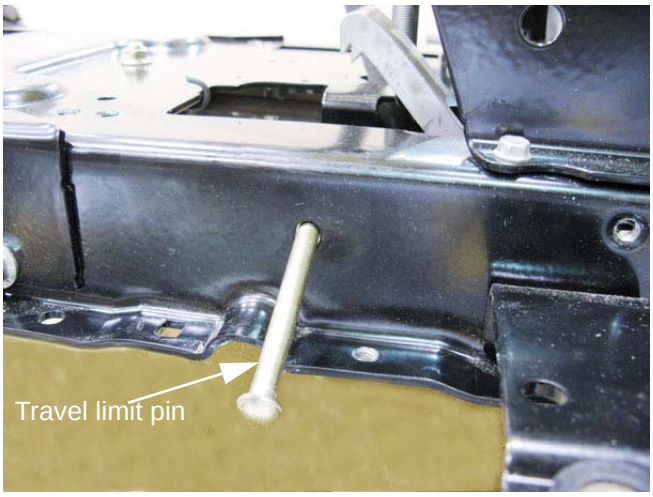


Figure 5.21

Pedal shaft assembly removal

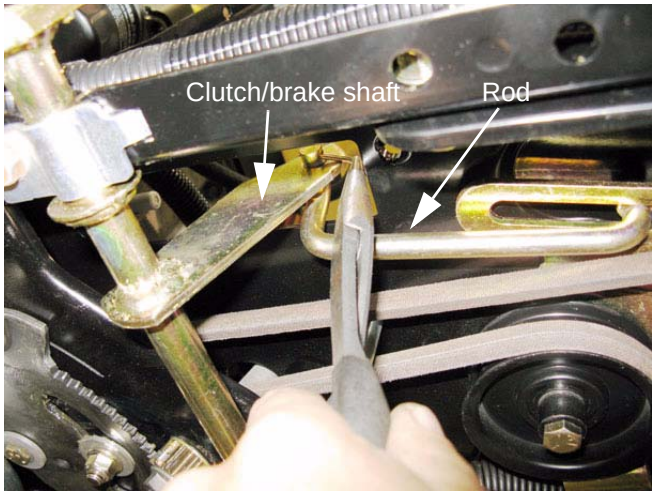


Figure 5.22

NOTE: Confirm that the parking brake is released before starting work.

1. Remove the mowing deck.
2. Remove the fenders, as described in the body panels chapter of this manual.
3. Disconnect the rod that joins the arm at the left side of the brake/clutch shaft to the drive belt tensioner pulley bracket. See Figure 5.22.
   - Remove and discard the cotter pin to disconnect the rod.

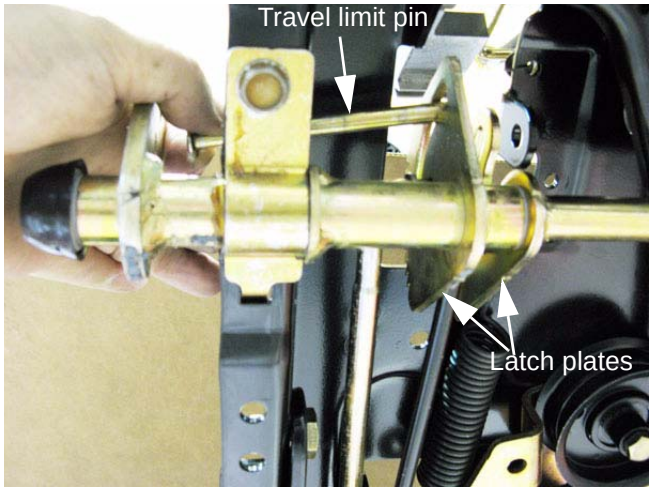


Figure 5.23

4. Remove the locking clip that holds the travel limit pin in place.
5. Withdraw the travel limit pin. See Figure 5.23.

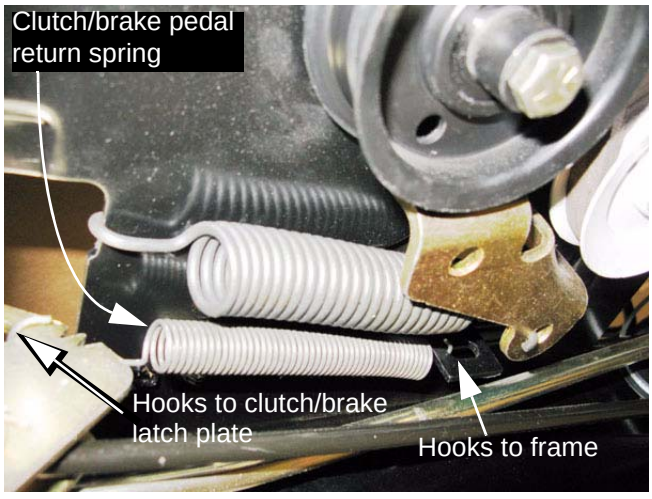


Figure 5.24

6. Unhook the clutch/brake pedal return spring. See Figure 5.24.

7. Remove and discard the push cap that holds the drive control pedal shaft onto the clutch/brake shaft. See Figure 5.25.

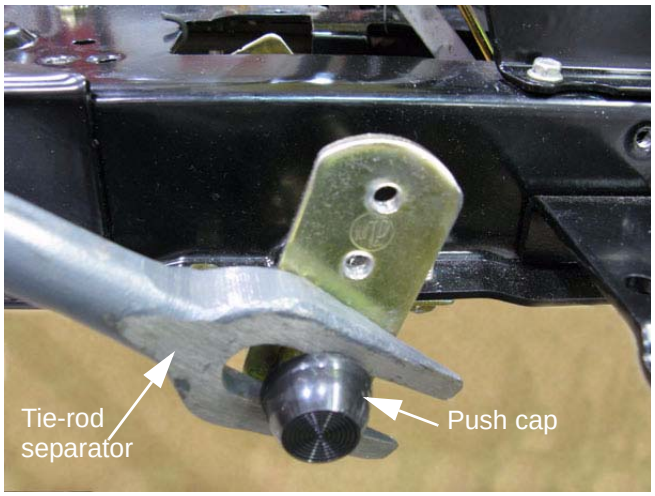


Figure 5.25

8. Loosen the bolt that holds the left pedal shaft support strap using a 1/2” wrench. See Figure 5.26.
9. Remove the bolt that holds the right pedal shaft support strap using a 1/2” wrench.

   NOTE: This will allow the pedal shaft assembly to hang-down slightly on the right side of the tractor.

Figure 5.26

10. Disconnect the drive control rod from the drive pedal latch plate. See Figure 5.27.
    - Remove and discard the cotter pin.
    - Unhook the drive control rod.

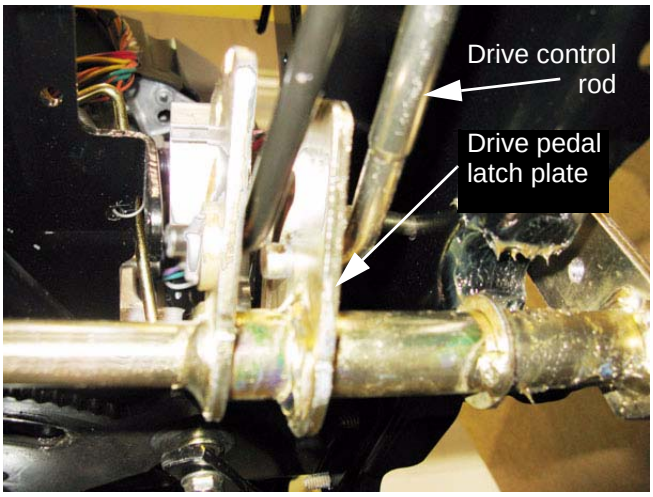


Figure 5.27

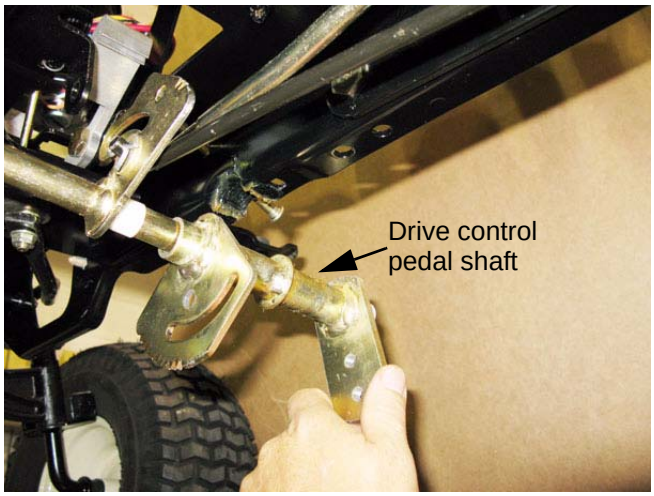


Figure 5.28

11. Allow the drive pedal shaft to rotate down, then pull it off of the pedal shaft assembly. See Figure 5.28.

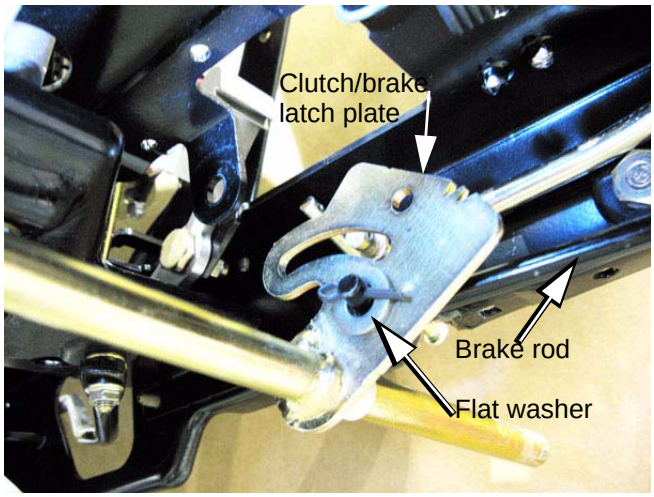


Figure 5.29

12. Disconnect the brake rod from the clutch/brake latch plate. See Figure 5.29.
    - Remove the cotter pin and flat washer to disconnect the brake rod. Discard the cotter pin.
    - Unhook the brake rod from the clutch/brake latch plate.

Figure 5.30

13. Remove the left side pedal shaft support strap, and lower the pedal shaft assembly out of the tractor. See Figure 5.30.

NOTE: The pedal shaft support straps are two different sizes. The smaller strap holds-up the left (brake pedal) end of the pedal shaft assembly. The larger strap holds-up the right (drive control pedal) end of the pedal shaft assembly. See Figure 5.31.

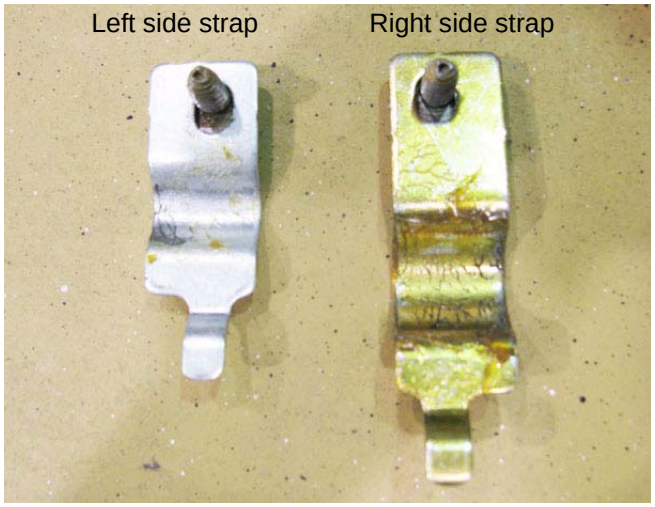


Figure 5.31

14. Inspect the pedal shaft components individually. Replace any parts that are worn or damaged. See Figure 5.32.
    - The plastic bushings that fit between the two pedal shafts should be replaced any time they are removed. Lubricate them with a dry PTFE or graphite-based lubricant on assembly. NOT grease.
    - Replace the push cap and all removed cotter pins with new parts.

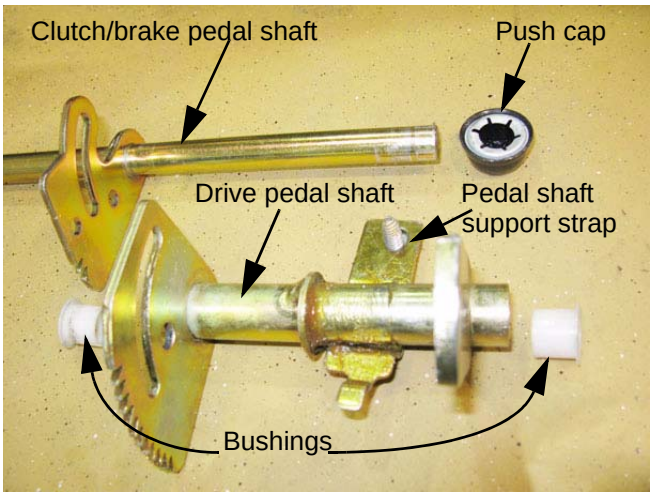


Figure 5.32

15. Install the pedal shaft assembly by reversing the steps used to remove it, then install the fenders.

    15a. Lubricate the points where the pedal shafts meet the frame with a good quality lithium-based grease. See Figure 5.33.

Figure 5.33

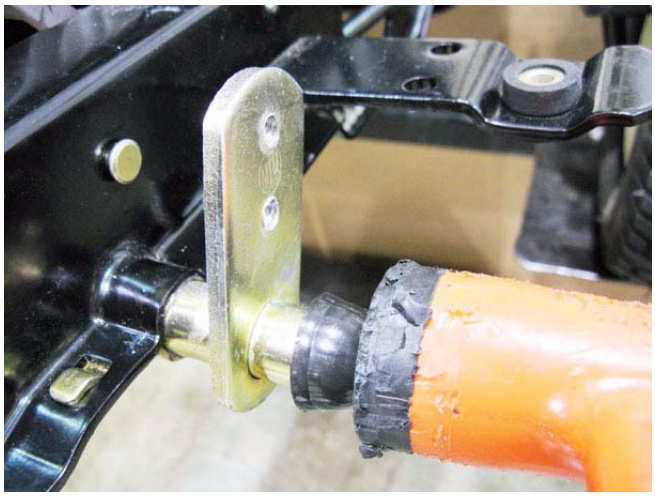


Figure 5.34

NOTE: Leaving the drive control pedal shaft loose until after the brake rod is secured will make it easier.

15b. Position the drive control shaft and bushings, fasten the drive control rod to it, then drive the push cap on. See Figure 5.34.

15c. Tighten the pedal shaft support strap bolts to a torque of 12-15 ft-lbs. (16-20 N-m).

15d. Attach the belt tensioner pulley rod.

16. Test the drive system and all safety features before returning the tractor to service.

Belt control; tensioner and idler pulleys

NOTE: The V-idler pulleys can be removed from below using a 1/2” wrench, with no disassembly beyond removing the cutting deck. See Figure 5.35.

NOTE: Confirm that the parking brake is released before starting work.

1. Remove the mowing deck.
2. Remove the fenders by following the steps described in Chapter 4: Body Panels.

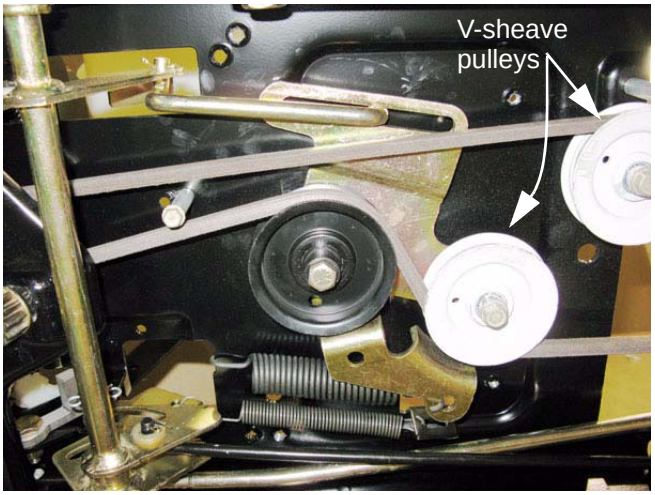


Figure 5.35

3. Disconnect the rod that joins the arm at the left side of the clutch/brake shaft to the drive belt tensioner pulley bracket. See Figure 5.36.
   - Remove and discard the cotter pin to disconnect the rod.

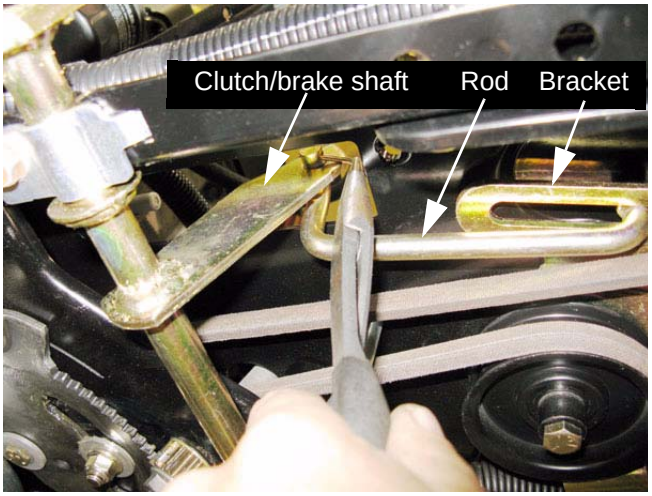


Figure 5.36

4. Disconnect the extension spring that pulls on the bracket to tension the drive belt. See Figure 5.37.

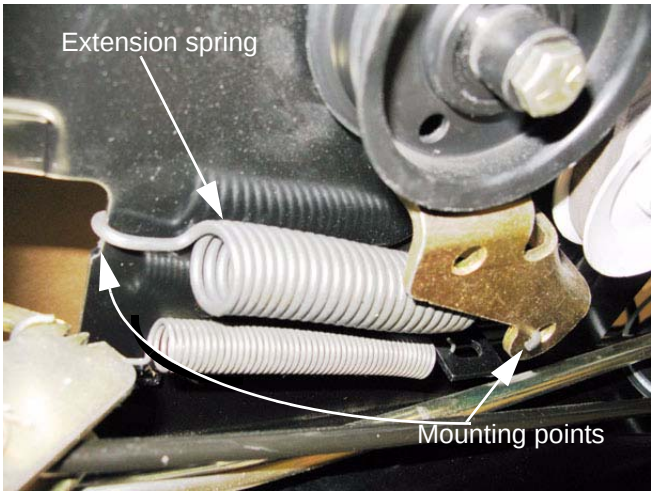


Figure 5.37

Figure 5.38

5. Note the belt routing, then slip the drive belt off of the two pulleys on the tensioning bracket.
6. Remove the nut and bolt that hold the belt tensioner pulley bracket to the frame using a pair of 9/16” wrenches. See Figure 5.38.

Figure 5.39

7. Maneuver the belt tensioner bracket assembly to clear the belt, and remove it from the tractor. See Figure 5.39.

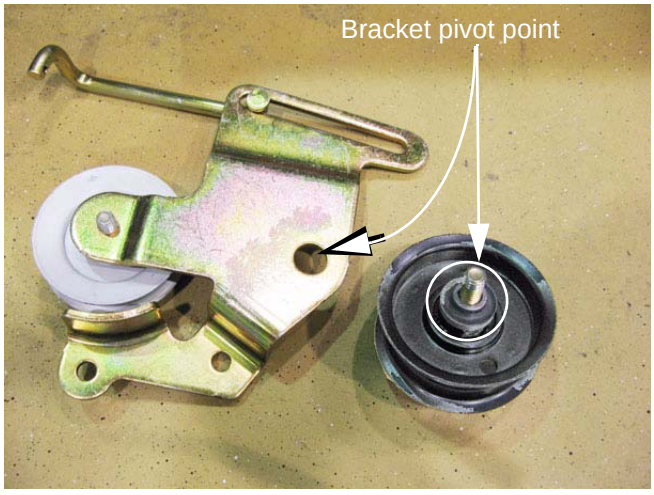


Figure 5.40

NOTE: The bracket assembly pivots on the bolt that passes through the fixed, flat-sheave idler pulley.

8. On the bench, the flat-sheave idler pulley, and the spacers used to position it can be lifted off of the pulley bracket. See Figure 5.40.

NOTE: When installed, the head of the bolt that holds the bracket assembly to the tractor rests against the shouldered side of the flat sheave idler pulley. See Figure 5.41.

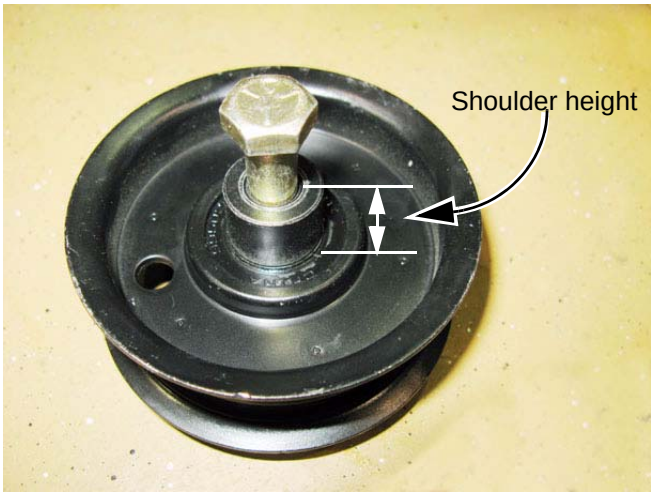


Figure 5.41

- When installed, the spacers fit against the flat side of the flat sheave idler pulley. See Figure 5.42.

9. The V-sheave tensioner pulley can be un-bolted from the bracket using a 1/2” wrench.

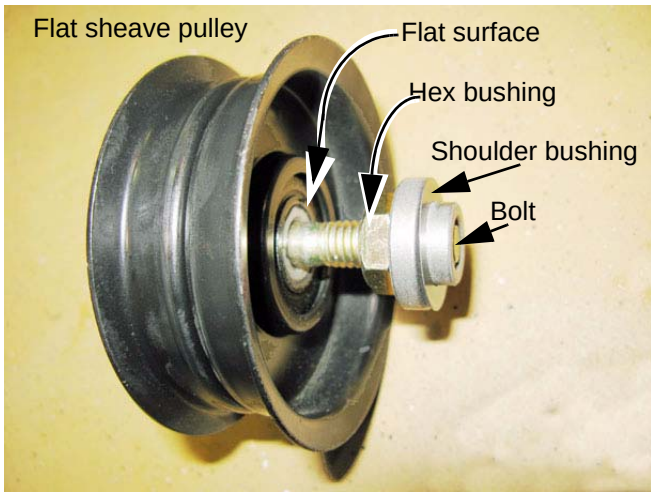


Figure 5.42

10. The rod that connects the bracket to the clutch/brake pedal shaft can be maneuvered to come out of its slot in the bracket. See Figure 5.43.
11. Assemble and install the belt tensioner pulley by reversing the steps used to remove and disassemble it.
    - Lubricate the pivot point with a good quality lithium-base grease.
12. Reinstall the fenders.
13. Test the drive system and all safety features before returning the tractor to service.

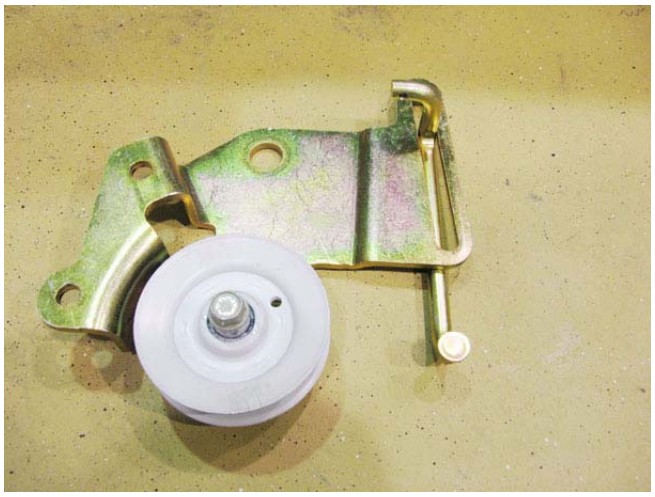


Figure 5.43

Drive belt replacement

CAUTION The battery will be removed in this procedure. Review the Operator's Manual and Chapter 7: Electrical System for important safety information about handling batteries before proceeding.

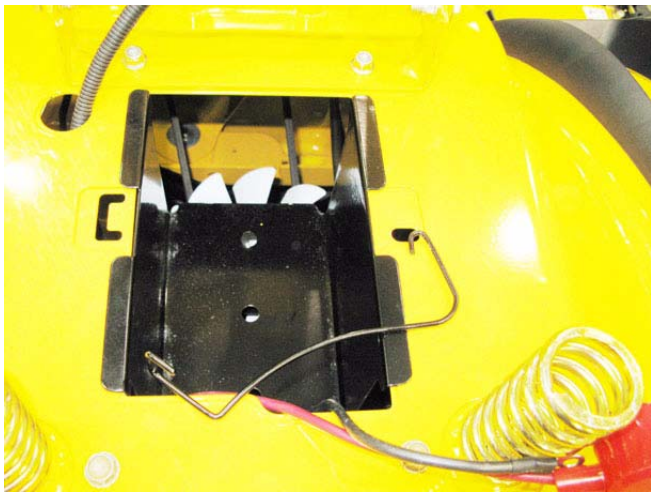


Figure 5.44

1. Remove the mowing deck.
2. Set the park brake to release belt tension.
3. Remove the battery and battery tray by following the procedures described in Chapter 4: Body Panels. See Figure 5.44.

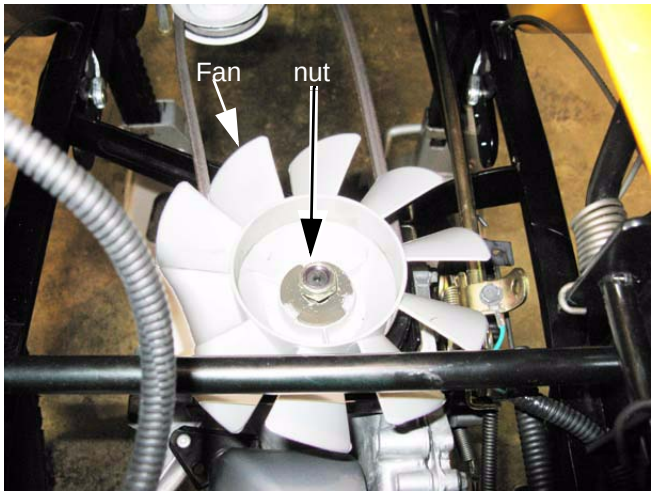


Figure 5.45

4. Remove drive belt from the transaxle pulley. See Figure 5.45.
   - 4a. Remove the nut using a 3/4" wrench. An impact wrench with a socket will be most effective.
   - 4b. Lift-off the cooling fan.

4c. Remove the pulley. The belt will clear the belt keepers on top of the transaxle as the pulley comes up. See Figure 5.46.

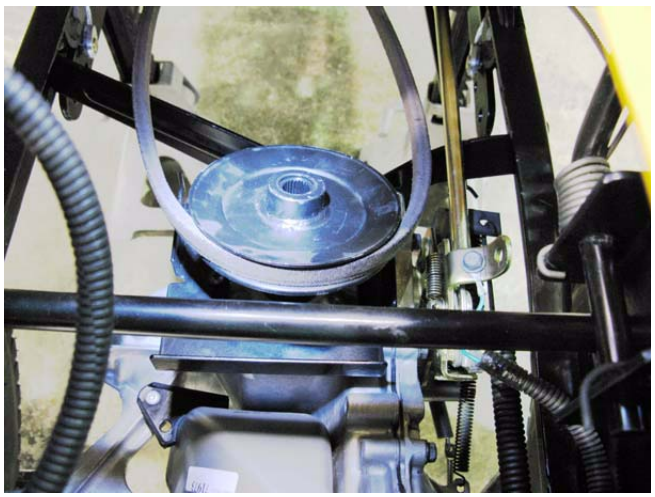


Figure 5.46

NOTE: Correct orientation of input pulley: See Figure 5.47.

- Tall shoulder goes up.
- Short shoulder with snap-ring stop goes down.

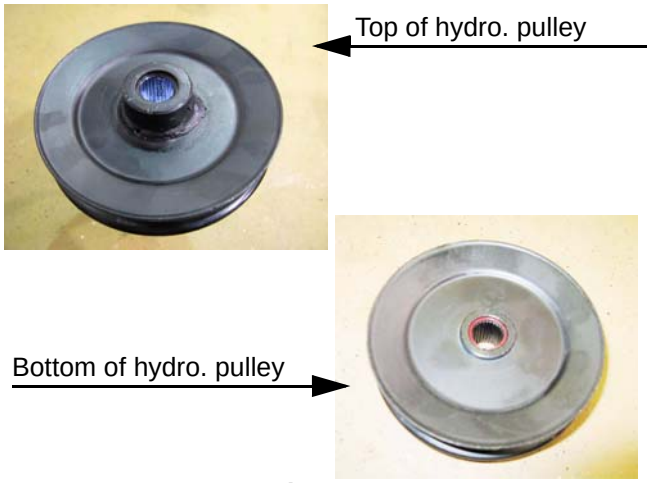


Figure 5.47

5. Lift and safely support the tractor. See Figure 5.48.

Figure 5.48

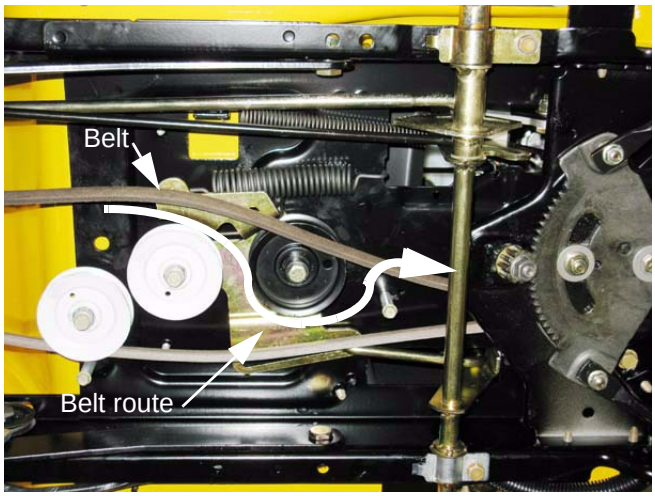


Figure 5.49

6. Work the belt out of the two pulleys on the belt tensioner bracket. See Figure 5.49.

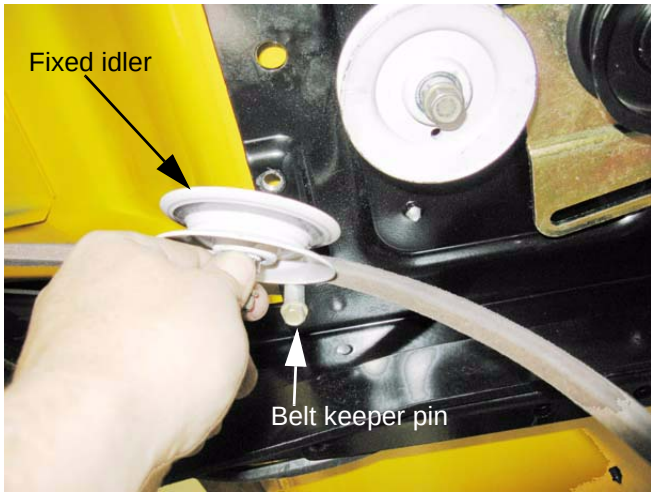


Figure 5.50

7. Remove the single, fixed idler from the frame of the tractor using a 1/2” wrench. See Figure 5.50.

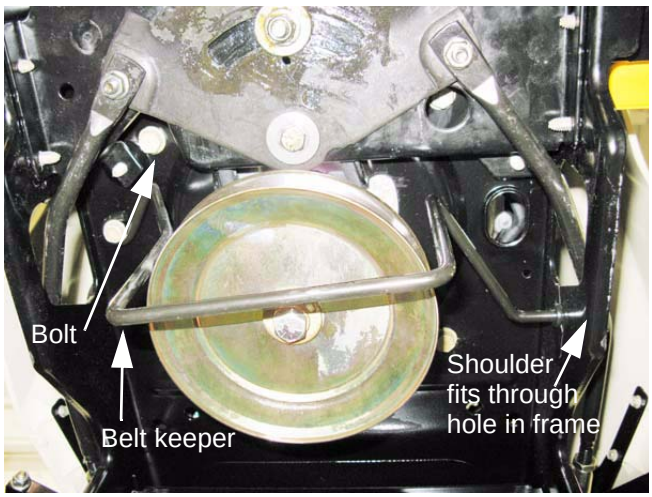


Figure 5.51

8. Remove the belt keeper near the engine pulley or electric PTO clutch, using a 1/2” wrench.

   8a. With manual PTO, a single bolt holds the belt keeper to the frame, to the left side of the engine. See Figure 5.51.

8b. With electric PTO, there are two fasteners: See Figure 5.52.

8c. One bolt holds the belt keeper to the frame, to the left side of the engine.

8d. A nut holds the belt keeper to the right-side frame channel.

NOTE: The electric PTO belt keeper incorporates an anti-rotation bracket for the PTO clutch.

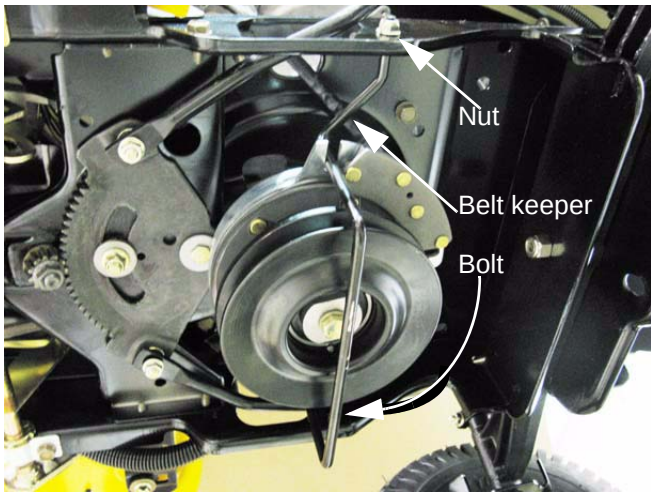


Figure 5.52

9. Lower the engine pulley to remove the belt; manual PTO.

9a. Remove the bolt that holds the engine pulley to the crankshaft using a 5/8” wrench.

9b. Slide the pulley off of the engine crankshaft. The belt will clear the belt keepers as the pulley comes down. See Figure 5.53.

9c. Remove the belt.

Figure 5.53

10. Lower the engine pulley to remove the belt; electric PTO.

10a. Disconnect the PTO clutch electrical plug from the harness. See Figure 5.54.

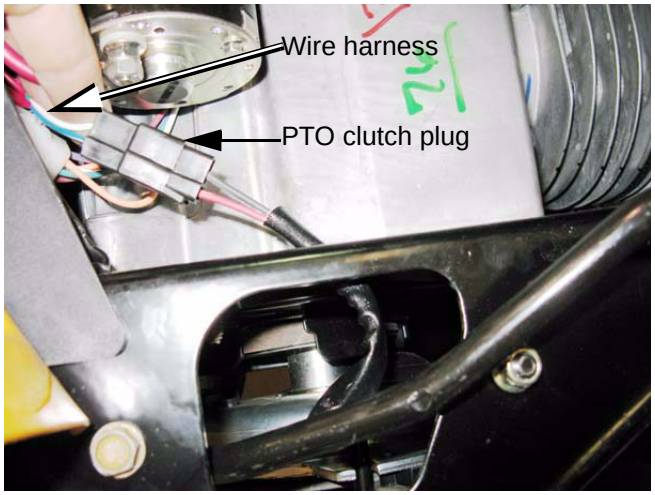


Figure 5.54

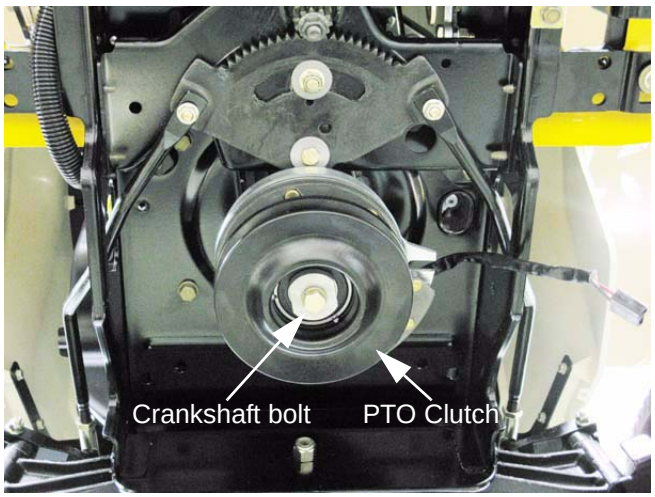


Figure 5.55

10b. Remove the bolt that holds the PTO clutch to the engine crankshaft using a 5/8" wrench. See Figure 5.55.

NOTE: An impact wrench and socket will be most effective. Otherwise it may be necessary to block the ring-gear to prevent the crankshaft from turning .

⚠CAUTION The PTO clutch is heavy, and it may fall as the bolt is removed.

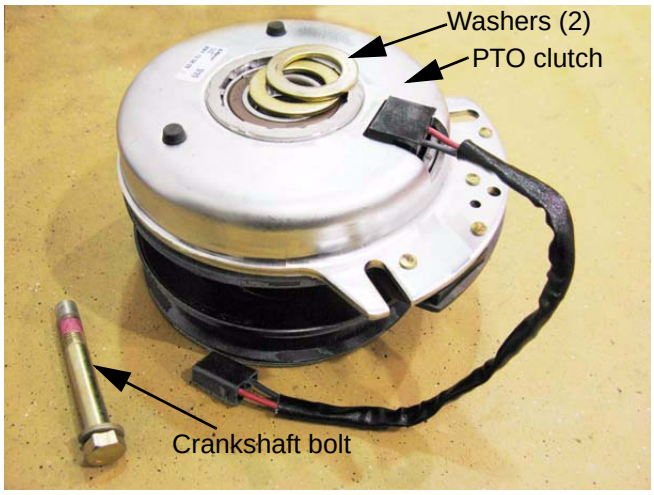


Figure 5.56

10c. Carefully lower the PTO clutch and any associated hardware. See Figure 5.56.

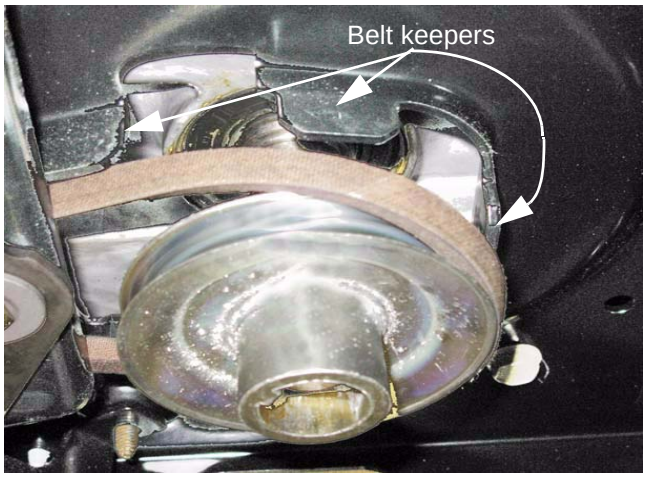


Figure 5.57

10d. Slide the pulley off of the engine crankshaft. The belt will clear the belt keepers as the pulley comes down. See Figure 5.57.

10e. Remove the belt.

NOTE: The flat edge of the crankshaft pulley faces the electric PTO clutch. The end with the inside diameter chamfered goes against the fillet near the base of the crankshaft. See Figure 5.58.

11. If the drive belt failed prematurely, identify and correct the cause of the failure before installing a new belt.

12. Install the new belt by reversing the steps used to remove it.

Belt installation notes:

- Install only a correct OEM belt. Incorrect belts may cause problems that effect the performance and/or safety of the tractor.
- Apply a small amount of anti-seize compound to the engine crankshaft before installing the crankshaft pulley.
- Apply a small amount of thread locking compound such as Loctite 271™ (red) to the threads of the crankshaft bolt.
- Tighten the bolt to a torque of 36-50 ft-lbs. (50-68 N-m).
- The belt is routed to the left of the steering shaft, and the fore-most keeper pin goes between the runs of the belt. See Figure 5.59.

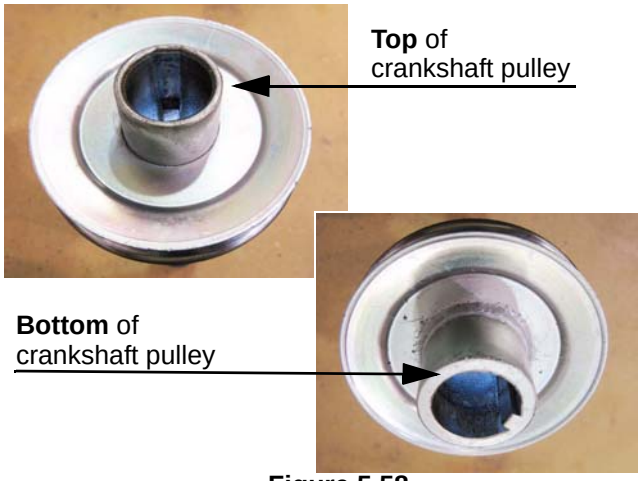


Figure 5.58

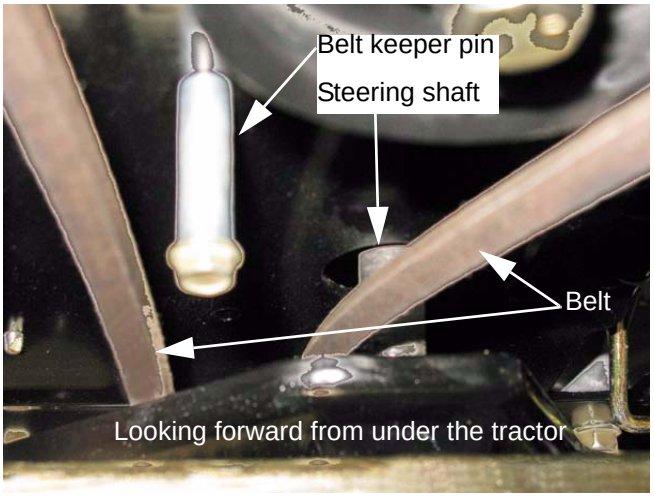


Figure 5.59

- Correct routing. See Figure 5.60.
- Tighten the nut that holds the fan and pulley to the input shaft to a torque of 30-43 ft-lbs (41-58 N-m).

13. Thoroughly test the operation of the drive system and all safety features before returning the tractor to service.

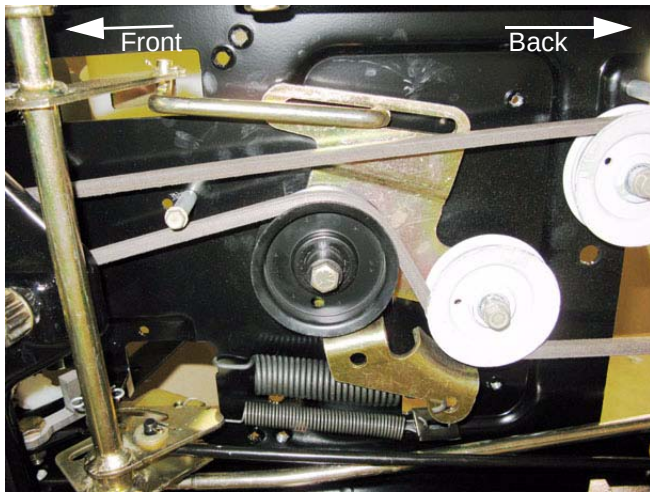


Figure 5.60

Changing transaxle hydraulic fluid

NOTE: The Hydro-Gear hydrostatic transaxle used in the Cub Cadet 1000 Series tractors typically lasts for many years of homeowner use without fluid maintenance. The primary reason to change the fluid would be contamination.

NOTE: The ambient temperature should be above 60 deg. f. (15.5 deg. C.) to allow the fluid to drain and fill in a reasonable amount of time.

⚠CAUTION The battery will be removed in this procedure. Review the Operator's Manual and Chapter 7: Electrical System for important safety information about handling batteries before proceeding.

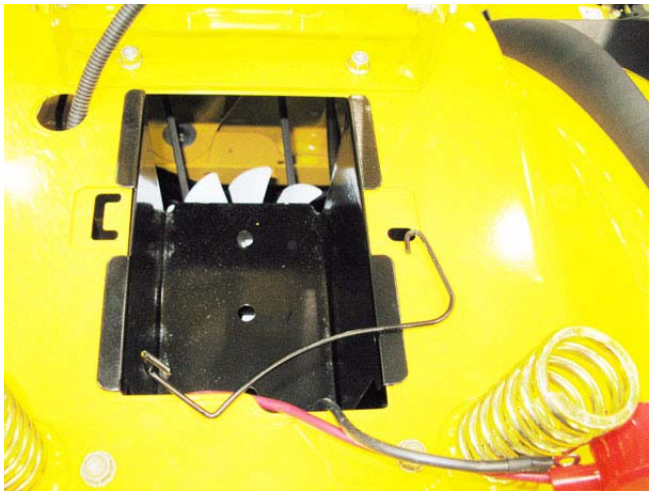


Figure 5.61

1. Allow the drive system to cool before starting work on the tractor.
2. Remove the battery and battery tray by following the procedures described in Chapter 4: Body Panels. See Figure 5.61.
3. Locate the drain plug near the bottom of the differential housing of the transaxle.
4. Clean the area around the drain plug, and place a drain pan of at least 1 gallon (4 liters) capacity under the transaxle.
5. Remove the plug using a 1/4" allen wrench, and allow the fluid to drain.

NOTE: If the transaxle does not have a drain plug:

- The fluid may be siphoned out or the transaxle may be removed from the tractor and drained through the fill port.

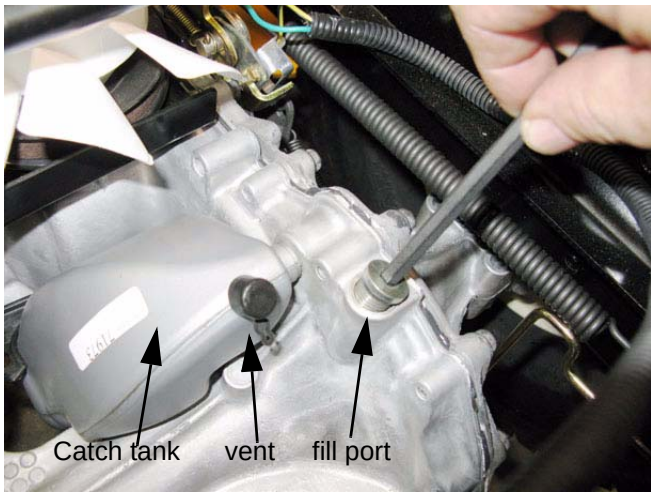


Figure 5.62

6. Locate the fill port. It is the socket-head cap plug on top of the transaxle casting. It is not the black cap on top of the plastic catch tank.
7. Clean the area around the fill port.
8. Remove the plug using a 1/4" allen wrench. See Figure 5.62.

NOTE: If the transaxle is draining slowly, this will allow more air to enter the housing, speeding up the draining process.

9. After the transaxle has drained completely, reinstall the drain plug.

10. Fill the transaxle with 77 to 80 fluid ounces (2.3 to 2.4 L) of 20W-50 engine oil that has a minimum API classification of SL, and a minimum rating of 55 SUS @ 210 deg. F. (99 deg. C).

11. Purge the transaxle. See Figure 5.63.

    11a. Open the bypass valve.

    11b. Start the engine, and run it at low RPMs.

    11c. Slowly cycle the drive pedal 6 times from full forward to full reverse, taking about 10 seconds to complete a stroke.

    11d. Close the bypass valve.

    11e. Slowly cycle the drive pedal 6 times from full forward to full reverse, taking about 10 seconds to complete a stroke.

Figure 5.63

    11f. Turn the engine off.

    11g. Check the fluid level, and add fluid if necessary to bring the level within 1-1/4” of the top of the casting.

    11h. Close the bypass valve. See Figure 5.64.

    11i. Start the engine, and run it at low RPMs.

    11j. Slowly cycle the drive pedal 6 times from full forward to full reverse, taking about 10 seconds to complete a stroke.

    11k. Close the bypass valve.

    11l. Slowly cycle the drive pedal 6 times from full forward to full reverse, taking about 10 seconds to complete a stroke.

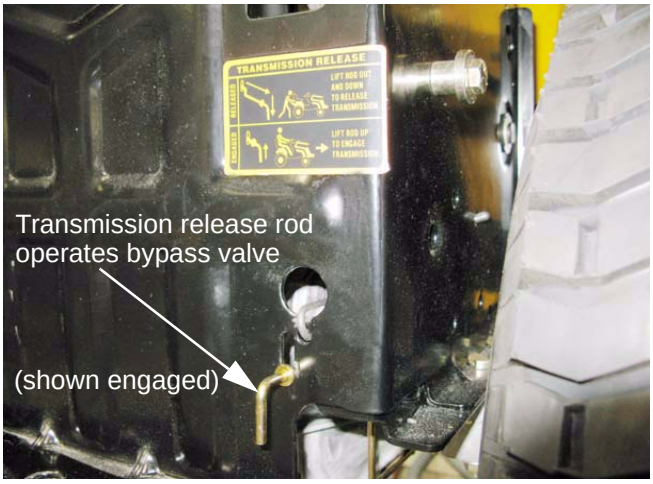


Figure 5.64

    11m. Turn the engine off.

    11n. Check the fluid level, and add fluid if necessary to bring the level within 1-1/4” of the top of the casting.

12. Test drive the tractor. If it does not operate at normal speed with no unusual transmission noise, repeat the purging process.

Brakes

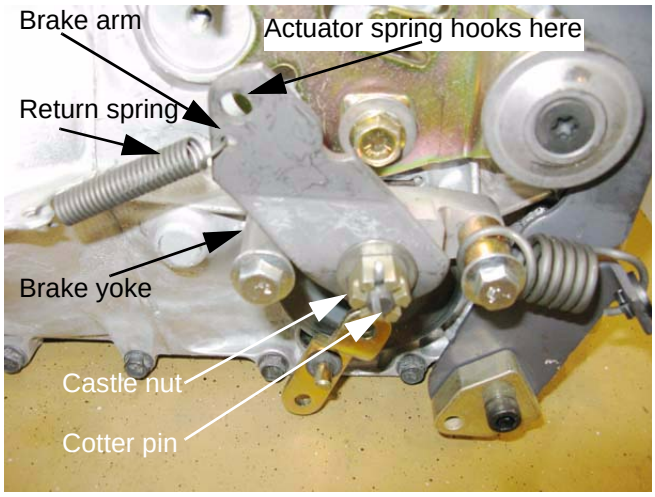


Figure 5.65

NOTE: The brakes may be repaired in the tractor, using procedures shown on the bench.

1. The brake yoke is located on the right side of the transaxle. See Figure 5.65.
   - The heavy actuator spring connects to the top hole on the brake arm.
   - The light return spring draws the brake arm to the OFF position.
   - Remove the cotter pin and loosen or tighten the castle nut to adjust the brakes. Use a 9/16” wrench to set a 0.015” (0.381mm) gap.

Figure 5.66

2. There are two main reasons to remove the caliper: to replace the pads, or to free stuck parts.
3. Loosen both brake yoke bolts using a 3/8” wrench. See Figure 5.66.

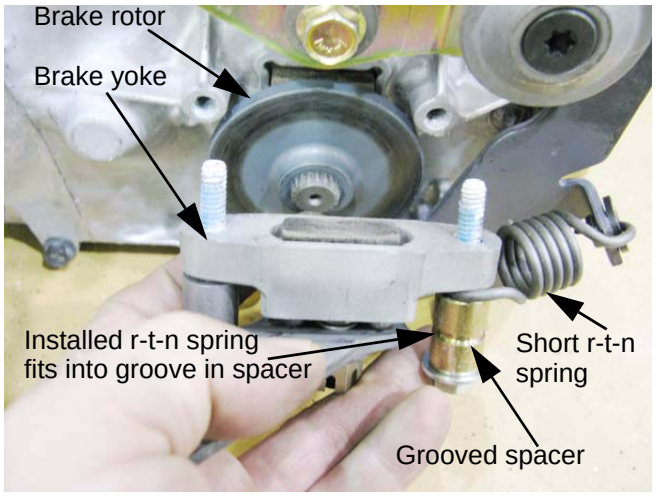


Figure 5.67

4. Slip the return-to-neutral (r-t-n) spring off of the spacer on the front bolt.
5. The yoke and outer pad will separate from the transaxle. See Figure 5.67.

6. Inside the brake yoke;
   - A steel backing plate fits between the friction pad and the actuator pins.
   - The pins fit into holes in the brake yoke housing.
   - The brake arm acts as a cam, pushing the pins when it rotates.
   - A small compression spring pushes the cam arm away from the pins, helping to release the brake.

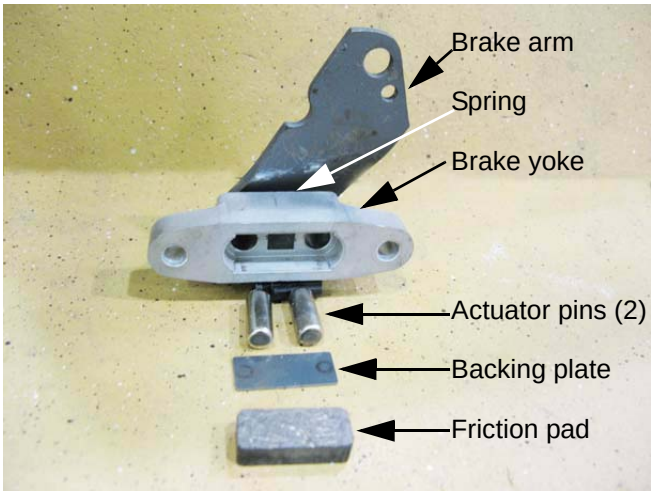


Figure 5.68

7. With the brake yoke removed, the brake rotor floats on a splined brake shaft. See Figure 5.69.
   - The bypass linkage must be removed to take the rotor off.
   - The flat side goes in, the collar faces out.
   - A second brake pad fits into a recess behind the rotor.
8. Assembly notes:
   - If any lubricant is used on the pins or between the brake shaft and the rotor, apply it VERY sparingly.
   - Apply a small amount of thread locking compound such as Loctite 242TM(blue) to the threads of the brake yoke bolts.
   - Tighten the brake yoke bolts to a torque of 80 to 120 in-lbs. (9 to 14 N-m).
9. Adjust and test the brakes after any work on brake system.

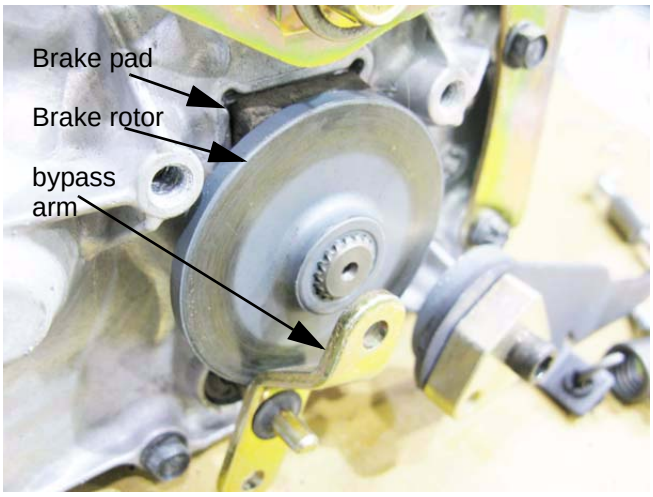


Figure 5.69

Transaxle removal and replacement

CAUTION The battery will be removed in this procedure. Review the Operator's Manual and Chapter 7: Electrical System for important safety information about handling batteries before proceeding.

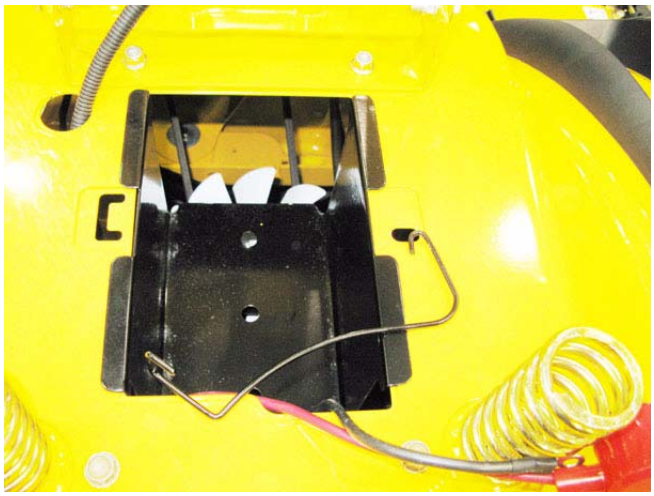


Figure 5.70

1. Remove the mowing deck by following the procedures described in Chapter 8: Cutting Decks and Lift Shaft.
2. Set the park brake to release belt tension.
3. Remove the battery and battery tray, as described in the body work chapter of this manual.
   See Figure 5.70.

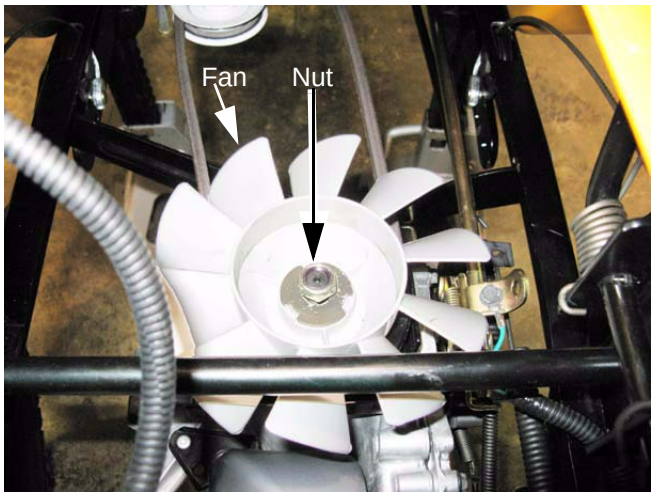


Figure 5.71

4. Remove drive belt from the transaxle pulley.
   See Figure 5.71.
   - 4a. Remove the nut using a 3/4" wrench. An impact wrench with a socket will be most effective.
   - 4b. Lift the cooling fan off.

4c. Remove the pulley. The belt will clear the belt keepers on top of the transaxle as the pulley comes up. See Figure 5.72.

5. Loosen, but do not remove the wheel bolts (Double-D axles) or lug nuts, using a 1/2” wrench or a 3/4” wrench, respectively.

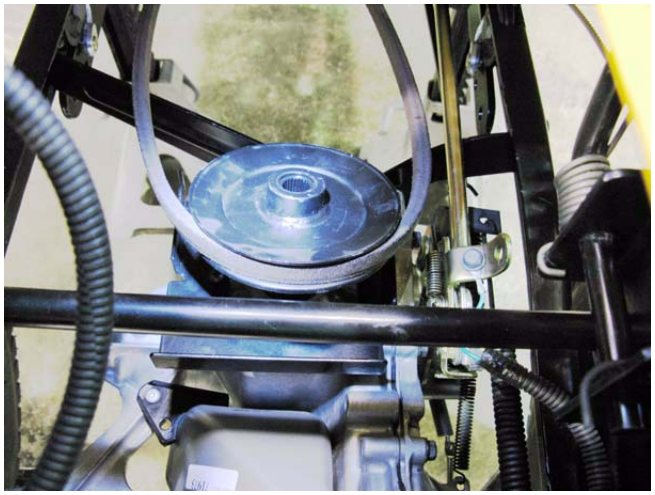


Figure 5.72

6. Unhook the large return-to-neutral spring from the back of the tractor frame. Leave the other end connected to the top of the return-to-neutral cam. See Figure 5.73.

NOTE: There is a second, shorter return-to-neutral spring that stretches between the cam and the grooved spacer on the front mounting bolt of the brake yoke.

7. Release the parking brake.

8. Lift, and safely support the tractor. The rear of the tractor should be high enough to allow the transaxle to pass under it.

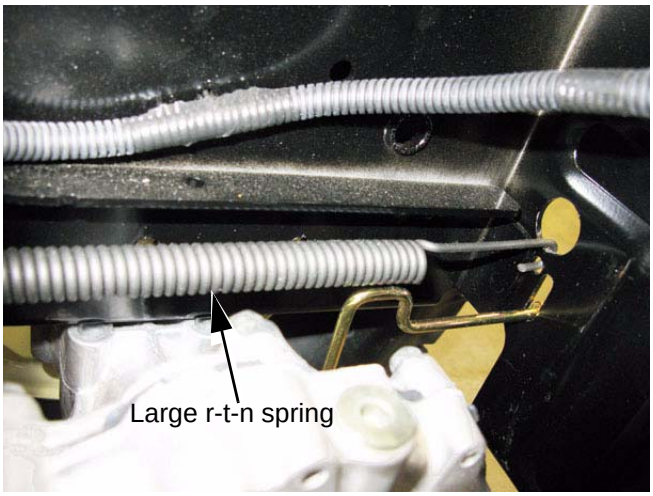


Figure 5.73

9. Remove the rear wheels. If the tractor has Double-D axles, remove the wheel spacers too. See Figure 5.74.

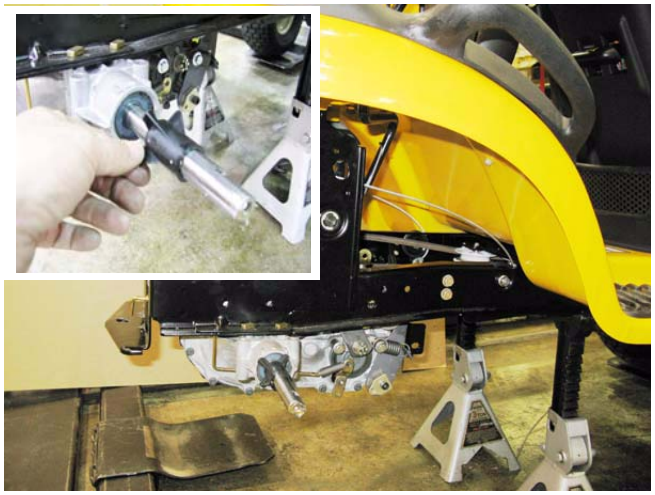


Figure 5.74

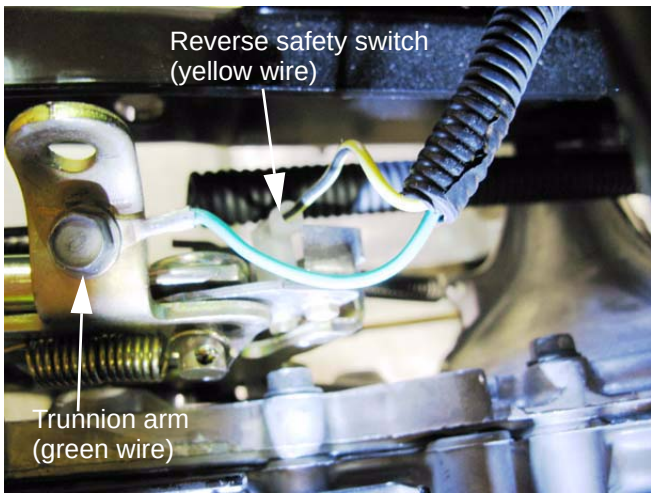


Figure 5.75

10. Disconnect the wires from the reverse safety switch. See Figure 5.75.

    10a. Unplug the yellow w/black trace wire.

    10b. Remove the bolt that holds the green ground wire using a 3/8” wrench.

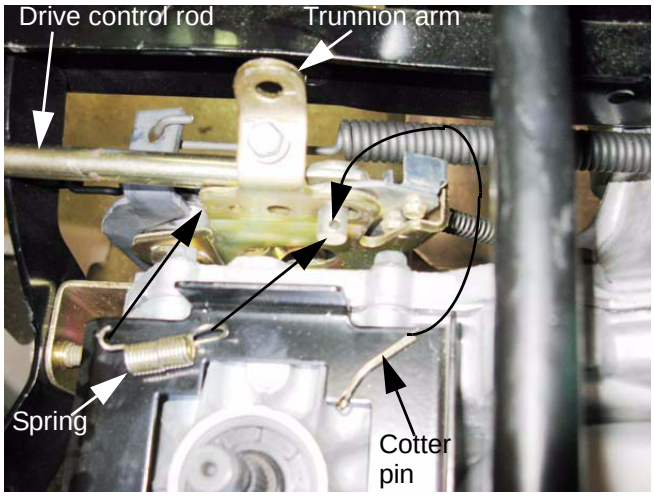


Figure 5.76

11. Disconnect the drive control rod from the trunnion arm of the hydro. See Figure 5.76.

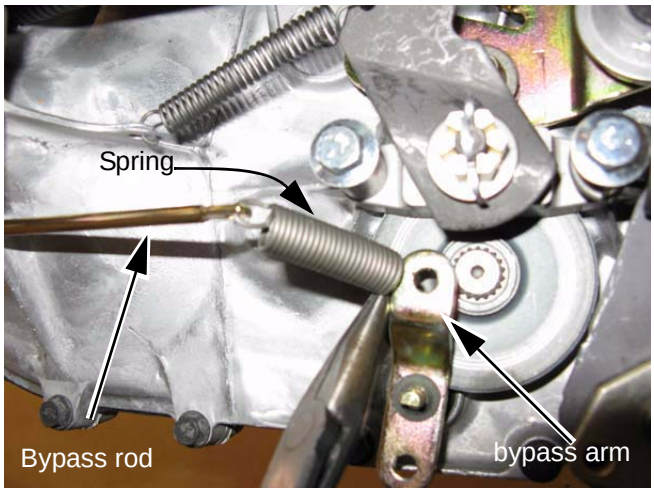


Figure 5.77

12. Disconnect the spring at the end of the bypass rod rod from the bypass arm on the transaxle. See Figure 5.77.

NOTE: The closed end of the spring hooks downward into the rod.

13. Support the transaxle so that it can be lowered out of the tractor in a controlled fashion.

14. Remove the torque bracket bolts using a 1/2” wrench. See Figure 5.78.

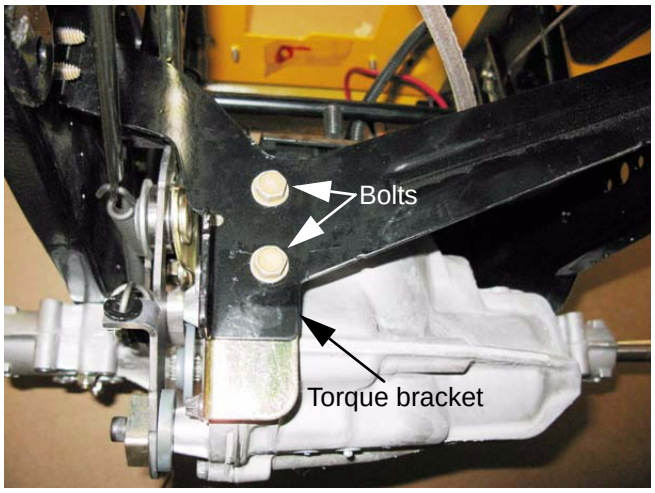


Figure 5.78

15. Take the nuts off of the T-bolts that hold the transaxle to the frame using a 1/2” wrench. See Figure 5.79.

NOTE: At this point, the brake actuator spring is still attached to the brake rod from the pedal shaft, and the brake arm on the transaxle.

Figure 5.79

16. Carefully lower the transaxle out of the tractor. See Figure 5.80.

Figure 5.80

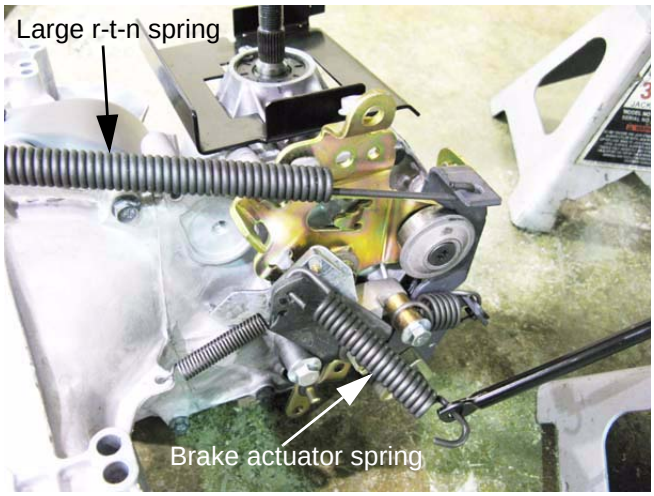


Figure 5.81

17. Move the transaxle forward to make some slack in the brake linkage. Use the slack to unhook the brake spring from the brake arm.
18. Carefully lift the transaxle onto a workbench for draining or disassembly as needed.

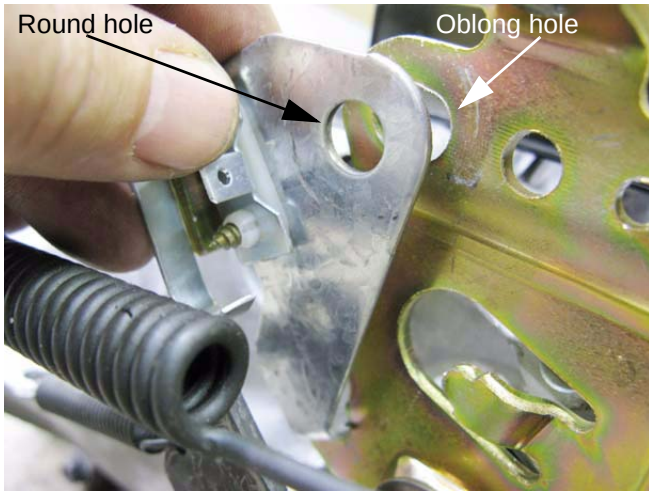


Figure 5.82

19. On the bench;

    19a. The top of the reverse safety switch is held against the trunnion arm by the post on the drive control rod. See Figure 5.82.

NOTE: The post passes through a round hole in the switch plate and an oblong hole in the trunnion arm.

