Professional Shop Manual

2000 Series Tractors

(2011 Model year and Newer)

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.

MTD Products Inc. - Product Training and Education Department

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CHAPTER 1: INTRODUCTION

Professional Shop Manual intent

This Manual is intended to provide service dealers with an introduction to the electrical and mechanical aspects of the 2000 series tractor.

- Detailed service information about the engine will be provided by the engine manufacturer.

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 thread 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 and of 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 2000 series tractor

Figure 1.1

The Cub Cadet 2000 series tractor has been substantially up-dated for the 2011 season. These tractors feature:

- Kohler Command horizontal shaft engines.
- A drive shaft that transfers power efficiently to the transmission without the need for belts.
- Cast-iron transmission and front axle.
- 12 gauge steel ladder frame.
- Electric PTO Clutch.
- Manual and electric deck lift systems are available.
- Adjustable tilt steering column (available on most models.

Figure 1.2

The 50th Anniversary model also features:

- Electronic Power Steering.
- Electric deck lift is standard.
- 54” fabricated deck.
- A special 2-tone painted hood.
- A custom front bumper.

Model and Serial Numbers

The model and serial number tag can be found under the seat. See Figure 1.3.

The serial number is located to the right of the model number as shown above. See Figure 1.3.

Figure 1.3

The model number is 14W-3AE-010. The break down of what the number mean is as follows:

14 .....Garden tractor

.....W. .....Sales revision

.....-. .....Marketing revision

.....3. .....Frame

.....A.....Engine (A = Kohler twin 23 hp)

.....E.....Deck lift (E = electric)

.....- .....Deck (The 50th anniversary model is the only version that comes equipped with a deck)

.....010 .....Customer number

The serial number is 1C281B20053. The serial number reads as follows:

1 ..... Engineering level

..C..... Month of production (C=March)

.....28 ..... Day of the month

.....1 ..... Last digit of the year

.....B..... Plant it was built in (Willard, OH)

.....2 ..... Assembly line number

.....0053 ..... Number of unit built

CHAPTER 2: ENGINE RELATED PARTS

This chapter covers the engine accessories that are manufactured by Cub Cadet.

IMPORTANT: The engine is manufactured by Kohler. Refer to the Kohler manual for engine specific service information.

Muffler

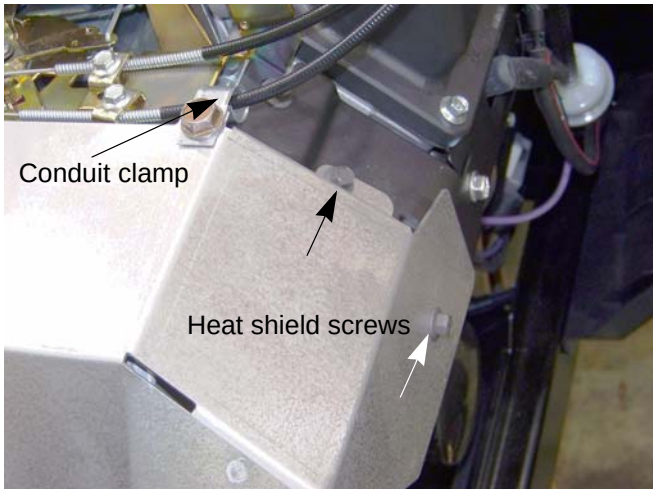

Figure 2.1

To Remove/replace the muffler:

1. Remove the hood by following the procedures described in Chapter 4: Body.
2. Remove the screw that holds the conduit clamp to the heat shield using a 1/2” wrench. See Figure 2.1.
3. Remove the four screws (two on each side) that hold the heat shield to the engine using a 5/16” wrench.
4. Slide the heat shield off of the engine.

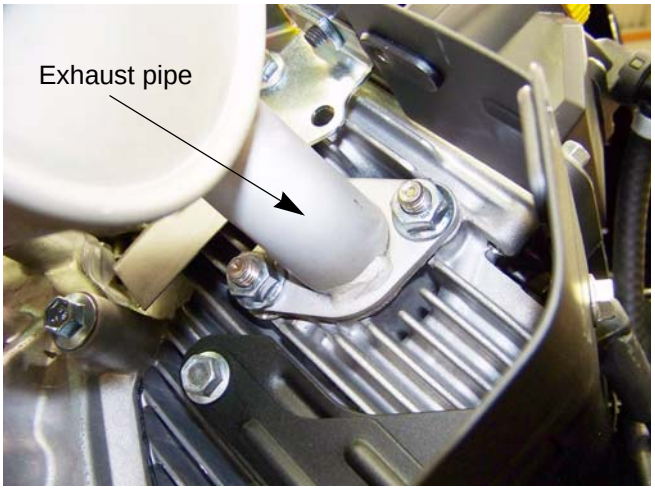

Figure 2.2

5. Remove the two nuts that hold each exhaust pipe to the cylinder head using a 1/2” wrench. See Figure 2.2.
6. Remove the muffler and exhaust pipes.

NOTE: The exhaust pipes are welded to the muffler. The pipes and the muffler are serviced as one assembly.

7. Clean and remove all gasket material from the cylinder head (and the exhaust pipes if they are being reused).
8. Using new gaskets, install the muffler by following the previous steps in reverse order.

NOTE: Tighten the exhaust nuts to a torque of 246 in lbs (27.8 Nm).

9. Test drive the mower in a safe area before returning it 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

1. Safely drain the gasoline from the fuel tank.
2. Disconnect the seat switch. See Figure 2.3.

   NOTE: On the GTX2154LE, it will be necessary to cut the wire tie that holds the seat switch connector to the seat frame.

   NOTE: When reconnecting the seat switch plug on the GTX2154LE, it must be wire tied back together and attached to the seat frame. Failure to do this can cause the connector to get caught in the seat bracket and rip the wires out of the seat. If this happens, the tractor will shut down when the brake is released and the whole seat must be replaced.
3. Push the barbed fastener on the seat switch harness out of the hole in the fender.

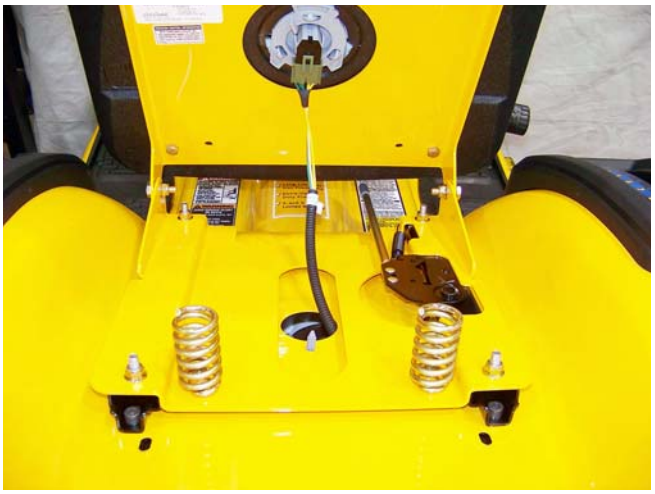

Figure 2.3

4. Remove the four socket headed cap screws that hold the seat tracks to the fender using a T-40 torx driver. See Figure 2.4.

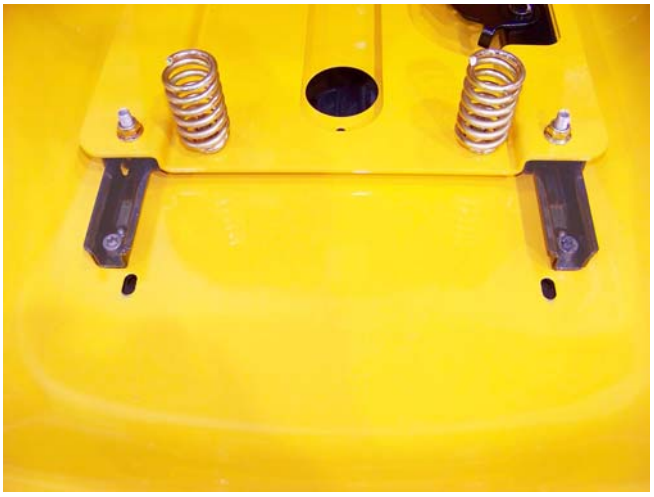

Figure 2.4

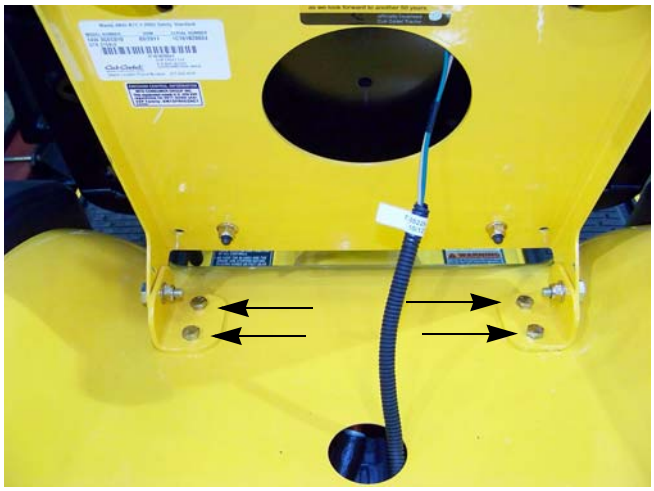

Figure 2.5

NOTE: On the GTX2154LE:

- Remove the four screws, indicated by the arrows in Figure 2.5, that hold the seat frame to the fender using a 7/16” wrench.
- Remove the two screws that hold the rear of the fender to the frame using a 7/16” wrench.

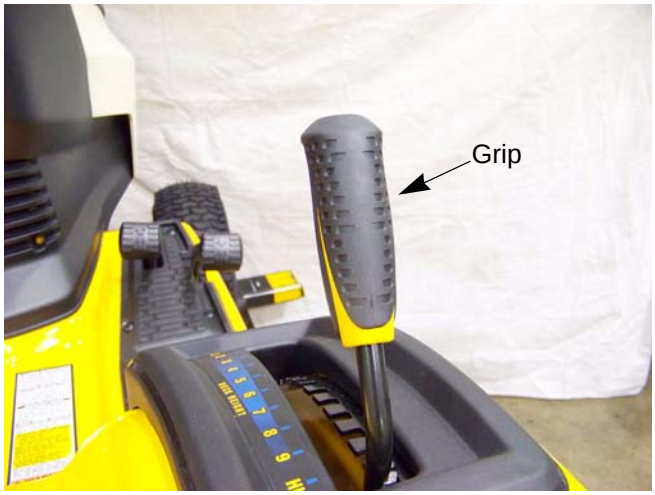

Figure 2.6

On manual deck lift models:

5. Remove the deck lift lever grip. See Figure 2.6.

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.

Figure 2.7

On electric deck lift models:

6. Remove the screw that holds the deck cutting height lever to the shaft using a T40 torx driver.
7. Pull the cutting height lever off of the shaft.
8. Disconnect the deck lift switch.

9. Unthread the fuel cap.

10. Pull the fuel cap tether retainer out of the fuel tank using a long pair of pliers. See Figure 2.8.

    NOTE: The fuel cap tether is mandated by the EPA. If it is broken, the fuel cap must be replaced.

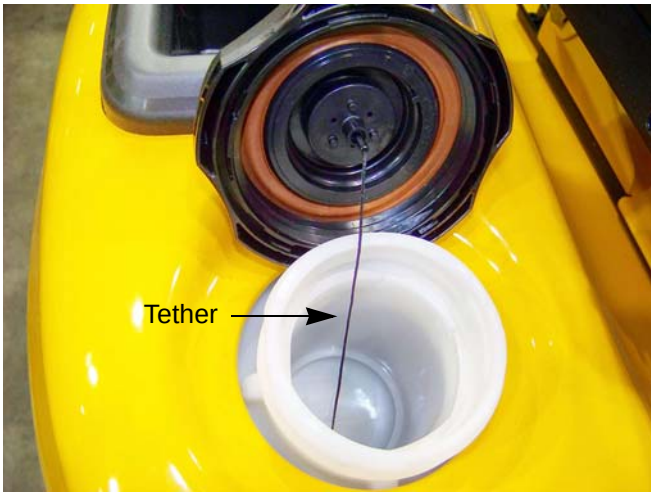

Figure 2.8

11. Gently pry out the barbed fasteners that hold the end of the running board mats to the fender. See Figure 2.9.

Figure 2.9

12. Remove the six nuts and bolts, indicated by the arrows in Figure 2.10, that hold the fender to the running board using a pair of 7/16” wrenches.

13. Lift the fender off of the tractor.

Figure 2.10

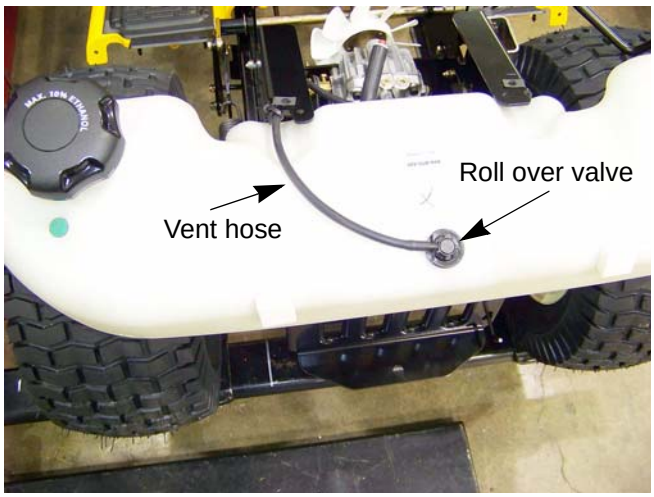

Figure 2.11

14. Re-install the fuel cap.
15. Disconnect the vent hose from the roll over valve. See Figure 2.11.

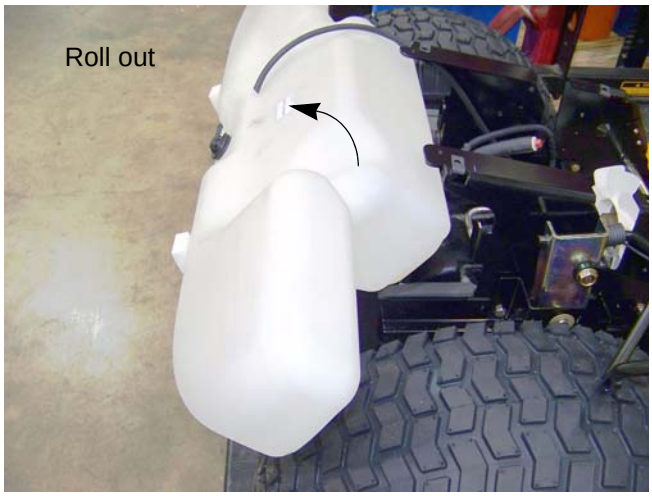

Figure 2.12

16. Roll the fuel tank towards the rear of the tractor until it is free from the tractor. See Figure 2.12.
17. Disconnect the fuel line from the fuel tank.
18. Install the fuel tank by following the previous steps in reverse order.
19. Test run the tractor in a safe area before returning it to service.

Throttle cable adjustment

If the engine does not achieve its high (no load) speed when the throttle is moved to the full throttle position, check the cable adjustment before performing any other engine or carburetor inspections.

To adjust the throttle cable:

1. Raise the hood and locate the engine control panel.
2. Operate the throttle lever while observing its direction of movement. See Figure 2.13.
3. Loosen the screw that secures the throttle cable clamp.
4. Push and hold the throttle arm at the full throttle position.
5. While holding the throttle arm, remove the slack in the cable by pulling the cable jacket back through the clamp.
6. Tighten the screw in the clamp to secure the cable.
7. Start the engine.
8. Check the engine RPMs using a tachometer.

   NOTE: Refer to the service manual provided by the engine manufacturer for any further engine speed adjustments needed.

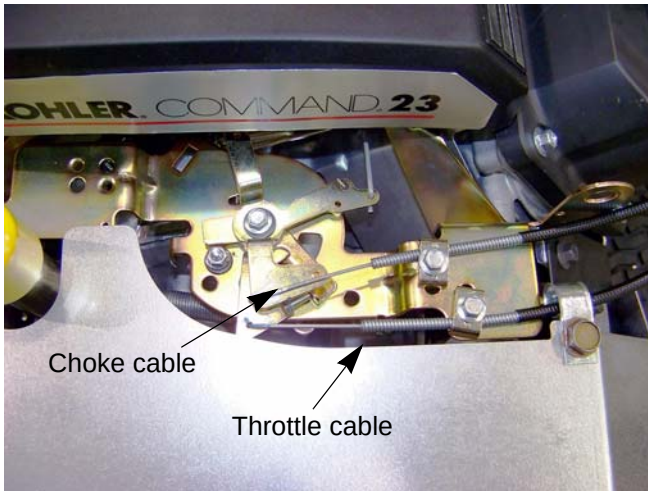

Figure 2.13

Choke cable adjustment

If the engine is difficult to start or runs roughly after it warms up, check the choke cable setting before performing any other engine or carburetor inspections.

To adjust the choke cable:

1. Remove the air filter.
2. Locate the engine control panel.
3. Loosen the screw that secures the choke cable clamp.
4. Move the choke arm until the choke plate is fully closed.

   NOTE: Look down the carburetor throat to confirm that the choke plate is fully closed. See Figure 2.14.
5. While holding the choke arm, remove the slack in the cable by pulling the cable jacket back through the clamp.
6. Tighten the screw in the clamp to secure the cable.
7. Check the operation of the cable and choke plate.
8. Re-install the air filter.
9. Test run the tractor in a safe area before returning it to service.

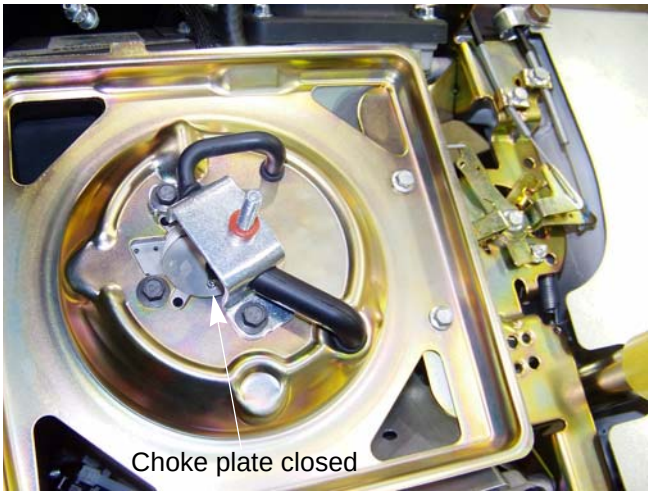

Figure 2.14

Choke and Throttle levers and cables

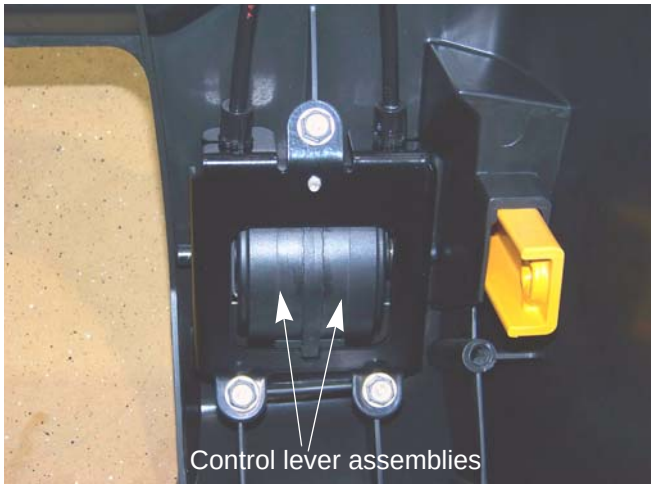

Figure 2.15

To remove/replace levers and cables:

NOTE: The choke and throttle cables must be removed with the lever assemblies before they can be separated and replaced.

1. Remove the dash by following the procedures described in Chapter 4: Body.
2. Remove the three screws that secure the control lever assemblies in place using a 3/8” wrench. See Figure 2.15.
3. Rotate the levers while pulling the assemblies out of the dash.

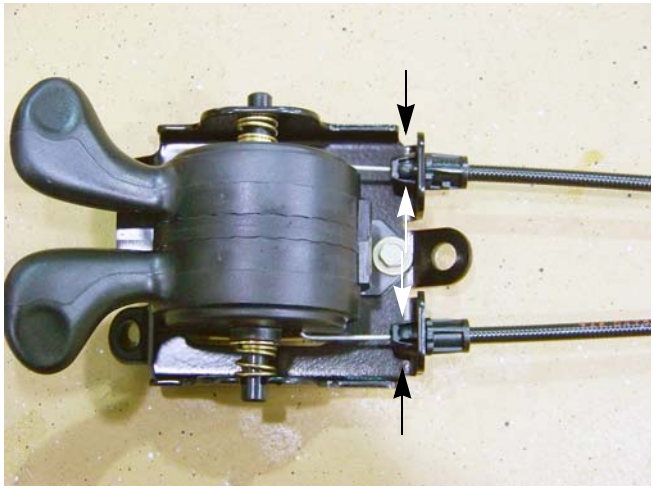

Figure 2.16

4. Remove the cables:
   - 4a. Squeeze in the ears on the cable jacket fittings. See Figure 2.16.
   - 4b. Slide the cable jackets out of the bracket.
   - 4c. Un-hook the cables from the levers.

NOTE: If just replacing the cables, install the cables by follow steps 1 - 4 in reverse order.

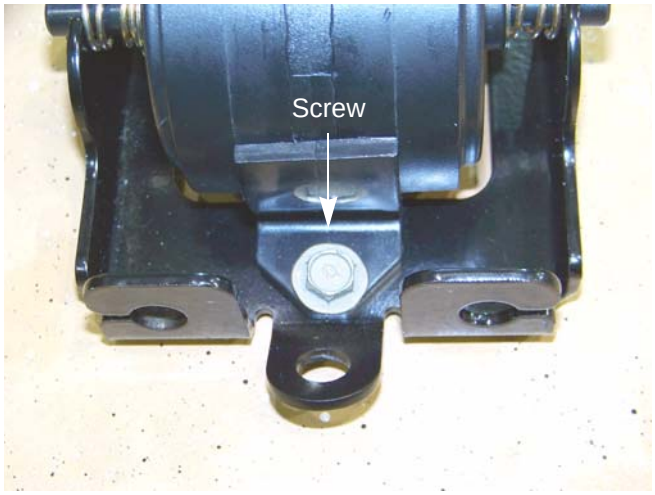

Figure 2.17

5. Remove the screw that holds the lever retainer to the bracket using a 5/16” wrench. See Figure 2.17.

6. On the side of the lever assembly that has the slot, lift the shaft that the levers pivot on enough to slide the spring off. See Figure 2.18.
7. Slide the lever assembly toward the side with the slot until the assembly clears the other side.

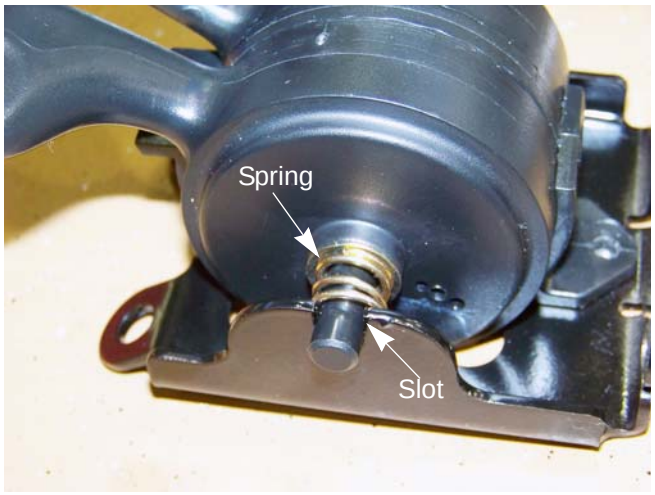

Figure 2.18

8. Slide the levers off of the indexing plate. See Figure 2.19.
9. Install the levers and cables by following the previous steps in reverse order.

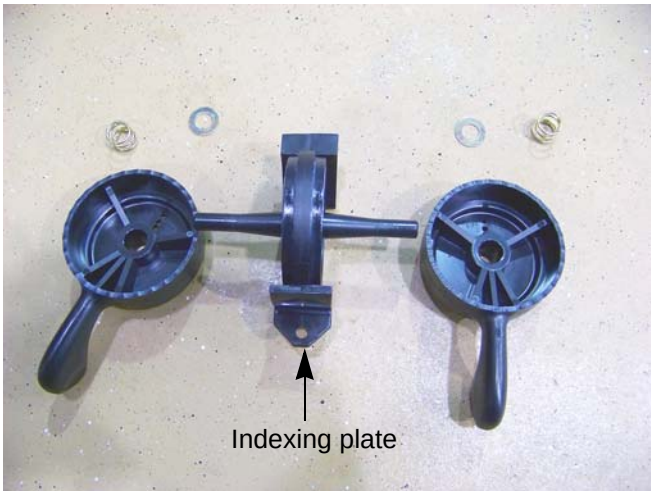

Figure 2.19

Engine removal/installation

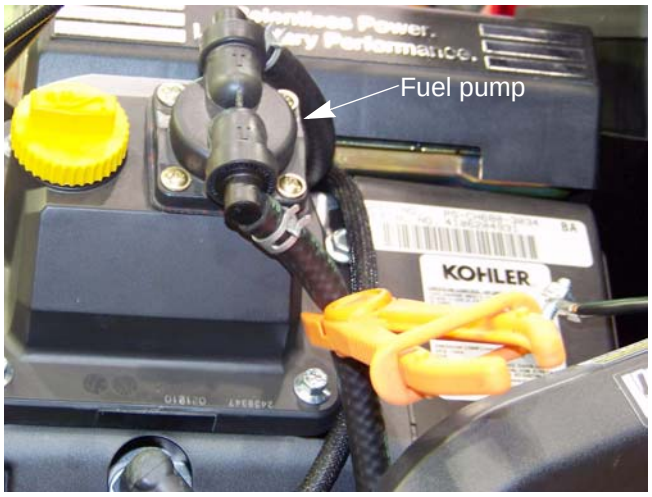

Figure 2.20

It may be necessary to remove the engine to perform engine repairs such as replacing the ignition coil, flywheel, alternator or to work on the cylinder heads.

To remove the engine:

1. Remove the hood by following the procedures described in Chapter 4: Body.
2. Disconnect the negative battery cable from the battery.
3. Remove the muffler by following the procedures described in the muffler section of this chapter.
4. Clamp off the fuel line just below the fuel pump. See Figure 2.20.

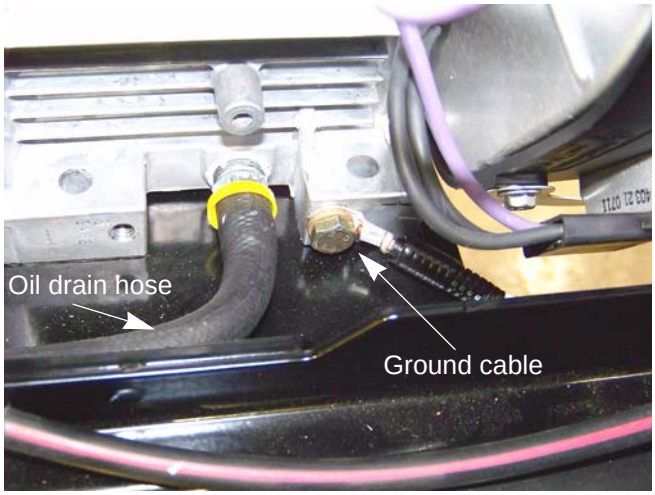

Figure 2.21

5. Disconnect the ground cable from the left side of the engine using a 1/2” wrench. See Figure 2.21.

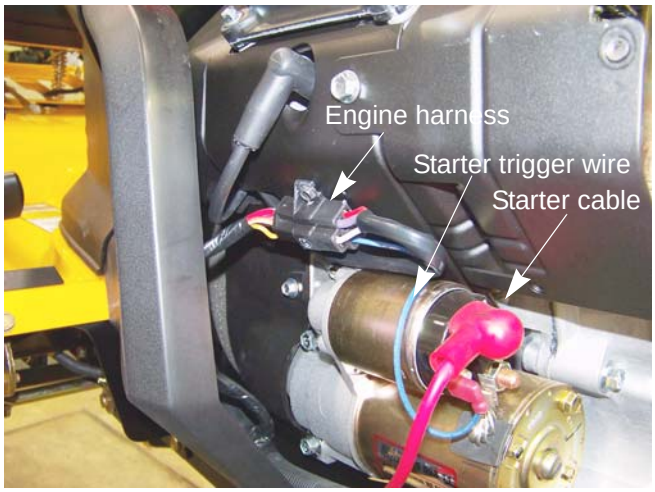

Figure 2.22

6. Disconnect the PTO clutch harness.
7. Disconnect the engine harness.
8. Disconnect the starter wires. See Figure 2.22.
9. Remove the starter.

10. Remove the dash by following the procedures described in Chapter 4: Body.

11. Disconnect the drive shaft from the engine by removing the four patch bolts using a 7/16” wrench. See Figure 2.23.

Figure 2.23

12. Remove the four nuts and bolts, indicated by the arrows in Figure 2.24, that hold the engine to the sub frame using a pair of 9/16” wrenches.

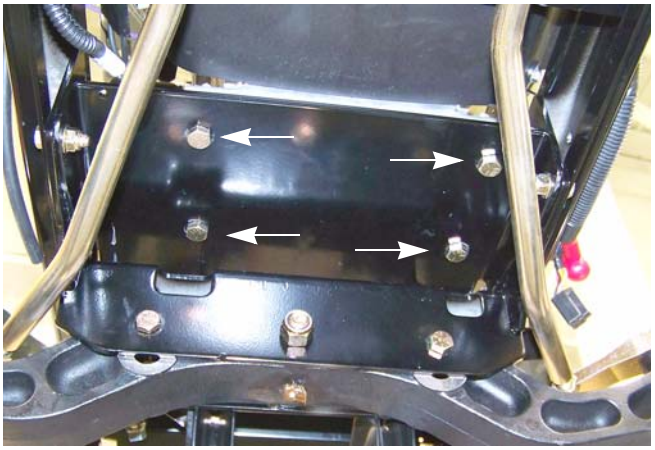

Figure 2.24

13. Attach a lift chain to the engine’s lifting points. See Figure 2.25.

    NOTE: The lift chain should be approximately 2’ - 2.5’ (61 - 76 cm) long and is of sufficient strength to safely support weight of the engine.

14. Using an engine hoist, gently lift the engine while sliding it off of the drive shaft and out the front of the tractor.

    NOTE: Be careful sliding the engine off of the drive shaft. If the drive shaft coupling gets caught, it will come apart, spilling the blue rollers on the ground.

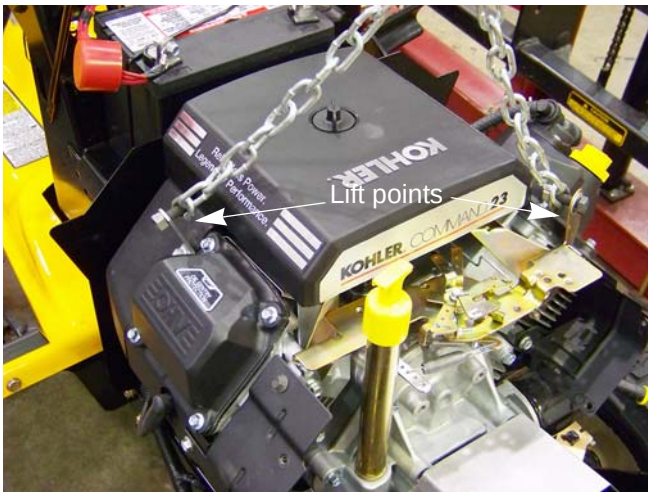

Figure 2.25

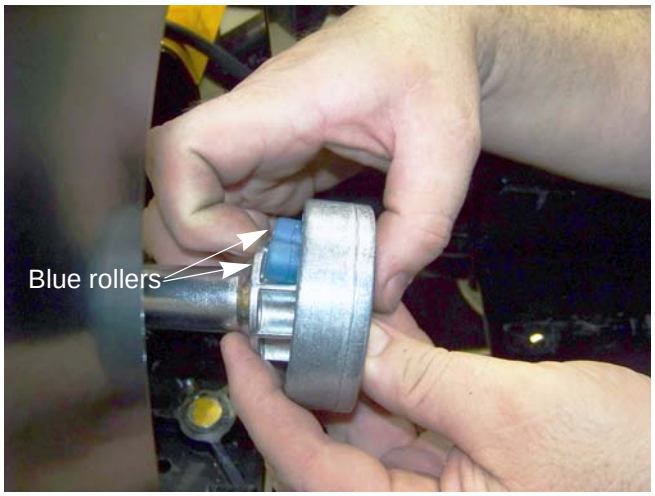

Figure 2.26

NOTE: If the front drive shaft coupling comes apart:

- Remove the engine.
- Insert the rollers in between the drive shaft end and the coupler housing one at a time, until all eight are in place. See Figure 2.26.

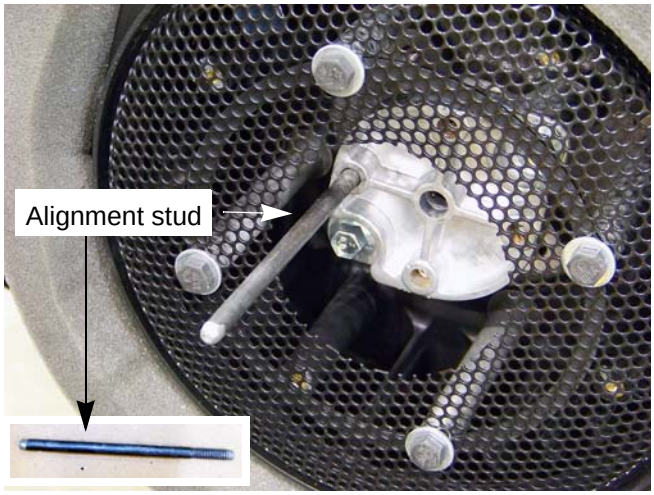

Figure 2.27

To install the engine:

1. Install an alignment stud into one of the drive shaft coupler holes on the engine. See Figure 2.27.

NOTE: To make an alignment stud: See Figure 2.27.

- Obtain a 1/4” x 20 bolt that is a minimum of 4” long.
- Cut the head off of the bolt.
- Grind a tapper onto the side of the bolt the head was on.

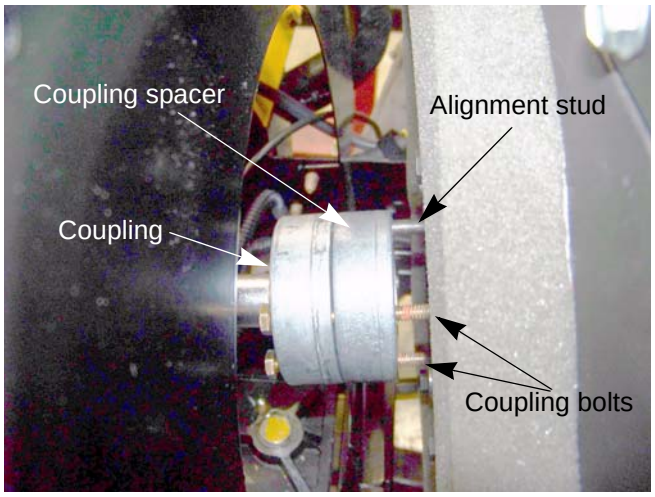

Figure 2.28

2. Insert three of the bolts into the coupling and the spacer.
3. Slide the engine into place, using the alignment stud to guide the drive shaft coupler into place. See Figure 2.28.
4. Start the three coupling bolts.
5. Remove the alignment stud.
6. Install the fourth coupling bolt.
7. Tighten all of the coupling bolts to a torque of 10 - 12 ft lbs (14 - 16 Nm).