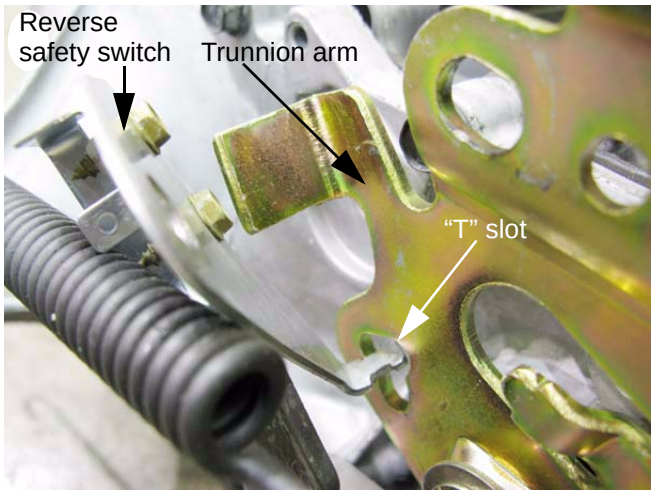


Figure 5.83

19b. The bottom of the reverse safety switch fits into a "T" slot in the trunnion arm. See Figure 5.83.

19c. The large return-to-neutral spring can be unhooked from the return-to-neutral cam. See Figure 5.84.

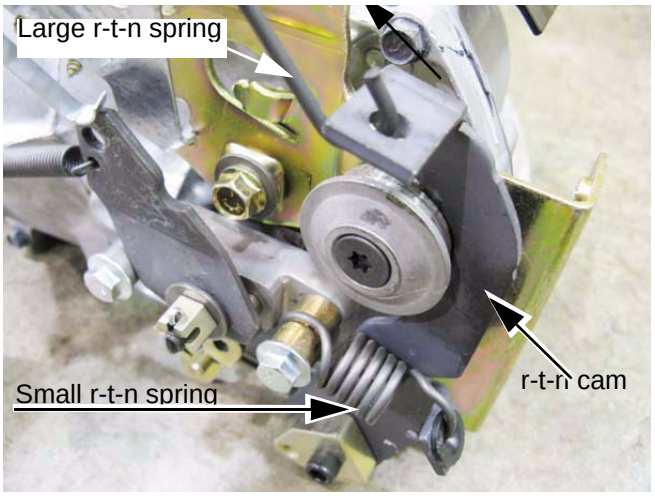


Figure 5.84

19d. Remove the belt keeper from the top of the transaxle using a phillips head screwdriver. See Figure 5.85.

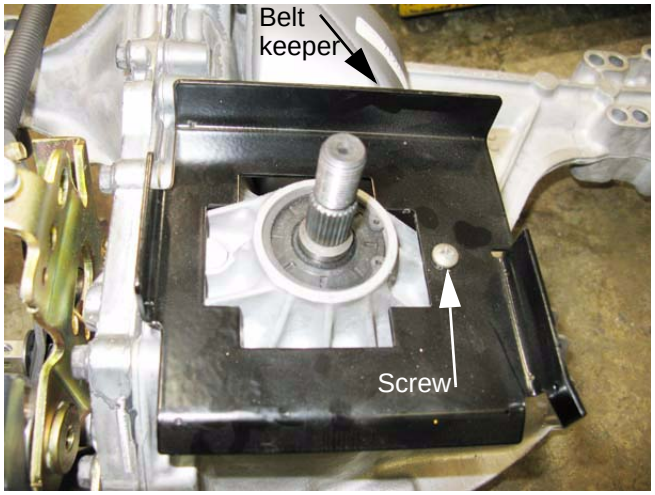


Figure 5.85

20. Installation notes:

20a. After repairs are done, and the transmission is re-filled with fluid, it may be “bench purged” if the technician has a way to drive the input shaft using a 1/2” drill motor.

20b. Check adjustment of the brake before installing the transaxle.

20c. Position the large return-to-neutral spring on the return-to-neutral cam before lifting the transaxle back into the tractor.

20d. Connect both ends of the brake actuator spring before lifting the transaxle back into the tractor.

20e. Coat the Double-D axle shaft with a high quality grease or anti seize compound before installing the wheels.

20f. The spring in the bypass linkage hooks downward into the transmission release rod.

20g. Tighten fasteners according to the accompanying torque table.

20h. Fully purge the drive system before operating the tractor.

20i. Operate and test the drive system, brake system, and all safety features before returning the tractor to service.

Drive System Torque Specs.

Fastener	Torque in-lb.	Torque N-m
Seat bolt	150-180	17-20
Lug nut	350-500	41-57
Wheel bolt	160-190	18-22
Fan/pulley nut	360-520	41-59
Tq. bracket bolt	150-180	17-20
Axle T-bolt nuts	150-180	17-20
Brake yoke bolts	80-120	9-14
Pedal shaft straps	150-180	17-20
Belt keeper nut /bolt	150-180	17-20
Idler pulley bolt	150-180	17-20
Tensioner bracket	150-180	17-20

CHAPTER 6: CVT DRIVE AND BRAKE SYSTEM

About this chapter

The drive and brake systems for the Cub Cadet Series 1000 tractor are combined. Two reasons for this:

- The brake on the Series 1000 tractor is supplied with the transaxle.
- The brake pedal applies the brake and disengages the drive system. Both systems share common linkage.

The transaxle used in the Cub Cadet Series 1000 is a relatively simple gearbox containing forward, neutral, and reverse gears. The variation in speed is all handled by the variable speed pulley system that drives the transaxle.

If the tractor has drive system problems within the warranty period, the servicing Cub Cadet dealer has the following responsibilities:

- Eliminate any external causes for drive system problems before removing the transmission from the tractor.
- External problems would include, but are not limited to: belt, linkage, or brake issues.
- Look for signs of over-use or abuse. Transaxles that fail because of over use or abuse are not warrantable. They are to be repaired or replaced at the customer's expense.
- If the problem is internal, the transmission is to be replaced under the like-kind exchange policy.
- If a transaxle is replaced under warranty, the original transaxle may be called-back for evaluation by MTD Vendor Recovery Dept.
- Warranty Claims will be denied, returned, or adjusted if the returned transaxle does not meet Cub Cadet's replacement criteria.
- Dealers are encouraged to open transaxles for inspection, allowing them to identify a problem within the transaxle.
- Beyond warranty, dealers are free to repair transmissions at customer expense.
- If the dealer has questions regarding transaxle replacement, they should call Cub Cadet Service using the dealer only line before proceeding.

About the variable speed drive system.

There are two drive belts in the system. A long drive belt transfers power from the engine crankshaft to the lower sheave of the variable-speed pulley. A shorter belt fits in the upper sheave of the variable speed pulley; transferring power from there to the input pulley on the transaxle.

- The drive control pedal tensions the front drive belt.
- The center partition of the variable speed pulley separates the lower (front) belt from the upper (rear) belt.
- As the front belt is tensioned, it is drawn deeper into its sheave. The effective circumference of the driven pulley shrinks.
- As the front belt is drawn deeper into its sheave, the center partition is forced upward, making the upper shave narrower.
- As the upper sheave pinches-down on the rear drive belt, the belt is forced outward in the sheave. The effective circumference of the pulley driving the rear belt grows.
- As the upper and lower sheaves change size, the drive ratio shifts increasing the speed of the rear belt.
- As the sheave that drives the rear belt changes size, the belt must be kept under constant tension. A tension idler pulley accomplishes this task.
- The clutch/brake pedal automatically de-tensions the front belt when it is applied.

Externally repairable drive system problems:

Most of the problems listed in this section will result in a customer complaint of low power or low ground speed. If the tractor is difficult to push, check the brakes.

Figure 6.1

1. Engine performance:
   - If the engine does not turn at the specified RPM, the tractor will not travel at its designed speed. See Figure 6.1.
   - If the engine does not produce the specified amount of power, the tractor will not have its designed amount of tractive force.

   1a. Find the specified engine RPM for the tractor (3,375-3,525 RPM for the Cub Cadet Series 1000).

   1b. Check the engine with a tachometer to confirm that it maintains the specified RPM under normal load.

   1c. Correct engine performance problems before trying to diagnose drive system problems.

2. Check the tires: Confirm that the correct size tires are on the tractor.

   Smaller rear tires will yield lower ground speed. Under-filled tires will put additional load on the drive system.
   - LTX 1040 Series has 20” x 8” rear tires.
   - LTX 1050 Series has 20” x 10” rear tires.
   - SLTX 1050 Series has 22” x 9.5” rear tires.

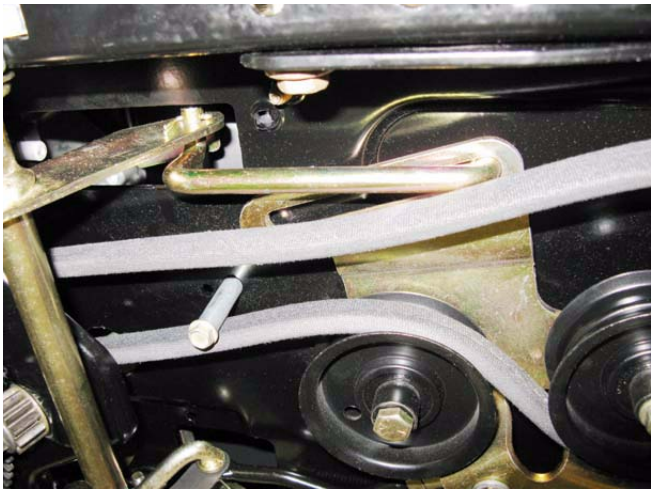


Figure 6.2

3. Check the brakes: See Figure 6.2.

   3a. The brake linkage applies the brakes and disengages the drive belt. Confirm that both parts of the linkage are moving properly.
   - When the brake pedal is released, the front drive belt should be slightly slack.
   - The drive and brake linkages are connected in such a way that the pedals will “see-saw”, and it should not be possible to apply drive and clutch/brake pedal at the same time.

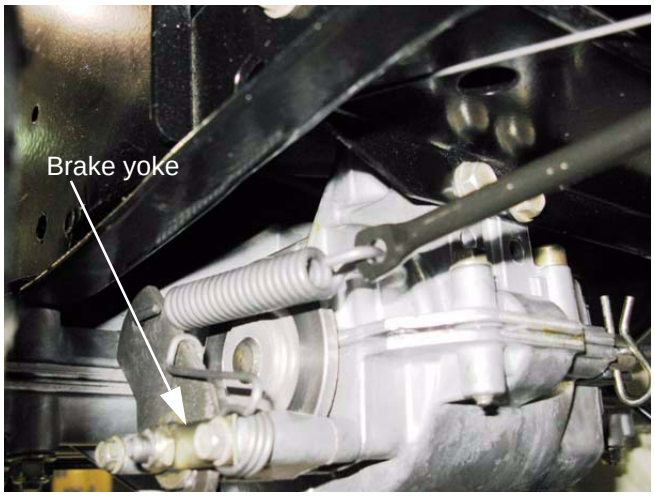


Figure 6.3

3b. If the linkage is working properly, but the brakes seem to be dragging, check the brake yoke. The linkage is not adjustable. See Figure 6.3.

- When the brakes are released, it should be possible to wiggle the brake rotor within the yoke.
- If the rotor is tight in the caliper, check the yoke adjustment.
- If the rotor is tight in the yoke, check the operation of the yoke to confirm that it is not stuck.
- When the brake pedal is released, the brake arm on the yoke should fall completely back against the axle housing.

4. Check the drive belts. See Figure 6.4.

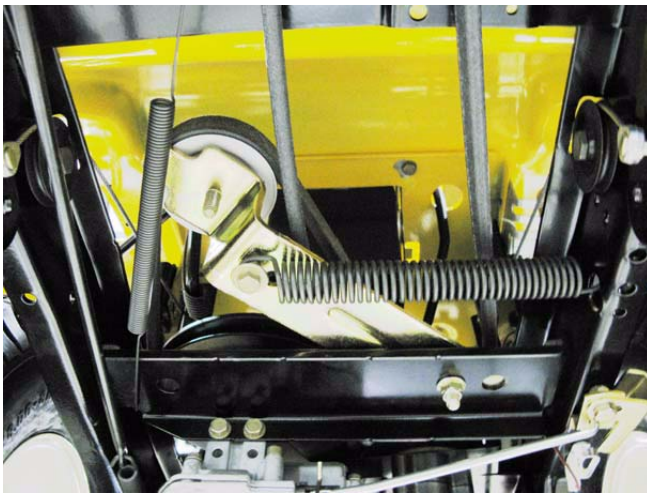


Figure 6.4

- In normal use, drive belts typically last for years without problems.
- If the belt fails prematurely, identify and correct the cause of the belt failure before returning the tractor to service.

4a. Look-up the part number for the belts, and confirm that the correct OEM belts are on the tractor.

4b. Check the belt routing.

4c. Check the brake/clutch linkage and belt tensioning pulleys.

4d. Check for foreign objects jammed against the belt.

4e. Check for missing or out-of-place belt guides. See the belt replacement section of this chapter.

4f. Check the engine crankshaft and transaxle input pulleys; Confirm that the sheaves are not spread-out, causing a loose belt fit.

5. Check the drive control linkage. See Figure 6.5.

   5a. The travel limit pin fits into the curved slot in the drive pedal latch plate. The pedal bracket should have enough travel for the pin to hit both ends of the curved slot when the pedal is moved through the full range of its travel.

   5b. Some relatively simple things that may go wrong with the pedal linkage:

   • The drive pedal itself being loose on the bracket.

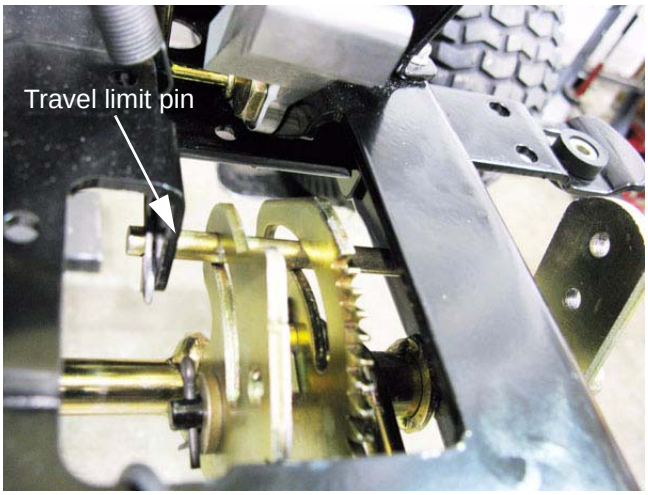


Figure 6.5

   • Worn plastic bushings between the drive pedal bracket and the brake cross-shaft. See Figure 6.6.

   5c. Check the adjustment of the front tensioner pulley control rod.

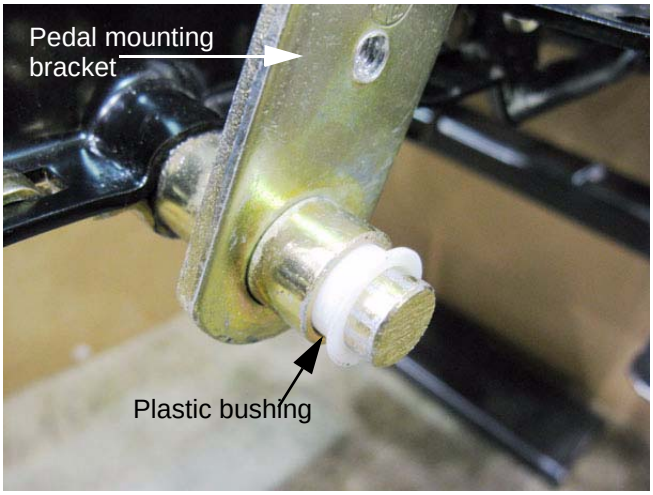


Figure 6.6

6. Transaxle mounting: See Figure 6.7.

   6a. The primary symptoms of a transaxle that is loose in the frame are that it will lose drive or throw-off the upper drive belt in reverse.

   6b. Check the torque bracket and the axle mounting points at the frame.

7. If there is no drive in either direction, check the gear selector adjustment.

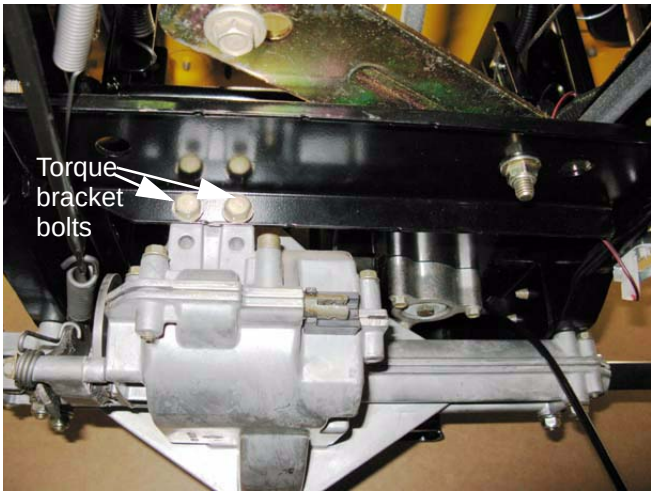


Figure 6.7

Indications that a transaxle is not warrantable

Anything that would indicate misuse, abuse, neglect, accident, improper maintenance, alteration, vandalism, theft, fire, water or damage because of other peril or natural disaster will render the transaxle non-warrantable even though it is within the normal warranty period.

Typical indicators of a void warranty would be:

- The normal warranty is for 3 years or 120 hours, whichever comes first. Beyond 120 hours of use, the tractor is out of warranty
- Abnormally high wear indicators for the age of the tractor (usually consistent with high hours of usage). As an example, if the tires are completely worn-out on a tractor that is 6-months old, it is reasonable to think it has been used pretty heavily even if the hour meter has been unplugged.
- Bent axle, broken housing, or other obvious signs of impact damage
- Contaminated fluid or low fluid
- Damage to the cooling fan
- Indication that the tractor has been overloaded.

Brake adjustment

Figure 6.8

1. Test the operation of the brakes: See Figure 6.8.
   - 1a. Put the transaxle in neutral.
   - 1b. Set the parking brake by depressing the brake/clutch pedal and pushing-down on the parking brake/cruise control lever.
   - 1c. Attempt to push the tractor. If it can be pushed by hand without skidding a rear wheel, check and adjust the brakes.
   - 1d. Release the parking brake.
   - 1e. Attempt to push the tractor again. If it cannot be pushed with little effort, check and adjust the brakes.

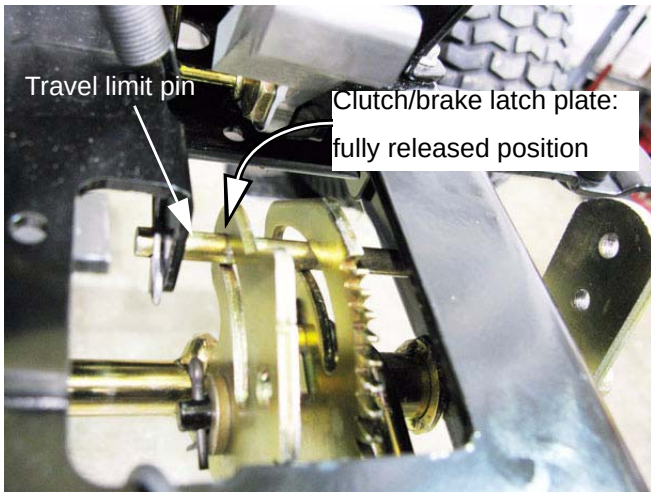


Figure 6.9

2. Visually inspect the linkage to confirm that it functions properly. See Figure 6.9.
   - Beneath the floor panel, on the right side of the tractor there are two semi-circular latch plates.
   - The outer latch plate rotates with the drive control pedals. The inner latch plate rotates with the clutch/brake pedal.
   - 2a. With the clutch/brake pedal fully released:
   - The travel limit pin should be resting against the front of the curved slot. See Figure 6.9.

- The rod that connects the clutch/brake latch plate to the heavy brake actuator spring should be just slack. See Figure 6.10.

2b. Check the gap between the brake rotor and the brake pads.

- There is a fixed pad in the transaxle housing.
- There is a moving pad in the brake caliper.
- Wiggle the brake rotor slightly, and attempt to insert a 0.010” (0.38mm) feeler gauge between the rotor and either pad.

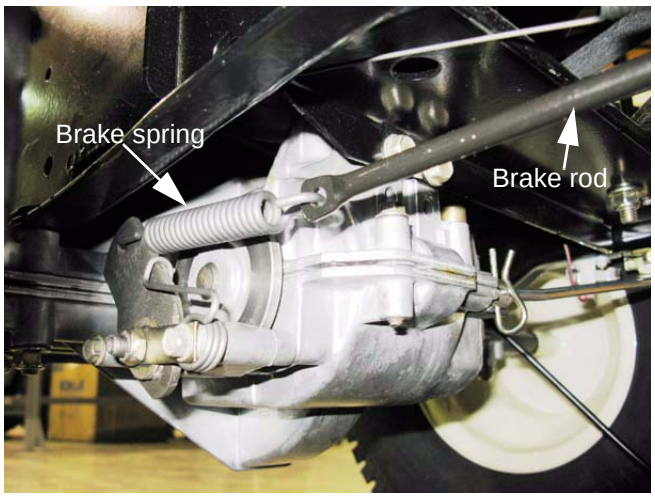


Figure 6.10

2c. Adjust the gap, if necessary, so that the feeler gauge slips between the pad and the rotor with light pressure. See Figure 6.11.

- Turn the nut to adjust the gap. The gap should be in the range of 0.010”-0.015” (0.25mm-0.38mm)
- Apply and release the brake pedal, then re-check the gap.

2d. If the brake seems to be sticking, or the rotor is discolored from dragging, remove the brake yoke for repair or replacement.

2e. Set the brake. The front drive belt should be slack.

2f. Re-test the operation of the brakes before returning the tractor to service.

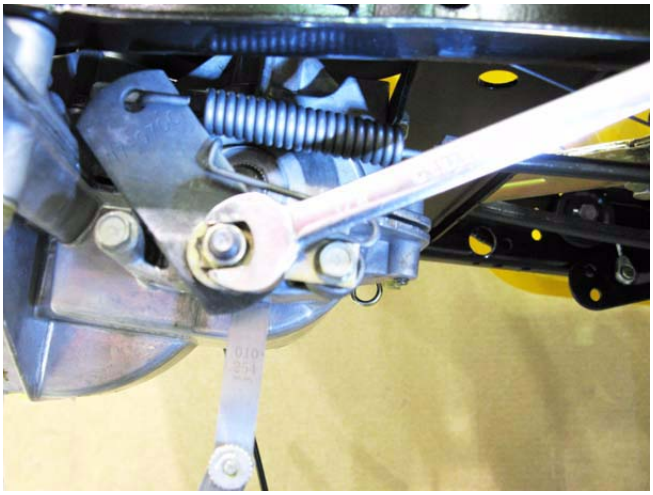


Figure 6.11

Gear selector

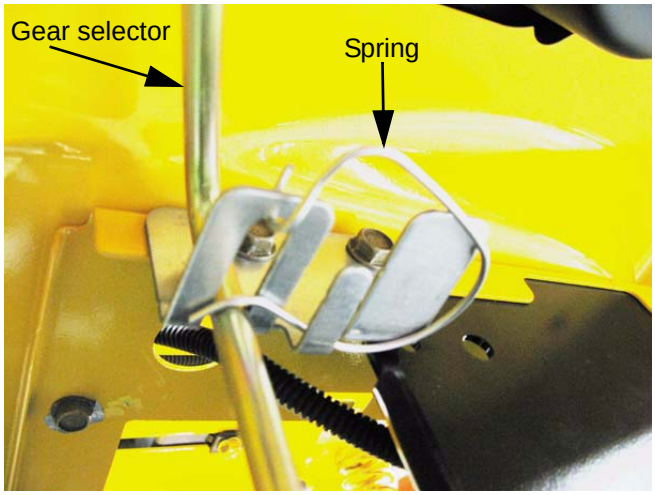


Figure 6.12

- The forward-neutral-reverse gear selector is on the left rear fender of the tractor.
- A bracket and spring under the fender keep inward pressure on the selector to give it positive feel. See Figure 6.12.

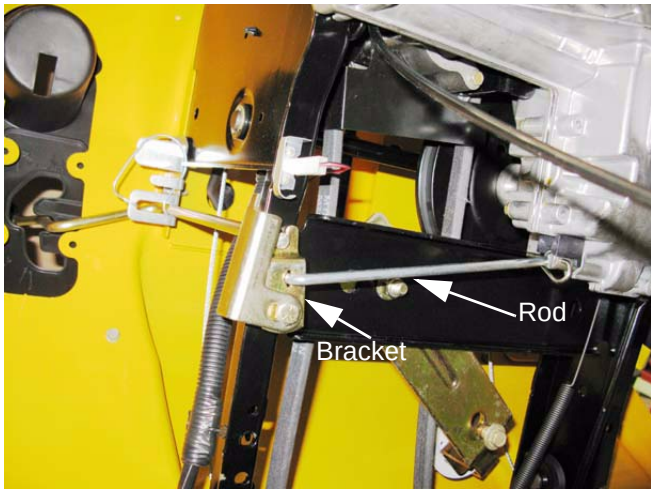


Figure 6.13

- The selector pivots on a frame-mounted bracket, transferring the motion to a push-pull rod connected to the transaxle. See Figure 6.13.
- The linkage contacts the reverse safety switch tang when the tractor is in reverse.
- The linkage is adjustable.

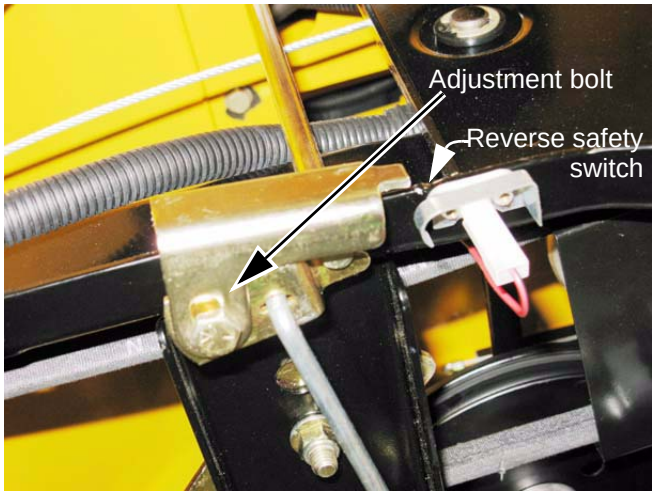


Figure 6.14

1. To adjust the linkage, put the gear selector in neutral position.
2. Confirm that the tractor is in neutral by releasing the brakes and rolling it back and forth.
3. Loosen the adjustment bolt using a 1/2” wrench. See Figure 6.14.

4. Check that the gear selector handle is fully seated in the N notch on the fender. See Figure 6.15.
5. Tighten the adjustment bolt and re-check the position of the gear selector.

Figure 6.15

Tensioner pulley control rod

The tensioner pulley control rod is the link that ties the pedal shaft to the pulleys that tighten the front drive belt. See Figure 6.16.

If the tensioner pulley control rod is out of adjustment:

- Gear engagement may be crunchy (if the clutch/brake is not set) because the front drive belt tension is not fully released. Link too short.
- The tractor may creep when it is in gear, even though the operator's foot is not on the drive control pedal. Link too short.
- The tractor may not have it's full range of ground speeds. Link too long.

The tensioner pulley control rod may also need to be adjusted after the drive belts are replaced.

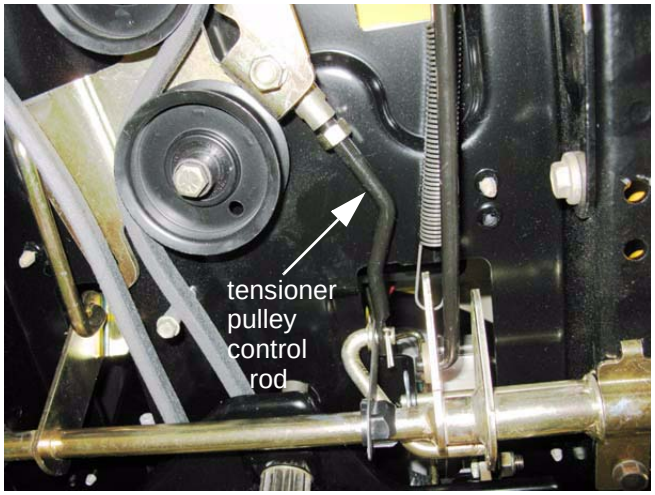


Figure 6.16

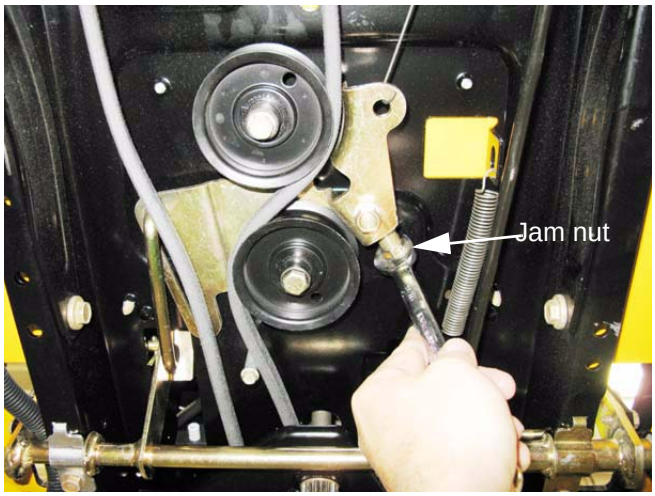


Figure 6.17

To check and adjust the link:

1. Set the belts to their lowest speed position;
   - 1a. Start the engine.
   - 1b. Place the gear selector in Neutral and release the brake pedal.
   - 1c. Depress the drive pedal to the end of its travel.
   - 1d. Slowly release the drive pedal.
   - 1e. When the drive pedal has reached the top of its travel, turn-off the engine.
2. Remove the mowing deck.
3. Loosen the link jam nut using a 9/16” wrench. See Figure 6.17.

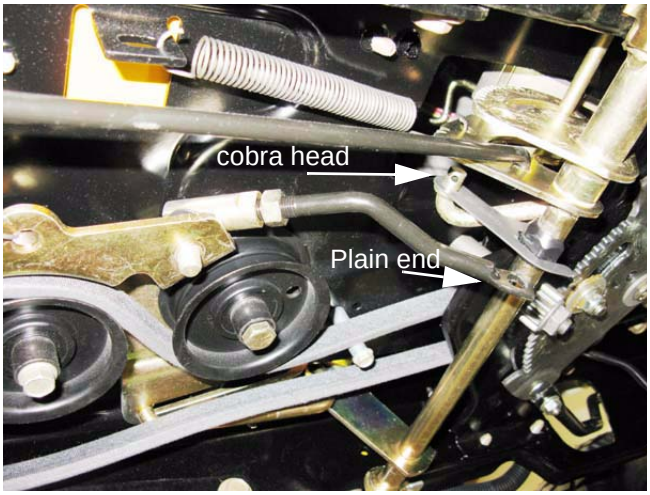


Figure 6.18

4. Remove the nut that holds the link to the tensioner pulley bracket using a 9/16” wrench.
5. Remove and discard the cotter pin that holds the plain end of the rod to the cobra head arm on the pedal shaft. See Figure 6.18.
6. Pull both pedals (clutch/brake & drive control) all the way back. Secure them with a shock cord if necessary.

NOTE: The ball joint end of the rod will not come out of the tensioner pulley bracket, but pushing it up slightly makes it easier to adjust the rod length.

7. Thread the rod into or out of the ball joint end to lengthen or shorten it.
8. Adjust the rod so that the hole in the plain end fits over the arm on the pedal shaft.
9. Install the lock-washer and nut on the ball-joint stud, then re-check the adjustment.
10. Once the adjustment is correct, fasten the rod to the arm with a new cotter pin.
11. Tighten the jam nut.
12. Test-run the tractor to confirm that the drive and brake systems work correctly before reinstalling the mowing deck.
13. Test run the tractor again after the mowing deck is installed, and confirm that all of the safety features work properly.

Linkage: pedal shaft

Description: The Clutch/brake pedal and the drive control pedal operate on two concentric shafts.

- The clutch/brake shaft runs the full width of the tractor.
- The drive control shaft is tubular, and pivots on the clutch/brake shaft.
- Each shaft has a toothed latch plate. The latch plates are next to each other.
- The cruise control/park brake lever operates a common pawl that engages the latch plate of whichever pedal is applied. See Figure 6.19.

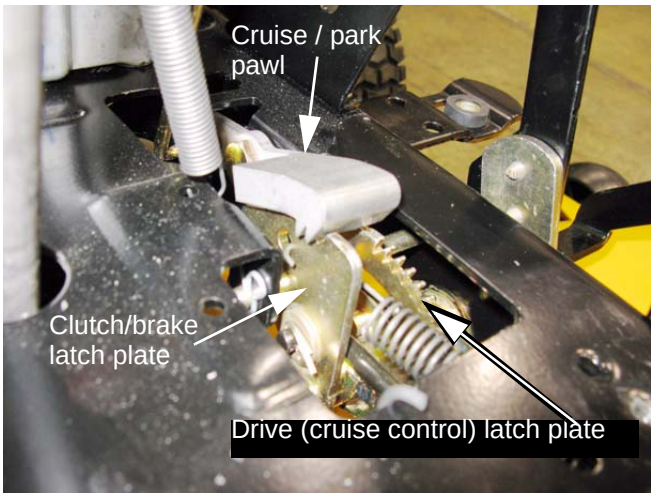


Figure 6.19

- A travel limit pin passes through curved slots in both of the latch plates. The pin is blocked into place by the fenders. See Figure 6.20.

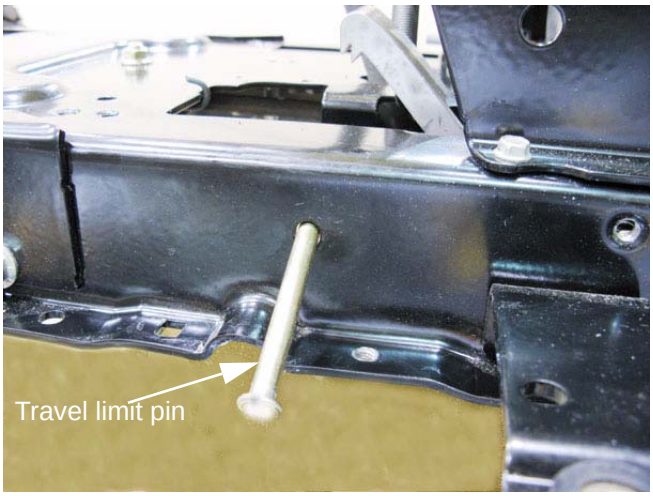


Figure 6.20

Pedal shaft assembly removal:

NOTE: Confirm that the parking brake is released before starting work.

1. Remove the mowing deck.
2. Remove the fenders, as described in the body panels chapter of this manual.
3. Disconnect the rod that joins the arm at the left side of the brake/clutch shaft to the drive belt tensioner pulley bracket. See Figure 6.21.
   - Remove and discard the cotter pin.
   - The rod will come out easily as the pedal shaft assembly is lowered out of the tractor.

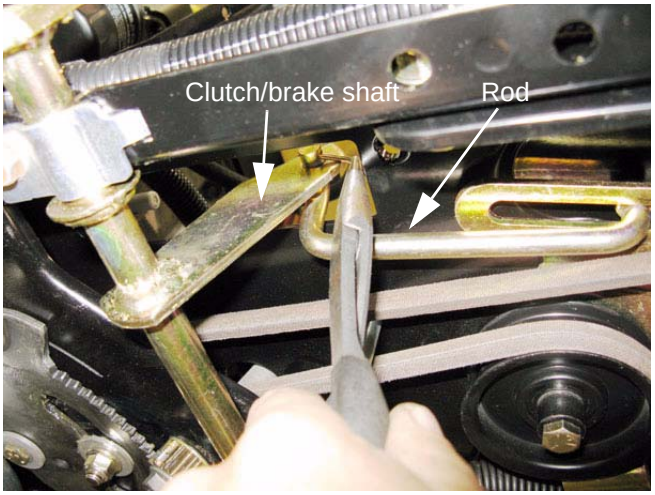


Figure 6.21

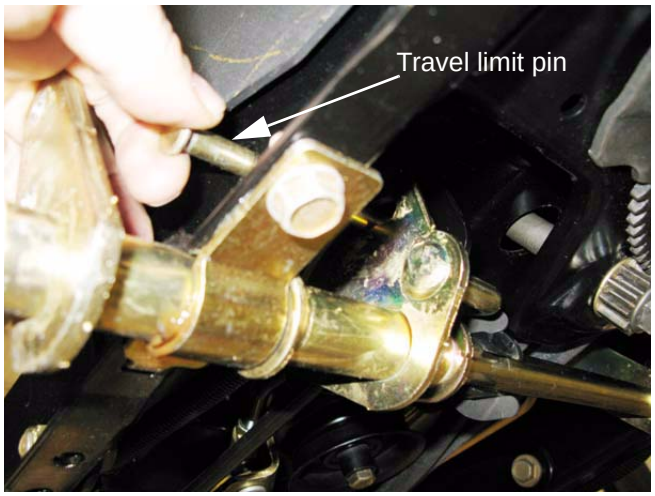


Figure 6.22

4. Remove the locking clip that holds the travel limit pin in place.
5. Withdraw the travel limit pin. See Figure 6.22.
6. Unhook and remove the clutch/brake pedal return spring.
7. Remove the cotter pin and flat washer that hold the brake rod into the latch plate. Discard the cotter pin.

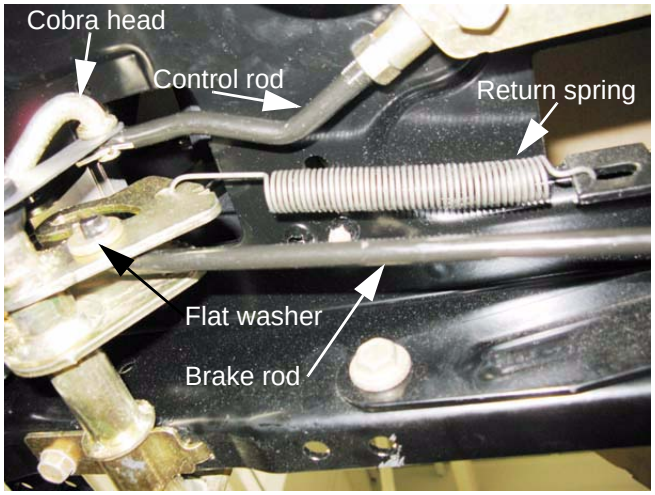


Figure 6.23

8. Remove and discard the cotter pin that holds the tensioner pulley control rod to the “cobra head” arm on the drive control pedal. See Figure 6.23.

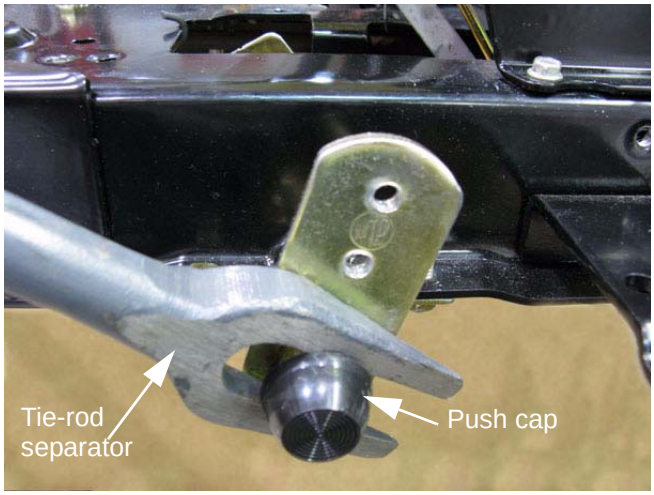


Figure 6.24

9. Remove and discard the push cap that holds the drive control pedal shaft onto the clutch/brake shaft. See Figure 6.24.

10. Loosen the bolt that holds the left pedal shaft support strap using a 1/2” wrench. See Figure 6.25.

11. Remove the bolt that holds the right pedal shaft support strap using a 1/2” wrench.

    NOTE: This will allow the pedal shaft assembly to hang-down slightly on the right side of the tractor.

Figure 6.25

12. As the pedal shaft is lowered, and the drive control pedal shaft can be slipped to the right: See Figure 6.26.
    - The brake rod will slip out of the latch plate on the brake pedal shaft.
    - The rod that ties the arm at the left end of the brake pedal shaft to the tensioner pulley bracket will slip free.

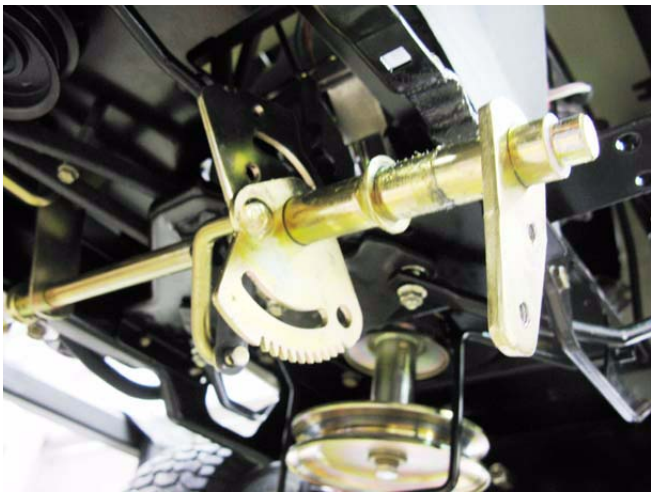


Figure 6.26

13. Remove the bolt from the left side pedal shaft support strap, and remove the pedal shaft assembly from the tractor. See Figure 6.27.

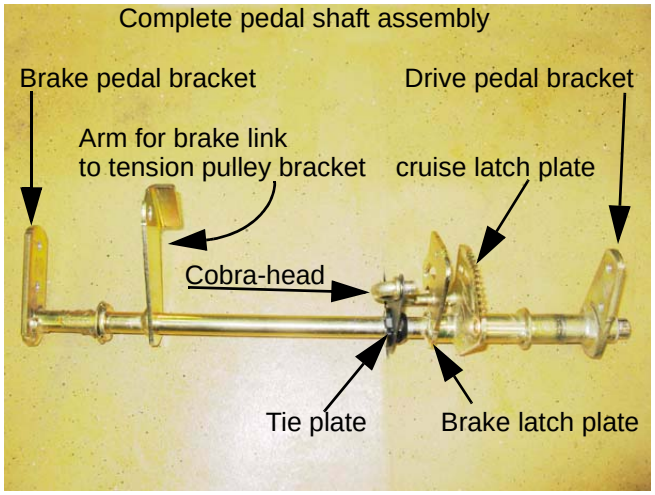


Figure 6.27

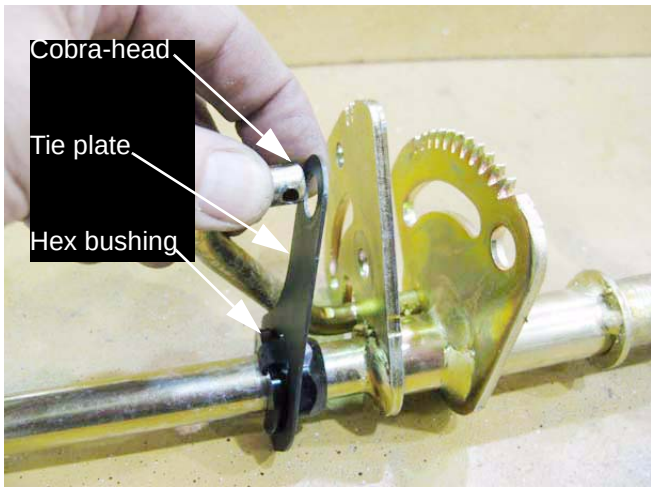


Figure 6.28

14. Disconnect the cobra-head rod from the pedal shaft tie plate. See Figure 6.28.
    - Slip the tie plate off of the cobra head rod.
    - Push the hex bushing out of the big end of the pedal shaft tie plate.
    - The hex bushing can be snapped-off of the brake pedal shaft.

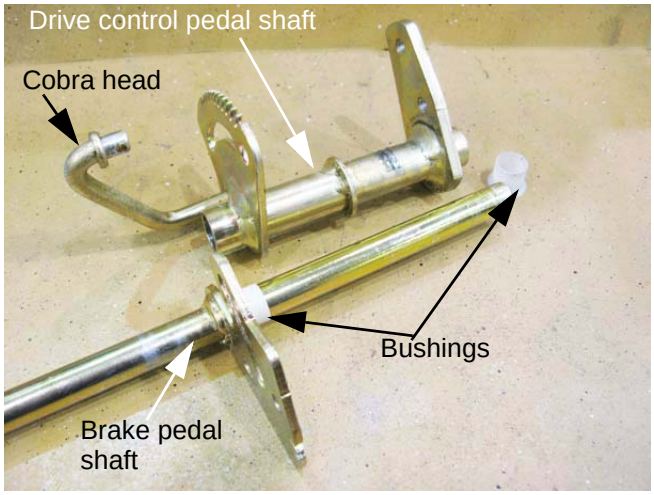


Figure 6.29

15. Once the cobra-head rod is loose, the drive control pedal shaft can be rotated and slipped off of the brake pedal shaft. See Figure 6.29.
16. Inspect the pedal shaft components individually. Replace any parts that are worn or damaged.
    - The plastic bushings that fit between the two pedal shafts should be replaced any time they are removed. Lubricate them with a dry PTFE or graphite-based lubricant on assembly. NOT grease.
    - Replace the push cap and all removed cotter pins with new parts.

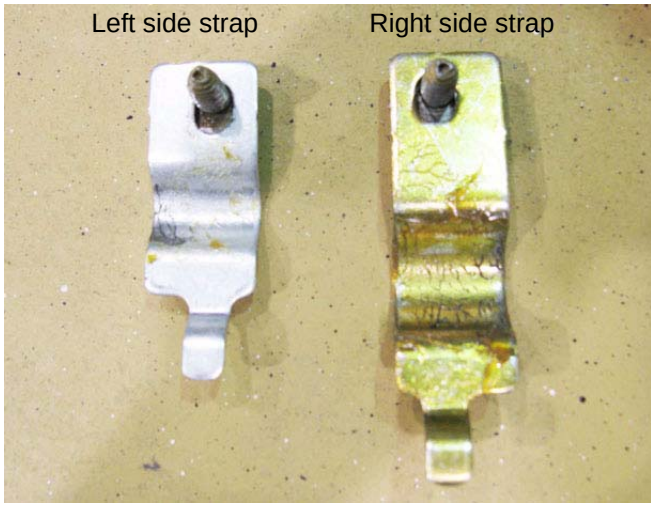


Figure 6.30

17. Install the pedal shaft assembly by reversing the steps used to remove it, then install the fenders.

NOTE: The pedal shaft support straps are two different sizes. The smaller strap holds-up the left (brake pedal) end of the pedal shaft assembly. The larger strap holds-up the right (drive control pedal) end of the pedal shaft assembly. See Figure 6.30.

17a. Lubricate the points where the pedal shafts meet the frame with a good quality lithium-based grease. See Figure 6.31.

17b. Position the two rods that connect to the brake pedal shaft as the pedal shaft assembly is being lifted into the tractor:

- The rod that de-tensions the drive belts when the brake pedal is pressed.
- The brake rod.
- The rods fit into the holes in the brake shaft much more easily before the pedal shaft is fully in position.

Figure 6.31

17c. Position the drive control shaft and bushings, fasten the drive control rod to it, then drive the push cap on. See Figure 6.32.

17d. Tighten the pedal shaft support strap bolts to a torque of 12-15 ft-lbs. (16-20 N-m).

17e. Check the adjustment of the tensioner pulley control rod

17f. Attach the belt tensioner pulley control rod.

18. Test the drive system and all safety features before returning the tractor to service.

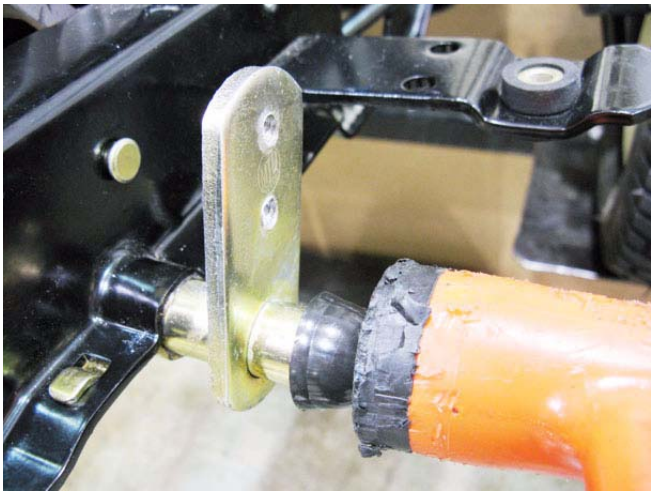


Figure 6.32

Linkage: pedal tie strap

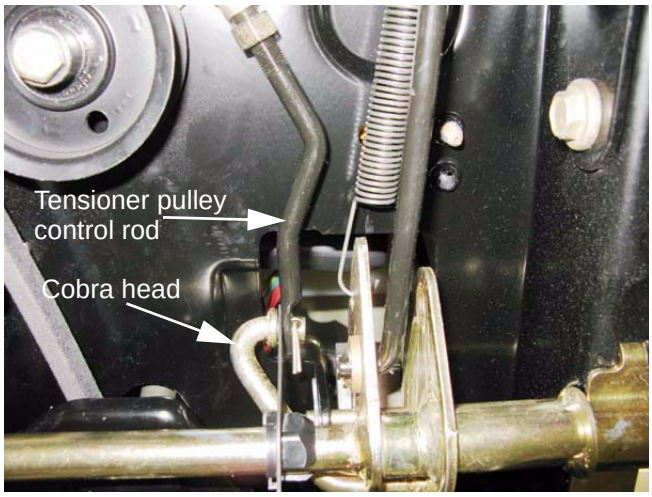


Figure 6.33

NOTE: If there is reason to remove the pedal tie strap, it can be taken off without further disassembly of the pedal shaft. The most likely reason for this would be the discovery of damage to the plate or hex bushing while making an adjustment to the tensioner pulley control rod.

1. Remove the mowing deck.
2. Remove and discard the cotter pin that holds the tensioner pulley control rod and the tie plate to the "cobra-head" arm on the drive control pedal shaft. See Figure 6.33.

Figure 6.34

3. Slip the tie strap off of the "cobra-head" arm, and pivot it downward. See Figure 6.34.

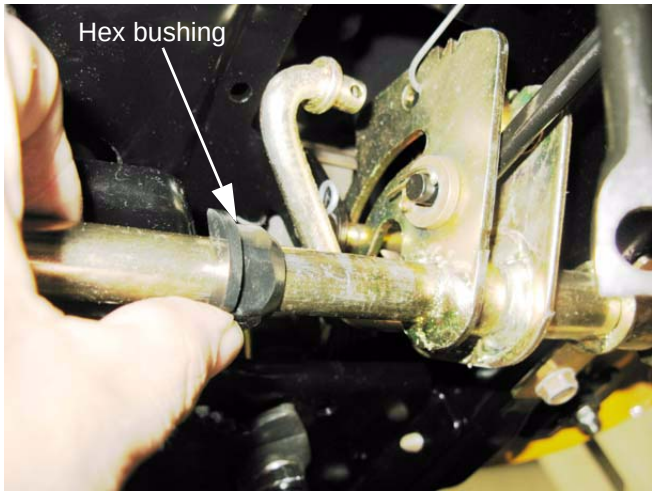


Figure 6.35

4. Slip the tie plate off of the hex bushing, and remove it.
5. Snap the hex bushing off of the brake pedal shaft. See Figure 6.35.

NOTE: The hook on the tie strap goes over the trimmed section of the flange on the hex bushing. See Figure 6.36.

6. Install the tie strap by reversing the process used to remove it. Use a new cotter pin.

7. Test-drive the tractor to confirm that the drive system is working correctly before returning it to service.

Figure 6.36

Belt control: tension make-up pulley

CAUTION The battery will be removed in this procedure. Review the Operator's Manual and Chapter 7: Electrical System for important safety information about handling batteries before proceeding.

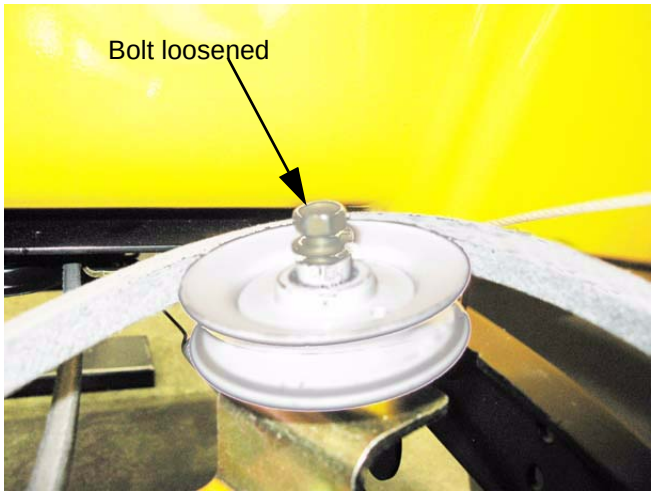


Figure 6.37

1. Remove the upper drive belt from the make-up tensioner pulley as described in the drive belts section of this chapter. See Figure 6.37.

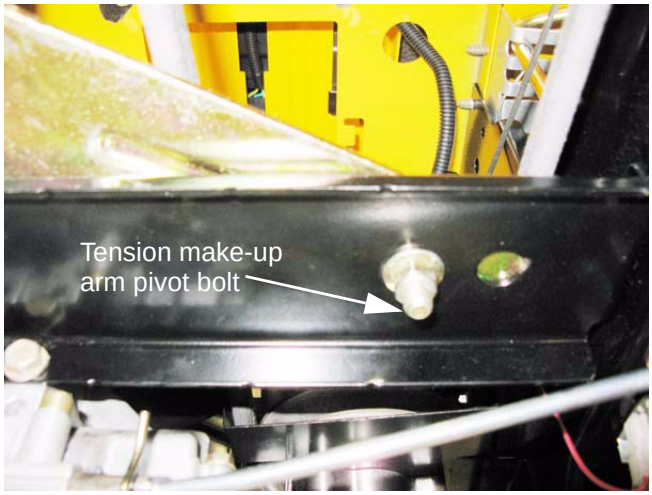


Figure 6.38

2. Unbolt the arm from the torque bracket using a pair of 9/16" wrenches. See Figure 6.38.

3. The arm pivots on a shouldered bushing. See Figure 6.39.
   - A shoulder bolt threads into the bottom of the arm, for the tension spring to hook onto.
   - The tension make-up pulley bolts to the top of the arm.

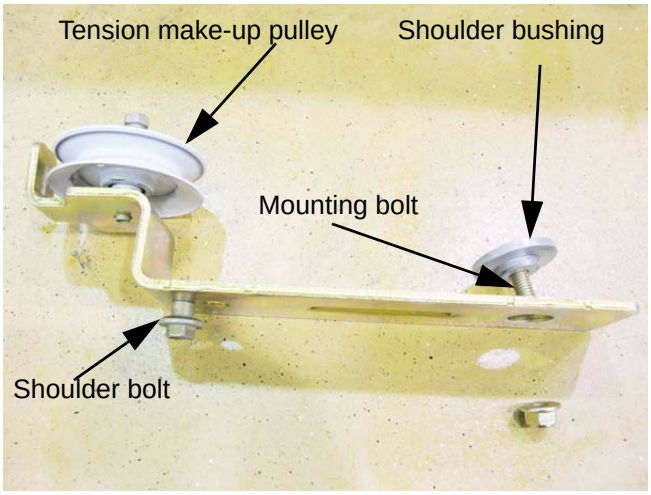


Figure 6.39

4. Install the arm by reversing the procedure used to remove it.
   - Lubricate the pivot point with grease or anti-seize compound.
   - One end of the tensioner spring is offset. The offset end connects to the arm.

Figure 6.40

Belt control: variable speed pulley

CAUTION The battery will be removed in this procedure. Review the Operator's Manual and Chapter 7: Electrical System for important safety information about handling batteries before proceeding.

Figure 6.41

1. Remove the battery and battery tray by following the procedures described in Chapter 4: Body Panels. See Figure 6.41.

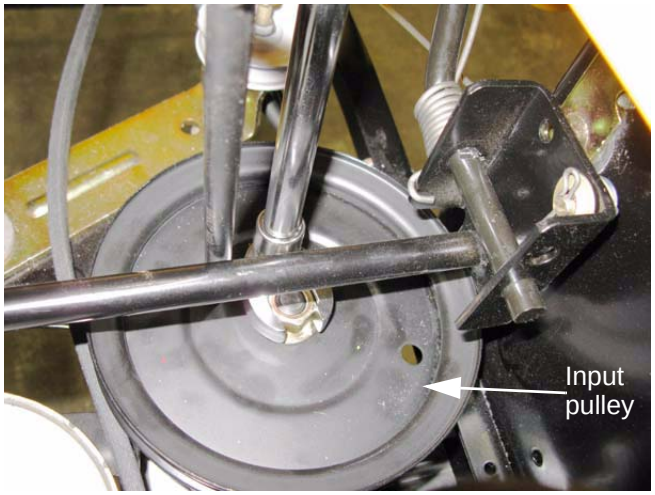


Figure 6.42

2. Disconnect the lateral spring from the frame, relieving tension from the make-up pulley.
3. Roll the upper drive belt off of the transmission input pulley and the top sheave of the variable speed pulley.
4. Remove the input pulley from the transaxle using a 7/8" wrench. See Figure 6.42.

5. Roll the lower drive belt out of the lower sheave of the variable speed pulley. See Figure 6.43.
6. Unbolt variable speed pulley bracket from the transaxle using a 3/8” wrench.

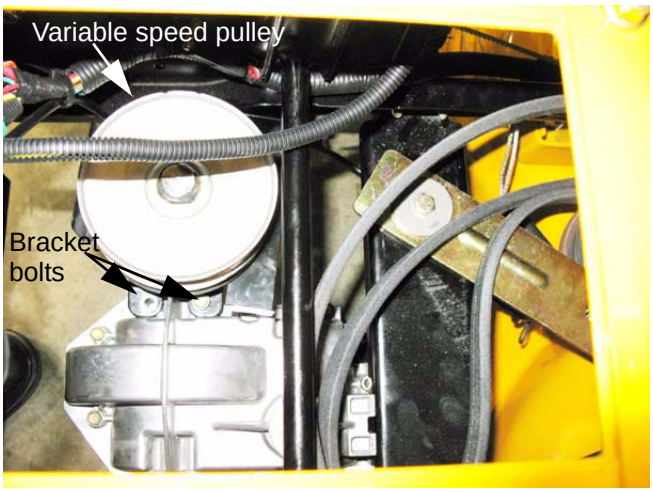


Figure 6.43

7. Loosen, then remove the bolts that hold the variable speed pulley bracket to the frame using a 1/2” wrench. See Figure 6.44.
8. Lift the variable speed pulley and bracket out of the tractor.

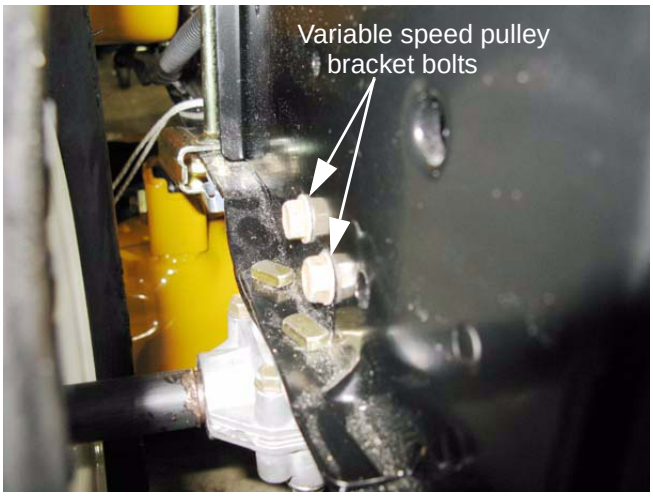


Figure 6.44

9. Bench repairs:
   - 9a. Clamp the pulley and bracket assembly into a vise, gripping the center shaft of the variable speed pulley.
   - 9b. Use a 1/2” wrench to remove the pulley bolt. See Figure 6.45.

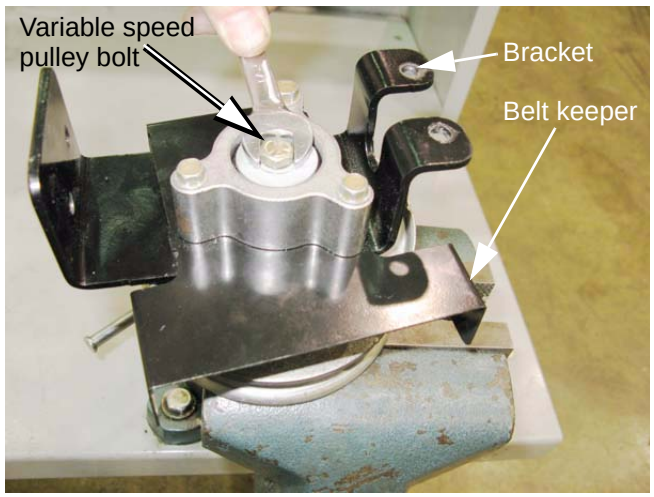


Figure 6.45

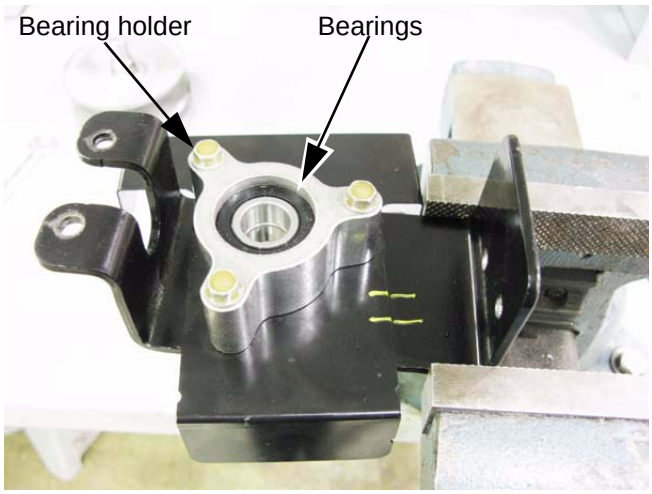


Figure 6.46

9c. Lift the bracket, belt keeper, and bearing holder off of the pulley.

9d. Clamp the variable speed pulley bracket into a vise. Match-mark the bracket to the belt keeper. See Figure 6.46.

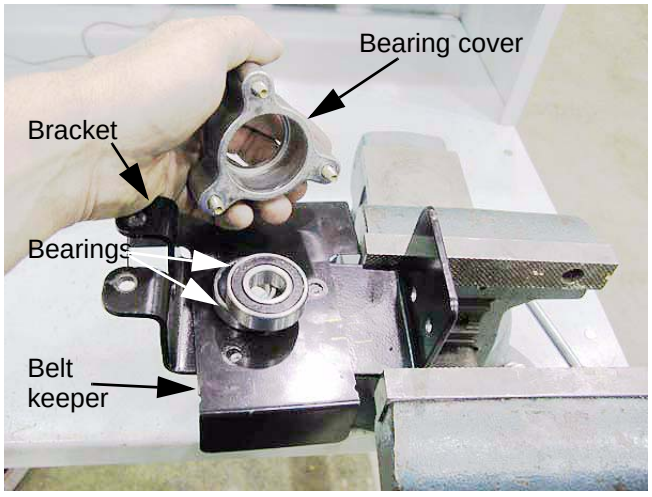


Figure 6.47

9e. Remove the three screws that fasten the bearing holder to the bracket, and lift away the bearing holder. See Figure 6.47.

9f. Inspect the bearings and variable speed pulley.

- The bearings should turn smoothly, with no unusual noise.
- The variable speed pulley should spin true in the bearings.
- The center partition of the variable speed pulley should slide up-and-down smoothly.

9g. Reassemble the variable speed pulley by reversing the steps used to disassemble it.

10. Reinstall the variable speed pulley assembly in the tractor by reversing the steps used to remove it.

- Apply thread locking compound such as LocTite™ 242 (blue) to the variable speed pulley bolt. Tighten the bolt to a torque of 150-180 in-lbs (17-20 N-m).
- Tighten the bearing holder screws to a torque of 90-135 in-lbs (10-15 N-m).

11. Run and test the drive system before returning the tractor to service.

Belt control: tensioner pulleys

NOTE: The V-pulley can be removed from below using a 1/2” wrench, with no disassembly beyond removing the cutting deck. See Figure 6.48.

NOTE: Confirm that the parking brake is released before starting work.

1. Remove the mowing deck.
2. Remove the fenders, as described in the body panels chapter of this manual.

Figure 6.48

3. Disconnect the rod that joins the arm at the left side of the clutch/brake shaft to the drive belt tensioner pulley bracket. See Figure 6.49.
   - Remove and discard the cotter pin to disconnect the rod.

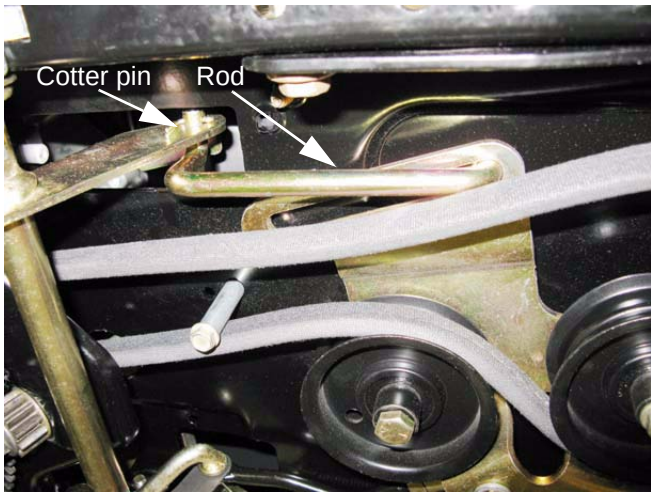


Figure 6.49

4. Disconnect the light extension spring that returns the bracket and pulley to the relaxed position when the drive pedal is released. See Figure 6.50.

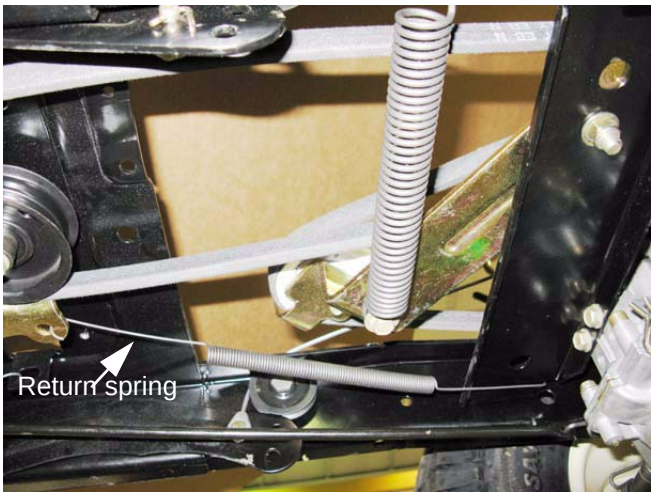


Figure 6.50

Figure 6.51

5. Remove the nut that holds the ball joint end of the tensioner pulley control rod to the tensioner pulley bracket using a 1/2” wrench. See Figure 6.51.
6. Note the belt routing, then slip the drive belt off of the two pulleys on the tensioning bracket.

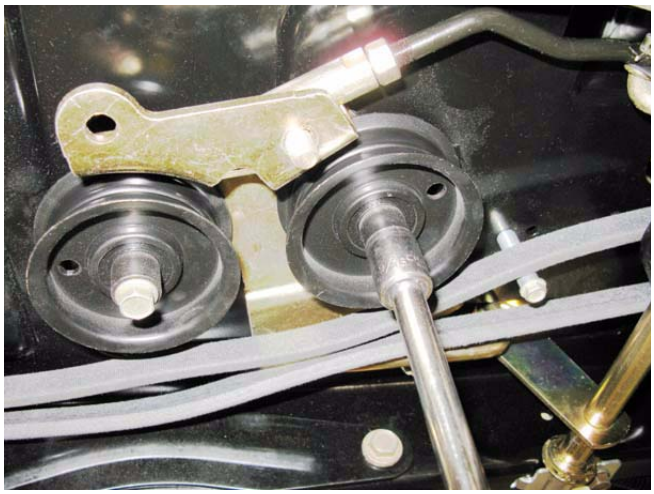


Figure 6.52

7. Remove the nut and bolt that hold the belt tensioner pulley bracket to the frame using a pair of 9/16” wrenches. See Figure 6.52.

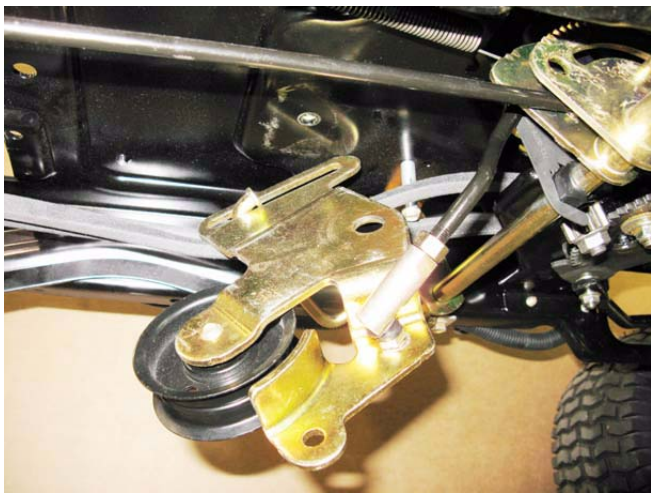


Figure 6.53

8. Maneuver the belt tensioner bracket assembly to clear the belt, and remove it from the tractor. See Figure 6.53.

NOTE: The bracket assembly pivots on the bolt that passes through the fixed flat-sheave idler pulley.

9. On the bench, the flat-sheave idler pulley, and the spacers used to position it can be lifted off of the pulley bracket. See Figure 6.54.

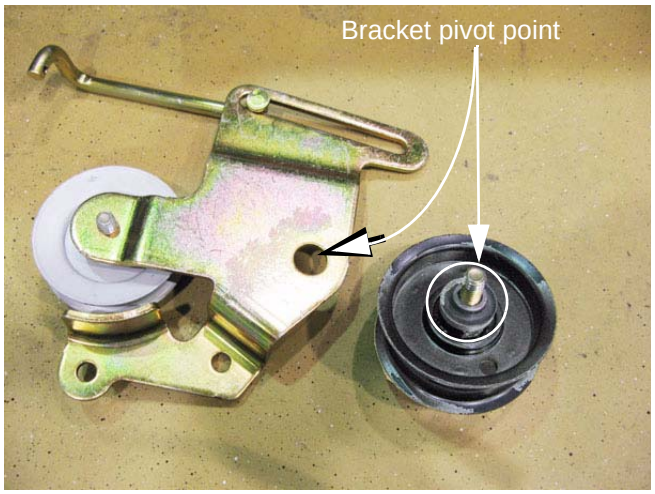


Figure 6.54

NOTE: When installed, the head of the bolt that holds the bracket assembly to the tractor rests against the shouldered side of the flat-sheave idler pulley. See Figure 6.55.

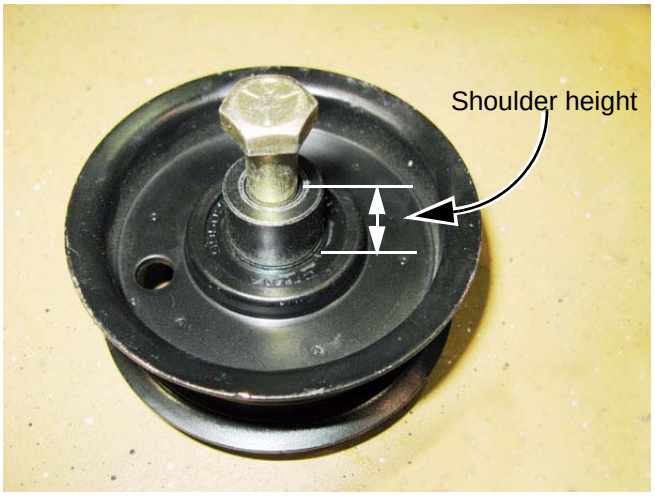


Figure 6.55

NOTE: When installed, the spacers fit against the flat side of the flat-sheave idler pulley. See Figure 6.56.

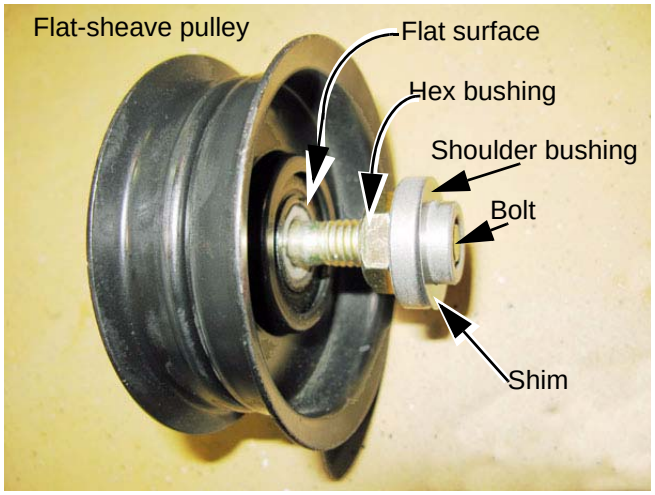


Figure 6.56

Figure 6.57

10. The V-sheave tensioner pulley can be un-bolted from the bracket using a 1/2” wrench.
11. The rod that connects the bracket to the clutch/brake pedal shaft can be maneuvered to come out of its slot in the bracket. See Figure 6.57.
12. Assemble and install the belt tensioner pulley by reversing the steps used to remove and disassemble it.
    - Lubricate the pivot point with a good quality lithium-base grease.
13. Reinstall the fenders.
14. Test the drive system and all safety features before returning the tractor to service.

Drive belt replacement

CAUTION The battery will be removed in this procedure. Review the Operator's Manual and Chapter 7: Electrical System for important safety information about handling batteries before proceeding.

NOTE: The variable speed pulley system that drives this tractor counts on interplay between two belts:

- If one belt fails, replace both belts. One new belt and one partially worn belt will not work the same as two new belts.
- Do not use any belt other than the correct Cub Cadet part number belt. This drive system counts on an unusual cross-section shape of the belts. Use of a wrong belt will very likely cause the tractor not to drive properly.
- Check the tensioner pulley control rod adjustment after replacing belts.

1. Remove the mowing deck.
2. Set the park brake to release belt tension.
3. Remove the battery and battery tray by following the procedures described in Chapter 4: Body Panels. See Figure 6.58.

Figure 6.58

4. Remove upper (rear) drive belt:

   4a. Release the lateral spring that provides force for the tension idler pulley. See Figure 6.59.

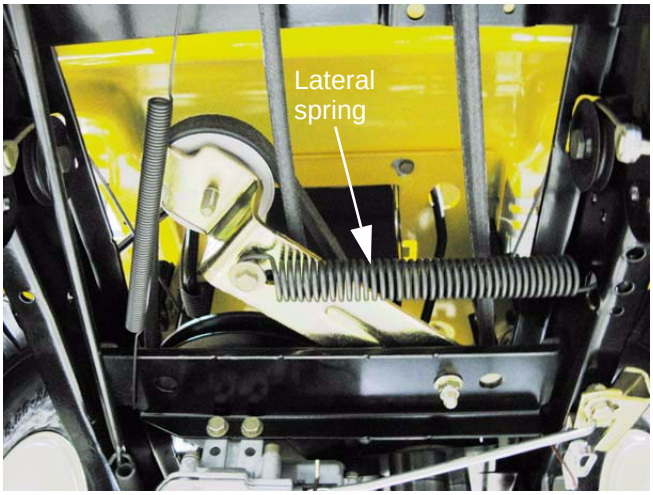


Figure 6.59

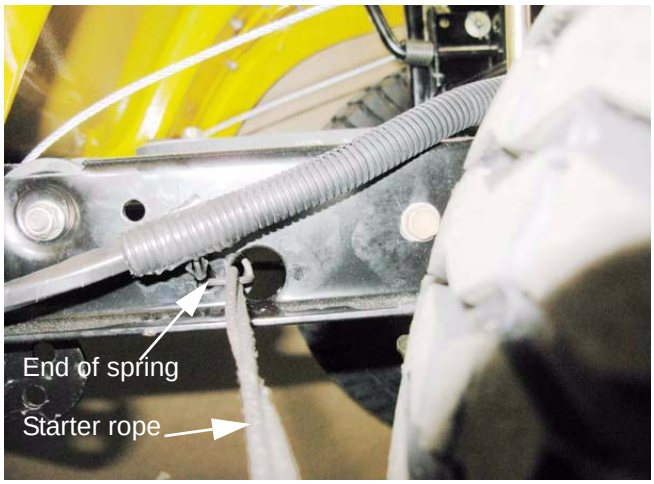


Figure 6.60

NOTE: Use a rope to unhook the spring from the frame. See Figure 6.60.

4b. Loosen the tension idler pulley from its bracket using a 1/2” wrench.

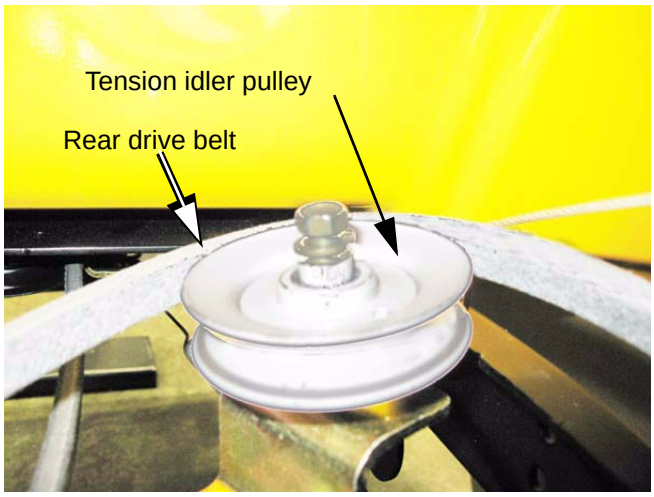


Figure 6.61

4c. Lift the pulley far enough to allow the belt to clear the belt keepers. See Figure 6.61.

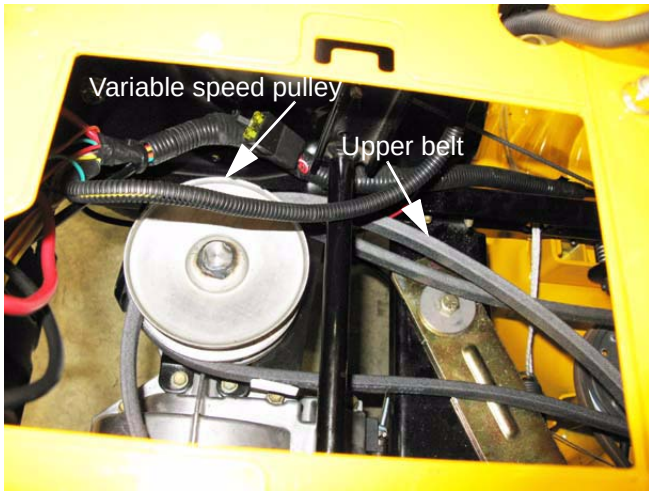


Figure 6.62

4d. The slack created will allow the upper belt to slip easily out of the top sheave of the variable speed pulley and off of the transmission input pulley. See Figure 6.62.

4e. Withdraw the belt through the battery opening under the seat.

5. Remove the lower (front) drive belt:

5a. Slip the belt off of the two tensioner pulleys. See Figure 6.63.

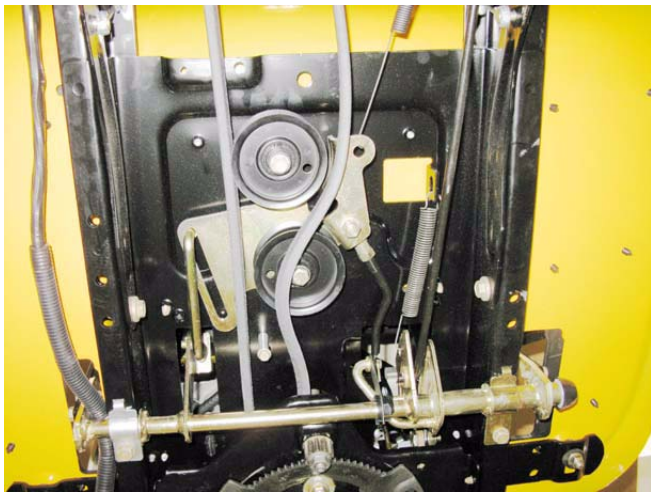


Figure 6.63

5b. Roll the belt off of the lower sheave of the variable speed pulley. See Figure 6.64.

NOTE: The belt can be walked-up from the lower sheave to the upper sheave, then off. Rotate the variable speed pulley to help slip the belt past the belt keepers.

5c. Remove the belt from the engine pulley.

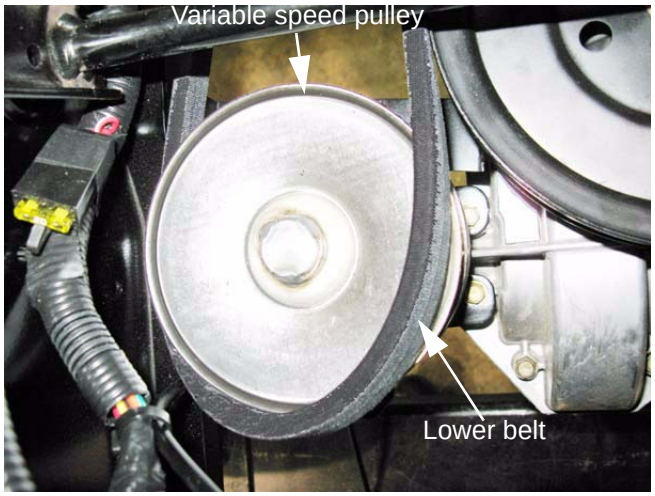


Figure 6.64

Manual PTO

A. Loosen the crankshaft pulley using a 5/8" wrench.

NOTE: An impact wrench and socket will be most effective. Otherwise it may be necessary to block the ring-gear to prevent the crankshaft from turning .

B. Drop crankshaft pulley down far enough to let the belt clear the belt keepers that are built into the bottom of the frame. See Figure 6.65.

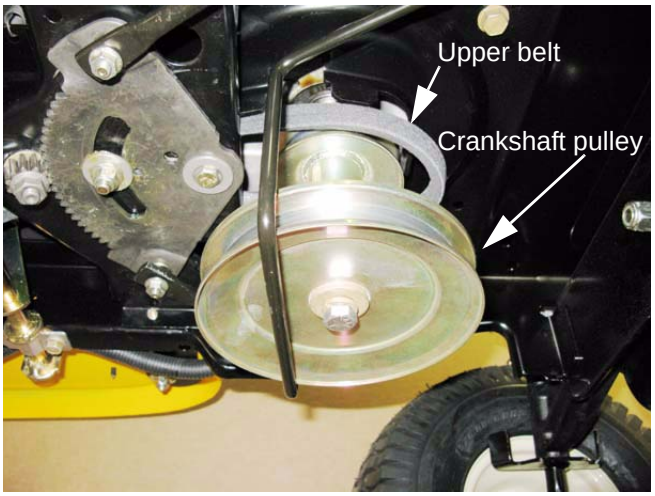


Figure 6.65

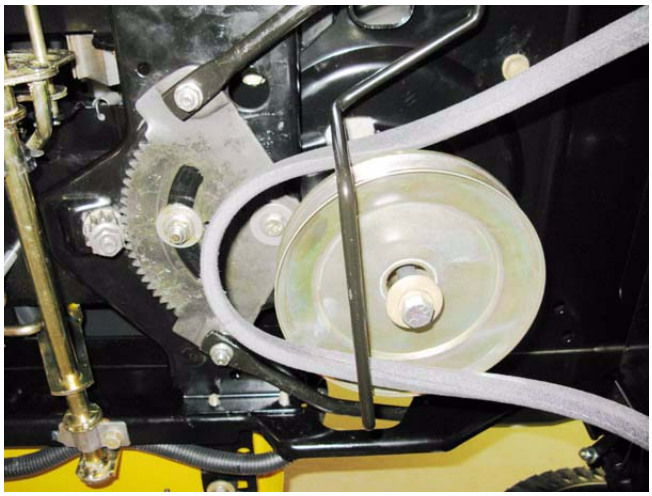


Figure 6.66

C. Work the belt past the PTO pulley, and withdraw it from the front of the tractor. See Figure 6.66.

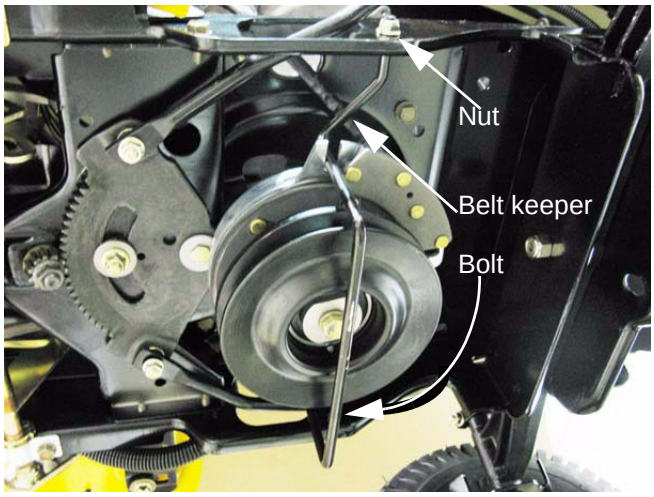


Figure 6.67

Electric PTO

A. Remove the belt keeper near the crankshaft using a 1/2” wrench.

- One bolt holds the belt keeper to the frame, to the left side of the engine.
- A nut holds the belt keeper to the right side frame channel.

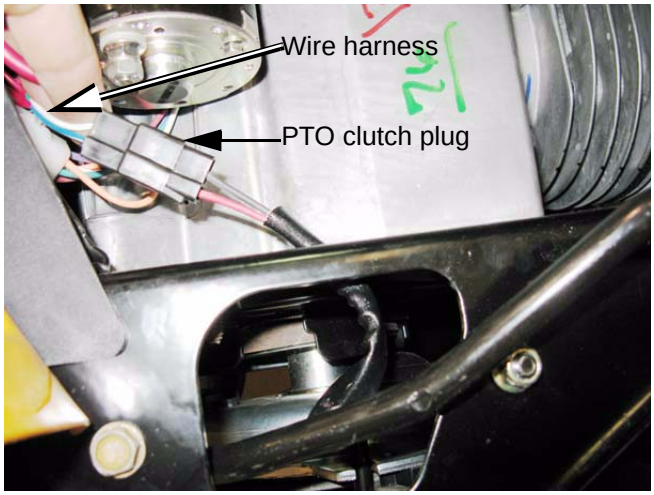


Figure 6.68

NOTE: The electric PTO belt keeper incorporates an anti-rotation bracket for the PTO clutch.

B. Disconnect the PTO clutch electrical plug from the harness.

C. Remove the bolt that holds the PTO clutch to the engine crankshaft using a 5/8” wrench. See Figure 6.69.

NOTE: An impact wrench and socket will be most effective. Otherwise it may be necessary to block the ring-gear to prevent the crankshaft from turning .

CAUTION The PTO clutch is heavy, and it may fall as the bolt is removed.

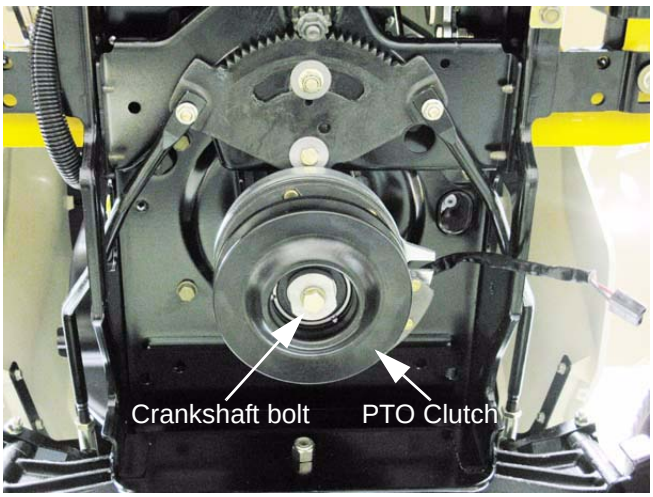


Figure 6.69

D. Carefully lower the PTO clutch and any associated hardware. See Figure 6.70.

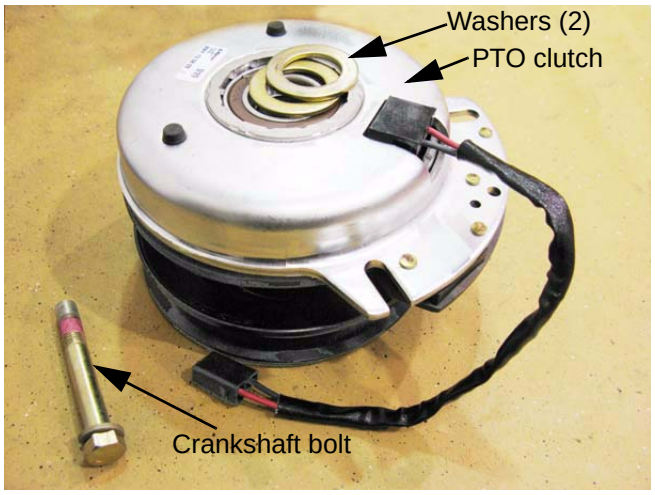


Figure 6.70

E. Slide the pulley off of the engine crankshaft. The belt will clear the belt keepers as the pulley comes down. See Figure 6.71.

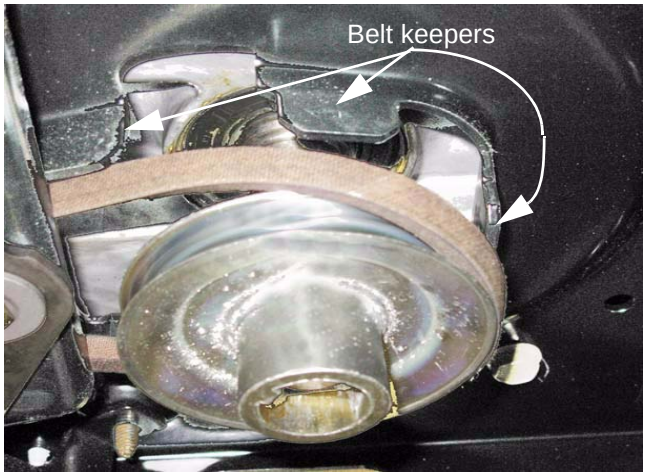


Figure 6.71

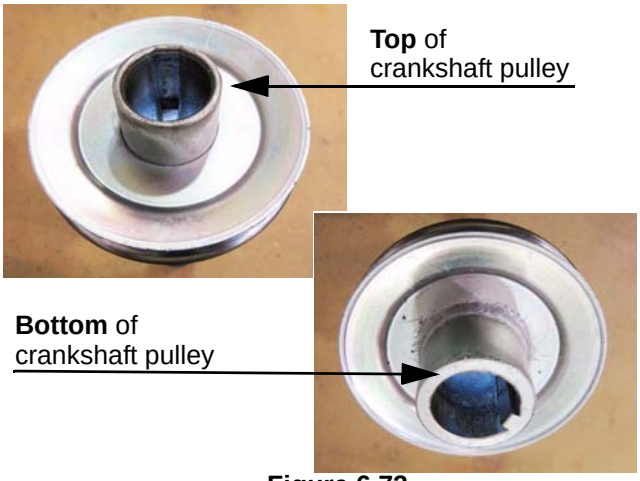


Figure 6.72

F. Withdraw the belt from the front of the tractor.

NOTE: The flat edge of the crankshaft pulley faces the electric PTO clutch. The end with the inside diameter chamfered goes against the fillet near the base of the crankshaft. See Figure 6.72.

NOTE: If the drive belt failed prematurely, identify and correct the cause of the failure before installing a new belt.

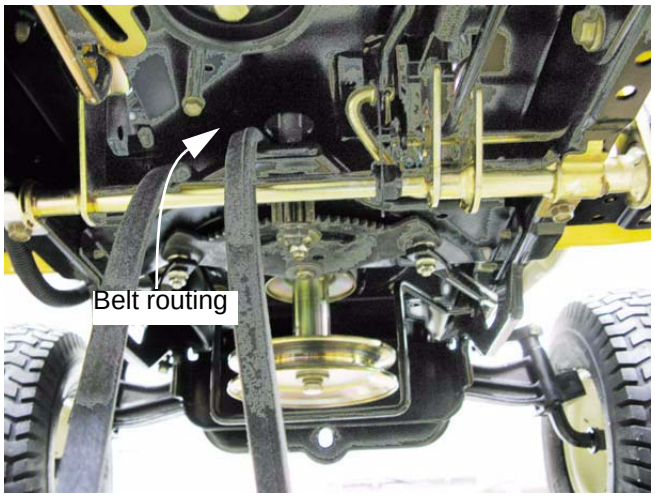


Figure 6.73

6. Install the new belt by reversing the steps used to remove it.

Belt installation notes:

- Install only correct OEM belts. Incorrect belts may cause problems that effect the performance and/or safety of the tractor.
- Apply a small amount of anti-seize compound to the engine crankshaft before installing the crankshaft pulley.
- Apply a small amount of thread locking compound such as Loctite 271™ (red) to the threads of the crankshaft bolt.
- Tighten the crankshaft bolt to a torque of 36-50 ft-lbs (50-68 N-m).
- The belt is routed to the left of the steering shaft, and the foremost keeper pin goes between the runs of the belt. See Figure 6.73.

7. Thoroughly test the operation of the drive system and all safety features before returning the tractor to service.

Transaxle removal and replacement

CAUTION The battery will be removed in this procedure. Review the Operator's Manual and Chapter 7: Electrical System for important safety information about handling batteries before proceeding.

1. Remove the upper drive belt as described in the drive belt replacement section of this chapter.
2. Remove the input pulley and input pulley adaptor from the transaxle using a 7/8" wrench. See Figure 6.74.

   NOTE: A crow foot wrench with a long extension works well for this step. Use a tapered pin to keep the pulley from rotating.

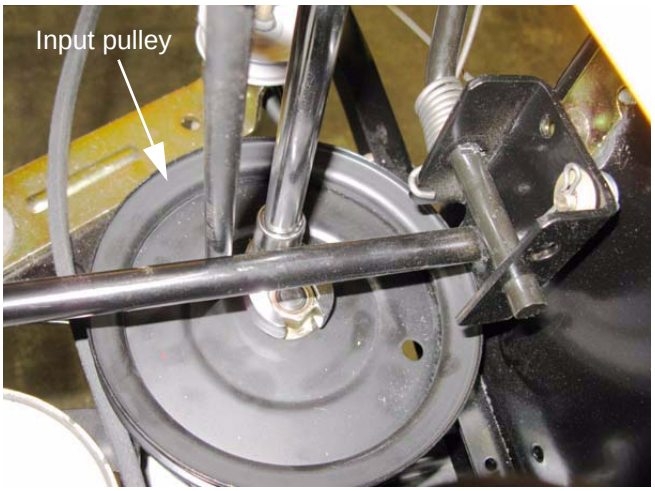


Figure 6.74

NOTE: The recessed side of the pulley faces up. See Figure 6.75.

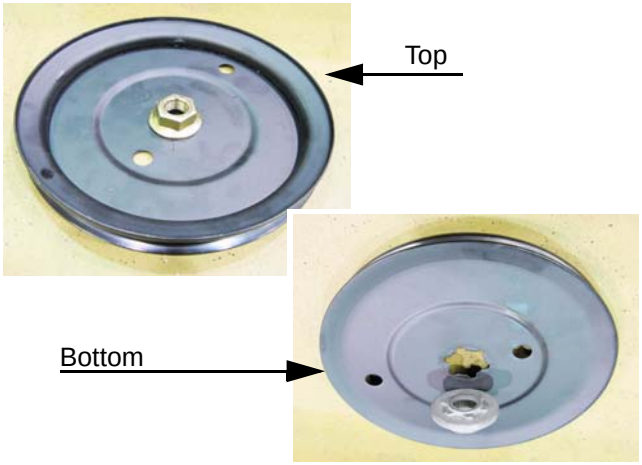


Figure 6.75

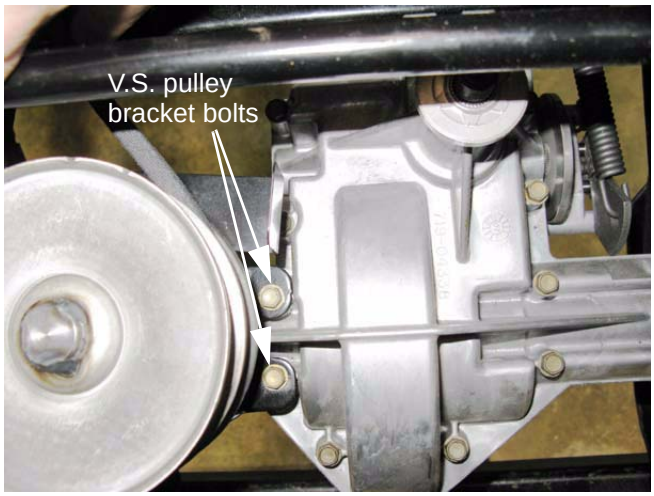


Figure 6.76

3. Loosen, but do not remove the wheel bolts (Double-D axles) or lug nuts, using a 1/2” wrench or a 3/4” wrench, respectively.
4. Unbolt the variable speed pulley bracket from the transaxle using a 3/8” wrench. See Figure 6.76.

Figure 6.77

5. Lift, and safely support the tractor. The rear of the tractor should be high enough to allow the transaxle to pass under it.
6. Remove the rear wheels. If the tractor has Double-D axles, remove the wheel spacers too. See Figure 6.77.

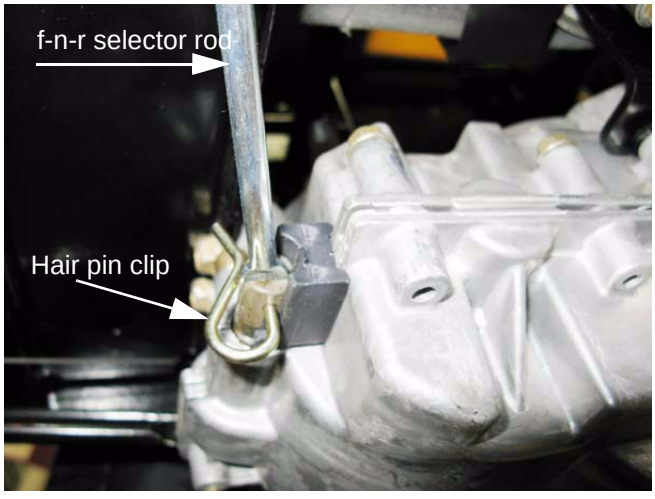


Figure 6.78

7. Disconnect the forward-neutral-reverse gear selector rod from the transaxle by removing the hair pin clip. See Figure 6.78.

8. Disconnect the forward-neutral-reverse gear selector rod from the gear selector by rotating the rod 90 degrees. The coined ears on the rod will align with notches in the selector, and the rod can be pulled-free. See Figure 6.79.

9. Support the transaxle so that it can be lowered out of the tractor in a controlled fashion.

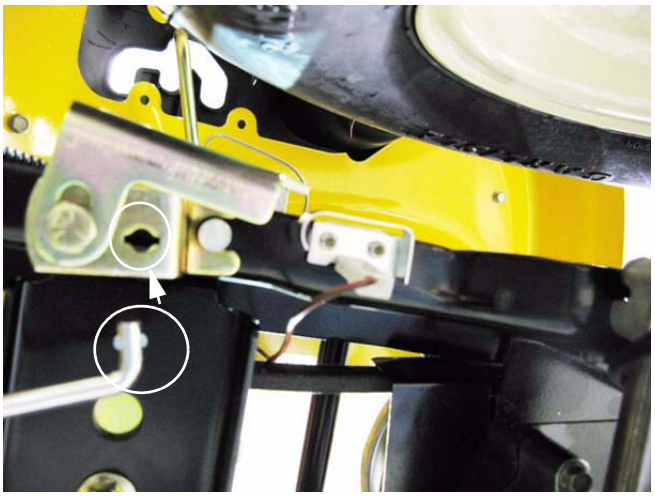


Figure 6.79

10. Remove the torque bracket bolts using a 1/2” wrench. See Figure 6.80.

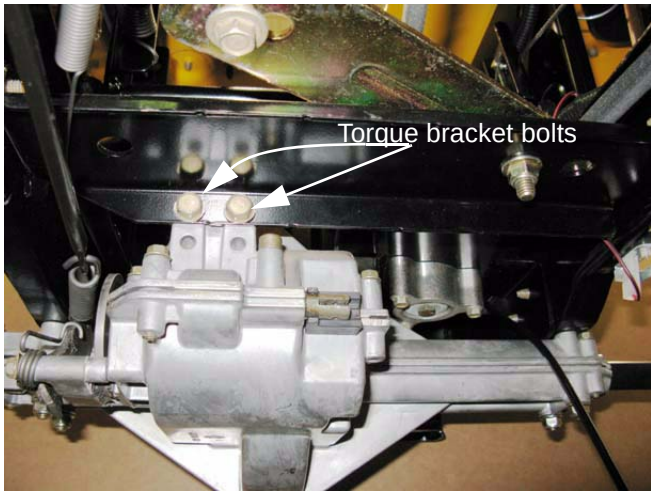


Figure 6.80

11. Take the nuts off of the T-bolts that hold the transaxle to the frame using a 1/2” wrench. See Figure 6.81.

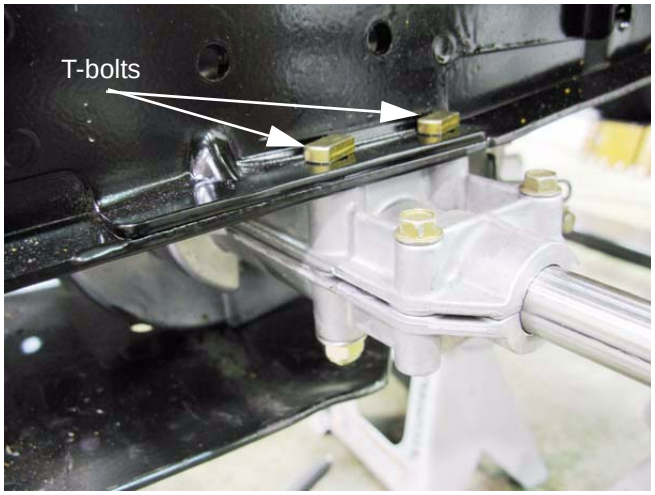


Figure 6.81

Figure 6.82

NOTE: At this point, the brake actuator spring is still attached to the brake rod from the pedal shaft, and the brake arm on the transaxle.

12. Carefully lower the transaxle out of the tractor. See Figure 6.82.

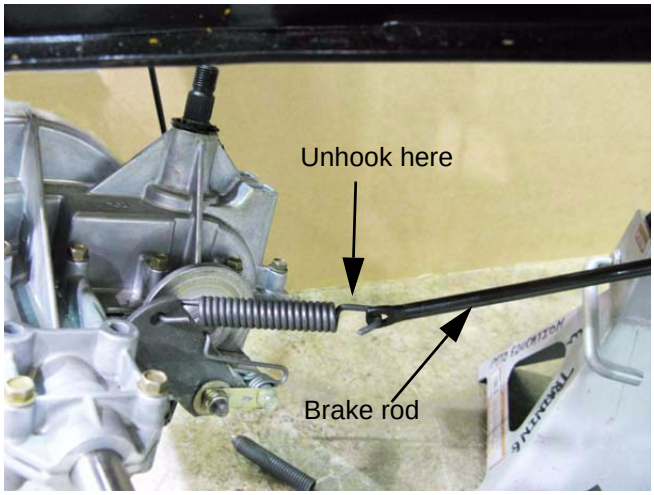


Figure 6.83

13. Move the transaxle forward to make some slack in the brake linkage. Use the slack to unhook the brake spring from the brake rod. See Figure 6.83.

NOTE: The brake spring has a tighter hook on the brake arm end than on the brake rod end. It is much easier to disconnect the spring from the rod. See Figure 6.84.

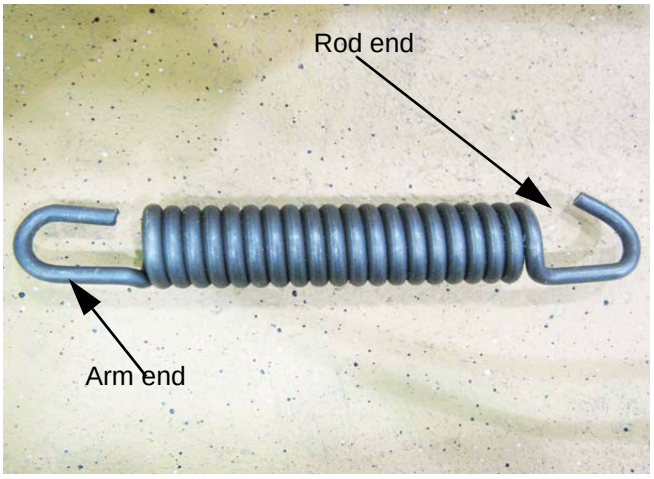


Figure 6.84

14. Carefully lift the transaxle onto a workbench for disassembly as needed.

15. Installation notes:

    15a. Check adjustment of the brake before installing the transaxle.

    15b. Connect both ends of the brake actuator spring before lifting the transaxle back into the tractor.

    15c. Coat the Double-D axle shaft with a high quality grease or anti seize compound before installing the wheels

    15d. The wheel spacer sleeves are of different lengths: the short one goes on the right, the long one goes on the left.

    15e. Install the transaxle by reversing the steps used to remove it.

    15f. Tighten fasteners according to the torque table at the end of this chapter.

16. Operate and test the drive system, brake system, and all safety features before returning the tractor to service

Transaxle repair

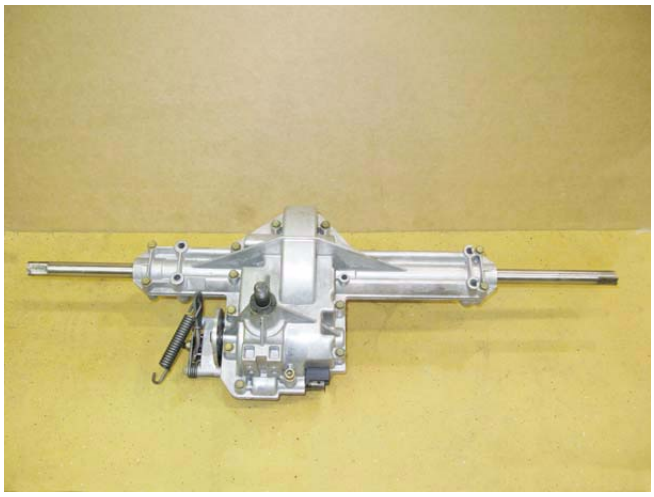


Figure 6.85

1. Assess the damage from the outside:
   See Figure 6.85.
   - 1a. If the tractor is within the warranty period, is the damage consistent with a warrantable failure?
   - 1b. If the tractor is beyond the warranty period, is the transaxle feasible to repair?
   - 1c. Are the axles bent?
   - 1d. Is the housing broken from the outside-in?
   - 1e. Is the housing broken from the inside-out?
   - 1f. Spin-test:
     - Will the input shaft turn in neutral?
     - Will it drive the wheels forward in forward gear? Hold the brake rotor and check input-shaft backlash. It should be 0.006”-0.014” (0.15-0.36mm).
     - Will it drive the wheels backward in reverse gear? Hold the brake rotor and check input-shaft backlash. It should be 0.006”-0.014” (0.15-0.36mm).
   - 1g. If it fails the spin test, are the brakes too tight?
2. If further investigation is required to determine the cause of the failure or to asses the feasibility of repair, disassemble the transaxle using the following steps:

NOTE: steps #4 through #6 can be skipped if this is a warranty-related autopsy.

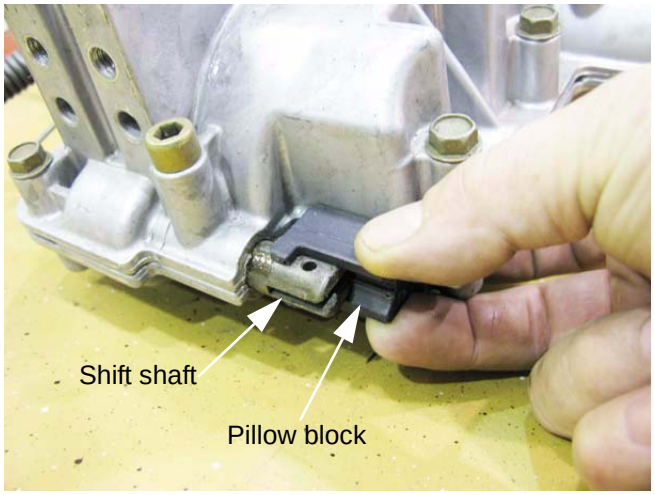


Figure 6.86

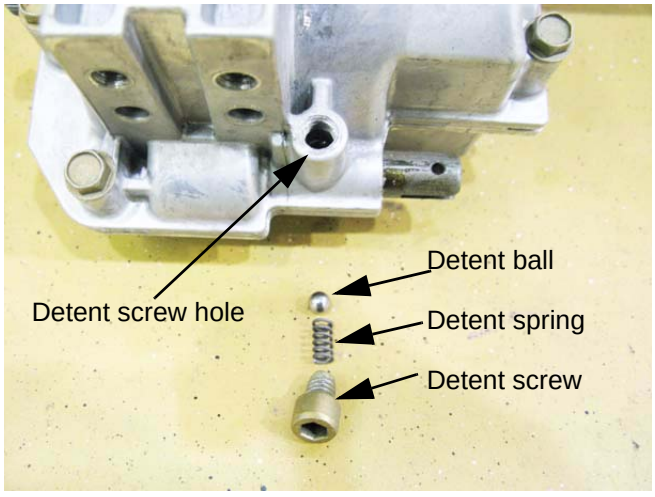


Figure 6.87

3. Slide the shift shaft pillow block off of the shift shaft. See Figure 6.86.
4. Remove the detent screw using a 1/4” allen wrench.
5. Use a magnet, or turn the transaxle upside-down to remove the detent ball and spring. See Figure 6.87.

6. Disassemble the brake:

6a. Unhook and remove the brake spring. See Figure 6.88.

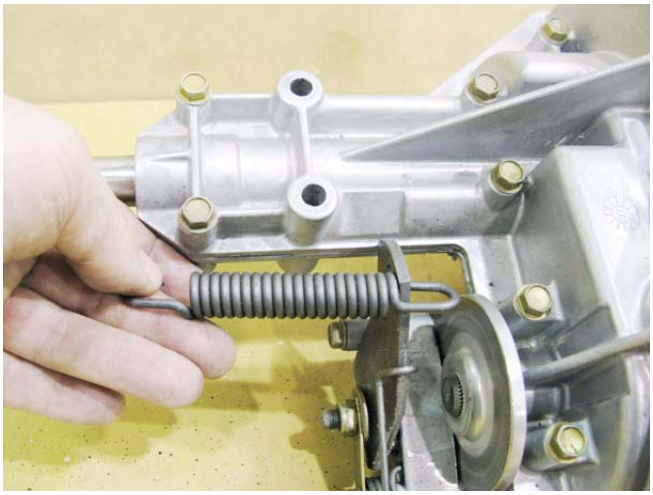


Figure 6.88

6b. Unbolt the brake yoke from the transaxle using a 3/8” wrench. See Figure 6.89.

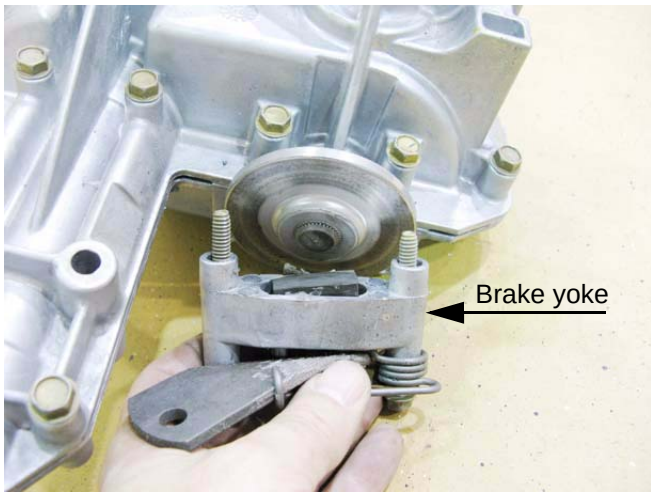


Figure 6.89

6c. Slip the brake rotor off of the brake shaft (splined end of bevel gear shaft). See Figure 6.90.

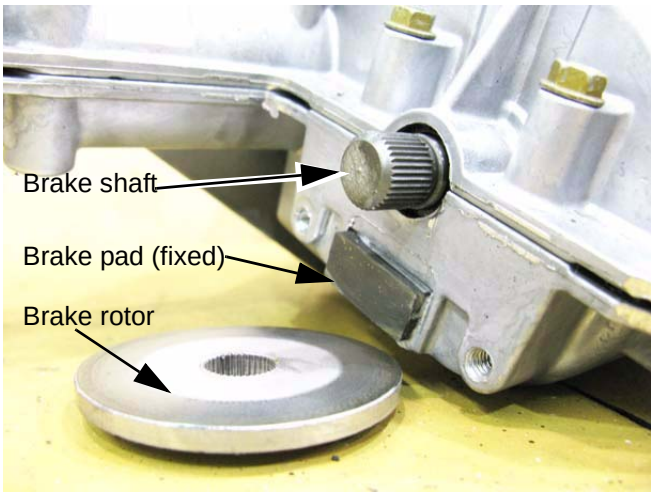


Figure 6.90

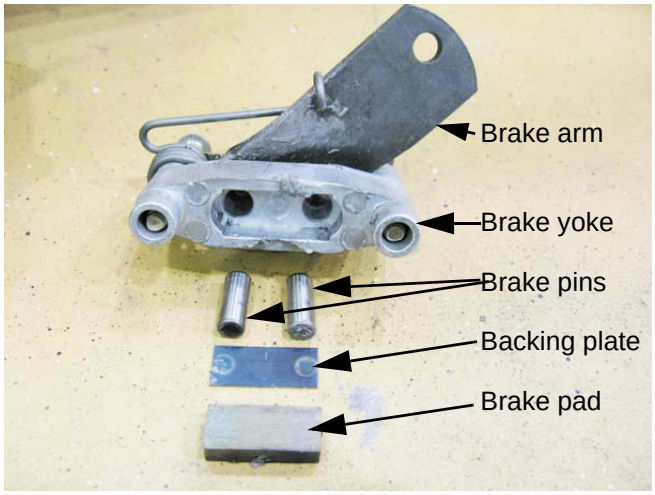


Figure 6.91

6d. Inspect the brake shaft and inner brake pad.

NOTE: The inner pad is epoxied in-place, but may be pried-out for replacement.

6e. Disassemble and inspect the brake yoke. See Figure 6.91.

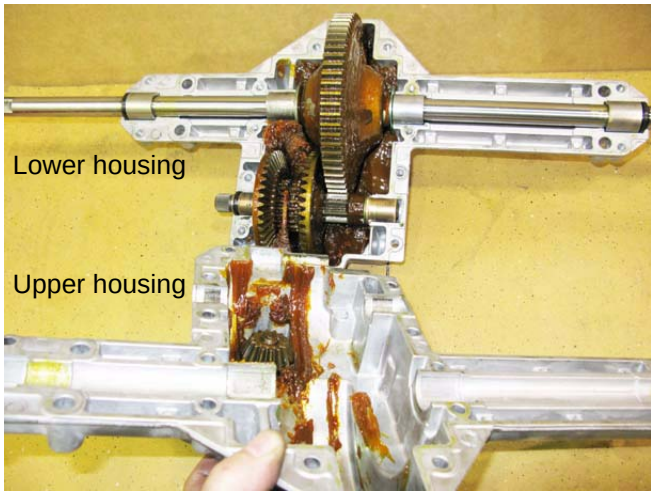


Figure 6.92

7. Remove the 13 remaining perimeter screws that hold the upper transaxle housing to the lower transaxle housing using a 3/8” wrench.
8. Separate the two housings. See Figure 6.92.

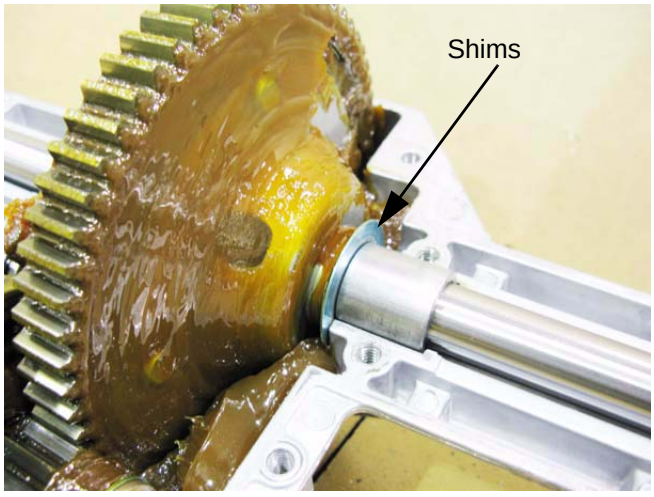


Figure 6.93

NOTE: The axle shafts will generally be of different lengths. Mark, or note the orientation of the differential and axle assembly to the transaxle housing before removing it.

9. Lift the axle and differential housing out of the transaxle. See Figure 6.93.
10. Note the positions of the shim washers.

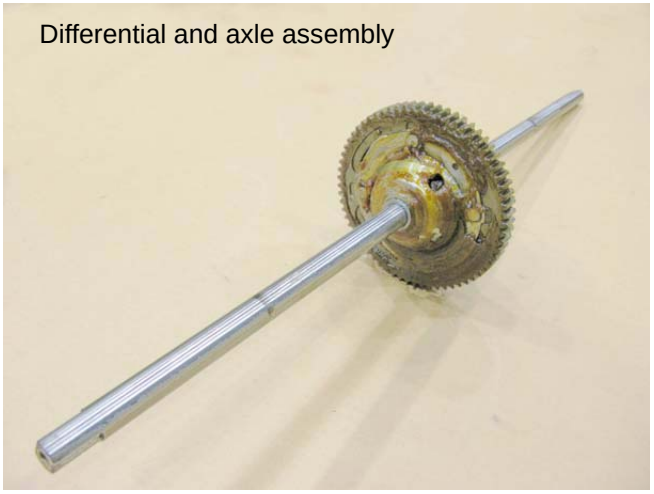


Figure 6.94

11. Slip the seals, bearings, and washers off of the differential and axle assembly. See Figure 6.94.

    NOTE: When correctly installed, the seals fit on the axle shaft with the lips facing out. Their primary purpose is to exclude dirt and moisture. Grease does not tend to migrate past the axle seals.

    NOTE: If the transaxle is to be re-built, replace the bearings and seals with new ones.

12. Inspect the differential and axle assembly.

    12a. Look for damaged ring gear teeth.

    12b. With the ring gear held still, turning one axle should cause the other axle to rotate smoothly in the opposite direction.

    12c. Look for rust or excessive wear on the bearing contact surfaces.

    12d. Problems in any of these areas mean the differential assembly should be replaced.

    12e. If this is a warranty-related autopsy, identify the root cause of the problem. If it is not something that was done wrong at the factory, the problem is not warrantable.

    NOTE: Cub Cadet does not have a part number for water, and it is not installed at the factory.

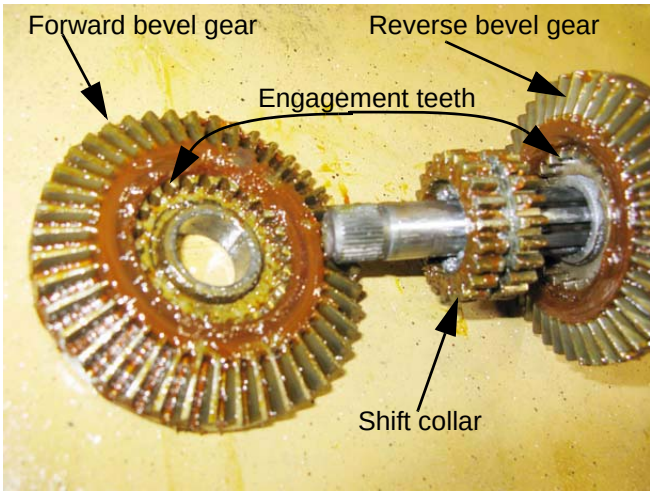


Figure 6.95

13. Lift the bevel gears out of the transaxle for disassembly and (mostly) visual inspection. See Figure 6.95.

    13a. Note the placement of the shims on the bevel gear shaft.

    13b. Check the bevel gear teeth (that mesh with the pinion gear) for wear or damage.

    13c. Check the shift collar engagement teeth on the bevel gears for wear or damage.

    13d. Check the inside bearing surface of each bevel gear for wear or damage.

    13e. Check the bevel gear shaft for wear or damage.

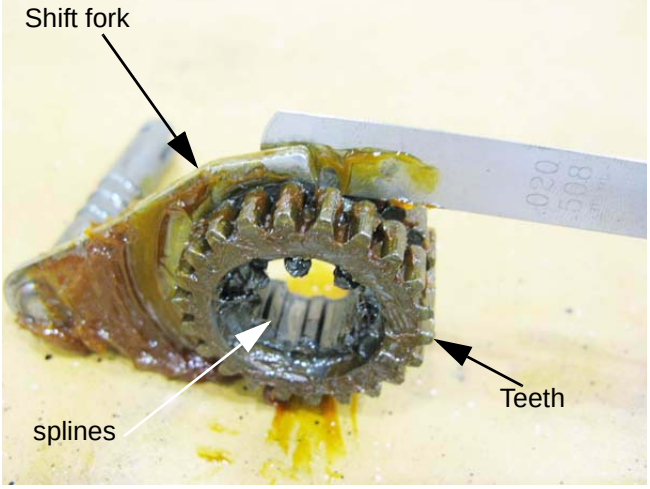


Figure 6.96

13f. Check the shift collar and fork for wear.

13g. Check shift collar teeth and splines for wear or damage. See Figure 6.96.

14. Check the interior of the transaxle housings.

14a. If there is heavy gear-tooth damage on the ring gear of bevel gears, there is likely to be large debris in the grease. Dispose of the grease if the transaxle is to be rebuilt.

14b. If there is heavy wear on any of the contact surfaces, there is likely to be small particles of metal in the grease. Dispose of the grease if the transaxle is to be rebuilt.

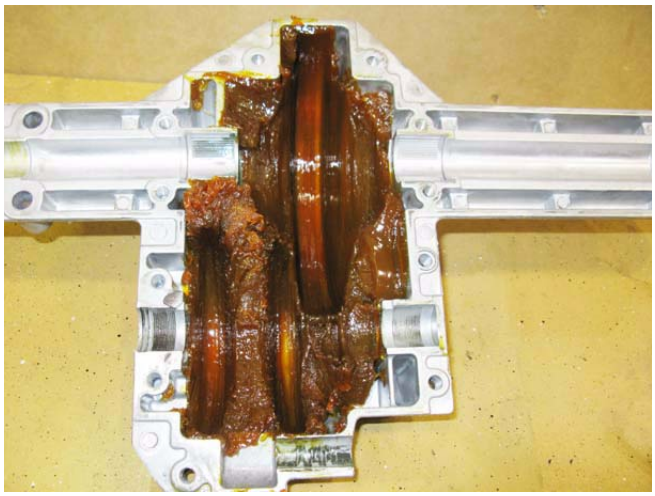


Figure 6.97

14c. If the grease is obviously contaminated with water or other substances, dispose of the grease if the transaxle is to be rebuilt.

14d. If the transaxle is being warranted, leave the grease and debris in place, after the root cause of the failure is identified.

14e. If the transaxle is repaired, the damage is isolated, and the grease is not contaminated with anything, it is acceptable to re-use the grease. See Figure 6.97.

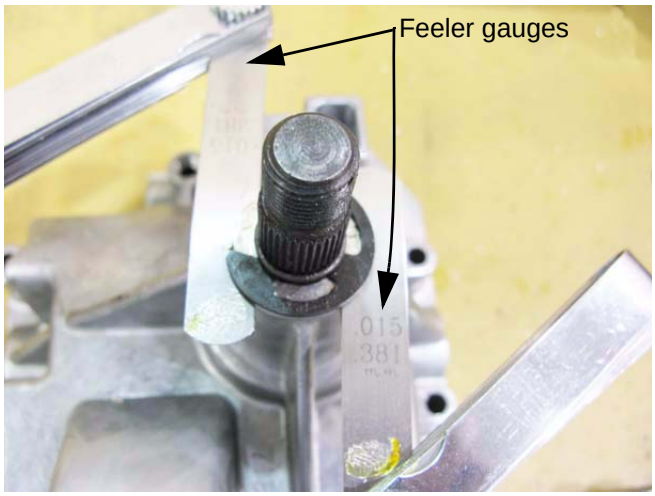


Figure 6.98

15. Inspect the pinion gear and input shaft assembly. See Figure 6.98.

15a. The pinion gear teeth should not show signs of heavy wear or damage.

15b. The input shaft should have 0.015”-0.020” (0.38-0.51mm) end-play, and 0.002”-0.010” run-out.

16. If there is a reason to take-apart the input pinion, use the following steps:

    16a. Remove the hog-ring pulley stop by prying-open the end gap and slipping it up the shaft. See Figure 6.99.

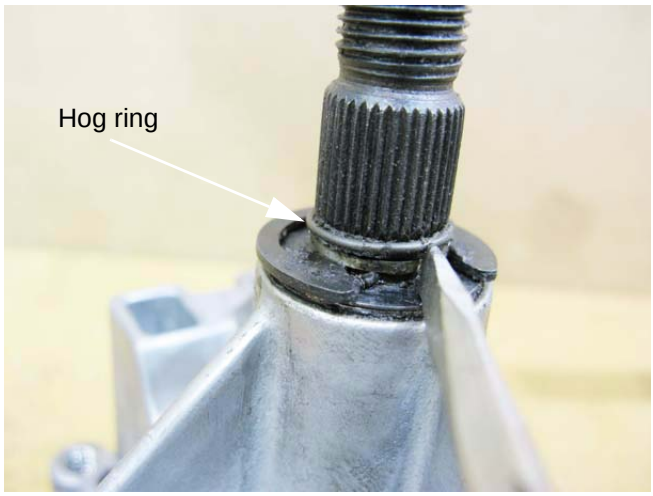


Figure 6.99

    16b. Use a screwdriver to pry-off the E-ring. See Figure 6.100.

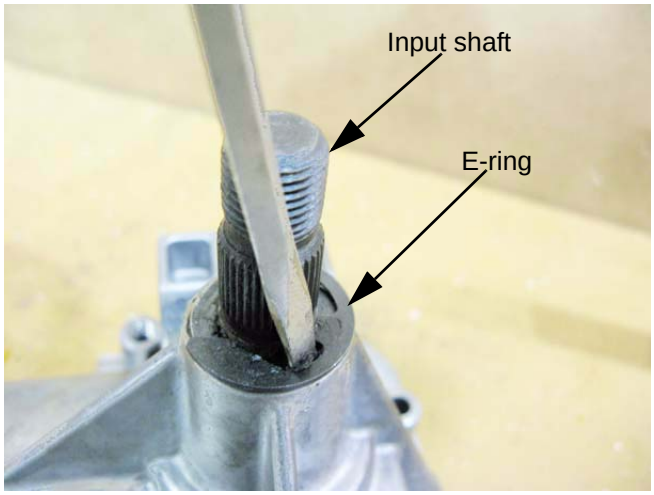


Figure 6.100

    16c. Remove the shim washers. See Figure 6.101.

Figure 6.101

Figure 6.102

16d. Pull the pinion shaft out of the housing. See Figure 6.102.

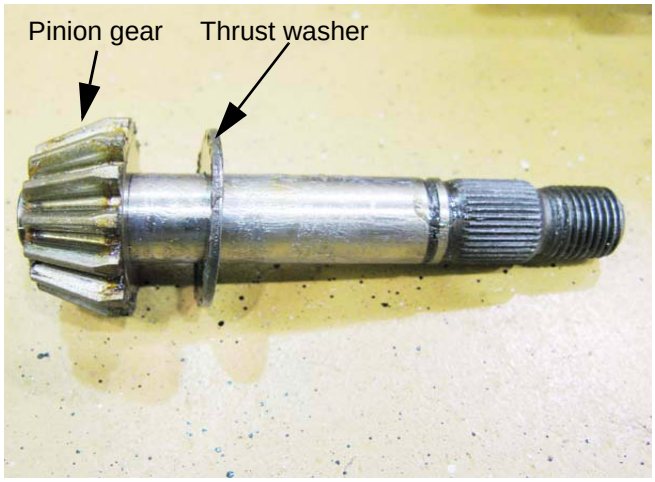


Figure 6.103

16e. Inspect the shaft and bearings. See Figure 6.103.

17. Final evaluation:

It may not be necessary to fully disassemble the transaxle to identify the damage or find the root cause of a warrantable failure.

At this point of disassembly, or some point earlier in the process, the technician should be able to make an assessment of whether it is feasible to repair the transaxle. It should also be possible to positively identify what went wrong in a warrantable transaxle replacement.

If the transaxle is to be warranted, reassemble it for shipping. It may be called back for inspection.

If repair is feasible, proceed by the following steps:

18. Assemble the pinion gear:

18a. Press-in new bearings, if necessary.

18b. Apply some Durina grease to the shaft and the contact surfaces between the base of the pinion gear and the thrust washer.

18c. Insert the shaft and washer from the inside of the housing.

18d. Install the shim washers and E-clip previously removed, then check end-play and run-out.

- Add shims to reduce end-play.
- Take-out shims to increase end-play.

19. Assemble and install the bevel gear shaft:

19a. Apply a small amount of anti-seize compound to the splined section of the shaft.

19b. Slide the reverse gear, shift collar, and forward gear onto the bevel gear shaft. See Figure 6.104.

NOTE: The gears are identical. Forward and reverse are functional references. The reverse bevel gear is nearest the reduction gear, while the forward gear is nearest the brake rotor spline.

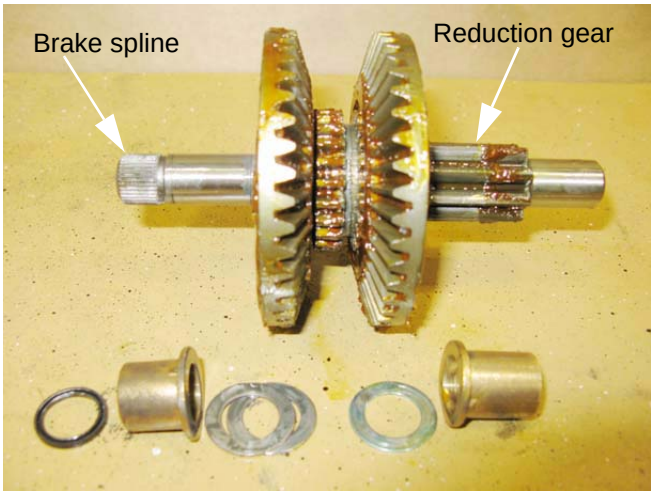


Figure 6.104

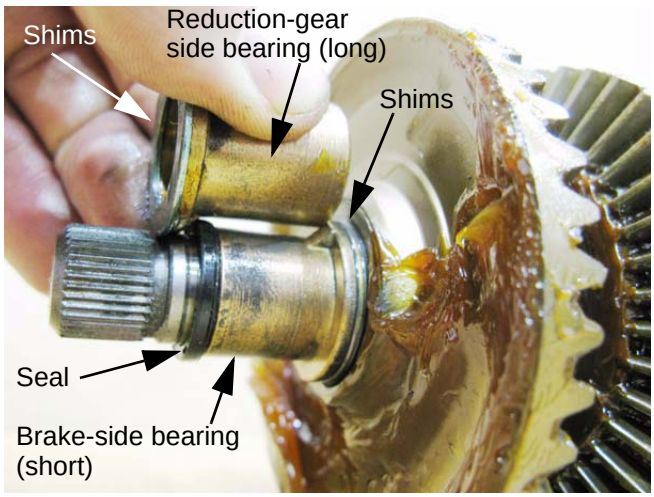


Figure 6.105

19c. Re-install the shims in their original locations on the bevel gear shaft.

19d. Smear some Durina™ grease on the surfaces of the shaft that will ride in the flange bearings.

19e. Install new bevel gear shaft bearings, with their flanges facing the shims. See Figure 6.105.

NOTE: The bevel gear shaft bearings are of different lengths.

The longer bearing goes on the reduction gear end of the shaft. The shorter bearing goes on the brake-spline end of the shaft.

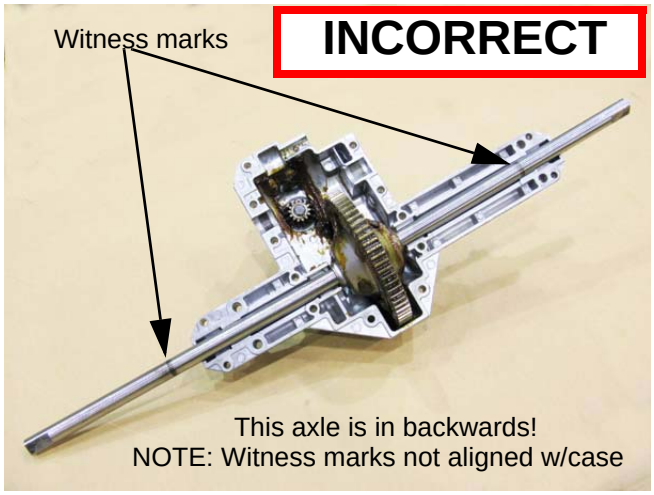


Figure 6.106

19f. Install the brake shaft seal. The primary purpose of this seal is to keep grease away from the brakes. The seal should be installed with the lip facing in.

19g. Install the bevel gear shaft into the transmission housing for a dry fit check.

20. Install the axle and differential assembly:

20a. Check notes, markings, or witness marks on the axle shafts to confirm the correct orientation. See Figure 6.106.

20b. Reinstall the end-play shims in their original positions.

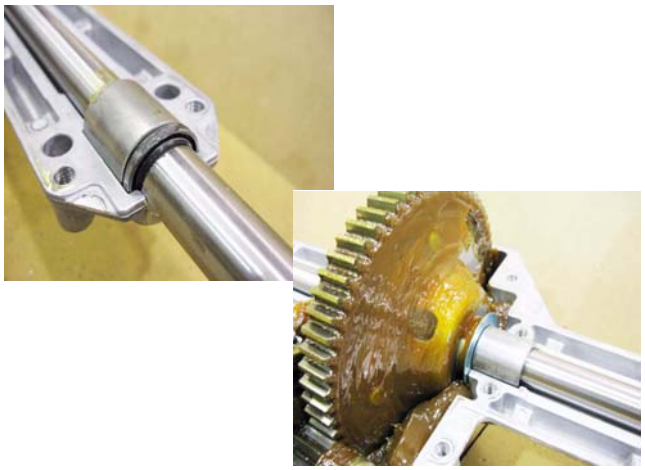


Figure 6.107

20c. Apply a small amount of Durina™ grease to the inboard bearing contact surfaces of the axle, then slide new bearings into place.

20d. Apply a small amount of Durina™ grease to the outer bearing contact surfaces of the axle, then slide new bearings into place.

20e. Slip the seals onto the axle shaft. The seal lip should face outward.

20f. Carefully place the assembly into the housing for a dry fit. See Figure 6.107.

21. Press the differential and the reverse gears as close together as they will go while remaining properly seated in the housing.
22. Confirm that there is at least 0.030” (0.762mm) between the rivet heads on the differential and the back side of the reverse gear. See Figure 6.108.
23. Collective axle end play (the amount one axle shaft moves when the opposite axle is pushed) should be between 0.010”-0.080” (0.25-2.0mm).
24. Adjust the shims as necessary to achieve these two conditions.
25. Install the shift fork.
26. Install the top of the transaxle housing, and tighten the perimeter screws finger-tight.
27. Spin-test the transaxle in forward, neutral, and reverse.

Figure 6.108

28. Check the input shaft backlash:

    28a. Engage forward gear, hold the brake spline and rotate the input shaft. The top edge of the input shaft should rotate between 0.006”-0.014” (0.15-0.36mm).

    28b. Engage reverse gear, hold the brake spline and rotate the input shaft. The top edge of the input shaft should rotate between 0.006”-0.014” (0.15-0.36mm).

29. Remove the top of the housing, and adjust the bevel shaft gear shims as necessary, then re-check.

    NOTE: The backlash in the input shaft is a function of the amount of play between the pinion gear and the bevel gear it is driving. Shimming a bevel gear to run nearer the pinion shaft will reduce the backlash. Removing shims to allow more space between the pinon and bevel gears will increase the amount of backlash.

30. Install, or add Durina™ grease to a total of 20 fl.oz. (0.59 liters) in the housing.
31. Carefully install the top of the housing, and install the 13 perimeter screws, leaving 2 empty screw holes; 1 on each side of the brake spline.

    NOTE: No sealant is necessary.

32. Tighten the screws to a torque of 90-135 in-lbs. (10-15 N-m).
33. Install the detent ball, spring, and screw.
34. Tighten the detent screw to a torque of 160-200 in-lbs. (18-23 N-m).
35. Assemble the brake yoke:

    35a. Apply a small amount of anti-seize compound to the brake rotor splines and to the actuator pins in the brake yoke.

⚠CAUTION Do not get anti-seize on the friction surfaces of the brake.

    35b. Install the steel backing plate against the pins, then place the friction pad against the backing plate. See Figure 6.109.

Figure 6.109

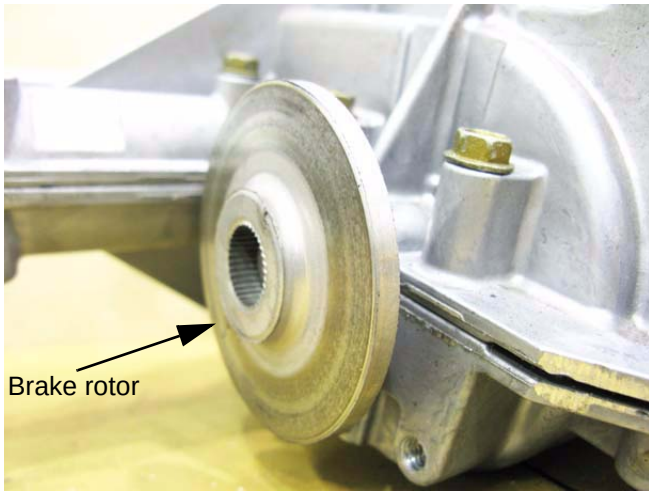


Figure 6.110

35c. Install the brake rotor, with the flat side facing the transaxle housing. See Figure 6.110.

35d. Install the brake yoke to the transaxle, being careful not to let the friction pad or backing plate fall out of place.

35e. Tighten the brake yoke screws to a torque of 90-135 in-lbs. (10-15 N-m).

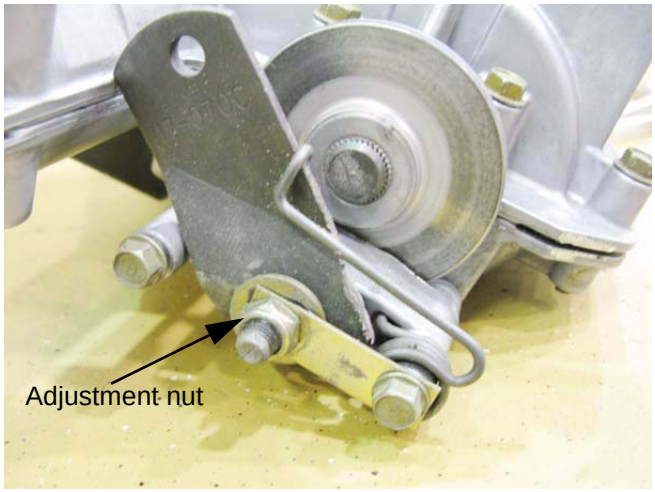


Figure 6.111

35f. Set the clearance between the pads and rotor to 0.010-0.015” (0.25-0.38mm) using the adjusting nut on the brake yoke.
See Figure 6.111.

35g. Re-hook the brake spring to the brake arm

35h. Re-install the shift rod pillow block.

35i. Give the transaxle a final spin-test before installation.

Transmission Specifcations

Specification	U.S.	Metric
Pinion end play	0.010”-0.015”	0.25-0.38mm
Pinion run-out	0.002”-0.010”	0.05-0.25mm
Pinion backlash	0.006”-0.014”	0.15-0.36mm
Differential rivet.-to-gear clearance	0.030” minimum	0.762mm
Axle end-play	0.010”-0.08”	0.25-2.0
Amount of Durina grease, 2 10 oz. tubes (P/N: 737-0148)	20 fl.oz	0.59 liters
Brake clearance	0.010”-0.015”	0.25-0.38mm

Drive System Torque Specs.