8. Install the engine mounting nuts and bolts.
9. Remove the engine lift chain.
10. Install the dash by following the steps described in Chapter 4: Body.
11. Install the starter.
12. Reconnect the starter wires.
13. Reconnect the engine harness.
14. Reconnect the ground cable to the base of the engine.
15. Reconnect the fuel line to the fuel pump.
16. Install the muffler by following the procedures described in the muffler section of this chapter.
17. Install the hood.
18. Check the oil and fuel levels, top off as needed.
19. Test drive the tractor in a safe area before returning it to service.

CHAPTER 3: BRAKES

Brake adjustment

The transmission on the 2000 series tractor is driven by a Hydro-Gear BDU-10L pump. The pump will provide the braking action when it is in operation. There is a mechanical brake on the side of the transmission. This brake is used primarily as a parking brake. It is also used as a back up brake in case of a failure of the hydro pump.

The operation of the brakes should be tested before performing any adjustments.

Figure 3.1

To test the operation of the brakes:

1. Disengage the hydro pump by-pass rod by pulling it out and hooking it. See Figure 3.1.
2. Set the parking brake by depressing the brake pedal and lifting-up on the parking brake lever.
3. Attempt to push the tractor. If it can be pushed by hand without skidding a rear wheel, check and adjust the brakes.
4. Release the parking brake.
5. Attempt to push the tractor again. If it cannot be pushed with reasonable effort, check the hydro pump by-pass and adjust the brakes.

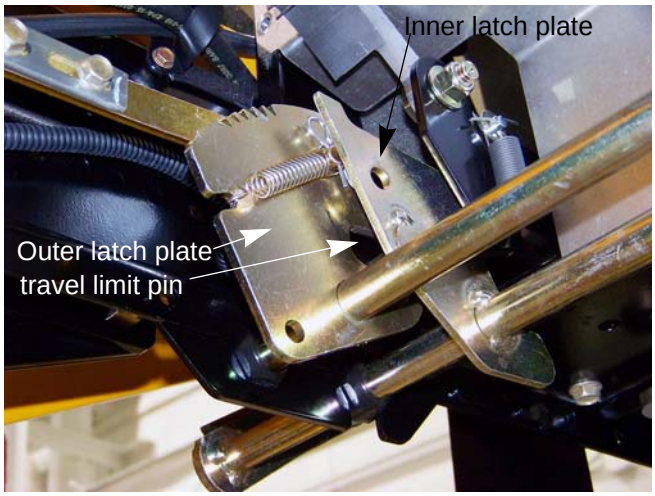

Figure 3.2

6. Visually inspect the linkage to confirm that it functions properly.
   - Beneath the floor panel, on the left side of the tractor there are two semi-circular latch plates (bell cranks).
   - The outer latch plate rotates with the drive control pedals. The inner latch plate rotates with the clutch/brake pedal.

   6a. With the clutch/brake pedal fully released:

   - The travel limit pin should be resting against the front of the curved slot. See Figure 3.2.

- The rod that connects the clutch/brake latch plate to the heavy brake actuator spring should not droop. See Figure 3.3.
- Check the brake pedal shaft bushings for wear.

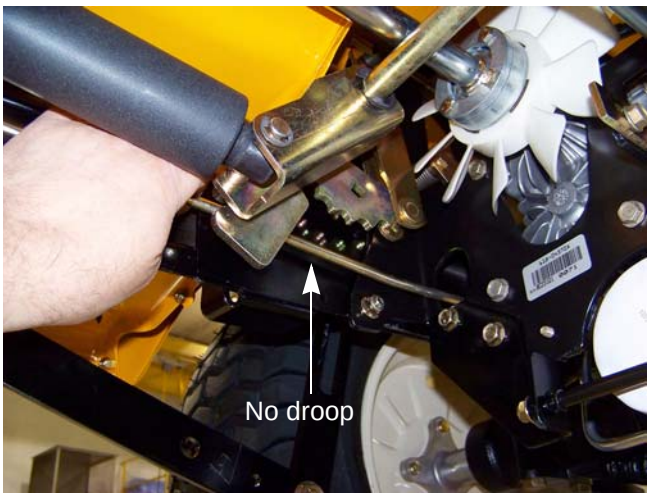

Figure 3.3

Adjust the brakes by:

NOTE: The brake is located between the frame and the transmission on the right side of the tractor. It is a tight fit, but it can be reached from the under side of the tractor aft, of the rear axle.

NOTE: In Figure 3.4, the by-pass rod was removed for a clearer view of the caliper.

1. Wiggle the brake rotor slightly, and attempt to insert a 0.010” (0.38mm) feeler gauge between the rotor and either pad.

   NOTE: There is a fixed pad in the transaxle housing.

   NOTE: There is a moving pad in the brake caliper.

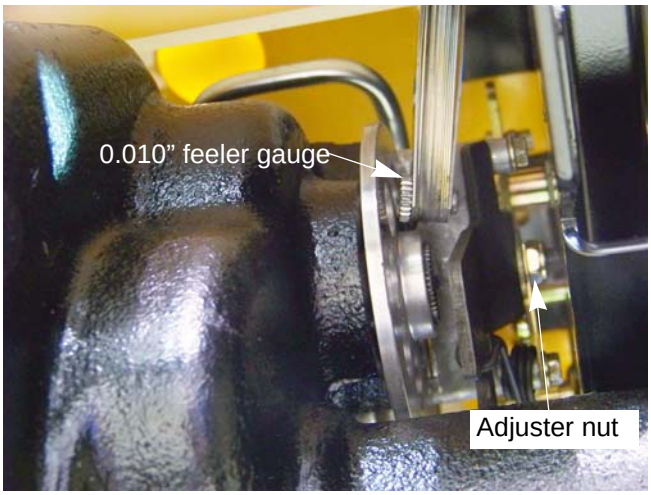

Figure 3.4

2. Adjust the gap, if necessary, so that the feeler gauge slips between the pad and the rotor with light pressure. See Figure 3.4.

   2a. Turn the nut to adjust the gap.

   NOTE: The gap should be in the range of 0.010” - 0.015” (0.25mm - 0.38mm)

   2b. Apply and release the brake pedal, then re-check the gap.

   NOTE: If the brake seems to be sticking, or the rotor is discolored from dragging, fix the cause of the sticking and replace the rotor.

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

Brake puck/rotor replacement

On transmission used on the 2000 series tractor, the brake pucks are wearing parts that will need to be serviced from time to time. If the tractor is operated with the parking brake dragging, the pucks will wear out rapidly and the brake rotor will develop hot spots. If the tractor is operated long enough, the rotor may have grinding marks on it with excessively worn pucks.

⚠CAUTION If the rotor shows hot spots or any other signs of damage, including warpage, it must be replaced. Failure to do so can result in the failure of the brakes

NOTE: The brake pucks and the rotors are serviced at the same time.

Figure 3.5

To remove/replace the brake pucks and rotor:

1. Lift and safely support the rear of the tractor.
2. Remove the transmission by following the procedures describe in Chapter 5: Drive.
3. Remove the two screws that secure the brake caliper to the right transmission housing using a 3/8” wrench. See Figure 3.5.
4. Lift the caliper off of the transmission.

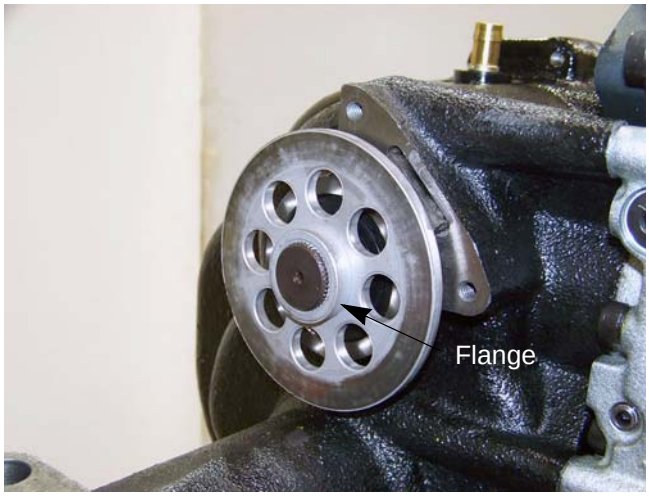

Figure 3.6

5. Remove the brake disk from the output shaft. See Figure 3.6.

NOTE: The center flange of the brake disk faces outward.

6. With the caliper on a work bench, remove the brake puck, backing plate and the two brake pins. See Figure 3.7.
7. Inspect all the components of the brake assembly for damage or wear: brake pads, puck plate, actuator pins, actuator arm, anti-rotation bracket, yoke, torsion spring, flat washer and locking hex nut.
8. Check for free movement of the brake pins. A dry lubricant can be used on the brake pins sparingly.

⚠CAUTION Never put grease or anti-seize on brake pins. It can migrate to the brake pucks, preventing the braking action of the pucks.

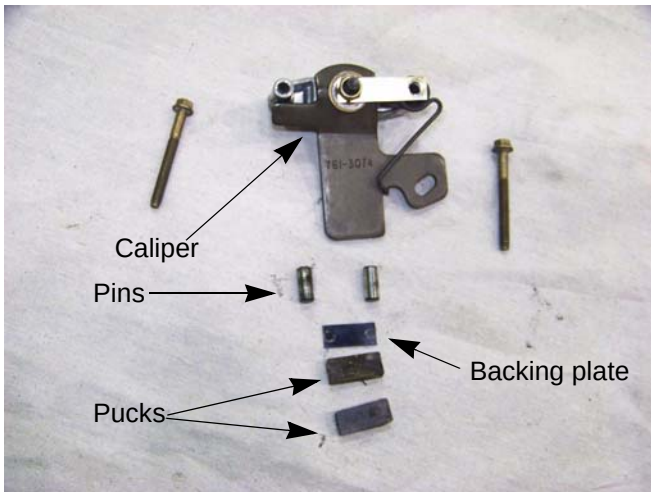

Figure 3.7

9. Slide the brake pins into the caliper.
10. Place the backing plate in the caliper.
11. Place a new puck into the caliper. See Figure 3.8.

    NOTE: A piece of scotch tape may be used to hold the new brake pucks in place for assembly. The tape will grind away when the brakes are applied.
12. Place a new brake puck into the recess in the transmission. Use a piece of scotch tape to hold it in place.
13. Slide the brake rotor in place, shoulder out.
14. Mount the brake caliper to the transmission. Apply a small amount of releasable thread locking compound such as Loctite® 242 (blue) to the mounting bolts and tighten to a torque of 80 - 120 in-lbs (9 - 13.5 Nm).
15. Wiggle the brake rotor slightly and insert a 0.010” (0.38mm) feeler gauge between the rotor and either pad.
16. Adjust the gap, if necessary, so that the feeler gauge slips between the pad and the rotor with light pressure. See Figure 3.9.

    16a. Turn the nut to adjust the gap.

    NOTE: The gap should be in the range of 0.010” - 0.015” (0.25mm - 0.38mm)

    16b. Operate the brake cam arm a few times, then re-check the gap.
17. Install the transmission by following the procedures described in Chapter 5: Drive System.
18. Test drive the tractor in a safe area before returning it to service.

Figure 3.8

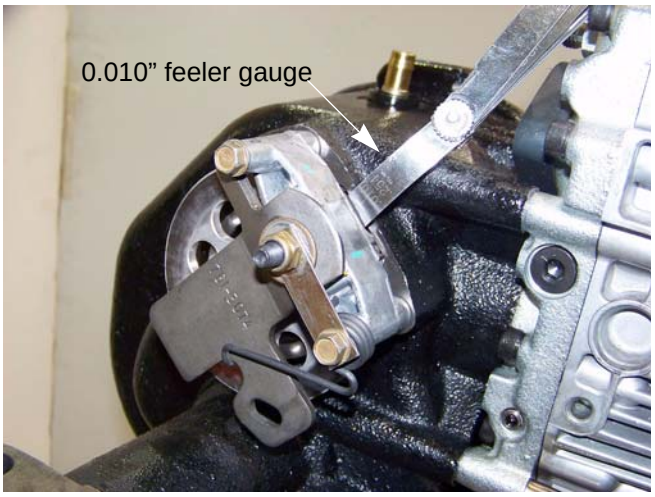

Figure 3.9

Brake shaft assembly

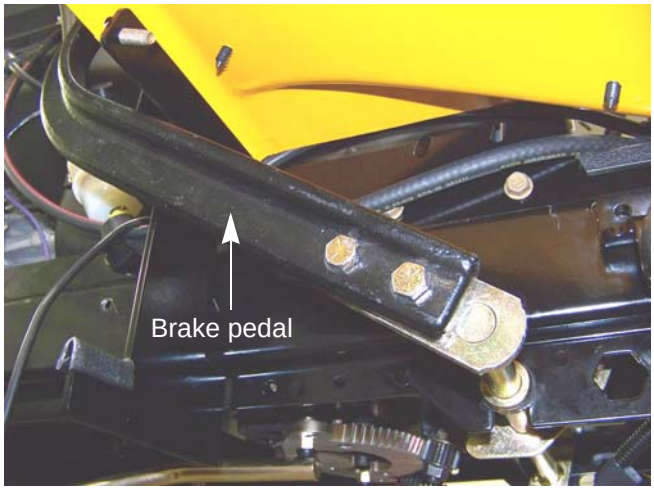

Figure 3.10

To remove/replace the brake shaft:

1. Remove the cutting deck by following the procedures described in Chapter 8: Cutting Decks and Lift shaft.
2. Lift and safely support the tractor.
3. Remove the forward drive pedal shaft by following the procedures described in Chapter 5: Drive System.
4. Disconnect the brake pedal by removing the two nuts and bolts that attach it to the brake pedal shaft using a pair of 1/2” wrenches. See Figure 3.10.

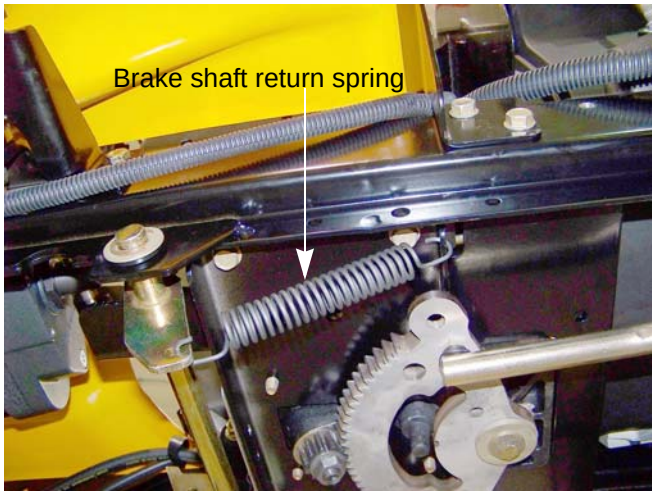

Figure 3.11

5. Disconnect the brake shaft return spring. See Figure 3.11.

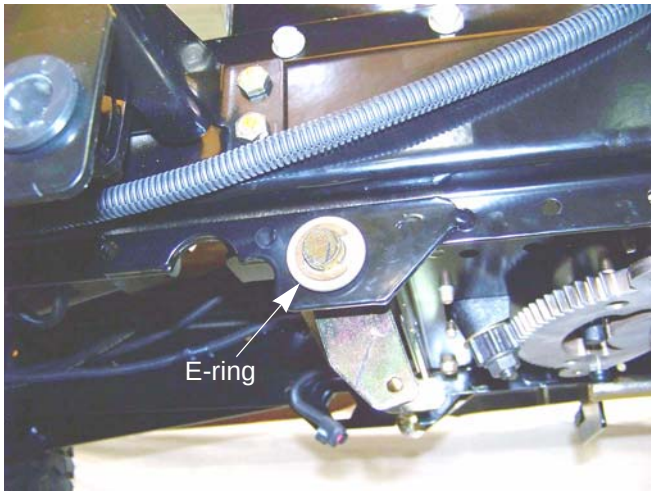

Figure 3.12

6. Remove the E-ring and washer(s) from the right side of the brake shaft. See Figure 3.12.
7. Remove the hex bushings from both ends of the brake pedal shaft.

8. Slide the brake pedal shaft to the left enough for it to clear the frame on the right side.
9. Lower the shaft enough to gain access to the cotter pin that secures the brake rod to the pedal shaft.
10. Remove and discard the cotter pin. See Figure 3.13.
11. Remove the pedal shaft from the tractor.
12. Install the brake pedal shaft by following the previous steps in reverse order.

    NOTE: The cotter pin that secures the brake rod to the pedal shaft can be replaced with a bow tie clip (714-04040). This will make it easier to perform the brake rod adjustment.

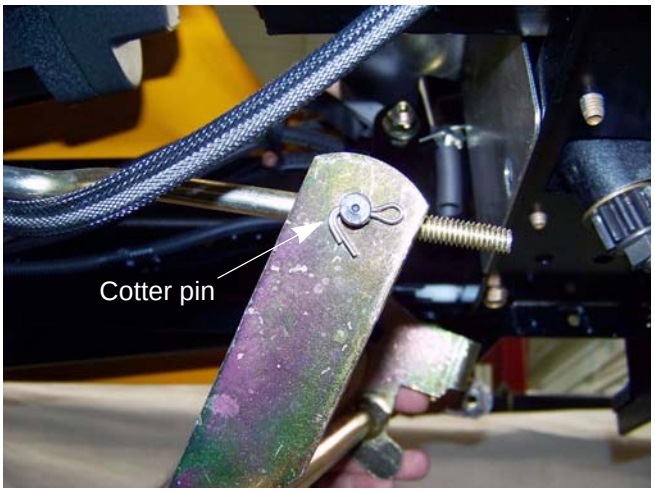

Figure 3.13

13. Perform a brake rod adjustment by following the procedures described in the brake rod adjustment section of this chapter.
14. Test drive the tractor in a safe area before returning it to service.

Brake rod adjustment

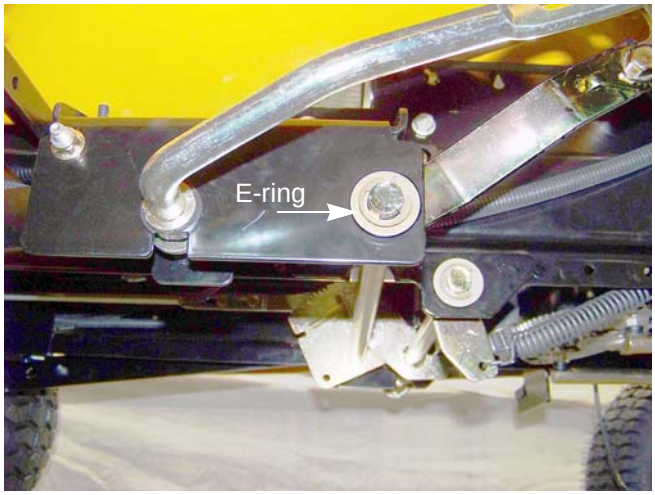

Figure 3.14

NOTE: The brake rod should not come out of adjustment on its own. If the brake rod does need to be adjusted, check for a bent rod, worn bushing and worn brake pucks.

To adjust the brake rod:

1. Remove the cutting deck by following the procedures described in Chapter 8: Cutting Decks and Lift Systems.
2. Lift and safely support the tractor.
3. Remove the E-ring and washers from the right side of the forward drive pedal shaft. See Figure 3.14.
4. Slide the drive pedal shaft to the left until it stops.

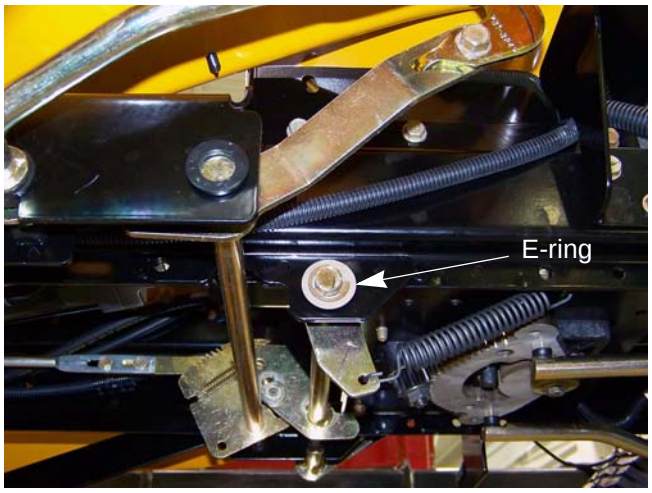

Figure 3.15

5. Remove the E-ring and washer(s) from the right side of the brake pedal shaft. See Figure 3.15.
6. Slide the brake pedal shaft to the left until it stops.

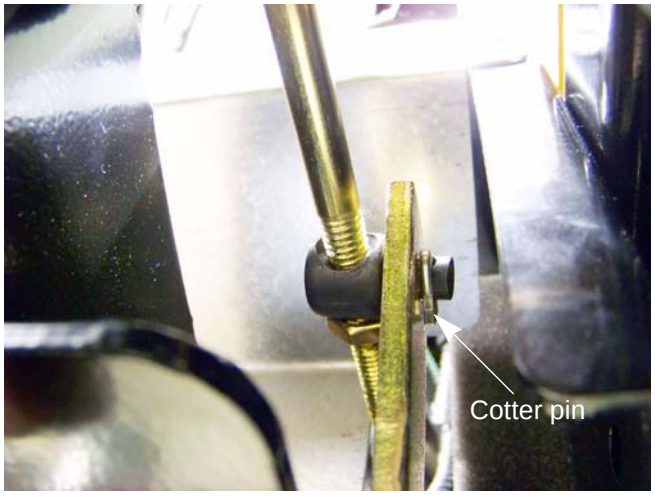

Figure 3.16

7. Disconnect the brake rod from the brake pedal shaft by removing the cotter pin and discarding it. See Figure 3.16.

8. Loosen the jam nut. See Figure 3.17.
9. Tighten or loosen the ferrule as needed so that it aligns with the hole in the bell crank of the brake pedal shaft with no slack in the brake spring.
10. Tighten the jam nut.
11. Attach the brake rod to the brake pedal shaft.

    NOTE: The cotter pin that secures the brake rod to the pedal shaft can be replaced with a bow tie clip (714-04040).
12. Slide the brake pedal shaft to the right until it stops.
13. Install the E-ring and washer(s) on to the brake pedal shaft.

    NOTE: If the bushings popped out while shifting the shafts, re-install them before installing the E-rings.
14. Slide the forward drive pedal shaft to the right until it stops.
15. Install the E-ring and washer(s) on to the drive pedal shaft.
16. Test drive the tractor in a safe area before returning it to service.

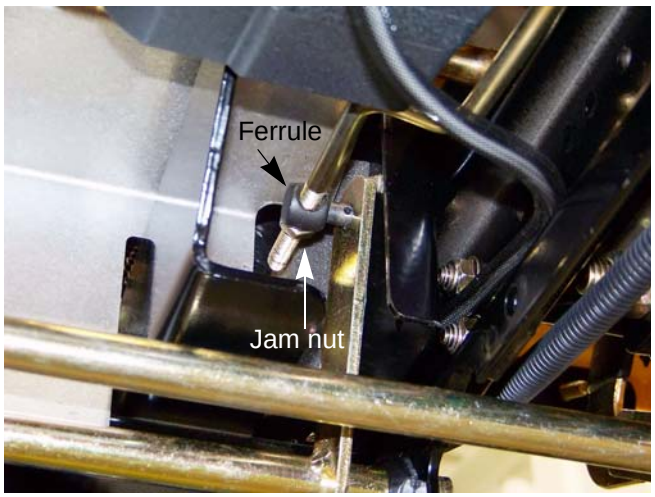

Figure 3.17

CHAPTER 4: BODY

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

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.

Hood

Figure 4.1

Hood removal:

1. The hood is front-hinged. See Figure 4.1.
2. Open the hood by lifting the rear edge to tilt it forward.

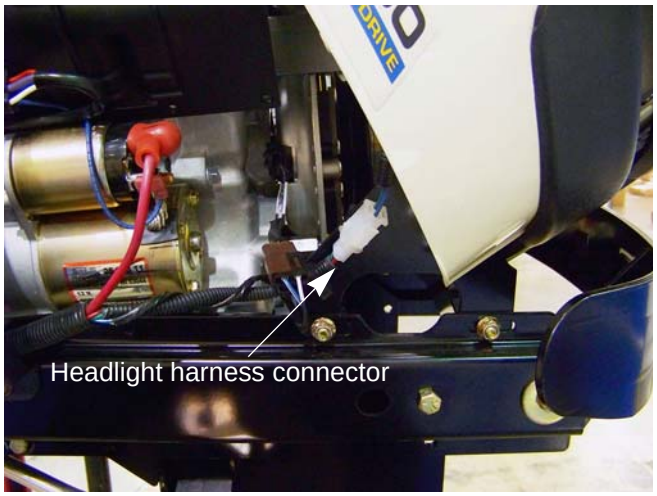

Figure 4.2

3. Disconnect the headlight harness. See Figure 4.2.

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 4.3.

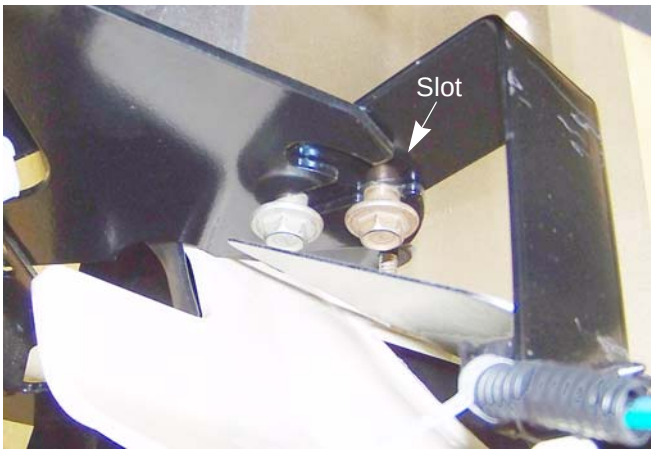

Figure 4.3

Hood components: side vent removal

1. Carefully pry the vent free of the lock tabs.
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.

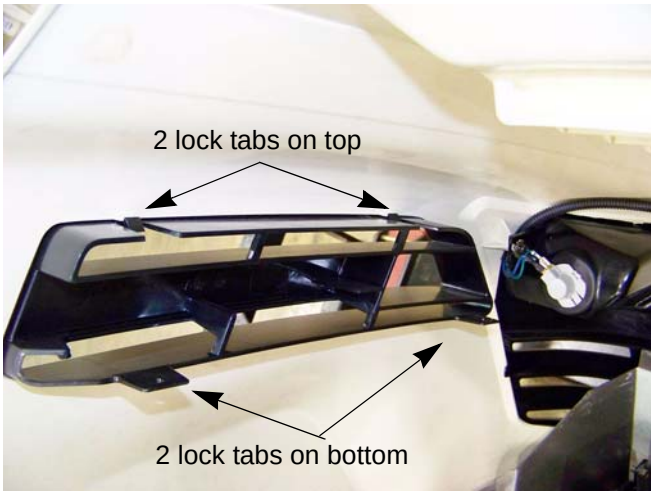

Figure 4.4

Hood components: Headlight removal

Figure 4.5

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

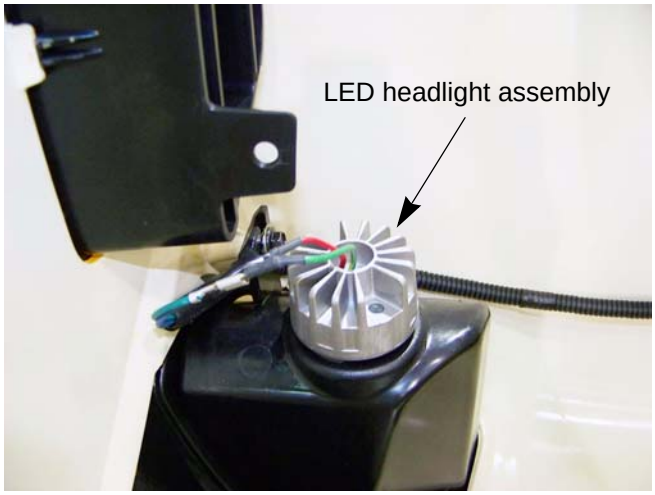

Figure 4.6

NOTE: The GTX2154LE has a LED headlight assembly. It is removed the same way as the incandescent headlight assemblies.

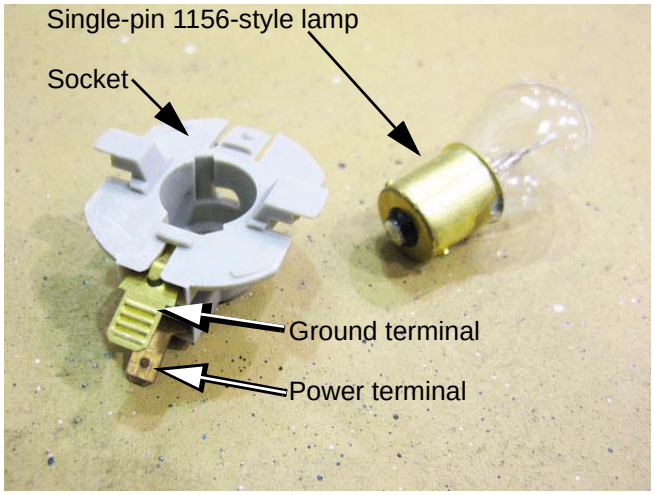

Figure 4.7

2. Rotate the bulb to release it from the socket. See Figure 4.7.

NOTE: The LED assembly does not come apart.

3. Install the replacement lamp following the above steps in reverse order.

Hood components: grille removal

1. Remove the hood assembly from the tractor, and place it on a stable work surface.
2. Disconnect the wires from the headlights.
3. Remove the two screws, one in each headlight housing, that hold the upper corners of the grille to the hood using a 5/16” wrench. See Figure 4.8.

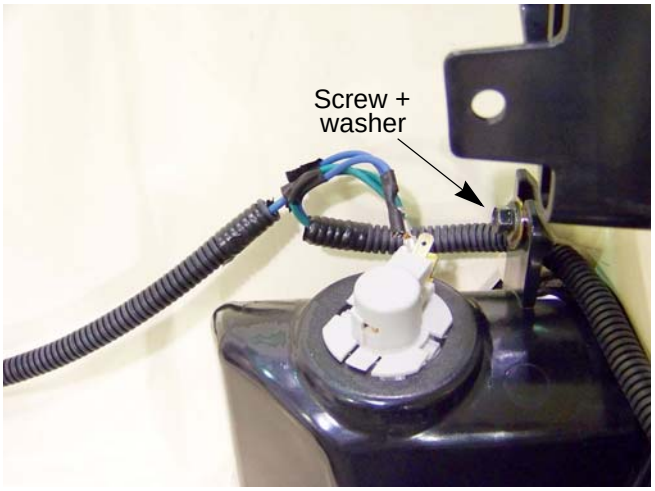

Figure 4.8

4. Remove the four screws, indicated by the arrows in Figure 4.9, using a 3/8” wrench.
5. Slide the heat shield out of the hood.

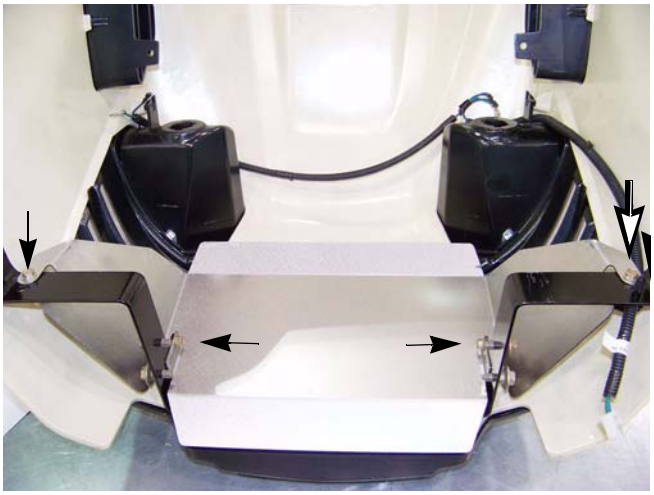

Figure 4.9

Figure 4.10

6. Remove the two screws that hold the pivot bracket and grille to the hood assembly using a 3/8” wrench. See Figure 4.10.
7. Unlatch the tabs, where the screws were in step 3, while pushing the grille out of the hood.

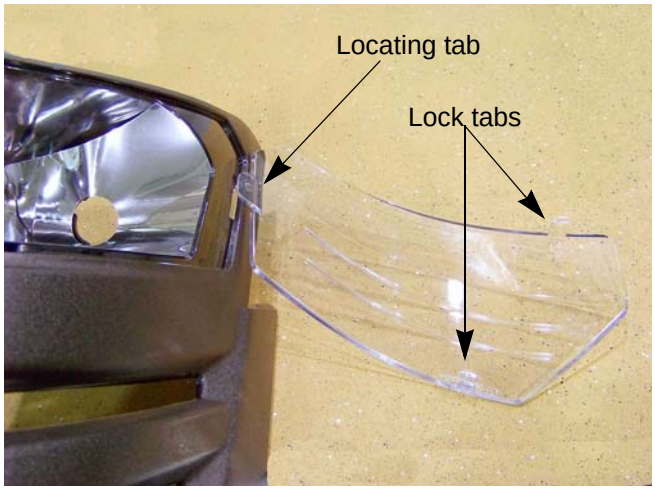

Figure 4.11

8. Once removed, the headlight lens may be removed for cleaning by carefully prying the two lock tabs at the inner edge. See Figure 4.11.

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

9. Assemble and install the grille 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 hood assembly from the tractor, and place it on a stable work surface.
2. Remove the four screws, indicated by the arrows in Figure 4.12, using a 3/8” wrench.
3. Slide the heat shield out of the hood.

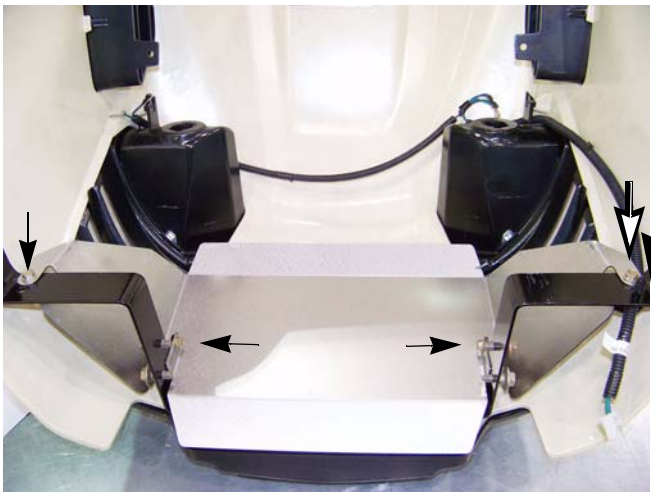

Figure 4.12

4. Remove the two screws that hold the pivot bracket and grille to the hood assembly using a 1/2” wrench. See Figure 4.13.

Figure 4.13

5. Remove the four screws, indicated by the arrows in Figure 4.14, that hold the outer arms of the pivot bracket to the hood using a 3/8” wrench.
6. Assemble and install the grille 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 4.14

Fender and running board

On the Cub Cadet 2000 series tractor, the fender and the running board are two pieces. It may be necessary to remove the fender and running board to gain access to items such as the deck lift shaft

When removing the fender and running board, it is generally easier to remove both of them as one piece.

NOTE: When working on the fuel tank, only the fender needs to be removed.