Fastener	Torque in-lb.	Torque N-m
Seat bolt	60-80	17-20
Lug nut	350-500	41-57
Wheel bolt	160-190	18-22
Crankshaft bolt	450-600	51-68
Tq. bracket bolt	175-250	20-28
Axle T-bolt nuts	150-180	17-20
Tensioner bracket	150-180	17-20
Pedal shaft straps	150-180	17-20
Belt keeper nut /bolt	150-180	17-20
Idler pulley bolt	150-180	17-20
Brake yoke bolts	90-135	10-15
Input pulley nut	300-400	34-45
Housing screws	90-135	10-15
Detent screw	160-200	18-23
V.S. pulley bolt	150-180	17-20
V.S. bearing cover	90-135	10-15
Make-up pulley pivot bolt	175-250	20-28

CHAPTER 7: ELECTRICAL SYSTEM

Introduction

This chapter is divided into four sections:

- **Section 1:** About this chapter and precautions
- **Section 2:** Components
  - This section will describe the location and operation of the electrical components on the mower. Where appropriate, some disassembly or component removal instructions will be included.
- **Section 3:** Diagnostic Techniques
  - This section will cover basic tools, techniques, and methodology for diagnosing electrical issues on the mower. A lot of the information in this section can be applied to other equipment.
- **Section 4:** Schematics

⚠CAUTION

Before disconnecting any electrical component, take precautions to prevent the component or the wires attached to it from shorting out. The most effective means of doing this is to disconnect the battery ground cable from the negative battery terminal. Unless performing tests that require the electrical system to be in operation, disconnect the negative cable from the battery before doing any work to the electrical system of the mower.

Components

RMC Module

The **RMC module contains electronic logic circuits**. When diagnosing anything that is connected to the RMC module, a high impedance test light or a high impedance digital multimeter (DMM) must be used. The amperage draw of a standard incandescent test light may over-burden some internal electronic circuits, burning out the module.

NOTE: These tools are not outrageously expensive or exotic. High impedance test lights (Thexton model 125 is typical) can be purchased locally, for under $30.00. Appropriate multimeters can be purchased for under $100.00, and are an invaluable tool for any competent technician.

- It is typical when industries shift from electromechanical to electronic controls that diagnosis shifts from tracing through a number of independent circuits to checking the inputs to and outputs from a central processor. This is similar to, but much less complex than the transition that the auto industry made with the conversion to fuel injection in the 1980's.

NOTE: The starter safety circuit has no connection to the RMC module.

- It is still important to be familiar with the workings of the individual components of the electrical system, but some of them can now be checked from a central point on the mower. This makes life easier on the technician, frequently making it unnecessary to connect to difficult to reach switches in the preliminary stages of diagnosis.
- The function of individual safety switches can be seen as providing information "inputs" to the RMC module.
- The next part of this section gives a detailed description of the electrical components on this mower, their function in the system, and their physical location on the mower. Armed with this information and the proper tools, a technician should be able to efficiently diagnose most electrical problems.

Key switch

The Key Switch is similar to those used in a variety of MTD applications since 1999. The difference, in this case, is that it is incorporated in the same housing as the RMC module. The two items are not available separately. See Figure 7.1.

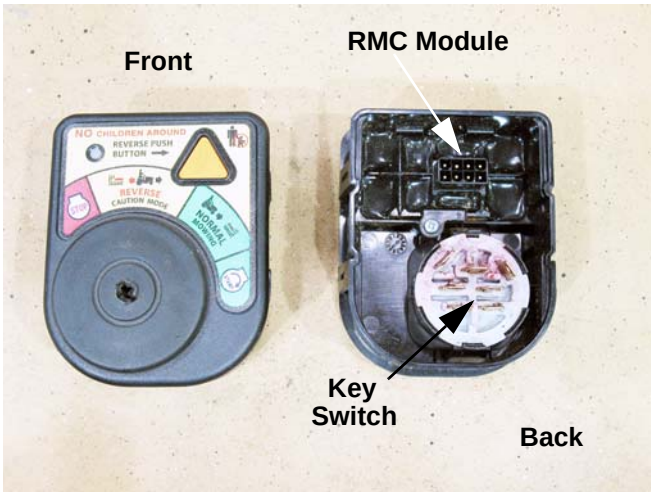


Figure 7.1

1. In the “OFF” position, continuity can be found between the M, G, and A1 terminals. See Figure 7.2.

   - M is connected to the magneto by a yellow wire, G is connected to ground by a green wire, and A1 is connected to the afterfire solenoid.

   NOTE: In the “OFF” position, the magneto primary windings are grounded, disabling the ignition system. The afterfire solenoid loses its power from the B terminal. This turns off the fuel supply.

   NOTE: The A1 terminal is shorted to ground when the key is moved to the “OFF” position. This is a legacy feature from older tractors that had the afterfire solenoid powered directly from the alternator. This feature is not needed on current production tractors.

   - **Symptom:** loud “BANG” when key is turned to the OFF position: The afterfire solenoid is not closing, either because it is physically damaged or the power is not being turned off. Check for power at the solenoid. Check continuity between G and A1 terminals. Check for no continuity between A1 and the B terminals.

   NOTE: If the engine is at an idle when the key is turned off, fuel is drawn into the engine through the idle ports of the carburetor bypassing the fuel shut off solenoid. The raw fuel will travel through the engine and ignite in the muffler causing an afterfire.

   - **Symptom:** Engine runs 3-5 seconds after key is turned to OFF position: The afterfire solenoid is turning off the fuel supply, but the ignition is continuing to operate. Check continuity between the M and G terminals in the OFF position. Check continuity from yellow wire connection all the way to the spade terminal on the magneto.

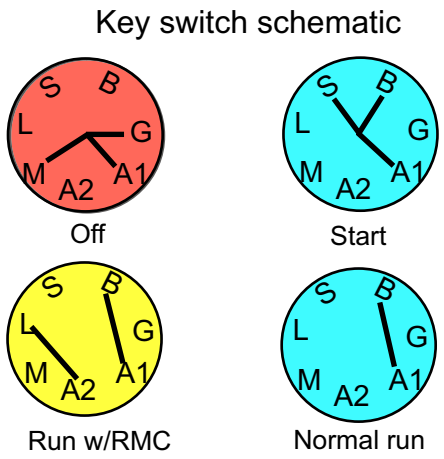


Figure 7.2

2. In the **START** position, continuity can be found between B, S, and A1 terminals.

   - Battery power from the B terminal is directed to the start circuit through the S terminal and to the afterfire solenoid through A1.
   - **Symptom:** No crank and no starter solenoid click: Power is not getting to the trigger spade on the starter solenoid. Test for a fully charged battery, then check for power where the fused red wire with white trace connects to the B terminal. Check for continuity between B and S terminals in START position. If power is getting to the S terminal in the START position, the problem lies down-stream in the starter circuit. Check continuity from the orange wire on the S terminal to the orange wire with white trace on the trigger spade on the starter solenoid. If it is broken, trace through the brake and PTO switches.
   - **Symptom:** No crank, solenoid click: The problem lies in the heavy-gauge side of the starter circuit: low battery voltage, battery cables, starter cable, solenoid, or ground issue.

- **Symptom:** Crank, spark, but no fuel: First check the fuel tank to verify that there is fuel in it. If there is fuel in the fuel tank, test for power at the afterfire solenoid. If there is no power there, then check for continuity from B to A1 in the START position. If power is reaching the red wire that connects to the A1 terminal in the start position, the problem lies down stream of the key switch. A handy quick-check is to apply power to the red wires where they connect to the S terminal (whole circuit) or directly to the afterfire solenoid to listen for the audible “click” that it makes when functioning.
- **Symptom:** Crank, but no spark: This is a highly unlikely scenario. If it occurs after a key switch has been changed independently of the RMC module, this would arouse suspicion that the wrong key switch was installed. Otherwise, the problem lies elsewhere in the safety circuits or engine. Do not over look the possibility of a bad magneto or chafed ground lead within the engine harness.

3. In the **NORMAL RUN** position (green zone), the B and A1 terminals should have continuity. Once the engine is running, the alternator produces current that tracks back to charge the battery, via the red wire connected to the B terminal.

   - **Symptom:** Battery does not charge: Follow the engine manufacturer’s recommendations for testing alternator output. If alternator output is getting to and through the key switch, but not reaching the battery, the fuse may have blown after start-up. A blown fuse will disable the starter circuit. A simple quick-test for the presence of alternator output at the battery is to check across the battery posts for DC voltage.
   - **Symptom:** afterfire solenoid does not work: engine starts and dies: The afterfire solenoid is powered directly by the red wire with a white trace from the A1 terminal of the key switch, and should operate independently of anything else on the mower once the engine is running. If the alternator fails *and* battery power is not reaching the afterfire solenoid through the key switch, it will not work. This is an unusual set of circumstances.

4. In the **REVERSE CAUTION MODE** (yellow zone), the same characteristics are true as for the normal run position, but *in addition* the L terminal will have continuity with the A2 terminal. The A2 terminal is connected to the RMC module by a purple wire (electric PTO) or a white wire (manual PTO). The L terminal (formerly used for the lighting circuit) connects directly to the ground circuit of green wires. When the key is in the REVERSE CAUTION MODE position, the purple or white wire carries a ground signal to the RMC module. When the seat is occupied, this ground signal arms (enables), *but does not turn on* the RMC module.

   - **Symptom:** RMC module will not turn on: Check for continuity between A2 and L terminals on the key switch when it is in the REVERSE CAUTION MODE position. Confirm that the green wire has continuity to ground. If the switch is capable of establishing a ground signal to the RMC module, the problem is likely to lie elsewhere in the system.
   - **Symptom:** RMC module will not turn on: confirm that the ground path (continuity to ground) to the purple or white wire is broken when the key switch is in any position other than REVERSE CAUTION MODE.
     - The RMC module is disarmed (disabled) when the seat is empty. To re-arm the module, the key is moved to another position, breaking the ground signal, then returned to the REVERSE CAUTION MODE, re-establishing the ground signal. It works something like a latched relay. If it is not possible to break the ground-path, it is not possible to freshly establish it either, and the RMC module will not be armable.
     - Causes for such a condition might include a shorted or incorrect key switch, or a chafed purple or white wire shorting to ground between the key switch and the RMC module.

RMC Module

The RMC Module is in the same housing as the key switch and is not available separately. For the purpose of diagnosis, it is treated separately. Diagnosis of the module with the key switch introduces too many overlapping variables. See Figure 7.3.

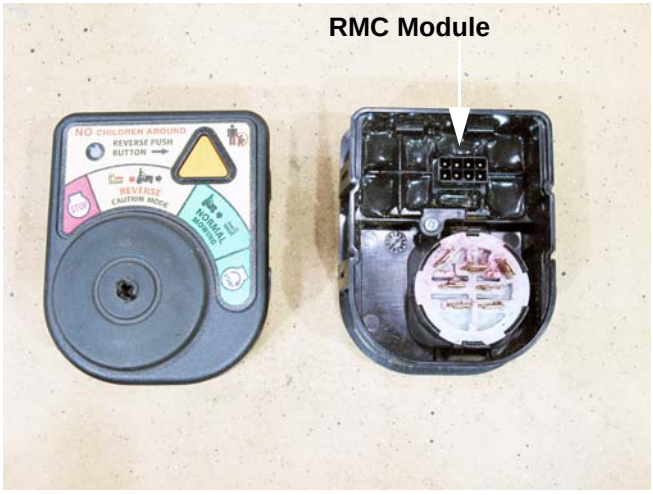


Figure 7.3

- **Principle:** To diagnose the module, the simplest approach is to check all of the inputs (safety circuits) that are connected to it. If the inputs work properly, but the RMC module does not work properly (outputs), then the module can be determined to be faulty. A specific procedure is covered, following the description of the correct operation of the RMC module.
- **Working properly:** The module cannot be diagnosed if its function is not understood. It is designed to work as follows: See Figure 7.4.
- When the **RMC module is disarmed**, the mower will operate as MTD mowers have historically operated:
  - If reverse is engaged when the PTO is ON, the PTO clutch will turn off (electric PTO) or the engine will turn OFF (manual PTO).
  - If the operator leaves the seat with the PTO on, the PTO will turn off (electric PTO) or the engine will turn OFF (manual PTO).
  - If the operator leaves the seat with the PTO in the OFF position, the engine will turn off unless the parking brake is applied.
  - When the RMC module is armed, the mower will operate identically to when the module is disarmed.

Figure 7.4

- When the **RMC module is armed and turned on:** The mower will operate identically to when the module is disarmed, except that the operator will be able to put the transmission in reverse with the PTO engaged and the cutting deck will continue to run. The operator may put the mower into and out of reverse as many times as they wish without having to re-arm or turn on the module again.
- **To arm the RMC module:** The operator must turn the key switch to the REVERSE CAUTION MODE (yellow zone), while sitting in the operator's seat.
- **To turn the RMC module ON:** The module must first be armed, then the orange triangular button is depressed, illuminating the red LED indicator to indicate that it is ON. It is important that the operator must take two actions to turn the RMC module ON so that they do not do so inadvertently.
- **The RMC module will turn OFF and disarm if:** The operator moves the key to any position other than REVERSE CAUTION MODE or gets out of the seat. If the operator leaves the seat without setting the parking brake, the engine will turn off. The key movement necessary to re-start the engine will make it necessary to re-arm and turn on the RMC module if the operator wishes to continue with the ability to put the mower in reverse while the PTO is running.
- **To re-arm and turn the module ON:** If the key is in REVERSE CAUTION MODE position, it must be turned to another position (Normal Run), then returned to REVERSE CAUTION MODE. Once rearmed, the module can be turned on by pressing the orange triangular button. It will be confirmed that the module is ON by the illumination of the red LED on the module.

RMC module plug test (electric PTO)

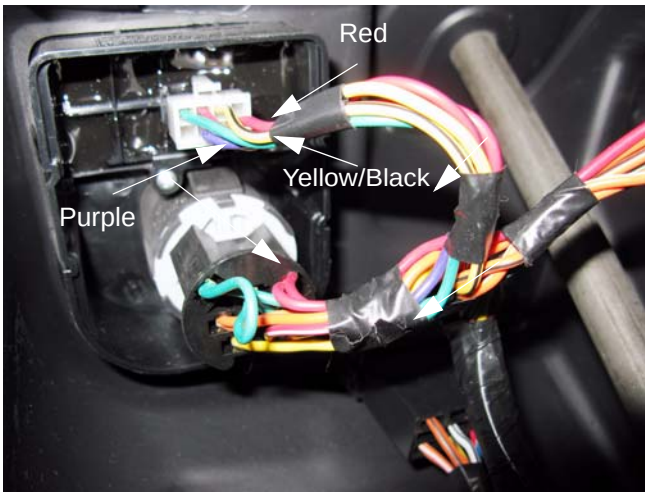


Figure 7.5

1. Disconnect the molded 8-pin plug from the RMC module. See Figure 7.5.
2. Looking at the plug head-on, it will be configured as shown in the diagram: There will be 8 female pin terminals. When probed they should yield the results described in the following sections. See Figure 7.6.
3. Top left middle square-shape: Yellow wire with Black trace:
   - **Behavior**: Should show DC power with the key on.
   - **Circuitry**: The yellow wire with black trace leads to the PTO switch and the PTO relay. It allows the RMC module to apply a ground to the coil of the PTO relay, which energizes the relay, severing the ground to the PTO clutch. When the PTO relay energizes it also applies a ground to the PTO switch. This ground loops back to the PTO relay's coil, latching it in the energized position.
   - **Interpretation**: If behavior is correct, the N.C. side of the PTO switch circuit is functioning properly

   If there is continuity to ground, then there is a short to ground either between the PTO relay and the RMC module or in the PTO switch circuit.

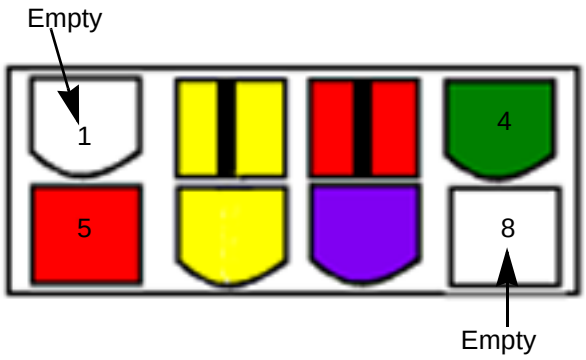


Figure 7.6

4. Bottom left middle rounded-shape: Yellow wire
   - **Behavior**: When the terminal is probed (yellow wire), there should be continuity to ground *only* when the seat is empty.
   - **Circuitry**: The yellow wire leads to the seat safety switch, where it finds a path to ground when the seat is empty.
   - **Interpretation**: If behavior is correct, the seat safety circuit is good. If there is continuity to ground when the seat is occupied, the switch may be inoperative, or there may be a short to ground in the wire leading to it. If there is not continuity to ground when the seat is empty, the switch may be inoperative or there may be an open condition in the wire leading to it.
5. Top right middle square-shape: There is a red wire with black trace between yellow wire with a black trace and the green wire. This wire provides the module with input from the **reverse switch.**
   - **Behavior**: When the tractor is in reverse, this terminal should have continuity to ground.
   - **Circuitry**: This wire runs directly to the reverse safety switch.
   - **Interpretation**: Continuity to ground when the tractor is not in reverse would indicate a short to ground. This could take the form of a chafed wire contacting ground or a shorted reverse safety switch.

   Lack of continuity to ground would indicate:
   - A broken or disconnected wire leading to the reverse safety switch
   - A switch that is not closing because of physical damage or corrosion.

- Loss of ground to the reverse switch.

6. Top right rounded-shape: is a green wire.
   - **Behavior**: The green wire should always have continuity to **ground**.
   - **Circuitry**: The green wire leads to ground.
   - **Interpretation**: If this ground path is not good, there will probably be other ground-related issues with the tractor: slow starter motor, slow battery charge, dim lights. All ground connections should be mechanically secure and corrosion free.
7. Bottom left square-shape: The red wire on the OCR plug carries **battery voltage**.
   - **Behavior**: With key switch in any of the run positions, D.C. battery voltage should show-up on a volt meter when the red probe is touched to this terminal and the black probe is grounded.
   - **Circuitry**: This wire draws power from the A1 terminal on the key switch.
   - **Interpretation**: If there is not battery voltage at this terminal, the tractor is probably not function at all. Look for a blown fuse or a bad key switch.
8. Bottom right middle rounded-shape: The purple wire provides a **ground signal** to the RMC module when the key switch is placed in the **REVERSE CAUTION MODE.**
   - **Behavior**: There should be continuity to ground at this terminal when the key switch is in the REVERSE CAUTION MODE position.
   - **Circuitry**: When the key switch is in the REVERSE CAUTION MODE position, a ground path is established by connecting terminal A2 to terminal L within the key switch. The purple wire from the RMC module connects to A2, and a green ground wire connects to L.
   - **Interpretation**: If the purple wire fails to reach a ground path when the key switch is in the REVERSE CAUTION MODE position, the RMC module will not arm or operate. Check the key switch for continuity between A2 and L in the REVERSE CAUTION MODE position, confirm that the green wire connecting to the L terminal does have good continuity to ground, and check for any loss of continuity in the purple wire that extends from the key switch to the RMC module, including the molded connector between the two components.
9. If the RMC plug test indicates fault with any of the safety switches, the next step is to test the suspect switch. The operation of those switches is described in the following sections.

RMC module plug test (manual PTO)

1. Disconnect the molded 8-pin plug from the RMC module. See Figure 7.7.

2. Looking at the plug head-on, it will be configured as shown in the diagram: There will be 8 female pin terminals. When probed they should yield the results described in the following sections. See Figure 7.8.

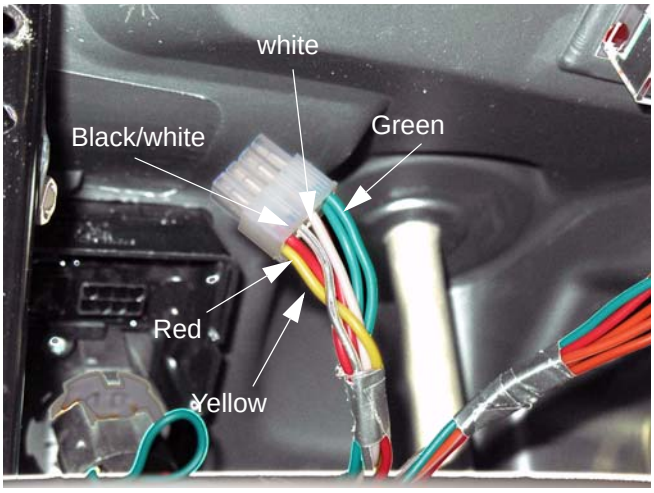


Figure 7.7

3. Top left rounded-shape: Yellow wire

   - **Behavior**: When the terminal is probed (yellow wire), there should be continuity to ground when the seat is empty.
   - **Circuitry**: The yellow wire leads to the seat safety switch, where it finds a path to ground when the seat is empty.

   NOTE: The yellow wire also branches off to the PTO switch. If the PTO is "on" and the key switch is turned to the "off" position, the yellow wire will get a ground through the key switch.

   - **Interpretation**: If behavior is correct, the seat safety circuit is good. If there is continuity to ground when the seat is occupied, the switch may be inoperative, the PTO is on while the key switch is off or there may be a short to ground in the wire leading to it. If there is not continuity to ground when the seat is empty, the switch may be inoperative or there may be an open condition in the wire leading to it.

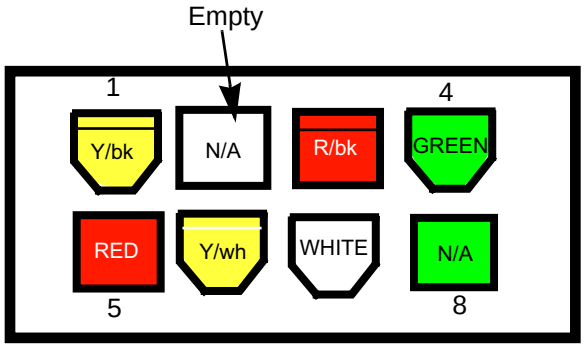


Figure 7.8

4. Top right middle square-shape: There is a red wire with black trace between yellow wire and the green wire. This wire provides the module with input from the **reverse switch.**

   - **Behavior**: When the tractor is in reverse, this terminal should have continuity to ground.
   - **Circuitry**: This wire runs directly to the reverse safety switch.
   - **Interpretation**: Continuity to ground when the tractor is not in reverse would indicate a short to ground. This could take the form of a chafed wire contacting ground or a shorted reverse safety switch.

   Lack of continuity to ground would indicate:

   - A broken or disconnected wire leading to the reverse safety switch
   - A switch that is not closing because of physical damage or corrosion.
   - Loss of ground to the reverse switch.

5. Top right rounded-shape and the bottom right square shape: are green wires.

   - **Behavior**: The green wires should always have continuity to **ground**.
   - **Circuitry**: The green wires leads to ground.

- **Interpretation**: If this ground path is not good, there will probably be other ground-related issues with the tractor: slow starter motor, slow battery charge, dim lights. All ground connections should be mechanically secure and corrosion free.

6. Bottom left square-shape: The red wire on the OCR plug carries **battery voltage**.
   - **Behavior**: With key switch in any of the run positions, D.C. battery voltage should show-up on a volt meter when the red probe is touched to this terminal and the black probe is grounded.
   - **Circuitry**: This wire draws power from the A1 terminal on the key switch.
   - **Interpretation**: If there is not battery voltage at this terminal, the tractor is probably not functional at all. Look for a blown fuse or a bad key switch.
7. Bottom left middle square-shape: There is a black wire with a white trace between the red wire and the white wire. This wire provides the module with input from the **park brake switch.**
   - **Behavior**: When the brake pedal is depressed and the park brake is set, a ground path is established through the black wire with a white trace.
   - **Circuitry**: This wire runs to the brake switch, then on to the park brake switch.
   - **Interpretation**: Continuity to ground when the park brake is not set would indicate a short to ground. This could take the form of a chafed wire contacting ground or a shorted reverse safety switch.

   Lack of continuity to ground would indicate:
   - A broken or disconnected wire leading to the brake or park brake switches
   - A switch that is not closing because of physical damage or corrosion.
   - Loss of ground to the park brake switch.
8. Bottom right middle rounded-shape: The white wire provides a **ground signal** to the RMC module when the key switch is placed in the **REVERSE CAUTION MODE.**
   - **Behavior**: There should be continuity to ground at this terminal when the key switch is in the REVERSE CAUTION MODE position.
   - **Circuitry**: When the key switch is in the REVERSE CAUTION MODE position, a ground path is established by connecting terminal A2 to terminal L within the key switch. The white wire from the RMC module connects to A2, and a green ground wire connects to L.
   - **Interpretation**: If the white wire fails to reach a ground path when the key switch is in the REVERSE CAUTION MODE position, the RMC module will not arm or operate. Check the key switch for continuity between A2 and L in the REVERSE CAUTION MODE position, confirm that the green wire connecting to the L terminal does have good continuity to ground, and check for any loss of continuity in the white wire that extends from the key switch to the RMC module, including the molded connector between the two components.

If the RMC plug test indicates fault with any of the safety switches, the next step is to test the suspect switch. The operation of those switches is described in the following sections.

Electric PTO switch

Understanding the electric PTO switch

- In A-Com, power is supplied to the PTO switch from the A1 terminal of the ignition switch through a red wire. When the PTO switch is turned on this completes the circuit to allow power to go to the PTO clutch. It is a normally opened (N.O.) set of contacts. See Figure 7.9.
- B-COM is in the safety shut-down circuit. It is a normally opened (N.O.) set of contacts. A circuit is completed from the (N.O.) terminal on the PTO relay through the white wire with black trace to the E-PTO terminal on the RMC module and the PTO relay coil through the yellow wire with black trace when the contacts are closed. This gives the RMC module the ability to turn-off the PTO clutch.
- C-COM is in the starter inhibit circuit. It is a normally closed (N.C.) set of contacts. When the PTO is OFF, and the contacts are closed, power coming from the brake switch (key switch in START, brakes ON) through the orange wire with black trace is passed on to the trigger terminal on the starter solenoid through the orange wire with white trace.

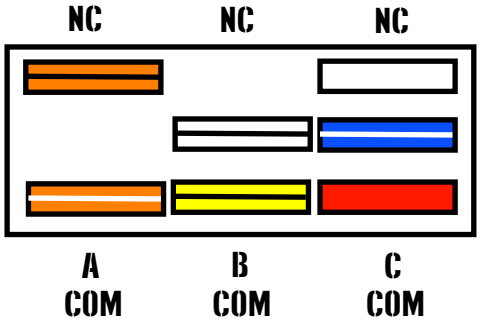


Figure 7.9

NOTE: The top terminals are showing normally closed at rest and the middle terminals are normally open at rest

NOTE: There are three contacts on the right side in the C-COM. For this application the normally opened (N.O.) contact is used.

PTO relay

The PTO relay is located on the main harness, underneath the electric PTO switch. See Figure 7.10.

The PTO relay disengages the PTO clutch when it is energized and latches on until the PTO switch is turned-off. The list below details the function of the PTO relay.

3	Green wire	COM (Common) terminal
Ground for PTO clutch (not energized) or relay latch (energized). Hard-wired to ground		
5	White/black trace	Normally Open (N.O.) terminal
Connects to COM terminal when the relay is energized. Power from PTO switch B-N.O. when PTO is ON.		
2	Red wire	Power for windings
Hot when the key switch is in any position other than OFF.		
4	White wire	Normally Closed (N.C.) terminal
Connects PTO clutch to its ground path (through 30) when the relay is not energized.		
1	Yellow/black trace	Ground path for windings
Receives a ground when the seat is empty and the PTO is turned ON. It also receives a ground signal from the reverse switch when the tractor is put into reverse with the PTO engaged, unless the RMC module is turned ON.		

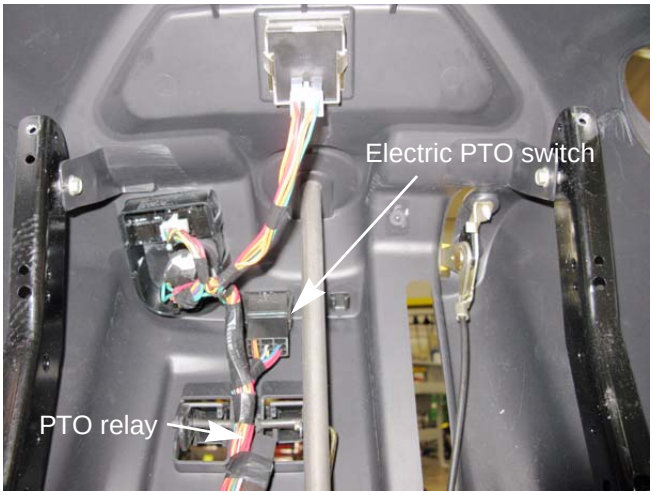


Figure 7.10

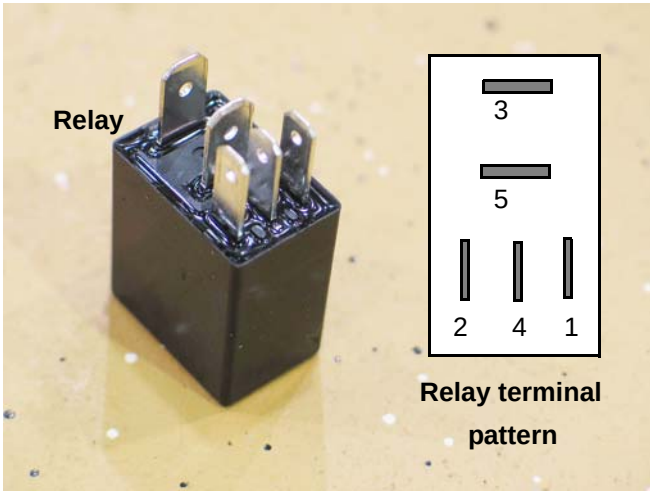


Figure 7.10

PTO switch (manual PTO)

- The manual PTO switch is mounted on the right side of the seat box section of the frame. See Figure 7.11.
- The PTO switch plunger is depressed when the PTO lever is moved to the “off” position.
- The switch has two pair of contacts: one (N.O.) and one (N.C.).
- The Orange wire with black trace connects to one of the (N.O.) terminals of the PTO switch. When the PTO is turned “off” the (N.O.) contacts close, completing a circuit from the brake switch to the starter solenoid through the orange wire with white trace.
- There are three yellow wires connected to the (N.C.) terminals.

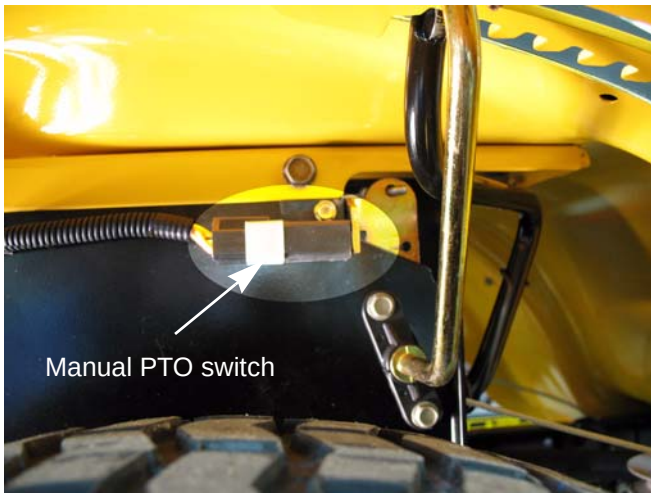


Figure 7.11

1. The yellow wire from the seat switch and the yellow wire from the RMC module are connected to the same terminal.
2. The other yellow wire goes to the ignition module.
3. If the seat is empty or an unsafe condition is sensed by the RMC module, a ground signal is sent to the PTO switch. If the PTO is “on” the ground signal will pass through the switch and go to the ignition module turning the engine off.

Brake switch (manual PTO)

- The brake switch is mounted on the top side of the frame, on the left side behind the dash.
- The brake switch used on manual PTO tractors is a triple pole single throw switch. It has one set of contacts that are normally closed (N.C.) and the other two sets are normally open (N.O.). See Figure 7.12.
- The plunger on the switch is depressed when the clutch / brake pedal is depressed, de-clutching the drive belt and applying the brakes. The switch contains two sets of contacts.
- The normally closed (NC) set of contacts is in the safety shut-down circuit. If the seat is vacant, the seat switch contacts will close connecting the yellow wire with white trace to ground. When the brake pedal is up, the contacts close connecting the ground signal in the yellow wire with white trace to the module through the yellow wire.
- A normally open (N.O.) set of contacts is in the starter inhibit circuit. When the clutch / brake pedal is depressed, the contacts are closed. Power comes from the key switch (key switch in START) through the orange wire is passed on to the PTO switch through the orange wire with black trace.
- The other set of (N.O.) contacts receives the signal from the parking brake switch through the purple wire. When the brake pedal is down, the contacts close, sending that signal to the RMC module through the black wire with white trace.

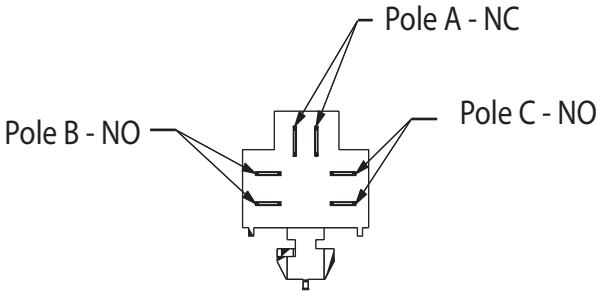


Figure 7.12

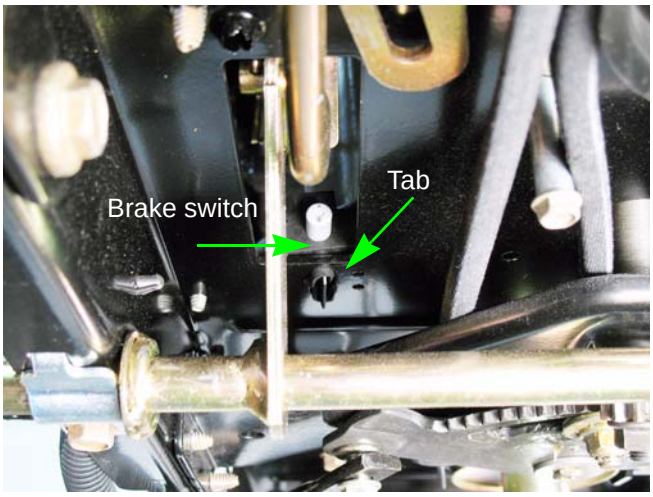


Figure 7.12

To access the brake switch:

1. Remove the deck by following the steps described in Chapter 8: Cutting Decks and Lift Shaft.
2. Squeeze the tab on the underside of the brake switch with a pair of pliers, while pushing up on the brake switch. See Figure 7.12.
3. Reach in between the left side of the engine and the dash. Pull the switch and harness pigtail out as one piece. See Figure 7.12.
4. Install the brake switch by following the previous steps in reverse order.

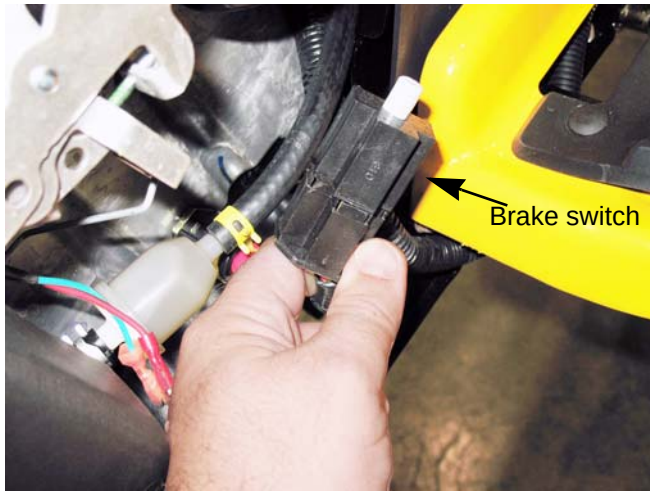


Figure 7.12

Brake switch (electric PTO)

The brake switch is mounted on the top side of the frame, on the left side behind the dash. See Figure 7.13.

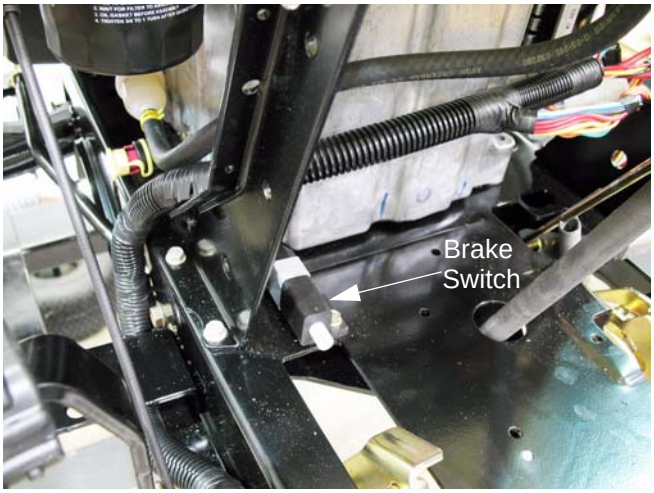


Figure 7.13

- The plunger on the switch is depressed when the clutch / brake pedal is depressed, de-clutching the drive belt and applying the brakes. The switch contains two sets of contacts.
- The brake switch is accessed by removing the fender and dash. The fender and dash can be removed by following the steps described in Chapter 4: Body/Chassis.
- A normally open (N.O.) set of contacts is in the starter inhibit circuit. When the clutch / brake pedal is depressed, the contacts are closed. Power comes from the key switch (key switch in START) through the orange wire is passed on to the PTO switch through the orange wire with black trace.
- A normally closed (NC) set of contacts is in the safety shut-down circuit. A circuit is completed from the ignition module's primary windings to ground. If the seat is empty, a ground signal passes through the seat switch and goes to the brake switch through the yellow wire with black trace. If the brake pedal is up, that ground signal will pass through the brake switch to the ignition through the yellow wire.

Park brake switch

The park brake switch is only used on tractors that are equipped with a manual PTO. The park brake switch is a simple (N.O.) Single Pole Single Throw (SPST) switch.

The park brake switch is located on the frame, behind the dash on the right hand side. See Figure 7.14.

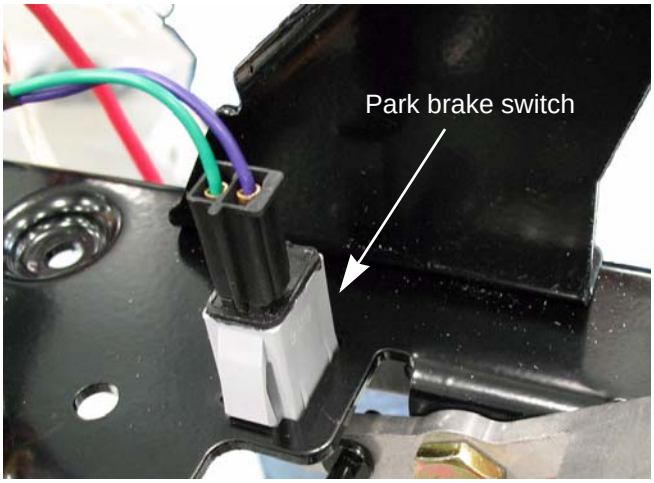


Figure 7.14

- The green wire is attached to ground.
- The purple wire is connected to the brake switch.
- If the brake pedal is depressed and the parking brake is set, a ground signal will pass from the park brake switch, through the brake switch to the RMC module.

Reverse Safety Switch

The Reverse Safety Switch is a simple metal contact tang switch.

CVT transmissions

Tractors that have the CVT transmissions have the reverse switch mounted on the left side of the frame, by the rear wheel. When the tractor is placed in reverse, the shift linkage will contact the switch providing a ground, See Figure 7.15. This switch has a red wire with black trace that goes directly to the RMC module. See Figure 7.15.

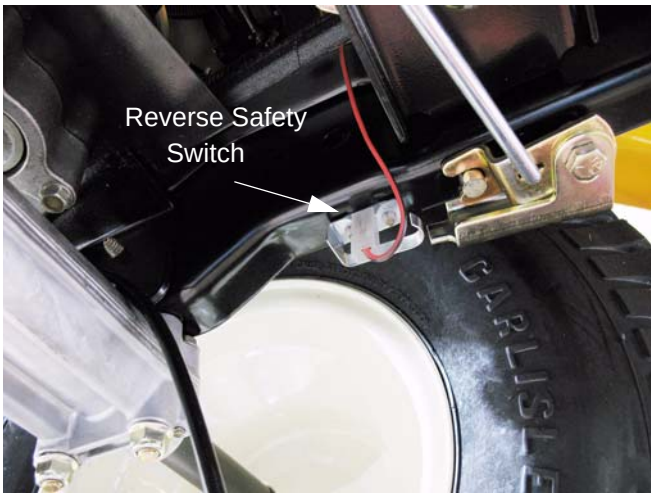


Figure 7.15

Hyrdostatic transmissions

Tractors equipped with a hydrostatic transmission have the reverse switch mounted on the transmission, next to the selector plate. See Figure 7.16.

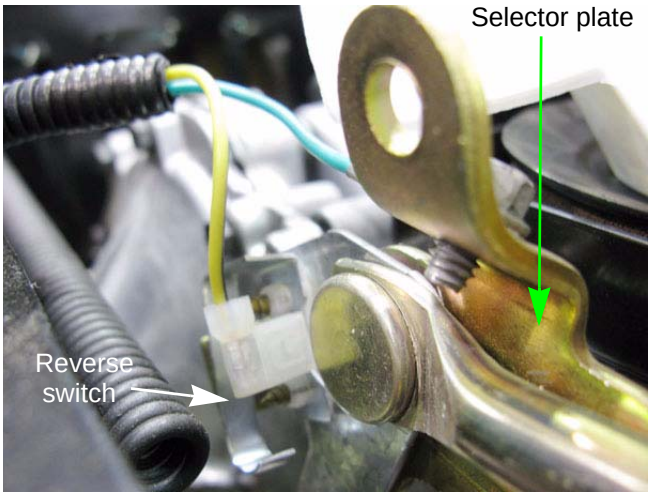


Figure 7.16

This switch has a yellow wire with black trace connected to it. The yellow wire with black trace plugs into the main harness by the starter solenoid and becomes the red wire with black trace that goes directly to the RMC module. See Figure 7.17.

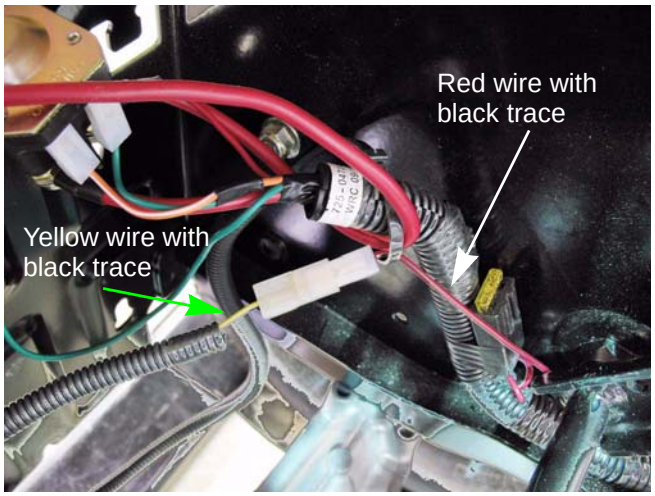


Figure 7.17

Seat Safety Switch

The Seat Safety Switch is mounted inside the seat. It contains two sets of (N.O.) contacts See Figure 7.18.

Figure 7.18

- The yellow wire goes to the RMC module. When the seat is vacant, the contacts close, providing a ground path to the RMC module. If the seat is empty, the circuit is completed, de-activating the RMC module.
- The yellow wire with white trace goes to the brake switch. When the seat is vacant, the contacts close, providing a ground path in series with the brake switch. If the brake is not applied, and the seat is empty, the circuit is completed, shorting out the primary windings of the magneto and stopping the engine.
- The two green wires are ground wires.
- The most common problems are likely to be caused by bad grounds in the green wires.

NOTE: The seat switch connector is a shorted (N.C.) connector. That means when the connector is unplugged, a tiny jumper inside the connector shorts out all of the contacts. When the connector is shorted, the circuit acts as if the seat is empty.

Starter solenoid

The starter solenoid is mounted inside the seat box section of the frame. See Figure 7.19.

Figure 7.19

The starter solenoid can be accessed by removing the battery box and reaching through the opening.
See Figure 6.20.

When the proper safety conditions are met (brake applied/ PTO OFF), the orange wire with white trace energizes the windings that magnetize an iron core, pulling the contacts closed between the two heavy posts, connecting battery power to the starter motor.

The green wire provides a ground for the coil inside the starter relay.

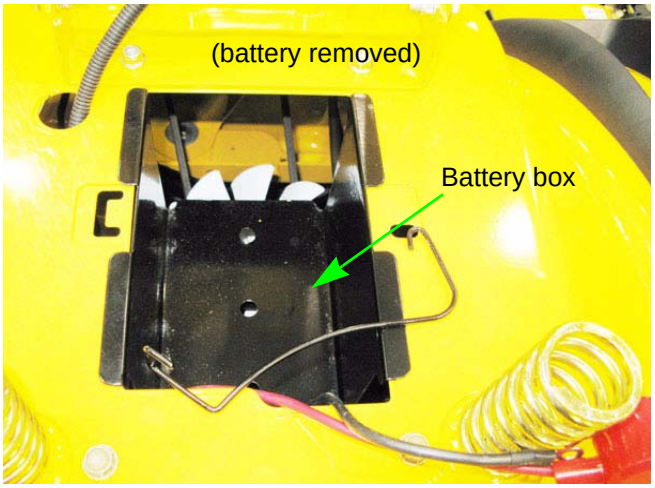


Figure 6.20

Start Circuit

Turning the key to the START position:

- spins the starter motor
- enables the ignition
- energizes the afterfire solenoid

Looking at the circuit that sends power to the starter motor: See Figure 7.21.

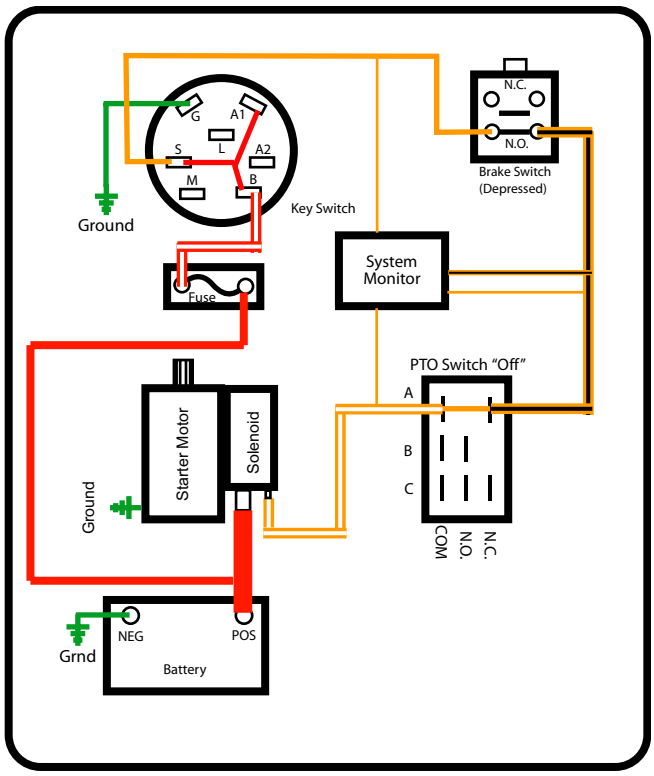


Figure 7.21

1. When the key switch is in the START position, battery power is passed from the B terminal to the S terminal.
2. Power goes from the key switch S terminal to the brake switch (N.O.) contacts. (orange wire)
   - 2a. If the brake is off, the switch plunger will be up and the (N.O.) contacts will be open. The system monitor will measure open circuit voltage, illuminating the brake symbol.
   - 2b. If the brake is depressed, the switch plunger will be depressed, and the (N.O.) contacts will be closed. Power will be passed along to the PTO switch.
3. When the key is in START, and the brake is depressed, power will continue to the A-N.C. terminal (electric PTO) or to one of the (N.C.) terminals (manual PTO) of the PTO switch (orange/black trace).
   - 3a. If the PTO switch is on, the (N.C.) terminal on the A set of contacts will not connect to anything. The system monitor will measure open circuit voltage, illuminating the PTO symbol.
   - 3b. If the PTO switch is off, the (N.C.) terminal on the A set of contacts will be connected to the COM terminal on the A set of contacts. Power will be passed along to the trigger terminal on the starter solenoid.
4. When the following conditions are met:
   - Key to START
   - Brake pedal is depressed
   - PTO off

   The starter solenoid trigger terminal will receive power (orange wire).
5. When the starter solenoid trigger terminal receives power two things happen:
   - A. A set of contacts close inside the solenoid allowing the power to pass through to the starter motor.
   - B. The solenoid pushes the bendix gear out so that it may engage the ring gear of the flywheel.

Once the starter motor spins, we still need spark and fuel to make the engine run.

1. The ignition sparks are generated by an **ignition module**. The ignition module will work as long as the primary windings are not grounded. With the key switch in any position other than off, there is no connection between the M (Module) terminal and the G (Ground) terminal. See Figure 7.22.

   NOTE: In ignition systems that have breakers to cause the magnetic field to collapse, the coil is called a magneto. In systems that use solid state electronics to collapse the field, the coil is called an ignition module. However, the term “magneto” is used by some to refer to both coils.

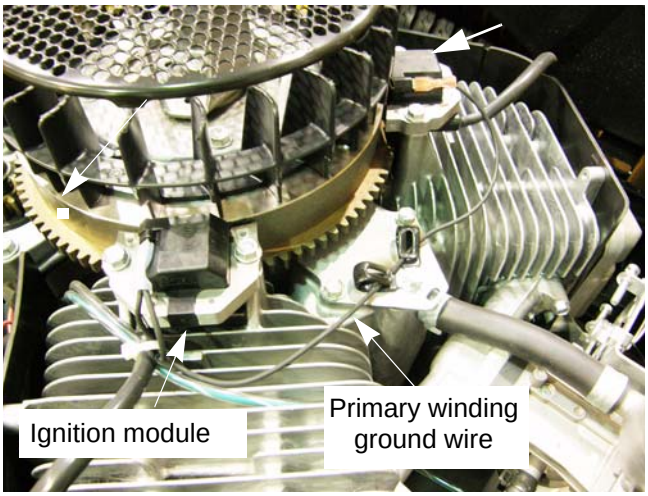


Figure 7.22

2. There is an **afterfire solenoid** on the carburetor. When it is energized, fuel flows normally through the carburetor. When it is not energized, it closes off the fuel flow through the main jet of the carburetor. The purpose of the solenoid is to prevent unburned fuel from being pumped through the engine after the ignition is turned off. This unburned fuel accumulates in the muffler and may ignite with an alarming noise. See Figure 7.23.

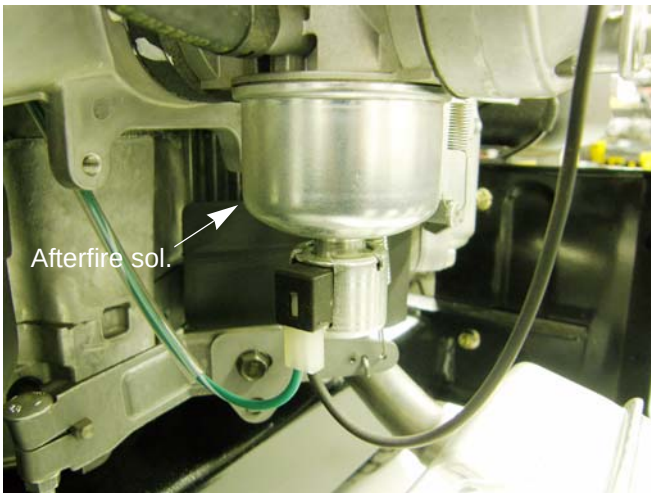


Figure 7.23

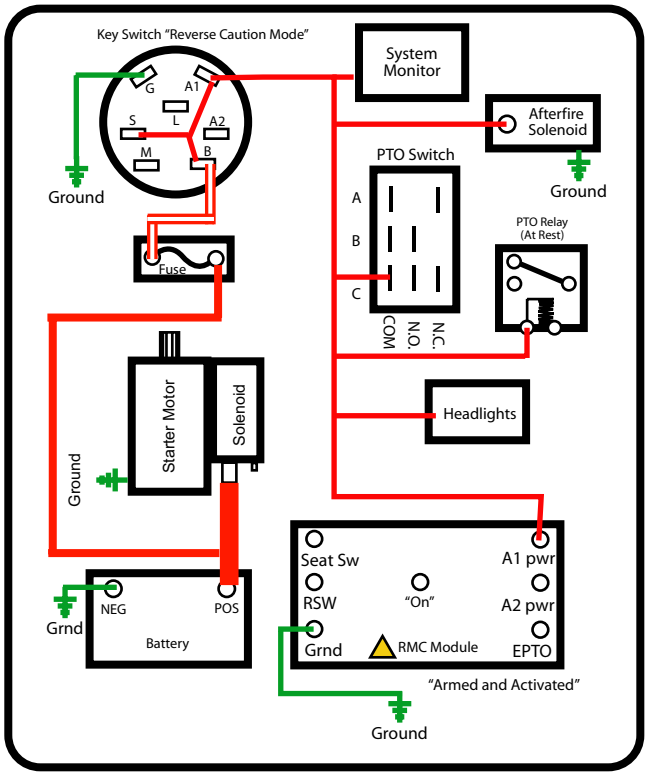


Figure 7.24

3. The A1 terminal on the key switch sends power to:
   - the afterfire solenoid
   - the windings of the PTO relay (electric PTO)
   - the PTO switch C-COM terminal (electric PTO)
   - the RMC module "A1 pwr" terminal
   - the headlights
   - the system monitor

See Figure 7.24.

Run Circuit

With the key switch in the RUN position, the A1 terminal sends power to:

- the afterfire solenoid
- the windings of the PTO relay (electric PTO)
- the PTO switch C-COM terminal (electric PTO)
- the RMC module “A1 pwr” terminal
- the headlights
- the system monitor

See Figure 7.25.

This is identical to what happens with the key in the START position, except that the circuit that actually spins the starter motor is not energized.

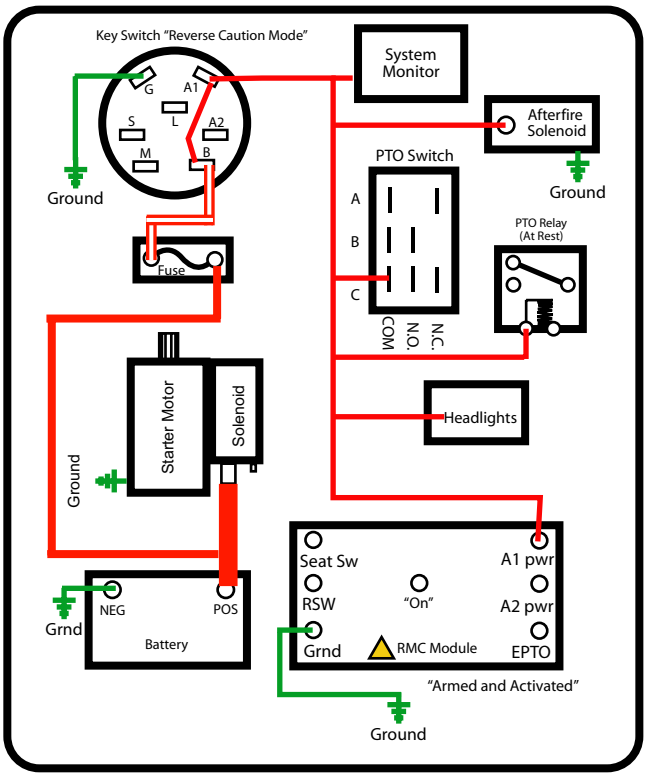


Figure 7.25

Run Circuit / Reverse Caution mode

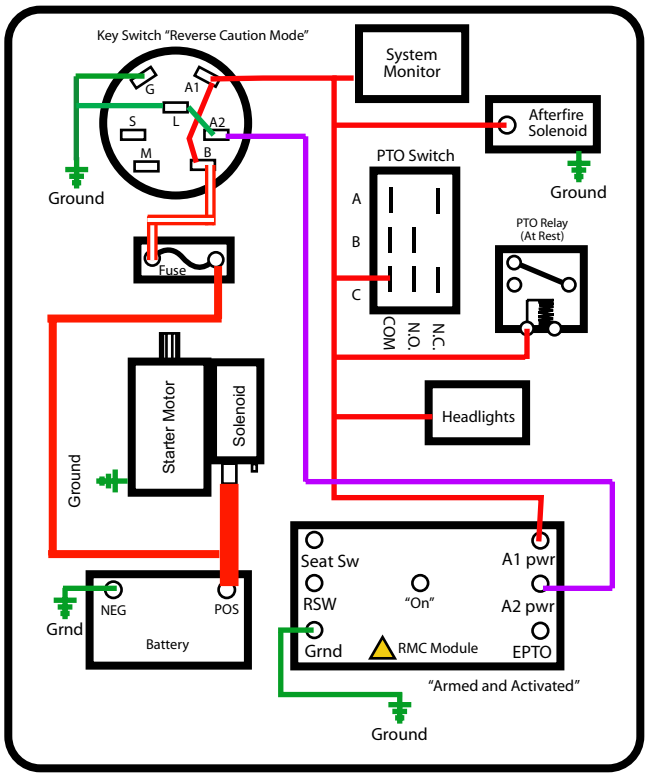


Figure 7.26

1. With the key in Reverse Caution mode, A1 gets power from the B terminal, just like the normal run position.
2. In addition, A2 is internally connected to the L terminal. L is normally used for the lighting circuit.
   - 2a. In this case, a separate lighting circuit draws power from A1
   - 2b. L is connected to the ground wire on the G terminal by a jumper.
3. The RMC module arms when it gets a ground signal from A2 through the "A2 pwr" terminal on the RMC module. See Figure 7.26.

Engine shutdown circuits

Engine shutdown circuits stop the engine by disabling the ignition and removes power from the afterfire solenoid.

Key switch shut-down: See Figure 7.27.

The key switch turned to OFF connects the M (Magneto) terminal and A1 to G (Ground).

- Grounding the magneto primary windings prevents the magneto from developing the magnetic field that it collapses to generate a spark. This disables the ignition.
- The A1 terminal is de-energized.

NOTE: On older electrical systems, prior to 2008, the afterfire solenoid was powered by the alternator. In order to turn off the afterfire solenoid, the A1 terminal was shorted to ground inside the key switch. This drains the current from the alternator, de-energizing the solenoid. That function was left in place so that the same key switch can be used, but it is not needed. The 900 series tractors powers the solenoid through the A1 terminal of the key switch and not the alternator.

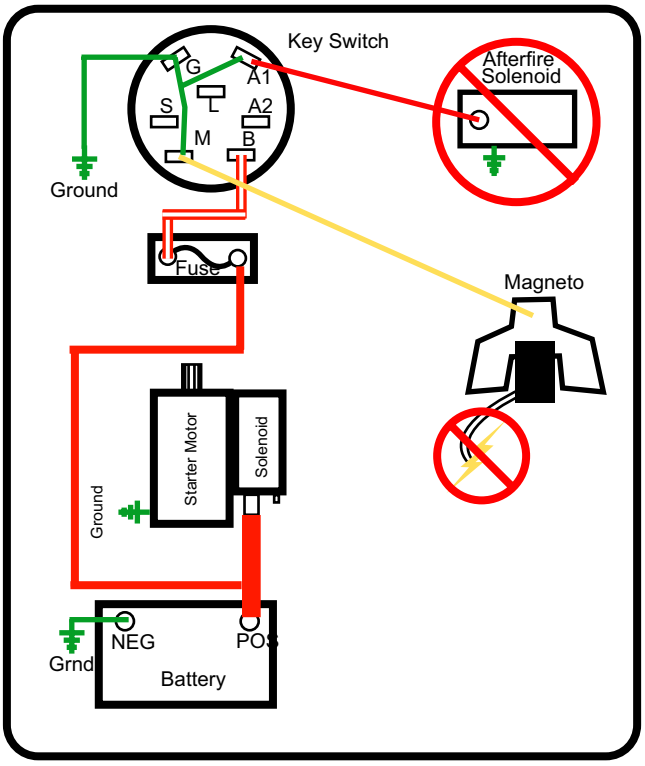


Figure 7.27

Seat switch and brake switch: See Figure 7.28.

The seat switch and brake switch work in series to ground the magneto primary windings if the brake is released while the seat is vacant.

1. The yellow magneto wire is connected to the (N.C.) terminal of the **brake switch**.
   - 1a. When the park brake is applied, the plunger of the park brake switch is depressed, opening the (N.C.) contacts within the switch.
   - 1b. When the park brake is released, the plunger on the switch is extended, closing the (N.C.) contacts within the switch. This completes part of the ground path.
   - 1c. The seat switch is the next part of the ground path. The yellow/white trace wire connects the park brake switch to the seat switch.
2. The **seat switch** is connected to the (N.C.) terminal of the brake switch (yellow/white trace wire).
   - 2a. When the seat is occupied, the (N.C.) contacts within the seat switch are open.
   - 2b. When the seat is vacant, the (N.C.) contacts within the seat switch are closed. This completes the final leg of the ground path when the park brake is not set, disabling the ignition.

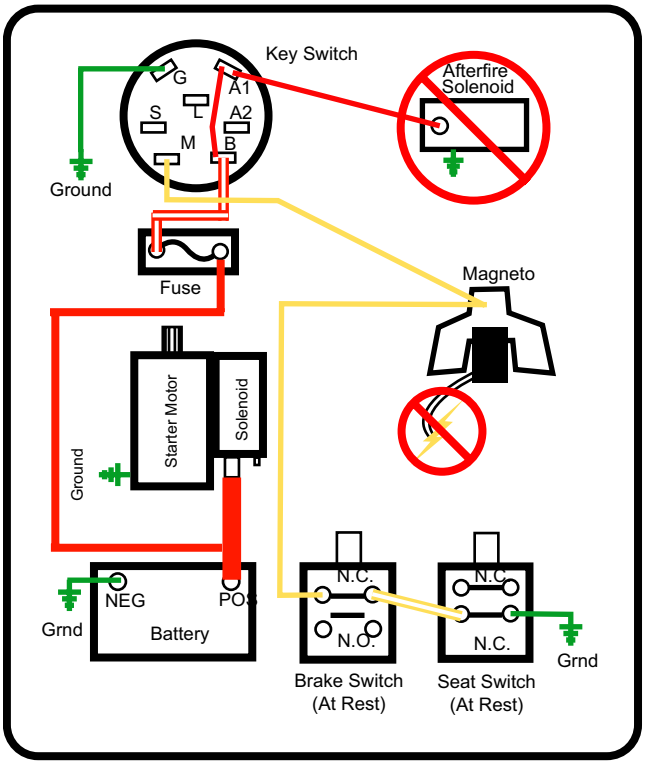


Figure 7.28

Charging circuit

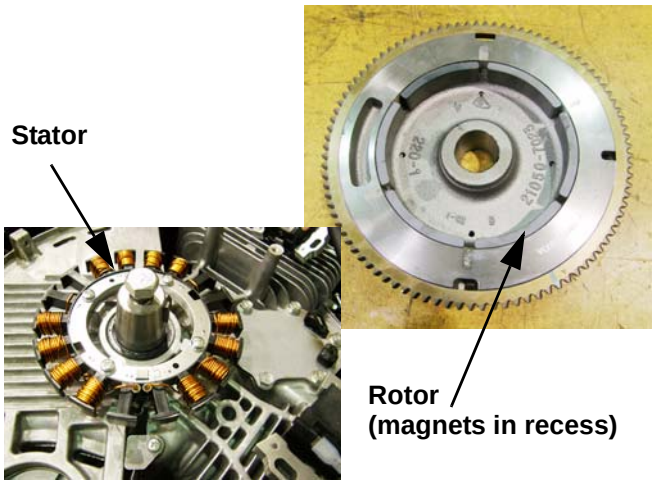


Figure 7.29

How it works

1. When the engine is running, magnets attached to the underside of the flywheel induce A.C. (Alternating Current) in the stator that is mounted beneath the flywheel. See Figure 7.29.
2. The A.C. travels from the stator to and from the regulator/rectifier through the two white wires.

NOTE: The magnets inside the flywheel act as a rotor for the charging system.

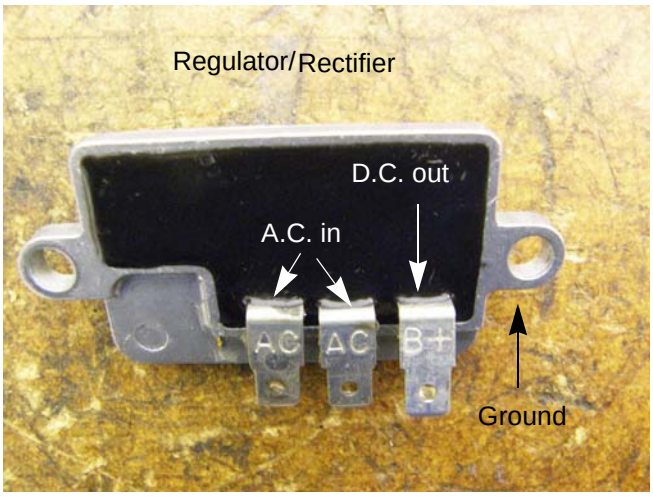


Figure 7.30

3. The regulator/rectifier takes alternating current and converts (rectifies) it to D.C. (Direct Current). The regulator rectifier also regulates the voltage to a nominal 12 volts. See Figure 7.30.
   - Actual output is closer to 14 volts, but should be no more than 15 volts.
   - To work properly, the regulator/rectifier must have a good ground connection to the engine block and ultimately, back to the battery negative post.
4. Regulated D.C. power leaves the regulator/rectifier.
   - 4a. A purple wire comes out of the regulator/rectifier.
   - 4b. The purple wire changes to a red/white trace wire at the harness connector.

5. From the harness connector: See Figure 7.31.

   5a. The red/white trace wire leads to the 20A fuse.

   5b. From the fuse, the wire connects to the starter solenoid, sharing the “hot” post with the battery cable.

   5c. The shared post on the starter solenoid provides the final connection for the alternator output to reach the battery.

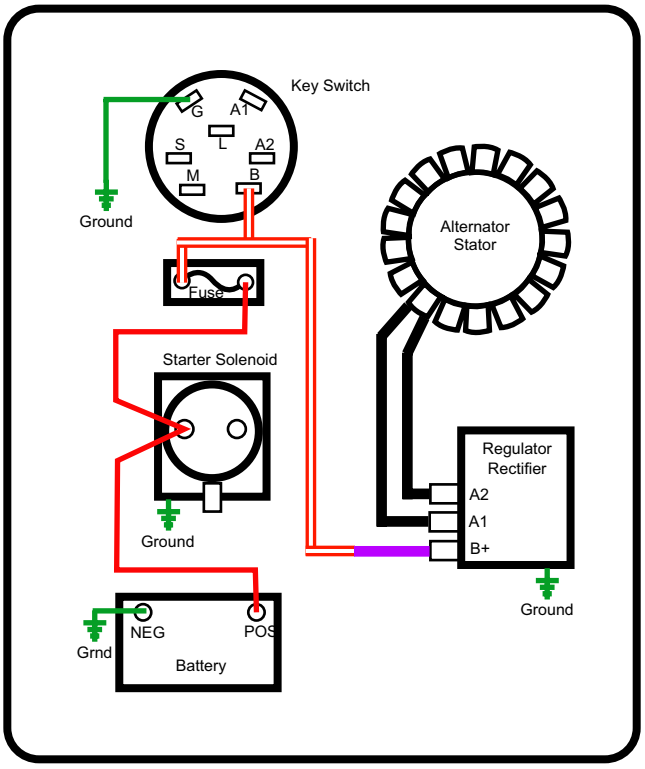


Figure 7.31

Testing Sequence:

1. Charge and check the battery or confirm that a known-good battery is installed in the mower.
2. Make a visual inspection of the mower. Look for:
   - Loose connections - power and ground
   - Corroded connections - power and ground
   - Ground wires all present
   - Blown fuse
   - Obvious damage to the wiring harness (burns, chafed wires, kinks).

3. Quick check, to see if there is a problem. See Figure 7.32.

⚠CAUTION This step involves running the engine. Before starting the engine, make sure that no unsafe conditions will arise from doing so. Potential hazards include: motion hazards from contact with spinning parts or moving equipment, heat-source hazards, and asphyxiation hazard.

   3a. Check base-line battery voltage.

   3b. Start the engine and advance the throttle to 3,000 RPM.

   3c. Check operating voltage.

   3d. If operating voltage does not rise with engine RPM, proceed with the system check.

4. System check, to identify the problem

The system check consists of:

- Stator Check
- Regulator Rectifier Check
- Down stream Check

Stopped -12.54v	Running 14.18v

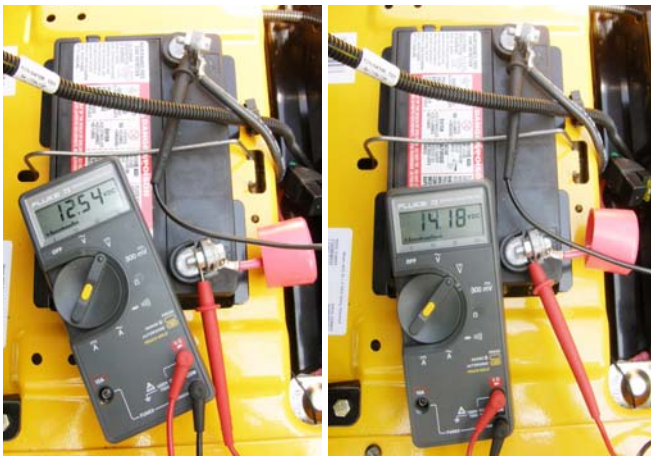


Figure 7.32

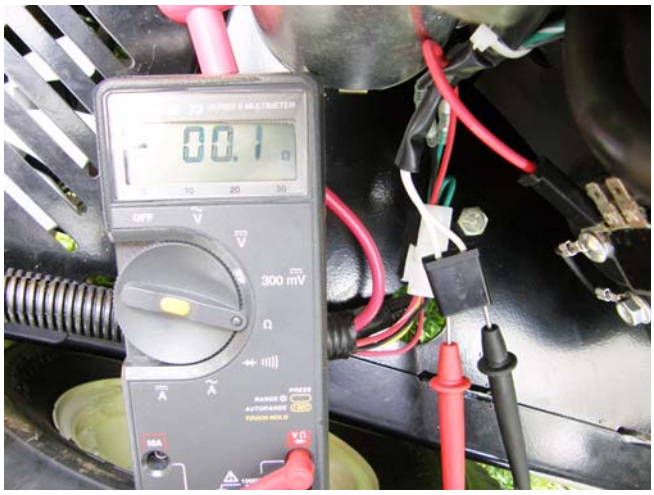


Figure 7.33

Figure 7.34

5. Stator check: See Figure 7.33.

5a. With the key switch OFF, unplug the stator from the regulate/rectifier.

5b. Check resistance through the stator using a digital multimeter set to read Ohms.

- It should be between 0.1Ω and 0.14Ω.
- A high reading indicates a fault in the windings.
- A low reading indicates a short in the windings.
- There should be a reading of O.L. (Open Line) between either lead and the engine block.
- It is good practice to check the stator cold, and again when the engine is at operating temperature.

5c. Check the raw output of the stator. See Figure 7.34.

- Connect a meter set to read Volts A.C. to the output leads of the stator.
- Start the engine and advance the throttle to 3,000 RPM.
- The stator should produce at least 26 Volts A.C. In some cases, output will be as high as 34 Volts A.C.

5d. Interpretation:

- If the stator fails either or both tests, it is likely to be bad.
- If the stator fails the output test, but passes the resistance test, there is a possibility that the magnets on the rotor (flywheel) have lost their fields. This is theoretically possible, but extremely rare in practice.
- It is necessary to remove the flywheel to test the magnets. If the magnets inside the flywheel will draw a steel screwdriver to them, they are good. If not, the flywheel must be replaced.

6. Regulator/rectifier check: See Figure 7.35.

6a. Check the ground.

- With the engine running and the stator leads re-connected to the regulator/rectifier, perform a ground-side voltage-drop test from the regulator/rectifier to the engine block.
- If the voltage reading is greater than 0.1 Volts D.C., replace or properly fasten the ground wire that connects the regulator/rectifier to the engine block. Retest to confirm good connection.

Figure 7.35

6b. Bench Test: See Figure 7.36.

- Set a digital multimeter to read on the X100Ω scale.
- With the key switch OFF and the fuse removed, unplug all the wires from the regulator/rectifier.
- Remove the regulator/rectifier from the engine (not strictly necessary, but provides easy access).
- Make the resistance tests described in the accompanying table.
- B+ is the D.C. terminal
- A.C.1 is the A.C. terminal nearest B+
- A.C.2 is the A.C. terminal furthest from B+

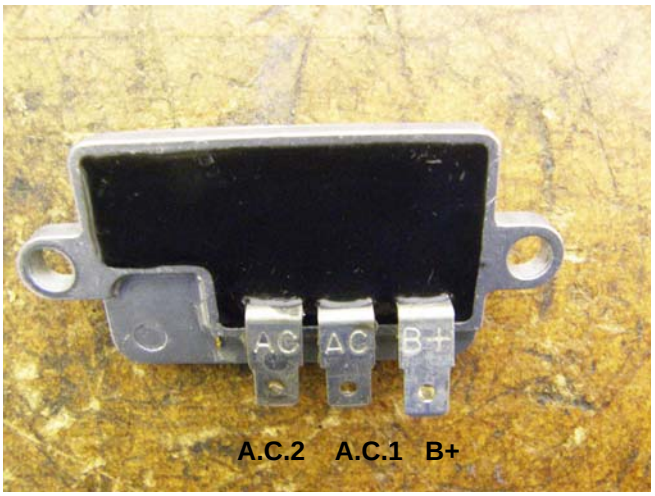


Figure 7.36

7. If the regulator/rectifier fails any one of these tests, replace it with a new one.

Test #	Pos. Probe	COM. Probe	Results
1	Housing	B+	O.L. (infinite resistance)
2	Housing	A.C. 1	O.L. (infinite resistance)
3	Housing	A.C.2	> 1.0 Ω (5 second delay)
4	B+	A.C.1	0 Ω (Perfect continuity)
5	B+	A.C.2	> 1.0 Ω
6	B+	Housing	> 1.0 Ω
7	A.C.1	B+	0 Ω (Perfect continuity)
8	A.C.1	A.C.2	> 1.0 Ω
9	A.C.1	Housing	> 1.0 Ω
10	A.C.2	B+	O.L. (infinite resistance)
11	A.C.2	A.C.1	O.L. (infinite resistance)
12	A.C.2	Housing	> 1.0 Ω

Figure 7.37

8. Check the D.C. amperage output of the regulator/rectifier using an Ammeter of sufficient capacity or a D.C. Shunt tool and a volt meter set to read on the millivolt scale, as described in the TOOLS section of this chapter.

9. If the regulator/rectifier passes all of these tests, but the battery is not charging, check the circuit between the regulator/rectifier D.C. output (B+) terminal and the battery positive post for a voltage drop. See Figure 7.37.

   - The harness connector, the 30A fuse, and the hot post on the starter solenoid all lie between the regulator/rectifier and the battery.

PTO Circuit (electric PTO)

Basic Operation: See Figure 7.38.

1. With the key switch in any position other than OFF, the A1 terminal supplies power to the windings of the PTO relay and to the C-COM terminal of the PTO switch.
2. The PTO clutch gets power from the A1 terminal of the key switch through the C-(N.O.) terminal of the PTO switch when it is turned ON.
3. The PTO clutch gets ground through the PTO relay COM terminal via the PTO relay (N.C.) terminal when the relay is not energized.

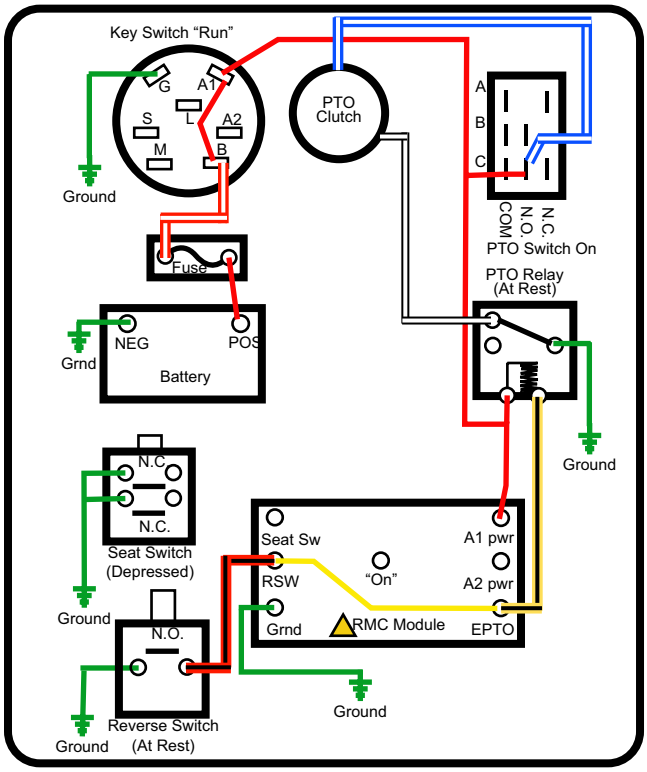


Figure 7.38

Safety Circuits:

There are some conditions when it is best to automatically turn off the mower deck to ensure safety.

- When the mower is put in Reverse, we want to turn off the blades unless the RevTec (RMC) module has been armed and engaged.
- When the operator leaves the seat for any reason, we want to turn off the blades.

NOTE: When the operator leaves the seat without setting the park brake, the engine turns off stopping the blades as well.

1. The PTO clutch loses its ground when the PTO relay is energized. See Figure 7.38.

1a. The Yellow/black trace wire connected to the windings of the PTO relay leads to the "E-PTO" terminal on the RMC module.

1b. The reverse switch has (N.O.) contacts.

- A red/black trace wire leads to the "Rev.Sw" terminal on the RMC module.

1c. When the mower is put in reverse, the switch is grounded against the hydro control rod.

1d. This provides a ground path that passes through the RMC module from the Rev.Sw terminal to the E-PTO terminal when the RMC module is not armed and activated.

NOTE: When the RMC module is armed and activated, Rev.Sw terminal is disconnected from the E-PTO terminal inside the module.

1e. The ground path reaches the PTO relay windings, and the PTO relay is energized when the mower is put in reverse.

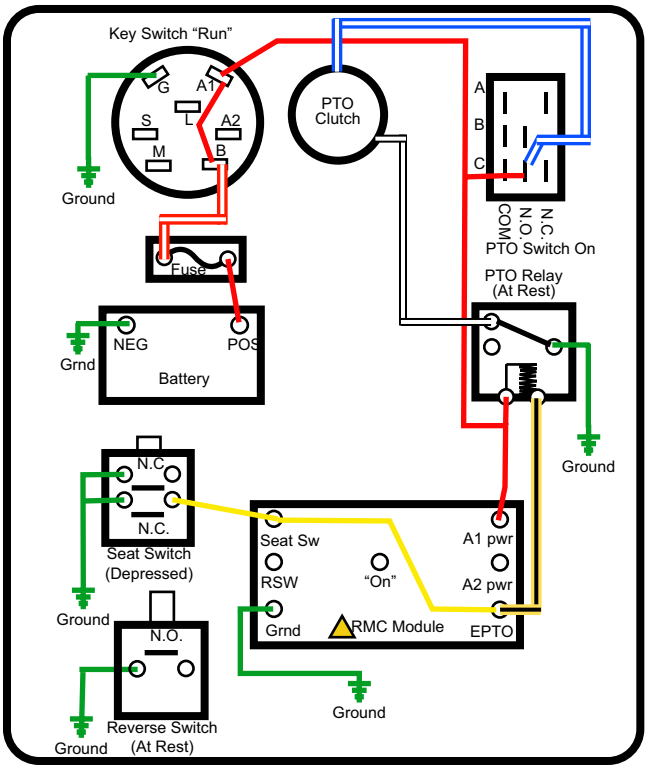


Figure 7.39

2. The seat switch contains two sets of contacts. The set with the yellow wire leads to ground when the contacts of the seat switch are closed. See Figure 7.39.

   2a. When the operator leaves the seat, the seat switch connects the yellow wire to a ground path.

   2b. That ground path passes through the RMC module to ground the PTO relay windings when the mower is put in reverse.

NOTE: The seat switch connector is a shorted (N.C.) connector. That means when the connector is unplugged, a tiny jumper inside the connector shorts out the contacts. When the connector is shorted, the circuit acts as if the seat is empty.

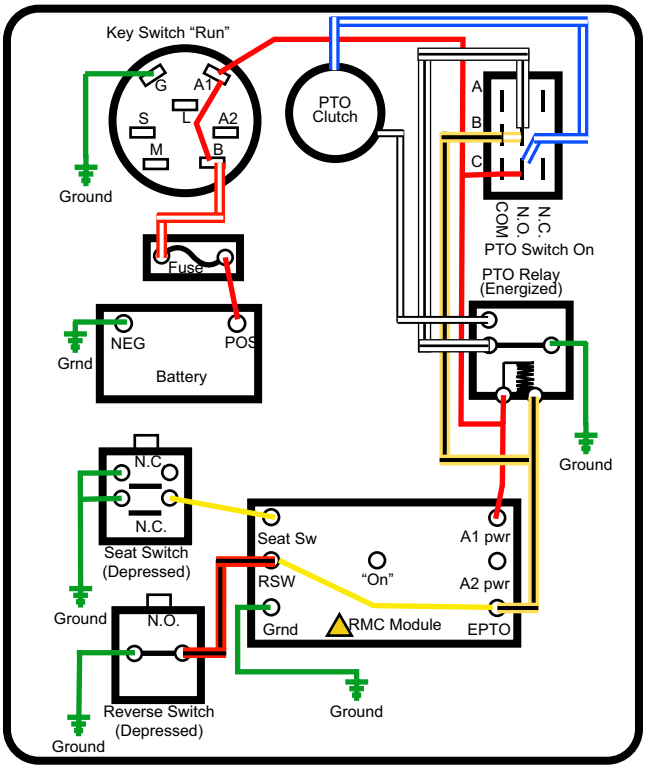


Figure 7.40

3. Once the PTO relay is energized by a ground path through one of the safety switches, it latches. See Figure 7.40.

   3a. The PTO clutch ground path that passes through the PTO relay is disconnected from the clutch.

   3b. The ground path formerly used by the clutch is shifted to provide a second ground path for the relay windings.

   3c. Once the relay windings have established the second ground path, the relay is latched on, even if the ground path that initially energized the relay is broken.

   3d. The second ground path loops through the B contacts inside the PTO switch. As long as the PTO switch is in the ON position, the second ground path will continue.

   3e. For this reason, when the PTO is shut off by the seat switch or the reverse switch, it is necessary to get back in the seat or take the mower out of reverse and turn the PTO switch off and back on again to re-engage the PTO.

Reverse Mower Control (RMC) circuit operation

Historically, Cub Cadet residential mowers have not been able to mow in reverse. This has not been required by any laws or safety regulations, it was just safer for our customers and those around them. Then in 2005, ANSI regulations for residential mowers were changed, requiring that the mowing blades turn off when the mower is put in reverse. The new standard did allow for a user controlled over ride system. This system must require two actions in order for it to turn on. We introduced the Reverse Mower Control (RMC) system to meet these new standards.

We want to make sure that the operator of a mower with Reverse Mower Control is always cognizant of the risks that they take upon themselves by mowing in reverse. To accomplish this, we make the operator take two distinct actions: See Figure 7.41.

1. The operator must arm the RMC module by turning the key switch to the Reverse Caution Mode position.
2. Once armed, the RMC module must be engaged by pressing the orange triangular button on the front of the module. When it is armed and engaged, a red LED on the face of the module lights-up.

Figure 7.41

(electric PTO)

If the **operator gets out of the seat**, the mower has no way of knowing if the same person had gotten back into the seat. For that reason, the module is disarmed and deactivated whenever the seat is vacated. The person who gets back in the seat must then rearm the module by turning the key out of and back into the Reverse Caution Mode position.

The easiest way to understand the RMC circuit is to think of the RMC module as a switch that obeys commands.

In normal operation, the reverse safety switch and one set of contacts in the seat switch simply pass through the module to connect with the yellow/black trace wire that triggers the PTO relay by providing a ground for the windings. See Figure 7.42.

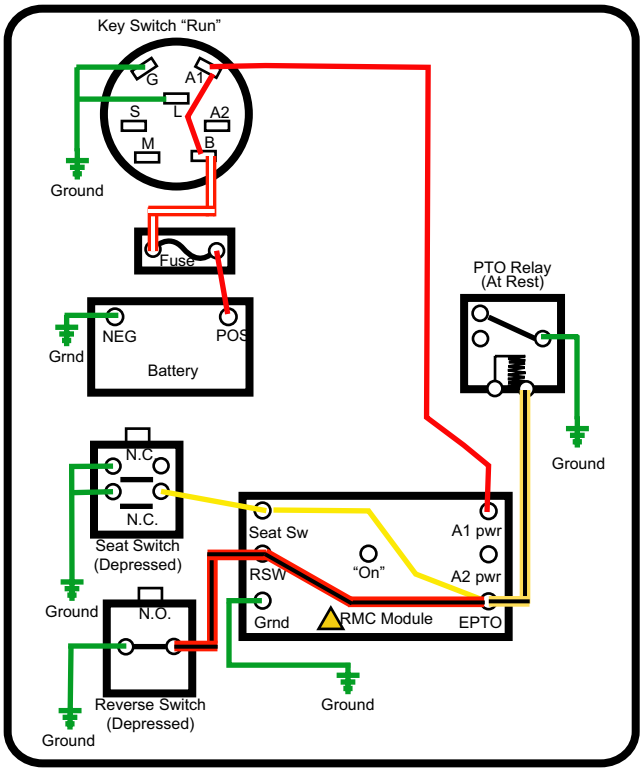


Figure 7.42

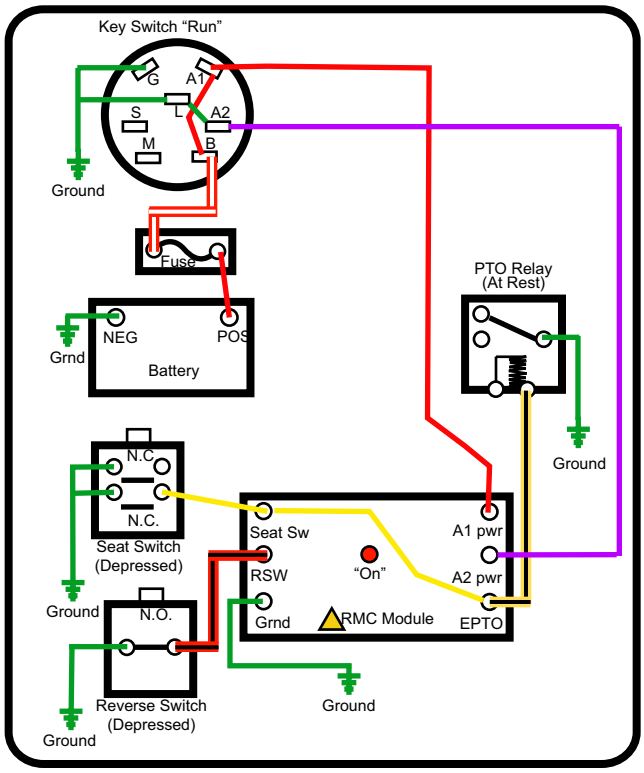


Figure 7.43

When the RMC module is armed and activated, it effectively disconnects the reverse switch from the circuit. See Figure 7.43.

The RMC module is disarmed and deactivated when the seat is vacated. It gets a ground signal through the second set of contacts in the seat switch.

(Manual PTO)

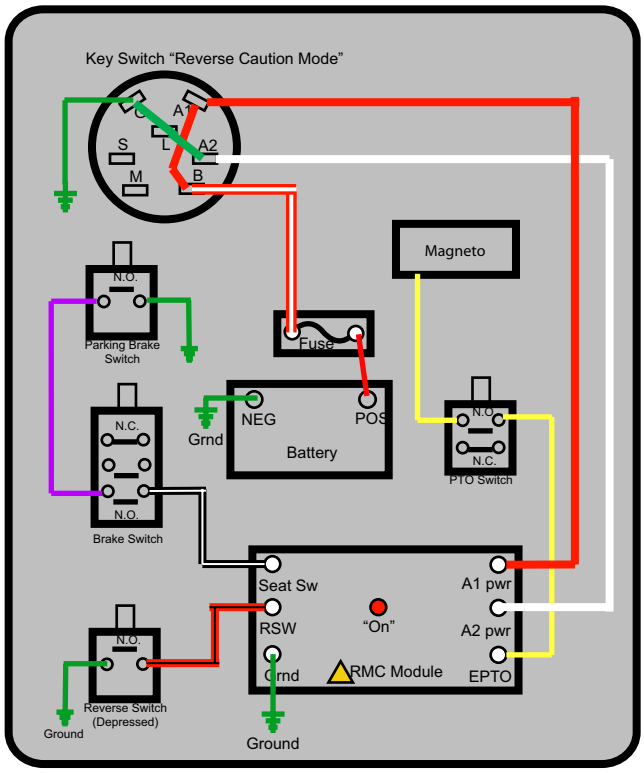


Figure 7.44

On tractor with a manual PTO, the circuits change a little. First, the trigger wire from the A2 terminal of the key switch is white. The second change is the addition of a parking brake switch. See Figure 7.44.

On tractors with a manual PTO, both sides of the seat switch are used for safety circuits and are unable to turn off the RMC module. To get around this, a parking brake switch is installed. The only way to get off of a tractor without turning off the engine is to set the parking brake, which will send a signal the RMC module to turn it off.

When the parking brake lever is activated, a ground signal passes through the parking brake switch. Since the parking brake and cruise control are controlled by the same lever, the ground signal from the parking brake switch is sent to a set of (N.O.) contacts in the brake switch through a purple wire. If the brake is set (pedal is depressed), the (N.O.) contacts in the brake switch will close, sending the ground signal to the RMC module, turning it off.

Electrical diagnosis

NOTE: Electrical diagnostic procedures and tools are the same for all Cub Cadet and MTD mowers. This section is written in a way to provide basic trouble shooting skills that can be used on any mower.

With a basic understanding of the behavior of electricity and the tools used to measure that behavior, a technician can be about 80% effective at finding electrical problems.

80% effective is not bad, but the remaining 20% of the diagnoses are the really difficult ones that can devour the same amount of time as the easy 80%. Experience plays a big part in successfully diagnosing the really difficult electrical problems. Experience leads to greater understanding.

Two German Physicists, working independently during the late 18th and early 19th centuries, summarized what they had figured out about electricity into some basic laws that can help a technician understand how a system works or why it does not work. Their names were Gustav Kirchhoff and Georg Ohm, and their laws are named for them.

There are basically three things that a technician is likely to test in trying to identify an electrical problem: Volts, Resistance, and Current. To help technicians understand the behavior of electricity, this section begins with an explanation of:

- Basic electrical values.
- Ohm's Law.
- Kirchhoff's Current Law (KCL).
- Kirchhoff's Voltage Law KVL).
- How the system is wired together.

NOTE: A graphic explanation of Kirchhoff's laws can be found at the following web site: http://online.cctt.org/physicslab/content/phyapb/lessonnotes/DCcircuits/lessonKirchoff.asp

The next section then continues by explaining handy tools and techniques for diagnosing electrical problems on outdoor power equipment.

Electronics

Outdoor power equipment has historically had relatively simple electromechanical controls. Customer expectations and regulatory demands has driven change in the industry, while electronic controls have become relatively inexpensive.

In many cases, electronic controls can simplify a system that would otherwise be very complex. Instead of creating a huge array of switches and relays that are tied together by spaghetti-like wiring. Sensors (switches) in an electronic system send signals to a processor. These input signals are processed by a control module that produces outputs.

Outputs can include power to run an electric PTO clutch, a trigger signal to a starter solenoid, or the grounding of a magneto to turn off an engine if an unsafe condition exists.

Most electronic devices are quite dependable, but they are vulnerable to things that simple electrical devices are not bothered by. Examples include:

- **EMI:** Electro-Magnetic Interference is created by electric "noise". This noise is general created by ignition systems with non-resistor spark plugs being especially "noisy". Alternators, and even power passing through wires can also generate EMI. Countermeasures against EMI include metal shielding and filtering devices built into vulnerable components. Something as simple as putting non-resistor spark plugs in a machine with electronic controls can disable the controls.
- **Voltage Spikes:** A dramatic increase in voltage will damage many electronic devices. Such spikes may be caused when jumper cables are disconnected or a voltage regulator fails. Some early electronic systems could even be damaged by personal discharge of static electricity. Most are better protected now.

- **Low Voltage:** Many electronic devices simply stop working if system voltage falls below a given threshold. If a 12 volt system is run at 11 volts with a failing alternator, electronic controls may stop working.
- **Bad Grounds:** Bad grounds can reduce the effective system voltage, create resistance and heat, and send false signals. This is the single most common source of electronic gremlins.
- **Heat and Vibration:** Heat and vibration are hard on most mechanical devices. The same is true of electronics.
- **Moisture:** Moisture causes a nasty combination of corrosion and shorts. Corroded connections and wires create resistance that results in low voltage and ground issue. Many electronic components are “potted” or encased in a sealant that protects them from moisture. They are still vulnerable to bad inputs caused by corroded external connections and damaged switches.
- **Improper Tools:** Some test lights can over load some sensitive electronic circuits.

Electrical environment: AC Vs. DC

Most modern outdoor power equipment, that has an electrical system complex enough to require diagnosis, will be equipped with an alternator that produces alternating current (AC). In most systems, this current is immediately rectified to direct current (DC), and regulated to a nominal 12 Volts. The presence of AC is very limited. The primary concern of this section is 12 Volt DC systems, though much of the theory and techniques apply equally well to other DC systems.

1. Voltage: Pressure

- Voltage is the “pressure” that electricity has. It is the amount of force pushing electrons through a circuit.
- The unit of measurement for this pressure is volts.
- The capital letter “V” is used to represent volts.
- Most outdoor power equipment operates on a nominal 12 volts. In practice, system voltage may run as high as 13.5V or 14V.

2. Current: Flow

- Current is the “flow” of electricity. It is the amount of electrons flowing in the circuit.
- The flow of current is measured in Amperes or Amps.
- The capital letter “I” (*Intensity* of current flow) is used to represent Amps.

3. Ohms: Resistance

- Resistance is the opposition to current flow. It is a restriction that slows down the flow of current.
- Resistance is measured in Ohm’s.
- The greek letter omega “Ω”, or the letter ”R” for Resistance is used to represent Ohm’s.
- Resistance creates heat. A circuit with too much electrical load or too much resistance for the load placed on it will get hot.

Ohm's Law

Ohm's Law relates voltage, amperage, and resistance. It states that voltage is the product of current times resistance.

- It is written as V = I x R.
- In simplest terms, it goes like this:
- It takes 1 volt to push 1 amp through a resistance of 1 ohm (1 = 1 x 1).
- This equation can be rearranged using algebra to solve for any one variable.
- Those who were traumatized by algebra can represent Ohm's law as a triangle. When using the triangle, cover the value to be found, and the two values left exposed signify how to obtain that value. See Figure 7.45.

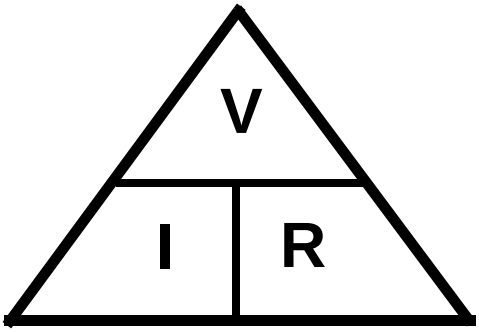


Figure 7.45

- As an example if the "R" is covered, the "V" is over the "I" which means "V" divided by "I" will solve for the covered letter "R" (V/I = R).
- If the "V" is covered, "I" and "R" are exposed on the same line, means multiplying "I" times "R" will solve for the unknown "V" (I x R = V).

Kirchhoff's current law

Kirchhoff's current law deals with nodes. Nodes are the junction of two or more wires or the junction of a wire to a component.

Kirchhoff's current law states that what ever current goes into a node must come out.

As an example: Three wires are connected with a wire nut. One wire has 5 amps going into the connection:

- The sum of the currents coming out of the other two wires must equal 5 amps. That could be 3 amps in one wire and 2 amps in the other or it could be 2.5 amps in each wire, but the total coming out must be the same as the current going in. See Figure 7.46.

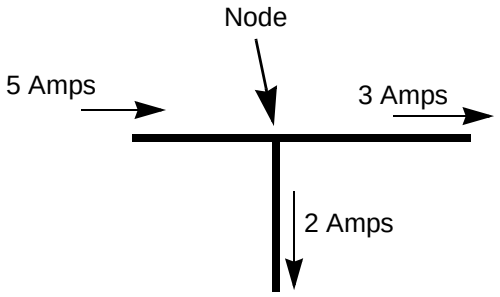


Figure 7.46

Kirchhoff's voltage law

Kirchhoff's voltage law deals with voltage drops. A voltage drop is the amount of voltage used up or "dropped" by resistance in a circuit. Ohm's law states that V = I x R, every component in a circuit has resistance, even the wires. To push current through resistance, it takes voltage. Kirchhoff's voltage law states that the sum of all the voltage drops equals the source voltage.

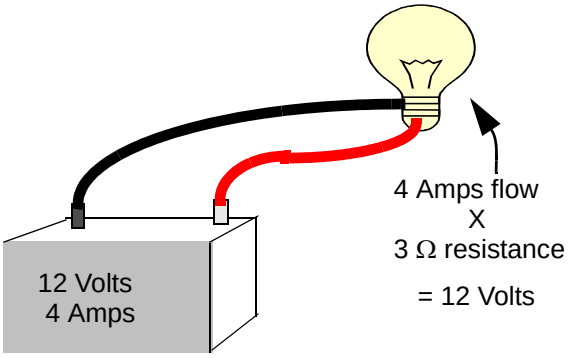


Figure 7.47

As an example, imagine a circuit that has a 12V battery that produces 4 amps of current powering a light bulb that creates 3 Ω of resistance. The wires are assumed to have 0 Ω resistance*. The light bulb uses 12 volts (4 amps x 3 ohms = 12 volts). The battery produces 12 volts that equals the 12 volts used by the light bulb.
See Figure 7.47.

NOTE: * If the proper size wire is used and there is no corrosion in the wire, the resistance will be too small to worry about.

How the system is wired together

The Rules

All circuits have some basic rules that must be followed:

1. All circuits must have at least one voltage source. It could be a battery, an altenator or both.
2. All circuits must have a load. A circuit without a load is the same as shorting out the power source. Typical loads could be:
   - lights
   - a motor
   - a solenoid
3. All circuits must have a complete path back to the voltage source. This is also known as having continuity.

   NOTE: On outdoor power equipment, the frame of the machine is frequently used as the return path to the battery. This is referred to as grounding the machine. Any point on the frame should be the same as the negative post of the battery (Electrically) unless there is a bad connection between the battery and the frame or between the frame and the component or cable that is assumed to be grounded to it.
4. Most circuits have additional components like switches and fuses.

Types of circuits

There are three ways a circuit can be wired:

- Series
- Parallel
- Series/parallel

Series

Series circuits are wired so that the current has only one path to follow. If one component in the system fails, the circuit will be broken and whole system will not work. See Figure 7.48.

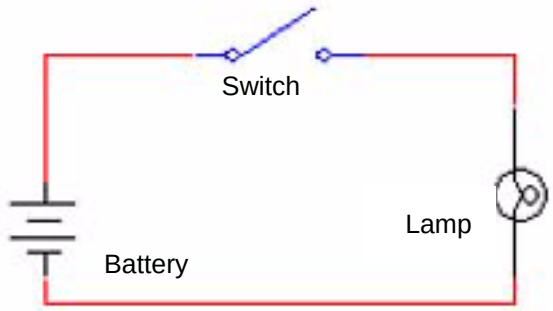


Figure 7.48

Parallel

Parallel circuits are wired so that current has multiple paths to follow. If a component in one of the parallel paths fails, the rest of the circuit will keep working. See Figure 7.49.

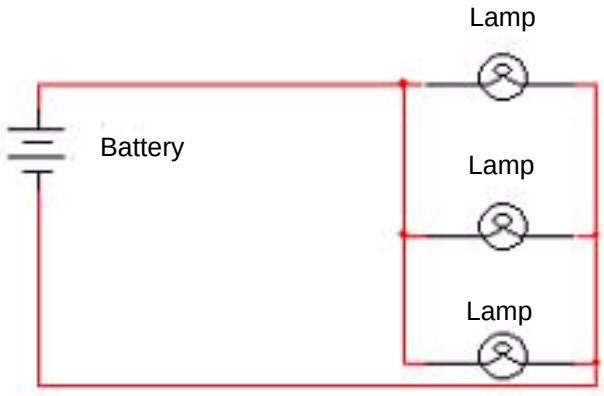


Figure 7.49

Series/parallel

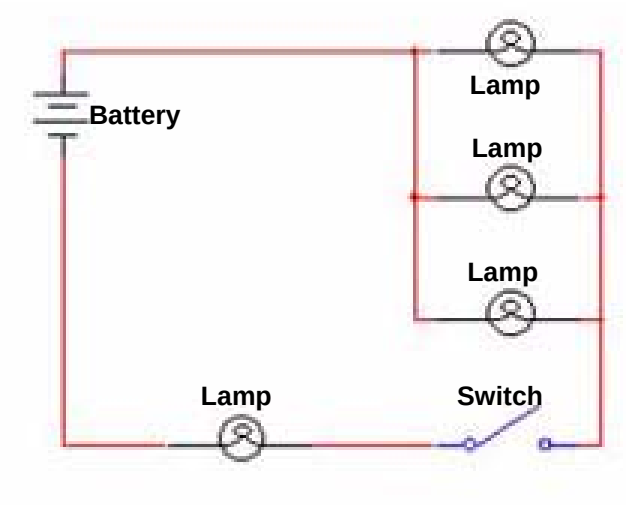


Figure 7.50

Series/parallel circuits have some sections wired in series and some in parallel. See Figure 7.50.

What can go wrong?

There are three types of failures that can occur in an electrical circuit:

1. Shorts
2. Opens
3. Increased resistance

Shorts

A short is when electricity takes a path that it was not designed to take bypassing a component in the circuit.

A common example of a short is a wire with insulation that chafed through, exposing the copper conductor. The bare copper will short the circuit when it touches a ground source.

Opens

An open is when current can not complete its path back to the power source. A common example of this is a burned-out bulb in a series circuit.

Increased resistance

Increased resistance is, as the name implies, an increase in resistance.

This can be caused by loose or corroded connections, or connections that are insulated by grease, paint, or coatings. Fasteners finished in oil and phosphate or black oxide are bad conductors. The use of zinc coated fasteners is recommended.

Resistance can be a problem on the ground side as well as the hot side of a system. Remember that electricity must complete a loop (circuit) back to the battery post. Any resistance in that loop will interfere with the flow.

Arguably, the most common electrical failure and the hardest to find, is increased resistance. It can have more subtle symptoms than outright open circuits. Many times affected circuits will still partially function. It is not an “open” because there is some current that can get through, but the increase in resistance is enough to affect the circuit.

The Tools

Equipment needed to diagnose an electrical system:

- DMM (Digital multimeter)
- Wiring schematic or diagram

Equipment that may be useful:

- Fused jumper wires.
- Test light
- Self-powered continuity light
- Ammeter
- Battery charger
- Battery tester
- Battery jumper cables
- Hand tools to gain access to components.
- Flashlight.

Digital multimeter

A DMM is the most useful tool to troubleshoot any electrical system. There is an amazing variety of DMMs on the market. Some are very basic, others are tailored to specific industries, and some high-end graphing meters function like oscilloscopes. Even the most basic ones are quite versatile. See Figure 7.51.

Figure 7.51

Uses

Voltage

Set DMM to read “Volts DC (_ _ _)” if using an auto-ranging meter or to an appropriate scale (typically 20 Volts DC) if using a more basic model.

- Connect the **DMM in parallel** to the circuit being measured, between the test point and a known-good ground. Turn on the circuit to be tested, and read the meter. For most tests the engine need not be running, but the key will need to be turned on.
- If the DMM is connected with the **polarity** reversed, a “-” will appear in front of the voltage reading. It has no ill effects on the DMM nor on accuracy.
- If the DMM is set to Volts AC (~) it may not register any DC voltage, but no physical harm will be done to the DMM nor the equipment being diagnosed. It may waste some time though.

Amperage

Most DMMs have a very limited capacity to test amperage (10 Amperes). When measuring current flow, the meter must be connected in series with the component to be measured. That means opening the circuit and having the circuit go through the meter.

NOTE: Some DMMs have an inductive “Amp clamp” accessory that can be used without breaking the circuit.

IMPORTANT: Testing amperage beyond the capacity of the DMM can burn out an internal fuse or cause serious damage.

Resistance

Set the meter for the “Ω” scale.

- Isolate the part of the circuit to be tested (disconnect it from the source of power).
- Most auto-ranging meters will provide readings on several scales. For outdoor power equipment, the standard Ohm scale is most appropriate. If a letter appears next to the W on the screen of the DMM, it indicates different scales of sensitivity.
  - **“μ”** is micro-Ohms, which is 1,000,000th (0.000001) of an Ohm
  - “**m**” is milli-Ohms, which is 1,000th (0.001) of an Ohm.
  - “**K**” is Kilo-Ohms, which is 1,000 Ohms.
  - “**M**” is Mega-Ohms, which is 1,000,000 Ohms
- A reading of “0” may be called “**Continuity**”. A reading of “OL” may be referred to as “**No Continuity**”.
- Mistaken Ohm readings most frequently come from bad technique. Poor connections between the probes and the point to be read can throw readings off. False readings can also be generated if the technician touches both probes with their fingers while taking the reading.
- The meter has it’s own power source to measure resistance. Connecting the meter to a component that has current from another source going through it may seriously damage the meter.

Wiring diagram or schematic

A wiring or a schematic diagram and the ability to read it are very important in troubleshooting a circuit. The diagram shows how the circuit was designed and what paths the electricity is suppose to flow.

Fused jumper wires

Fused jumper wires are handy to help find bad grounds or to jump across switches for testing purposes.

⚠CAUTION Only use fused jumper wires. If there is a short in the circuit, using an un-fused jump could damage components in the circuit.

Test lights

Test lights are used as a quick way to verify voltage at a point in a circuit. Like DMMs, they come in a wide variety from many manufacturers.

The most basic test lights simply use the current being checked to light an incandescent lamp. These should not be used on any equipment that has or may have solid-state circuitry. The power necessary to light the bulb is more than many solid-state circuits were designed to handle. Components will be destroyed in the process of testing them. See Figure 7.52.

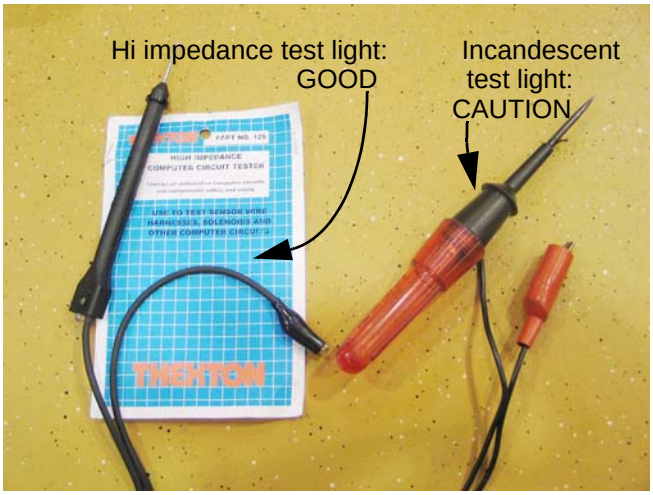


Figure 7.52

IMPORTANT: Do not use a test light on a 900 series tractor. It can damage the RMC module.

IMPORTANT: If a test light is used at all, it should have "**high-impedance**", indicating that it only takes a sample of the electricity being tested, and illuminates an LED to indicate the presence of power.

NOTE: Some high impedance test lights are capable of indicating whether the current being sampled is AC or DC.

Self-powered continuity lights

Continuity lights can indicate whether a circuit is complete or not, but they give no indication of resistance. They are handy for finding point-break when static-timing some older engines, but have largely been replaced by DMMs.

There are some powered high-impedance test lights on the market that have a continuity feature, and some technicians like the fact that they can be less bulky than a DMM.

Battery Jumper Cables

The obvious use of jumper cables is to jump-start equipment to get it into the shop.

NOTE: This is not recommended for any tractor equipped with electronic fuel injection or electronic power steering.

A clever use of jumper cables: If the technician suspects that there is resistance on the ground side of the system, a quick-and-dirty test can be made using jumper cables.

- Connect one cable clamp to the negative post of the battery, and connect the clamp at the other end of the same cable to the engine block.
- If there is an immediate difference in starter motor performance, use the voltage drop technique discussed later in this section to identify the source of the resistance.

Ammeters and specialized charging system testers

Figure 7.53

Inductive ammeters or “amp clamps” are available in many forms. Some are as simple as a gauge to be held against the circuit in question when it is energized. The operating principle is based on magnetic field induced by the current flow. See Figure 7.53.

There are two primary reasons to measure amperage. The first is to check the output of a charging system or battery. The second is to check the performance of a component that draws a substantial flow of power, typically a motor or clutch.

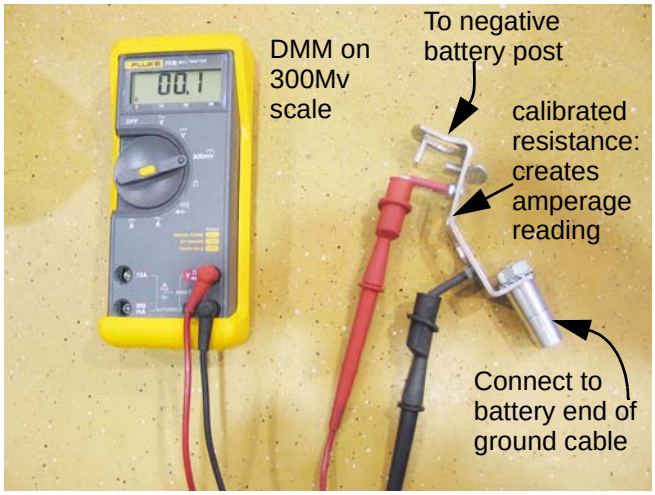


Figure 7.54

Briggs and Stratton sells a DC Shunt that converts amperage into a reading on the millivolt scale of a DMM. Briggs and Stratton part # 19359 covers low amperage systems, while part # 19468 tests higher amperage systems. The operating principle is based on Ohm’s Law, as described earlier in this section. See Figure 7.54.

NOTE: Usage of the DC Shunt tool is detailed in the 1995 and 1999 editions of their Update Seminar materials.

Batteries

CAUTION Batteries produce flammable and explosive gases, particularly during charging.

- Do not smoke or allow an open flame or heat source near the battery.
- Charge batteries in an open area
- Wear eye protection and acid resistant gloves when handling batteries.
- Do not allow direct metal contact across the posts. This will produce extreme heat that may cause direct burns or ignite flammable gas.

California Proposition 65 warning: Battery posts, terminals, and related accessories contain lead and lead compounds. These chemicals are known in the State of California to cause cancer and reproductive harm. Wash hands after handling

NOTE: The batteries used in current Cub Cadet equipment are sealed. It is not possible to check, test or add fluid.

Batteries contain electrolyte, which is highly corrosive. If a battery is ruptured, neutralize the electrolyte with baking soda, then carefully rinse the effected area with water.

A fully charged battery that is in good condition is an important factor when trying to diagnose other parts of an electrical system:

- Some charging systems do not work if the system voltage falls below 6V. It takes a certain amount of voltage to excite the fields in the alternator.
- Some solid-state components will not work if the system voltage falls below a given threshold.
- Some solid-state components can be damaged by the jump starting that accompanies operation with a dead battery.
- Many electric PTO clutches will fail to work dependably if battery needs to be replaced. Even though the charging system produces enough output to drive the clutch, it is over taxed driving the clutch and forcing a charge into a damaged battery.
- Continued operation with a weak battery over taxes the charging system.

Charging the battery

NOTE: It is best to remove batteries from equipment for charging to minimize corrosion from out-gassing during charging.

CAUTION When disconnecting or removing the battery, disconnect the ground cable first. When reconnecting or installing a battery, connect the ground cable last. These steps will minimize the chance of shorting-out the battery posts with a tool.

1. Batteries on most modern outdoor power equipment are 12 volts so set the charger to 12 volts.
2. Set the charge rate to 2 amps.

CAUTION Never charge an outdoor power equipment battery at a rate higher than 2 amps. Damage to the battery will result.

Never attempt to charge or jump a frozen battery.

3. Charge the battery until it is fully charged. Most battery chargers have an amp gauge to show the charging rate. When the gauge is at zero, stop charging the battery.

Checking battery condition

There are three things to do when testing a battery:

- Visual inspection
- Electrolyte test
- Operational test

1. Visual inspection
   - Inspect the battery and battery connections for corrosion. Clean if necessary. Neutralize acid with baking soda, and protect the terminals once they are cleaned.

     NOTE: Battery cable corrosion is the most common type of increased resistance circuit failures.
   - Inspect the battery case for signs of damage and missing vent caps. Battery cases that bow out in the middle indicate that the battery froze or overheated and should be replaced.

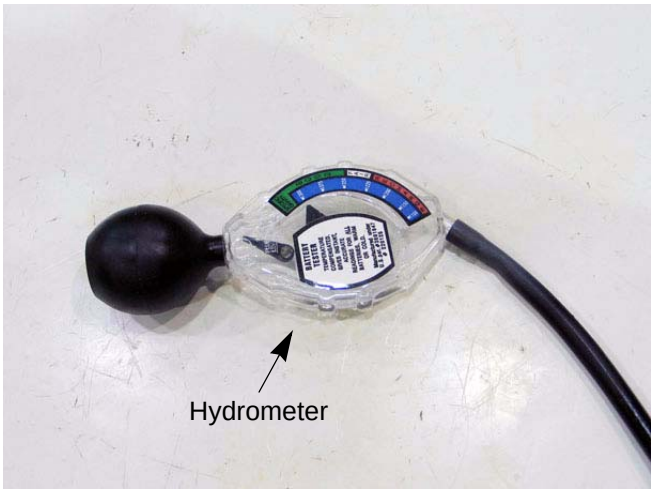


Figure 7.55

2. Check the electrolyte level, if the caps can be removed. Fill as needed with distilled water. After initial charging, do not add electrolyte to the battery.
3. Hydrometer test (non-sealed batteries only). See Figure 7.55.

CAUTION Always wear eye protection and acid resistant gloves when working with electrolyte. Use baking soda to neutralize any spilled acid.

3a. Give the battery at least ten minutes for the electrolyte to stabilize after charging the battery or adding water to the cells.

3b. Measure the temperature of the electrolyte in the middle cells of the battery.

3c. Squeeze the bulb on the hydrometer, then insert the hose into the cell.

3d. Release the bulb, drawing electrolyte into the hydrometer to the fill line.

IMPORTANT: Hold the hydrometer straight up and down when drawing up the electrolyte. The float needs to float free, not rubbing against the sides of the hydrometer.

Hydrometer Readings

Specific Gravity	Charge Condition
1.265	Fully Charged
1.225	75% Charged
1.190	50% Charged
1.155	25% Charged

3e. Write down the specific gravity of each cell.

3f. The readings must be corrected for the temperature of the electrolyte. The hydrometer manufacture should list the temperature the float is calibrated to. Most are calibrated to 80°. To correct the reading, add 0.004 to the reading for every 10° above the calibrated temperature or subtract 0.004 for every 10° below the calibrated temperature.

3g. Compare the reading to the Hydrometer readings chart.

IMPORTANT: To prevent damage to the charging system disconnect the battery to charge it.

NOTE: If battery needs to be charged, let battery sit for ten minutes to stabilize after charging. Apply a load to the battery for 15 seconds to remove the surface charge. Then re-check the battery.

Battery Testers

There are four major ways to check a battery:

- Electrolyte test using a specific gravity tester (hydrometer) to compare the density of the electrolyte in a fully charged battery to the density of water (water = 1.0 s.g.).
- Electrolyte test using a refractometer to check the density of the electrolyte by measuring the degree to which light waves bend when passing through the electrolyte.
- Load test that checks the output of the battery after the fully charged battery has done a certain amount of work. Fixed load testers are commonly available. Adjustable load testers are not generally found in outdoor power equipment repair shops.
- Capacitance test that checks the ability of the battery plates to hold a charge.

Adjustable load testers

Adjustable load testing is used if an adjustable load tester is available. Follow the procedures specified by the manufacturer of the tester to connect to the battery.

1. Disconnect the battery cables.

   IMPORTANT: Disconnect the negative cable first to help prevent a shorting hazard.

2. Measure the temperature of the electrolyte.
3. Connect a voltmeter and the load tester to the appropriate terminals.
4. Hook an amp probe onto the ground lead of the load tester.

   NOTE: A shunt can be used in place of the amp probe, but a second voltmeter will be needed to get a measurement from the shunt.

5. Apply a load equal to 50% of the battery's rated CCA for 15 seconds.

   NOTE: CCA stands for cold cranking amps. The rating should be on the battery for aftermarket batteries. For OEM batteries, contact the manufacturer for the CCA rating. The 900 series tractor comes with a 230 CCA battery.

Electrolyte Temperature	Minimum Required Voltage
≥70 deg. f. (21 deg. c.)	9.6 V
60 deg. f. (16 deg. c.)	9.5 V
50 deg. f. (10 deg. c.)	9.4 V
40 deg. f. (4 deg. c.)	9.3 V
30 deg. f. (-1 deg. c.)	9.1 V
20 deg. f. (-7 deg. c.)	8.9 V
10 deg. f. (-12 deg. c.)	8.7 V
0 deg. f. (-18 deg. c.)	8.5 V

6. Record the voltage while the load was applied. Compare the voltage to the above chart:
7. If the battery voltage is above what is listed in the chart, the battery is good.
8. If the battery voltage is below what is listed in the chart, replace the battery.

Fixed load testers

Fixed load testers (sometimes called toasters) are inexpensive load testers found at any auto parts store. See Figure 7.56.

Figure 7.56

NOTE: Because they have a fixed load value, they do not give most batteries a reliable and safe load test. Most fixed load testers have a load that is more than 50% of the rated CCA of riding mower batteries. This makes them inappropriate to use on smaller pieces of outdoor power equipment.

NOTE: Fixed load testers are often referred to as "toasters" because of the way that the resister element heats up and because of the way these testers tend to "toast"batteries.

1. Disconnect the battery cables, ground first.
2. Measure the temperature of the electrolyte in the middle cells.
3. Connect a voltmeter and the load tester to the appropriate terminals.
4. Apply the test load for 15 seconds. Monitor the meter on the load tester for the battery's performance.
5. Refer to the manufacturer of the tester on how to read the test meter.
6. The results of this test are not accurate and should only be relied on if the battery fails badly.

NOTE: Do not use any fixed load tester on a battery under 200 CCA. Doing so can boil the water out of the battery and damage the plates in the battery.

Conductance testers

There are several brands of conductance battery testers presently on the market. Conductance battery testers use the battery being tested as their power source. These testers send a small AC signal through the battery to measure the capacity of the plate to hold a charge.

Conductance testers are very easy to use and are far less damaging to the battery being tested. For these reasons, conductance battery testing is the preferred method of battery testing.

NOTE: Contact the manufacturer of the tester being used for specific test procedures.

1. Connect the tester to the battery.
2. Set the tester to the CCA rating of the battery.
3. Initiate the test.
4. Read the display of the tester. The tester's display will indicate if the battery passed or not. See Figure 7.57.

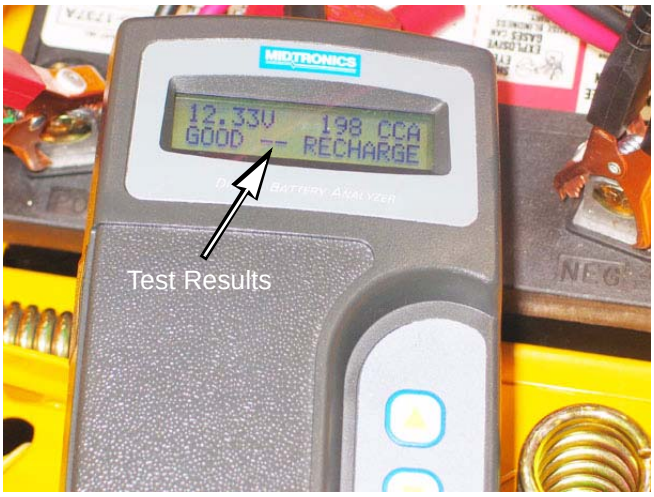


Figure 7.57

Battery discharge test

Occasionally a battery will discharge while sitting unused. To test for a battery that is “leaking” voltage:

Figure 7.58

1. Confirm that operator technique is not creating a situation that cases a draw. As an example, if a homeowner habitually turns their equipment off using a safety switch (perhaps vacating the seat with the key switch still ON), that may leave a relay or fuel shut-off solenoid energized.
2. Disconnect and charge the battery fully.
3. Use the ammeter function of a DMM to check for a power draw between the negative post on the battery and the end of the ground cable that normally connects to it. There should be no significant D.C. Amperage flow. See Figure 7.58.
4. A spark jumping from the post to the cable end is an indication that there is a substantial current draw, but should not be used repeatedly as a diagnostic tool. This is an extremely unkind thing to do to any electronic components of the mower.
5. Once the presence of a draw is confirmed, disconnect components of the system one at a time while monitoring an ammeter to see which makes the draw stop.
6. If the battery is being checked independently of the equipment it powers, measure and note the battery voltage while it is disconnected, over a three-day period.
7. There should be less than a 0.2 volt drop in the readings. If there is more than a 0.2 volt drop, the battery is bad.

Storage of batteries

1. Always store a battery with a full charge. This may require periodic re-charging.

   NOTE: This does not apply to a dry battery that has not had the electrolyte added to it yet.
2. Take measures to prevent the battery from freezing in cold weather. The electrolyte in a fully charged battery has a lower freezing point than the electrolyte in a battery with a lower state of charge.
3. Store the battery in a cool, dry place.
4. If storing multiple batteries (primarily store stock), rotate the stock so that the oldest battery goes out first. This will increase the life of the batteries.

Electrical Troubleshooting

1. The first step in troubleshooting is to always verify the complaint. Defining and verifying the problem reduces the possibility of misunderstanding and helps clarify the diagnostic approach.
2. The next step is to check the simple stuff first:
   - Check the fuse or fuses:

   NOTE: Failure of any fuse is an indication that there is a problem of some sort in the circuit that the fuse protects.

   - Look for obvious physical damage.
   - Use the hour meter and indicator lamps as a guide to direct the search. As an example, when diagnosing a “no-crank” condition on a 900 series tractor: if the PTO light is lit on the hour meter but the technician has visually verified that the PTO clutch is not engaged, the PTO circuit would be a reasonable place to check for problems.
   - Check the battery:

   IMPORTANT: A valid diagnosis of many systems cannot be performed unless the battery is fully charged, suppling 12.6 volts.
3. Take a methodical approach to finding the problem. As a rule of thumb, start at one end of the circuit and work to the other.
4. The next step is to decide what method to use to troubleshoot the circuit.
   - If checking a safety circuit that grounds the magneto, use an Ohms meter to test for continuity.
   - If checking a safety circuit that enables a starter motor or accessory, use a volt meter to confirm the presence of power at each junction in the system.
   - If a circuit does not work at all, look for a short or an open.
   - If the circuit works slowly or intermittently, look for resistance by doing a voltage drop test.

   NOTE: In all diagnose, it is very important to understand the circuit that is being checked. The use of a schematic is recommended, even if a technician is thoroughly familiar with the system.
5. Testing for opens/shorts

   NOTE: When checking circuits for continuity, disconnect the circuit at the nearest plug and use the metal terminals of the plug as a connection point for the test probes. DO NOT STAB THE WIRES.

   NOTE: When checking circuits for voltage, back-probe the terminals nearest the point to be checked. DO NOT STAB THE WIRES.

6. Starting with a fully charged battery and battery cable connections that are clean and tight, measure the battery voltage. See Figure 7.59.

Figure 7.59

7. With the circuit energized, start at either end of the circuit and check for voltage.
   - If starting at the battery end of a powered circuit, trace it through until power vanishes.
   - If starting at the ground end of a powered circuit, trace it through to the point that power appears.
   - If there is low voltage at the far end of the circuit, do a voltage drop test (as described later in this section) on the circuit to find the source of resistance.

NOTE: When working toward the battery, check each junction with the connector disconnected, then re-check it with the junction reconnected. If there is voltage with the connector unplugged but not when it is connected there is a short between that point and the last connector tested.

NOTE: When working toward the battery, if one junction has lost power, but the next connector has voltage with its junction still connected, there is an open between the two junctions.

8. Continue checking each connector until the other end of the circuit is reached or the fault is found.

Voltage Drop Test

To review:

- Ohm's law states that it takes voltage to push current through a resistance.
- Kirchhoff's voltage law states that the sum of all the voltage drops equals the source voltage.
- Combining those two laws, we see that any restriction in a circuit (e.g.: loose connector damaged wire, or corroded terminal) will use up some voltage as the current is pushed through.
- A voltage drop test is a way of looking for that voltage.
- Because electricity needs to complete a full circle (circuit), voltage drop tests are useful on both the positive or the negative side of the system.
- This text will address the negative side to begin with. Bad grounds are responsible for as many electrical failures as the positive side of the system, yet the ground side is frequently neglected by technicians. See Figure 7.60.

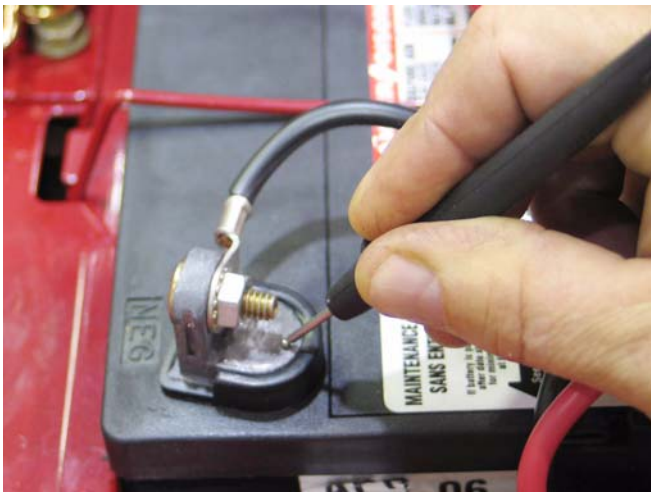


Figure 7.60

NOTE: Ultimately, all current will find its way back to the negative post of the battery.

To check ground-side voltage drop: set the DMM to measure 12V DC.

1. Make a good electrical connection between the black (-) probe and the negative post on the battery.
2. Make a good electrical connection between the red (+) probe and the suspect point of ground.
3. Power-up the circuit in question.
4. The voltage indicated on the meter is the voltage that is being used to pass current through a resistance in the circuit.
5. Voltage drop on a good circuit should be less than 0.1 volts. A voltage drop reading on the meter of greater than 0.2 volts indicates a fairly substantial problem that demands attention.

Figure 7.61

- As an example, if the starter solenoid does not engage properly, check for voltage drop between the ground point for the starter solenoid and the negative post on the battery. See Figure 7.61.
- With the starter engaged, this machine exhibited a voltage-drop reading of 0.308 volts, indicating a poor ground connection.

A similar ground-side test on a mower with a slow-cranking starter motor can be conducted between the engine block and the negative battery post.
See Figure 7.62.

1. With the starter engaged, this machine exhibited a voltage drop reading of 0.312 volts, indicating a poor ground connection.
2. Individually, these readings should lead a technician to inspect the connection between the solenoid and the ground path on the first mower (e.g. mounting hardware, green wire with eyelet beneath head of solenoid mounting bolt), or the engine and the frame on the second mower (e.g. loose or rusty engine mounting bolts).
3. If both of these readings were found on the same mower, a common point in the system would be the primary suspect (e.g. poor connection between negative battery cable and frame).

Figure 7.62

Applying this principle to the positive side of the system:

IMPORTANT: Ultimately, all positive current will find its way from the positive post of the battery to the negative post.

1. To check hot-side voltage drop: set the DMM to measure 12V DC. See Figure 7.63.
2. Make a good electrical connection between the red (+) probe and the positive post on the battery.
3. Make a good electrical connection between the black (-) probe and the suspect point of the circuit.
4. Power-up the circuit in question.
5. The voltage indicated on the meter is the power that is not following the intended path back to the negative battery post.

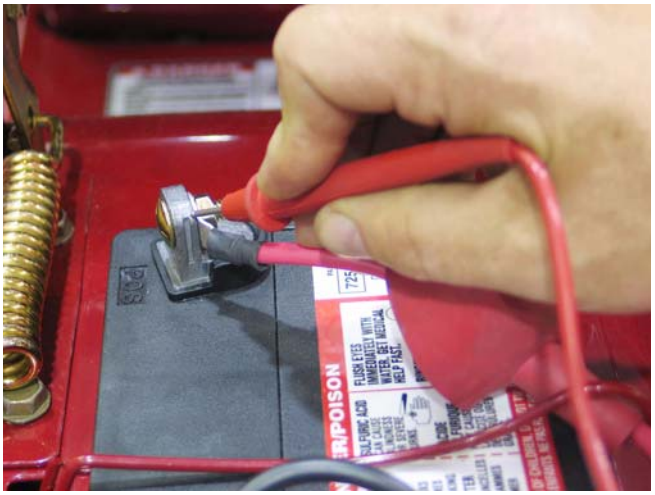


Figure 7.63

6. Voltage drop on a good circuit should be less than 0.1 volts. A voltage drop reading on the meter of greater than 0.2 volts indicates a fairly substantial problem that demands attention.

Figure 7.64

- As an example, if the mower had a slow-turning starter, the ground-side voltage drop measured below 0.1 volts, and there was not a parasitic load on the engine (e.g. PTO clutch that is not fully disengaged), it would be logical for the technician to check voltage drop to the starter. See Figure 7.64.
- With the starter motor engaged, the voltage drop reading here is nearly 0.6 volts, indicating a serious problem in the heavy-gauge circuit between the starter and the battery.
- Checking voltage drop at various points along the circuit can help pinpoint the problem.
- Check voltage drop at the output lug on the starter solenoid:
- If there is a significant difference, the problem lies between the lug on the solenoid and the lug on the starter.
- If there is little change, the problem lies further upstream.
- Check voltage drop at the input lug on the solenoid. If there is significant difference between the reading here and the reading at the output lug (greater than 0.10 volt), then the contacts inside the solenoid may be burned. If there is little change, the problem lies further upstream, between the battery and the solenoid.
- Results may be cross-checked by testing voltage drop across the two posts of the starter solenoid while cranking the starter motor.

Testing switches

- Refer to the “COMPONENTS” section of this chapter that describes the function of the individual switches to be tested.
- Switches can be tested “hot” by looking for voltage at the appropriate posts. This is not definitive, since the source of the voltage is not always confirmed. Checking for voltage does not work on switches that work by providing a ground path to the magneto primary windings or a solid state control device.
- The most valid way to test switches is a continuity test.

1. Understand the internal functions of the switch. Key switches and PTO switches can be fairly complex.
2. Isolate the switch from the rest of the circuit.
3. Test each pair of terminals for continuity in all modes of switch operation: at-rest, and actuated.
4. Many switches on Cub Cadet equipment are typed by their at-rest state: Normally Open, Normally Closed, Common.

- Normally Open (N.O.) contacts do not complete a circuit when the switch is at-rest (plunger extended). They close to complete a path through the switch when the plunger is depressed.
- Normally Closed (N.C.) contacts complete a circuit when the switch is at-rest (plunger extended). They open to break the path through the switch when the plunger is depressed.
- Some Cub cadet switches contain more than one pair of contacts. The same switch housing can contain normally open and normally closed switch elements.
- When testing a switch that contains more than one set of contacts (elements), the male spade terminals associated with Normally Closed contacts will be stamped “NC”
- The male spade terminals that are associated with each-other face each-other broad-surface to broad surface. See Figure 7.65.

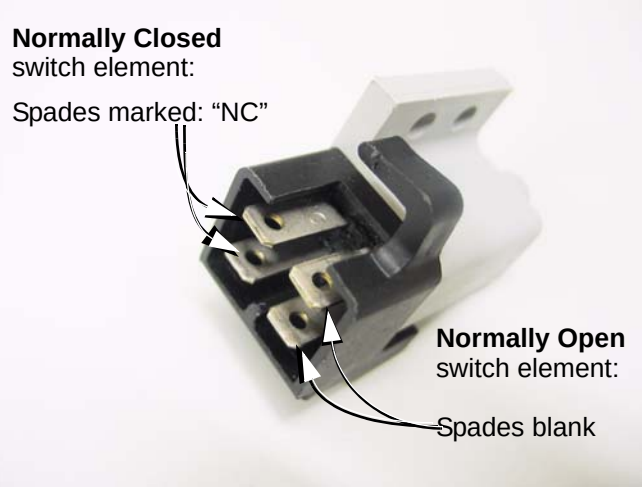


Figure 7.65

Diodes

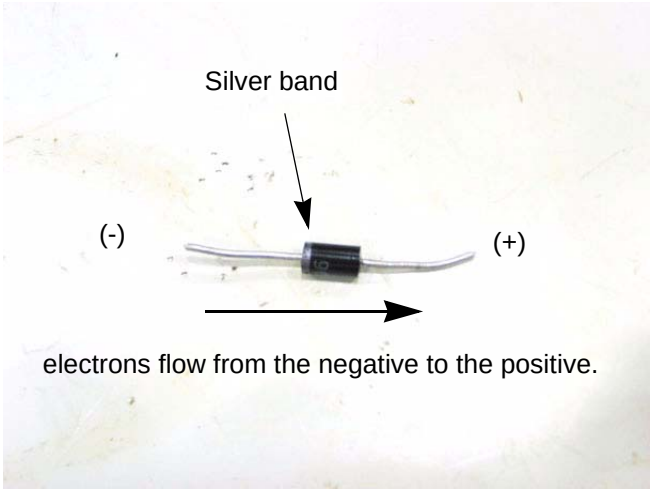


Figure 7.66

- What is a diode? A diode acts like a one way valve, allowing current to flow in only one direction. See Figure 7.66.
- Which way does this electrical check-valve work? There will be a band on one end of the diode. The band indicates the negative side of the diode
- Most DMMs have the ability to test a diode.

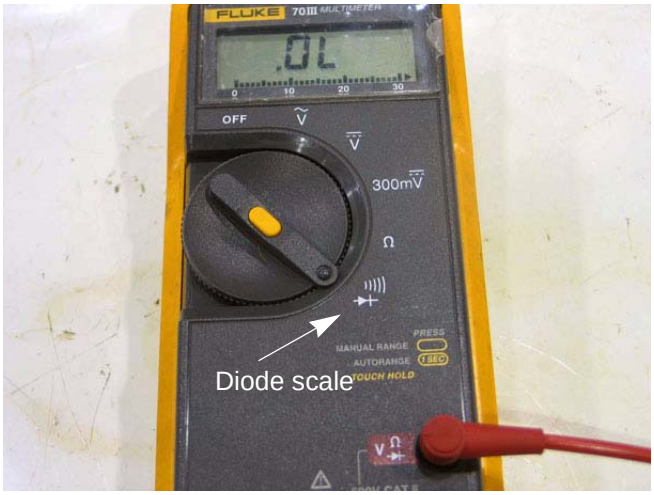


Figure 7.67

Testing a diode:

1. Isolate the diode in the circuit.
2. Set the DMM to the diode or Ω scale. See Figure 7.67.
3. Attach the negative lead of the DMM to the side of the diode with a band on it.
4. Place the positive lead on the other side of the diode.

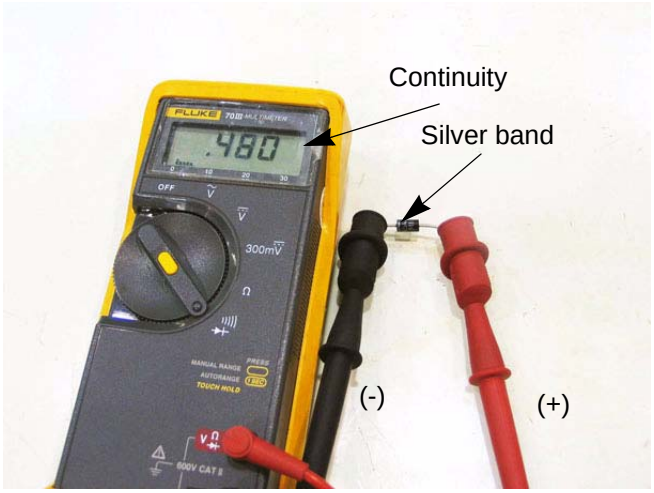


Figure 7.68

5. There should be continuity. See Figure 7.68.

6. Switch the leads and repeat the test.
7. The meter should indicate no continuity.
   See Figure 7.69.
8. If the results do not match the above, replace the diode.

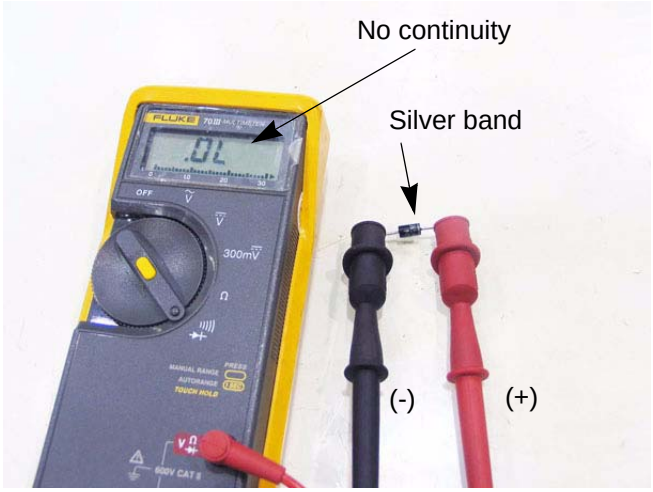


Figure 7.69

Relay

Most of the relays used by MTD or Cub Cadet have five pins. See Figure 7.70.

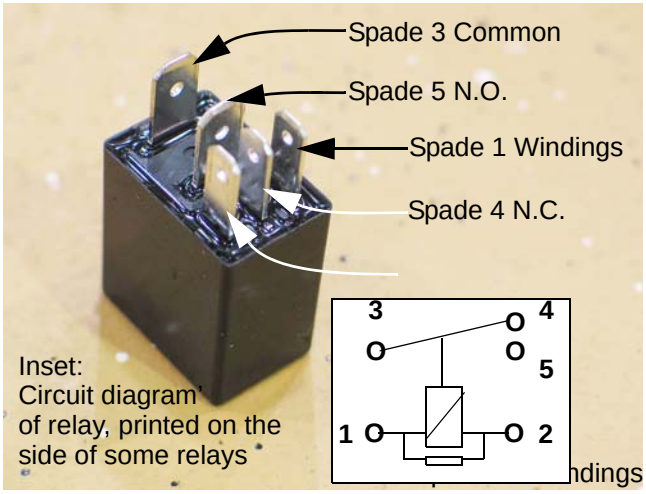


Figure 7.70

- Windings: Terminals 1 & 2 are the outer-most of the row of three small spade terminals. When one has power and the other is connected to ground, the relay is energized.
- Normally, a resistance reading between terminals 1&2 will produce a measurement of about 100Ω. This is the resistance in the windings around an iron core that energize an electromagnet or a solid-state equivalent.
- Terminal 3 is a “Common” connection. It may be connected to power or ground, depending on the application. It is the large spade terminal near the edge of the relay.
- Terminal 4 is the “Normally Closed” contact. When the relay is not energized, terminal 4 is connected to terminal 3. When the relay is energized, this connection breaks. An Ohm meter should show zero resistance or “0.0Ω” between 3 & 4 when the relay is at rest, and it should read no continuity when the relay is energized.
- Terminal 5 is the “Normally Open” terminal. It connects to terminal 3 when the relay is energized. When 3 & 4 are connected, 3 & 5 are disconnected, and vice-versa. An Ohm meter should show zero resistance, or “0.0Ω” between 3 & 4 when the relay is at rest, and it should read no continuity when the relay is energized.