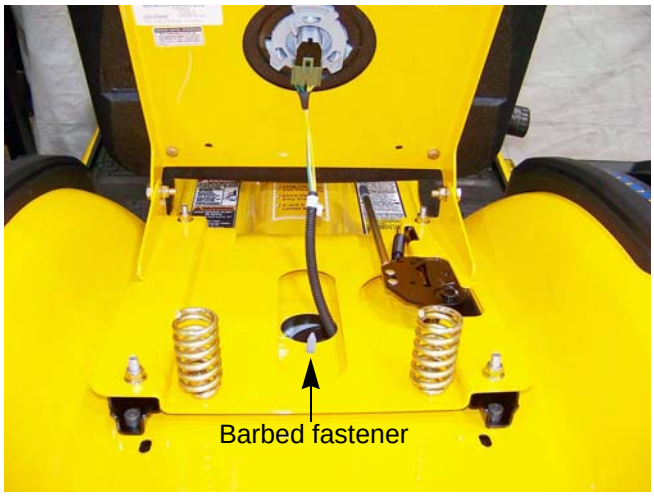

Figure 4.15

To remove/replace the fender:

1. Disconnect the seat switch. See Figure 4.15.

NOTE: On the GTX2154LE, it will be necessary to cut the wire tie that holds the seat switch connector to the seat frame.

NOTE: When reconnecting the seat switch plug on the GTX2154LE, it must be wire tied back together and attached to the seat frame. Failure to do this can cause the connector to get caught in the seat bracket and rip the wires out of the seat. If this happens, the tractor will shut down when the brake is released and the whole seat must be replaced.

2. Push the barbed fastener on the seat switch harness out of the hole in the fender.

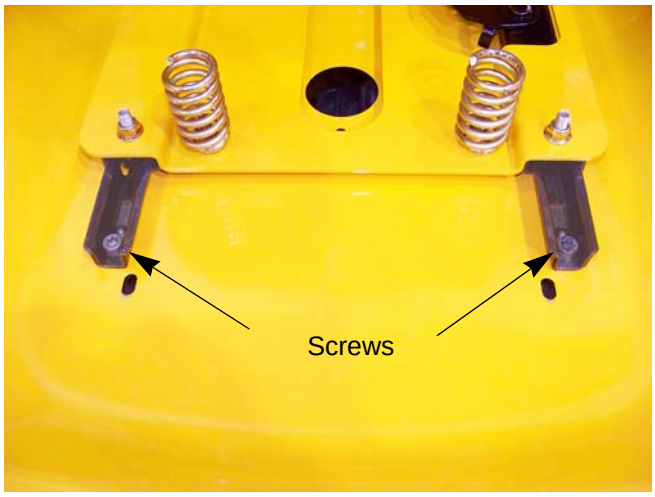

Figure 4.16

3. Remove the four socket headed cap screws that hold the seat tracks to the fender using a T-40 torx driver. See Figure 4.16.

NOTE: On the GTX2154LE:

- Remove the four screws, indicated by the arrows in Figure 4.17, that hold the seat frame to the fender using a 7/16” wrench.
- Remove the two screws that hold the rear of the fender to the frame using a 7/16” wrench.

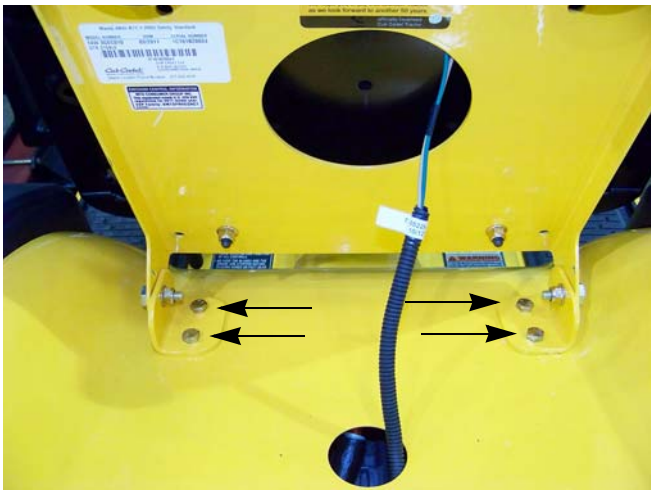

Figure 4.17

On manual deck lift models:

4. Remove the deck lift lever grip. See Figure 4.18.

   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.

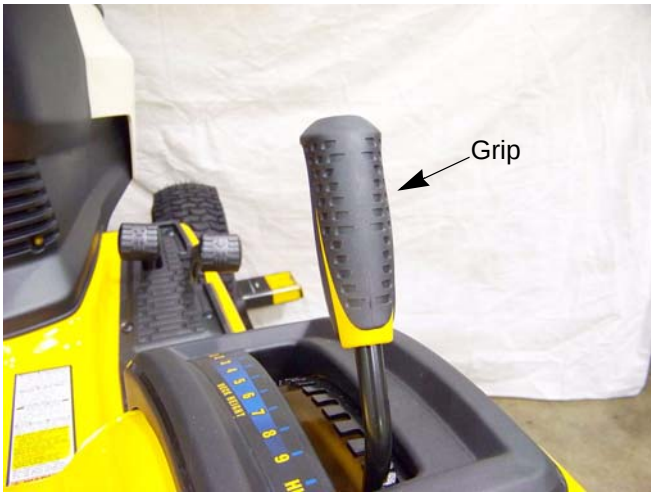

Figure 4.18

On electric deck lift models:

4. Remove the screw that holds the deck cutting height lever to the shaft using a T40 torx driver.
5. Pull the cutting height lever off of the shaft.
6. Disconnect the deck lift switch.

Figure 4.19

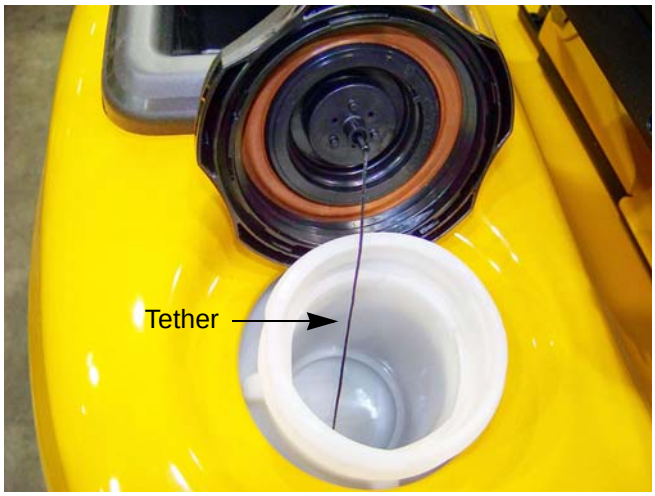

Figure 4.20

7. Unthread the fuel cap.
8. Pull the fuel cap tether retainer out of the fuel tank using a long pair of pliers. See Figure 4.20.

NOTE: The fuel cap tether is mandated by the EPA. If it is broken, the fuel cap must be replaced.

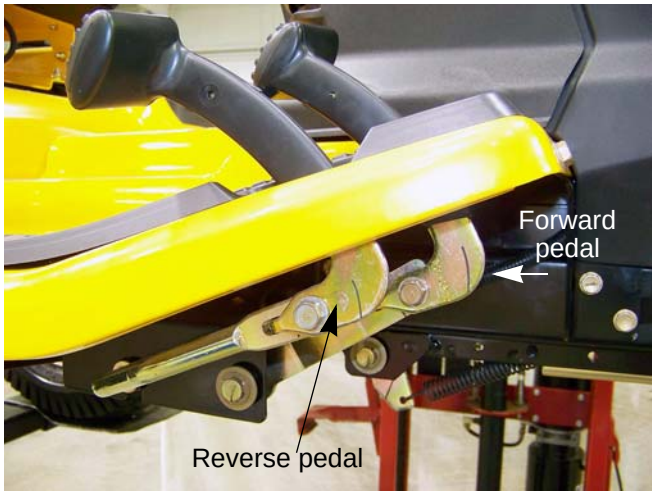

Figure 4.21

9. Remove the reverse drive pedal using a 9/16” wrench. See Figure 4.21.
10. Remove the forward drive pedal using a 9/16” wrench.

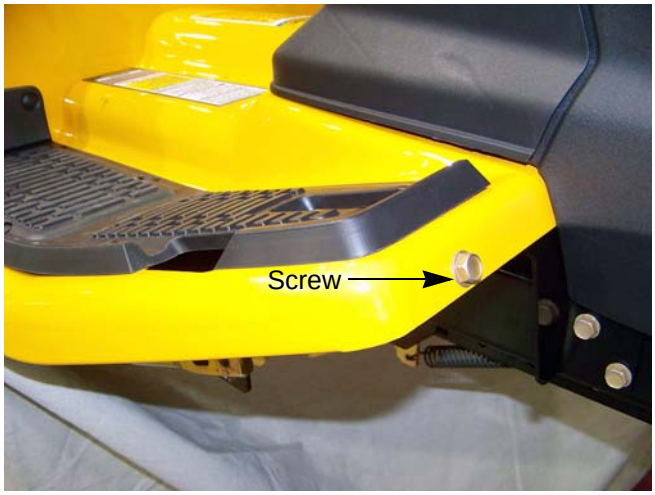

Figure 4.22

11. Remove the two screws, one on each side, that hold the front of the running board to the running board brackets using a 1/2” wrench.

12. Gently pry up the rubber foot pad on one side of the tractor enough to gain access to the screw under it. See Figure 4.23.
13. Remove the screw using a 1/2” wrench.
14. Repeat steps 10 & 11 on the other side of the tractor.

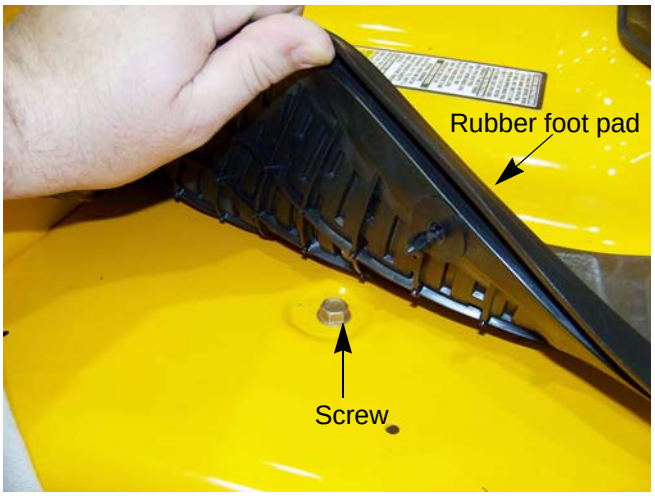

Figure 4.23

15. Remove running board brackets by removing the two screws, indicated by the arrows in Figure 4.24, that hold each of them to the frame using a 1/2” wrench.
16. Lift the rear of the fender far enough for it to clear the fuel tank and slide the fender off of the tractor.

Figure 4.24

NOTE: If the running board and fender need to be separated:

- Remove the six nuts and bolts, indicated by the arrows in Figure 4.25, that hold the fender to the running board using a pair of 7/16” wrenches.

17. Install the fender and running board by following the previous steps in reverse order.

NOTE: The seat switch connector on the GTX2154LE must be wire tied back together and attached to the seat frame. Failure to do this can cause the connector to get caught in the seat bracket and rip the wires out of the seat. If this happens, the tractor will shut down when the brake is released and the whole seat must be replaced.

Figure 4.25

Dash Panel

Figure 4.26

The dash panel may be removed to provide access to the tilt steering column, power steering, or to replace the dash or dash support brackets.

1. Remove the steering wheel
   - 1a. Remove the cover from the center of the steering wheel. See Figure 4.26.
   - 1b. Remove the bolt that holds the steering wheel to the steering shaft using a 1/2” wrench.
   - 1c. Lift the steering wheel off of the shaft.
2. Disconnect the negative battery cable.

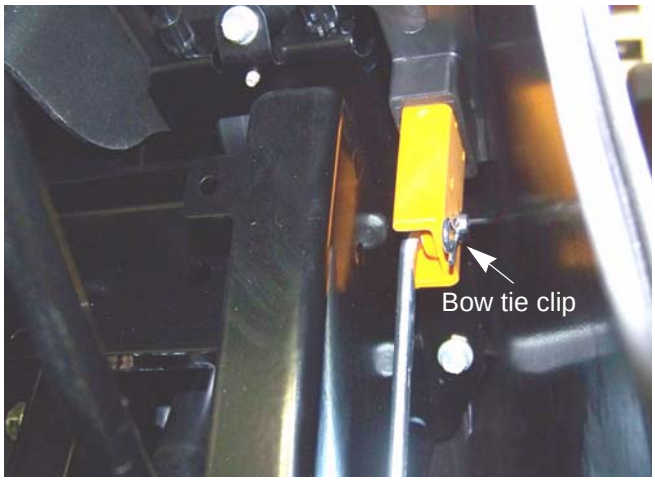

Figure 4.27

3. Remove the bowtie clip that holds the control rod to the cruise/parking brake lever. See Figure 4.27.
4. Slide the control rod out of the cruise/parking brake lever.

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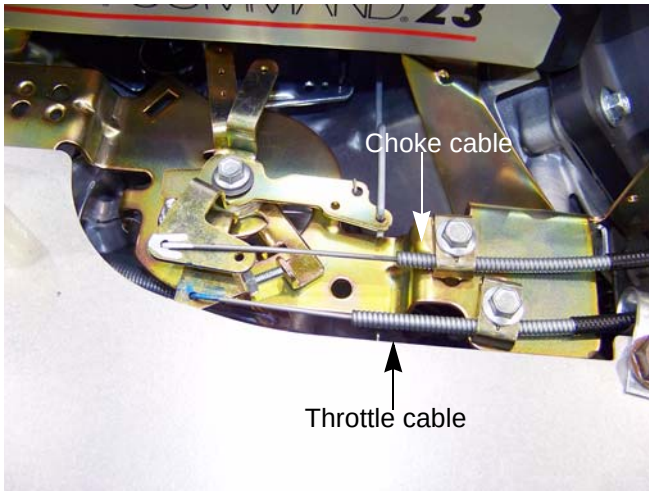


Figure 4.28

5. Disconnect the throttle cable from the control panel on the engine. See Figure 4.28.

NOTE: Mark the cable and the hole it goes into to ensure it goes back into the proper hole on re-assembly.

6. Disconnect the choke cable from the control panel on the engine.

NOTE: Mark the cable and the hole it goes into to ensure it goes back into the proper hole on re-assembly.

7. Disconnect the PTO switch. See Figure 4.29.
8. Disconnect the hour meter.

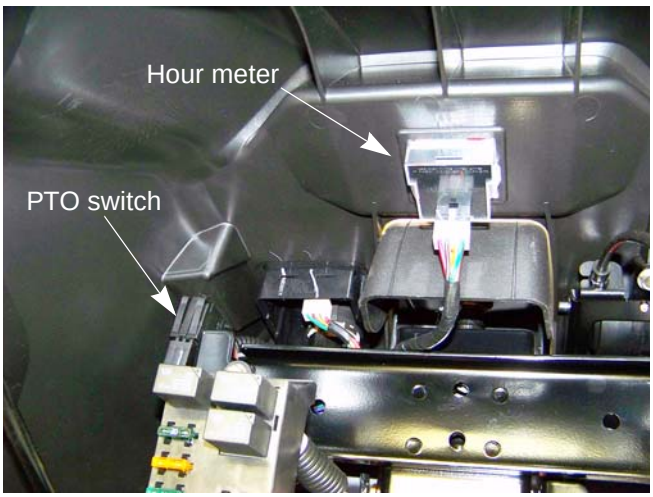


Figure 4.29

9. Remove the two screws, indicated by the arrows in Figure 4.30, that hold the left side of the dash to the dash support bracket using a 3/8” wrench.

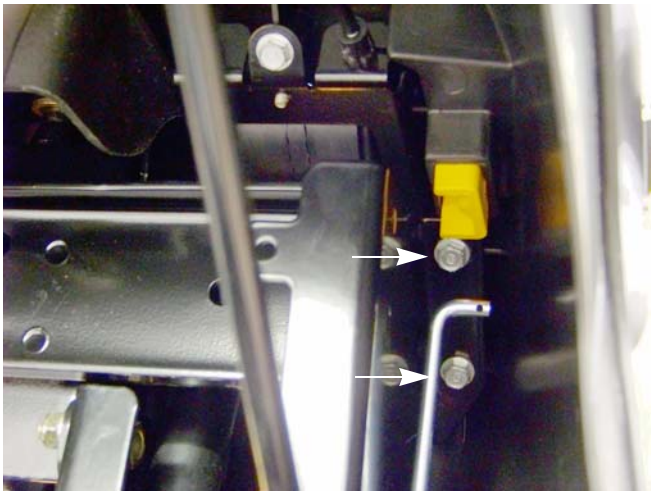


Figure 4.30

10. Remove the two screws that hold the right side of the dash to the dash support bracket using a 3/8” wrench. See Figure 4.31.

Figure 4.31

Figure 4.32

11. Remove the two screws, indicated by the arrows in Figure 4.32, from the bottom of the operators side of the dash using a 3/8” wrench.

Figure 4.33

12. Remove the two screws, indicated by the arrows in Figure 4.33, that holds the base of the left side panel to the frame using a 1/2” wrench
13. Lift up on the dash enough to disconnect the RMC module and the key switch.
14. Lift the dash panel off of the tractor.
15. 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.

NOTE: The seat switch connector on the GTX2154LE must be wire tied back together and attached to the seat frame. Failure to do this can cause the connector to get caught in the seat bracket and rip the wires out of the seat. If this happens, the tractor will shut down when the brake is released and the whole seat must be replaced.

CHAPTER 5: DRIVE SYSTEM

Transmission fluid filter

Figure 5.1

The oil filter should be changed every 100 hours.

NOTE: The filter can be changed without draining all of the transmission fluid.

To change the transmission fluid filter:

1. Remove the deck as described in chapter 8: Cutting Decks and Lift Systems.
2. Lift and safely support the rear of the tractor.
3. Remove the nut that secures the anti-sway rod to the transmission torque bracket. See Figure 5.3.
4. Slide the anti-sway rod out of the torque bracket.

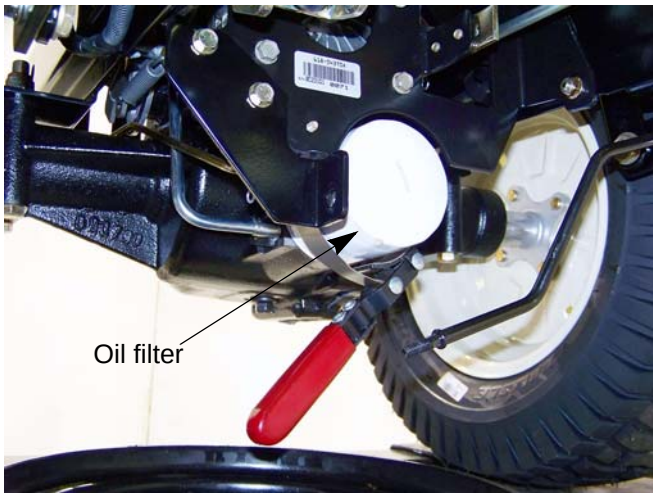


Figure 5.2

5. Clean around the oil filter to prevent any dirt from getting into the transmission.
6. Place a suitable container under the transmission filter to catch any fluid that may be spilled while changing the filter.
7. Pre-fill a new filter with Cub Cadet Drive System Fluid Plus oil (#737-3120).
8. Apply a light coating of oil to the O-ring of the new filter.

NOTE: To minimize the amount of oil lost, have the new filter ready to be installed as the old filter is removed.

9. Remove and discard the oil filter using a suitable strap wrench. See Figure 5.2.
10. Quickly install the oil filter hand tight.
11. Check the transmission oil level by using the dip stick at the rear of the tractor. Top off as needed.
12. Test drive the tractor in a safe area before returning it to service.

Transmission fluid change

NOTE: The transmission is filled with a high quality, specially blended oil. It only needs to be changed if it is contaminated.

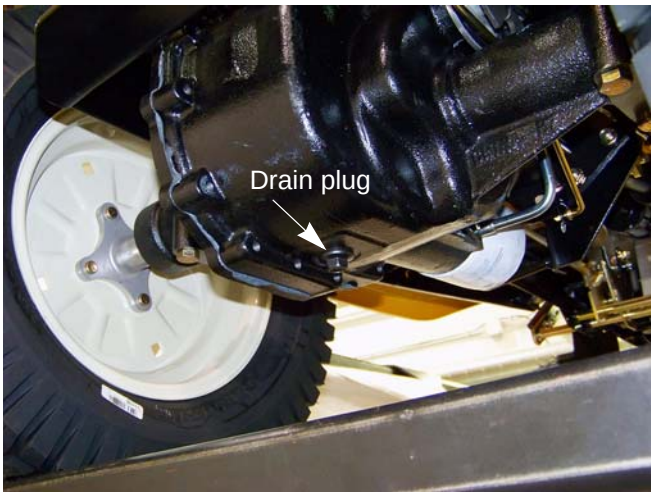


Figure 5.3

To change the transmission fluid:

1. Remove the deck as described in chapter 8: Cutting Decks and Lift Systems.
2. Lift and safely support the rear of the tractor.
3. Clean the transmission around the drain plug area.
4. Remove the drain plug using a 16 mm wrench. See Figure 5.1.
5. Remove the dip stick.
6. Remove the oil filter by following the procedures described in the transmission oil filter section of this chapter.
7. Install the oil drain plug.
8. Pre-fill a new filter with Cub Cadet Drive System Fluid Plus (#737-3120).
9. Apply a light coating of Cub Cadet Drive System Fluid Plus to the O-ring of the new filter.
10. Install a new oil filter hand tight.
11. Fill the transmission with 182 oz (5.4 L) of Cub Cadet Drive System Fluid Plus (#737-3120)

    NOTE: The Cub Cadet Drive System Fluid Plus (#737-3120) is a synthetic blended oil designed specifically for Cub Cadet transmissions.
12. Purge the transmission while the tractor is still supported off of the ground.:

    12a. Move the by-pass rod to the by-pass position.

    12b. Start the engine.

    12c. Cycle the drive pedal from full forward to full reverse six times.

    12d. Move the by-pass rod to the drive position.

    12e. Cycle the drive pedal from full forward to full reverse six times.
13. Test drive the tractor before returning it to service.

Drive shaft

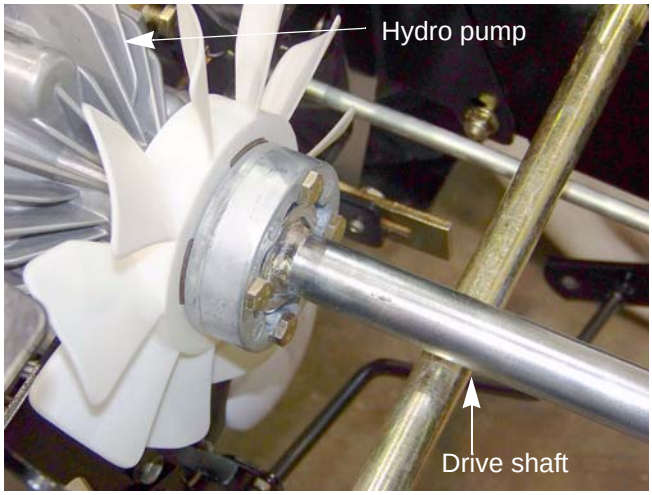


Figure 5.4

To remove/replace the drive shaft:

1. Remove the deck as described in chapter 8: Cutting Decks and Lift Systems.
2. Remove the dash by following the procedures described in Chapter 4: Body.
3. Remove the fender and running board by following the procedures described in Chapter 4: Body.
4. Remove the four screws that attach the drive shaft to the hydro pump using a 7/16” wrench. See Figure 5.4.

Figure 5.5

5. Remove the four screws that attach the drive shaft to the engine using a 7/16” wrench. See Figure 5.5.
6. Lift the drive shaft out of the tractor.

NOTE: There is a spacer between the drive shaft and the engine.

7. Install the drive shaft by following the previous steps in reverse order.

NOTE: Apply a small amount of a releasable thread locking compound such as Loctite® 242 (blue) to the drive shaft screws.

NOTE: Tighten the drive shaft screws to a torque of 10 - 12 ft lbs (14 - 16 Nm).

8. Test drive the tractor in a safe area before returning it to service.

Hydro 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's 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.

To perform the hydro neutral control adjustment:

1. Lift and safely support the rear of the tractor.
2. By-pass the seat safety switch. See Figure 5.6.
   - 2a. Slide the seat to the full forward position.
   - 2b. Flip the seat up.
   - 2c. Press in the seat bottom until the tang on the seat switch is fully extended.
   - 2d. Place a spring clamp on the tang to hold the seat switch in this position.

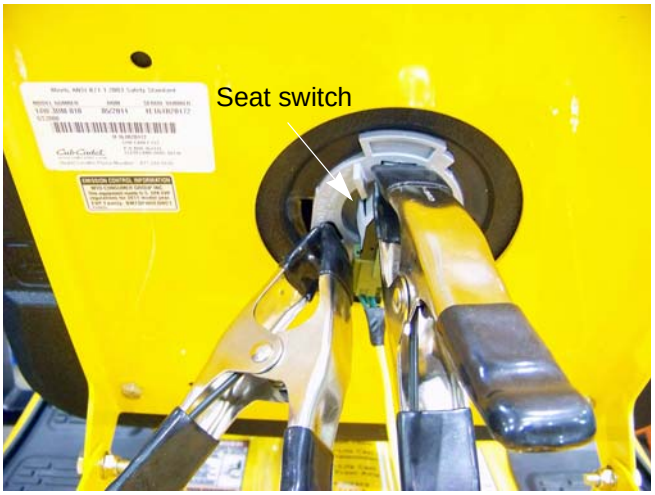


Figure 5.6

3. Disconnect the drive control rod from the hydro pump by removing the bow tie clip. See Figure 5.7.

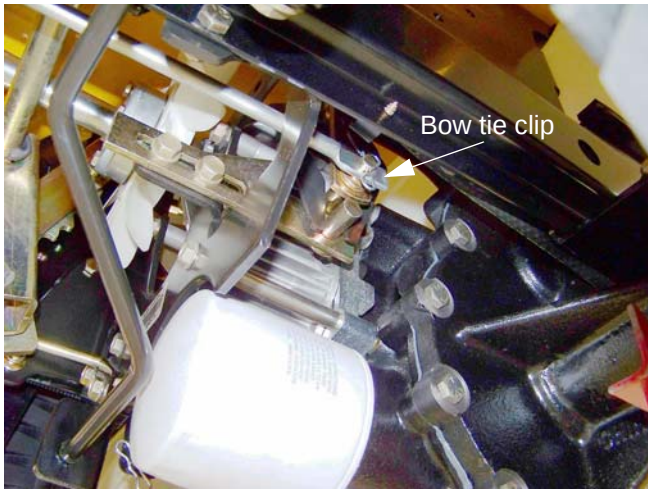


Figure 5.7

Figure 5.8

4. Start the engine and advance throttle to maximum RPM.
5. Release the parking brake.
6. Watch both rear tires for movement. See Figure 5.8.

NOTE: If there is no wheel movement, the hydro pump is in neutral and doesn't need to be adjusted. Skip to step 14.

NOTE: If one or both rear wheels move, the hydro pump needs to be adjusted.

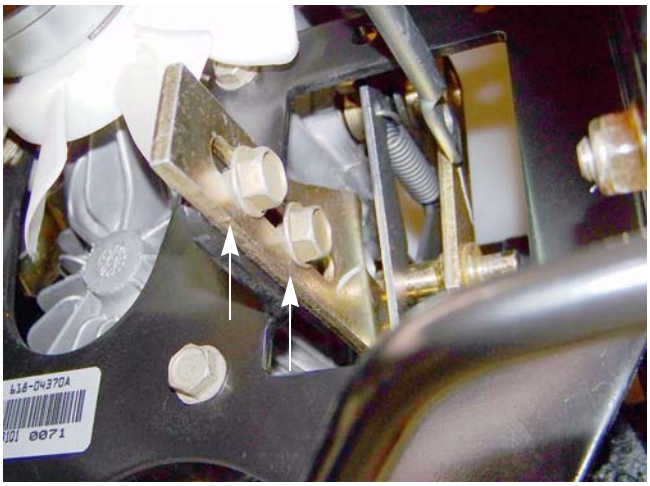


Figure 5.9

To adjust the hydro pump:

7. Turn off the engine.
8. Loosen the two screws, indicated by the arrows in Figure 5.9, that hold the return to neutral bracket to the transmission torque bracket using a 1/2" wrench.
9. Start the engine and advance the throttle to maximum RPMs.
10. Move the return to neutral bracket forward or backwards until the wheel(s) stops moving.
11. Tighten the two screws using a 1/2" wrench.
12. Confirm that the adjustment did not shift when the screws were tightened.
13. Turn-off the engine.

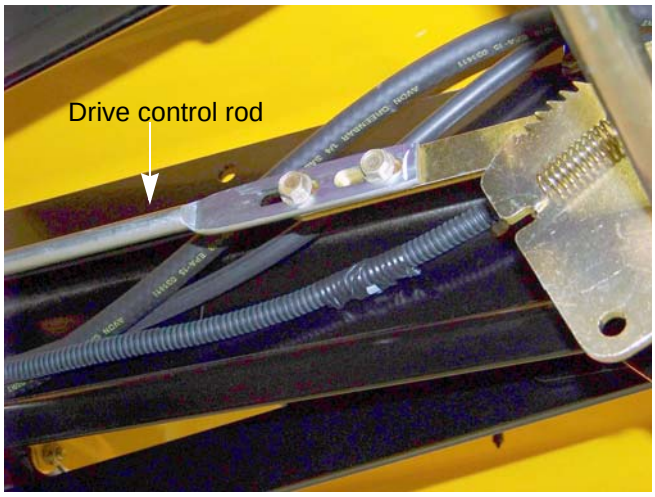


Figure 5.10

14. Set the parking brake.
15. Loosen the two screws at the front of the drive control rods using a 3/8" wrench. See Figure 5.10.
16. Adjust the length of the drive control rod so that it slides freely onto the pin on the hydro selector plate. Install the bow tie clip.
17. Tighten the two screws at the front of the drive control rod using a 3/8" wrench.
18. Lower the tractor to the ground.
19. Test the drive system and all safety features before returning the unit to service.

Transmission removal/replacement

To remove/replace the transmission:

1. Remove the deck as described in Chapter 8 Cutting Decks and Lift Shaft.

   NOTE: If the transmission is being removed to open it up, drain the fluid at this point by following the procedures described in the transmission fluid change section of this chapter.

2. Lift and safely support the rear of the tractor.
3. Remove the nut that secures the anti-sway rod to the transmission torque bracket. See Figure 5.11.
4. Slide the anti-sway rod out of the torque bracket.

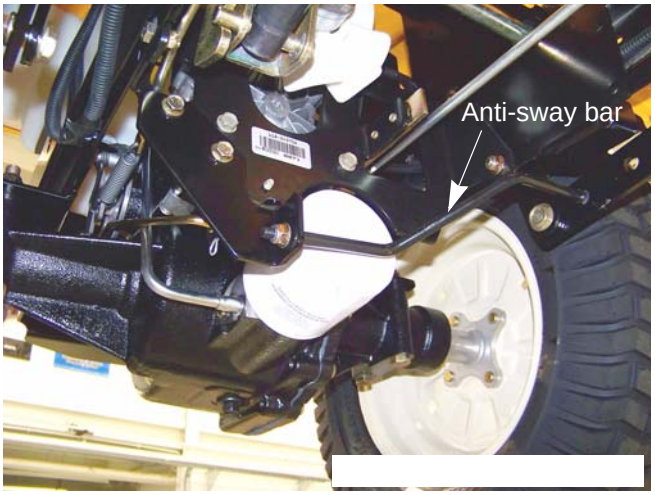


Figure 5.11

5. Remove the brake rod:

   5a. Remove the E-ring, bushing and washers from the right side of the forward drive pedal shaft. See Figure 5.12.

   5b. Slide the drive pedal shaft to the left until it clears the frame.

   NOTE: Let the drive pedal shaft hang there.

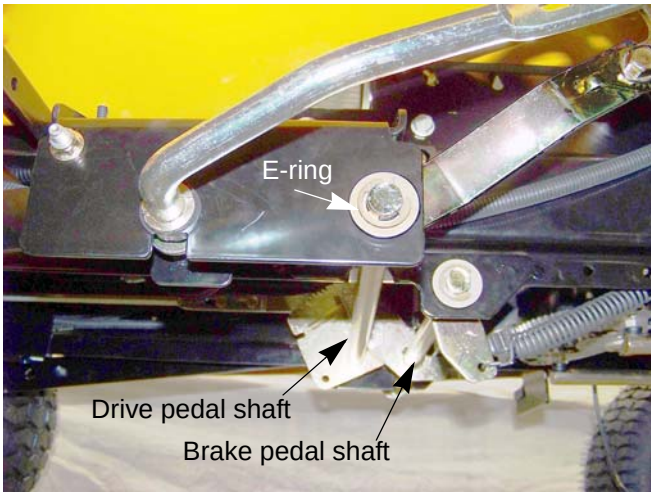


Figure 5.12

   5c. Remove the E-ring and washer(s) from the right side of the brake pedal shaft. See Figure 5.13.

   5d. Slide the brake pedal shaft to the left until it stops.

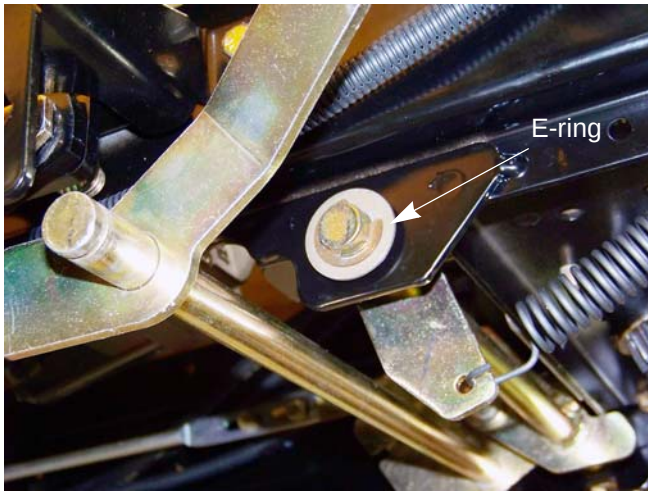


Figure 5.13

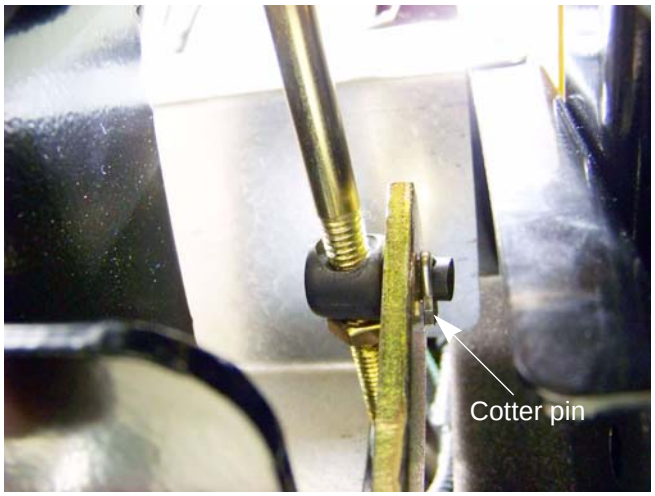


Figure 5.14

5e. Disconnect the brake rod from the brake pedal shaft by removing and discarding the cotter pin. See Figure 5.14.

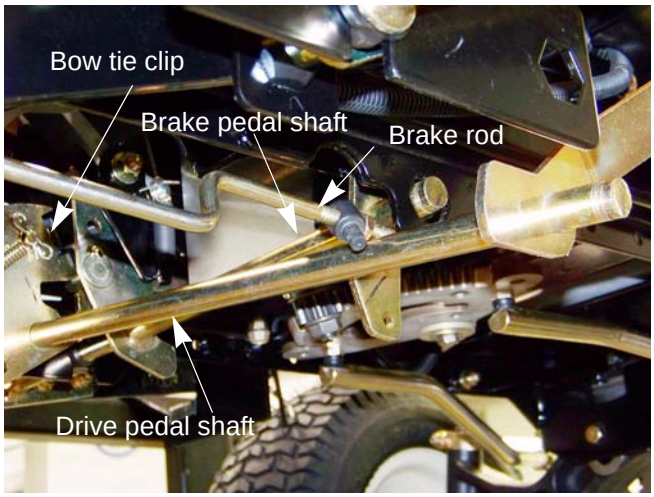


Figure 5.15

5f. Pull back on the brake rod and maneuver it past the brake shaft and forward drive shafts.