To test a relay

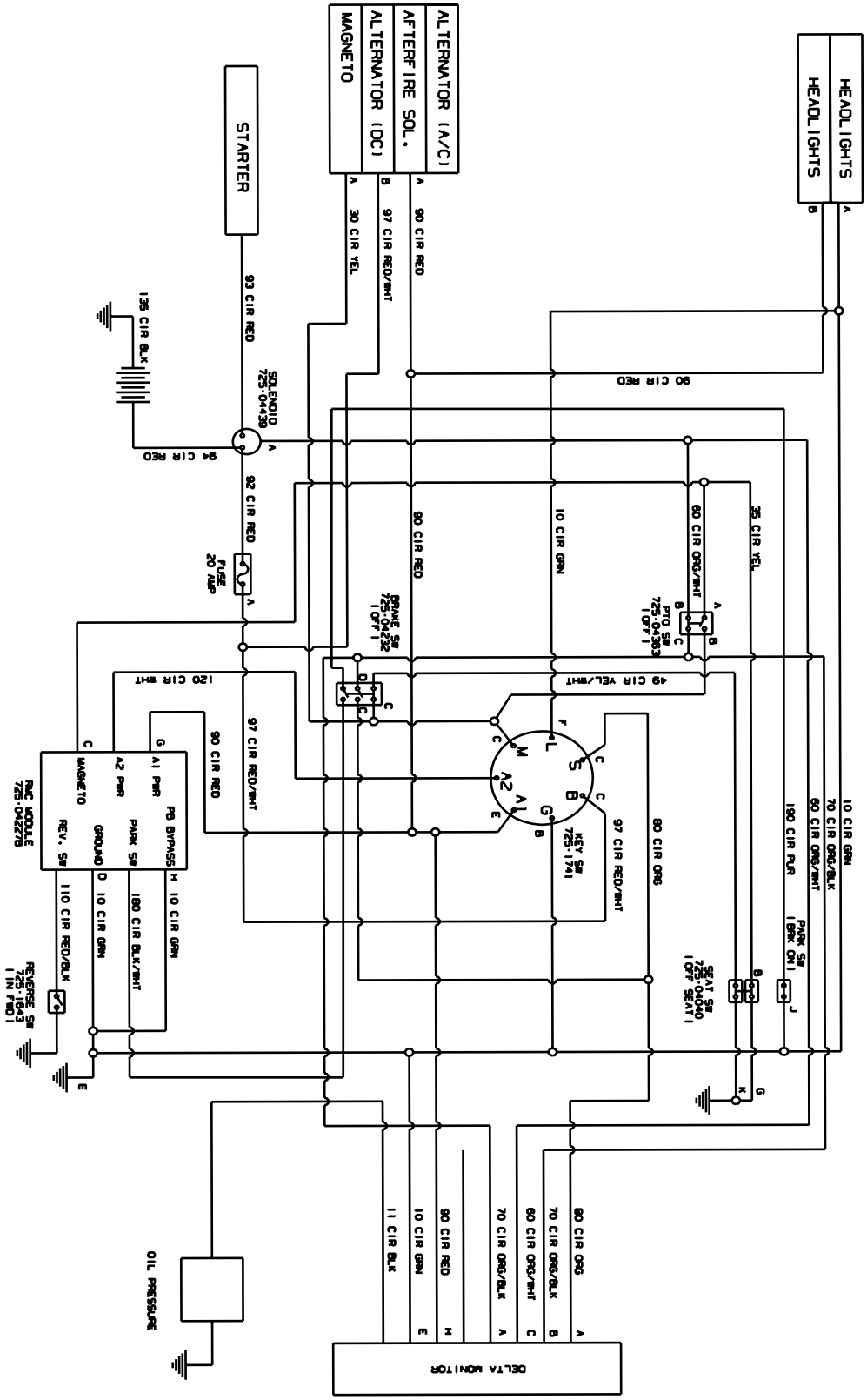
1. Test for continuity between the common and the (N.C.) terminals using a DMM.
2. Test for continuity between the common and the (N.O.) terminals using a DMM.

   NOTE: There should be continuity with the (N.C.) terminal and no continuity for the (N.O.) terminal. If the results vary from this the relay is bad.
3. Apply 12 volts to terminals 1 and 2. This will activate the relay.
4. Test for continuity between the common and the (N.C.) terminals.
5. Test for continuity between the common and the (N.O.) terminals.

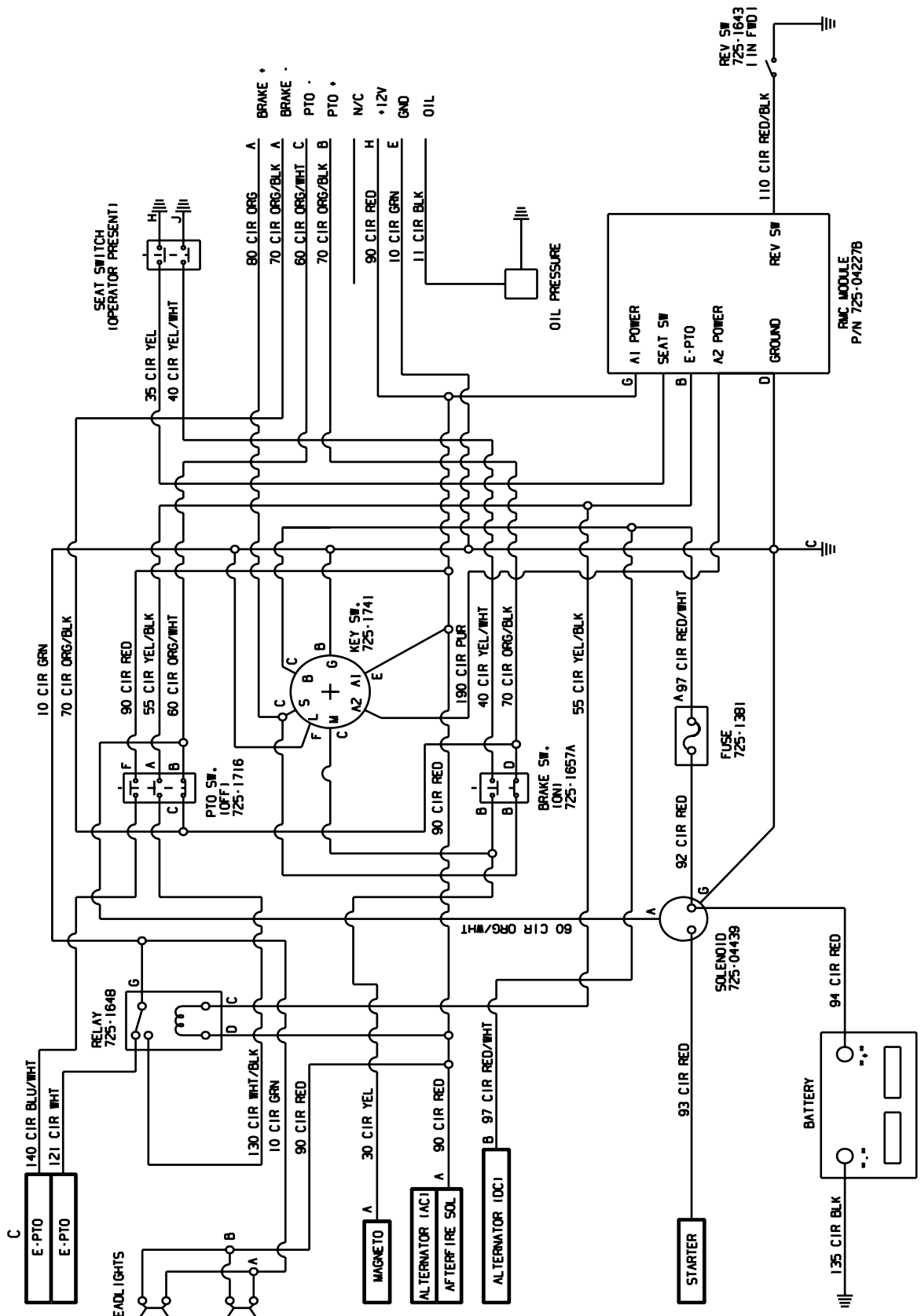
   NOTE: There should be no continuity with the (N.C.) terminal and continuity with the (N.O.) terminal. If the results vary from this, the relay is bad.

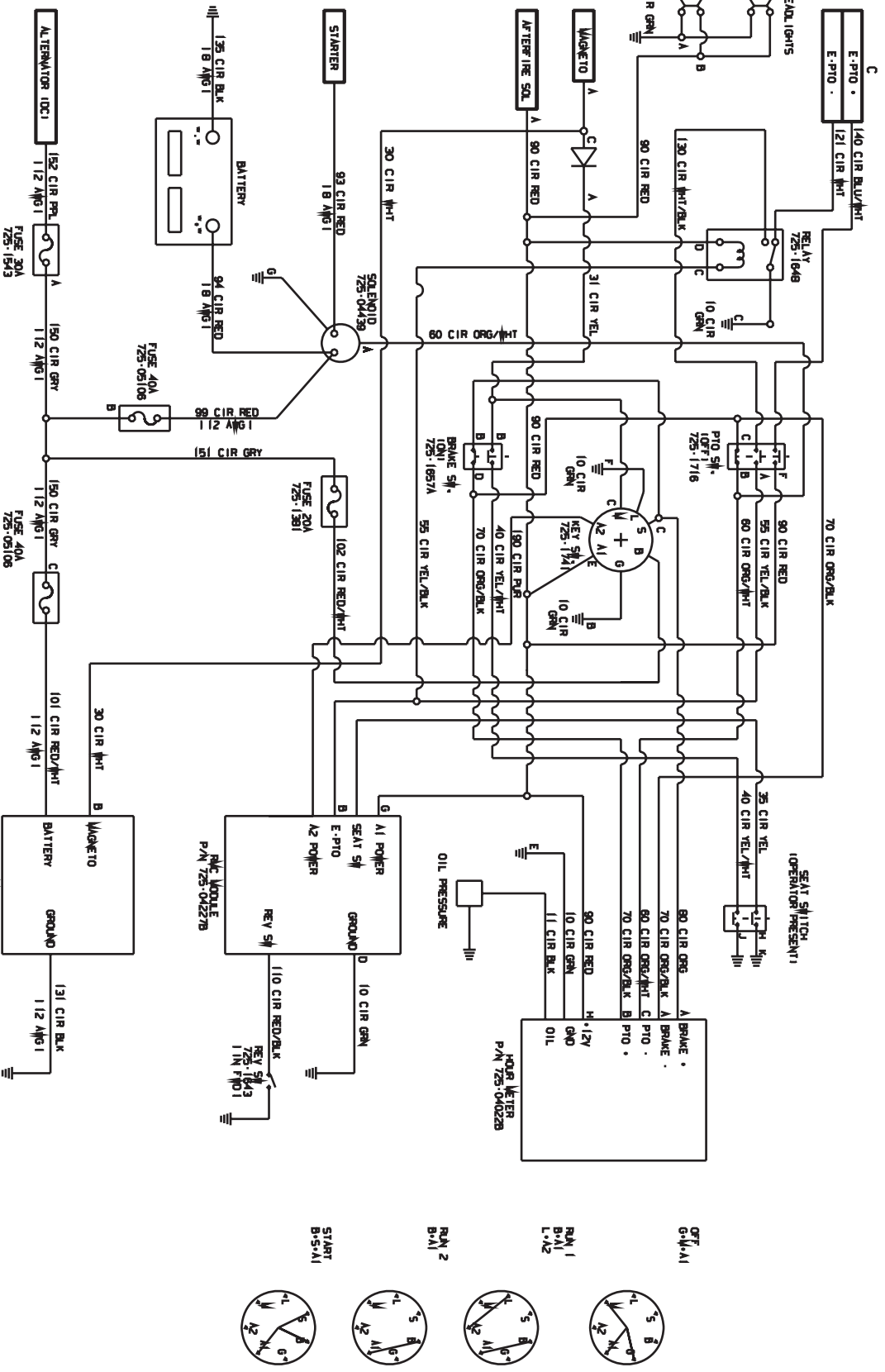
   NOTE: To test the relay for burned contacts, do a voltage drop test across the relay contacts while the circuit is being used.

Schematics

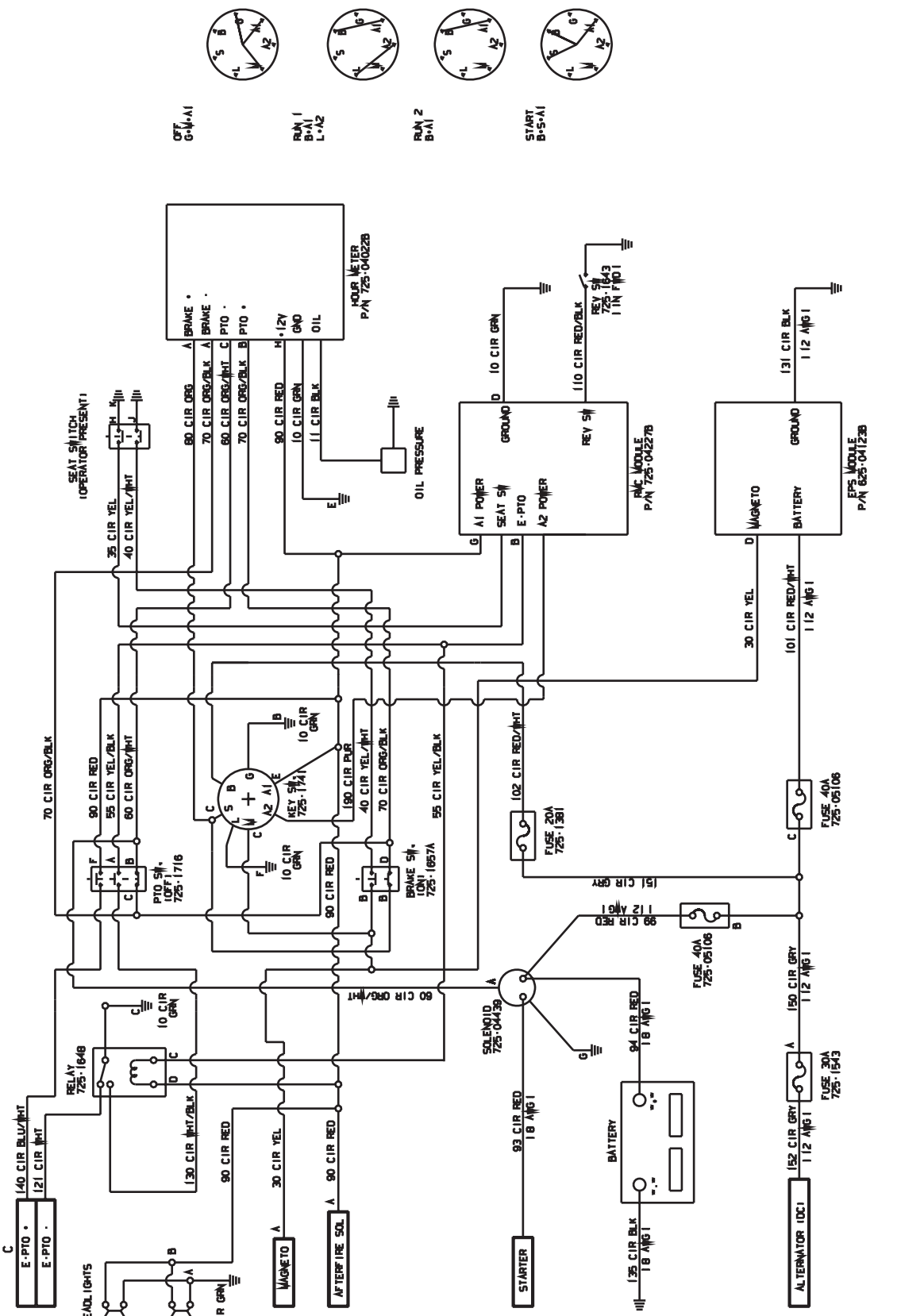


Manual PTO


Electric PTO
RMC MODULE
P/N 725-04227B
A1 POWER
SEAT SW
E-PTO
A2 POWER
GROUND
REV SW
REV SW
725-1643
(IN FWD)
110 CIR RED/BLK
BRAKE +
BRAKE -
PTO -
PTO +
N/C
+12V
GND
OIL
80 CIR ORG
70 CIR ORG/BLK
60 CIR ORG/WHT
70 CIR ORG/BLK
90 CIR RED
10 CIR GRN
11 CIR BLK
OIL PRESSURE
SEAT SWITCH
(OPERATOR PRESENT)
35 CIR YEL
40 CIR YEL/WHT
10 CIR GRN
70 CIR ORG/BLK
90 CIR RED
55 CIR YEL/BLK
60 CIR ORG/WHT
PTO SW.
(OFF)
725-1716
KEY SW.
725-1741
190 CIR PUR
40 CIR YEL/WHT
70 CIR ORG/BLK
55 CIR YEL/BLK
90 CIR RED
BRAKE SW.
(ON)
725-1657A
97 CIR RED/WHT
FUSE
725-1381
92 CIR RED
60 CIR ORG/WHT
SOLENOID
725-04439
94 CIR RED
BATTERY
135 CIR BLK
93 CIR RED
STARTER
RELAY
725-1648
140 CIR BLU/WHT
121 CIR WHT
130 CIR WHT/BLK
10 CIR GRN
90 CIR RED
30 CIR YEL
90 CIR RED
97 CIR RED/WHT
E-PTO
E-PTO
HEADLIGHTS
MAGNETO
ALTERNATOR (AC)
AFTERFIRE SOL
ALTERNATOR (DC)



SLTX with EPS and Kohler DSA Ignition


OFF
G-M-A1
RUN 1
B-A1
L-A2
RUN 2
B-A1
START
B-S-A1
HOUR METER
P/N 725-040228
BRAKE +
BRAKE -
PTO -
PTO +
+12V
GND
OIL
SEAT SWITCH
(OPERATOR PRESENT)
OIL PRESSURE
PMC MODULE
P/N 725-042278
A1 POWER
SEAT SW
E-PTO
A2 POWER
GROUND
REV SW
REV SW
725-1643
(IN PTO)
EPS MODULE
P/N 625-041238
MAGNETO
BATTERY
GROUND
PTO SW.
(OFF)
725-1716
KEY SW.
725-1741
BRAKE SW.
(ON)
725-1657A
FUSE 20A
725-1381
FUSE 40A
725-05106
FUSE 40A
725-05106
FUSE 30A
725-1543
RELAY
725-1648
SOLENOID
725-04439
BATTERY
STARTER
MAGNETO
AFTERFIRE SOL
HEADLIGHTS
ALTERNATOR (DC)
E-PTO +
E-PTO -
140 CIR BLU/WHT
121 CIR WHT
130 CIR WHT/BLK
90 CIR RED
30 CIR YEL
90 CIR RED
10 CIR GRN
93 CIR RED
18 AWG
94 CIR RED
18 AWG
135 CIR BLK
18 AWG
152 CIR GRY
12 AWG
150 CIR GRY
12 AWG
151 CIR GRY
12 AWG
99 CIR RED
12 AWG
101 CIR RED/WHT
12 AWG
131 CIR BLK
12 AWG
102 CIR RED/WHT
30 CIR YEL
70 CIR ORG/BLK
90 CIR RED
55 CIR YEL/BLK
60 CIR ORG/WHT
35 CIR YEL
40 CIR YEL/WHT
80 CIR ORG
70 CIR ORG/BLK
60 CIR ORG/WHT
70 CIR ORG/BLK
90 CIR RED
10 CIR GRN
11 CIR BLK
10 CIR GRN
90 CIR PUR
40 CIR YEL/WHT
70 CIR ORG/BLK
55 CIR YEL/BLK
10 CIR GRN
10 CIR GRN
10 CIR GRN
10 CIR GRN
60 CIR ORG/WHT

LTX with EPS

CHAPTER 8: CUTTING DECKS AND LIFT SHAFT

Cutting decks

The 900 series comes with a variety of deck options. The procedure to remove the deck is the same for all. The eighth digit of the model number will identify which deck is on the tractor.

Letter	Deck
F	38” Twin blade deck
G	42” Twin blade deck
R	42” Timed twin blade deck
S	42” Staggered deck
H	46” Triple blade deck
T	46” Twin blade deck
P	50” Triple blade deck
K	54” Triple blade deck

Deck removal

Figure 8.1

1. Place the tractor on firm level ground and set the parking brake.
2. Lower the deck to the lowest cutting height.
3. Remove the PTO belt:

Electric PTO

A. Slip the PTO belt off of the PTO clutch .

B. Slide the belt out, between the PTO clutch and the belt guard.

Manual PTO

A. Loosen the bolt that fastens the belt guard to the frame using a 1/2” wrench. See Figure 8.1.

B. Remove the nut that secures the belt guard to the right side of the frame using a 1/2” wrench. See Figure 8.2.

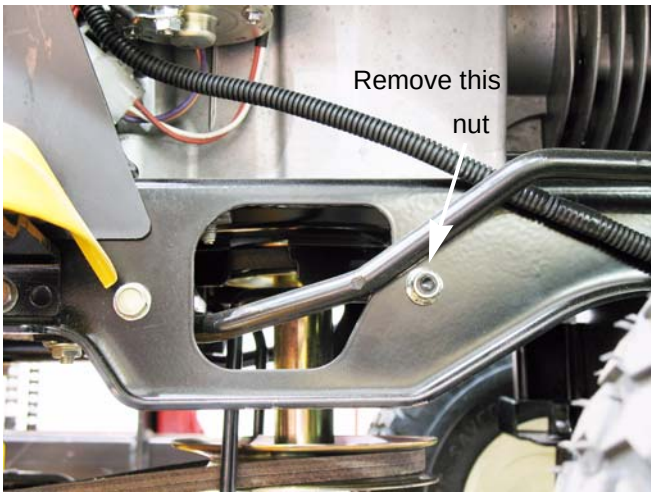


Figure 8.2

C. Pull in on the belt guard and slide it towards the rear of the tractor.

D. Slide the PTO belt off of the engine pulley.

E. Remove the hair pin clip that secures the PTO cable to the deck. See Figure 8.3.

Figure 8.3

F. Unhook the spring end of the PTO cable from the idler pulley bracket. See Figure 8.4.

Figure 8.4

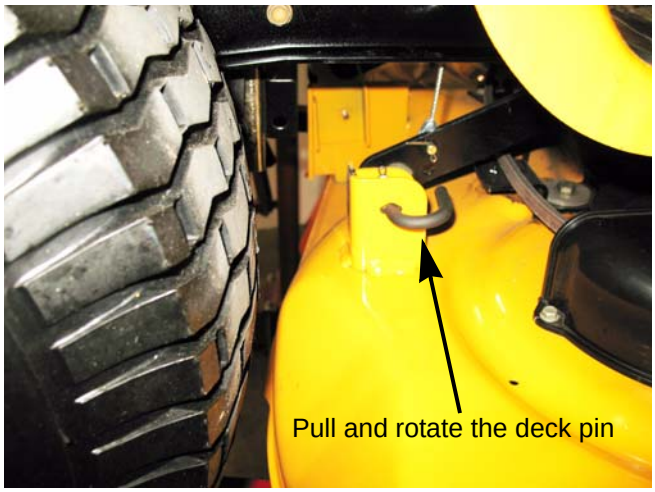


Figure 8.5

4. Pull the deck pins on both sides and rotate them to keep them out. See Figure 8.5.

Figure 8.6

NOTE: The 50” and 54” decks will have an addition stabilizer link on the back of the deck. Disconnect it by removing the bow tie clip. See Figure 8.6.

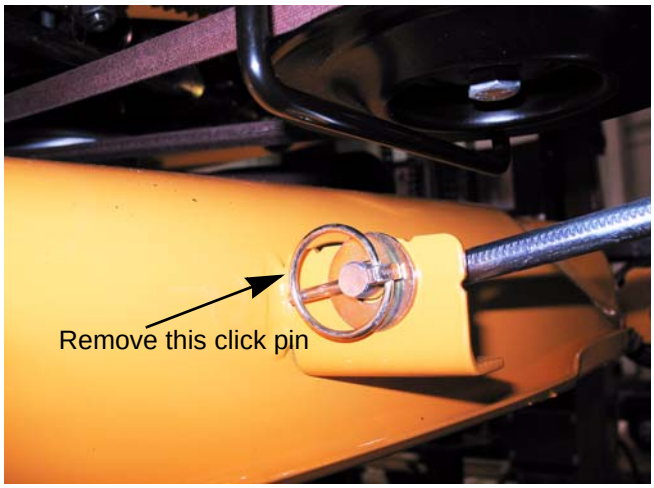


Figure 8.7

5. Remove the click pin and washer that secures the front lift rod to the deck and slide the rod away from the deck. See Figure 8.7.
6. Raise the deck lift lever to the highest setting.
7. Slide the deck assembly out to the right.
8. Install the deck by following the above steps in reverse order.

NOTE: The deck is easier to install if the front edge is supported by a length of 2”x4” lumber. This brings the front hanger closer to the horizontal position. The closer the front hanger is to horizontal, the further back the deck can move to connect to the “J” pins in the rear of the deck to the lift links.

Cleaning the deck

Clean the debris off of the mower deck every time the mower is used. It is routine maintenance that will make the deck easier to work on and prolong the life of the deck and spindles.

CAUTION Debris build up on the mower deck is an unsafe condition. The debris traps heat in the spindles causing damage to the spindle bearings. Debris around the belt can overheat.

To clean the deck while it is removed:

1. Blow all the debris off of the top of the deck using compressed air.
2. Scrape off the debris build up from the under side of the deck using a plastic scraper.

   NOTE: Applying a light coating of oil to the underside of the deck after scraping it clean will help prevent rusting of the deck and help keep debris from building up on the underside of the deck.

Blades

The condition of the blades will greatly affect the quality of the cut. The blades should be sharpened and balanced after every five acres, depending on local conditions. A dull blade tears the grass instead of cutting it. Torn grass blades leaves a rough look and makes the grass vulnerable to diseases.

Blades need to be examined for damage before sharpening. Blades must be balanced after sharpening to minimize vibrations. Bent blades are a sign of a blade impact. If a bent blade is found, the blades must be replaced and the spindles inspected for bent shafts and cracked housings.

Blades come in a variety of styles; side discharge, mulching, bagging and combination. There are even dethatching blades on the market. The 900 series tractor comes with what Cub Cadet calls 3 in 1 blades. These blades can side discharge, bag and mulch.

The cutting deck on the 900 series tractor mower is mounted with a slight rake, meaning that the front of the deck is a 1/4” lower than the rear of the deck. This is very important to get the proper air flow in the deck. Proper airflow will stand the grass blades up for a more even cut.

The air flow in the cutting deck is generated by the spinning blades. If the blades are mounted upside down, the air flow will be reversed pushing the grass down instead of standing up.

NOTE: Blades that are mounted upside down increase the risk of impacting an object.

490-850-0005

Figure 8.8

To remove the blades:

1. Remove the deck as described in the previous section of this chapter or lift the mower and safely support.
2. Block the blade with a piece of wood to prevent it from spinning.

NOTE: MTD blade holding tool 490-850-0005 can be used to hold the blade while removing the blade nut. See Figure 8.8.

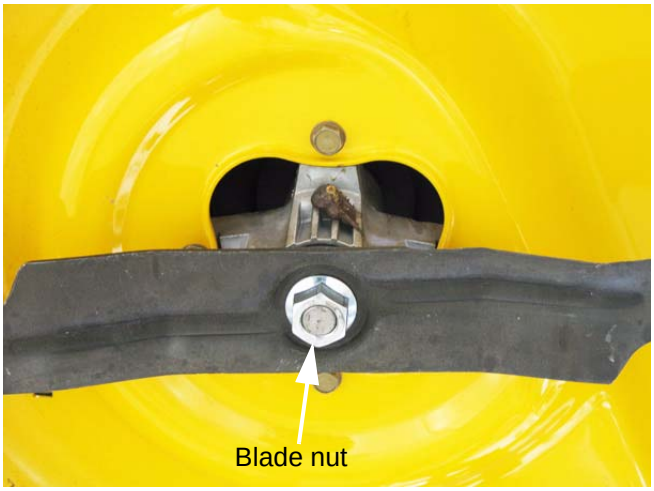


Figure 8.9

3. Remove the blade nuts using a 15/16” socket. See Figure 8.9.

⚠CAUTION Use care around the blade while removing or tightening the nut. The blade can spin and cause an injury to the technician.

4. Remove the blade.
5. Install the blade by following the above steps in reverse order. Tighten the blade nut to a torque of 70 - 90 ft-lbs (95 - 122 Nm).

   NOTE: There are words stamped onto the blade. They must be facing the ground while cutting grass. See Figure 8.10.

   NOTE: The spindle has a star on the shaft. The blade must be seated over the star before tightening the nut.

   NOTE: A 15/16” wrench can be used to hold the top of the spindle shaft.
6. Test run the mower in a safe area.

   NOTE: Confirm that all safety and control features work correctly. DO NOT return an unsafe mower to service.

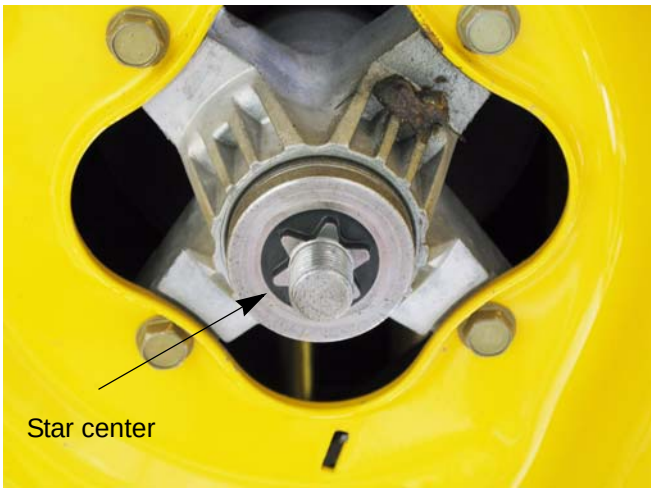


Figure 8.10

Sharpening the blades:

- To properly sharpen the cutting blades, remove equal amounts of metal from both ends of the blades along the cutting edges, parallel to the trailing edge, at a 25° to 30° angle.
- Sharpen the top of the blade only, maintaining the factory cutting edge angle.

IMPORTANT: If the cutting edge of the blade has already been sharpened to within 1 2/8” from the edge, or if any metal separation is present, replace the blades with new ones.

IMPORTANT: It is important that each cutting blade edge be ground equally to maintain proper blade balance.

IMPORTANT: Replace any blade with severe nicks or dents that cannot be removed by filing.

- Blade balance should be tested using a blade balancer tool. Grind metal from the heavy side until it balances evenly.

⚠CAUTION A poorly balanced blade will cause excessive vibration. This vibration may cause damage to the mower and result in personal injury.

Spindles

The spindles are a complete unit. The only replaceable part is the pulley. The spindles are equipped with a grease fitting that should get one squirt of grease after every use of the deck wash system or every 10 hours of use.

NOTE: The bearings are sealed. Grease fills the void around the bearings. Over-greasing the spindles may push the bearing out of the spindle housing, ruining the spindle.

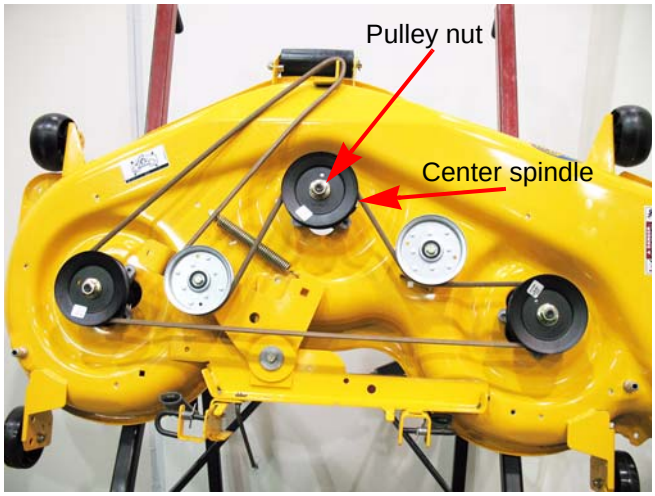


Figure 8.11

To replace a pulley:

1. Remove the deck as described at the beginning of this chapter.
2. If the deck is equipped with three blades, the center spindle pulley can be removed at this point using an impact wrench with a 15/16” socket to remove the pulley nut. See Figure 8.11.

NOTE: Greasing is intended to keep condensating moisture within the spindle from reaching the bearings.

3. Slip the PTO belt off of the spindle pulley that is to be serviced.

NOTE: Timed decks will need to have the timing belt removed also.

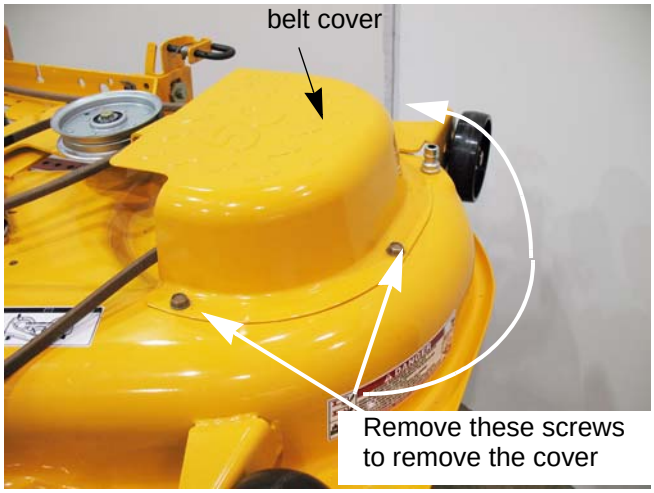


Figure 8.12

4. To access the outer spindles, remove the belt covers. See Figure 8.12.

NOTE: Some belt covers have belt guides built into them. See Figure 8.13.

5. Remove the pulley nut using an impact wrench with a 15/16” socket.
6. Install the spindle pulleys by following the above steps in reverse order.
7. Test run the tractor before returning to service.

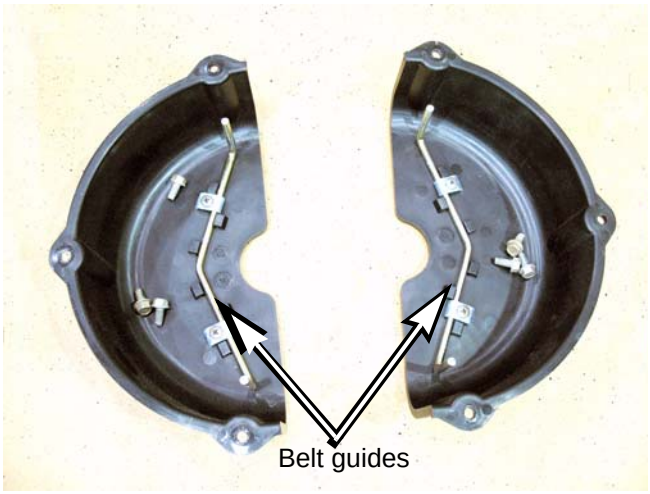


Figure 8.13

To replace a spindle:

1. Remove the deck as described at the beginning of this chapter.
2. Remove the blade following the steps described in the previous section of this chapter.
3. Remove the belt covers.
4. Slip the PTO belt off of the spindle pulley that is to be serviced.

   NOTE: Timed decks will need to have the timing belt removed also.
5. Remove the four bolts fastening the spindle to the deck. See Figure 8.14.
6. Lift the spindle out of the deck shell.
7. Install the spindle by following the above steps in reverse order.

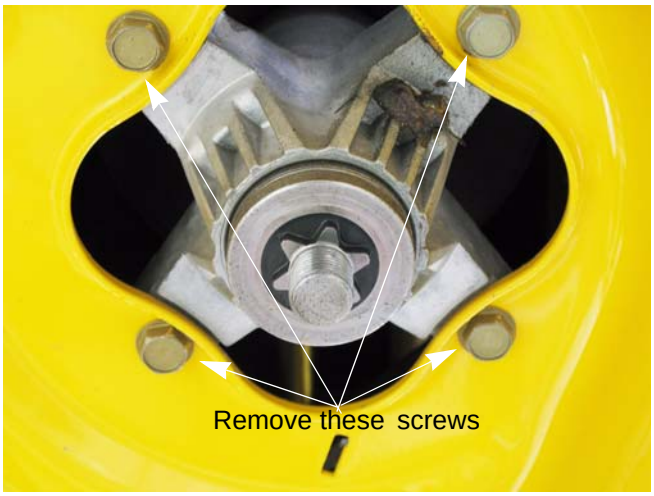


Figure 8.14

NOTE: The four spindle bolts are self tapping bolts. The new spindle housing will not have threads in it.

NOTE: Tighten the spindle bolts to a torque of 200 - 300 in-lbs (23 - 34 Nm).

PTO belt

The function of the PTO belt is to transfer the mechanical force from the engine to the blades. The PTO belt encounters many different forces:

- The friction of the belt grabbing the different pulleys creates heat. This heat softens the belt which weakens it.
- Every time the electric PTO is engaged, the PTO belt is subjected to an impact load. When the electric PTO is engaged, it goes from 0 to 3,600 RPM instantly. This can actual remove sections of the belt.

NOTE: Engaging the Electric PTO before the mowing deck is placed into the grass will reduce the impact load on the belt.

- When a blade impacts an object, like a rock or a tree root, the belt is subjected to an impact load similar to the impact load of engaging the electric PTO.
- The belt has rubber in it. As the rubber ages, it becomes brittle making it weaker.

NOTE: A damaged belt can cause the deck to vibrate when the deck is engaged. This vibration can be bad enough to simulate an engine issue.

NOTE: Not all belt damage is visible. Broken cords inside the belt are not visible to the naked eye, but can cause vibration issues and greatly reduce the life of the belt.

⚠CAUTION Cub Cadet belts are design to fit our equipment and are not standard lengths. Use of a non-OEM belt may prevent the mowing deck from working or stopping properly.

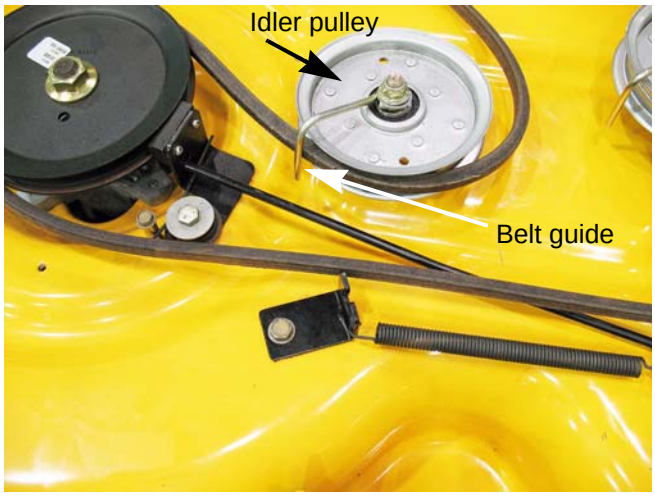


Figure 8.15

To replace the PTO belt:

1. Remove the deck as described at the beginning of this chapter.

NOTE: Removal of the deck is necessary because of the belt guides built into the belt covers.

2. Remove the belt covers.
3. Slide the belt off of the pulleys.

NOTE: Some decks have belt guides on the idler pulleys. Loosen the nut and bolt that secure the idler pulley enough so that the PTO can slip out from in between the guide and the pulley.
See Figure 8.15.

NOTE: On the 50” and the 54” deck, The belt keeper on the brake side of the idler bracket must be removed and the other belt keeper needs to be loosened. See Figure 8.16.

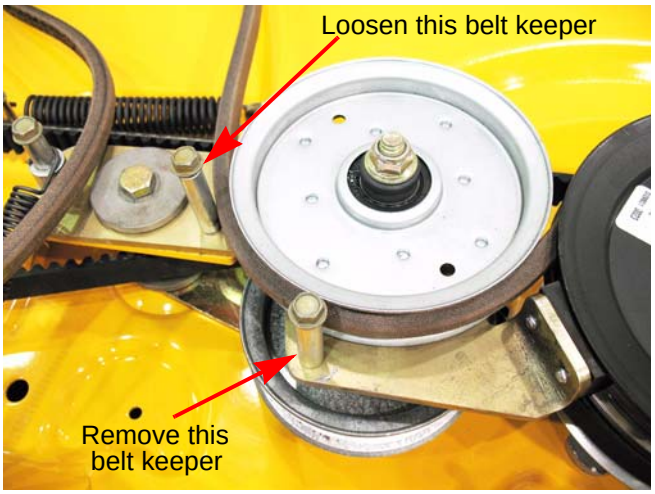


Figure 8.16

4. Route the new belt around the pulleys.
   - For a 38” “F” deck, See Figure 8.17.

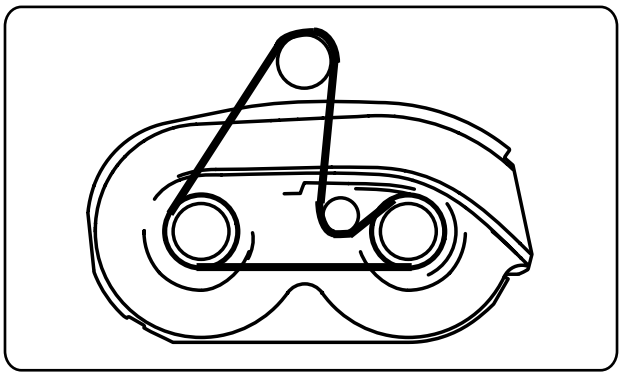


Figure 8.17

   - For a 42” “G” deck and a 46” “T” deck, See Figure 8.18.

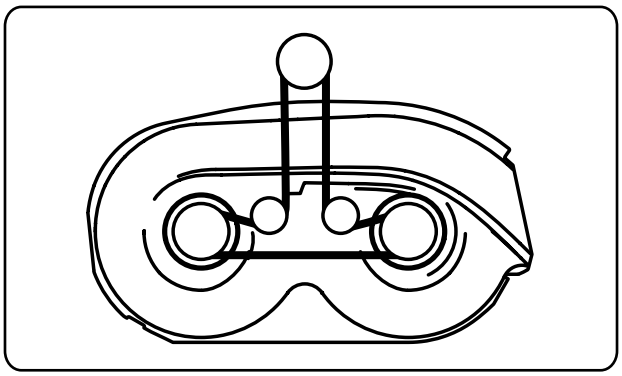


Figure 8.18

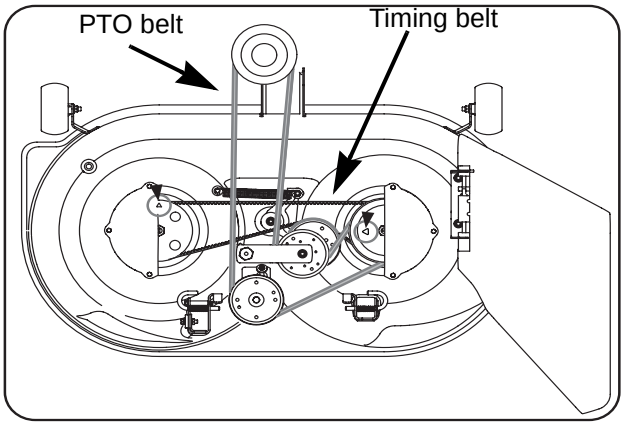


Figure 8.19

- For a 42” timed “R” deck, See Figure 8.19.

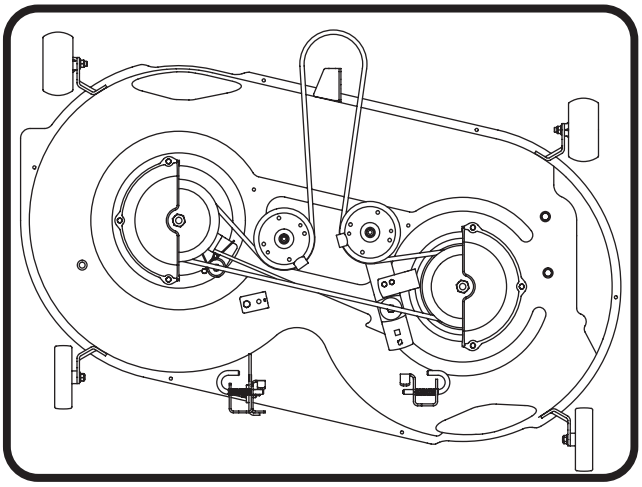


Figure 8.20

- For a 42” staggered “S” deck. See Figure 8.20.

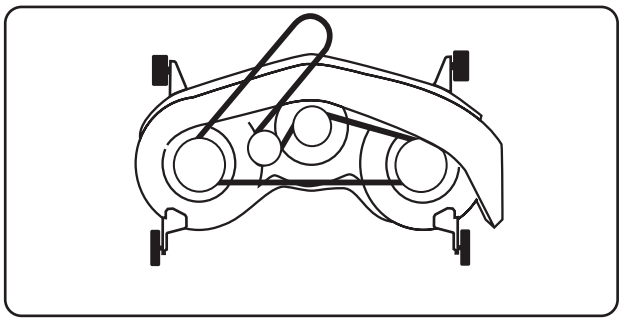


Figure 8.21

- For a 46” “H” deck, See Figure 8.21.

- For 50” “P” and 54” “K” decks, See Figure 8.22.

5. Reinstall and/or tighten all belt guards and keepers that were loosened to remove the PTO belt.
6. Install the deck as described at the beginning of this chapter.
7. Test drive the tractor before returning to service.

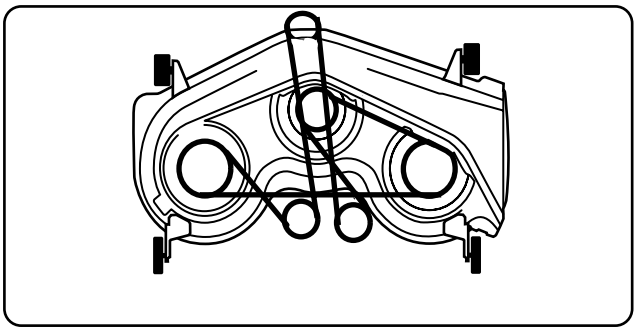


Figure 8.22

Timing belt

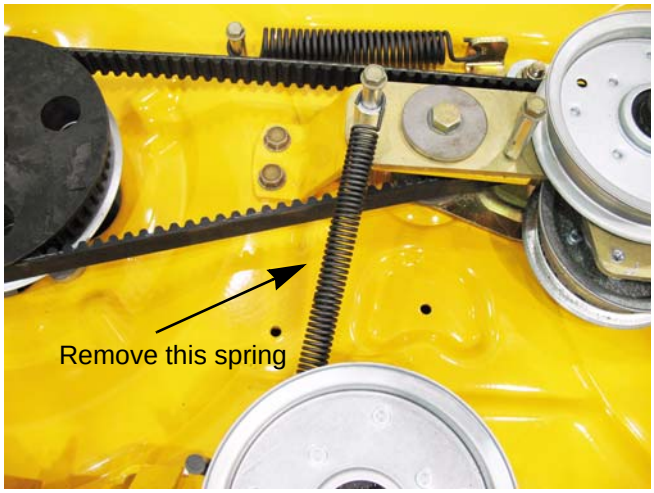


Figure 8.23

To service the timing belt:

1. Remove the deck as described at the beginning of this chapter.
2. Remove the PTO belt by following the steps described in the previous section of this manual.
3. Remove the PTO belt idler spring. See Figure 8.23.

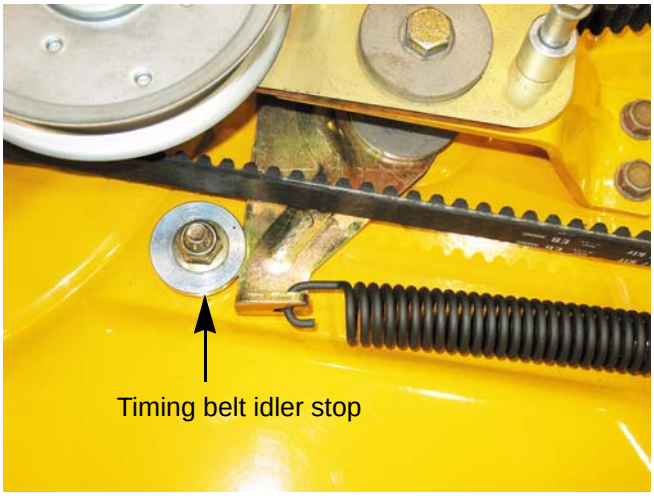


Figure 8.24

4. Remove the timing belt idler stop using a pair of 9/16” wrenches. See Figure 8.24.

NOTE: The idler spring pulley applies the tension to the timing belt. The timing belt idler stop will prevent the idler pulley from springing away from the timing belt during a blade impact. This helps prevent the blades from jumping time.

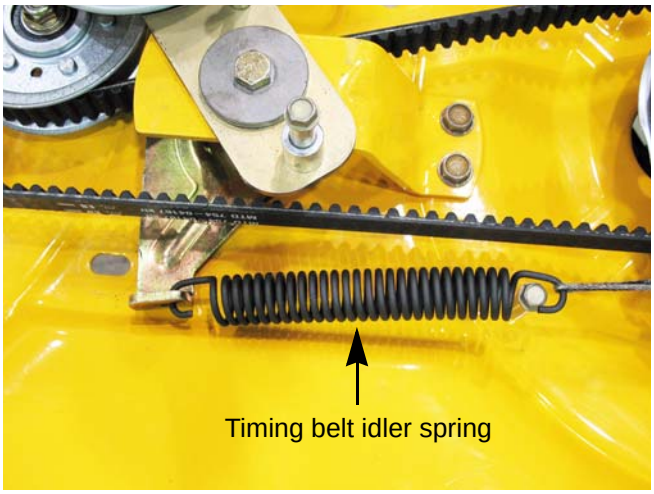


Figure 8.25

5. Remove the timing belt idler spring. See Figure 8.25.

6. Work the belt off of the pulleys.

NOTE: The PTO idler pulley and the timing belt idler pulley can be moved apart, making clearance to remove the timing belt. See Figure 8.26.

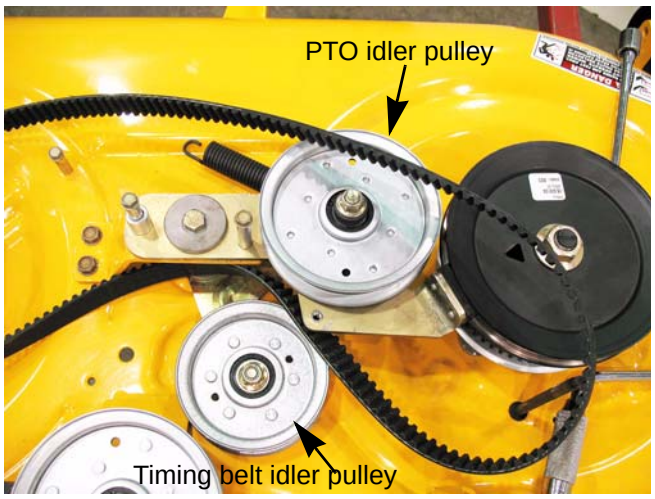


Figure 8.26

7. To install the timing belt turn the blades 90° apart. See Figure 8.27.

NOTE: Failure to time the blades will result in the blades hitting each other.

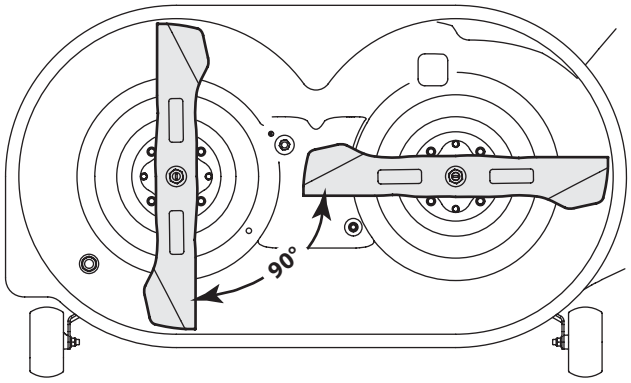


Figure 8.27

NOTE: The timing marks will line up with the blades and would need to be 90° apart. See Figure 8.28.

NOTE: The timing marks on the blade pulleys have been shown in white for clarity.

8. Install the timing belt by following steps 1 through 6 in reverse order.

9. Test run the tractor in a safe area before returning it to service.

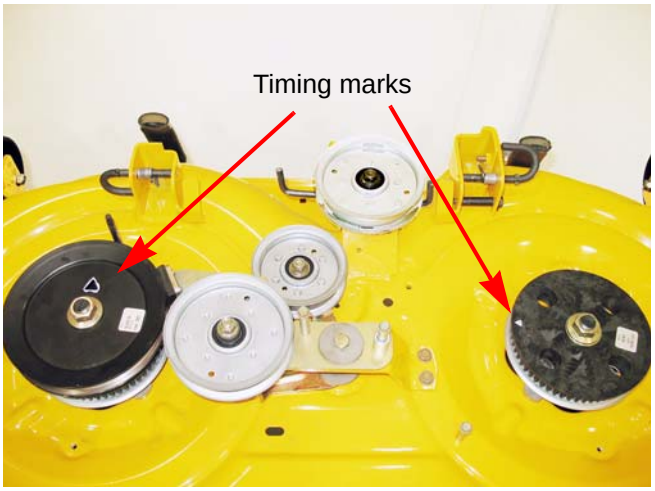


Figure 8.28

Leveling the deck

For the best quality cut, the deck must be level side to side and the front of the deck should be 1/4” - 3/8” lower than the rear of the deck.

To level the deck:

NOTE: Check the tractor’s tire pressure before performing any deck leveling adjustments. The recommended operating tire pressure are:

- Approximately 10 psi for the rear tires
- Approximately 14 psi for the front tires

Side to Side Leveling

Figure 8.29

1. With the tractor parked on a firm, level surface, move the deck to the mid height position (third or fourth notch) using the deck lift lever. Rotate both blades so that they are perpendicular with the tractor frame.

NOTE: On the timed decks, rotate one blade perpendicular to the frame, perform step two then repeat this procedure on the other blade.

2. Measure the distance from the outside of the left blade tip to the ground and the distance from the outside of the right blade tip to the ground. Both measurements taken should be equal. If they are not, note whether the left side of the deck is lower or higher and proceed to the next step.

NOTE: Use of Cub Cadet deck leveling gauge, part number 490-900-0041, will make measuring the blade tip height easier. See Figure 8.29.

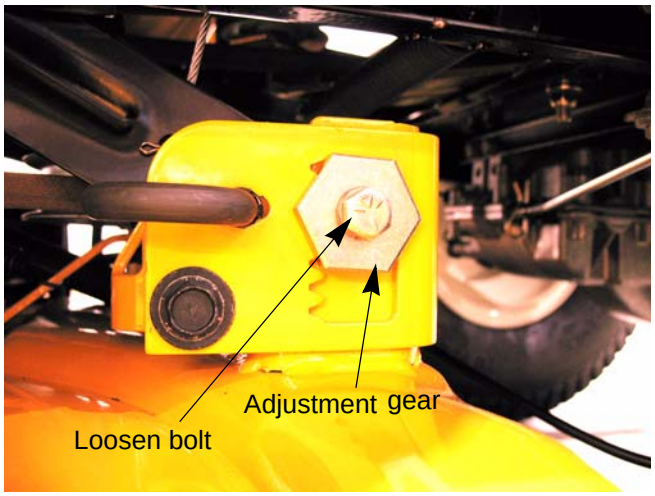


Figure 8.30

3. Working from the left side of the tractor, loosen, but do not remove, the bolt on the left deck hanger bracket. See Figure 8.30.
4. To level the deck turn the adjustment gear, located immediately behind the bolt, clockwise (rearward) to raise the left side of the deck. Turn the gear counterclockwise (toward front) to lower the left side of the deck. See Figure 8.30.
5. The deck is properly leveled when both blade tip-to-ground measurements, as described earlier, are equal.
6. Retighten the bolt on the left deck hanger bracket when proper adjustment is achieved.

Front To Rear Leveling

The front of the cutting deck is supported by an adjustable front deck hanger rod. This rod can be adjusted to set the front to rear pitch of the deck. The front of the deck should be between 1/4-inch and 3/8-inch lower than the rear of the deck. Adjust if necessary as follows:

1. With the tractor parked on a firm, level surface, move the deck to the mid height position (third or fourth notch) using the deck lift lever. Rotate the blade nearest the discharge chute so that it is parallel with the tractor frame.
2. Measure the distance from the front of the blade tip to the ground and the rear of the blade tip to the ground.

   NOTE: The front measurement taken should be between 1/4” - 3/8” less than the rear measurement. Determine the approximate distance necessary for proper adjustment and proceed, if necessary, to the next step.
3. Working at the front of the tractor, loosen the two hex lock nuts at the front of the deck hanger rod. Thread the lock nuts away from the hex nuts behind them. See Figure 8.31.

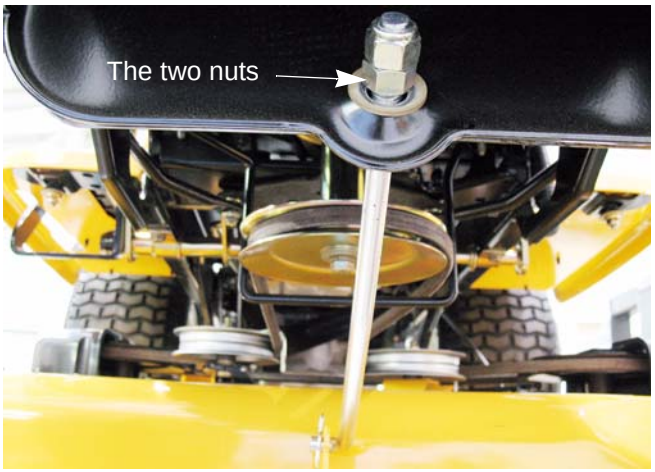


Figure 8.31

   NOTE: Both nuts are on the top side of the bracket to float and rise if the deck impacts something. This helps to minimize the damage to the deck
4. Using a wrench, turn the inner hex nuts clockwise to raise the front of the deck, or counterclockwise to lower the front of the deck.
5. Retighten the two hex lock nuts when properly adjusted.

Deck Wheel Adjustment

The cutting decks are of a “floating” design. This means that they are suspended above the ground. The gauge wheels occasionally touch the ground. They are designed to bump the deck up and over irregularities. This helps prevents scalping damage to the turf and damage to the deck.

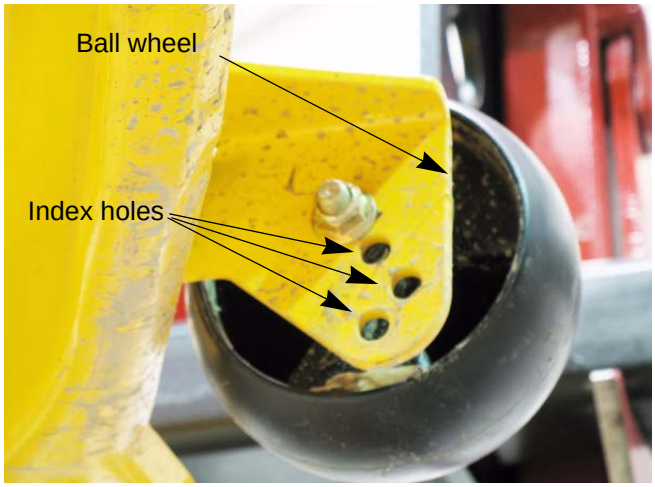


Figure 8.32

Adjust the wheels as follows:

1. Place the tractor on a smooth, flat surface and move the deck to the desired mowing height using the deck lift lever.
2. Check gauge wheels distance from the flat surface below. If the gauge wheels contact the ground, they must be raised. If the wheels are higher than 1/2" above the ground, they should be lowered.
3. Remove the shoulder bolt securing the one of the front wheels to the index bracket.
4. Reposition the wheel to align with the one of four index holes that places the wheel 1/4" to 1/2" above the ground. See Figure 8.32.
5. Secure the wheel to the index bracket with the shoulder bolt. Note the index hole used and secure the other wheel in the same position.
6. Repeat the previous steps on the rear wheels.

Deck lift shaft assembly bushings

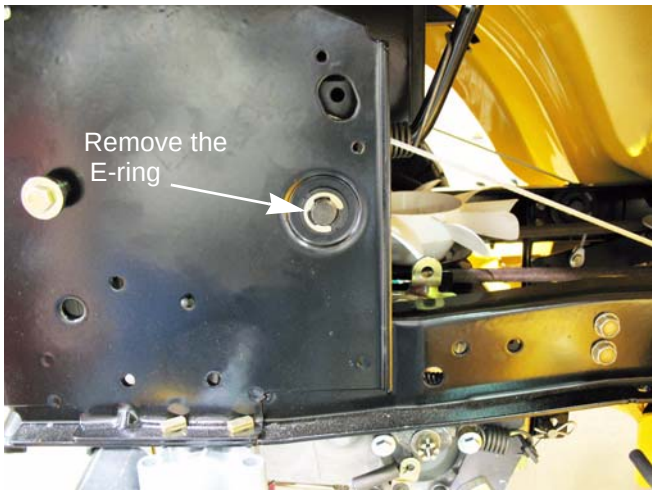


Figure 8.33

The deck lift shaft assembly bushings for the 900 series tractor can be replaced with out removing the deck lift shaft assembly. To replace the bushings:

1. Remove the deck by following the steps described at the beginning of this chapter.
2. Remove the E-ring that retains the lift shaft bushing. See Figure 8.33.

NOTE: Rear wheel was removed for picture clarity.

3. Slide the old bushing out.
4. Slide the new bushing in.
5. Install the E-ring that retains the bushing.
6. Repeat steps 2 - 6 on the opposite side.
7. Install the deck.
8. Test drive the tractor in a safe area before returning to service.

Deck lift shaft assembly removal/replacement

1. Remove the deck by following the steps described at the beginning of this chapter.
2. Remove the fender by following the steps described in Chapter 4: Body/Chassis.
3. Remove the hairpin clips that hold the top of the deck lift cables and slide the cables out of the deck lift shaft assembly. See Figure 8.34.

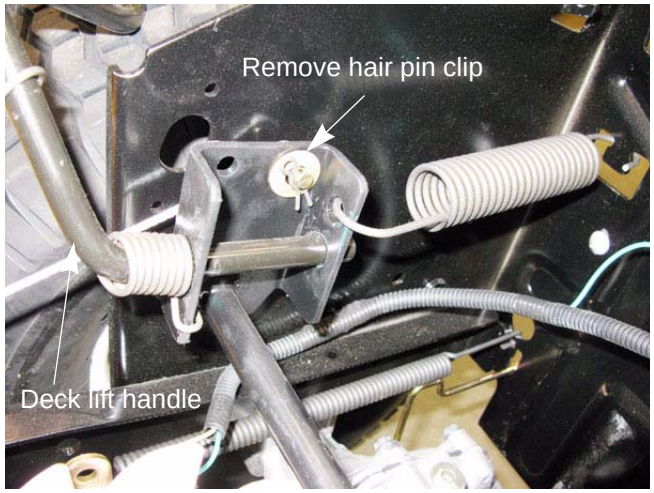


Figure 8.34

4. Unhook the lift assist spring (if equipped). See Figure 8.35.

Figure 8.35

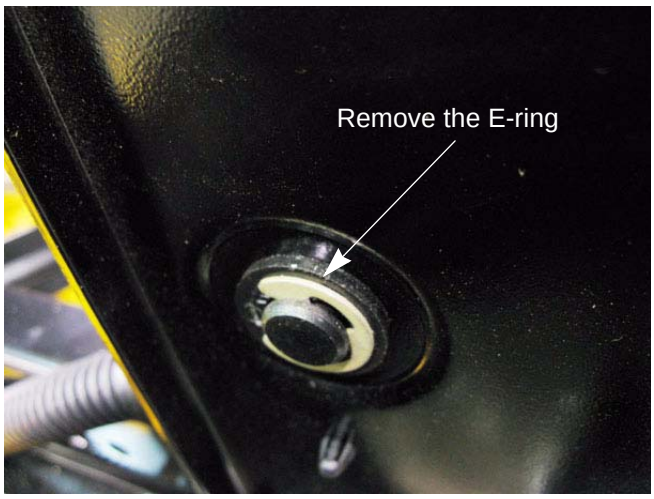


Figure 8.36

5. Remove the E-clips that retain the bushings. See Figure 8.36.

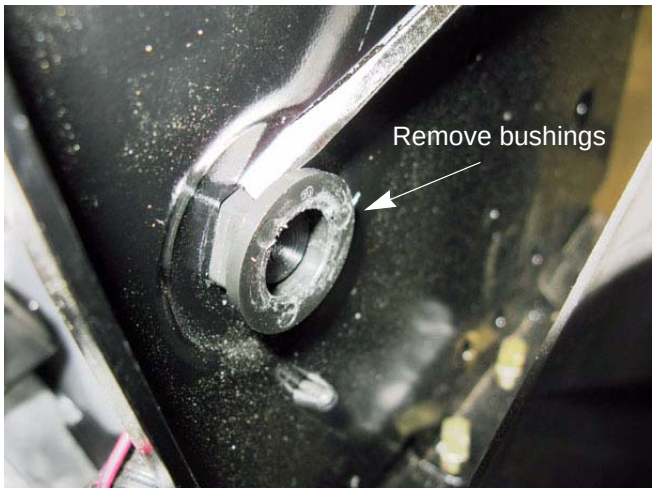


Figure 8.37

6. Remove the bushings. See Figure 8.37.
7. Work shaft out of the seat box assembly.
8. Work the lift shaft handle and spring off of the deck lift shaft.
9. Install the deck lift shaft by following the above steps in reverse order.

Deck lift links and cables

The deck lift links have two functions. The first function is to support the rear of the deck. The second function is to raise or lower the deck in response to movement of the deck lift lever.

To accomplish the second function, the deck lift cables run from the deck lift shaft assembly and over a pulley to the lift links.

There are two sets of lift links used on the 900 series tractors. The links used on the 38” and 42” decks have a left and a right lift link. The links used on the 46”, 50” and the 54” deck are all the same link.

The holes used in the lift link will vary depending on which deck is used. See Figure 8.38.

NOTE: If the cable or the deck “J” pin is installed in the wrong hole, the belt angle between the PTO and the deck will be off. This will result in the PTO belt being thrown off.

NOTE: The procedures to service the lift cables and lift links are the same, regardless of which deck is used on the tractor.

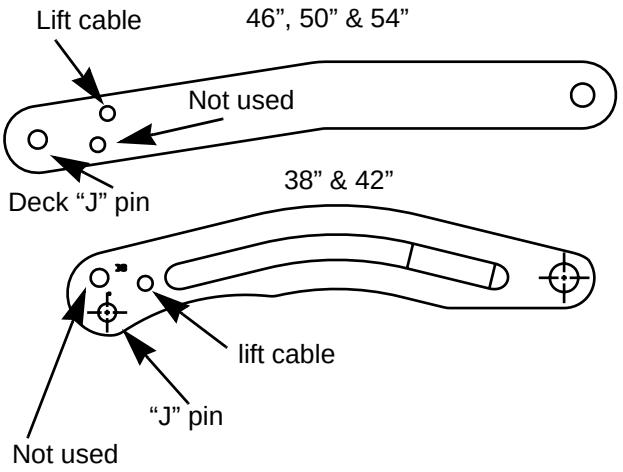


Figure 8.38

To remove/replace the lift link cables:

NOTE: The lift links and the lift cables can be serviced without removing the fender.

1. Remove the deck by following the steps described at the beginning of this chapter.
2. Remove the four screws the fasten that right side fender trim to the fender using a 3/8” wrench. See Figure 8.39.

NOTE: The screws are accessed from the underside of the fender.

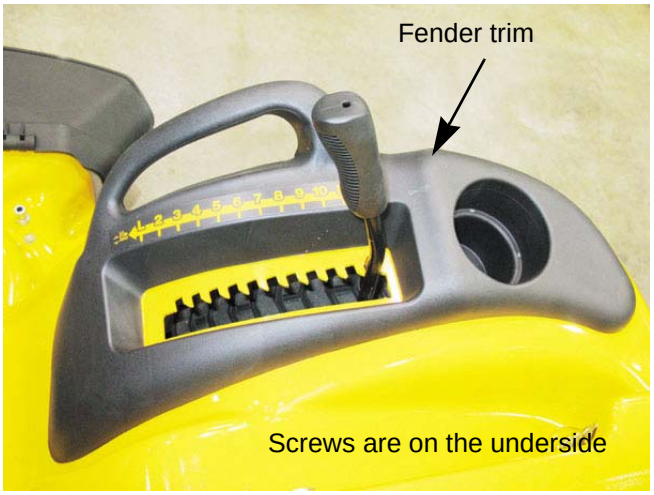


Figure 8.39

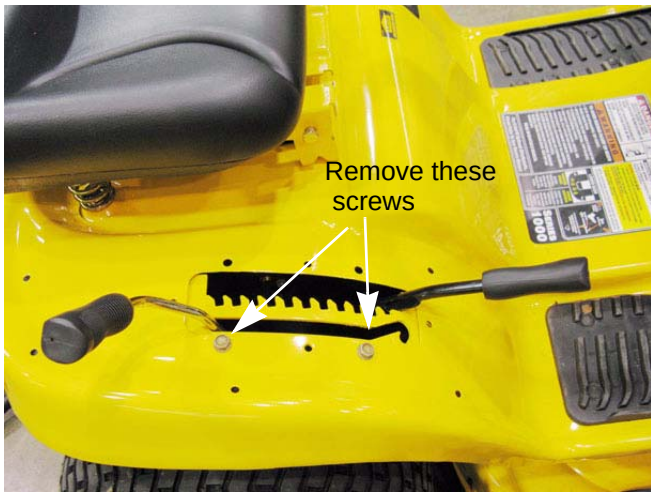


Figure 8.40

3. Remove the two screws that secure the deck lift arm indexing plate using a 1/2” wrench. See Figure 8.40.

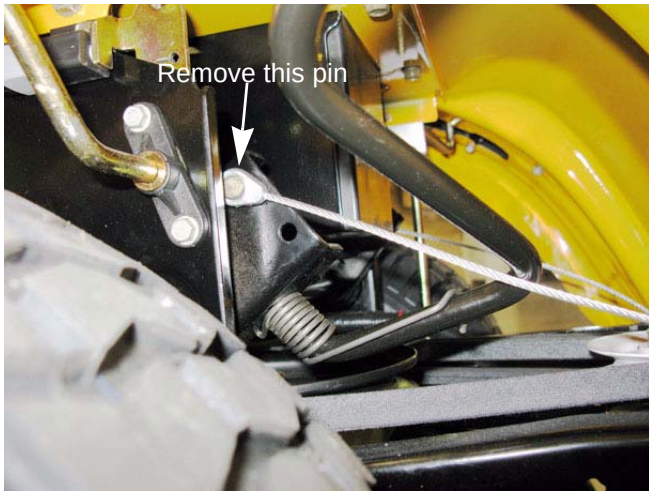


Figure 8.41

4. Push the deck lift arm as far forward as it will go.
5. Remove the hair pin clip that secures the lift cable to the lift shaft then slide the clevis pin out of the cable. See Figure 8.41.

NOTE: With the indexing bracket loose, there should be enough clearance to slide the clevis pin out past the frame.

6. Disconnect the lift cable from the lift link by removing the cotter pin.
7. Lift the cable off of the cable pulley.
8. Install the lift link cable by following the previous steps in reverse order.
9. Test run the tractor in a safe area before returning it to service.

CHAPTER 9: MAINTENANCE INTERVALS

Lubrication

To help keep the 900 series in proper running order it is recommended the following lubrication intervals be used (adjustable to local conditions). Use a high quality petroleum grease to lubricate the tractor.

Lubercation Points

Lube Point	Number of fittings	Interval
Pivot bar	2	25 hours
Wheel bearings	2	25 hours
Spindles	2 or 3	10 hours
Grease brake shaft		100 hours
Remove rear wheels or hub/ grease rear axle shaft		yearly

NOTE: Lubricate all of the pivot points with a light coating of oil once a season.

Engine maintenance

The recommended maintenance intervals listed in this manual are a guideline. They are adjustable for local conditions.

Engine Maintenance

Maintenance items	Interval
Oil Change	100 hrs
Air filter pre-cleaner	25 hrs
Air filter	50 hrs
Spark plugs	100 hrs
Fuel filter	100 hrs

The spark plug(s)

The spark plug(s) should be checked, cleaned and re-gapped on a monthly basis or every 100 hours of use. The plugs should be replaced every six months or 300 hours of use.

When checking the spark plug(s), a dry, light colored residue on the plugs is a sign of running lean. If there is a thick, wet, black residue on the plug the engine is running rich. If either of these conditions are present, it would indicate a problem with the carburetor.

There should be a dry tan coating on the plug(s). this would indicate the proper mixture.

1. To remove/replace the spark plug(s):

   1a. Remove the spark plug wire(s). See Figure 9.1.

   NOTE: Do not use metal pliers on spark plug wire(s). Damage to the wire can result.

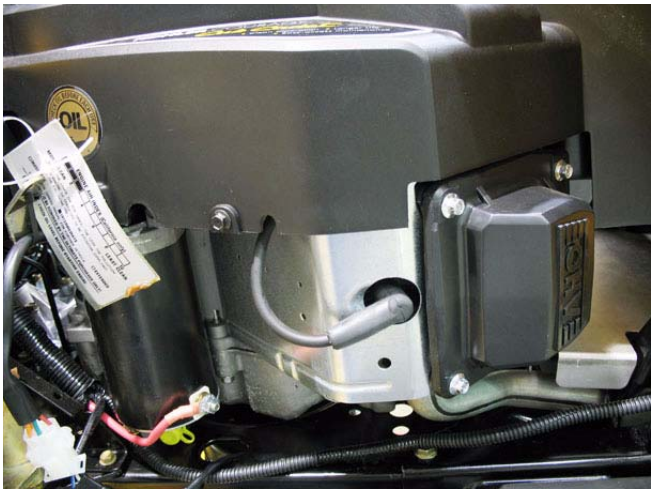


Figure 9.1

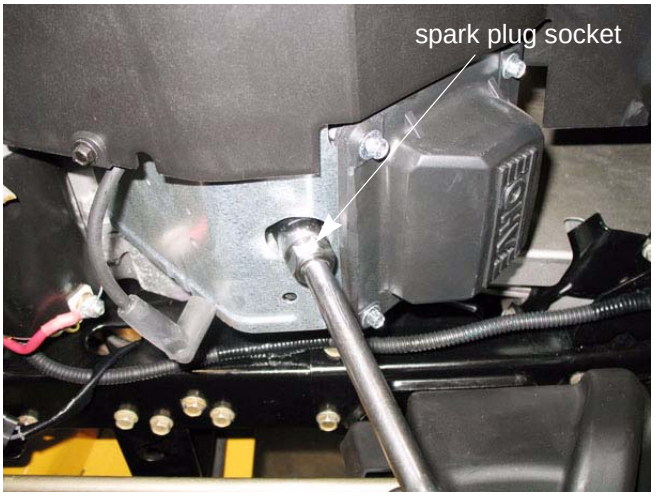


Figure 9.2

   1b. Remove the spark plug(s) with the appropriate spark plug socket. See Figure 9.2.

   1c. Clean the Spark plug(s) with carburetor cleaner or replace them with the spark plug(s) suggested by the engine manufacturer.

   NOTE: Do not clean the spark plug(s) mechanically (sand blasting or scraping). This will damage the insulator.

   1d. Gap the electrodes according to the engine manufacturer's specifications.

   1e. Thread the spark plug(s) into the spark plug hole(s).

   1f. Tighten the spark plug(s) to a torque specified by the engine manufacturer.

   NOTE: Refer to engine manufacturer's service manual for more detailed instructions.

   1g. Push the spark plug wire(s) onto the spark plug(s) until they snap into place.

Air filter and foam pre-cleaner

A dirty air filter and/or foam pre-cleaner can reduce engine power, increase fuel consumption and make starting more difficult.

The foam pre-cleaner should be checked before each use and cleaned every 25 hours.

The air filter should be cleaned before each use and replaced every two months or 50 hours of use.

Refer the engine manufacturer’s service manual for the proper procedure access the air filter.

To clean a pre-cleaner:

1. Remove the pre-cleaner following the steps described by the engine manufacturer.
2. The foam pre clean should be cleaned by:

   2a. Wash the foam filter in warm soapy water.

   2b. Rinse it and let it air dry.

   IMPORTANT: Always replace a damaged filter.

   NOTE: If the pre-cleaner does not directly contact the paper element air filter, work a few drops of light oil into the pre-cleaner before installation. If the pre-cleaner directly contacts the paper air filter, do not oil the pre-cleaner, as the oil may wick into the air filter, reducing the air flow through the air filter.

   *These filters may vary with the engine models and individual filter designs.

Oil change

The oil change interval is every 100 hrs.

NOTE: The first oil change should be preformed at 5 hours.

To change the oil:

1. Remove the cap from the oil drain. See Figure 9.3.
2. Slide a piece of 1/2” i.d. rubber hose onto the drain.
3. Push in on the oil drain and rotate 90 degrees to open the drain.
4. After all of the oil has been drained, close the oil drain.
5. Remove the drain hose.
6. Place the cap back on the oil drain.
7. Fill engine with new oil. Use a good quality motor oil that meets the specifications recommended by the engine manufacturer.
8. Check the dip stick to verify that the oil is at the proper level before returning to service.

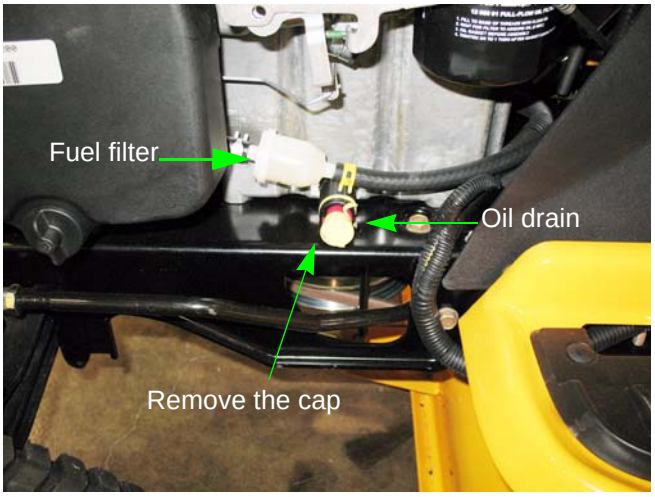


Figure 9.3

Oil filter

To replace the oil filter:

1. Drain the oil by following the previously described steps.
2. Remove the oil filter using an oil filter wrench.
3. Place a light coating of oil on the O-ring of the new filter.
4. Pre-fill the new filter with fresh, clean oil.
5. Thread the new filter on to the engine. Hand tighten only.
6. Fill the engine with oil.
7. Test run the engine and check for leaks before returning to service.

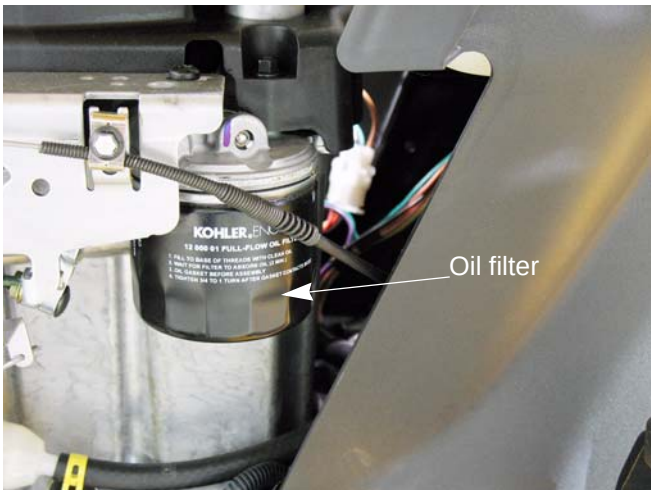


Figure 9.4

Fuel system

What you should know about fuel.

Most of the fuel presently available in North America is oxygenated to some extent. This is commonly done through the addition of ethanol. Most engines offered for sale on outdoor power equipment in the North American markets are designed to tolerate no more than 10% ethanol by volume

Ethanol is hygroscopic, meaning it absorbs water. If left exposed to air, it will draw water out of the air.

Ethanol is an oxygenator, which means that it will oxidize (corrode) metal that it comes into contact with. Exposure to air causes fuel to go bad quickly, leaving gum and varnish deposits.

Fuel used in Cub Cadet outdoor power equipment should be no more than 30 days old. Because it may already have been stored at the refinery or gas station for a week or more, fuel should be purchased in small quantities and stored in safety approved gas cans with the caps closed.

For off-season storage, all fuel should be run out of the tank and engine. Anti-oxidation additives such as Sta-bil will help keep the fuel fresher.

Servicing the fuel system

Inspect the fuel system every time the tractor is operated. If old or dirty fuel is suspected in the fuel tank, drain the fuel tank and replace the fuel filter

Drain the fuel tank by removing the fuel line from the fuel filter and drain the fuel into an empty safety approved gas can. Dispose of the bad fuel in a safe manner that follows local laws.

Fuel filter

Figure 9.5

A dirty fuel filter can result in a lean run condition. The fuel filter should be replaced every 100 hours.

To replace the fuel filter:

1. Clamp off the fuel lines to prevent fuel from leaking when the lines are disconnected. See Figure 9.5.

   IMPORTANT: Take care that the fuel lines are not damage when clamping them off. Never insert a screw or anything else into the fuel line to prevent fuel from coming out. This will damage the inside of the fuel line.

NOTE: There are commercially available fuel line clamping tools that will not damage the fuel lines.

2. Squeeze the tabs on the fuel line clamps and slide them away from the filter.
3. Carefully slide the fuel lines off of the filter. If there are pieces of rubber on the barbs of the fuel filter, replace the affected fuel line.

   IMPORTANT: The 900 series tractor uses low permeation fuel line to meet EPA guidelines. When replacing the fuel lines, they must be replaced with the same type of low permeation fuel line.

4. Install the new filter by following the above steps in reverse order.
5. Test run the engine and check for leaks before returning to service.

Clean the engine

Air cooled engines cool better when they are clean. Check for signs of animal or insect infestation, especially after off-season storage. Clean or replace any infested parts as needed.

Figure 9.6

Lubricate the pedal shaft

NOTE: The deck does not need to be removed to perform this procedure.

1. Remove the screw that secures the pedal shaft support strap using a 1/2” wrench. See Figure 9.7.
2. Gently pull down on the pedal shaft.
3. Apply a generous amount of a high quality lithium grease to the support strap and the shaft using a brush.
4. Put the support strap back in place and install the screw that was removed in step 1.
5. Repeat steps 1 through 4 on the opposite side.

Figure 9.7

HYDRO-GEAR APPENDIX

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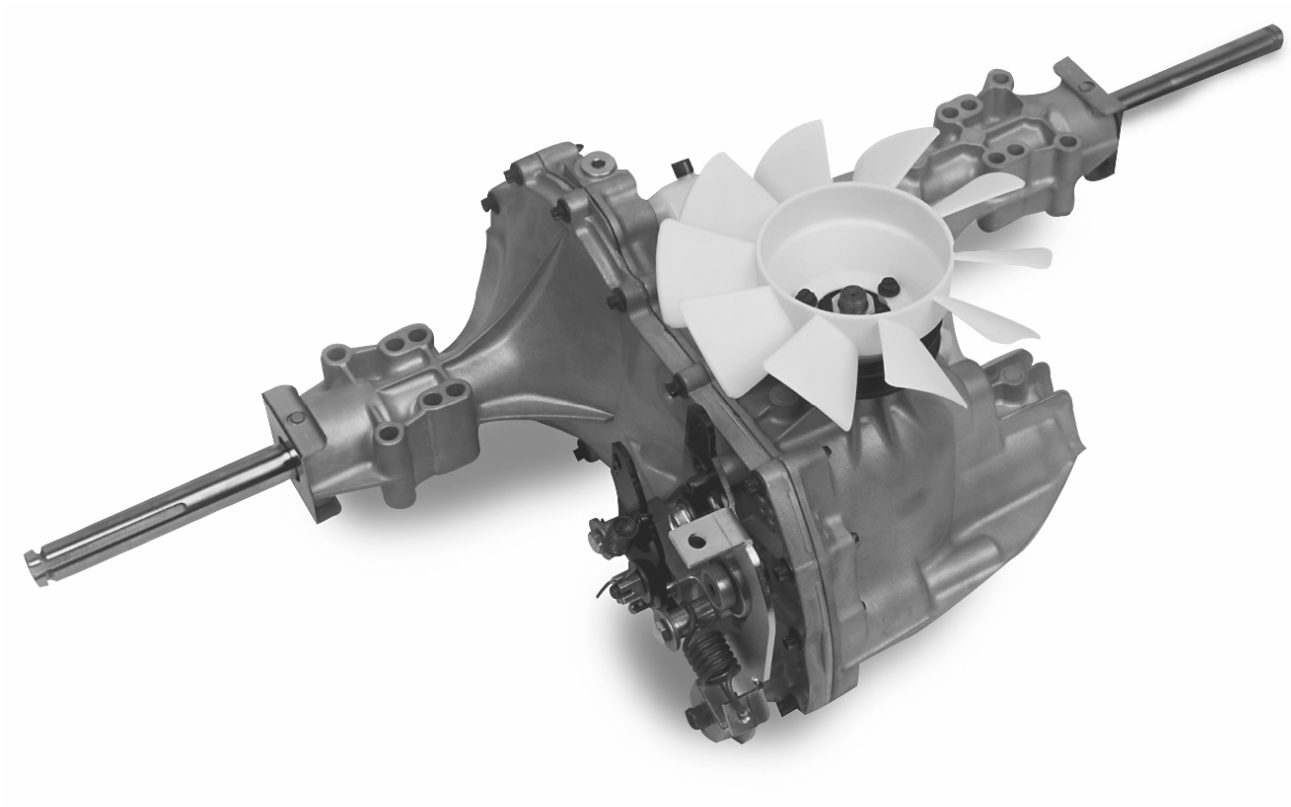
Hydro-Gear®

We set the wheels in motion.®



310-0510/-0610/-0710
Integrated Hydrostatic Transaxle
Service and Repair Manual

BLN-51260
April 2008

Table of Contents

Section Page

FOREWORD

Headquartered in Sullivan, Illinois, Hydro-Gear® is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear 310-0510 Integrated Hydrostatic Transaxle (IHT). Troubleshooting for the 310-0510 is further illustrated in video BLN-51368 (NTSC).

Also included is a glossary of terms that are frequently used throughout the industry and in Hydro-Gear service publications. Understanding terminology is very important!

It is necessary, and good shop practice, that your service area be equipped with the proper tools and the mechanics be supplied with the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Repair procedures require that the transaxle unit be removed from the vehicle.

This is not a certification, test or study guide for a certification test. If a technician is interested in certification they should contact an agent representing OPEESA (Outdoor Power Equipment and Engine Service Association) at (860) 767-1770 or their Hydro-Gear Distributor. Many distributors will be hosting certification testing. These study guides will cover most of the products and manufacturers in our industry.

For more information about Hydro-Gear or our products, please contact your Central Service Distributor, or call our Customer Service Department at (217) 728-2581.

SECTION 1. DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide information useful in servicing the Hydro-Gear® Integrated Hydrostatic Transaxle (IHT). This manual includes the IHT's general description, hydraulic schematic, technical specifications, servicing and troubleshooting procedures.

The transaxle normally will not require servicing during the life of the vehicle in which it is installed. Should other servicing be required, the exterior of the transaxle will need to be thoroughly cleaned before beginning most procedures. Do not wash the transaxle while it is hot. Do not use a pressure washer to clean the unit.

GENERAL DESCRIPTION

The 310-0510 is a self contained unit designed for the transfer and control of power. It provides an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation.

This transaxle uses a variable displacement pump with a maximum displacement of 10cc per revolution, and motor with a fixed displacement of 10cc per revolution. The variable displacement pump features a trunnion mounted swashplate with a direct-proportional displacement control. Reversing the direction of the swashplate reverses the flow of oil from the pump and thus reverses the direction of the motor output rotation. The pump and motor are of the axial piston design and utilize spherical nosed pistons which are held against a thrust race by internal compression springs.

The 310-0510 has a self contained fluid supply and an internal filter. The fluid is forced through the filter by a positive "head" on the fluid in the housing/expansion tank with an assist by the negative pressure created in the pump pistons as they operate.

The check valves in the center section are used to control the makeup flow of the fluid to the low pressure side of the loop.

A check ball lifting bypass is utilized in the 310-0510 to permit moving the vehicle for a short distance at a maximum of 2 m.p.h. (3.2 Km/h) without starting the engine.

WARNING

Actuating the bypass will result in the loss of hydrostatic braking capacity. The machine must be stationary on a level surface and in neutral when actuating the bypass.

The 310-0510 utilizes an in-line floating disc brake controlled by a "cam" style actuating arm.

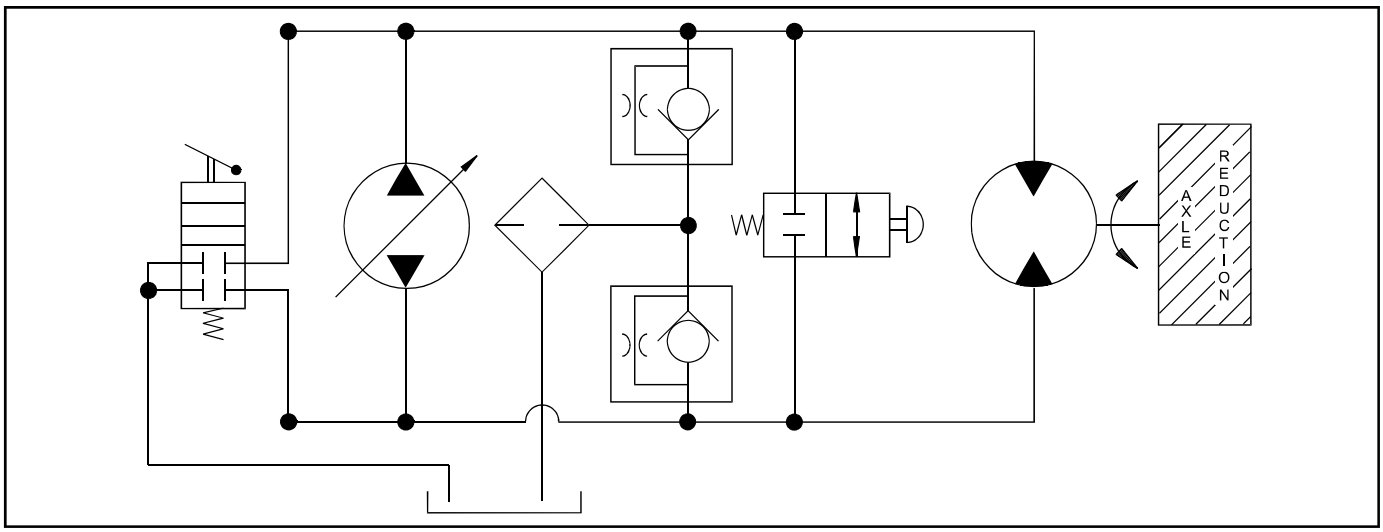


Figure 1. 310-0510 Hydraulic Schematic

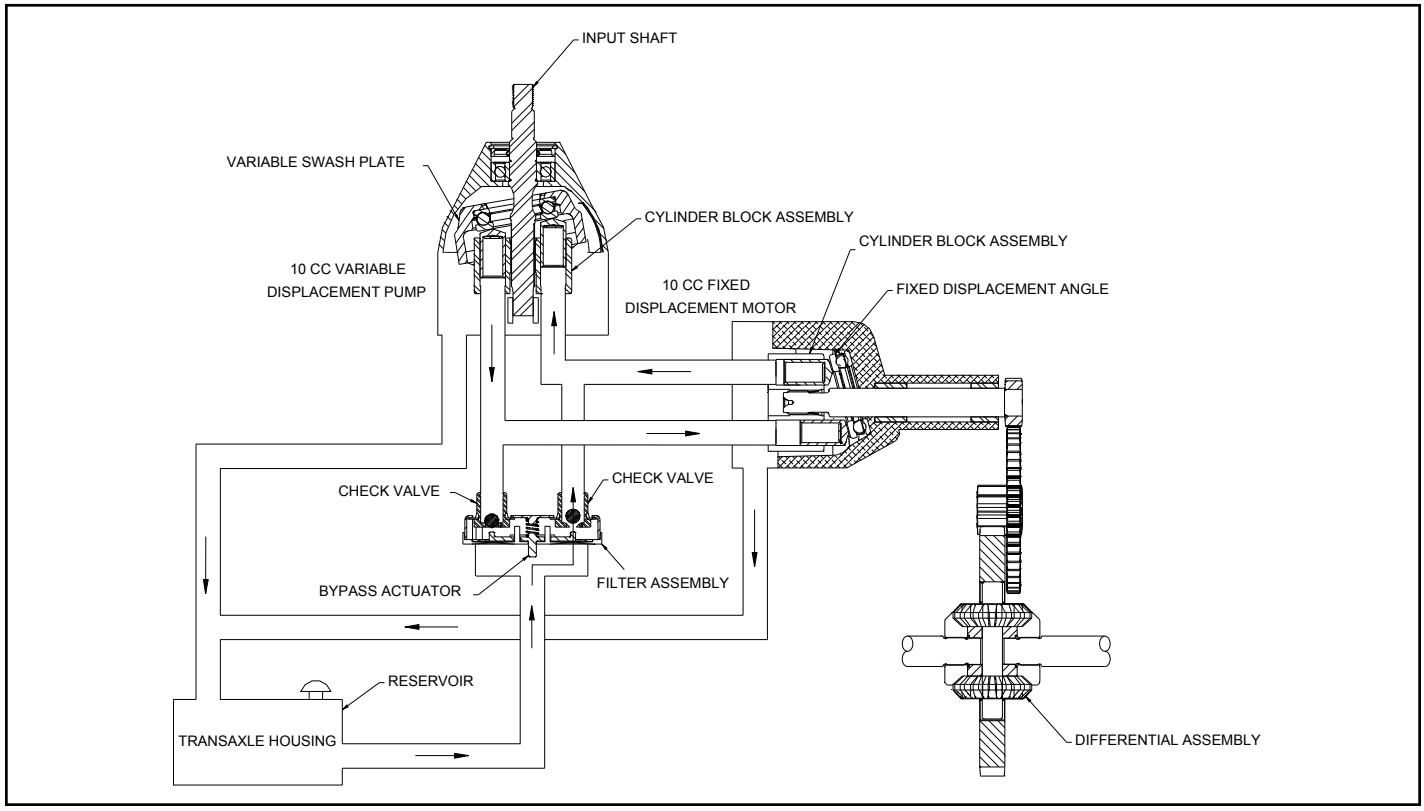


Figure 2. 310-0510 Hydraulic Flow Illustration

HYDRAULIC SCHEMATIC

Figure 2 provides an illustration of the hydraulic oil circuit. The oil supply for the hydraulic system of the 310-0510 IHT is also utilized for lubricating the components of the final drive assembly.

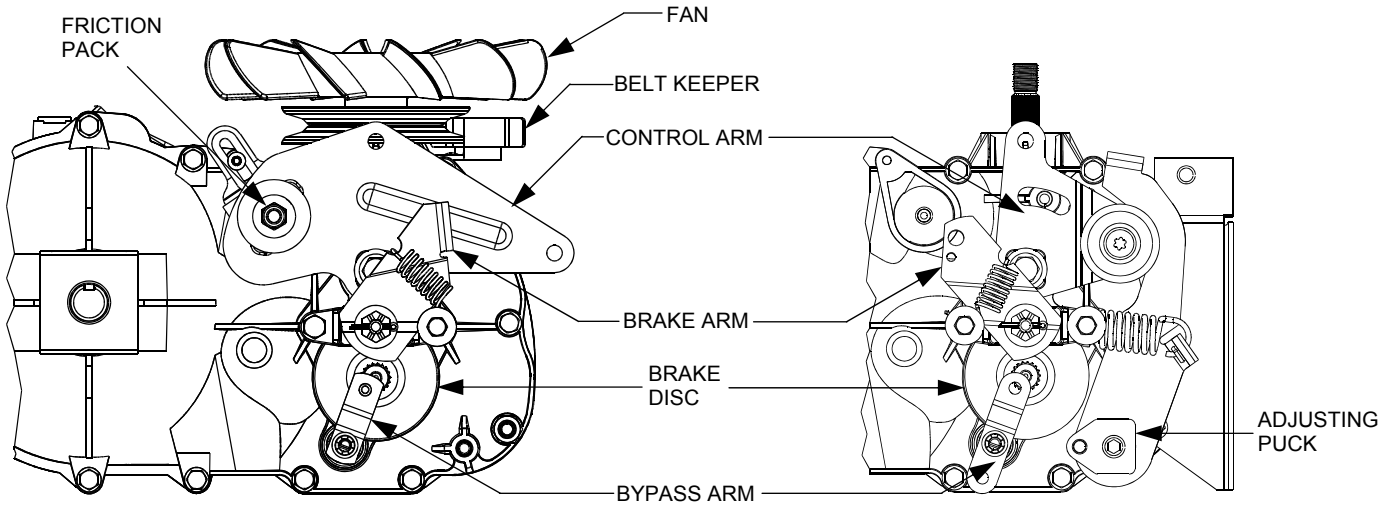
The input shaft and pump cylinder block are turned in one direction only by the engine/drive belt/pulley combination. Output of the oil flow is controlled by the direction and amount that the variable swashplate is angled. As the pump pistons compress they force the oil to flow through one of two passageways (forward or reverse) in the center section to the motor cylinder block and motor shaft. Since the motor has a fixed displacement angle it is forced to turn with the flow of oil. As the angle of the pump swashplate is increased the amount of oil being pumped will increase and cause a higher speed output of the motor. Reversing the angle of the swashplate will reverse the direction of oil flow.

During the operation of the transaxle, fluid is “lost” from the hydraulic loop through leak paths designed into the product for lubrication purposes (around pistons, under the rotating cylinder blocks, etc.). This “lost” fluid returns to the transaxle housing, then is pulled back into one of the check valves depending upon the direction of vehicle operation. All of this oil must pass through an internal filter.

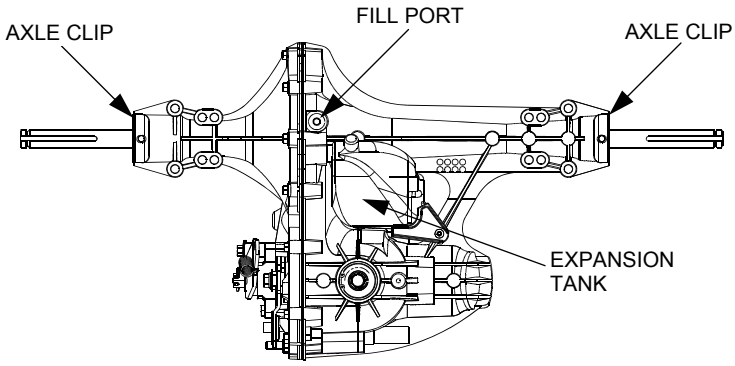
The motor cylinder block mounts onto a splined motor shaft which drives the gear train.

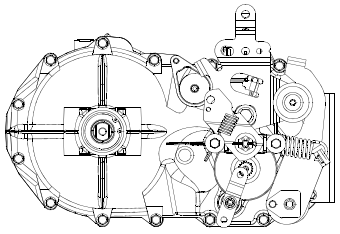
The bypass feature in the 310-0510 has a mechanical lever which lifts the check valve balls off their seat. This allows oil flow from the cylinder blocks to be discharged.

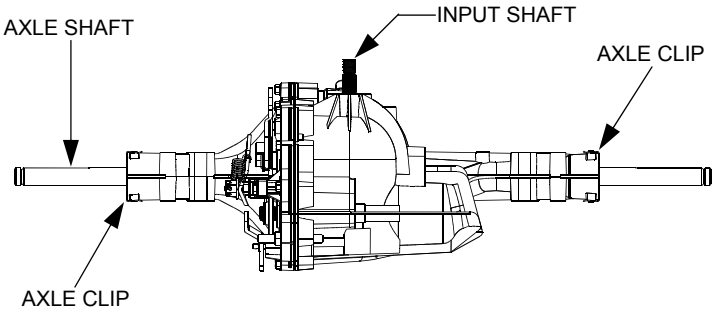
EXTERNAL FEATURES 310-0510



Friction Pack Option **Return to Neutral Option**







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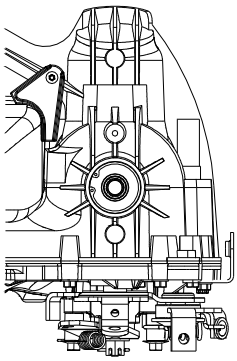

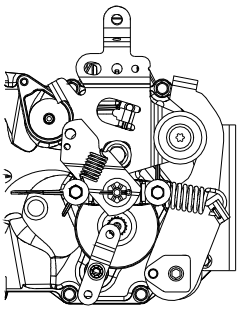

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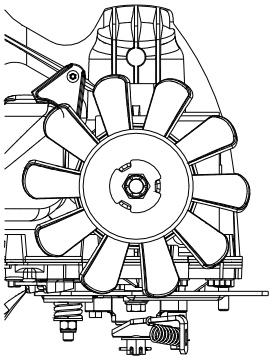

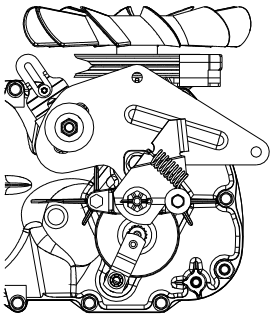

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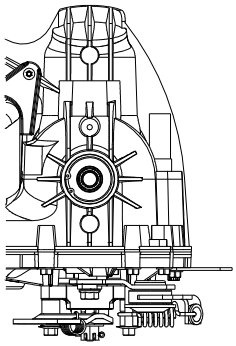

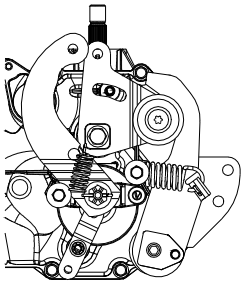

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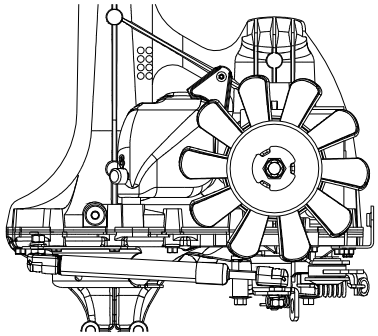

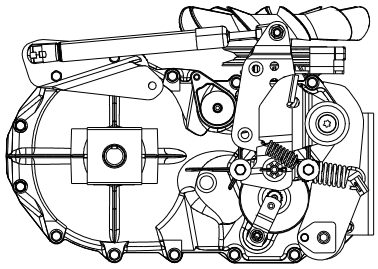

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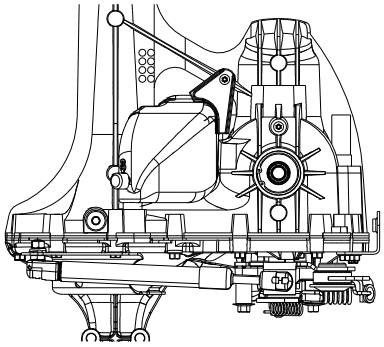

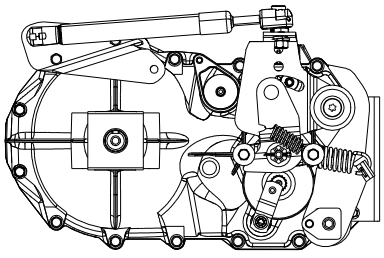

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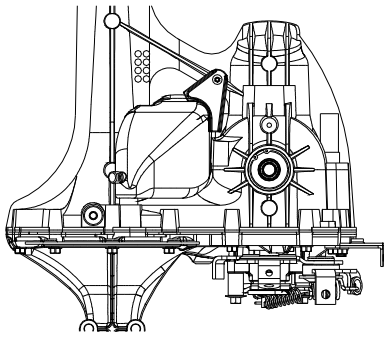

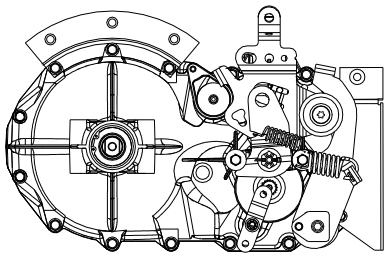

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TECHNICAL SPECIFICATIONS

Technical specifications for the 310-0510 IHT are listed in Table 1.

Table 1. 310-0510 Technical Specifications

Overall Transaxle Reduction 22.15:1	**Axle Shaft Options** Type: Keyed / Double “D” Diameter: 0.75 inch; 19.05 mm
Input Speeds Maximum: 3000 RPM Minimum: 1800 RPM	**Brake Type** Disc
Maximum Tire Diameter 20 inch; 508 mm	**Weight of Unit** 30 lb; 14 kg

PRODUCT IDENTIFICATION

The model and configuration of the 310-0510 IHT can be determined from the label shown in Figure 3.

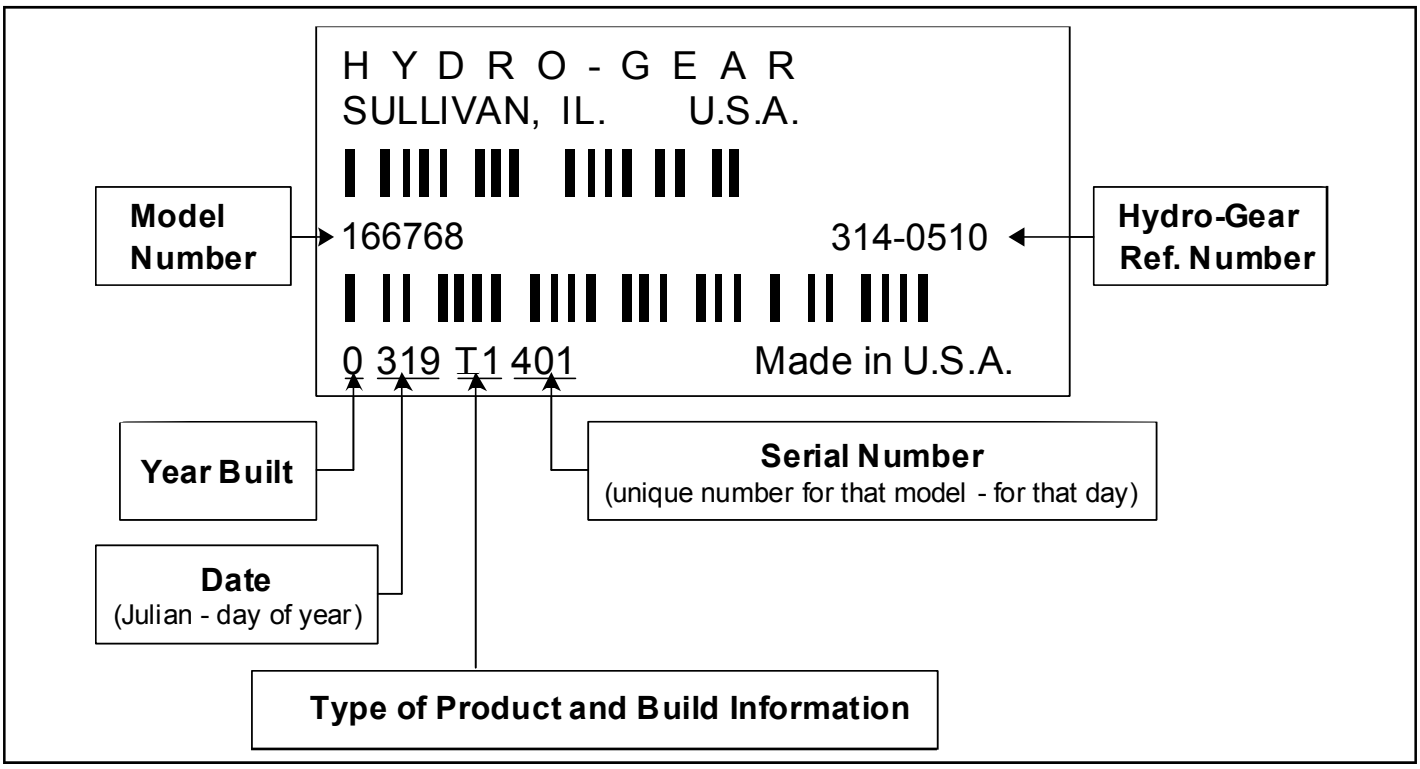


Figure 3. 310-0510 Configuration Label

SECTION 2. SAFETY

This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your transaxle. When you see this symbol - **HEED ITS WARNING.**

WARNING

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the 310-0510 IHT, fully read and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the 310-0510 IHT. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

1) Other manuals pertaining to this machine,
2) Local and shop safety rules and codes,
3) Governmental safety laws and regulations.

Be sure that you know and understand the equipment and the hazards associated with it. Do not place speed above safety.

Notify your supervisor whenever you feel there is any hazard involving the equipment or the performance of your job.

Never allow untrained or unauthorized personnel to service or repair the equipment.

Wear appropriate clothing. Loose or hanging clothing or jewelry can be hazardous. Use the appropriate safety equipment, such as eye and hearing protection, and safety-toe and slip-proof shoes.

Never use compressed air to clean debris from yourself or your clothing.

TOOL SAFETY

Use the proper tools and equipment for the task.

Inspect each tool before use and replace any tool that may be damaged or defective.

WORK AREA SAFETY

Keep the work area neat and orderly. Be sure it is well lit, that extra tools are put away, trash and refuse are in the proper containers, and dirt or debris have been removed from the working areas of the machine.

The floor should be clean and dry, and all extension cords or similar trip hazards should be removed.

SERVICING SAFETY

Certain procedures may require the vehicle to be disabled in order to prevent possible injury to the servicing technician and/or bystanders.

The loss of hydrostatic drive line power may result in the loss of hydrostatic braking capability. Proper brake maintenance is very important should this condition develop.

Some cleaning solvents are flammable. Use only approved cleaning materials. Do not use explosive or flammable liquids to clean the equipment.

To avoid possible fire do not use cleaning solvents in an area where a source of ignition may be present.

Discard used cleaning material in the appropriate containers.

SECTION 3. TROUBLESHOOTING

WARNING

Do not attempt any servicing or adjustments with the engine running. Use extreme caution while inspecting the drive belt assembly, and all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual!

In many cases problems with the 310-0510 are not related to a defective transaxle, but are caused by slipping drive belts, partially engaged bypass valves, and loose or damaged control linkages. Be sure to perform all operational checks and adjustments outlined in Section 4, Service and Maintenance before assuming the unit is malfunctioning. Table 2 below provides a troubleshooting check list to help determine the cause of operational problems.

Table 2. 310-0510 Troubleshooting Checklist

Possible Cause	Corrective Action
UNIT OPERATES IN ONE DIRECTION ONLY	
Control linkage bent or out of adjustment	Repair or replace linkage, Page 9
Drive belt slipping or pulley damaged	Repair or replace drive belt or pulley, Page 9
VEHICLE DOES NOT DRIVE/TRACK STRAIGHT	
Vehicle tires improperly inflated	Refer to vehicle manufacturer suggested pressure
Control linkage bent, loose or out of adjustment	Repair, adjust or replace vehicle linkage
Bypass partially engaged	Adjust bypass linkage
UNIT IS NOISY	
Oil level low or contaminated oil	Fill to proper level or change oil, Page 10
Excessive loading	Reduce vehicle loading, Page 9
Brake setting incorrect	Adjust brake to proper setting, Page 13
Loose parts	Repair or replace loose parts
Bypass assembly sticking	Repair or replace valve or linkage
Air trapped in hydraulic system	Purge hydraulic system, Page 11
UNIT HAS NO/LOW POWER	
Engine speed low	Adjust to correct setting
Control linkage bent or out of adjustment	Repair or replace linkage, Page 9
Brake setting incorrect	Adjust brake to proper setting, Page 13
Drive belt slipping or pulley damaged	Repair or replace drive belt or pulley, Page 9
Oil level low or contaminated oil	Fill to proper level or change oil, Page 10
Excessive loading	Reduce vehicle loading, Page 9
Bypass assembly sticking	Repair or replace valve or linkage
Air trapped in hydraulic system	Purge hydraulic system, Page 11
UNIT OPERATING HOT	
Debris buildup around transaxle	Clean off debris, Page 9
Brake setting incorrect	Adjust brake to proper setting, Page 13
Cooling fan damaged	Repair or replace cooling fan
Oil level low or contaminated oil	Fill to proper level or change oil, Page 10
Excessive loading	Reduce vehicle loading, Page 9
Air trapped in hydraulic system	Purge hydraulic system, Page 11
TRANSAXLE LEAKS OIL	
Damaged seals, housing, or gaskets	Replace damaged component
Air trapped in hydraulic system	Purge hydraulic system, Page 11

SECTION 4. SERVICE AND MAINTENANCE

NOTE: Any servicing dealer attempting a warranty repair must have prior approval before conducting maintenance of a Hydro-Gear® product unless the servicing dealer is a current Authorized Hydro-Gear Service Center.

EXTERNAL MAINTENANCE

Regular external maintenance of the 310-0510 IHT should include the following:

1. **Check the vehicle operator's manual for the recommended load ratings. Insure the current application does not exceed load rating.**
2. Check oil level in accordance with Figure 4 Page 10.
3. Inspect the vehicle drive belt, idler pulley(s), and idler spring(s). Insure that no belt slippage can occur. Slippage can cause low input speed to the transmission.
4. Inspect the transmission cooling fan for broken or distorted blades and remove any obstructions (grass clippings, leaves, dirt, etc.).
5. Inspect the axle parking brake and vehicle linkage to insure proper actuation and adjustment of the parking brake.
6. Inspect the vehicle control linkage to the directional control arm on transaxle. Also, insure the control arm is securely fastened to the trunnion arm of the transaxle.
7. Inspect the bypass mechanism on the transaxle and vehicle linkage to insure it actuates and releases fully.

SERVICE AND MAINTENANCE PROCEDURES

All the service and maintenance procedures presented on the following pages can be performed while the 310-0510 is mounted on the vehicle. Any repair procedures as mentioned in the repair section of this manual must be performed after the unit has been removed from the vehicle.

FLUIDS

The fluids used in Hydro-Gear products have been carefully selected, and only equivalent, or better products should be substituted.

Typically, an engine oil with a minimum rating of 55 SUS at 212°F (100° C) and an API classification of SL is recommended. A 20W-50 engine oil has been selected for use by the factory and is recommended for normal operating temperatures.

FLUID VOLUME AND LEVEL

Fluid volume information is provided in Table 3.

Certain situations may require additional fluid to be added or even replaced. Refer to Page 4 and Figure 4 for the proper fill port location.

Fill the 310-0510 to the top of the oil fill port.

Recheck the fluid level once the unit has been operated for approximately 1 minute.

Purging may be required. Refer to the purging procedures on page 11.

FLUID CHANGE

FLUID CHANGE PROCEDURE

This transaxle is factory filled, sealed and does not require oil maintenance. However, in the event of oil contamination or degradation, oil addition or change may alleviate certain performance problems.

1. Remove the transaxle from the vehicle.
2. Clean the expansion tank and oil fill port areas of any debris.
3. Remove the oil fill port fitting.
4. Position the transaxle so the oil will drain completely out of the housing.
5. After all the oil is drained from the transaxle, remove the expansion tank by removing the self tapping bolt (10-32 x ½) that holds the tank support bracket.
6. Remove the tank and drain the oil from the tank. DO NOT remove the vent cap from the tank. DO NOT remove the tank hose or o-ring unless a replacement is needed.
7. Install the tank by first inserting the hose into the opening in the expansion tank. Push the tank opening over the o-ring to ensure a proper seal.
8. Install the tank support bracket and self tapping bolt making sure not to cross thread the bolt. Torque the bolt to the lower value of the torque specification listed in Table 5.
9. Fill the transaxle at the oil fill port according to Figure 4.
10. Install the oil fill port fitting.

EXPANSION TANK FUNCTION

The expansion tank allows the 310-0510 to operate free of air entrainment and provides maximum lubrication to the mechanical and hydraulic components in the transaxle.

As the 310-0510 transaxle is operated, oil in the transaxle housing heats up which causes the oil to expand. The oil flows through an internal hose to the bottom of the vented expansion tank. As the oil cools, the oil in the transaxle housing contracts, causing the oil level to go down in the housing. This creates a negative pressure in the housing causing the oil to be drawn back into the case. This keeps the transaxle housing full of oil at specified operating temperatures.

Table 3. Fluid Volumes for the 310-0510 IHT

Fluid Description	Volume
20W-50 engine oil	79 fl. oz. (2336 ml.)

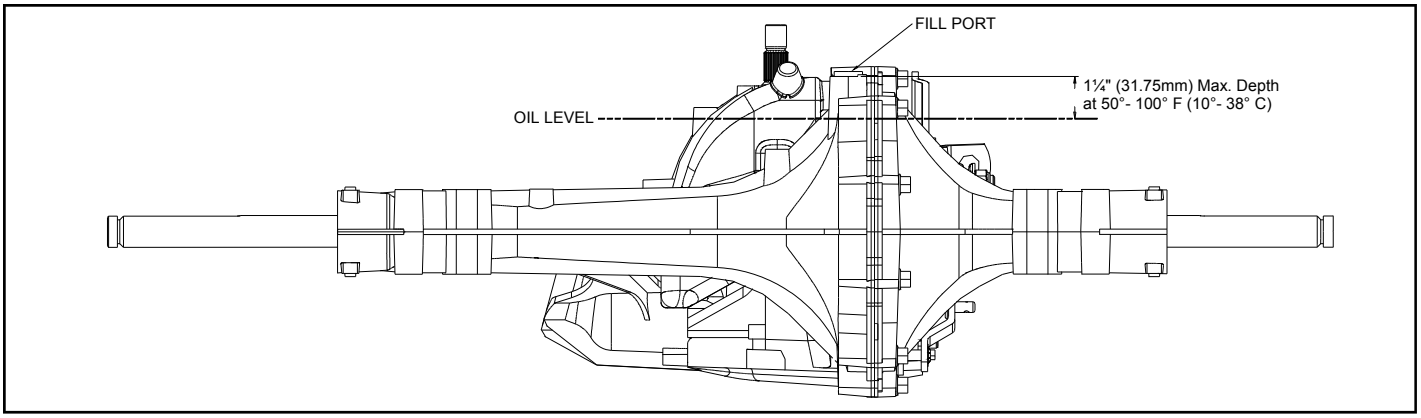


Figure 4. 310-0510 Fluid Level and Fill Port

PURGING PROCEDURES

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that it be purged from the system.

These purge procedures should be implemented any time a hydrostatic system has been opened to facilitate maintenance or any additional oil has been added to the system.

Air creates inefficiency because its compression and expansion rate is higher than that of the oil approved for use in hydrostatic drive systems.

The resulting symptoms in hydrostatic systems may be:

1. Noisy operation.
2. Lack of power or drive after short term operation.
3. High operation temperature and excessive expansion of oil.

Before starting, make sure the transaxle/ transmission is at the proper oil level. If it is not, fill to the specifications outlined on page 10, Figure 4.

The following procedures should be performed with the vehicle drive wheels off the ground, then repeated under normal operating conditions.

1. With the bypass valve open and the engine running, slowly move the directional control in both forward and reverse directions (5 to 6 times), as air is purged from the unit, the oil level will drop.
2. With the bypass valve closed and the engine running, slowly move the directional control in both forward and reverse directions (5 to 6 times). Check the oil level, and add oil as required after stopping engine.
3. It may be necessary to repeat Steps 1 and 2 until all the air is completely purged from the system. When the transaxle moves forward and reverse at normal speed purging is complete.

RETURN TO NEUTRAL SETTING (FOOT CONTROL)

WARNING

POTENTIAL FOR SERIOUS INJURY

Certain procedures require the vehicle engine to be operated and the vehicle to be raised off the ground. To prevent possible injury to the servicing technician and/or bystanders, insure the vehicle is properly secured.

The return to neutral mechanism on the transmission is designed to set the directional control into a neutral position when the operator removes their foot from the foot control. Follow the procedures below to properly adjust the return to neutral mechanism on the transaxle:

1. Confirm the transaxle is in the operating mode (bypass disengaged). Raise the vehicle's drive tires off the ground to allow free rotation.

   NOTE: It may be necessary to remove the drive tire from the axle hub to access the linkage control and the transaxle return arm.

2. Remove the Original Equipment Manufacturer's (OEM's) control linkage at the control arm. Refer to Figure 5.

3. Start the engine and increase the throttle to full engine speed.

WARNING

Do not attempt any adjustments with the engine running. Use extreme caution while inspecting all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual.

4. Check for axle rotation. If the axles do not rotate, go to Step 5. If the axles rotate, go to Step 6.

5. Stop the vehicle's engine. Reattach and adjust the OEM linkage according to the OEM manual. Recheck according to Step 3 and 4. Stop the vehicle engine. Refer to Figure 5.

6. Note the axle directional movement. Stop the vehicle engine. Loosen the adjusting puck screw until the puck can be rotated. Rotate the adjusting puck the opposite direction of the wheel rotation in 5 degree increments. Tighten the adjusting puck screw. Refer to Table 5. Required Torque Values, Page 15. Recheck according to steps 3 and 4. Stop the vehicle engine. Reattach and adjust the OEM linkage according to the OEM manual. Recheck according to steps 3 and 4. Refer to Figure 5.

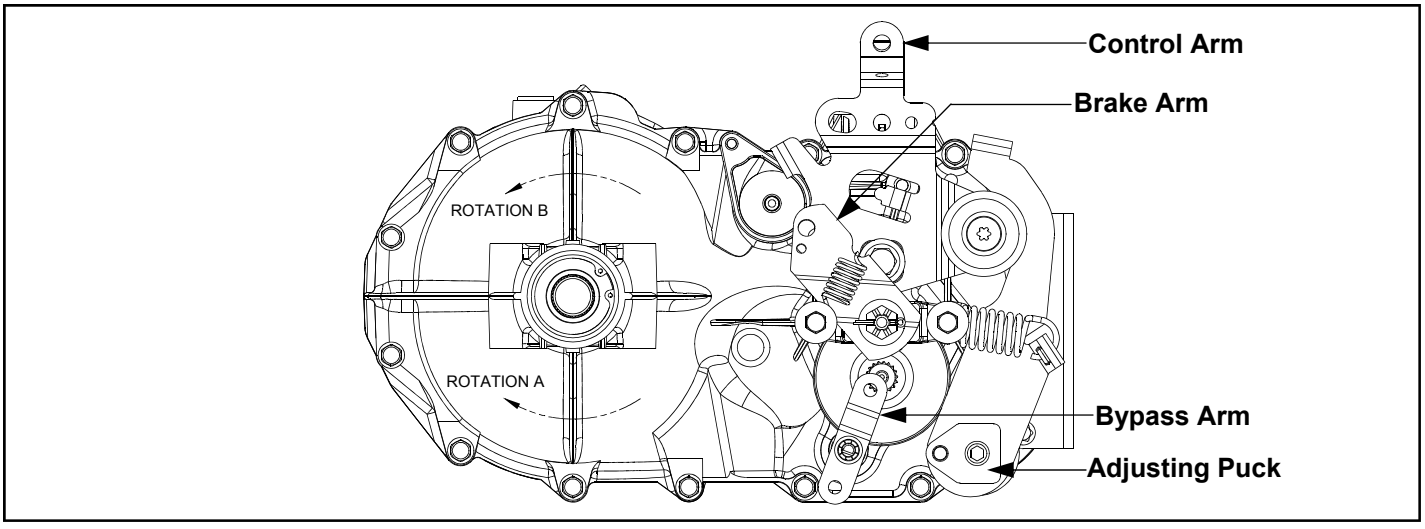


Figure 5. Return to Neutral, Foot Control

BRAKE MAINTENANCE

BRAKE SETTING

1. Remove the brake arm bias spring, and then the cotter pin securing the brake castle nut.
2. Insert a 0.015" feeler gage between the brake disc and top brake puck, and then set the brake by finger tightening or loosening the castle nut.
3. Install a new cotter pin to secure the castle nut, and then install the brake arm bias spring.

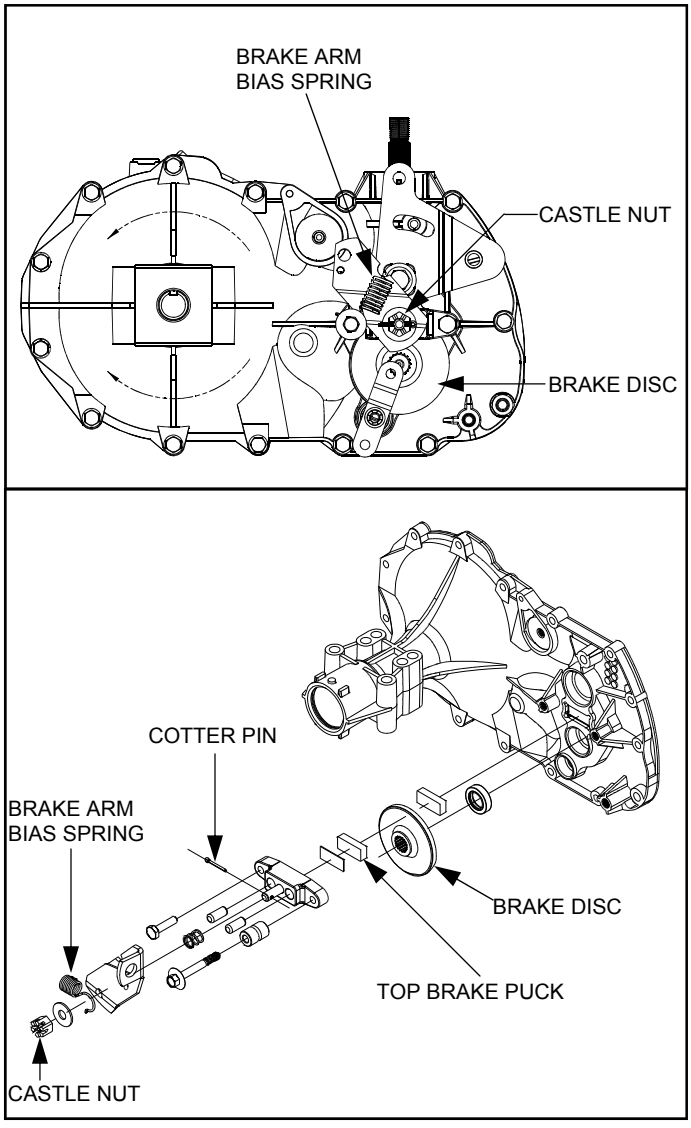


Figure 6. Brake Components

FRICTION PACK ADJUSTMENT

The friction pack dampens or holds the operator control lever in its desired position.

Adjustment for the amount of drag or holding force can be made by turning the friction pack nut in or out.

Adjustments should be made in no more than 1/4 turn increments.

Over-tightening will result in difficulty or inability of the operator to move the control lever.

Note: The factory setting for the friction pack is tightening of the friction pack nut to 100 in-lbs (11 Nm) torque. The friction pack nut is then backed off per the vehicle manufacturer's specifications.

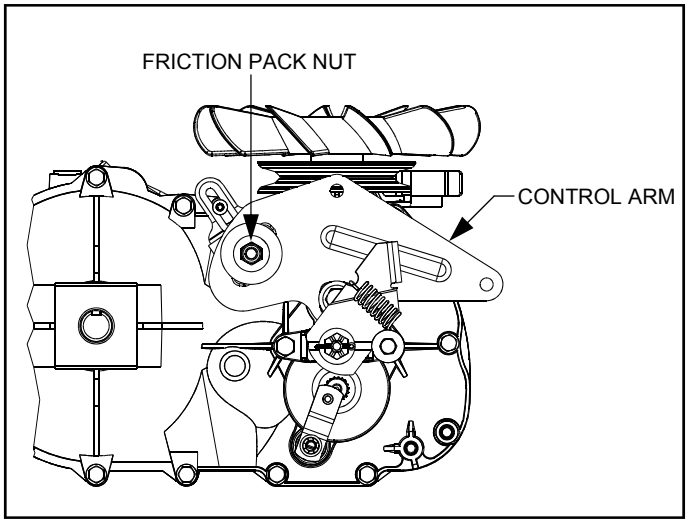


Figure 7. Friction Pack

SECTION 5. REPAIR

HOW TO USE THIS SECTION

Each subassembly illustrated in this section is illustrated by an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See pages 31 and 33 for part names and descriptions. A complete exploded view and item list of the transaxle is provided at the end of this section.

Many of the parts and subassemblies of this transaxle can be removed and serviced independently of other components. Where some components and assemblies must be removed before a given assembly can be serviced, that information is given at the beginning of the disassembly instructions.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation lightly lubricate all seals, O-rings, gaskets with a clean petroleum jelly prior to assembly. Also protect the inner diameter of seals by covering the shaft with a cellophane (plastic wrap, etc.) material.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear® replacement parts found listed in BLN-51427 (CD).

IMPORTANT: When internal repair is performed on the 310-0510 IHT, the filter assembly must be replaced.

TRANSAXLE REMOVAL

It is necessary to remove the 310-0510 from the vehicle before performing the repair procedures presented in this section.

LIMITED DISASSEMBLY

The following procedures are presented in the order in which they must be performed to completely disassemble the unit. Do not disassemble the unit any farther than is necessary to accomplish the required repairs. Each disassembly procedure is followed by a corresponding assembly procedure.

Reassembly is accomplished by performing the “Assembly” portions of the procedures. If the unit has been completely disassembled, a summary of the assembly procedures, in the order in which they should occur, is given on page 27.

TOOLS AND TORQUES

Table 4. Required Tools

Miscellaneous	**Sockets**
310-0510 Service & Repair Manual	1/2"- 3/8" Adapter
Flat Blade Screw Driver (2)	1/2" Deep
Torque Wrench	7/16" Deep
Air Impact Wrench	9/16" Deep
Rubber Mallet	3/4" Deep
Breaker Bar	7/8"
Side Cutters/Snips	10 mm
Pliers	T-25 Torx Head
Needle Nose	
Large External Snap Ring	

Table 5. Required Torque Values

Operation	U.S. Torque	Metric Torque	Item	Description
Side Housing Screws	105-155 lb-in	12-17 Nm	7	Screw ¼-20 x 1.25
Housing Stud	230-310 lb-in	26-35 Nm	8	Stud 5/16-24 Hex
Control Arm Screw	230-310 lb-in	26-35 Nm	16	Screw 5/16-24 x 0.75
Check Plugs	280-400 lb-in	32-45 Nm	23/75	Check Plug Assembly
Center Section Bolts	525-700 lb-in	60-80 Nm	44	Screw 3/8-24 x 2.5
Brake Yoke Bolt	80-120 lb-in	9-14 Nm	63	HFHCS ¼-20 x 2
Brake Yoke Bolt	80-120 lb-in	9-14 Nm	64	Bolt ¼-20 x 1
Friction Pack Mounting Stud	50-120 lb-in	6-14 Nm	76	Stud 5/16-24
Friction Pack Nut	85-120 lb-in	10-14 Nm	80	Lock Nut 5/16-24
Expansion Tank Hose Fitting	96-120 lb-in	11-14 Nm	84	Fitting 5/16 SAE 5/32 Tube
Belt Keeper Screw	40-70 lb-in	5-8 Nm	88	Screw, Self-Tapping 10-32 x .5
Bracket Support Bolt	42-65 lb-in	5-7 Nm	88	Bolt 10-32 x 0.5
Friction Pack Wedge Screw	30-70 in-lb	3.4-8 Nm	88	Screw, Self Tapping 10-32 x .5
Puck Inner Wedge Bolt	42-65 lb-in	5-7 Nm	88	Bolt 10-32 x 0.5
Adjusting Puck Screw	250-320 lb-in	28-36 Nm	95	Socket Hd CS 5/16-24 x 1.50
RTN Screw	180-240 lb-in	20-27 Nm	97	Screw, Countersunk 5/16-18 x 1
Bracket Screw	230-310 lb-in	26-35 Nm	110	Screw, Torx Hd 5/16-18 x 1.50
Fan/Pulley-Input Shaft Nut	300-460 lb-in	34-52 Nm	121	Nut, Hex Lock ½-20 w/nylon
Fan/Pulley Screws	65-90 lb-in	8-10 Nm	122	Screw, Hex Flange ¼-20 x .75
Fan/Pulley Nuts	35-50 lb-in	4-6 Nm	124	Nut, Hex ¼-20
Cruise Damper Bracket Nuts	160-210 lb-in	18-24 Nm	132	Nut, Hex 5/16-18
Axle Hub Nut	180-200 lb-ft	244-271 Nm	152	Nut, Hex Lock 3/4-16

BRAKE ASSEMBLY AND BYPASS ARM

Refer to Figure 8.

DISASSEMBLY

1. Remove the brake arm bias spring (66). *Note the orientation of the spring for proper reassembly.*
2. Remove the cotter pin (70), castle nut (69), washer (73), brake arm (68), spring (71) and actuating pins (62). *Note the orientation of the brake arm for proper reassembly.* Discard the cotter pin (70).
3. Remove the two brake yoke screws (63/64) and spacer (65) from the side housing assembly (2). *Note the orientation of the spacer(s) (65) on the brake yoke assembly to ensure proper reassembly.* Remove the brake yoke assembly (58), puck plate (61) and puck (60).
4. Remove the bypass arm retaining ring (50) and bypass arm (49). Discard the retaining ring.
5. Remove the brake rotor (59) and puck (60). *Note: The hub on the rotor faces away from the transaxle.*

INSPECTION

1. Inspect the brake arm bias spring (66), castle nut (69), washer (73), brake arm (68), actuating pins (62), spring (71), brake yoke screws (63/64), brake yoke (58), pucks (60), puck plate (61), bypass arm (49), spacer (65) and brake rotor (59) for wear or damage.

ASSEMBLY

1. Install the brake puck (60) and brake rotor (59).
2. Install the bypass arm (49) onto the bypass rod. Secure the bypass arm with a new retaining ring (50).
3. Install the brake puck (60), puck plate (61), brake yoke assembly (58), spacer(s) (65) and brake yoke screws (63/64).
4. Insert the brake actuating pins (62) into the brake yoke (58). Install the spring (71).
5. Assemble the brake arm (68), washer (73) and castle nut (69). Adjust the brake gap. Refer to page 13. Install the brake arm bias spring (66).

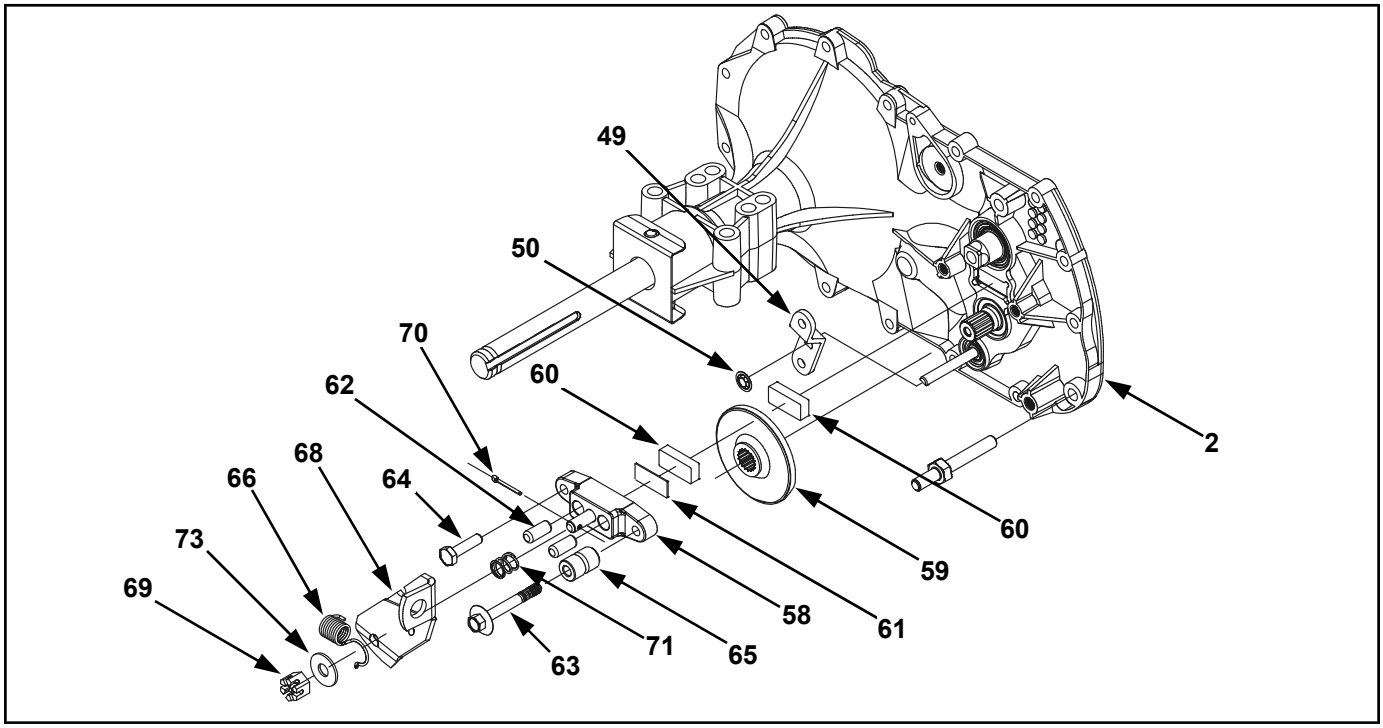


Figure 8. Brake Assembly and Bypass Arm

Refer to Figure 9.

DISASSEMBLY

1. Remove the brake assembly. See page 16.
2. Loosen and remove the friction pack lock nut (80), flat washer (73), spring (78), spacer (79), washer clip (82) and puck (77). Discard the lock nut (80).
3. Remove the hex head screw (16) from the directional control.
4. Remove the flat washer (73) and control arm (18).
5. Remove the inner wedge puck (90).
6. Removal of the friction pack wedge (81) should not be necessary. *Note: If it is removed, mark the orientation of the wedge for ease in reassembly.*
7. If necessary, remove and replace the friction pack stud (76).

INSPECTION

1. Inspect the friction pack assembly components for wear or damage.
2. Inspect the control arm for wear or damage.
3. Inspect the inner wedge puck (90).
4. Inspect the friction pack stud (76) for wear or damage.

ASSEMBLY

1. Install the friction pack stud (76), if removed. Torque according to specifications in Table 5.
2. If previously removed, install the friction pack wedge (81) and self tapping bolt (88). Refer to Table 5 for bolt torque specifications. Use the marks made during disassembly to reposition the wedge properly.
3. Install the inner wedge puck (90).
4. Install the control arm (18).
5. Install the flat washer (73) and control arm screw (16). *Note: Remember to apply thread adhesive to the screw threads before installation.* Refer to Table 5 for screw torque specifications.
6. Install the puck (77), washer clip (82), spacer (79), spring (78), flat washer (73) and a new lock nut (80). Adjust the friction pack according to instructions on page 13.
7. Install the brake assembly. See page 16.

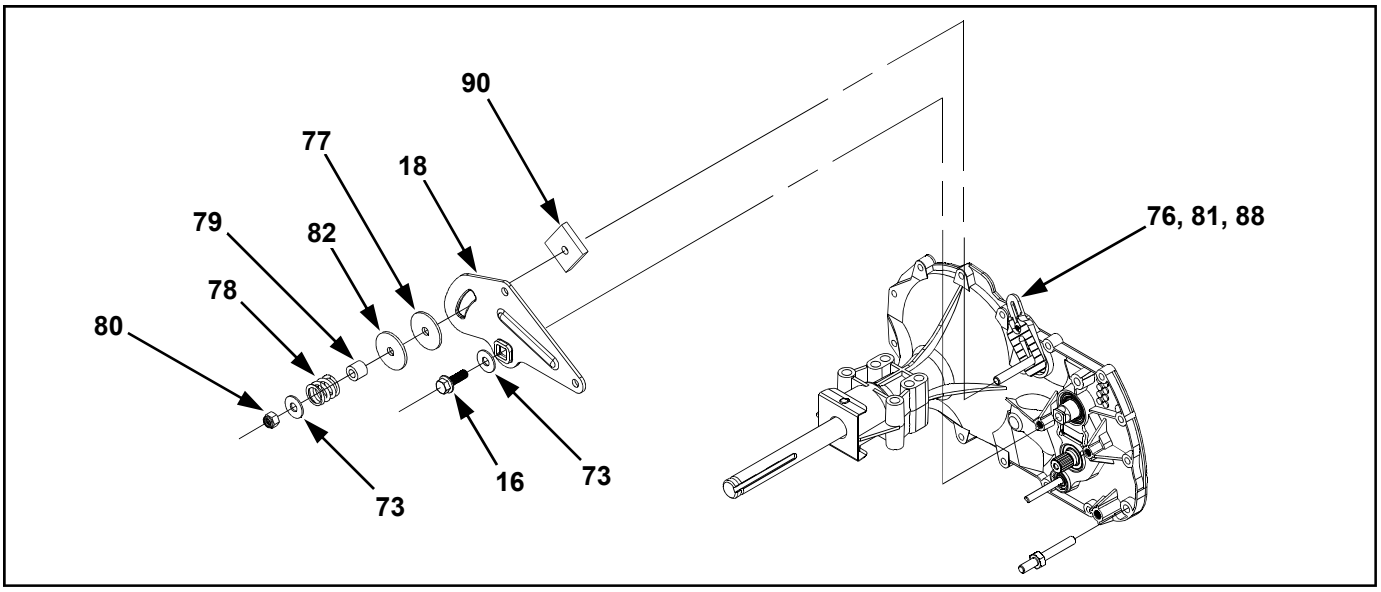


Figure 9. Control Arm & Friction Pack

SEAL KIT REPLACEMENT

Before disassembly, wipe the unit free of any debris to avoid contamination.

Refer to Figure 10.