5g. Unhook the brake rod from the brake spring.

6. Remove the drive control rod:

6a. Remove the bow tie clip that holds the drive control rod and spring to the bell crank on the pedal shaft. See Figure 5.15.

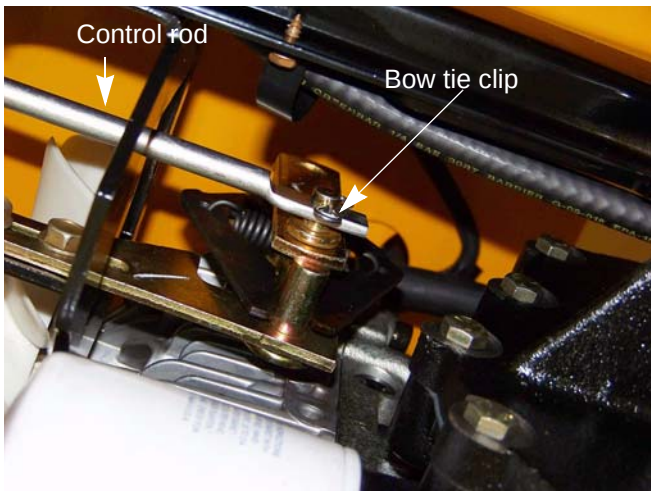


Figure 5.16

6b. Remove the bow tie clip that holds the drive control rod to the hydro pump. See Figure 5.16.

6c. Slide the control rod off of the pin.

7. Remove the by-pass rod:

   7a. Remove the bow tie clip. See Figure 5.17.

   7b. Slide the by-pass rod out the rear of the tractor.

8. Remove the rear wheels by removing the four lug nuts that secure each wheel to the hubs using a 3/4" wrench.

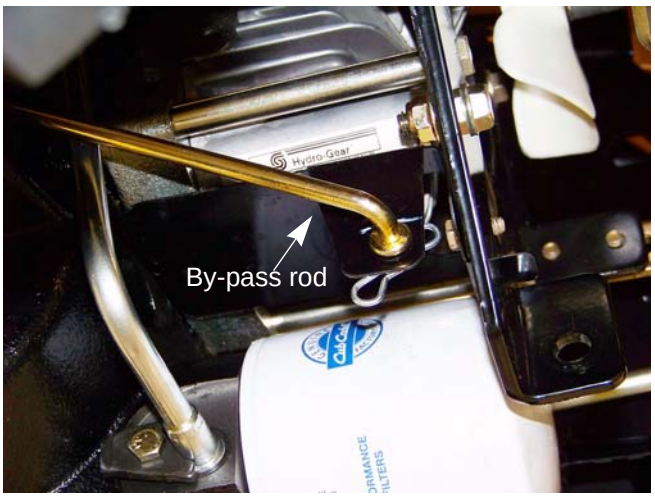


Figure 5.17

9. Remove the four bolts that attach the drive shaft to the hydro pump using a 7/16" wrench. See Figure 5.18.

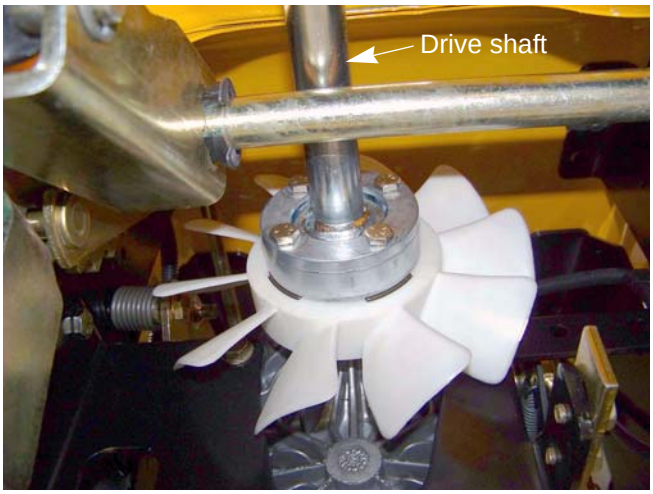


Figure 5.18

10. Remove the four nuts and bolts (two on each side) that hold the torque bracket to the frame using a pair of 1/2" wrenches. See Figure 5.19.

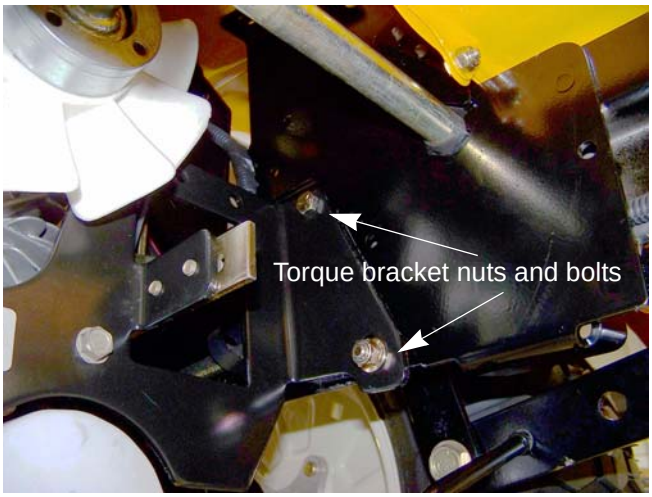


Figure 5.19

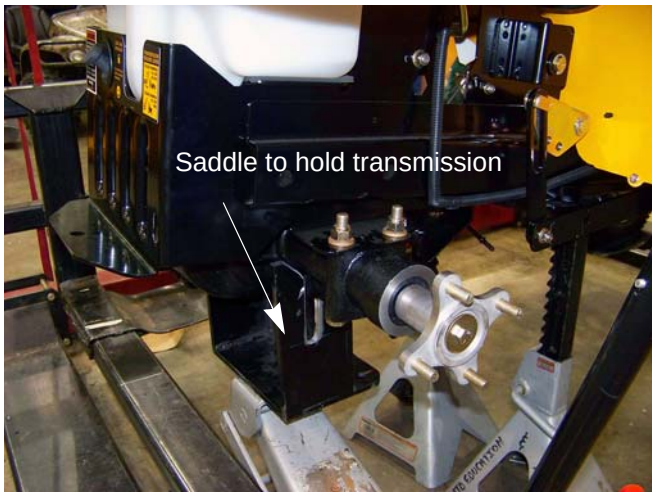


Figure 5.20

11. Support the transmission with a transmission jack to prevent it from falling while the mounting bolts are removed.

⚠CAUTION

The transmission is very front heavy and can not be balanced on a floor jack. The transmission will fall off of the jack as soon as the torque bracket clears the frame.

Use of a transmission jack or a saddle made to fit this transmission and mounted onto a floor jack will help prevent this from happening.

12. Remove the four bolts that fasten the transmission to the frame. See Figure 5.20.
13. Slide the transmission far enough to the left for the brake assembly to clear the hole in the frame.
14. Gently lower the transmission until it clears the frame.

    NOTE: The dipstick and dipstick tube should remain attached to the rear of the frame.
15. Remove the transmission from the tractor.
16. Install the transmission by following the previous steps in reverse order.

    NOTE: The cotter pin that secures the brake rod to the pedal shaft can be replaced with a bow tie clip (714-04040).

    NOTE: The upper torque bracket nuts and bolts must be installed with the nuts on the outside. The lower torque bracket nuts and bolts must be installed with the nuts on the inside.

    NOTE: Before lowering the tractor to the ground purge the transmission by:

    - Move the by-pass rod to the by-pass position.
    - Start the engine.
    - Cycle the drive pedal from full forward to full reverse six times.
    - Move the by-pass rod to the drive position.
    - Cycle the drive pedal from full forward to full reverse six times.
    - Check the fluid level and top off as needed.
17. Perform a hydro neutral control adjustment by following the steps described in the hydro neutral control adjustment section of this chapter.
18. Test drive the tractor before returning it to service.

Forward drive pedal shaft

To remove/replace the forward drive pedal shaft:

1. Remove the deck as described in Chapter 8: Decks and Lift Systems.
2. Remove the screw that holds the forward drive pedal to the pedal shaft using a 9/16" wrench. See Figure 5.21.
3. Unhook the forward drive pedal and remove it.

Figure 5.21

4. Remove the E-ring and hex bushing from each end of the drive pedal shaft. See Figure 5.22.

   NOTE: The right side of the pedal shaft will have shim washers between the E-ring and the bushing.

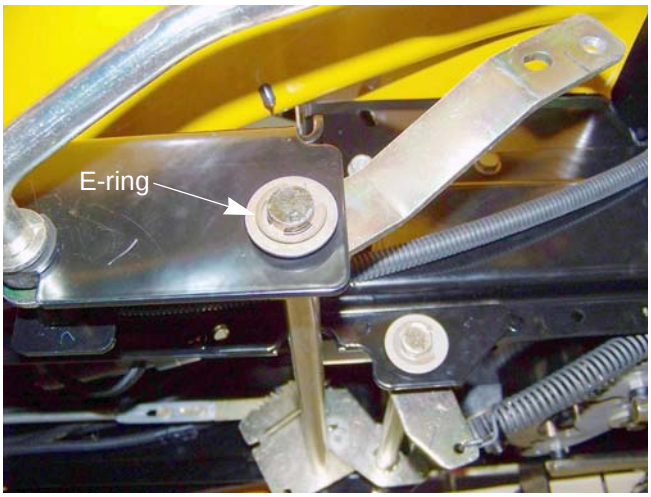


Figure 5.22

5. Slide the pedal shaft towards the left enough to gain access to the bow tie clip on the drive control rod. See Figure 5.23.
6. Disconnect the drive control rod from the drive pedal shaft's bell crank by removing the bow tie clip.

   NOTE: There is a spring that is attached to the drive control rod that is also held in place by the bow tie clip. See Figure 5.23.

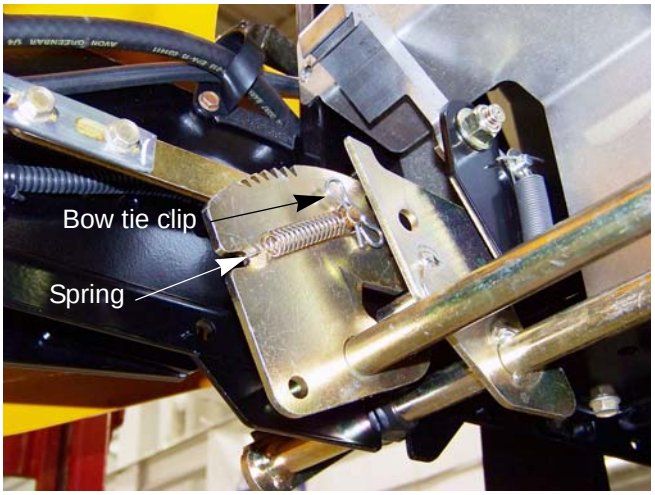


Figure 5.23

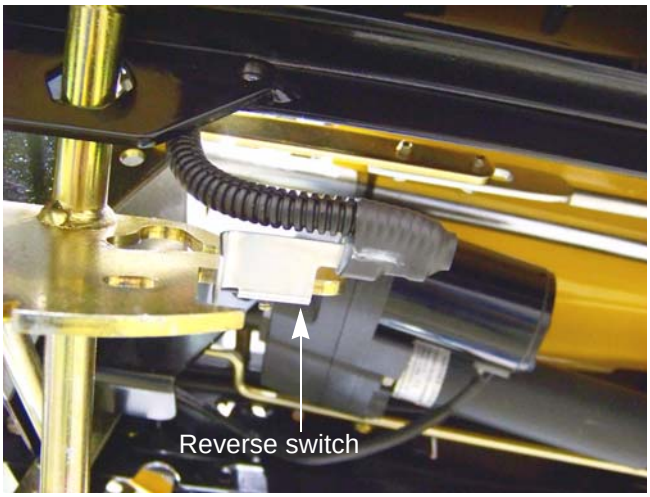


Figure 5.24

7. While holding the drive control rod up and out of the way, slide the drive pedal shaft towards the left enough for the bell crank to clear the pin on the brake shaft's bell crank.
8. Rotate the drive pedal shaft towards the rear of the tractor enough for the bell crank to clear the brake pedal shaft's bell crank.
9. Remove the drive pedal shaft by sliding it towards the right enough for it to clear the hole in the frame.
10. If the reverse switch is mounted on the drive control rod, disconnect it. See Figure 5.24.

NOTE: The reverse switch was moved to the transmission for the 2012 model year.

11. Install the drive pedal shaft by following the previous steps in reverse order.
12. Perform a hydro neutral control adjustment by following the procedures described in that section of this chapter.
13. Test drive the tractor in a safe area before returning it to service.

Reverse drive pedal shaft

To remove/replace the reverse pedal shaft:

1. Remove the deck as described in Chapter 8 Cutting Decks and Lift Shaft.
2. Remove the screw that holds the reverse pedal to the pedal shaft using a 9/16” wrench. See Figure 5.25.
3. Unhook the reverse pedal and remove it.

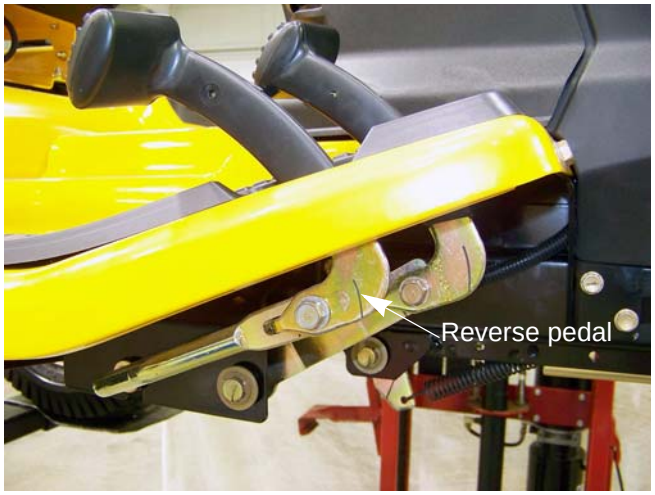


Figure 5.25

4. Remove the E-ring and washer from the right side of the forward pedal shaft.

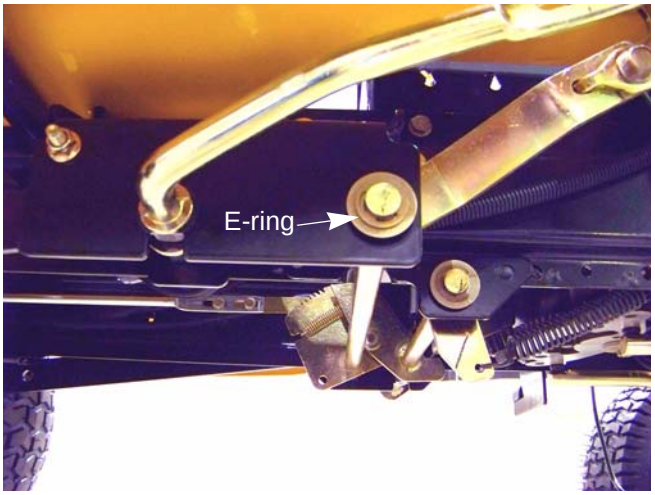


Figure 5.26

5. Disconnect the spring from the bolt in the reverse pedal channel. See Figure 5.27.

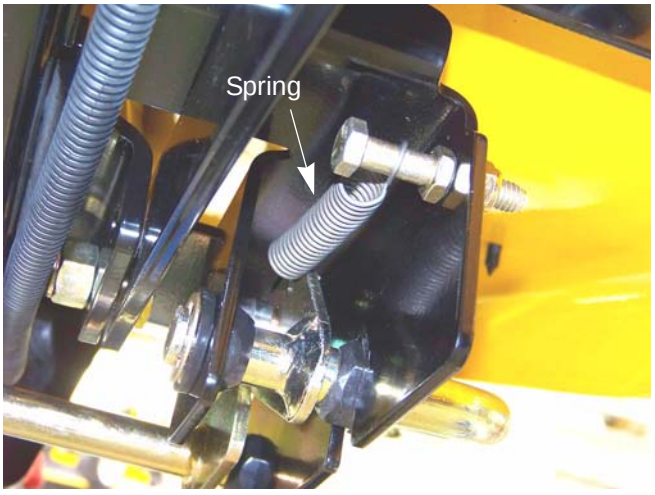


Figure 5.27

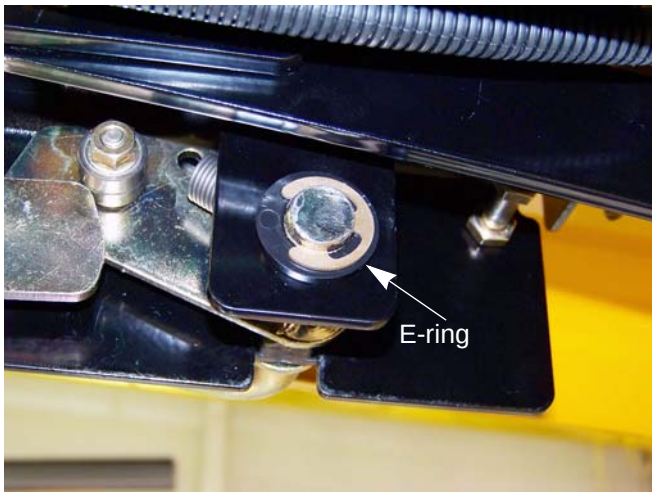


Figure 5.28

6. Remove the E-ring and washer from the reverse pedal shaft. See Figure 5.28.
7. Slide the reverse pedal towards the right while sliding the forward pedal shaft left far enough for the nut and bolt of the roller to fit between the frame and the forward pedal's bell crank.

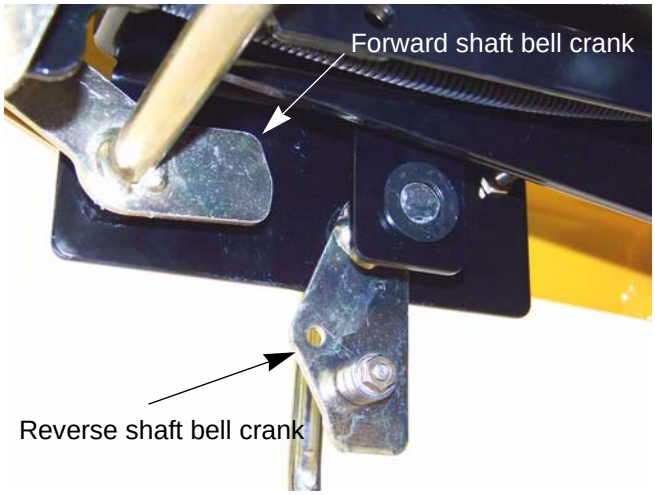


Figure 5.29

8. Rotate the reverse shaft until its bell crank and rollers drop below the bell crank on the forward shaft. See Figure 5.29.
9. Remove the hex bushings.

NOTE: The split hex bushing on the outboard side will be difficult to pry off.

10. Slide the reverse shaft out of the frame.

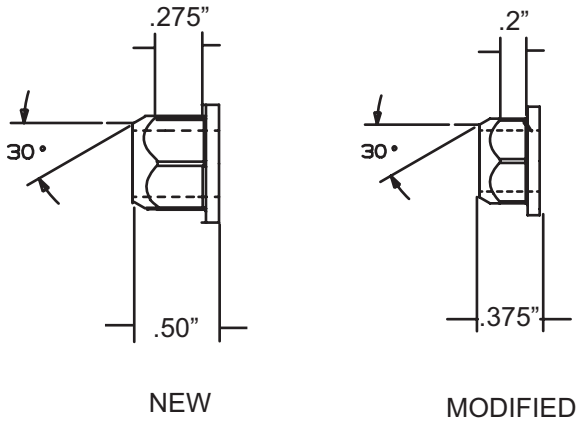


Figure 5.30

11. Install the reverse pedal shaft by following the previous steps in reverse order.

NOTE: The split hex bush can be shorted to make it easier to install.

12. Test drive the tractor in a safe area before returning it to service.

Transmission Disassembly

NOTE: The transmission used on 2000 series tractors is driven by a Hydro-Gear BDU-10L-225 pump. The service procedures for that pump are available in Hydro-Gear service manual BLN-50327.

1. Drain the oil from the transmission: See Figure 5.31.
   - 1a. Clean the transmission around the drain plug area.
   - 1b. Remove the drain plug using a 16 mm wrench. Leave the drain plug out.
2. Remove the transmission assembly by following the procedures described in the transmission removal section of this chapter.

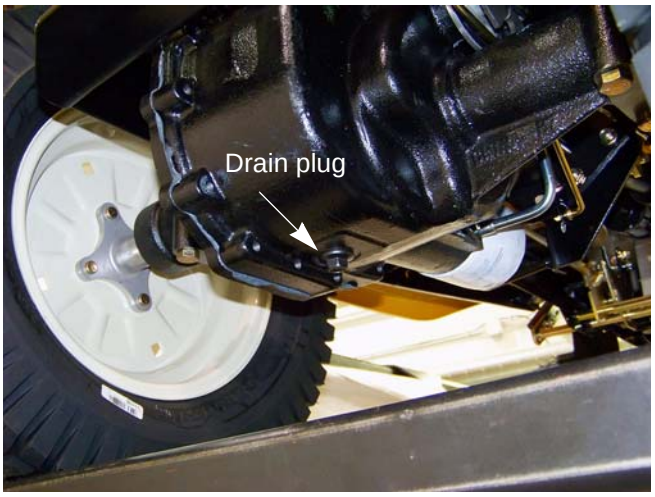


Figure 5.31

3. Disconnect the hydraulic pick up tube to the back of the BDU-10L using two 11/16 in. wrenches. See Figure 5.32.

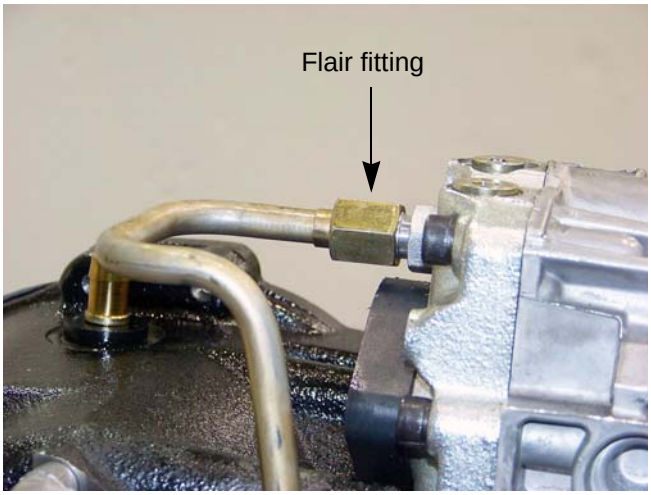


Figure 5.32

4. Remove the hex cap screw securing the hydraulic pick-up tube clamp and tube to the right transmission housing using a 7/16” wrench. See Figure 5.33.

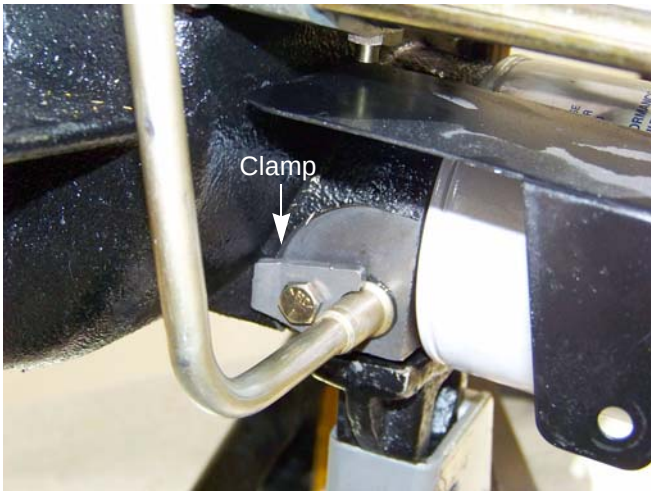


Figure 5.33

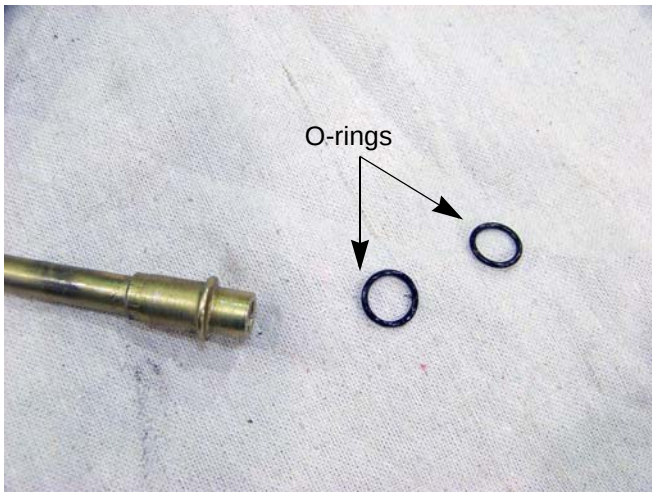


Figure 5.34

5. Inspect the o-rings at the end of the hydraulic pick up tube. See Figure 5.34.

NOTE: Two O-rings normally seal the lower end of the pick up tube.

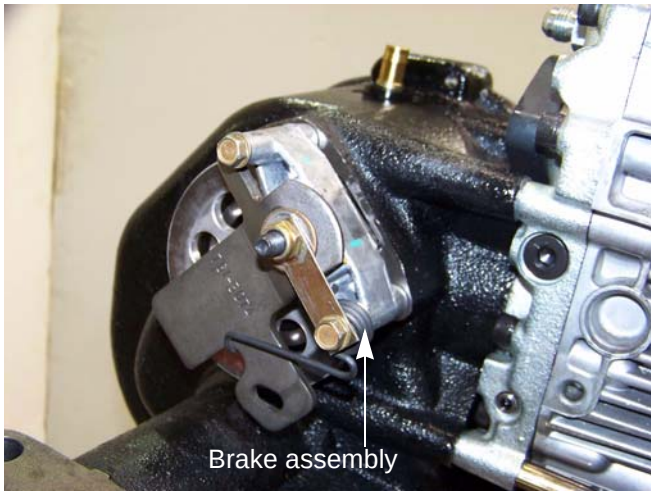


Figure 5.35

6. Remove the two screws that secure the brake assembly to the right transmission housing using a 3/8” wrench. See Figure 5.35.

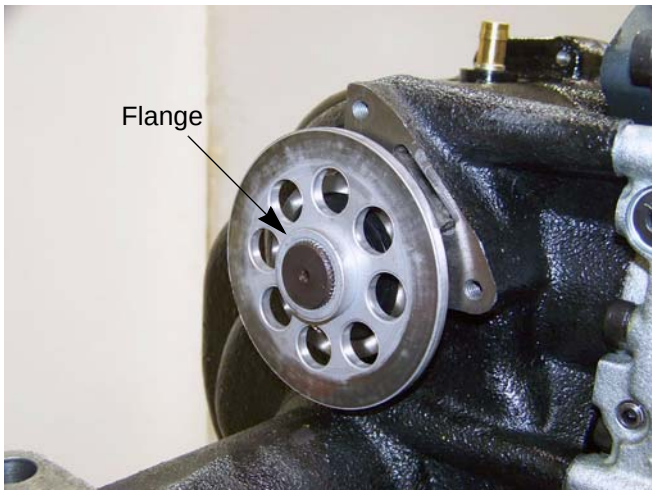


Figure 5.36

7. Remove the brake disk from the output shaft. See Figure 5.36.

NOTE: The center flange of the brake disk faces outward.

8. Remove the inside brake pad from the right transmission housing.

NOTE: The factory glues the inside brake pad to housing during assembly.

9. Remove and discard the output shaft seal from the right transmission case using a flat blade screwdriver.

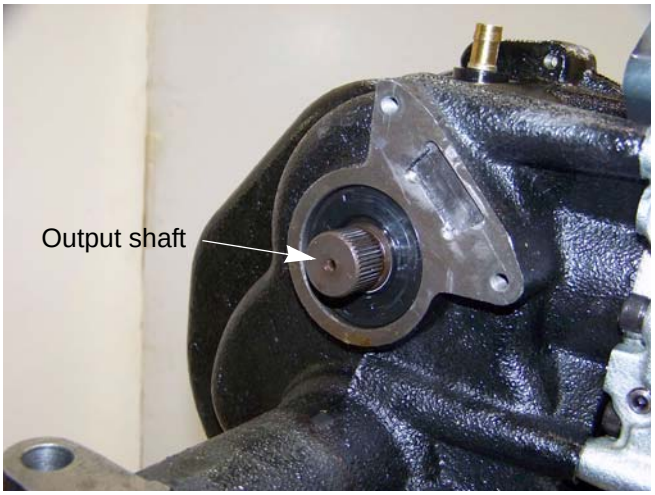


Figure 5.37

10. Remove the four screws securing the front torque bracket, spacers and the pump to the transmission using a 1/2” wrench. See Figure 5.38.

    NOTE: The 3/4” spacers are located at the top, and the 3-1/2” spacers are located at the bottom.

11. Remove the front torque bracket, spacers and pump from the right transmission housing.

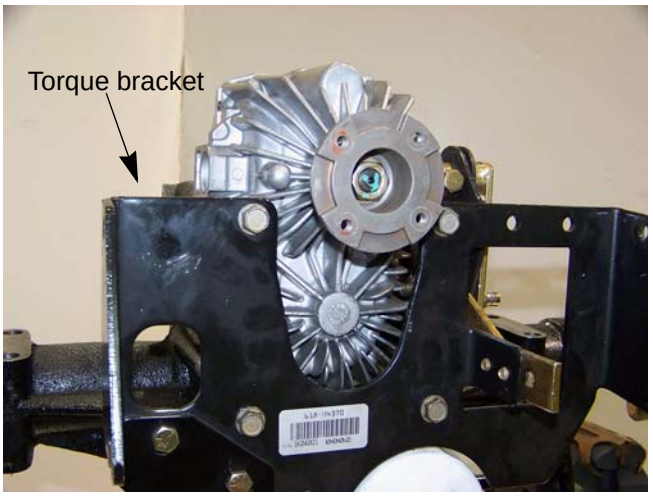


Figure 5.38

12. Remove the spring washer and the gland seal from the right transmission housing. See Figure 5.39.

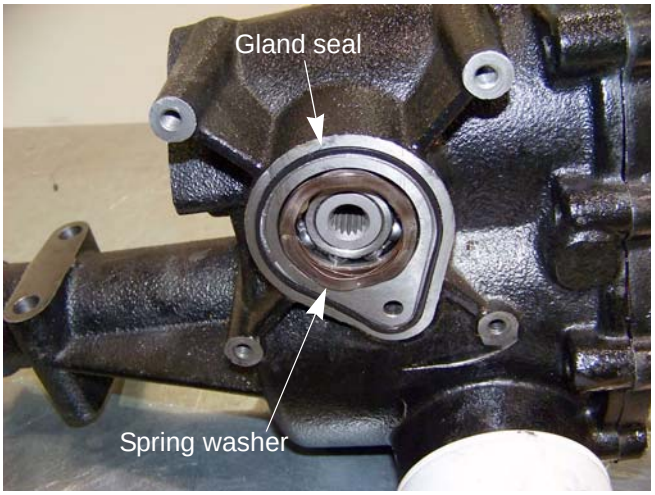


Figure 5.39

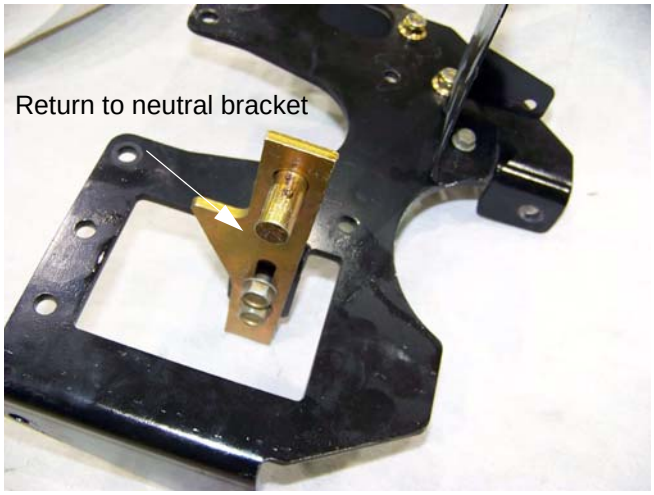


Figure 5.40

13. Inspect the return to neutral bracket assembly. If the return to neutral bracket shows sign of wear or damage, it must be replaced. See Figure 5.40.

NOTE: Neutral return adjustment will be necessary after the transmission assembly and installation sections have been performed.

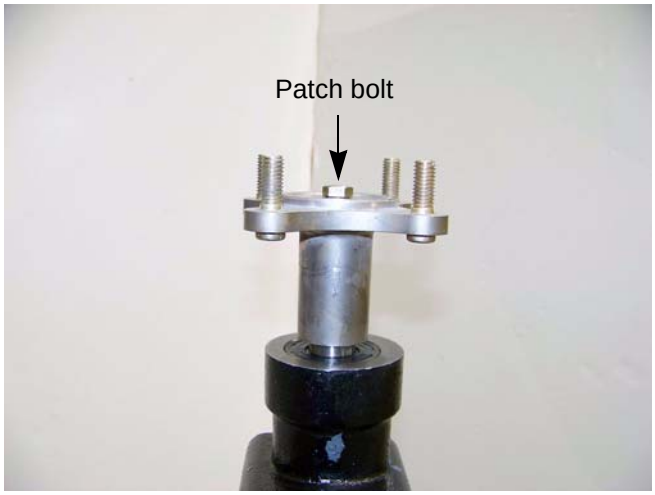


Figure 5.41

14. Stand the transmission up on end so that the left hub is facing up. See Figure 5.41.
15. Remove patch bolt and washer securing the left hub assembly to the left axle using a 1/2” wrench.
16. Slide the hub off of the axle shaft.

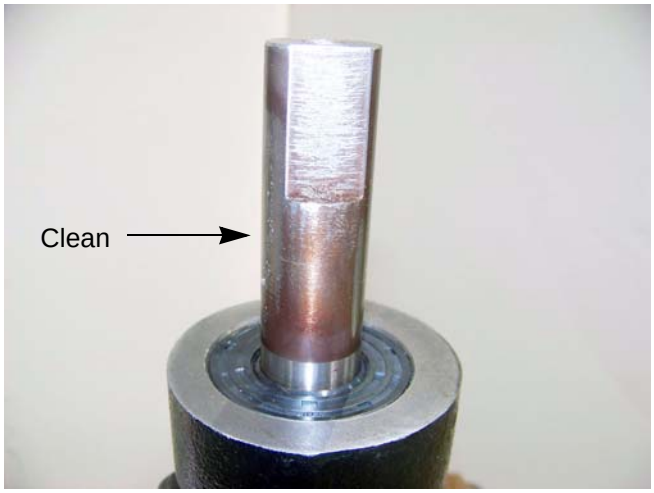


Figure 5.42

17. Clean the smooth exposed surface of the axles with fine emery cloth. See Figure 5.42.

NOTE: For the 2012 model year, the axle shafts and hubs will be splined.

18. Remove the fourteen screws securing the left transmission housing to the right transmission housing using a 1/2” wrench. See Figure 5.43.