Axle Seal

1. Remove the axle clips (93) from the axle horns (for units with keyed axle shafts).
2. Remove the seal retaining rings (12).
3. Carefully pull the axle seals (34) out of the housing bore with a “hook” type tool. Care must be taken to avoid damage to the housing bore or to the shaft sealing areas.
4. Lubricate the new seal with petroleum jelly prior to installation.
5. Wrap the shaft keyway (splines) with cellophane to prevent damage to the seal lip during installation.
6. Slide the seal over the shaft and press it into the housing bore.
7. The seal should seat against the sleeve bearing.
8. Install the seal retaining rings (12).
9. Install the axle clips (93), if applicable.

Input Seal

1. Remove the input pulley and fan from the input shaft.
2. The seal (13) can be replaced by following steps 2-6 of the procedure used to replace the axle seals.

Trunnion Seal

1. Remove the control arm and any attachments to the control arm. See page 17.
2. The seal (17) can be replaced by following steps 3-6 of the procedure used to replace the axle seals.

Brake Seal

1. Remove the brake assembly and any attachments to the brake assembly. See page 16.
2. The seal (74) can be replaced by following steps 3-6 of the procedure used to replace the axle seals. Install a new retaining ring (74).

Bypass Seal

1. Remove the bypass arm and any attachments to the bypass arm. See page 16.
2. The seal (51) can be replaced by following steps 3-6 of the procedure used to replace the axle seals.

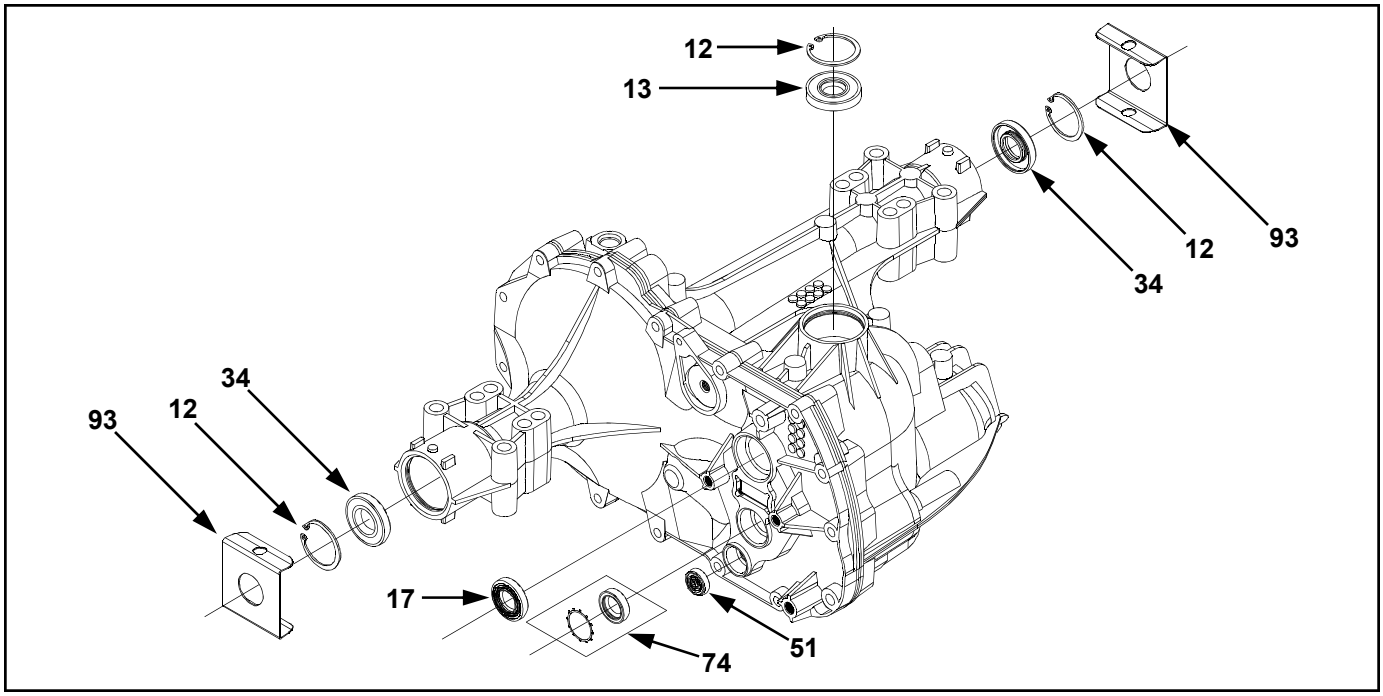


Figure 10. Seal Kit Replacement

Refer to Figure 11.

DISASSEMBLY

1. Remove the brake assembly and bypass arm. See page 16.
2. Remove the control arm and friction pack. See page 17.
3. Remove the oil from the transaxle. See page 10.
4. After all of the oil has been removed from the transaxle, remove the housing screws (7) and torque strap screw (8).
5. Pull away the side housing (2), leaving the axle assembly (35, Page 32) in the main housing (1). It may be necessary to use screwdrivers at the pry points to break loose the sealant (positions B-H and G-J, Fig. 11).
6. Remove all the seals in the side housing. See page 18.
7. Clean off **all** the old sealant on the side and main housings. Take care not to damage the sealing surfaces. A wire brush and solvent is effective.

INSPECTION

1. Inspect the bearing areas in the side housing.

ASSEMBLY

1. Apply a bead of sealant around the perimeter of the side housing face. See sealant pattern on page 28.
2. Install the axle and sleeve bearing (31). *Note the orientation of the locating tab on the sleeve bearing. It is essential for this to align with the side housing bore.*
3. Install the locating pins (83), if not already installed.
4. Install the side housing (2) while aligning the bypass rod into its side housing bore. Use care not to smear the sealant bead.
5. Install the torque strap screw (8). Tighten the screw according to the specifications in Table 5.
6. Install the side housing screws (7). Refer to the screw tightening pattern in figure 11 and torque specs in Table 5.
7. Install the remaining seals. Refer to page 18. Remember to use a seal protector during installation.
8. Fill the transaxle with new oil. See page 10.
9. Install the control arm and friction pack. See page 17.
10. Install the bypass arm and brake assembly. See page 16.

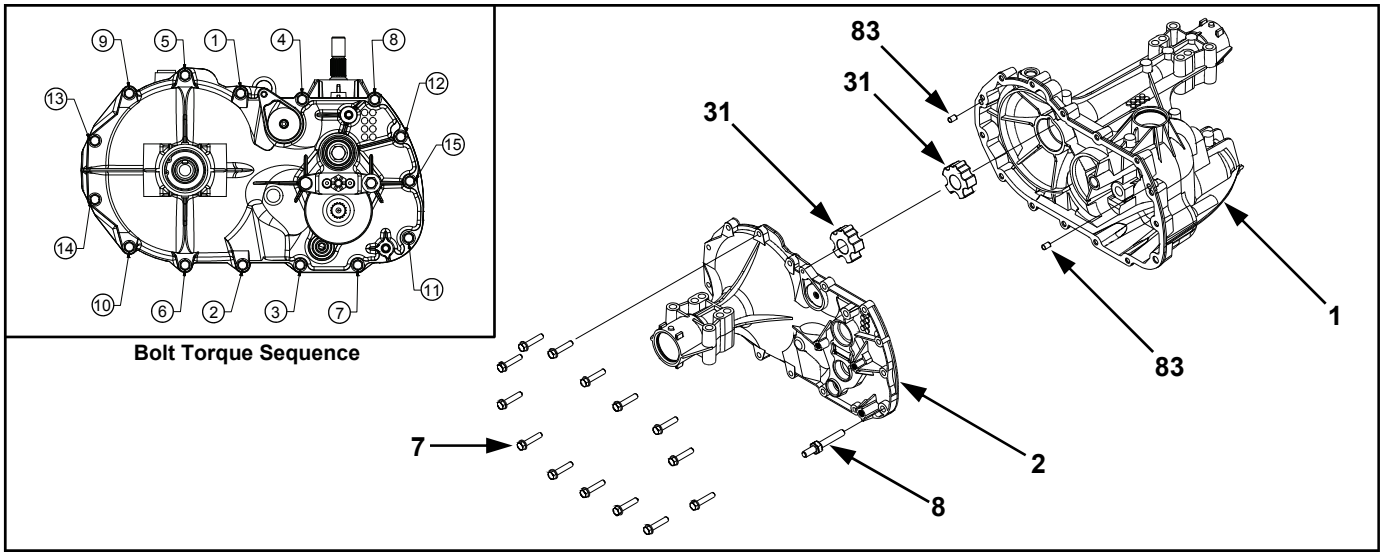


Figure 11. Side Housing Assembly

AXLE SHAFT, DIFFERENTIAL & REDUCTION GEARS

Refer to Figure 12.

DISASSEMBLY

1. Remove the brake assembly and bypass arm. See page 16.
2. Remove the control arm and friction pack. See page 17.
3. Remove the oil from the transaxle. See page 10.
4. Remove the side housing. See page 19.
5. Remove the axle assembly (36), sleeve bearing (31) and washer (33).
6. Remove the center block bearing (54) (earlier models), differential cross shaft(s) (39) and miter gears (38).
7. Remove the bull gear (30).
8. Remove the reduction gears (28 & 29), jack shaft pin (41) and washers (72).

INSPECTION

1. Inspect the axle, sleeve bearing and washer for wear or damage. Replace as necessary.
2. Inspect the differential cross shaft, center block bearing and miter gears for wear or damage.
3. Inspect the bull gear for wear or damage.
4. Inspect the reduction gears, shaft and washers.
5. Inspect the housing bores.

ASSEMBLY

1. Reassemble and install the reduction gears (28 & 29), jack shaft pin (41) and washers (72).
2. Install the bull gear (30).
3. Reassemble and install the center block bearing (54) (earlier units), differential cross shaft(s) (39) and miter gears (38).
4. Install the washer (33), sleeve bearing (31) and axle assembly (36).
5. Install the side housing. See page 19.
6. Install the outer sleeve bearing (32), axle seal (34) (see page 18) and retaining ring (12).
7. Install all remaining seals. See page 18.
8. Fill the unit with oil. See page 10.
9. Install the control arm and friction pack. See page 17.
10. Install the brake assembly and bypass arm. See page 16.

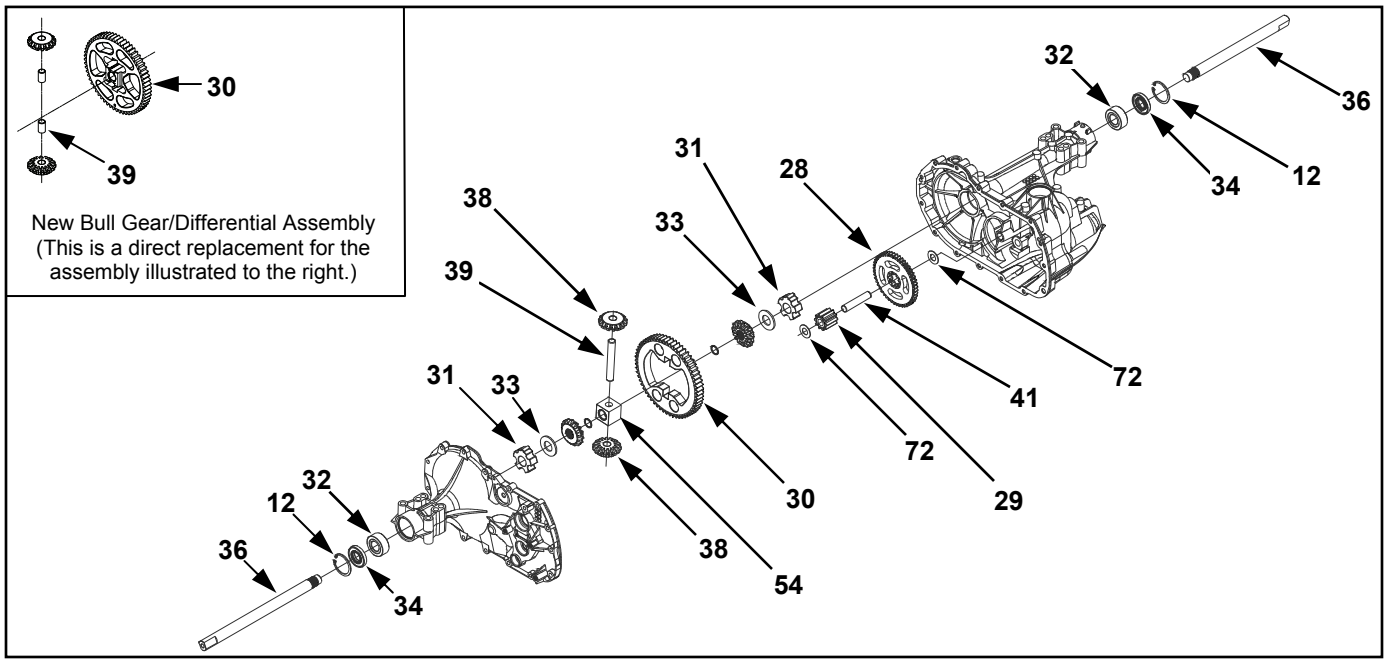


Figure 12. Axle Shaft, Differential & Reduction Gears (earlier bull gear shown)

MOTOR SHAFT AND BYPASS ROD

Refer to Figure 13.

DISASSEMBLY

1. Remove the brake assembly and bypass arm. See page 16.
2. Remove the control arm and friction pack. See page 17.
3. Drain the oil from the transaxle. See page 10.
4. Remove the side housing. See page 19.
5. Remove the axle shaft, differential and reduction gears. See page 20.
6. Remove the flat washer (52), motor shaft and pinnion gear (24 & 27), and the flat washer (108).
7. Remove the bypass rod (48). Clean the magnet (42) of any foreign material.

INSPECTION

1. Inspect the motor shaft (24), pinnion gear (27) and flat washers (52 & 108) for wear or damage.
2. Inspect the bypass rod (48) for wear or damage.

ASSEMBLY

1. Insert the bypass rod's (48) short end into the housing while aligning the rod's flat with the bypass actuator. Confirm proper bypass function.
2. Insert the motor shaft (24) with the pinnion gear (27) and flat washers (52 &108) into the center section (3).
3. Install the axle shaft, differential and reduction gears. Refer to page 20.
4. Install the side housing. Refer to page 19.
5. Install new seals. Refer to page 18.
6. Fill the transaxle with oil. See page 10.
7. Install the control arm and friction pack. See page 17.
8. Install the brake assembly and bypass arm. See page 16.

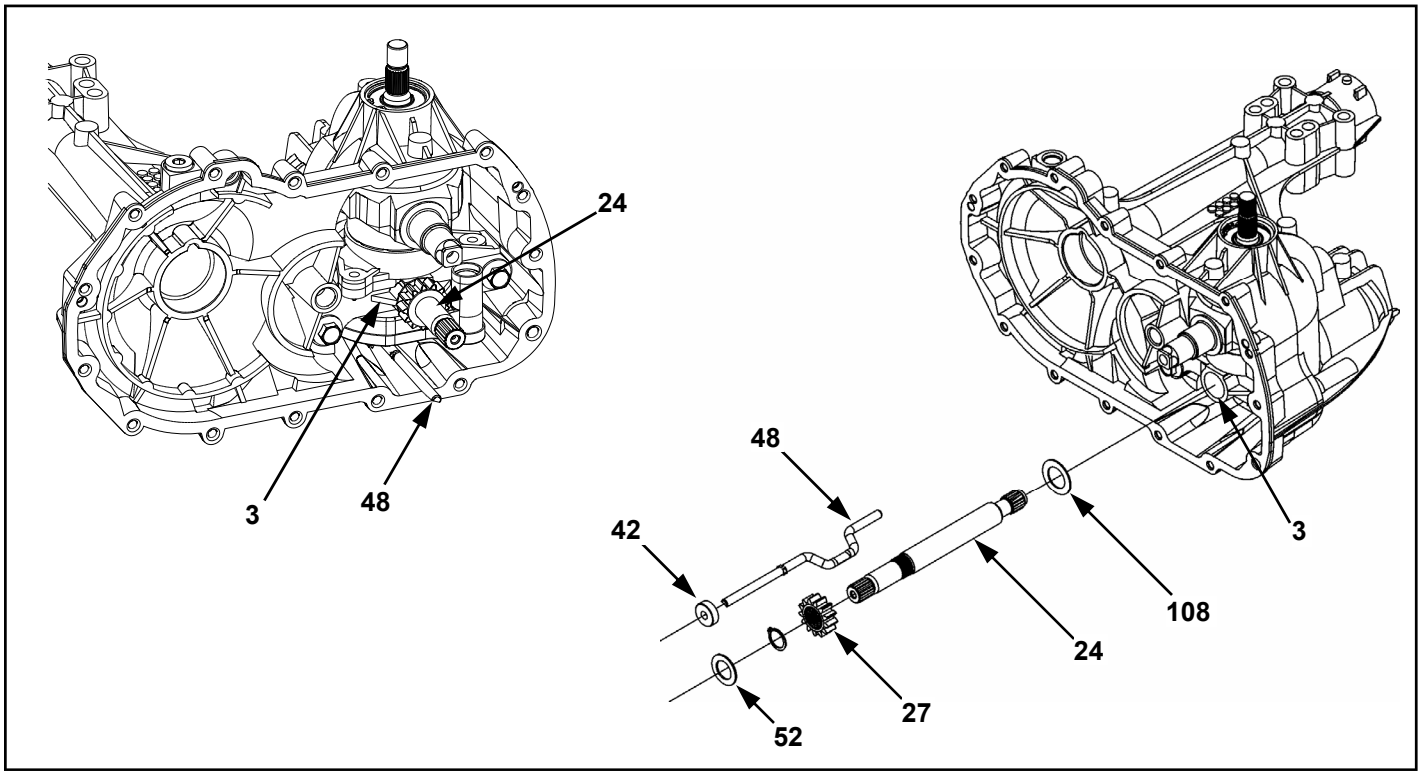


Figure 13. Motor Shaft & Bypass Rod Assemblies

INPUT SHAFT

Refer to Figure 14.

DISASSEMBLY

1. Remove the brake assembly and bypass arm. See page 16.
2. Remove the control arm and friction pack. See page 17.
3. Drain the oil from the transaxle. See page 10.
4. Remove the side housing. See page 19.
5. Remove the seals in the side housing. See page 18.
6. Remove the axle shaft, differential and reduction gears. Refer to page 20.
7. Remove the motor shaft and bypass rod. See page 21.
8. Remove the retaining ring (12) and shaft seal (13). Discard the seal.
9. Remove the washer (11), input shaft assembly (9,10 and 14), block thrust washer (56) and block spring (55).

INSPECTION

1. Inspect the input shaft components for wear or damage.

ASSEMBLY

1. Install the block thrust washer (56) and spring (55) onto the input shaft (9).
2. Ensure that the pump block is aligned concentrically with the center section running face.
3. Insert the input shaft (9), with bearing (14) and retaining ring (10), into the pump block assembly. NOTE: *Do not force the shaft and bearing as damage may occur. If alignment is correct the shaft assembly will fit into place*.
4. Install the washer (11), seal (13) and retaining ring (12).
5. Install the motor shaft & bypass rod. See page 21.
6. Install the axle, differential & reduction gears. Refer to page 20.
7. Install the side housing. Refer to page 19.
8. Install new seals in the side housing. See page 18.
9. Fill the transaxle with oil. See page 10.
10. Install the control arm and friction pack. See page 17.
11. Install the brake assembly and bypass arm. See page 16.

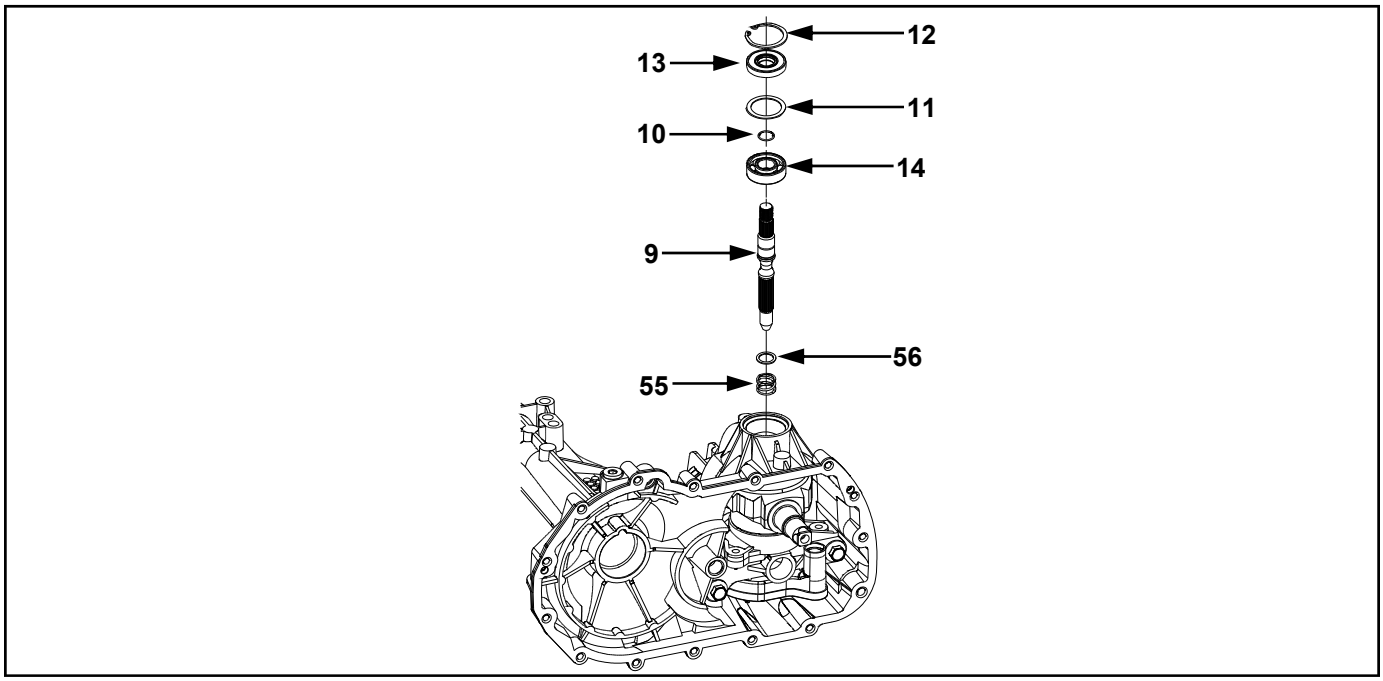


Figure 14. Input Shaft Assembly

Refer to Figures 15-24.

DISASSEMBLY

(Pump Block)

1. Remove the brake assembly and bypass arm. See page 16.
2. Remove the control arm and friction pack. See page 17.
3. Drain the oil from the transaxle. See page 10.
4. Remove the side housing. See page 19.
5. Remove the seals in the side housing. See page 18.
6. Remove the axle shaft, differential and reduction gears. Refer to page 20.
7. Remove the motor shaft and bypass rod. See page 21.
8. Remove the input shaft. See page 22.
9. **(See Fig. 15)** Remove the swashplate (4) and pump cylinder block (5) as one assembly. NOTE: *Removal will be aided by applying a small amount of pressure on the trunnion mounted swashplate towards the center section. Also note that the control arm (18, Page 32) may be loosely assembled at this point to assist in swashplate removal. While gently removing the swashplate and block assembly, keep the block face flush with the center section* to *minimize damage to the running surface*.
10. **(See Fig. 16)** Disassemble the pump cylinder block (5) from the swashplate (4).
11. **(See Fig. 17)** Check each piston for proper operation by pressing the pistons in and releasing them in the block bore. Disassemble the pump cylinder block. Check for piston/block wear in the cylinder bore. Inspect the pistons (1), piston springs (2) and piston seats (3) for excessive wear or damage. NOTE: Piston seats may be held in place in the piston by residual oil.
12. Reassemble the pistons, springs and seats into the cylinder block and set aside.
13. **(See Fig. 18)** Remove the thrust bearing assembly (19) from the swashplate (4).

(Center Section/Filter)

14. **(See Fig. 19)** Remove the center section mounting screws (44). NOTE: The center section is under motor block piston spring pressure. These screws are factory installed to 700 in. lbs. (80 Nm) and use an anaerobic thread adhesive. A breaker bar will be required at this step. Clean the internal threads of the mounting holes with compressed air.
15. Remove the center section and filter assembly (124, Fig. 20).
16. **(See Fig. 21)** Remove the filter (45) from the filter base (46) by snipping the four posts with side cutters or applicable tool. NOTE: This filter cannot be reused.
17. Remove and inspect the deflector (107), bypass actuator (47) and bypass spring (43).
18. Note the location of both check plugs (23 & 75) before removal for correct placement during reassembly. Remove and inspect the check plug assemblies (23) for debris or damage.
19. Remove the filter base (46) and discard it. NOTE: The filter base is included in the filter kit to be installed during reassembly of the unit.

(Motor Block)

20. **(See Fig. 22)** Remove the motor cylinder block assembly (5) from the housing (1).
21. Disassemble the motor cylinder block assembly (5). Check each piston for proper operation by pressing the pistons in and releasing them in the block bore. Disassemble the motor cylinder block. Check for piston/block wear in the cylinder bore. Inspect the pistons, piston springs and piston

seats for excessive wear or damage. NOTE: Piston seats may be held in place in the piston by residual oil.

22. Reassemble the pistons, springs and seats into the cylinder block and set aside.

23. Remove the thrust bearing assembly (19) from the housing (1). Inspect the thrust bearing and thrust bearing cavity in the housing.

INSPECTION

1. Inspect the pump cylinder block running surface for wear or damage.

2. Inspect the swashplate and thrust bearing assemblies for wear or damage.

3. Inspect the center section block running surfaces. NOTE: These “sealing” surfaces should be smooth in appearance without scratches, scoring, nicks or abrasions. Drag a fingernail across the surface to detect uneven wear or scratches which may not be visible.

4. Inspect the threaded check plug ports of the center section for debris or damage.

5. Inspect the motor cylinder block running surface for damage and wear.

6. Inspect all bearing, bushing and wear areas in the housing.

ASSEMBLY

(Motor Block)

1. **(See Fig. 22)** Turn the housing (1) so the axle horn is pointing down. This will assist in the installation of the thrust bearing assembly (19) keeping it in the bearing cavity during installation of the center section assembly.

2. Insert the thrust bearing (19) in the housing (1). NOTE: Place the thin race of the bearing towards the housing bearing cavity. The thick race must face the pistons.

(Center Section)

3. **(See Fig. 21)** Install the new filter base (46) onto the center section (3).

4. Install the check plugs (23 & 75), in their correct location, into the center section (3). Tighten the check plugs according to Table 5.

5. Install the bypass spring (43) into the filter base (46).

6. Install the deflector (107) into the underside of the filter (45).

7. Install the bypass actuator (47) into the underside of the deflector (107).

8. Hold the stem of the bypass actuator (47) from the top of the filter (45) to retain the deflector (107) and bypass actuator (47) in place when snapping the filter (45) onto the filter base (46). NOTE: Filter installation is best accomplished by using the spacer (65, Page 32) as an assembly tool over each of the (4) snaps while lightly tapping with a rubber mallet. Excessive force will result in damage to the plastic filter components.

9. **(See Figures 13 & 23)** Install the motor shaft (24), pinion gear (27) and flat washers (52 & 108) into the center section (3).

10. Assemble the motor block assembly (5) onto the motor shaft (24).

11. **(See Fig. 23)** Install the motor shaft, center section and motor block assembly so that the block pistons contact the thrust bearing race. NOTE: Hold in place and insure all pistons are still positioned correctly in the cylinder bore by confirming spring bias against the center section.

12. **(See Fig. 19)** After applying thread adhesive, insert the center section mounting screws (44) while holding downward pressure on the center section assembly (3, Fig. 23).

13. Tighten the center section mounting screws (44) to the proper torque. Refer to Table 5.

(Swashplate/Pump Block)

14. **(See Fig. 18)** Install the pump thrust bearing (19) in the trunnion machined swashplate (4). NOTE: Place the thin race of the bearing towards the swashplate. The thick race must face the pistons.

15. **(See Fig. 16)** Place the pump block assembly (5), pistons down, on top of the thrust bearing in the swashplate (4).

16. Coat the pump running surface with clean motor oil.

17. *Care must be taken to prevent the scaring or scratching of the center section sealing face during this step.* Insert the short shaft side of the swashplate/pump block assembly (Fig. 24) into the housing while simultaneously compressing the pistons in the block. NOTE: To assist in the installation of these components, insert the assembly until ¾ of the pump block is covered by the center section. Then slightly angle the trunnion shaft end away while pressing the short swashplate shaft into its pocket.

18. Install the input shaft. See page 22.

19. Install the bypass rod. See page 21.

20. Install the axle shaft, differential and reduction gears. Refer to page 20.

21. Install the side housing. See page 19.

22. Install the seals in the side housing. See page 18.

23. Fill the transaxle with new oil. See page 10.

24. Install the control arm and friction pack. See page 17.

25. Install the brake assembly and bypass arm. See page 16.

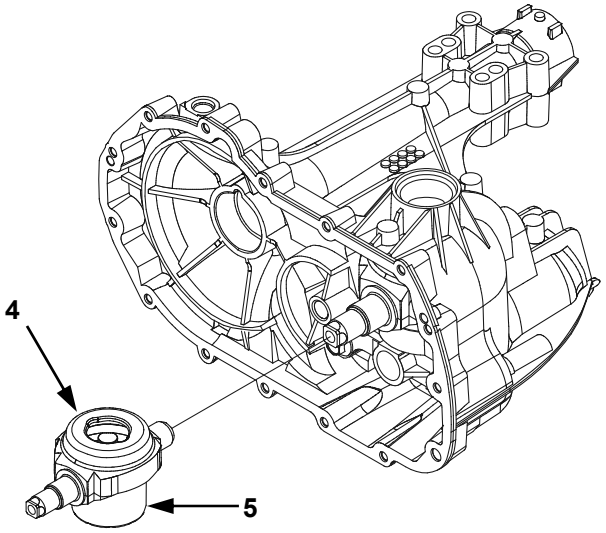


Figure 15

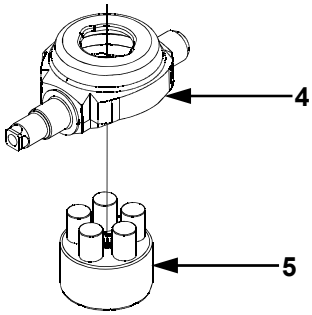


Figure 16

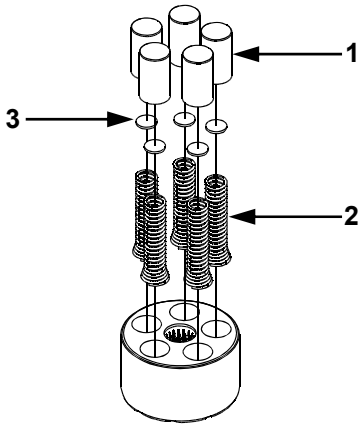


Figure 17

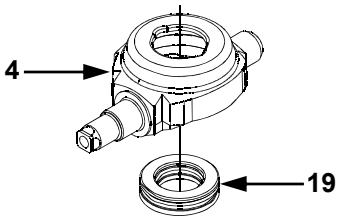


Figure 18

HYDRAULIC COMPONENTS

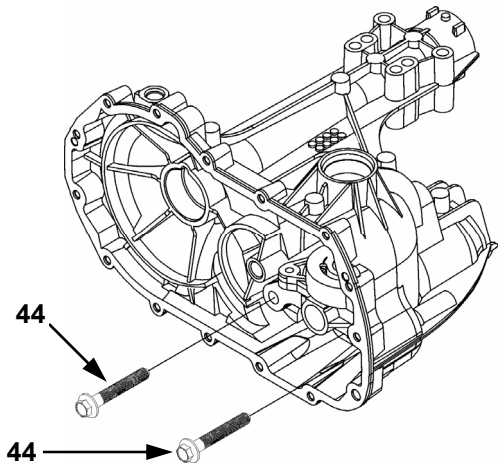


Figure 19

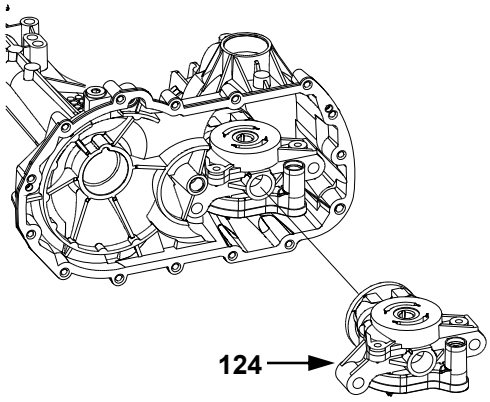


Figure 20

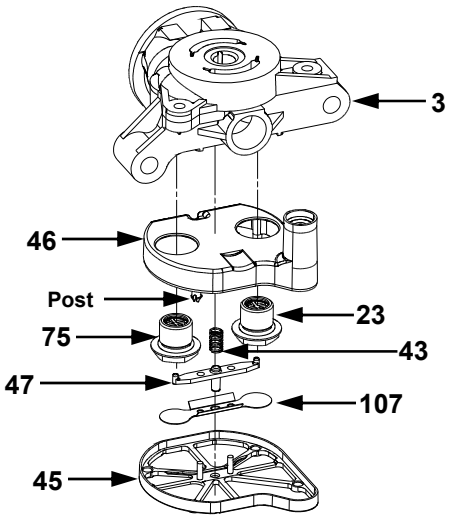


Figure 21

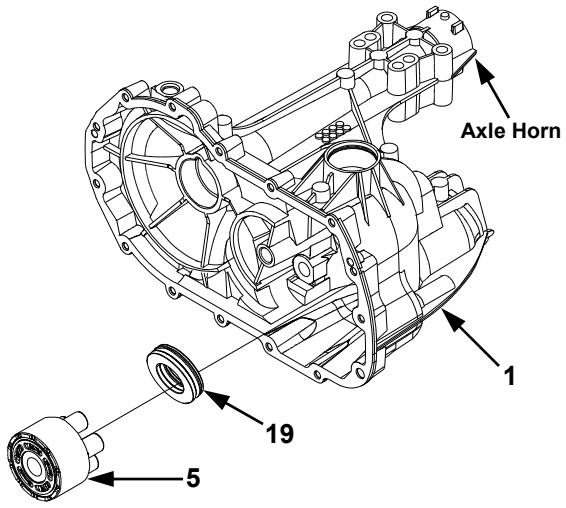


Figure 22

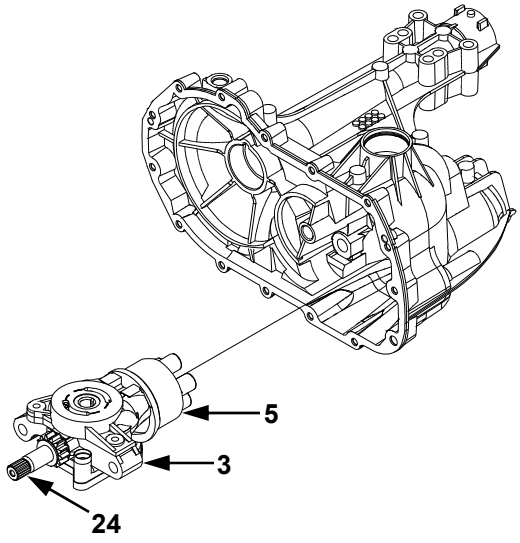


Figure 23

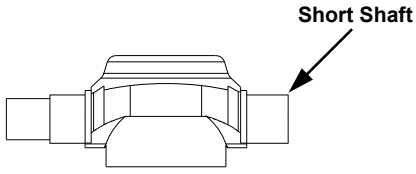


Figure 24. Swashplate/Pump Block Assembly

TRANSAXLE INSTALLATION

Use the following procedure to complete the installation of the transaxle on the vehicle.

1. Install and secure the transaxle on the vehicle according to the instructions in the vehicle owner's manual.
2. With the vehicle raised, install the wheels on the axles, and snug the wheel hardware.
3. Lower the vehicle wheels to the ground and torque the wheel hardware per the vehicle owner's manual.

ASSEMBLY AFTER A COMPLETE TEARDOWN

If the unit has been torn down completely, the following summary identifies the assembly procedures necessary to completely assemble the unit. Each assembly procedure is located by a page reference.

The part reference numbers provided in each assembly procedure are keyed to the individual exploded views, and are also keyed to the complete unit exploded view on page 32.

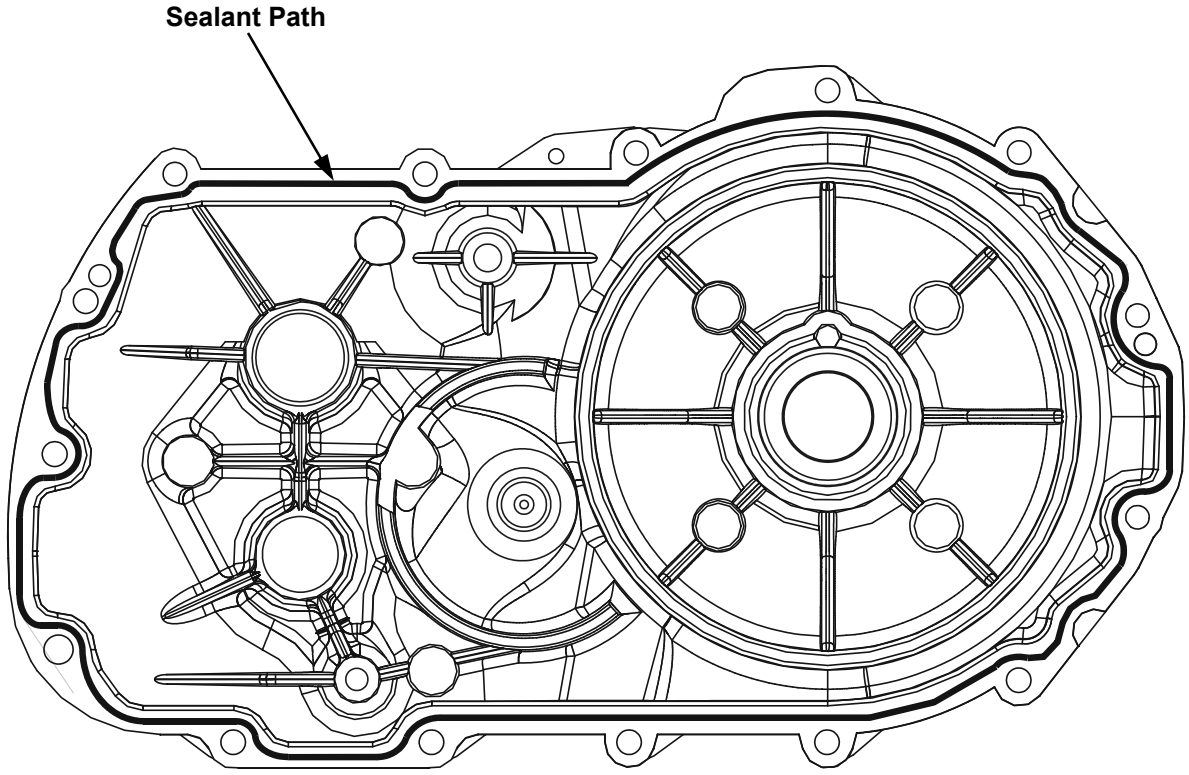
1. Install the hydraulic components. See pages 23-26.
2. Install the input shaft. See page 22.
3. Install the bypass rod. See page 21.
4. Install the axle shaft, differential and reduction gears. See page 20.
5. Install the side housing. See page 19.
6. Install new seals in the side housing. Refer to page 18.
7. Fill the transaxle with new oil. See page 10.
8. Install the control arm and friction pack. See page 17.
9. Install the brake assembly and bypass arm. See page 16.
10. Install the transaxle onto the vehicle.
11. Perform the purge procedures listed on page 11.
12. Perform the return to neutral procedure on page 12.

SEALANT APPLICATION

NOTE: Prior to applying the new sealant, the old sealant must be removed from all surfaces.

A small consistent bead of the sealant around the housing face will be sufficient. Use sparingly.

The illustration below indicates the correct areas.



310-0710 INTEGRATED HYDROSTATIC TRANSAXLE

DESCRIPTION

The 310-0710 transaxle is an upgraded 310-0510 unit with different axle shafts, pump cylinder block assembly, center section and seal kit. The 310-0710 will have, as standard, black axle shafts. Flanged hubs will be an available option.

Except for flanged hub removal and assembly described below, repair techniques for this model are the same as described in the preceding sections of this manual. Table 6 illustrates key feature differences between the 310-0510 and the 310-0710.

TRANSAXLE REMOVAL

It is necessary to remove the 310-0710 from the vehicle before performing the repair procedures presented in the repair section. Use the following procedure to prepare the unit for removal from the vehicle.

1. With the vehicle wheels on the ground, loosen the nuts retaining the hubs on the transaxle. Use an air impact wrench and socket to loosen the nuts.
2. Lift the vehicle wheels from the ground and remove the nut completely.
3. Remove the wheel from the hub.
4. Using a wheel or gear puller, remove the hub from the shaft. Always inspect the hub for damage after removal.

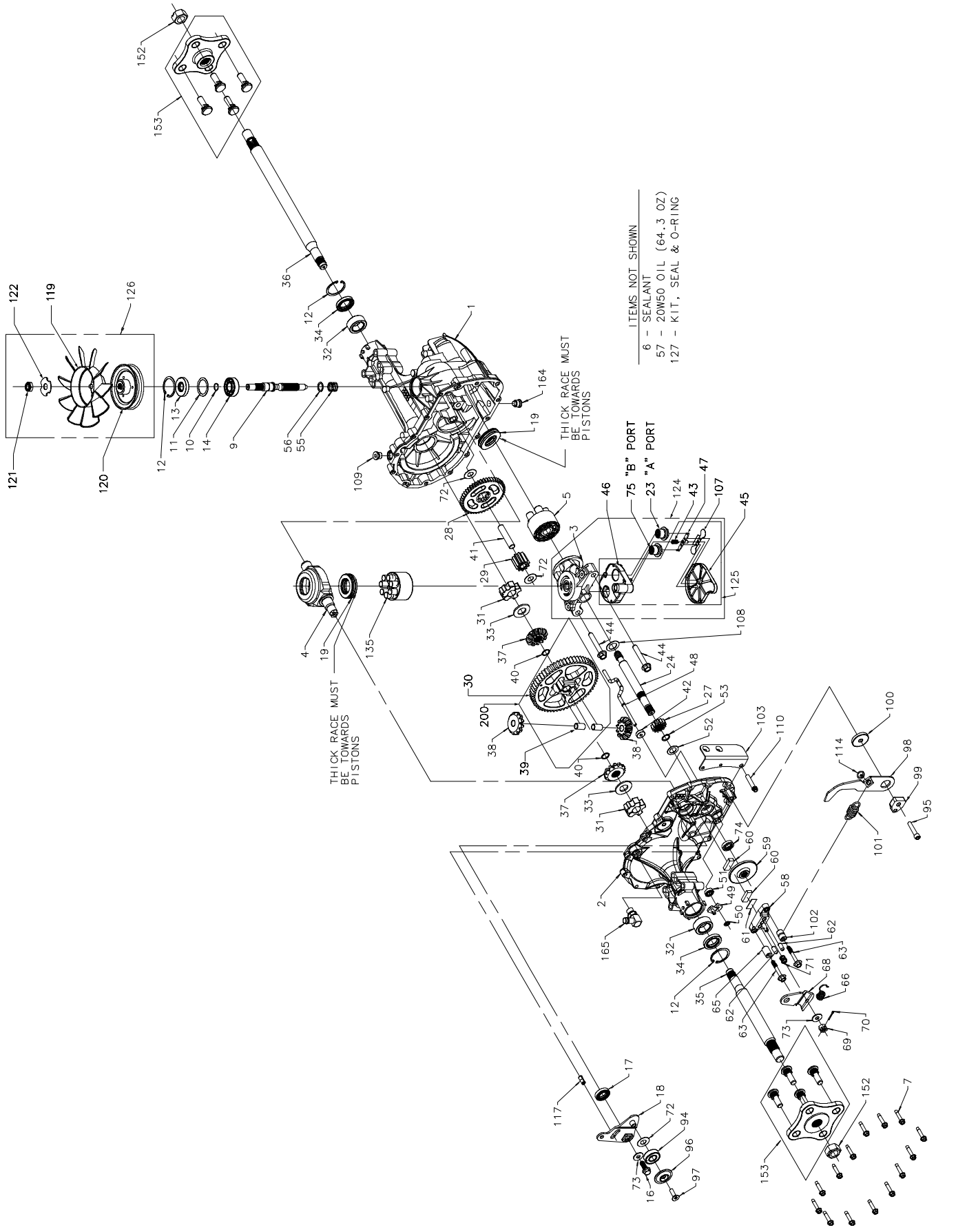
FEATURE COMPARISIONS

Table 6. Transaxle Features

310-0510/-0610 Features	310-0710 Features
• 5 piston 10cc pump	• 7 piston 10cc pump
• ¾" axle shafts	• 1" axle shafts
• Keyed and two flats axle end options	• Splined axle ends
• Seal Kit part no. 70463	• Seal Kit part no. 70722
	• Optional flanged hub

Note that larger (1") axle shafts make it necessary to specify a seal kit and axle bushings different from the 310-0510 unit. The center section, pump cylinder block assembly, and associated kits also differ from those on the 310-0510. Refer to the appropriate model schematic for specific component part numbers.

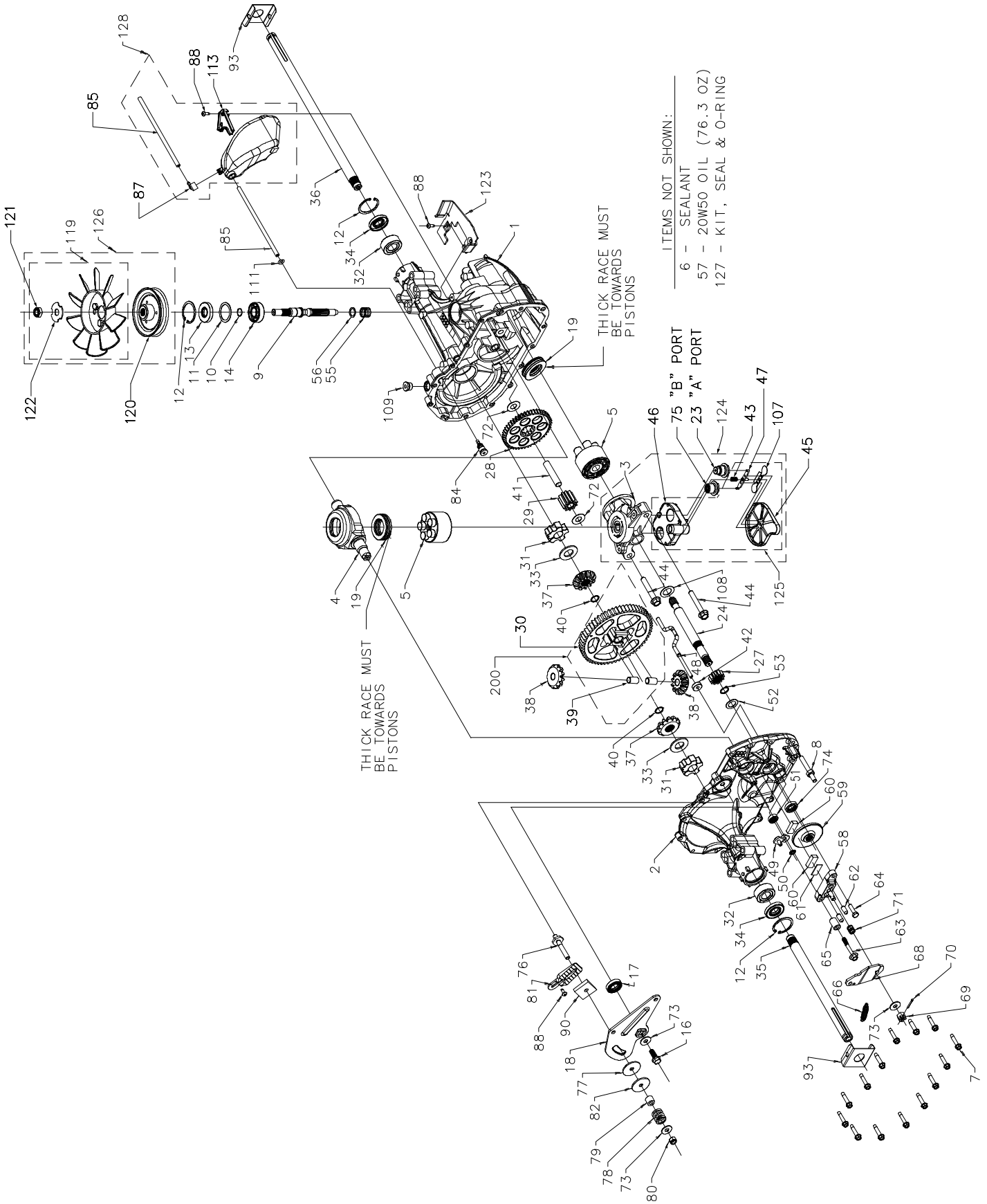
310-0710 EXPLODED VIEW



310-0710 ITEMS LIST

No.	DESCRIPTION
1	Main Housing, Assembly, Black
	Main Housing, Black
	Bushing .865 x .985 x .790
2	Side Housing, Assembly, Black
	Side Housing, Black
	Bushing .865 x .985 x .790
	Bushing .624 x .719 x .562
3	Center Section Assembly
	Center Section Machined
	Bushing .707 x .788 x .591
4	Swashplate, Trunnion Machined
5	Block - Assembly
	Block - Cylinder
	Piston
	Spring Compression
	Thrust - Washer
6	Sealant
7	Hex Flange Screw 1/4-20 x 1.25
9	Shaft, Input
10	Ring - Retaining
11	Washer, Flat 1.23 x 1.57 x .04
12	Ring - Retaining
13	Seal, Lip 17 x 40 x 7
14	Ball Bearing 17MM x 40MM x 12MM
16	Hex Flange Head Screw 5/16-24 x 0.94 w/patch
17	Lip Seal 18 X 32 X 7
18	Arm, Control
19	Bearing, 30X52X13 Thrust
23	Check Plug Assembly, .027, Washer, “A” Port
24	Shaft, Motor
27	Gear - Pinion, 13T
28	10T/48T Gear
29	Gear, 10T Jackshaft
30	60T Bull Gear
31	Sleeve Bushing (Inboard)
32	Sleeve Bushing (Outboard) 1.002 x 1.571 x .625
33	Washer, Flat .77 x 1.5 x .10
34	Lip Seal Axle Seal
35	Shaft, Black, Axle 1.00/.75 x 10.65 (Flange, R.H.)
36	Shaft, Black, Axle 1.00/.75 x 16.25 (Flange, R.H.)
37	Miter Gear, 12T (Splined)
38	Miter Gear 12T (0.5 ID)
39	Shaft
40	Ring, Spiral Retaining
41	Pin, Jackshaft
42	Magnet, Ring
43	Spring, Bypass
44	Bolt, Hex Flange 3/8-24 x 2.5
45	Filter
46	Base, Filter
47	Actuator, Bypass
48	Rod, Bypass Actuator
49	Arm, Bypass
50	Retaining Ring .250 External
51	Seal, Lip ..250 x .750 x .250 TC
52	Flat Washer, .63 x 1.0 x .05
53	Retaining Ring
55	Spring, Block
56	Washer, Thrust .59 x .79 x .04
57	20W-50 Oil
58	Brake Yoke Kit
59	Disk, Brake
60	Brake Puck
61	Puck Plate
62	Brake Actuating Pin
63	Bolt, Hex Head 1/4-20 x 2 w/patch
65	Spacer
66	Spring, Brake Arm Bias
68	Arm, Brake
69	Nut, Castle 5/16-24
70	Cotter Pin 3/32 X 3/4
71	Compression Spring Brake Anti-Drag
72	Washer, Flat .51 x 1.00 x .03
73	Washer, Flat .34 x .88 x .06
74	Oil Seal .625 X 1.0 X .25
75	Check Plug Assy, .027, Washer, “B” Port
94	Ball Bearing .62 I.D. x 1.38 x .44
95	Socket Head Cap Screw, 5/16-24 x 1-1/2
96	Spacer Locating
97	Screw, Countersunk 5/16-18 x 1.0
98	Arm, Return
99	Puck, Adjusting
100	Washer, .32 x 1.60 x .24
101	Spring, Extension
102	Spacer, .260 x .560 x .87
103	Bracket, Torque
107	Deflector
108	Washer, Motor Shaft .71 x 1.16 x .04
109	Plug, 9/16-18 (Metal)
110	Torx Head Screw 5/16-18 x 1.5
114	Spring Guide
117	Pin, Spring .304 x.75
119	Fan, 7.0 in. (10 Blade)
120	Pulley, 3.86 in.
121	Nut, Hex Lock 1/2-20 w/nylon insert
122	Washer, OD slotted .53 x 1.63 x .06
124	Center Section-Filter-Bypass Assy
	Center Section Machined
	Base Filter
	Check Plug Assy.
	Spring, Bypass
	Actuator, Bypass
	Deflector
	Filter
	Bushing, .707 X .788 X .591
125	Filter Assembly
126	Kit, Fan/Pulley
127	Kit, Seal & O-Ring
	Seal, Lip 17 x 40 x 7
	Seal, Lip 18 x 32 x 7
	Seal, Lip 1.00 X 1.577 X .250
	Seal, Lip .250 X .750 X .250
	Seal, Lip .625 X 1.0 X .25
	O-Ring .299 x .505 x .103
135	Assembly, Block 7 Piston
	Block, Cylinder
	Piston
	Spring, Compression
	Seat
152	Nut, Hex Lock 3/4-16
153	Assembly, Hub
	Hub, 4 Stud Metric (Painted)
	Stud, M12 x 1.5 (Rib Neck)
164	Plug, 9/16-18 (Magnetic)
165	Fitting, 90° 9/16 SAE Beaded
200	Kit, 60T Bull Gear Diff Pins
	Gear, 60T
	Pin, 0.5 OD
	Bulletin, Bull Gear

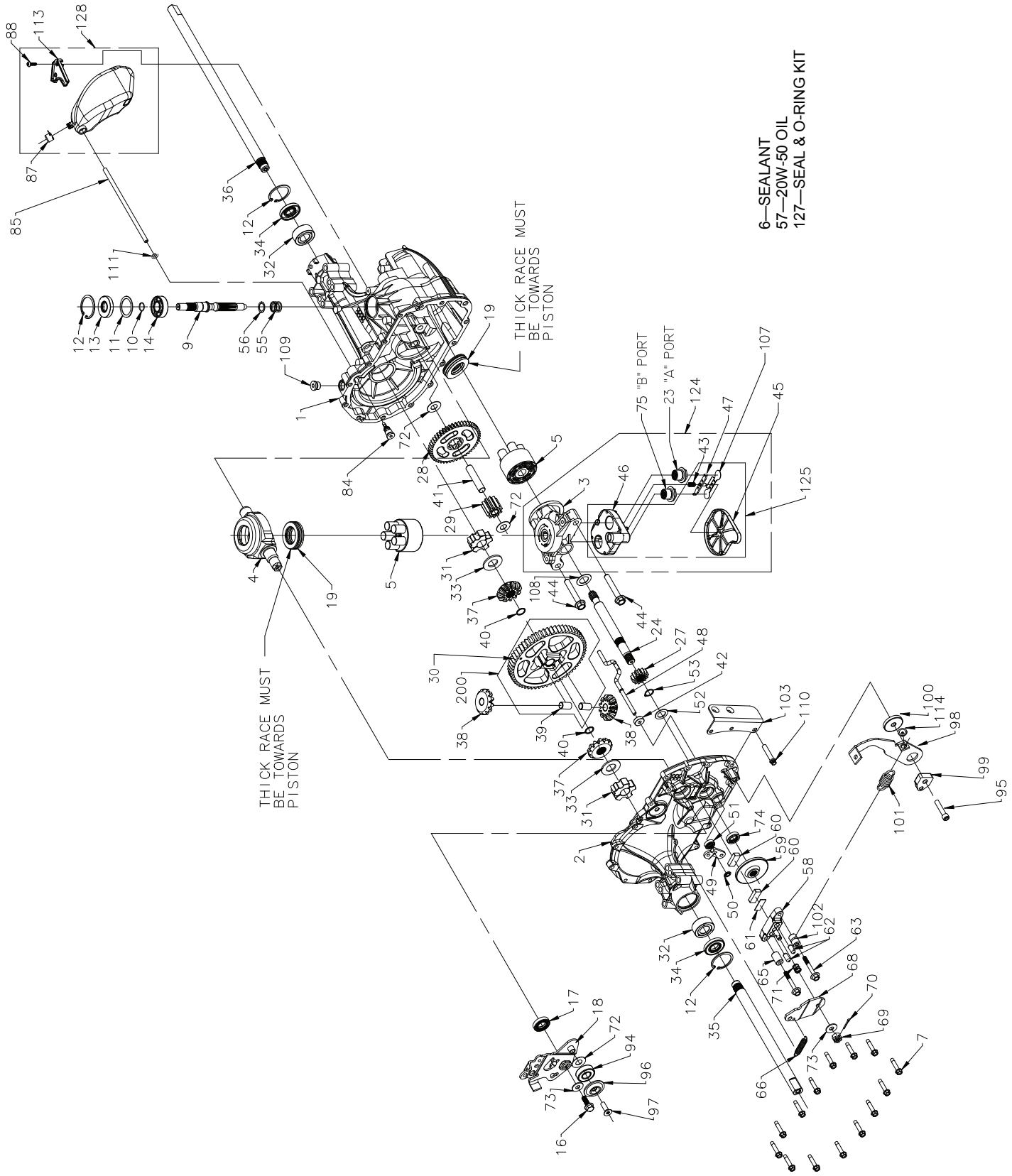
310-0610 EXPLODED VIEW



310-0610 ITEMS LIST

No.	DESCRIPTION
1	Main Housing, Assembly
	Main Housing
	Bushing .865 x .985 x .790
	Pin, Headless Standard
2	Side Housing, Assembly
	Side Housing
	Bushing .865 x .985 x .790
	Bushing .624 x .719 x .562
3	Center Section Assembly
	Center Section Machined (5 piston)
	Bushing .707 x .788 x .591
4	Swashplate, Trunnion Machined
5	Block - Assembly
	Block - Cylinder
	Piston
	Spring Compression
	Thrust - Washer
6	Sealant
7	Screw, Hex Washer 1/4-20 x 1.25
8	Stud, 5/16-18 THD, 5/16-18 Strap
9	Shaft, Input
10	Ring - Retaining
11	Washer, Flat 1.23 x 1.57 x .04
12	Ring - Retaining
13	Seal, Lip 17 x 40 x 7
14	Ball Bearing 17MM x 40MM x 12MM
16	Bolt, Hex Flange 5/16-24 x 0.94 w/patch
17	Lip Seal 18 x 32 x 7
18	Arm, Control
19	Bearing, Thrust 30 x 52 x 13
23	Shock Valve Assembly, .027, Washer, “A” Port
24	Shaft, Motor
27	Gear - Pinion, 13T
28	10T/48T Gear
29	Gear, 10T Jackshaft
30	60T Bull Gear
31	Sleeve Bushing (Inboard)
32	Sleeve Bushing .752 x 1.571 x .625
33	Washer, Flat .77 x 1.5 x .10
34	Lip Seal .750 x 1.577 x .250
35	Shaft, Axle .75 x 11.39 (Key, R.H.)
36	Shaft, Axle .75 x 16.99 (Key, L.H.)
37	Miter Gear, 12T (Splined)
38	Miter Gear 12T (0.5 ID)
39	Shaft
40	Ring, Spiral Retaining
41	Pin, Jackshaft .50 x 2.43
42	Magnet, Ring
43	Spring, Bypass
44	Bolt, Hex Flange 3/8-24 x 2.5
45	Filter
46	Base, Filter
47	Actuator, Bypass
48	Rod, Bypass Actuator
49	Arm, Bypass
50	Retaining Ring .250 External
51	Seal, Lip ..250 x .750 x .250 TC
52	Flat Washer, .63 x 1.0 x .05
53	Retaining Ring
55	Spring, Block
56	Washer, Thrust .59 x .79 x .04
57	20W-50 Oil
58	Brake Yoke Kit
	Yoke, Brake
	Bolt, Sq. Hd. 5/16-24 Ribbed
59	Disk, Brake
60	Brake Puck
61	Puck Plate
62	Brake Actuating Pin
63	Bolt, Hex Head 1/4-20 x 2 w/patch
64	Bolt, Hex Head 1/4-20 x 1 w/patch
65	Spacer .26 x .57 x .87
66	Spring, Brake Arm Bias
68	Arm, Brake
69	Nut, Castle 5/16-24
70	Cotter Pin 3/32 X 3/4
71	Compression Spring Brake Anti-Drag
72	Washer, Flat .51 x 1.00 x .03
73	Washer, Flat .34 x .88 x .06
74	Kit, Motor Shaft Seal .625 X 1.0 X .25
75	Check Plug Assy, .027, Washer, “B” Port
76	Stud, 5/16-24 Friction Pack
77	Puck .330 x 1.50 x .0975
78	Spring, Helical Compression
79	Spacer, .32 x .59 x .50
80	Nut, Hex lock 5/16-24 w/nylon insert
81	Wedge, Friction Pack
82	Spacer, Friction Pack
84	Fitting, 5/16 SAE 5/32 Tube
85	Hose, Expansion Tank 7.56
87	Cap, Barbed Vent
88	Bolt, Self Tapping
90	Puck, Inner Wedge
93	Spring Clip, Housing Thrust (.75 In Axle)
107	Deflector
108	Washer, Motor Shaft .71 x 1.16 x .04
109	Plug, 9/16-18 (Metal)
111	O-Ring .299 x .505 x .103
113	Bracket, Expansion Tank
119	Kit, Fan, 7.0 in. (10 Blade)
120	Pulley, 3.86 in.
121	Nut, Hex Lock 1/2-20 w/nylon insert
122	Washer, OD slotted .53 x 1.63 x .06
123	Bracket, Belt Keeper, Angled
124	Center Section-Filter-Bypass Assy
	Center Section Machined
	Base Filter
	Shock Valve Assy.
	Check Plug Assy.
	Spring, Bypass
	Actuator, Bypass
	Deflector
	Filter
	Bushing, .707 X .788 X .591
125	Filter Assembly
126	Kit, Fan/Pulley
127	Kit, Seal & O-Ring
	Seal, Lip 17 x 40 x 7
	Seal, Lip 18 x 32 x 7
	Seal, Lip 1.00 X 1.577 X .250
	Seal, Lip .250 X .750 X .250 TC
	Seal, Lip .625 X 1.0 X .25
	O-Ring .299 x .505 x .103
128	Kit, Expansion Tank
200	Kit, 60T Bull Gear Diff Pins
	Gear, 60T
	Pin, 0.5 OD
	Bulletin, Bull Gear

310-0510 EXPLODED VIEW



310-0510 ITEMS LIST

No.	DESCRIPTION
1	Main Housing, Assembly
	Main Housing, Machined
	Bushing .865 x .985 x .790
	Pin, Standard Headless
2	Side Housing, Assembly
	Side Housing, Machined
	Bushing .865 x .985 x .790
	Bushing .624 x .719 x .562
3	Center Section Assembly
	Center Section Machined (5 piston)
	Bushing .707 x .788 x .591
4	Swashplate, Trunnion Machined
5	Block - Assembly
	Block - Cylinder
	Pistons
	Springs, Compression
	Thrust - Washer
6	Sealant (10.1 oz.)
7	Hex Flange Screw 1/4-20 x 1.25
8	Stud, 5/16-24 Hex Double End
9	Shaft, Input
10	Ring - Retaining
11	Washer, Flat 1.23 x 1.57 x .04
12	Ring - Retaining
13	Seal, Lip 17 x 40 x 7
14	Ball Bearing 17MM x 40MM x 12MM
16	Hex Flange Head Screw 5/16-24 x 0.94 w/patch
17	Lip Seal 18 x 32 x 7
18	Arm, Control
19	Bearing, 30 x 52 x 13 Thrust
23	Check Plug Assembly, .027 Bleed, Washer (“A” port)
24	Shaft, Motor
27	Gear - Pinion, 13T
28	10T/48T Gear
29	Gear, 10T Jackshaft
30	60T Bull Gear
31	Sleeve Bushing (Inboard)
32	Sleeve Bushing .75 x 1.575 x .625
33	Washer, .77 x 1-1/2 x .10 THK
34	Lip Seal Axle Seal
35	Shaft, Axle .75 x 11.39 (DD, R.H.)
36	Shaft, Axle .75 x 17.99 (DD, L.H.)
37	Miter Gear 12T (Splined)
38	Miter Gear 12T (0.5 ID)
39	Pin
40	Ring, Spiral Retaining
41	Pin, Jackshaft
42	Magnet, Ring
43	Spring, Bypass
44	Bolt, Hex Flange 3/8-24 x 2.5
45	Filter
46	Base, Filter
47	Actuator, Bypass
48	Rod, Bypass Actuator
49	Arm, Bypass
50	Retaining Ring .250 External
51	Seal, Lip .250 x .750 x .250TC
52	Flat Washer, 5/8 x 1.0 x .05
53	Retaining Ring
55	Spring - Helical Compression
56	Washer, Thrust .59 x .79 x .04
57	20W-50 Oil
58	Brake Yoke
59	Rotor, Brake
60	Brake Puck
61	Puck Plate
62	Brake Actuating Pin
63	Bolt, Hex Hd 1/4-20 x 2 w/patch
65	Spacer
66	Spring, Brake Arm Bias
68	Arm, Brake
69	Nut, Castle 5/16-24
70	Cotter Pin 3/32 x 3/4
71	Compression Spring, Brake, Anti-Drag
72	Washer, HT .51 x 1.0 x .03
73	Flat - Washer .34 x .88 x.06
74	Oil Seal .625 x 1.0 x .25
75	Check Plug Assembly, .027 Bleed, Washer (“B” port)
84	Fitting, 5/16 SAE 5/32 Tube
85	Hose, Expansion Tank
87	Cap - Vent
88	Bolt, Self Tapping 10-32 x 1/2
94	Bearing, Ball .62 x 1.38 x.44
95	Screw, Socket Hd Cap 5/16-24 x 1.5
96	Spacer, Locating
97	Screw, Countersunk 5/16-18 1.0
98	Arm, Return
99	Puck, Adjusting
100	Washer, Flat .32 x 1.60 x .24
101	Spring, Extension Double Loop
102	Spacer .26 x .56 x .87
103	Bracket, Torque
107	Deflector
108	Washer, Flat .71 x 1.16 x .04
109	Plug, 9/16-18 (Metal)
110	Screw, Torx Hd 5/16-18 x 1.5
111	O-Ring .299 x .505 x .103
113	Bracket, Support Expansion Tank
114	Spring Guide
124	Center Section-Filter-Bypass Assy
	Center Section (5 piston)
	Base Filter (w/poppet)
	Check Plug Assy. .027 Bleed, Washer
	Spring, Bypass .50 in
	Actuator, Bypass
	Deflector
	Bottom, Filter
	Bushing, .707 x .788 x .591
125	Filter Assembly
	Bottom, Filter
	Spring, Bypass .50 in
	Actuator, Bypass
	Deflector
	Base, Filter w/poppet
127	Kit, Seal & O-Ring
	Seal, Lip 17 x 40 x 7
	Seal, Lip 18 x 32 x 7
	Seal Lip .75 x 1.577 x .250
	Seal, Lip .250 x .750 x .250 TC
	Seal, Lip .625 x 1.0 x .25
	O-Ring .299 x .505 x .103
128	Kit, Expansion Tank
	Tank, Expansion Assembly
	Cap, Expansion
	Bolt, Self Tapping 10-32 x 1/2
	Bracket, Expansion Tank
200	Kit, 60T Bull Gear Diff Pins
	Gear, 60T
	Pin, 0.5 OD

GLOSSARY OF TERMS

Axial Piston: Type of design for hydraulic motors and pumps in which the pistons are arranged parallel with the spindle (input or output shaft).

Bantam Duty: A descriptive term relating to the product capacity (meaning: light duty).

Bypass Valve: A valve whose primary function is to open a path for the fluid to bypass the motor or pump. Also referred to occasionally as the freewheel valve or dump valve.

Case Drain Line (Return Line): A line returning fluid from the component housing to the reservoir.

Cavitation: A concentrated gaseous condition within the fluid causing the rapid implosion of a gaseous bubble.

Center Section: A device which acts as the valve body and manifold of the transmission.

Charge Pump: A device which supplies replenishing fluid to the fluid power system (closed loop).

Charge Pressure: The pressure at which replenishing fluid is forced into a fluid power system.

Charge Relief Valve: A pressure control valve whose primary function is to limit pressure in the charge circuit.

Check Valve: A valve whose primary function is to restrict flow in one direction.

Closed Loop: A sealed and uninterrupted circulating path for fluid flow from the pump to the motor and back.

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section”

Entrained Air: A mechanical mixture of air bubbles having a tendency to separate from the liquid phase.

Gerotor: A positive displacement pump frequently used as a charge pump.

Hydraulic Motor: A device which converts hydraulic fluid power into mechanical force and motion by transfer of flow under pressure.

Hydraulic Pump: A device which converts mechanical force and motion into hydraulic fluid power by producing flow.

Hydrostatic Pump: See “Hydraulic Pump”

Hydrostatic Transaxle: A multi-component assembly including a gear case and a hydrostatic transmission.

Hydrostatic Transmission: The combination of a hydraulic pump and motor in one housing to form a device for the control and transference of power.

Inlet Line: A supply line to the pump.

Integrated Hydrostatic Transaxle (IHT): The combination of a hydrostatic transmission and gear case in one housing to form a complete transaxle.

Manifold: A conductor which provides multiple connection ports.

Neutral: Typically described as a condition in which fluid flow and system pressure is below that which is required to turn the output shaft of the motor.

Pressure Decay: A falling pressure.

Priming: The filling of the charge circuit and closed loop of the fluid power system during start up, frequently achieved by pressurizing the fluid in the inlet line.

Purging: The act of replacing air with fluid in a fluid power system by forcing fluid into all of the components and allowing the air a path of escape.

Rated Flow: The maximum flow that the power supply system is capable of maintaining at a specific operating pressure.

Scoring: Scratches in the direction of motion of mechanical parts caused by abrasive contaminants.

Swash Plate: A mechanical device used to control the displacement of the pump pistons in a fluid power system.

System Charge Check Valve: A valve controlling the replenishing flow of fluid from a charge circuit to the closed loop in a fluid power system.

System Pressure: The pressure which overcomes the total resistance in a system, including all losses.

Valve: A device which controls fluid flow direction, pressure, or flow rate.

Variable Displacement Pump: A pump in which the displacement per cycle can be varied.

Volumetric Displacement: The volume for one revolution.

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