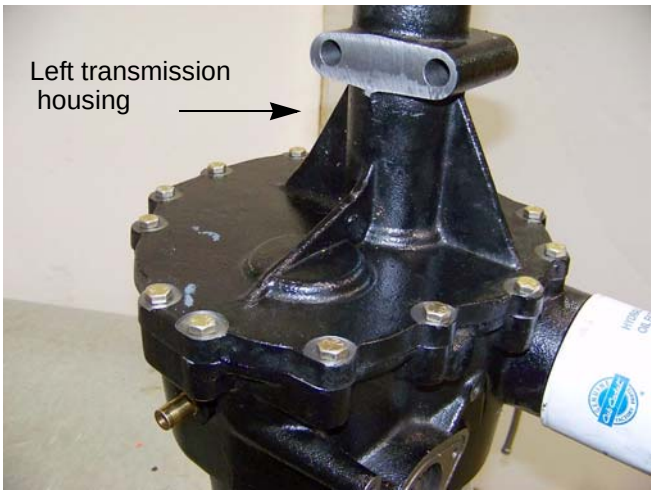


Figure 5.43

19. Lift the left transmission housing off of the right transmission housing. See Figure 5.44.

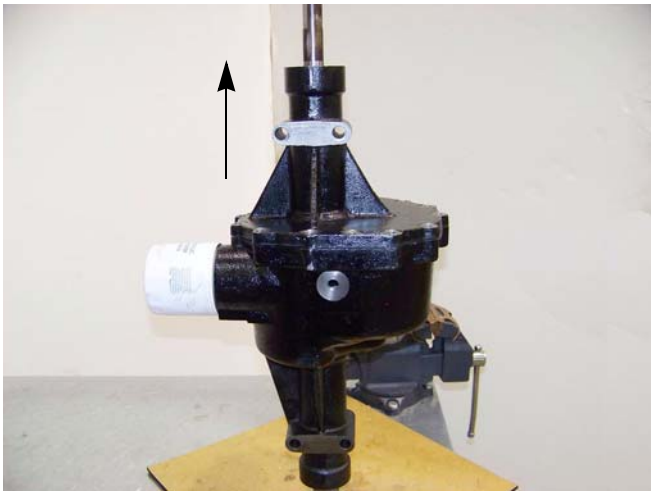


Figure 5.44

20. Lay the transmission down on the work surface.
21. Remove patch bolt and washer securing the right hub assembly to the right axle using a 1/2” wrench.
22. Slide the hub off of the axle shaft.
23. Remove the 13T input pinion and ball bearing from the right transmission housing using a wooden dowel. See Figure 5.45.

    NOTE: The 13T input pinion is pressed into the ball bearing.

Figure 5.45

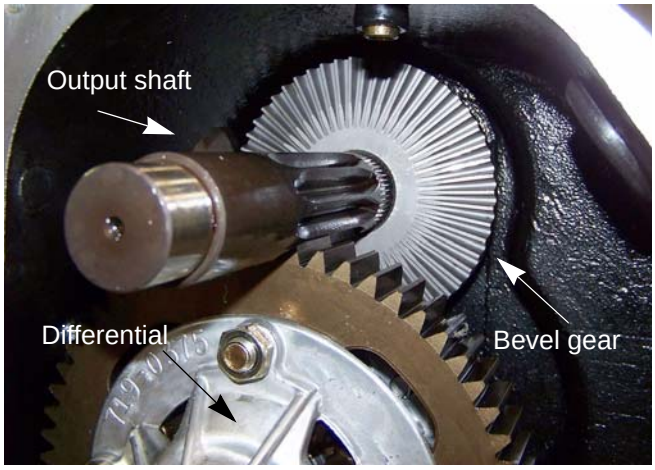


Figure 5.46

24. Grasp the differential assembly and the output shaft. See Figure 5.46.
25. Slowly pull the differential assembly and the output shaft out of the right transmission housing until the output shaft is clear of the transmission.
26. Remove the 54T bevel gear and thrust washer from the 9T output shaft.

NOTE: The differential ring gear fits into the output shaft, preventing it from being removed separately.

Figure 5.47

27. Continue removing the differential assembly from the right transmission housing. See Figure 5.47.

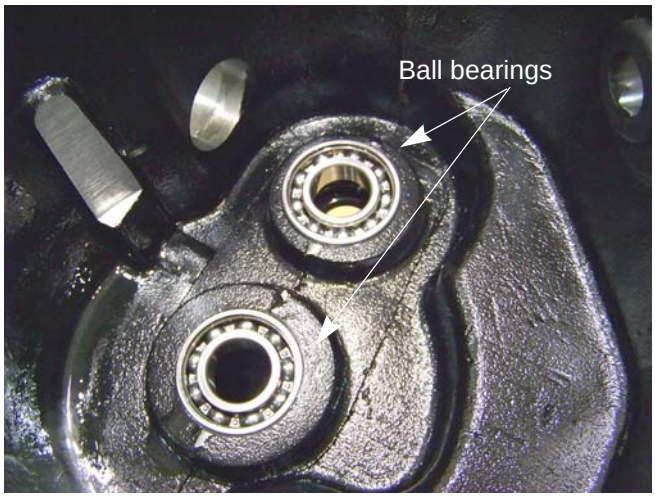


Figure 5.48

28. Inspect both ball bearings in the right transmission housing for wear or damage. See Figure 5.48.

29. Remove the spacers from the differential axles. See Figure 5.49.

    NOTE: The short spacer goes on the axle towards the right (deep) housing, and the longer spacer goes on the axle towards the left (shallow) housing.

    NOTE: Mark the direction of forward rotation on the spur gear. This will keep the worn in teeth matched to the teeth on the output shaft.

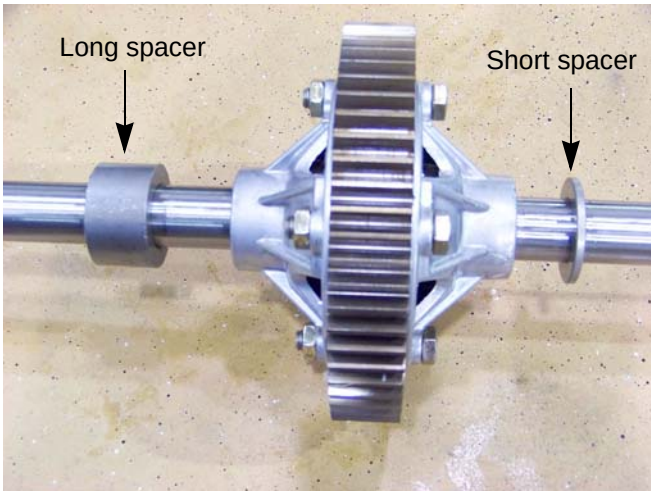


Figure 5.49

30. Secure the 60T spur gear in a soft jawed vice. See Figure 5.50.
31. Loosen the four hex bolts securing the differential assembly together using a pair of 9/16” wrenches.

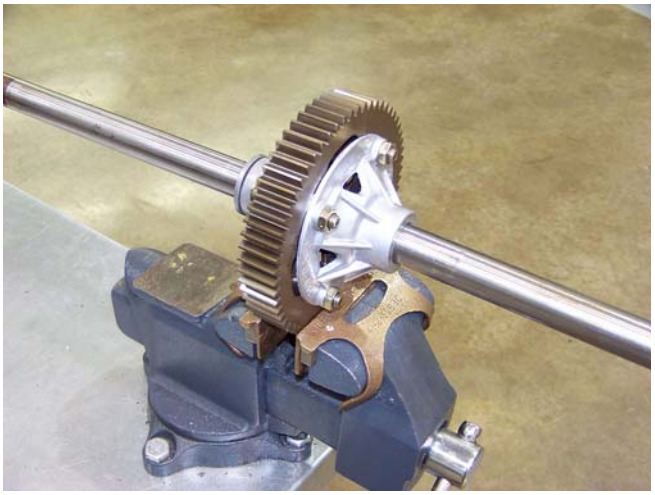


Figure 5.50

32. Secure the differential assembly in the vertical position, in the soft jaws of a vice, with the hex bolts facing up. See Figure 5.51.
33. Continue removing the hex bolts that hold the differential assembly together using a 9/16” wrench and a shop rag.

Figure 5.51

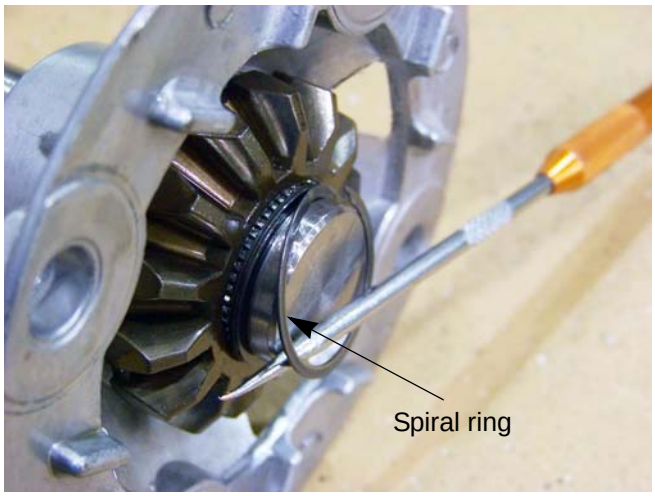


Figure 5.52

34. Lift the left axle, differential housing, 14T miter gear assembly off of the ring gear.
35. Separate the miter gear from the axle shaft by removing the pair of spiral lock rings. See Figure 5.52.

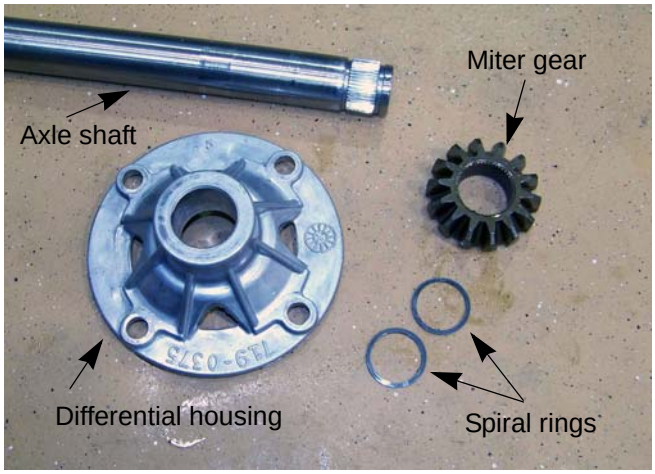


Figure 5.53

36. Separate the differential assembly components and inspect for damage or wear. See Figure 5.53.

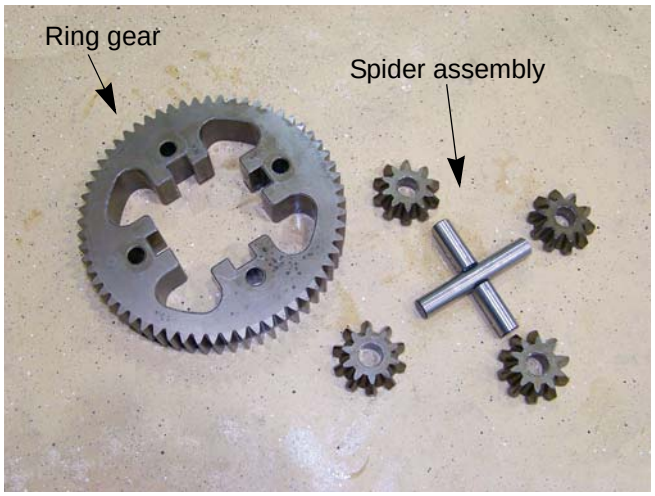


Figure 5.54

37. Lift the ring gear and the spider gear assembly off of the right axle assembly.
38. Separate the spider gear assembly and inspect for damage or wear. See Figure 5.54.
39. Repeat steps 35 & 36 on the right axle assembly.

40. Remove the oil filter from the right transmission housing using an oil filter wrench. See Figure 5.55.

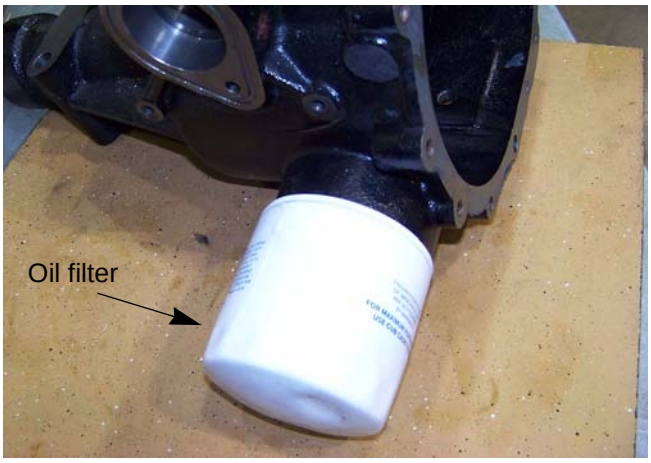


Figure 5.55

Transmission Assembly

Figure 5.56

1. Remove any excess sealant from the transmission housings mating faces.
2. Clean the mating faces of the transmission housings using a scrubbing pad and alcohol. See Figure 5.56.
3. Install a new oil filter onto the right transmission housing.
4. Secure the right axle, spiral retainer groove facing up, in the soft jawed vice.
5. Set the threaded differential housing over the right axle, cup facing up.
6. Place the 14T miter gear onto the right axle.
7. Secure the 14T miter gear to the axle with both spiral retaining rings.
8. Set the 60T spur gear in position on top of the threaded differential housing.
9. Assemble the differential assembly: cross-shaft and 10T miter gears.
10. Set the differential assembly into the 60T spur gear.

NOTE: There is no particular orientation for the differential assembly to be installed, but once broken-in, the spur gear should be kept driven in its original direction.

11. Set the left axle assembly onto the differential assembly.
12. Secure the left axle assembly to the right axle assembly with four hex cap screws using a 9/16” wrench.

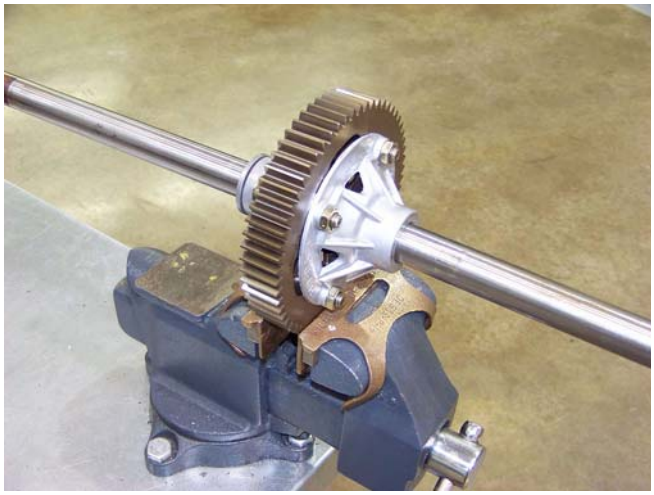


Figure 5.57

13. Secure the 60T spur gear in the soft jawed vice. See Figure 5.57.
14. Tighten the four of the hex cap screws securing the differential housings together to a torque of 220 - 280 in lbs (25 - 32 Nm).
15. Install the axle spacers up against the differential housing.

NOTE: The short spacer goes on the axle towards the right housing, and the longer spacer goes on the axle towards the left housing.

16. Begin to insert the differential assemblies right axle into the right transmission housing.
17. Place the 54T bevel gear and thrust washer onto the 9T output shaft.
18. Insert the output shaft, 54T bevel gear and thrust washer behind the differential assembly.
19. Slide the differential assembly and the output shaft assembly into the right transmission housing and into their respective ball bearings.

20. Place a 3/16” bead of Loctite® Ultra Black or similar sealant around the perimeter of the right housing mating face. See Figure 5.58.
21. Slide the left transmission housing over the left axle assembly and set it into position, aligning the mounting holes with the threads.
22. Apply a small amount of releasable thread locking compound such as Loctite® 242 (blue) to the fourteen hex cap screws that hold the two transmission halves together.
23. Install the fourteen hex cap screws and tighten them to a torque of 150 - 210 in lbs (17 - 24 Nm).

    NOTE: Torque all the hex cap screws securing the transmission housings together in a cross pattern.

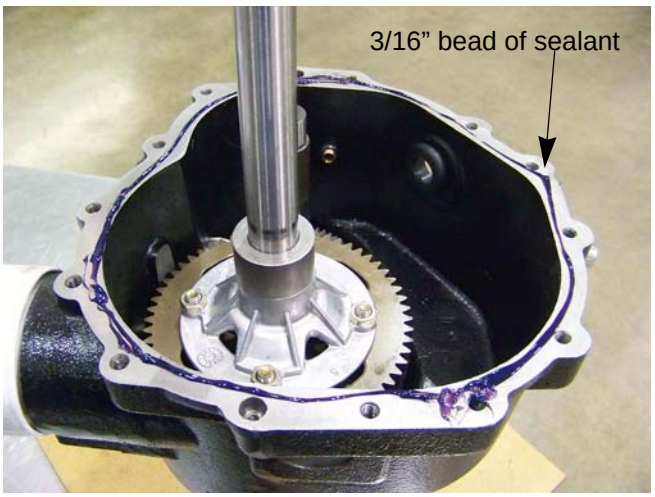


Figure 5.58

24. Slide the hub assemblies onto the axle shafts.
25. Apply a small amount of releasable thread locking compound such as Loctite® 242 (blue) to the wheel hub patch bolts.
26. Install the hub patch bolts and washer. Tighten them to a torque of 260 - 350 in lbs (29 - 40 Nm).

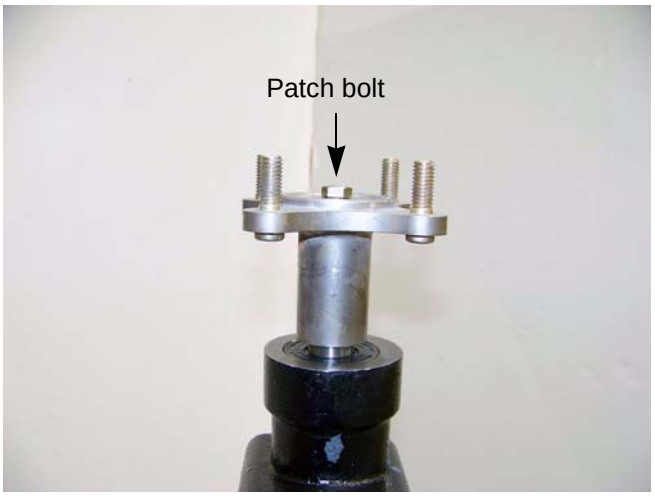


Figure 5.59

27. Install the output shaft double lip seal using a seal pusher and hammer. See Figure 5.60.
28. Apply anti-seize to the actuator pin contact surface of the brake actuation arm.
29. Reassemble the brake assembly as follows: yoke, actuation arm, torsion spring, flat washer, anti-rotation plate, lock nut, hex cap screws, actuation pins, puck plate and brake pad.
30. Secure the brake assembly together using tape.
31. Insert the brake pad into the right transmission housing.
32. Slide the brake disk over the output shaft.

    NOTE: The center shoulder of the brake disk faces outward.

Figure 5.60

33. Secure the brake assembly to the right transmission housing with the hex cap screws using a 3/8” wrench.

    NOTE: Tighten the brake assembly hex cap screws to a torque of 80 - 100 in lbs (9 - 11 Nm).

34. Adjust the brake pad clearance by following the procedures described in Chapter 3: Brakes.

35. Rotate the transmission so the filter is facing up.

36. Insert the 13T input pinion, ball bearing and spring washer.

37. Lubricate the gland seal and insert it into the right transmission housing.

    NOTE: Grease the gland seal and its groove.

38. Set the BDU-10L and front torque bracket in position, aligning the mounting holes.

39. Insert two 5-1/2” screws through the front torque bracket, short spacers, BDU-10L and into the right transmission housing.

40. Insert two 5-1/2” screws through the front torque bracket, long spacers, BDU-10L and into the right transmission housing.

41. Tighten all four of the 5-1/2” screws to a torque of 220 - 280 in lbs (25 - 32 Nm) using a 1/2” wrench.

42. Lubricate the hydraulic inlet tube o-rings with grease.

43. Set the hydraulic inlet tube into position.

44. Secure the flare fitting of the hydraulic inlet tube to the BDU-10L. by hand.

45. Pivot the hydraulic inlet tube to the outlet port of the right transmission housing.

46. Loosely secure the hydraulic tube clamp and the lower end of the hydraulic inlet tube to the right transmission housing using a 7/16 in. socket.

47. Tighten the flair fitting of the hydraulic inlet tube to the BDU-10L using an 11/16 in. wrench.

48. Tighten the hex bolt securing the hydraulic tube clamp.

49. Install the oil drain plug with a 16mm wrench.

50. Install the transmission by following the procedures described in the transmission removal section of this chapter.

51. Fill the transmission with 182 oz (5.4 L) of Cub Cadet Drive System Fluid Plus oil (#737-3120)

    NOTE: The Cub Cadet Drive System Fluid Plus oil (#737-3120) is a synthetic blended oil designed specifically for Cub Cadet transmissions.

52. Purge the transmission while the tractor is still supported off of the ground.:

    52a. Move the by-pass rod to the by-pass position.

    52b. Start the engine.

    52c. Cycle the drive pedal from full forward to full reverse six times.

    52d. Move the by-pass rod to the drive position.

    52e. Cycle the drive pedal from full forward to full reverse six times.

53. Perform a hydro neutral control adjustment by following the steps described in the hydro neutral control adjustment section of this chapter.

54. Test drive the tractor in a safe area before returning it to service.

Symptom	Root problem	Mechanical cause	Recommended action
Complete loss of drive	Loss of control input	Inoperative pedal linkage or control arm not moving trunnion shaft	Visually inspect linkage and force-check the control arm/ trunnion connection.
	Loss of power to hydro pump	Drive shaft and couplings to engine and Transmission	Inspect and force -check drive shaft and coupling. May require drive shaft removal.
		Sheared input shaft at hydro pump	Remove drive shaft and force-check input shaft (push/pull/ turn). May need to remove charge pump cover to confirm shaft rotation.
	Loss of hydraulic pressure	Bypass valve open	Check position of bypass control rod. Check for proper movement of the linkage and valve plunger.
		Low/no hydraulic fluid	Check the transmission's dipstick
		Restricted flow to charge pump	Check external parts: pick-up tube, fluid filter (Cub Cadet P/N 723-3014). NOTE: fluid & filter replacement is a reasonable first step
		Failed charge relief valve	Remove and inspect charge relief valve.
		Failed charge pump	Remove charge pump cover for physical inspection
		2 completely inoperative charge check valves (very unlikely scenario)	Remove and inspect charge valves.
	Mechanical drive failure	Pinion gear/bevel gear failure	The brake rotor is on the same shaft that carries the bevel gear. If the brake rotor turns in response to drive inputs, but the wheels do not, the problem is down-stream of the bevel gear
		Ring gear, differential, or axle failure	See cell above
		Wheel hub not driven by axle	Inspect and force-check wheel hub
Loss of drive in Forward only	Loss of hydraulic pressure in forward circuit	Completely inoperative charge relief valve	Remove and inspect charge check valves.

Symptom	Root problem	Mechanical cause	Recommended action
Loss of drive in Reverse only	Loss of hydraulic pressure in forward circuit	Completely inoperative charge relief valve	Remove and inspect charge check valves.
	Loss of control input	Damaged Reverse pedal linkage	Check the operation of the reverse pedal linkage. It transfers motion to the Forward pedal linkage.
Sluggish operation, no unusual noise	Low engine speed.	Mis-adjusted throttle or governor linkage, or engine performance issue.	Check engine RPM and performance.
	Linkage travel	Binding or lost motion stack-up in pedal linkages prevents full travel at hydro input arm.	Check linkages for wear or bind. Pay special attention to the bushings that support the pedal shafts. Pay special attention to the slotted adjustment point in the drive control rod.
	Wrong fluid or blocked filter	Wrong fluid or blocked filter	Change fluid filter if in doubt: filter = Cub Cadet P/N 723-3014, fluid = Cub Cadet Drive System Fluid Plus P/N 737-3120 gallon. NOTE: fluid & filter replacement is a reasonable first step
	Low pump output	Worn hydro pump.	Typically the hydro will work fine when cold, but lose power as it gets warm. Overheating will aggravate the condition, confirm that the transmission is clean enough to dissipate heat and that the cooling fan is intact. NOTE: fluid & filter replacement is a reasonable first step

Symptom	Root problem	Mechanical cause	Recommended action
Sluggish operation, hydraulic noise	Dragging brake	Brake caliper not releasing	Check the brake pedal and linkage to the brake caliper. Check brake adjustment. Check caliper operation.
	Entrained air in system	Damaged pick-up tube or fitting leak at end of pick-up tube.	Remove pick-up tube for inspection and replace O-ring seal. Bottom O-ring leak will leave a puddle under the tractor. Top fitting leak will allow air to be drawn-in.
		Low fluid level	Check dipstick. Symptoms may be more pronounced on a grade.
		Air leak near suction side of charge pump. (Unlikely scenario)	Charge pump housing may show fluid leak
		System not purged after fluid service	Purge system.
		Charge relief valve leaking	Remove and inspect charge relief valve
		Bypass valve leaking	Check linkage and plunger movement on the by-pass valve. Remove to inspect if necessary.
		Charge check valve leaking	Typically this will cause symptoms in one direction only. A leaky Forward charge check valve will effect performance in Reverse. A leaky Reverse charge check valve will cause performance issues in Forward. NOTE: The forward charge check valve is on the right side of the hydro. pump. The reverse charge check valve is on the left side of the hydro. pump.

CHAPTER 6A: MANUAL STEERING

Steering alignment

NOTE: Before performing a front end alignment, check for wear or damage that might cause the misalignment of the front wheels:

- Worn rod ends
- Bent drag links
- Loose steering arms or loose drag links
- Worn axles or king pin bores
- Worn wheel bearings
- Lift the front axle and spin each front wheel to check for excessive run-out.

NOTE: If there is run-out, find the midpoint of the run-out and use that point for your measurements.

- Repair as necessary before setting the toe angle.

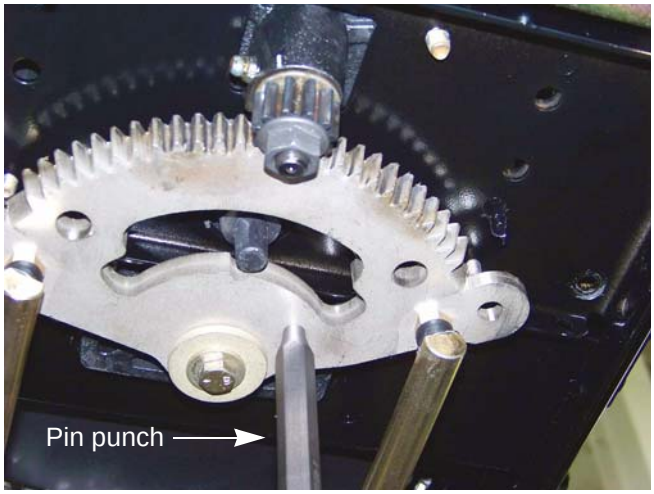


Figure 6A.1

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

1 Check the air pressure in the front tires and make certain that they are at approximately 14 PSI. The rear tires should be at 10 PSI.

2. Park the tractor on level ground.
3. Lower the deck lift lever to the lowest position.
4. Turn the steering wheel to line up the centering hole in the steering gear with the centering hole in the support plate, and insert a 5/16” pin punch up through both. See Figure 6A.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.

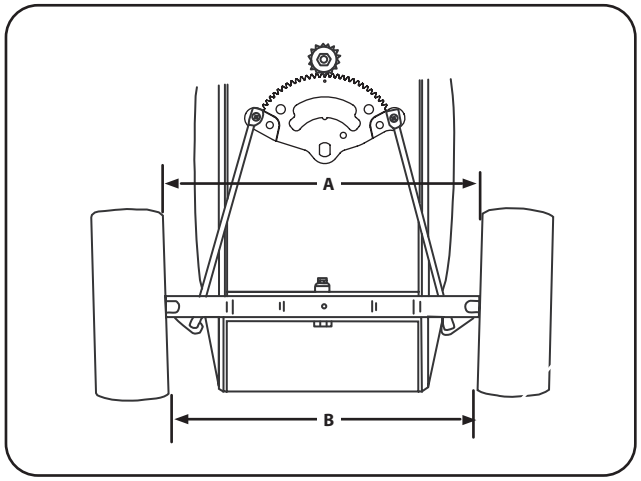


Figure 6A.2

5. In front of the axle, measure the distance (B) horizontally from the inside of the left rim to the inside of the right rim. See Figure 6A.2.
6. From behind the axle, measure the distance (A) horizontally from the inside of the left rim to the inside of the right rim.

7. The measurement taken in front of the axle (B) should be between 1/16” and 1/4” less than the measurement taken behind the axle (A). If not, perform the following steps:
8. Loosen the jam nut at the rear of the right spherical rod end using a 9/16” wrench and an 11/16” wrench. See Figure 6A.3.
9. Remove the nut, bolt and washer that secures the right spherical rod end to the right axle assembly using a pair of 9/16 wrenches.
10. Remove the right hand spherical rod end from the right hand drag link.
11. Repeat steps 8, 9 and 10 on the left side.
12. Place the left and right tire assemblies in the straight forward position.

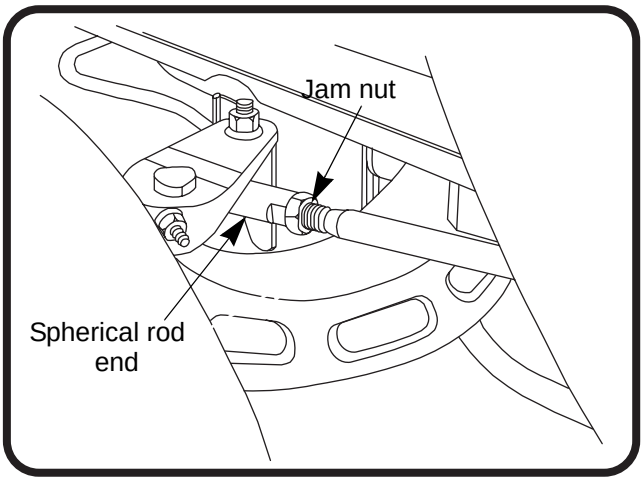


Figure 6A.3

13. Set the toe-in for the rim assemblies to 3/16”.
14. Thread the right hand spherical rod end onto the right hand drag link until the mounting hole in the right hand axle assembly lines up with the hole in the spherical rod end.

    NOTE: Count the number of turns the spherical rod end was rotated onto the drag link. This number should be with in 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 spherical rod end to the right hand axle assembly with the nut, bolt and washer removed earlier, using a pair of 9/16” wrenches.
16. Secure the right hand spherical rod end jam nut to the right hand drag link using a 9/16” wrench and an 11/16” wrench.
17. Install the left hand spherical rod end using steps 14, 15 and 16.

Front wheels

Figure 6A.4

Remove/ replace the front wheels:

1 Lift and safely support the front end of the tractor.

2. Gently pry off the hub cap. See Figure 6A.4.

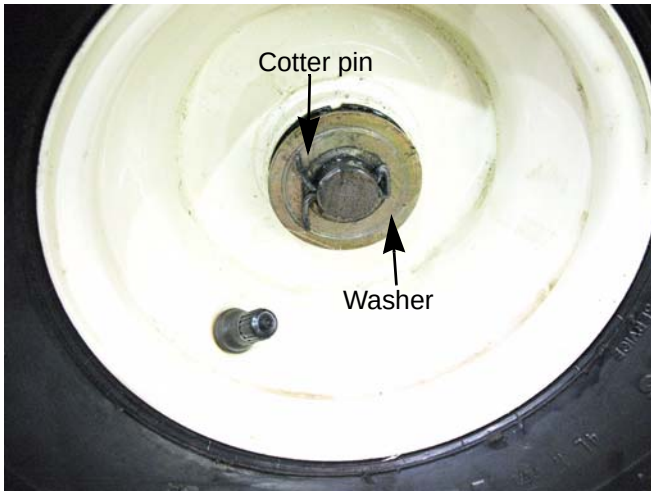


Figure 6A.5

3. Remove and discard the cotter pin. See Figure 6A.5.
4. Remove the washer. See Figure 6A.5.
5. Slide the wheel off of the axle.

Front wheel bearings

To replace the front wheel ball bearings:

1. Lift and safely support the front end of the tractor.
2. Remove the front wheel by following the procedures described in the previous section of this chapter.
3. Drive the bearings out of the wheel hub using a blunt ended punch. See Figure 6A.6.

Figure 6A.6

4. Drive in the new bearings using a brass punch or a suitable bearing driver that contacts only the outer race. See Figure 6A.7.
5. Install the front wheel.
6. Pump grease in the grease fitting on the front wheel until it starts to squirt out of the hub.
7. Test drive the tractor before returning it to service.

Figure 6A.7

Axles

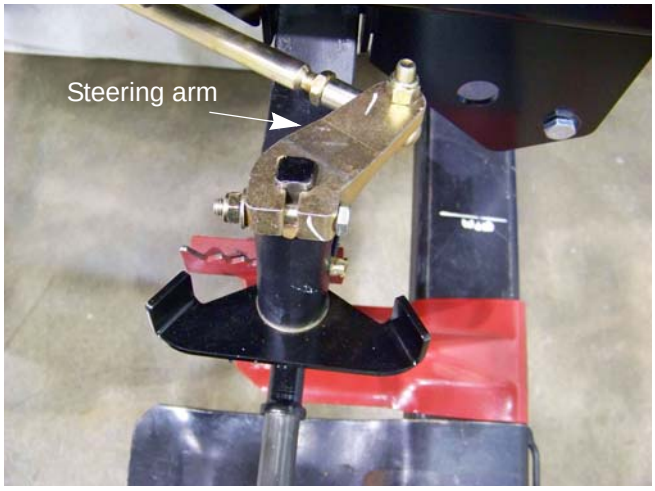


Figure 6A.8

NOTE: The axles used on the left side and right side are the same part number.

1 Lift and safely support the front of the tractor.

2. Remove the front wheel by following the procedures described in the front wheel section of this chapter.
3. Support the axle while loosening the nut and bolt that hold the steering arm onto the axle using a pair of 1/2” wrenches. See Figure 6A.8.
4. Lift the steering arm off of the axle.
5. Slide the axle out of the pivot bar.

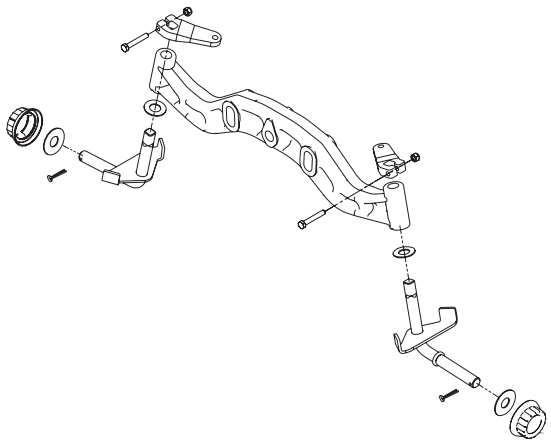


Figure 6A.9

6. Install the axle by following the previous steps in reverse order.

NOTE: There is a washer between the axle flange and the pivot bar. See Figure 6A.9.

7. Inject grease into the grease fitting of the axle being replaced until it oozes out.
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.

Steering sector gear and steering pinion gear

If you are replacing the steering 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.

If the steering gears show any unusual or accelerated wear, identify and correct the cause of the wear before replacing the gears. Possible causes of rapid wear include:

- Worn steering housing bores.
- Bent steering shaft.
- Worn sector gear pivot shaft.
- Binding drag links or axles (king pin).
- Broken travel stops

To remove/replace the steering gears:

1. Remove the cutting deck by following the steps described in Chapter 8: Cutting Decks and Lift Shaft
2. Lift and safely support the front of the tractor.
3. Insert a 5/16” pin punch into the alignment hole to lock the gears while removing the flange nut. See Figure 6A.10.
4. Remove the flange lock nut securing the steering pinion gear to the steering shaft using an 11/16” socket. See Figure 6A.10.
5. Slide the steering pinion gear off of the steering shaft.

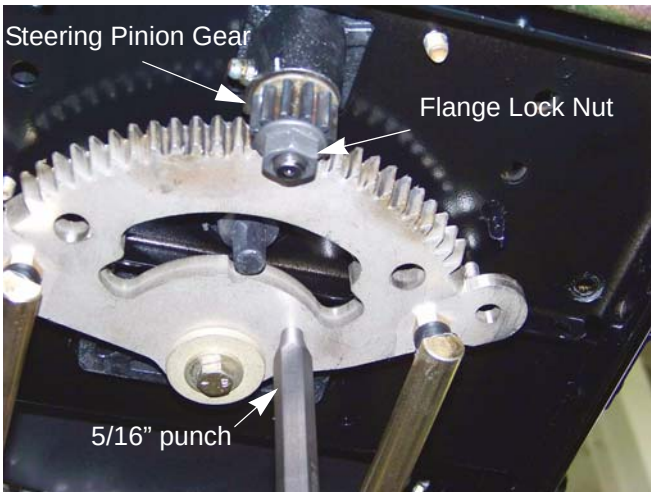


Figure 6A.10

6. Remove the bolt and washer, indicated by the arrow in Figure 6A.11, that secures the steering sector gear to the steering housing pivot shaft using a 1/2” wrench.
7. Slide the gear off of the shaft.

   NOTE: The sector gear fits on a double-D shaft. The shaft pivots in the steering housing.

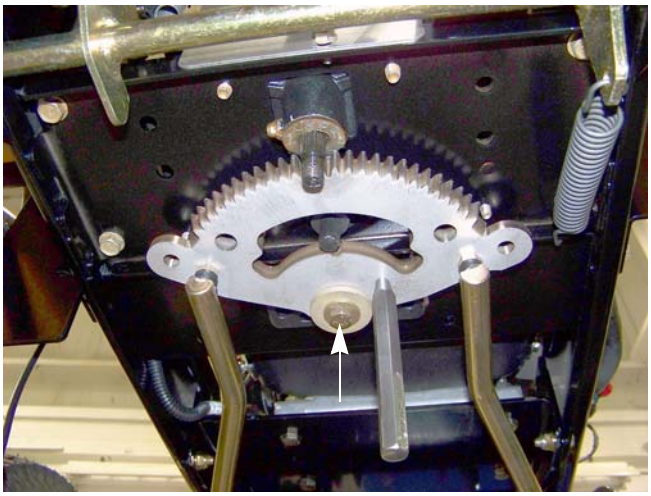


Figure 6A.11

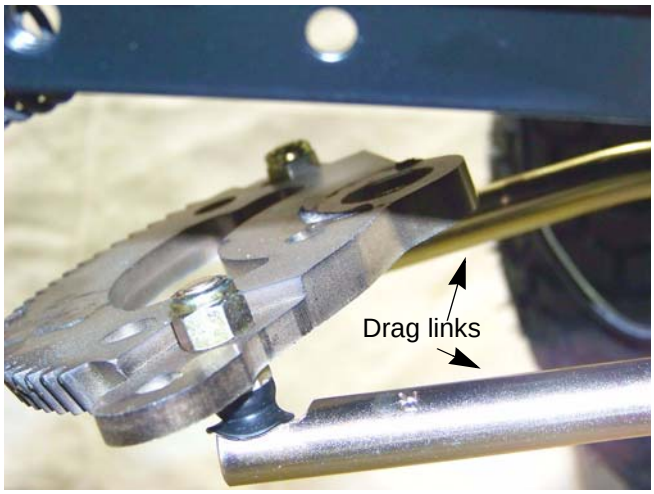


Figure 6A.12

8. Disconnect the drag links from the forward most holes in the sector gear using a 1/2” wrench and a 9/16” wrench. See Figure 6A.12.
9. Install the steering gears by following the previous steps in reverse order.

NOTE: Apply a small amount of releasable thread locking compound such as Loctite® 242 (blue) to the sector gear bolt.

10. Inject grease into the grease fittings on the pivot bar and the steering housing.
11. Perform a wheel alignment by following the steps described in the steering alignment section of this chapter.
12. Test drive the tractor in a safe area before returning it to service.

Steering shaft

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. Lift and safely support the front of the tractor.
3. Remove the flange lock nut securing the steering pinion gear to the steering shaft using an 11/16” socket. See Figure 6A.13.

   NOTE: If the steering shaft rotates while removing the nut, insert a 5/16” pin punch into the alignment hole in the steering gear. This will lock the steering shaft in place, allowing the nut to be removed.
4. Slide the steering pinion gear off of the steering shaft.

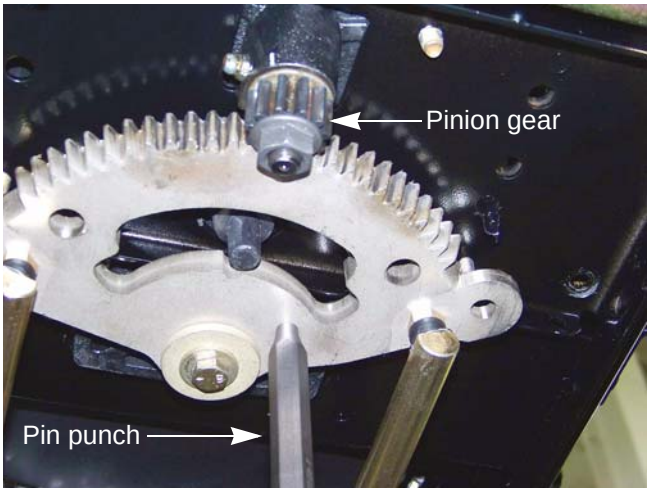


Figure 6A.13

5. Remove the steering wheel

   5a. Remove the cover from the center of the steering wheel. See Figure 6A.14.

Figure 6A.14

NOTE: The cover can be released by prying-in on the lock-tabs on the under-side of the steering wheel. See Figure 6A.15.

5b. Remove the bolt that holds the steering wheel to the steering shaft using a 1/2” wrench.

5c. Lift the steering wheel off of the steering shaft.

Figure 6A.15

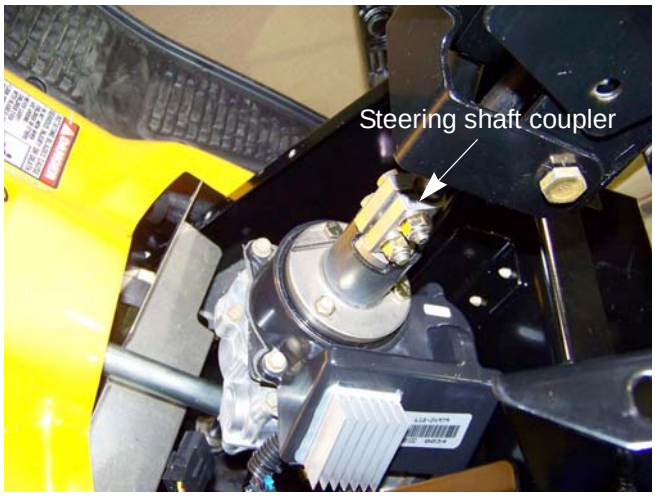


Figure 6A.16

NOTE: On tractors with power steering:

- Loosen the lower nut and bolt of the steering shaft coupler using a pair of 1/2” wrenches.
- Remove the top nut and bolt from the steering shaft coupler. See Figure 6A.16.

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

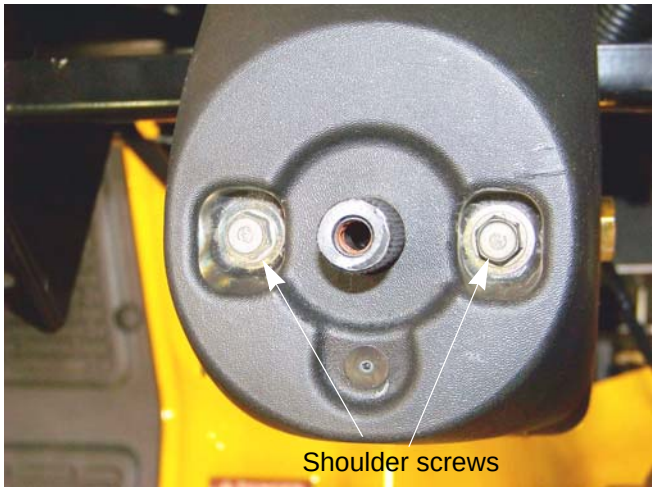


Figure 6A.17

6. Remove the two shoulder screws that hold the steering shaft collar to the tilt steering bracket using a 3/8” wrench. See Figure 6A.17.
7. Lift the steering collar off of the tractor.

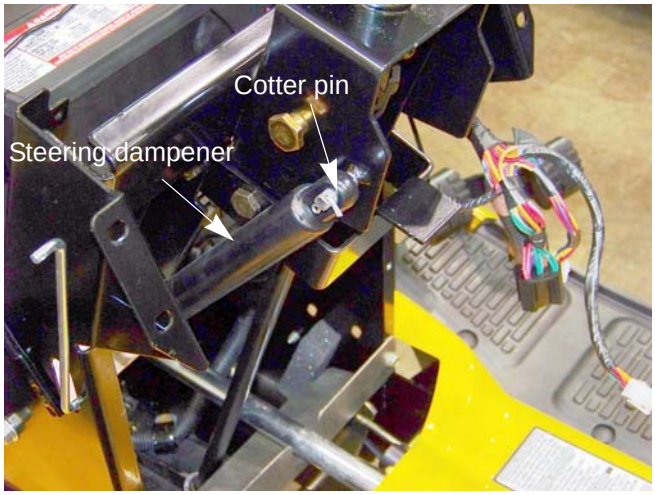


Figure 6A.18

8. Remove and discard the cotter pin that secures the tilt steering dampener. See Figure 6A.18.

9. While holding the tilt steering bracket shoulder bolts with a 3/4” wrench, remove the lock nuts using a 9/16” wrench. See Figure 6A.19.

NOTE: The threaded section of the shoulder bolts are a “D” shaft. Applying torque to the bolts will cause them to round over the “D” section, making it very difficult to get the bolt out.

NOTE: On early production units, a large nut was used as a spacer on the right shoulder bolt. See Figure 6A.19.

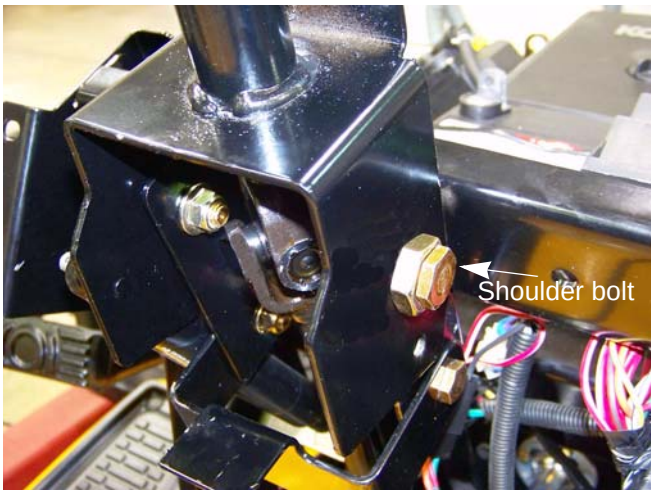


Figure 6A.19

NOTE: On current production models; there is an adjuster plate attached to the tilt steering bracket with a screw on each side of the bracket. See Figure 6A.20.

NOTE: The adjuster plates can remain attached to the tilt steering bracket.

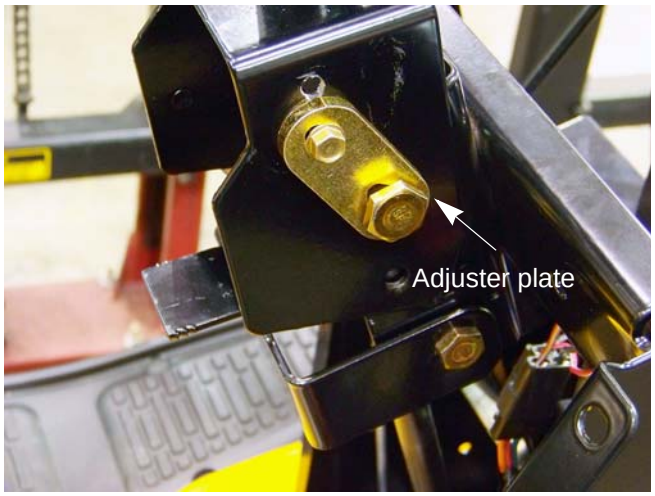


Figure 6A.20

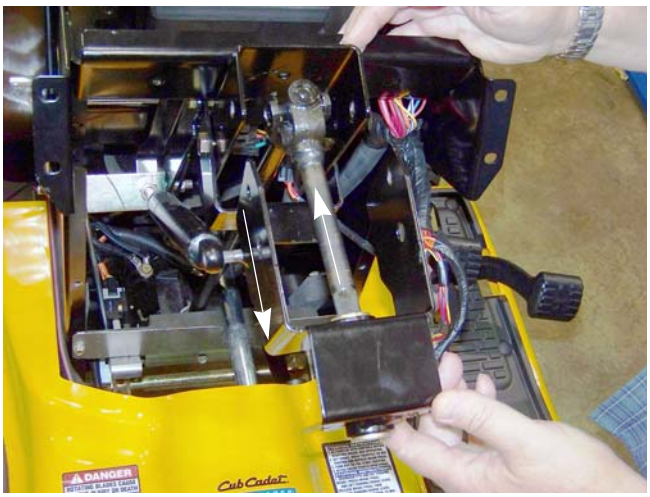


Figure 6A.21

10. Slide the tilt bracket up and towards the rear of the tractor enough that it clears the dash support tower.
11. Slide the tilt dampener off of the pin on the tilt bracket.
12. Lift the tilt bracket and steering shaft off of the tractor.

NOTE: On tractors with power steering, it will probably be necessary to pry the steering shaft coupler off of the EPS assembly.

⚠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.

Manual steering

13. Lift the steering shaft out of the tractor.

Power steering

13. Slide the steering shaft out of the tilt steering bracket.
14. Install the steering shaft by following the above steps in reverse order.

    NOTE: Tighten the shoulder bolt nuts to a torque of 240 - 350 (27 - 40 Nm)

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

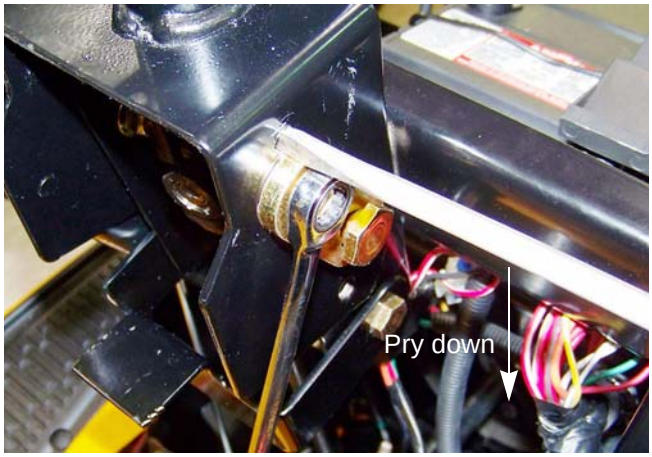


Figure 6A.22

NOTE: If the tilt steering is sloppy:

- Loosen the screw that holds the adjuster plate to the tilt steering bracket using a 3/8” wrench.
- Insert a flat headed screw driver into the hole above the adjuster plate. See Figure 6A.22.
- Pry down on the adjuster plate, driving it into the shoulder bolt, while tightening the screw that hold the plate in place.

Pivot bar

1. Remove the deck and PTO belt by following the procedures described in Chapter 8: Decks and Lift Systems.
2. Lift and safely support the front of the tractor.
3. Remove the axles by following the procedures described in the axle section of this chapter.
4. Slide the front deck link forward, out of the way. See Figure 6A.23.

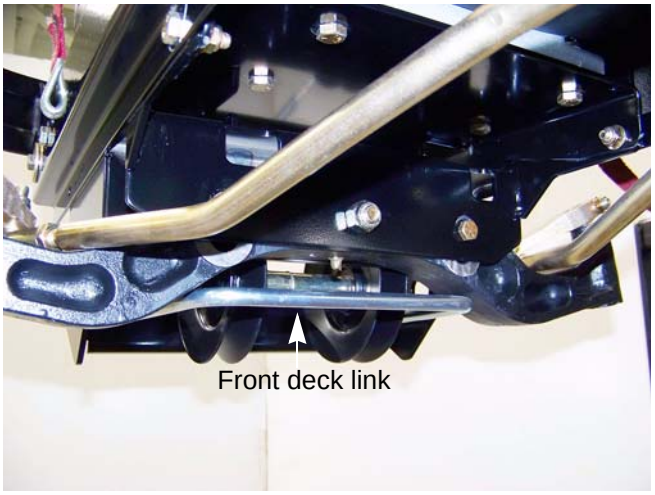


Figure 6A.23

5. Support the pivot bar.
6. Remove the two travel stop bolts using a pair of 9/16” wrenches. See Figure 6A.24.
7. Remove the pivot bar pivot bolt using two 3/4” wrenches.
8. Slide the pivot bar out of the frame.
9. Install the pivot bar by following the previous steps in reverse order.

   NOTE: Apply high quality grease to the frame and the pivot bar.
10. Inject a high quality lithium base grease into all of the grease fittings on the pivot bar.
11. Perform a wheel alignment by following the steps described in the steering alignment section of this chapter.
12. Test run the tractor in a safe area before returning it to service.

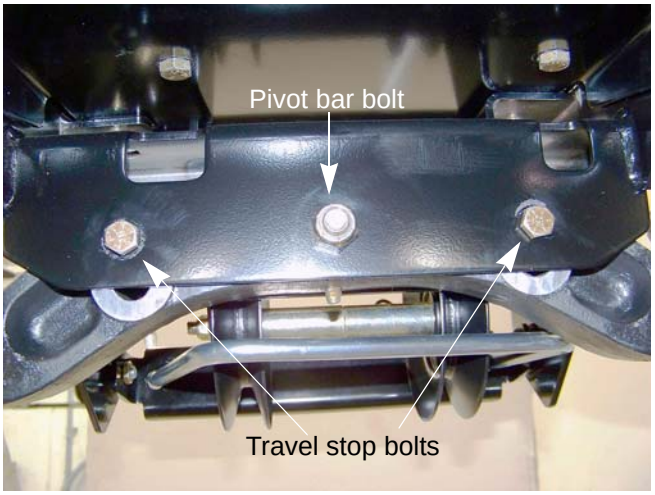


Figure 6A.24

Steering housing

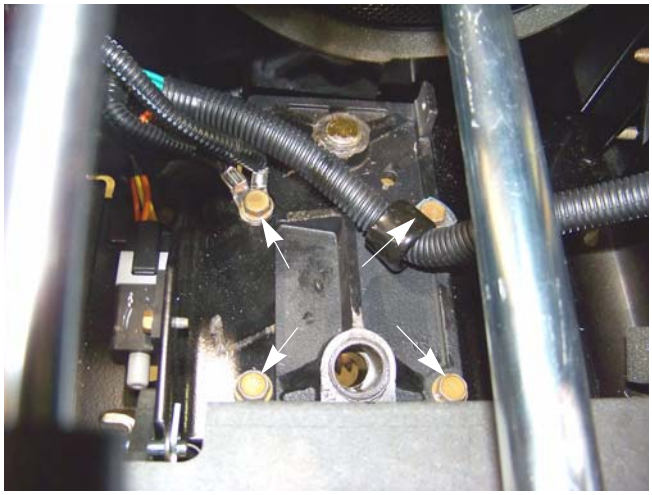


Figure 6A.25

To remove/replace the steering housing:

1. Remove the deck by following the procedures described in Chapter 8: Decks and Lift Systems.
2. Remove the dash by following the procedures described in Chapter 4: Body.
3. Remove the steering gears by following the procedures described in the steering gears section of this chapter.
4. Remove the steering shaft by following the procedures described in the steering shaft section of this section.

NOTE: On tractors equipped with power steering, remove the EPS assembly by following the procedures described in Chapter 6B: Electronic Power Steering.

5. Remove the four screws that hold the steering housing to the frame using a 1/2” wrench. See Figure 6A.25.

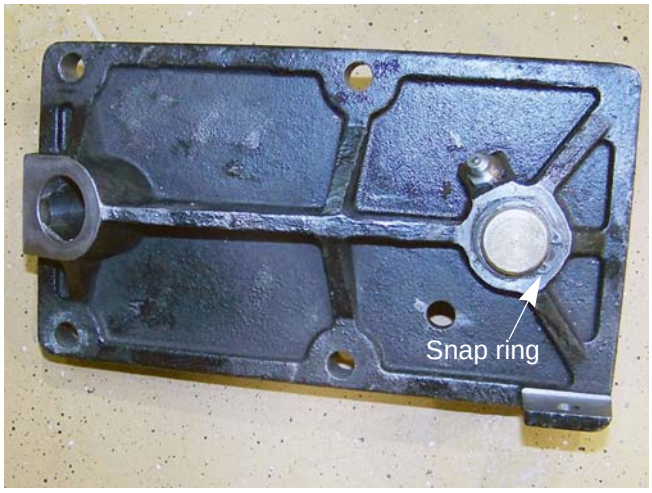


Figure 6A.26

6. Slide the parking brake latch bracket and the harness to the side while lifting the steering housing out of the tractor.
7. Remove the snap ring that holds the pivot shaft in the steering housing. See Figure 6A.26.
8. Slide the steering housing pivot shaft out of the steering housing.
9. Install the steering housing by following the previous steps in reverse order.

NOTE: Coat the steering housing pivot shaft with an anti-seize compound before inserting it into the steering housing.

NOTE: Make sure the ground strap connection to the steering housing is clean and electrically sound.

10. Inject a high quality lithium base grease into all of the grease fittings on the steering housing.
11. Perform a wheel alignment by following the steps described in the steering alignment section of this chapter.
12. Test run the tractor in a safe area before returning it to service.

Greasing the steering housing

The steering housing should be greased every 25 hours. To grease the steering housing:

1. Lift and safely support the front of the tractor.
2. Inject grease into the grease fitting at the steering pinion gear until grease starts to ooze out. See Figure 6A.27.
3. Lower the tractor to the ground.

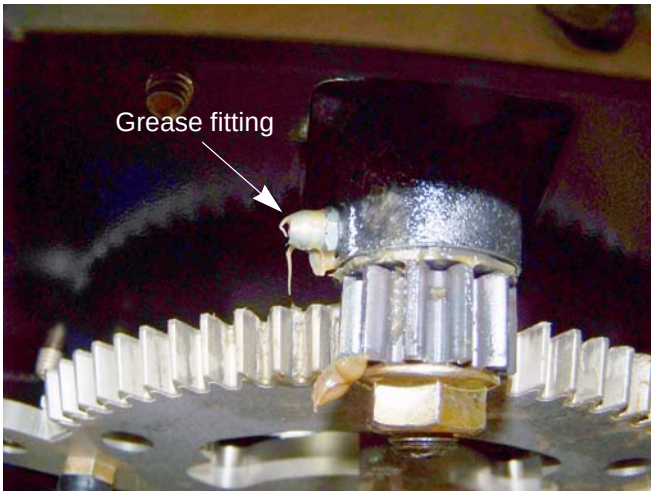


Figure 6A.27

4. Open the hood.
5. Inject grease into the grease fitting at the steering housing pivot shaft until it starts to ooze out. See Figure 6A.28.

   NOTE: An 18” flexible extension hose for the grease gun will make it easier to reach the grease fitting.

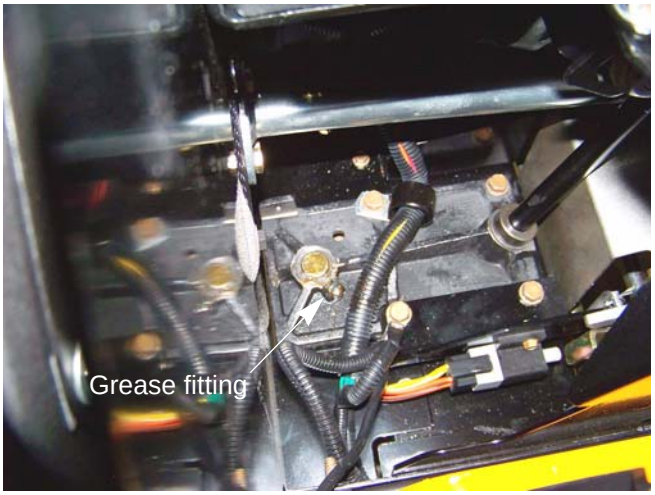


Figure 6A.28

CHAPTER 6B: ELECTRONIC POWER STEERING

NOTE: The basic steering system, such as the tie rod ends, drag links axles, etc., are covered in Chapter 6A: Steering.

In 2011, Cub Cadet introduced the Electronic Power Steering (EPS) system on the Cub GTX2154LE (50th anniversary edition) tractor. 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 the steering housing. The EPS system is treated as one part.

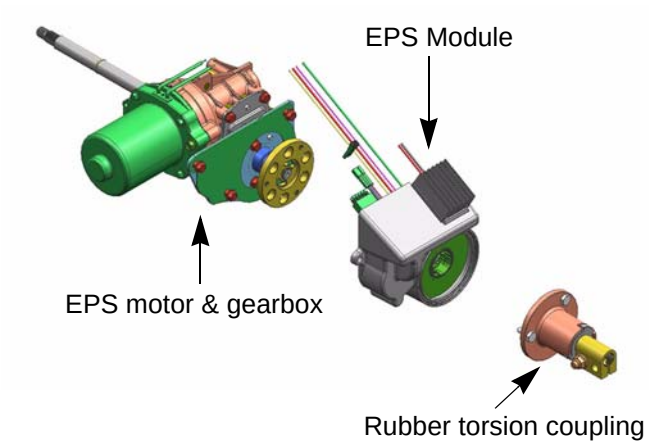


Figure 6B.1

⚠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 there is a failure of the EPS system.

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.

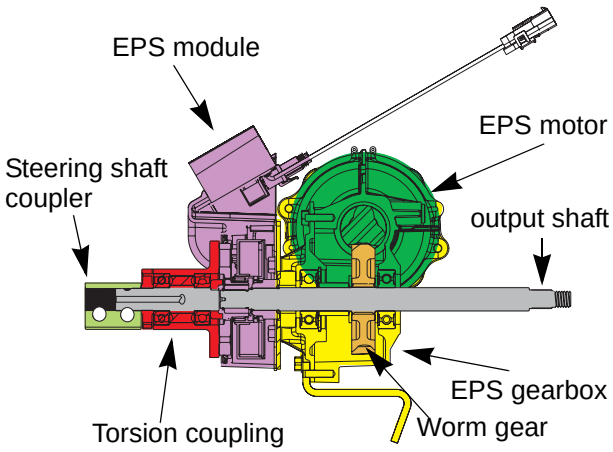


Figure 6B.2

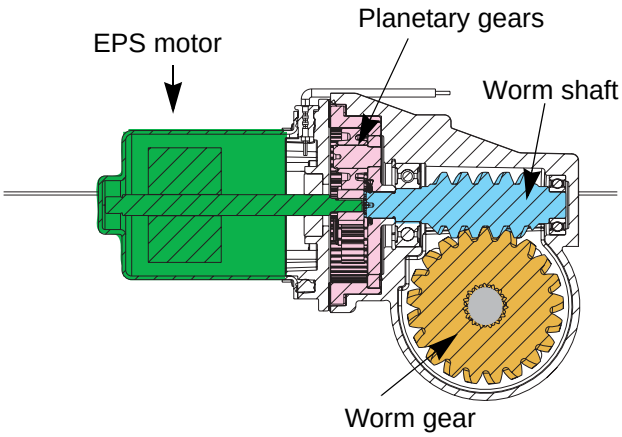


Figure 6B.3

Troubleshooting the EPS

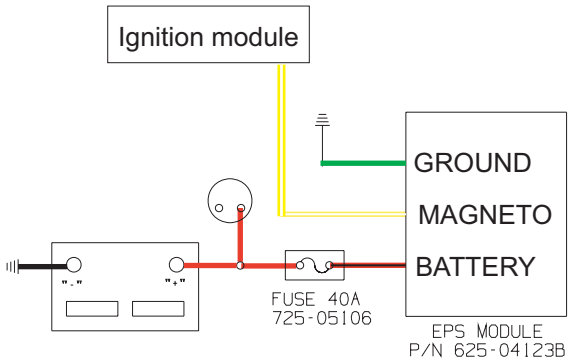


Figure 6B.4

The first step in troubleshooting the EPS system is to understand how it works. See Figure 6B.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.
- 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.

When troubleshooting the EPS system, The technician needs to 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.

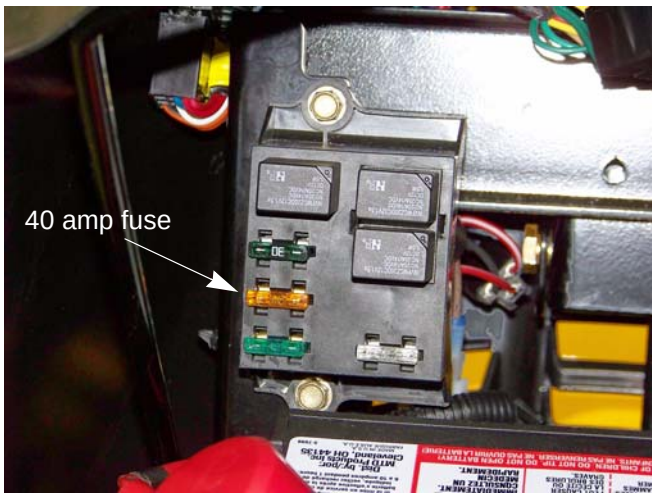


Figure 6B.5

To troubleshoot the EPS assembly:

1. Place the tractor on flat, level ground.
2. Remove any attachments that may be on the tractor.
3. Set the parking brake.
4. Turn the steering wheel so that the wheels are pointing straight forward.
5. With the ignition key in the off position, open the hood.
6. Check the 40 amp fuse in the fuse box. See Figure 6B.5.

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

7. Locate, but do not disconnect the EPS harness connector behind the battery. See Figure 6B.6.

8. Check for battery voltage at the red wire:

   8a. Set the Digital Multi Meter (DMM) to the DC volts scale.

   8b. Measure the battery voltage across the battery terminals

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

   8c. Connect the black (-) lead of the DMM to the negative post of the battery.

   8d. Back probe EPS harness connector at the red wire with a black trace, with the red (+) lead of the DMM.

   NOTE: The DMM should read battery voltage.

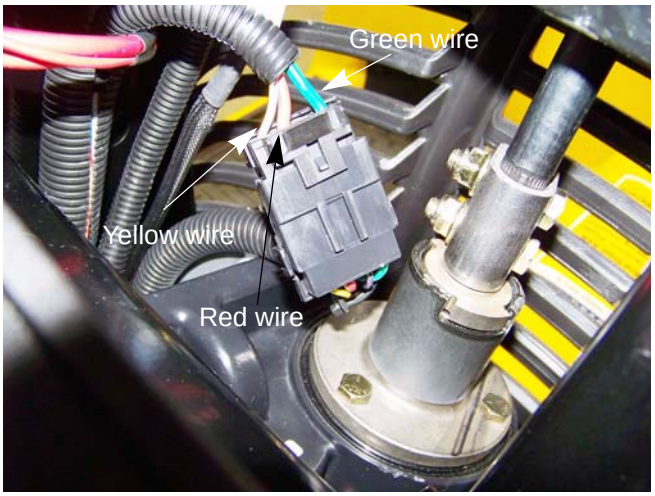


Figure 6B.6

9. Check the ground to the EPS: See Figure 6B.7.

   9a. Set the DMM to the DC volts scale.

   9b. Connect the red (+) lead to the positive post of the battery.

   9c. Back probe EPS harness connector at the green 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.

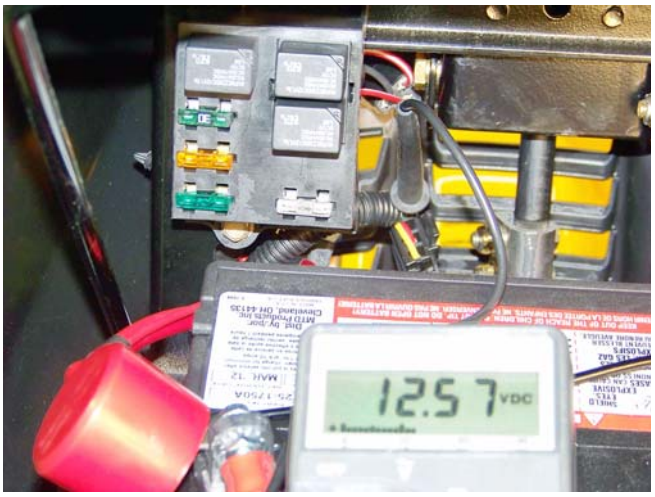


Figure 6B.7

   9d. Place an amp clamp meter on the red wire with a black trace. See Figure 6B.8.

   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.

   9e. 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.

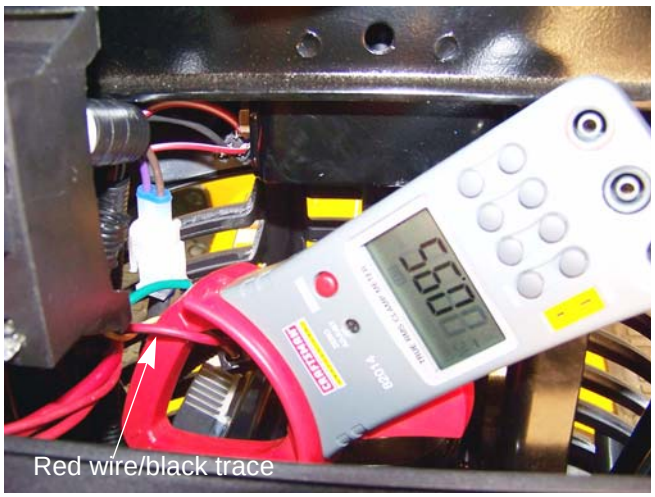


Figure 6B.8

9f. 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 does not rise above 10 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 10 amps, the problem is inside the EPS assembly and it must be replaced.

9g. Turn off the tractor.

10. Check the input from the ignition module.

Figure 6B.9

10a. Connect the ground lead of an oscilloscope to a good ground on the engine block.

10b. Back probe EPS harness connector at the yellow wire with a white trace using the positive (+) lead of the oscilloscope.

10c. Start the engine.

11. 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 6B.9.

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

13. 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.

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

14. Remove the steering pinion gear by following the procedures described in Chapter 6A: Steering.

15. Re-check the steering.

NOTE: If the steering now works, the problem lies between the sector gear and the front wheels. A frozen axle is a likely suspect.

16. Remove the EPS assembly.

NOTE: When removing the EPS from the steering housing, it should slide out easily. If it does not, repair the steering housing before condemning the EPS.

17. Check the steering shaft bushings.

NOTE: If the steering shaft is binding in the bushings, replace the bushings before condemning the EPS.

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

EPS motor

To remove/replace the EPS motor and test it:

NOTE: The EPS system comes with 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.
3. Remove the two screws, indicated by the arrows in Figure 6B.10, that secure the motor base to the EPS using a 3/8” wrench.
4. Lift the motor assembly off of the EPS.

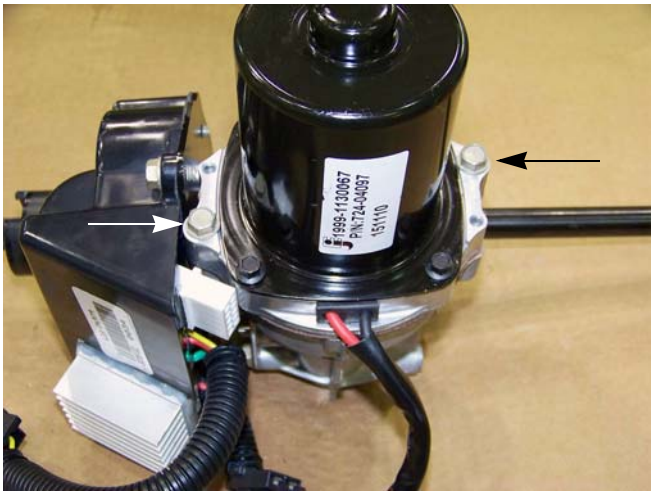


Figure 6B.10

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.

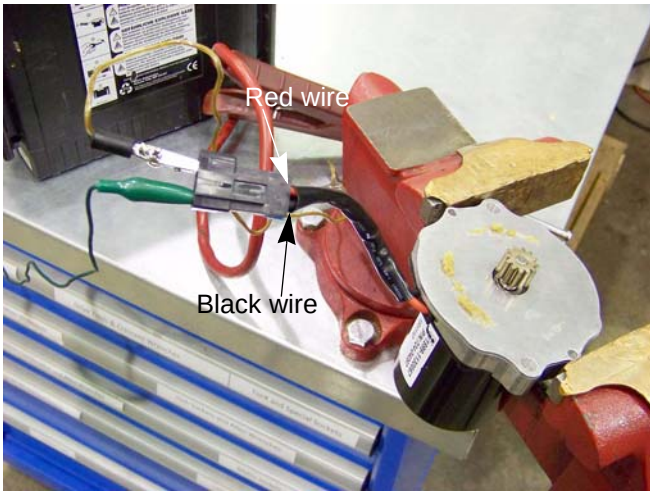


Figure 6B.11

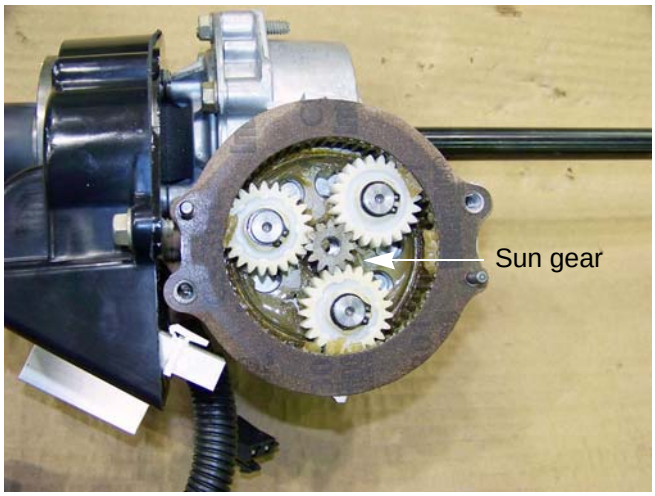


Figure 6B.12

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.

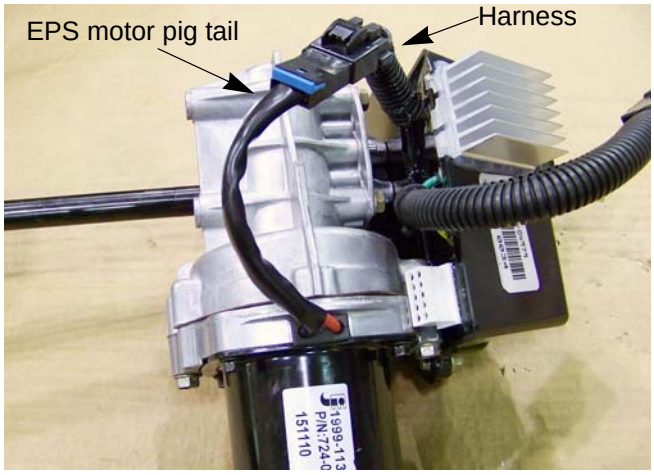


Figure 6B.13

11. Install the EPS motor.

NOTE: While installing the EPS motor, align the motor pig tail 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.
13. Test run the tractor in a safe area before returning it to service.

EPS removal/replacement

1. Open the hood.
2. Remove the battery: See Figure 6B.14.
   - 2a. Disconnect the negative battery lead.
   - 2b. Disconnect the positive battery lead.
   - 2c. Remove the screw that secures the battery hold down to the battery tray using a 3/8” wrench.
   - 2d. Swing the battery hold down out of the way.
   - 2e. Remove the battery from the tractor.

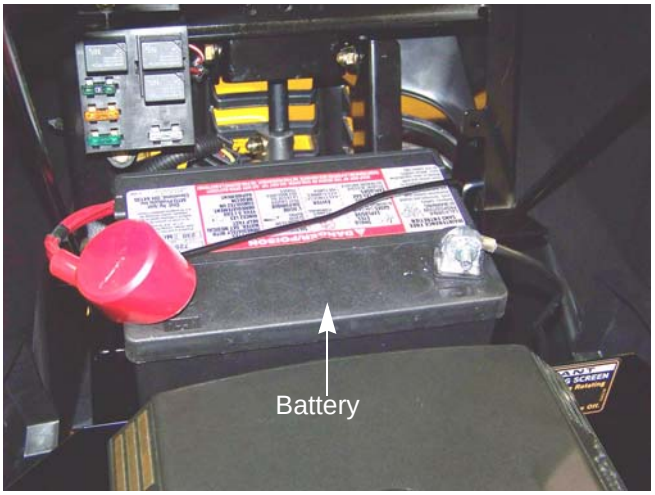


Figure 6B.14

3. Remove the dash by following the procedures described in Chapter 4: Body.
4. Thread the screw from the steering wheel into the steering shaft with a fender washer. See Figure 6B.15.

   NOTE: The screw and fender washer will keep the steering shaft from falling out while lifting the dash support off of the tractor.

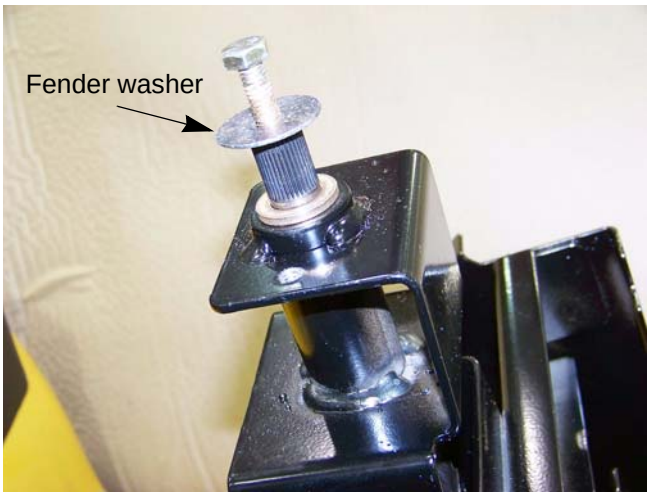


Figure 6B.15

5. Remove the three screws, indicated by the arrows in Figure 6B.16, that secure the lower baffle to the frame and dash support using a 3/8” wrench.

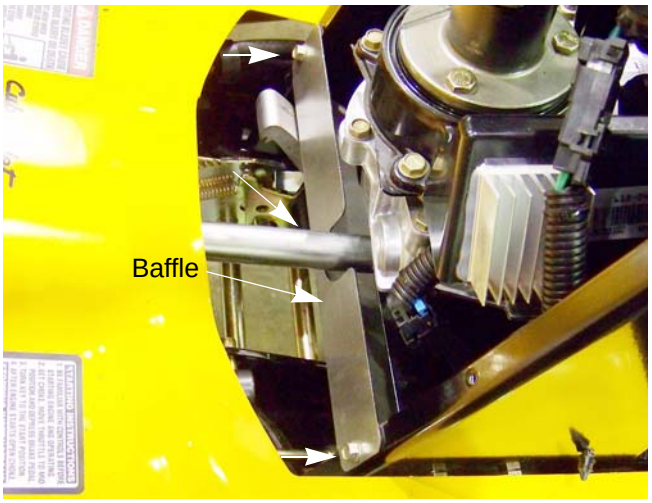


Figure 6B.16

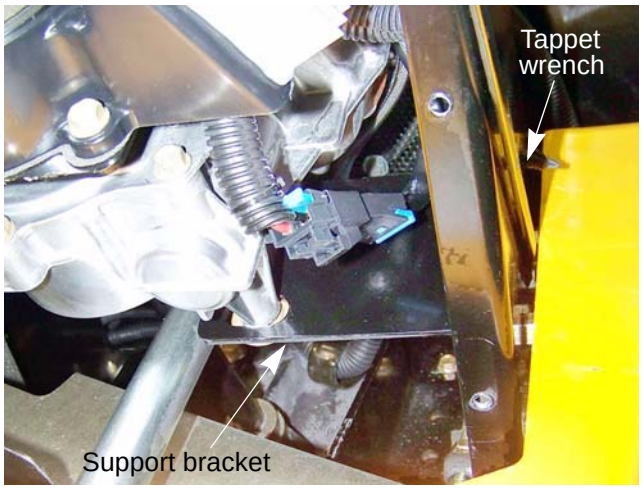


Figure 6B.17

6. Remove the EPS support bracket:

   6a. Remove the two screws and washers that hold the support bracket to the EPS using a 1/2” wrench

   6b. Remove the two nuts and bolts that secure the bracket to the dash support using a pair of 1/2” wrenches.

NOTE: A thin wrench, such as a tappet wrench can be slid between the fender and the dash support to hold the bolt heads. See Figure 6B.17.

7. Slide the support bracket out of the tractor.

Figure 6B.18

8. Remove the two screws that hold the fuse box to the dash support using a 3/8” wrench. See Figure 6B.18.

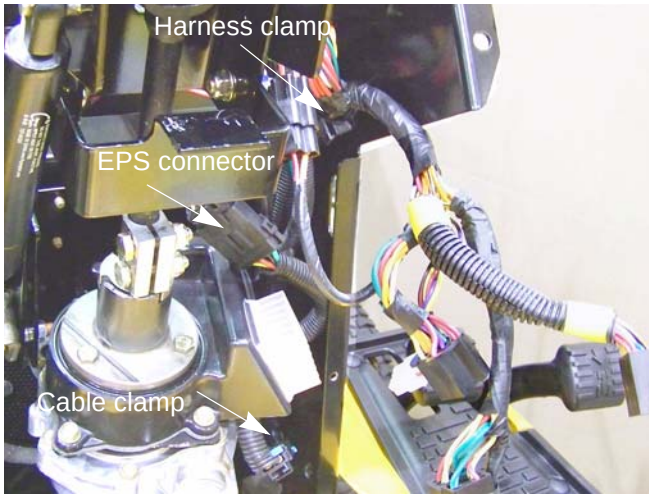


Figure 6B.19

9. Open the two harness clamps that hold the main harness to the dash support. See Figure 6B.19.
10. Unplug the EPS harness connector.
11. Unweave the harness from the dash support and let it lay on the fender, pointing towards the seat.

12. Remove the cotter pin that secures the cruise control rod to the latch. See Figure 6B.20.

    NOTE: There is a spring attached to the cruise rod that will come off when the cotter pin is removed.

13. Remove the cruise control rod.

Figure 6B.20

14. Remove the screws, two on each side of the tractor, that hold the dash support to the frame rails using a 1/2” wrench. See Figure 6B.21.

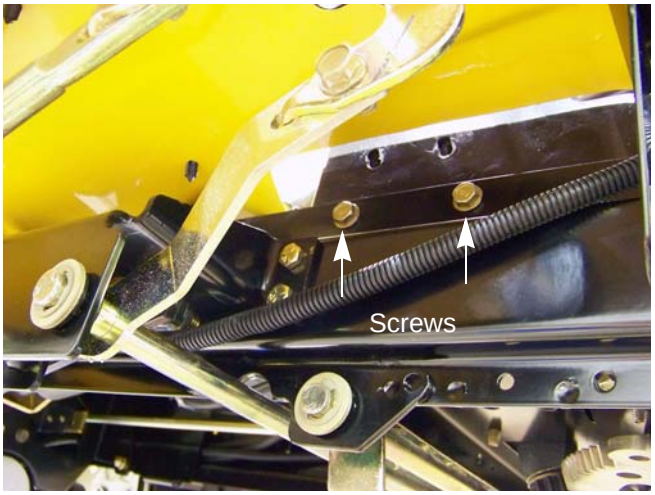


Figure 6B.21

15. Remove the four screws, indicated by the arrows in Figure 6B.22, that hold the dash support to the steering sub-frame using a 1/2” wrench.

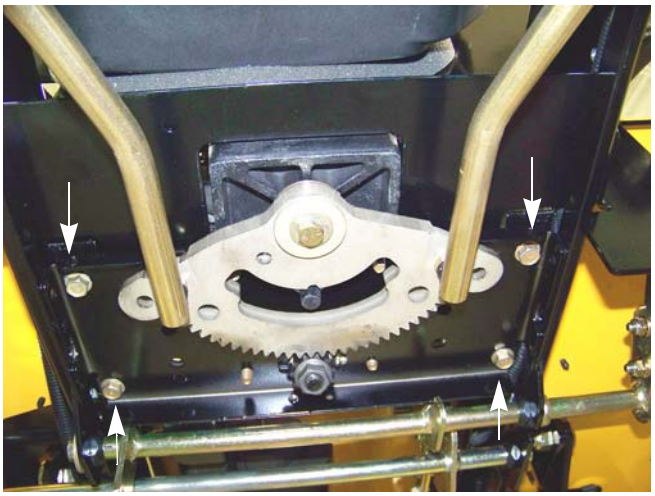


Figure 6B.22

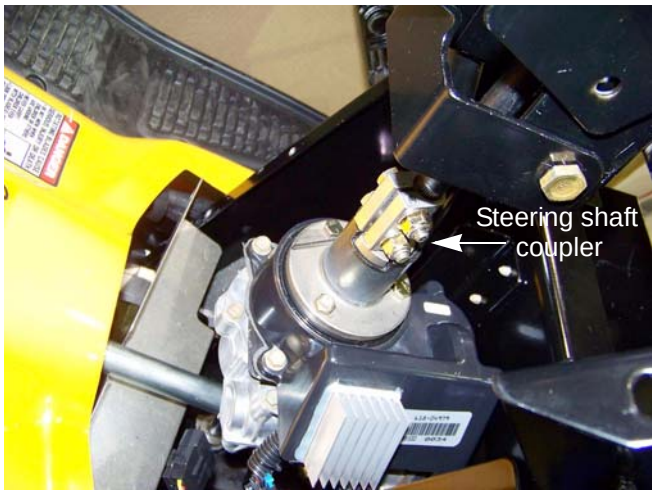


Figure 6B.23

16. Loosen the top nut and bolt of the steering shaft coupler using a pair of 1/2” wrenches.
17. Remove the lower nut and bolt from the steering shaft coupler. See Figure 6B.23.

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

18. Lift the dash support off of the tractor, taking the steering shaft with it.

NOTE: It will probably be necessary to pry the steering shaft coupler off of the EPS.

⚠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.

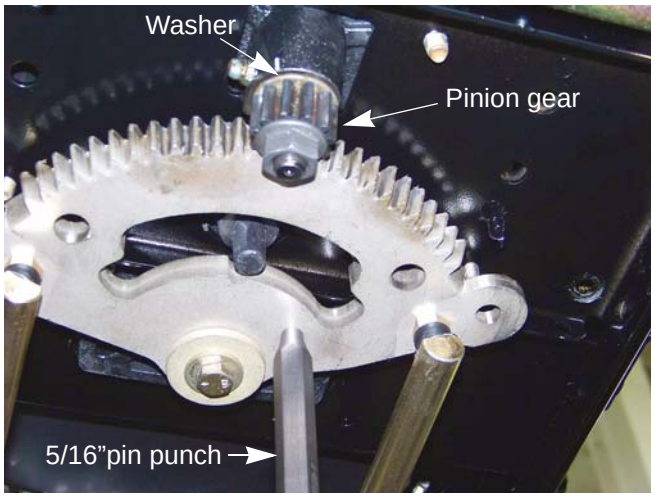


Figure 6B.24

19. Lock the steering by inserting a 5/16” pin punch into the alignment hole of the steering sector gear and the steering housing. See Figure 6B.24.
20. Remove the nut that secures the pinion gear to the EPS output shaft using an 11/16” wrench.
21. Remove the pinion gear.

NOTE: There is a flat washer between the pinion gear and the steering housing. This washer will be trapped between the sector gear and the EPS output shaft. Once the EPS is lifted out of the tractor, the washer will fall to the ground.

NOTE: Lift the EPS out of the tractor.

NOTE: The EPS output shaft will pass through a spacer, washer and the steering housing. See Figure 6B.25.

NOTE: 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.

22. Test drive the tractor in a safe area before returning it to service.

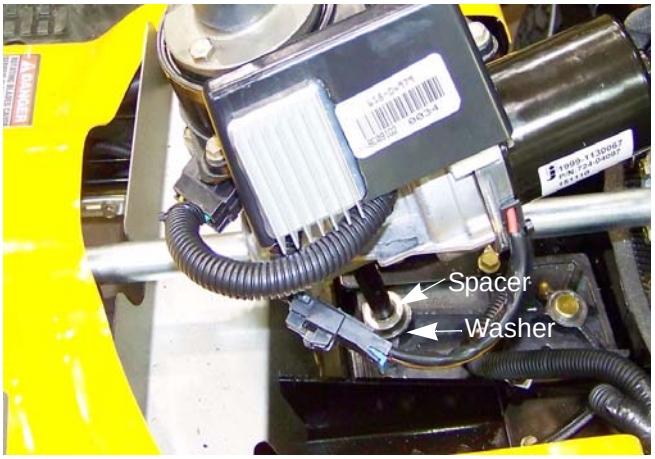


Figure 6B.25

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

The 2000 series tractors have the same Cub Cadet Rev-Tek system used on the 1000 series tractors.

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 multi-meter (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 from stores like NAPA for under $30.00. Appropriate multi meters 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 in-puts to and out-puts 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 1980s.

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.

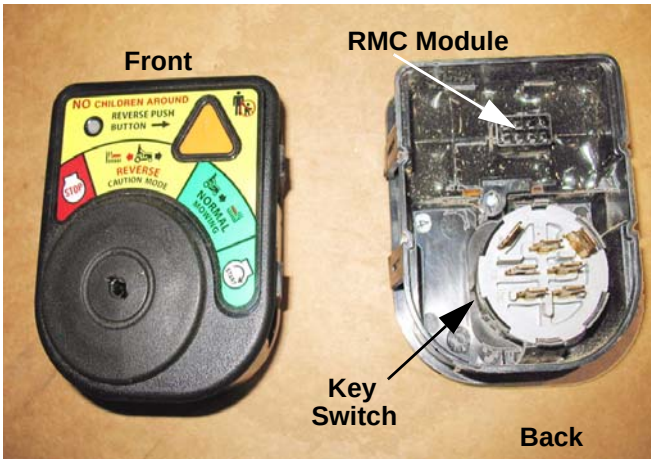


Figure 7.1

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 in 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 by-passing 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.

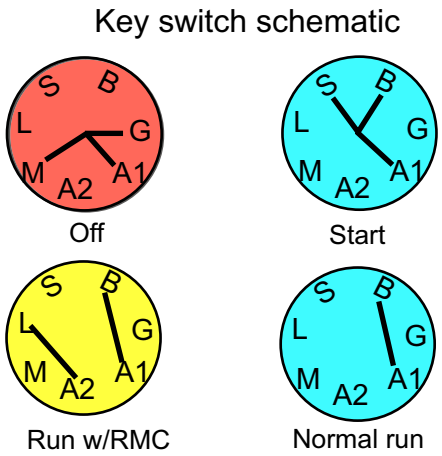


Figure 7.2

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. 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 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 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 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 over-lapping variables. See Figure 7.3.

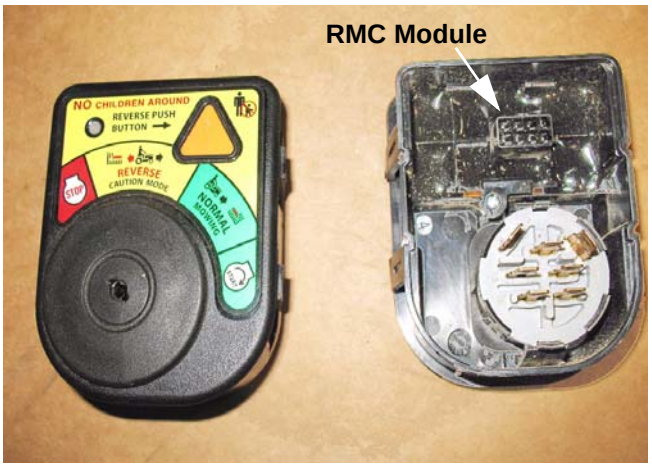


Figure 7.3

- **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 electric PTO is ON, the PTO clutch will turn off.
  - If the operator leaves the seat with the PTO on, the PTO will turn off.
  - 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 re-armed, 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.

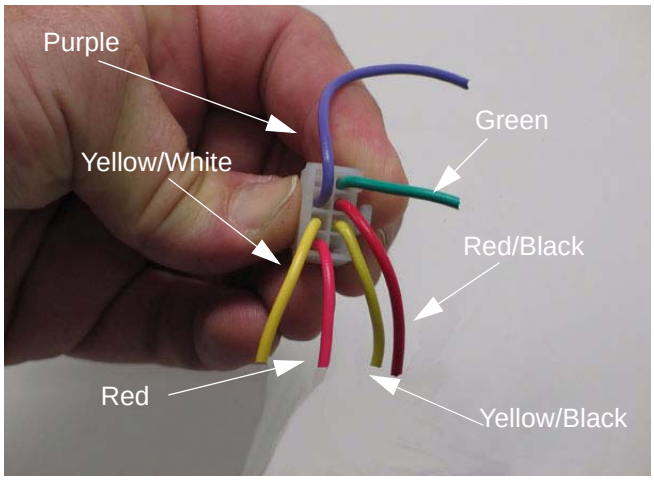


Figure 7.5

Figure 7.5

To identify a faulty RMC module:

If the RMC module does not function as described, the RMC plug test should be the first step in diagnosis.

- If the RMC plug test confirms that the safety circuits (inputs) work as designed, yet the RMC module does not work properly, the RMC module is faulty.
- The RMC plug test will give an indication of what the problem is if it is not a faulty RMC module. If the problem is identified in a particular circuit, check the safety switch that is associated with that circuit. If the switch is good, then the problem lies within the wiring harness.

NOTE: Like the electronic components found on most cars, the RMC module requires a fully charged battery to work properly. If the system voltage falls below 12 V, an accurate diagnosis of the RMC module is impossible because the module will be temporarily disabled by low voltage.

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 7.5.
3. Check the PTO and seat safety circuits with the 8-pin pigtail connector unplugged, then reconnect it and continue with the RMC plug test.

Yellow wire with black trace

- **Behavior:** When the female pin terminal leading into the main harness is probed (yellow wire with black trace), it should show DC power with the key on and the PTO switch off.
- **Circuitry:** The yellow wire with a black trace is the ground side of the PTO relay coil. It splits with one lead going to the PTO switch and the other going to the RMC module.
- If there is continuity to ground when the PTO is OFF, 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 PTO switch is ON, the PTO switch may be inoperative, or there may be an open condition in the wire that leads to it.
- **Interpretation:** If behavior is correct, the N.C. side of the PTO switch /circuit is functioning properly

Yellow wire

- **Behavior:** When the female pin terminal leading into the main harness is probed (yellow wire), there should be continuity to ground *only* when the seat is empty.
- **Circuitry:** The yellow wire with white trace 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.

Red wire with black trace

- **Behavior:** 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. When the mower is in reverse, this terminal should have continuity to ground.
- **Circuitry:** This wire runs directly to the reverse safety switch. This is a simple metal tang switch that grounds-out against the hydro control rod.
- **Interpretation:** Continuity to ground when the mower is not in reverse would indicate a short to ground. This could take the form of a chafed wire contacting ground, a bent reverse safety switch that is always in contact with another metal part, or a broken plastic insulator that separates the switch from the drive pedal shaft.

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

Green wire

- **Behavior:** At the opposite end of the top row from the yellow wire with black trace is a green wire. 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 mower: slow starter motor, slow battery charge, dim lights. All ground connections should be mechanically secure and corrosion free.

Red wire

- **Behavior:** The red wire on the OCR plug carries battery voltage. It should show D.C. battery voltage when the key switch is in any of the run positions.
- **Circuitry:** This wire draws power directly from the A1 terminal on the key switch.
- **Interpretation:** If there is no battery voltage at this terminal, the mower is probably not functioning at all. Look for a blown fuse, disconnected battery or some other major fault.

Purple wire

- **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.

4. 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.

PTO Switch

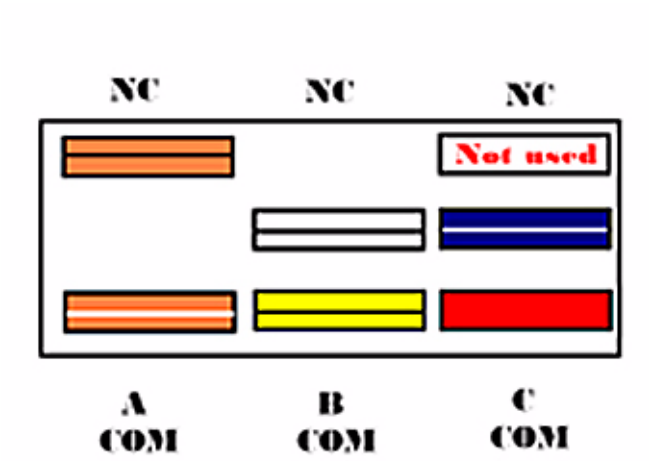


Figure 7.6

Understanding the PTO switch

1. A-COM is in the starter inhibit circuit. It is a normally closed (NC) set of contacts. Power coming from the brake switch (key switch in START, brakes ON) flows through the orange wire with black trace to the PTO switch. When the PTO is OFF, and the contacts are closed, the power continues through the orange wire with white trace to the trigger terminal on the starter solenoid.
2. B-COM is in the PTO relay latch circuit. It is a normally opened (NO) set of contacts. The yellow wire with a black trace is connected to the RMC module and the coil of the PTO relay. When the PTO switch is in the “ON” position, the yellow wire with a black trace is connected to the white wire with a black trace. If the PTO relay is energized, a ground signal will pass through the white wire with a black trace to the yellow wire with a black trace keeping the relay energized.
3. In C-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 (NO) set of contacts.

   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 (NO) contact is used.

Brake Switch

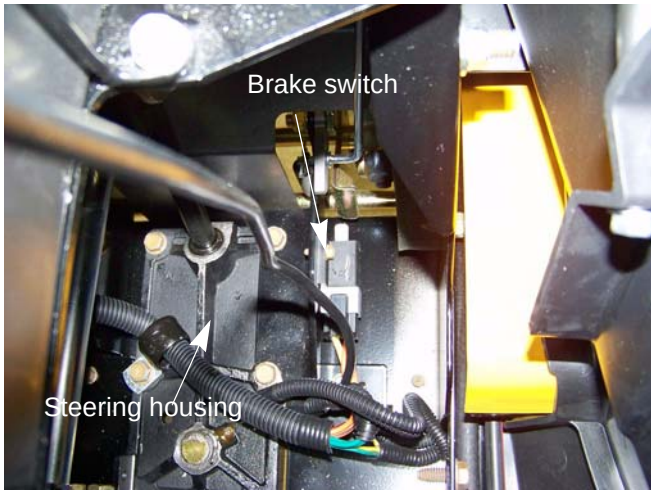


Figure 7.7

The brake switch is mounted on the frame plate, to the left of the steering housing. See Figure 7.7.

- When the brake pedal is depressed, a bell crank on the brake pedal shaft operates the brake switch. The switch contains two sets of contacts.
- A normally open (NO) set of contacts is in the starter inhibit circuit. When the parking brake is set, the contacts are closed, power coming 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. The yellow wire with a white trace carries a ground signal from the seat switch (seat is empty). Setting the parking brake closes the contacts, passing the ground signal through the yellow wire to the magneto primary windings.
- The yellow wire with a white trace leads to one element of the seat switch. If the seat is vacant *and* the pedal is up, the engine will turn off.

Reverse Safety Switch

The Reverse Safety Switch is a simple metal tang switch mounted on a bell crank of the drive pedal shaft. When the reverse pedal is depressed, the bell crank will rotate towards the rear of the tractor, pressing the reverse switch into the hydro control rod. See Figure 7.8.

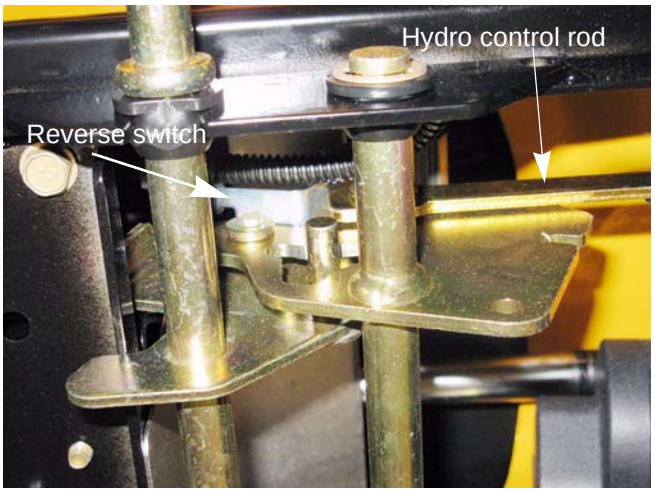


Figure 7.8

Seat Safety Switch

The Seat Safety Switch is mounted inside the seat. It contains two sets of N.O. contacts See Figure 7.9.

- 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, turning off 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, turning off 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.

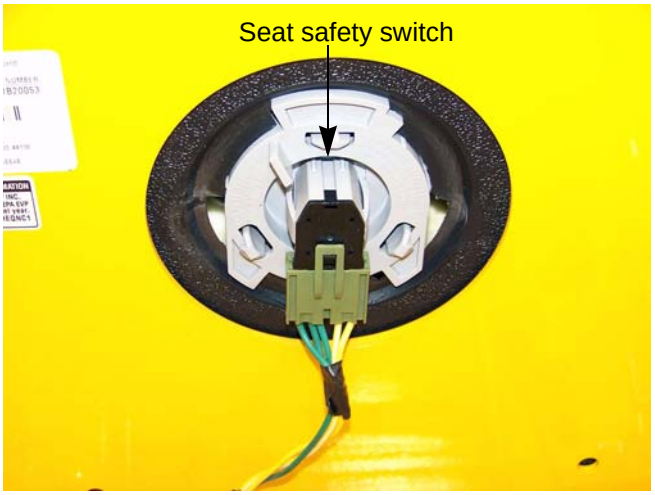


Figure 7.9

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 thinks that the seat is empty.

Seat circuit (GTX2154LE)

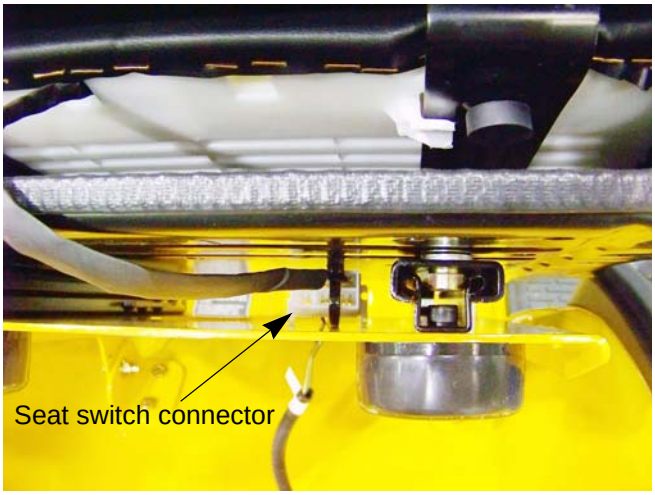


Figure 7.10

Most seat switches that MTD use are NC switches. This means that when the operator leaves the seat, the switch closes, allowing a ground signal to pass through it.

However, the 50th anniversary edition (GTX2154LE) is equipped with a special high back seat. This seat comes equipped with a SPST NO switch. This means that when the seat is empty, the switch is open, blocking the ground signal.

NOTE: The harness to seat switch pig tail connector is attached to the seat bracket. If the connector is allowed to hang free while the seat is moved, the connector can be pulled off of the seat switch pig tail, shorting the circuit. See Figure 7.10.

NOTE: The seat switch for the 50th anniversary edition is part the seat and can not be serviced separately.

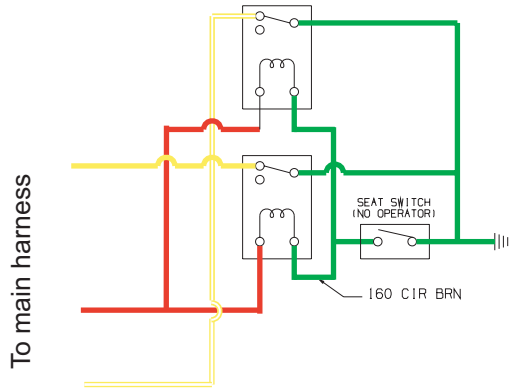


Figure 7.11

To overcome this problem, two relays are used to reverse the function of the switch. The relays also split the ground signal to the RMC module and the safety circuit.

The circuit functions as follows:

- The RMC and the safety circuits receive a ground signal through the NC contacts of the seat switch relays. See Figure 7.11.
- The windings of both relays receive battery power from the A1 terminal of the key switch.
- When the seat is occupied, the windings of both relays are grounded.
- The relays energize, breaking the ground path to the RMC and the safety circuits.

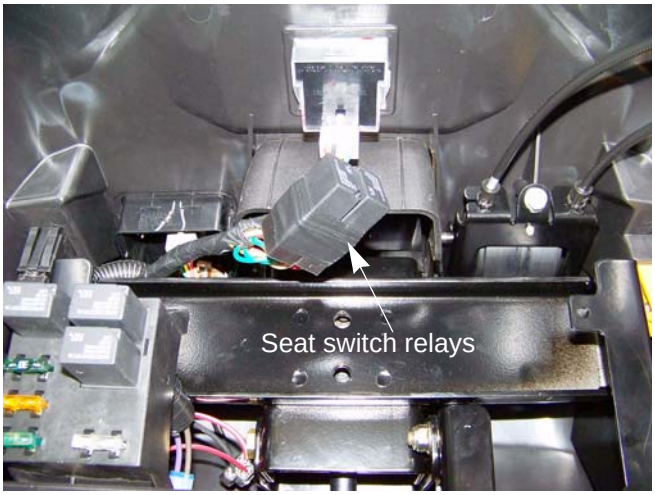


Figure 7.12

NOTE: Both of the relays are taped to the harness by the hour meter. See Figure 7.12.

Starter solenoid

On Kohler Command engines, the starter solenoid is part of the starter. See Figure 7.13.

- When the proper safety conditions are met (brake applied, PTO OFF), the orange wire with white trace carries battery power to the engine harness connector. At which point the battery power is transferred to a blue wire that carries it to the trigger terminal of the solenoid.

Figure 7.13

PTO Relay

The PTO relay is mounted in the fuse box and on tractors with the manual deck lift, it will be the only one. See Figure 7.14.

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.

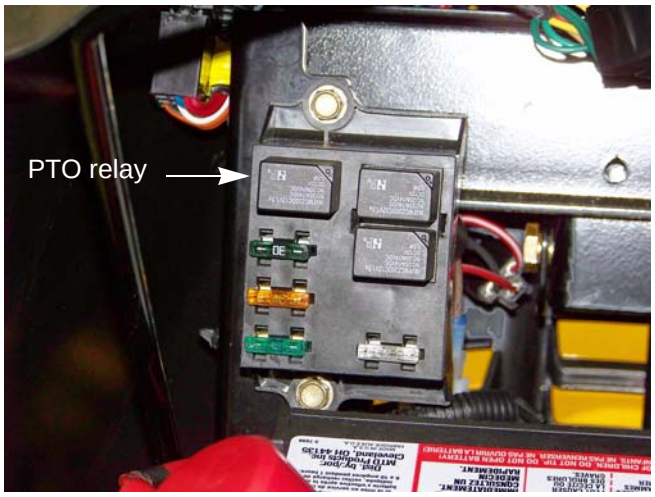


Figure 7.14

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
Provides ground path, energizing the relay: when seat is empty and the PTO is turned ON or when the mower is put in Reverse and the PTO is turned ON, unless the RMC is armed and activated.		

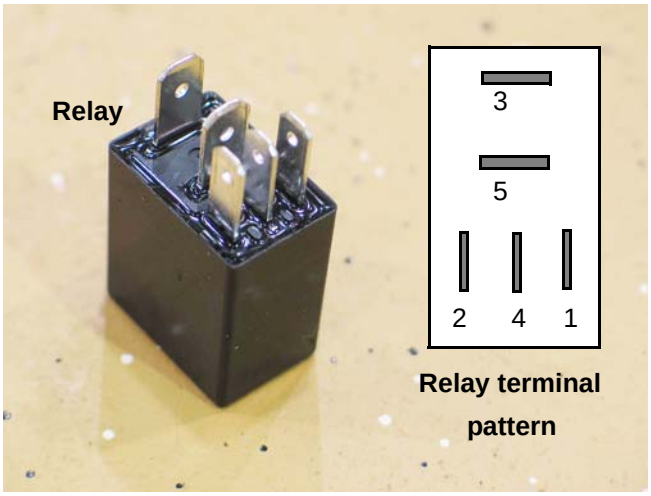


Figure 7.15

Start Circuit

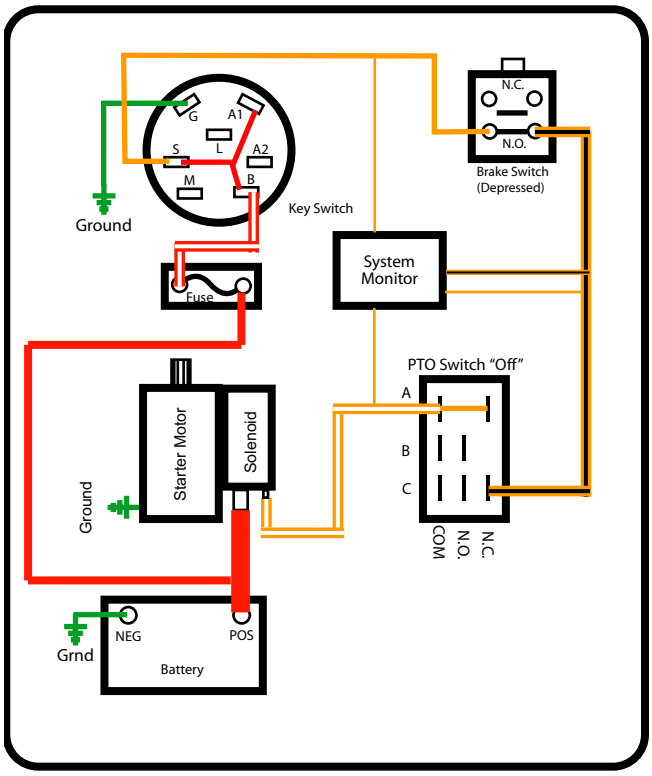


Figure 7.16

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 7.16.

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 park brake is set, power will continue to the A-N.C. terminal 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; first a set of contacts have to close inside the solenoid allowing the power to pass through to the starter motor. The second thing that happens is that 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. Looking at the circuits that do that:

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 7.17.

   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.

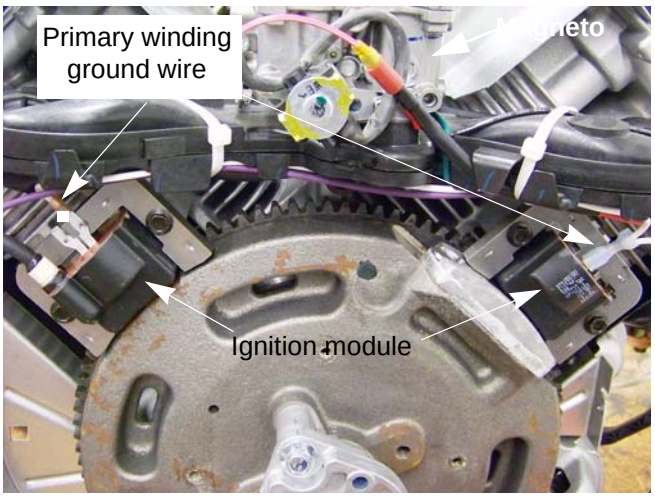


Figure 7.17

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 7.18.

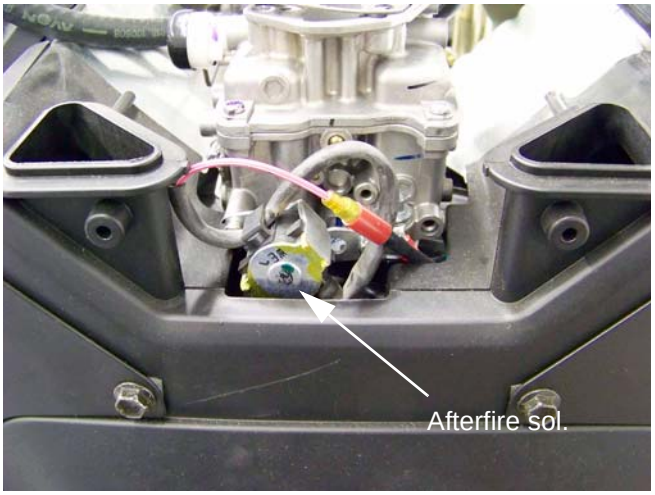


Figure 7.18

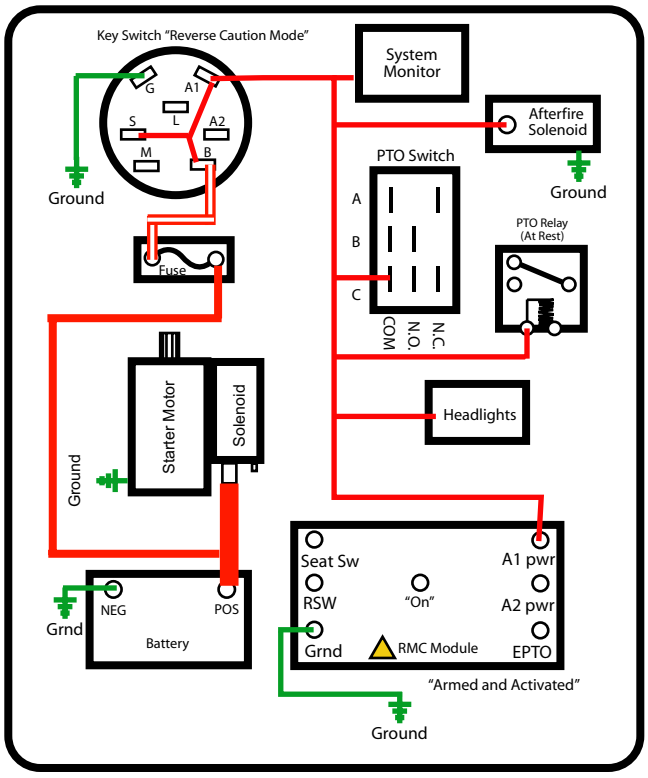


Figure 7.19

3. The A1 terminal on the key switch sends power to:
   - the afterfire solenoid
   - the windings of the PTO relay
   - the PTO switch C-COM terminal
   - the RMC module "A1 pwr" terminal
   - the headlight switch
   - the system monitor

See Figure 7.19.

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
- the PTO switch C-COM terminal
- the RMC module “A1 pwr” terminal
- the headlights
- the system monitor

See Figure 7.20.

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.

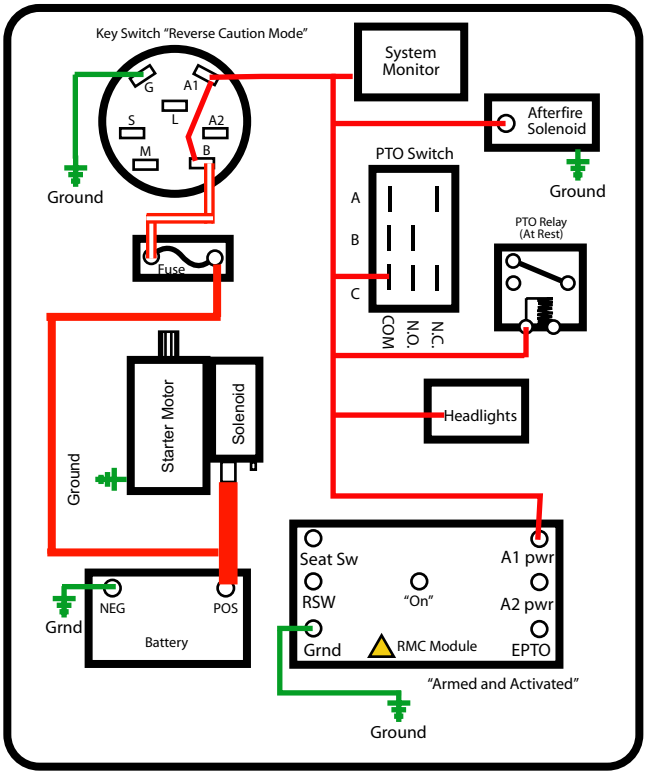


Figure 7.20

Run Circuit / Reverse Caution mode

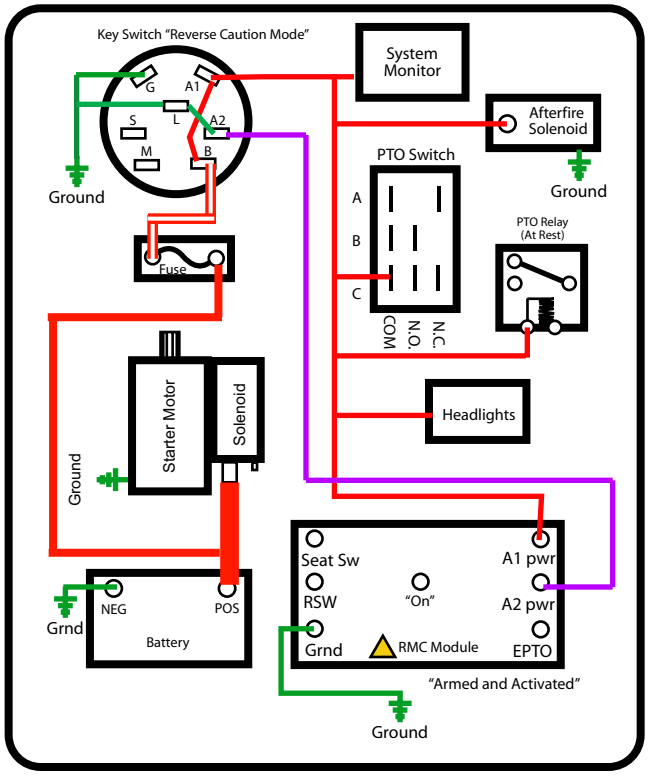


Figure 7.21

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 7.21.

Engine shut-down circuits

Engine shutdown circuits stop the engine by disabling the ignition and removes power from the afterfire solenoid.

Key switch shut-down: See Figure 7.22.

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 system, 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 2000 series tractors powers the solenoid through the A1 terminal of the key switch and not the alternator.

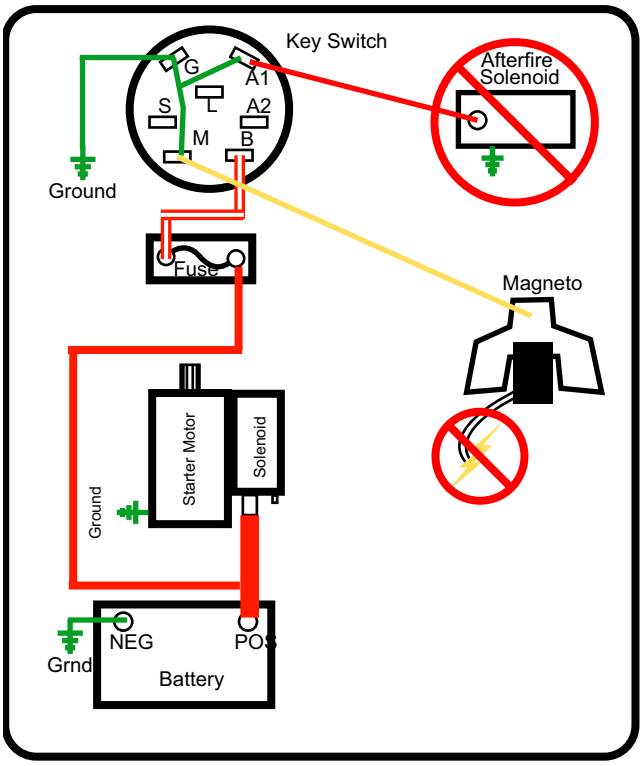


Figure 7.22

Seat switch and brake switch: See Figure 7.23.

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 magneto (yellow 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. (Normally Closed) 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 wire/white trace 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 wire/white trace).
   - 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.

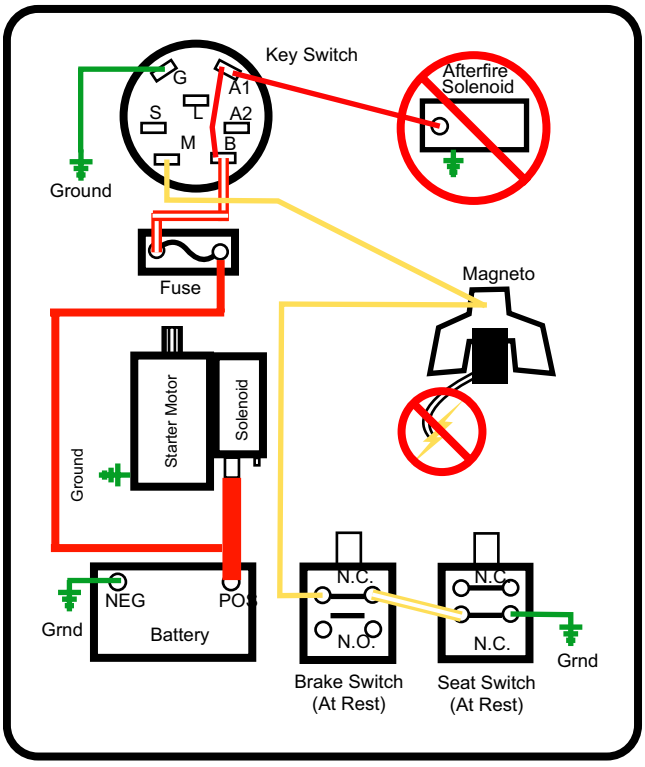


Figure 7.23

Charging circuit

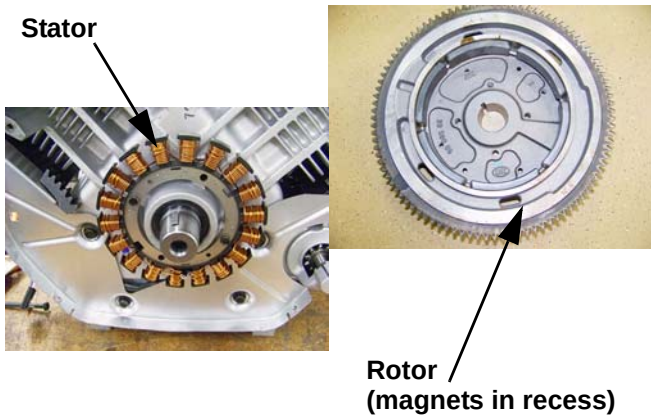


Figure 7.24

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 7.24.
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.

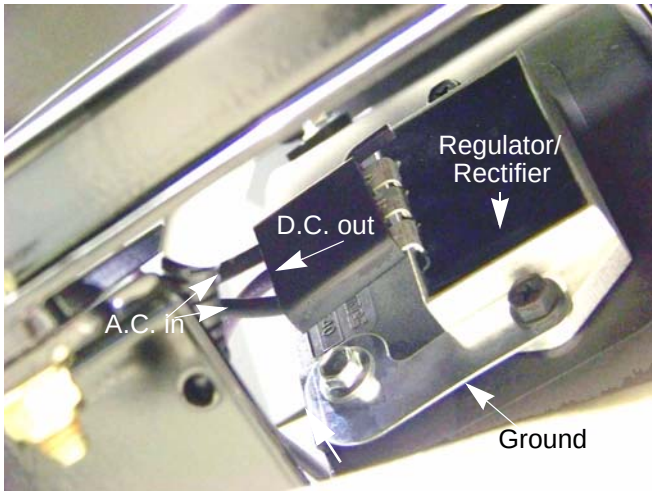


Figure 7.25

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 7.25.
   - 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 7.26.

   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.

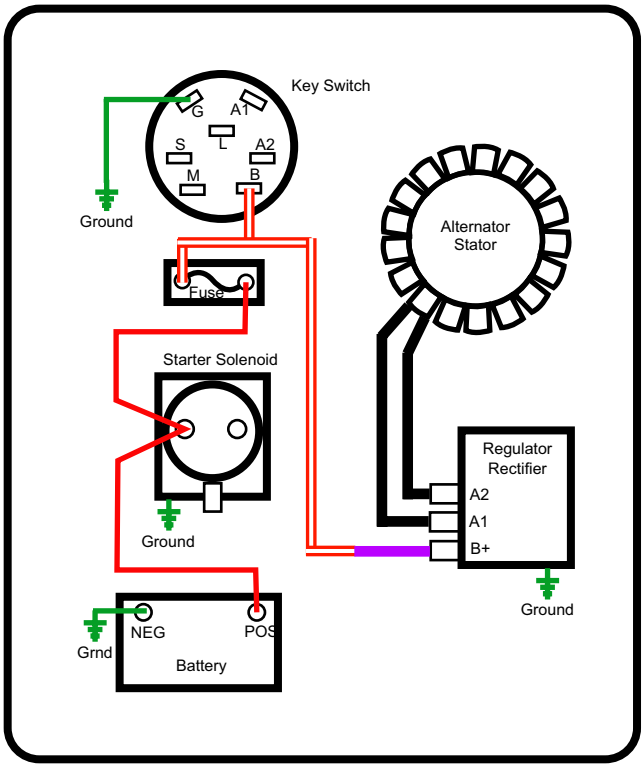


Figure 7.26

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 7.27.

⚠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

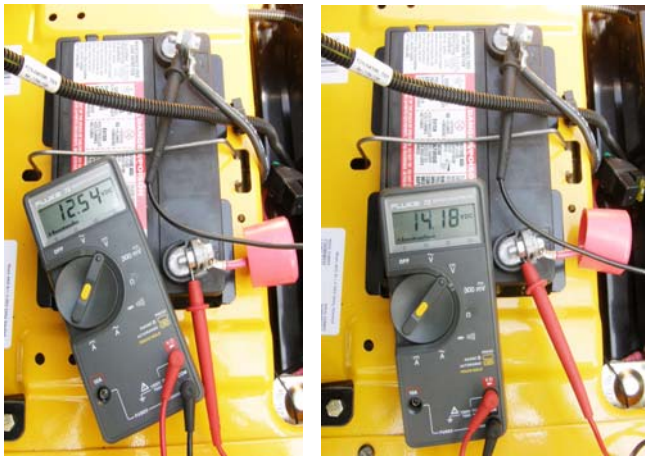


Figure 7.27

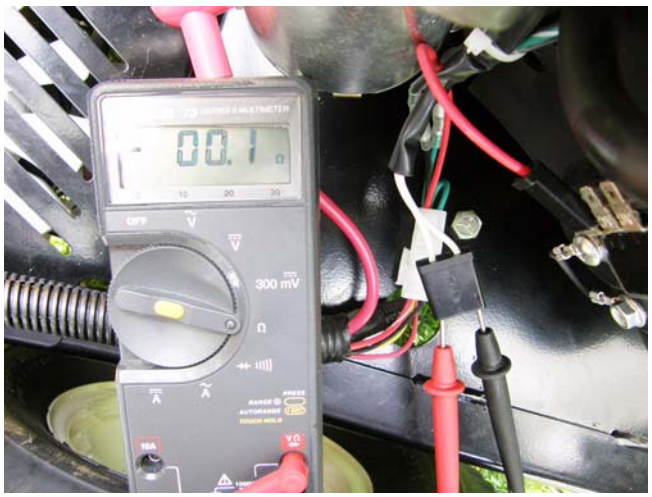


Figure 7.28

Figure 7.29

5. Stator check: See Figure 7.28.

5a. Key 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 7.29.

- 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 7.30.

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 7.30

6b. Bench Test: See Figure 7.31.

- Set a digital multi-meter to read on the X100Ω scale.
- With the key 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+

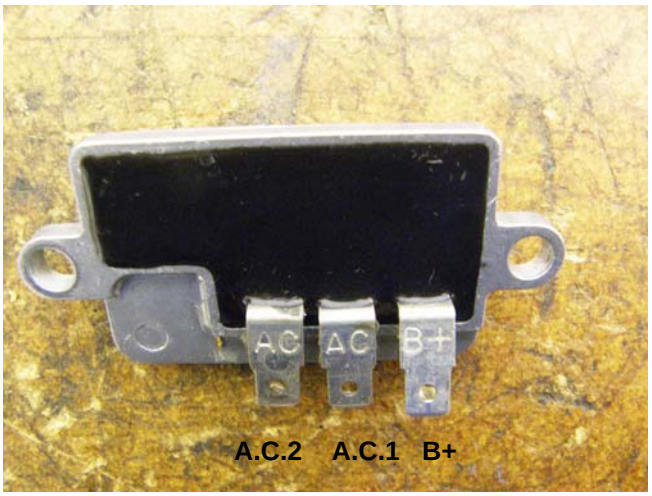


Figure 7.31

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 7.32

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 voltage for a voltage drop. See Figure 7.32.

   - 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

Basic Operation: See Figure 7.33.

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.

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.

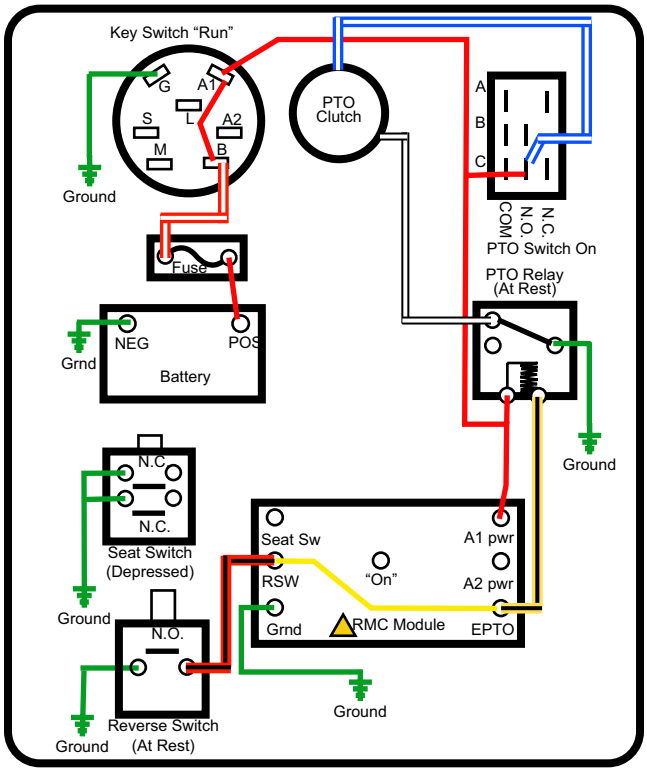


Figure 7.33

1. The PTO clutch loses its ground when the PTO relay is energized. See Figure 7.33.

   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. (Normally Open) 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.

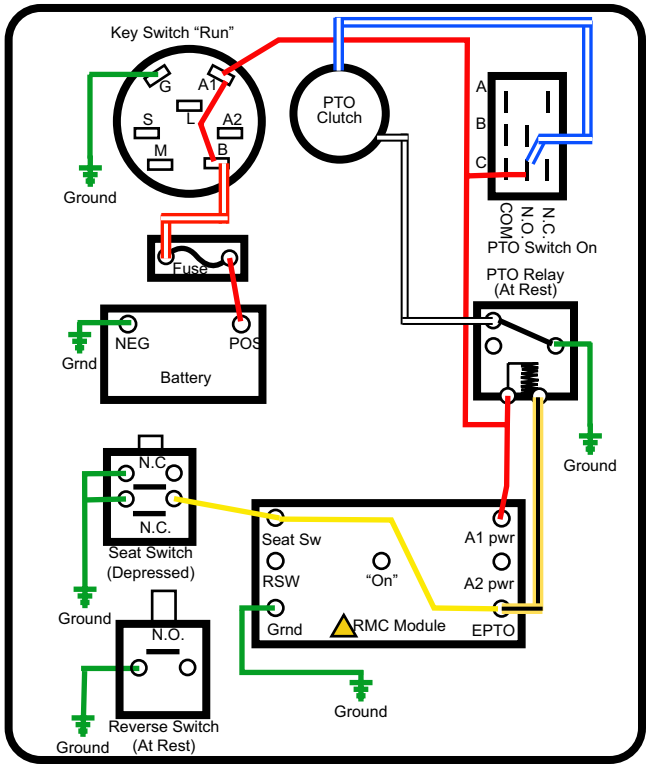


Figure 7.34

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 7.34.

   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 thinks that the seat is empty.

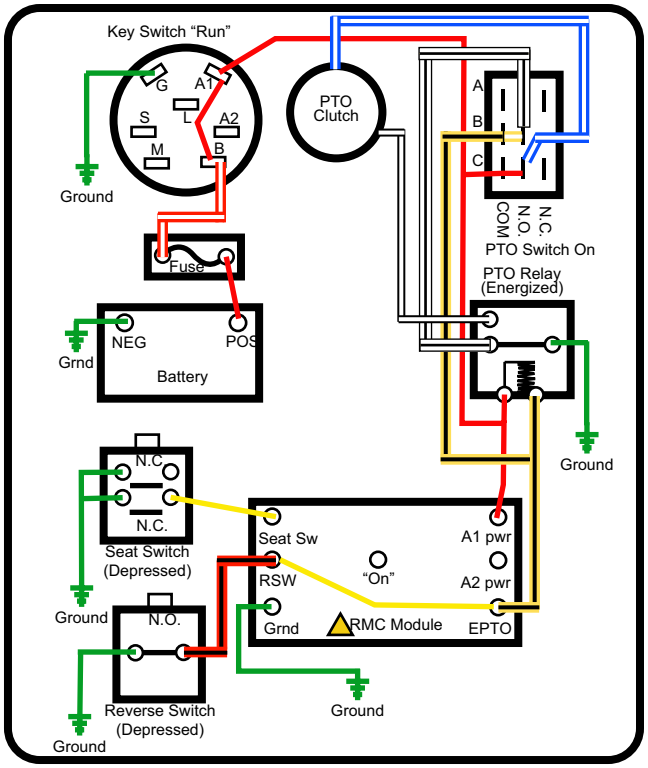


Figure 7.35

3. Once the PTO relay is energized by a ground path through one of the safety switches, it latches. See Figure 7.35.

   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 or 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 was 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 7.36.

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 7.36

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 shuts-down and dis-arms itself whenever the seat is vacated. The person who gets back in the seat must then re-arm 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 7.37.

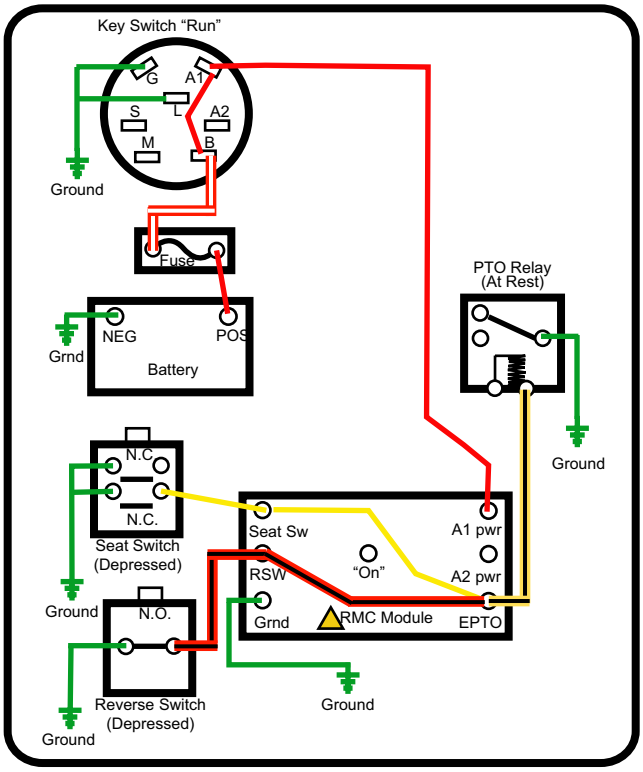


Figure 7.37

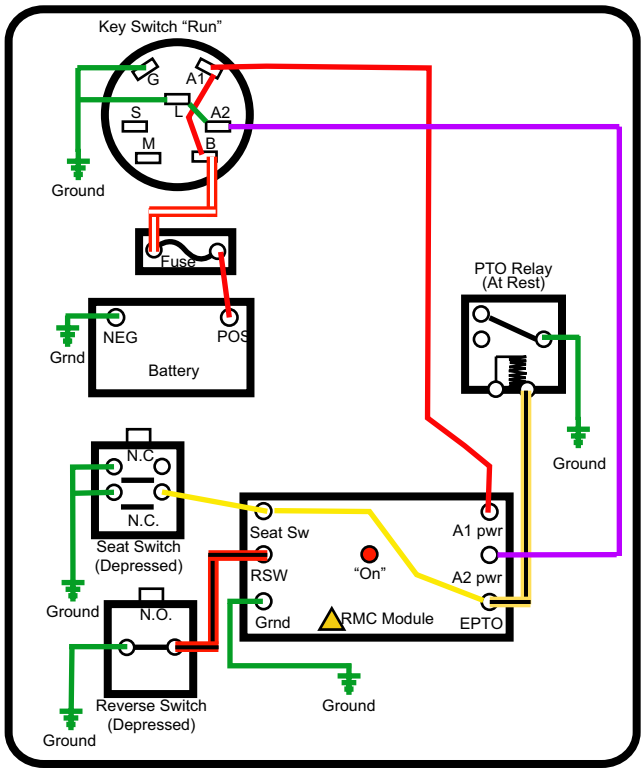


Figure 7.38

When the RMC module is armed and activated, it effectively disconnects the reverse switch from the circuit. See Figure 7.38.

The RMC module is disarmed and de-activated when the seat is vacated; it gets a ground signal through the second set of contacts in the seat switch.

Deck lift circuit

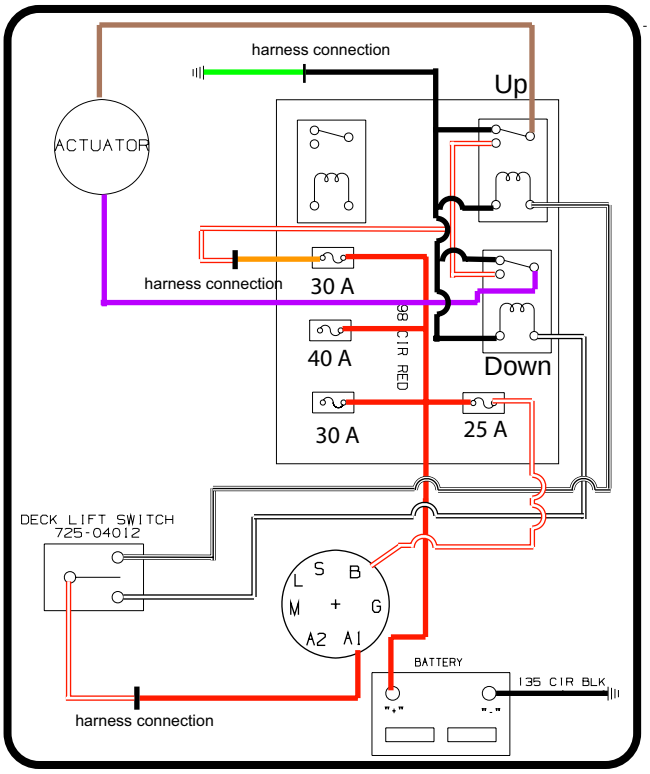


Figure 7.39

Basic Operation: See Figure 7.39.

1. Battery power goes through the top 30A fuse in the fuse box. It then flows through the orange wire until it reaches the deck lift harness connector. It then passes onto the red wire with a white trace. The red white with a white trace carries the power to the N.O. contacts of the deck lift relays.
2. Both of the deck lift relays have the N.C. contact connected to ground. This sends a ground signal to both sides of the deck lift actuator.
3. When the ignition key is moved to any position other than “OFF”, power is sent to the deck lift switch through a red wire with a white trace.
4. The deck lift switch is a Single Pole Double Throw (SPDT) center off switch. This means it has one common terminal (single pole) that can be connected to two different circuits (double throw). When the switch is at rest, the common terminal is not connected to either circuit (center off).
5. When the deck lift switch is moved to the “UP” position:
   - The “UP” relay is energized by the white wire with a black trace.
   - Battery power is sent to the actuator through the brown wire.
   - The “DOWN” relay remains at rest, allowing the ground path to pass through it to the purple wire, completing the circuit.
6. When the deck lift switch is moved to the “DOWN” position:
   - The “DOWN” relay is energized by the black wire with a white trace.
   - Battery power is sent to the actuator through the purple wire.
   - The “UP” relay remains at rest, allowing the ground path to pass through it to the brown wire, completing the circuit.

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.
- Kirchhoff's voltage law.
- 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

This 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 mass of switches and relays that are tied together by spaghetti-like wiring harness, 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 created by ignition systems in general 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 (take a look at the ignition system on a fiberglass-bodied Corvette), 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 automotive 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 breeding ground 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 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 (not all) 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 for short.
- 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 resistance times current.

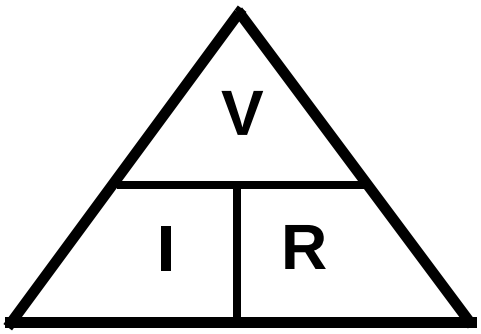


Figure 7.40

- 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 7.40.
- 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, meaning that the product of "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.

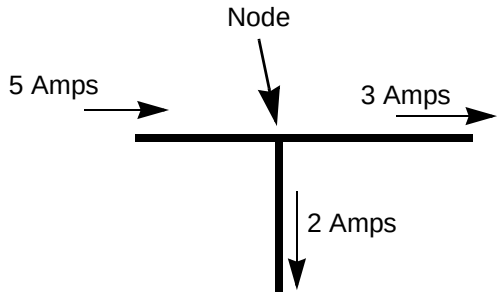


Figure 7.41

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 7.41.

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.

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 7.42.

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.

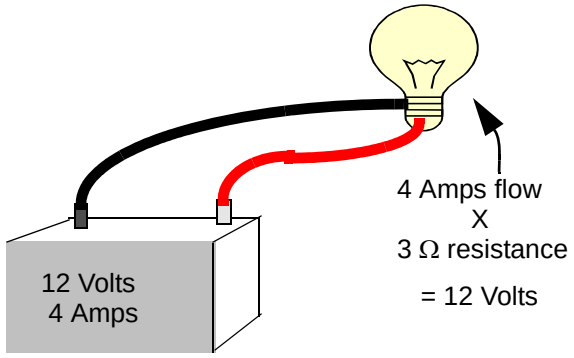


Figure 7.42

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

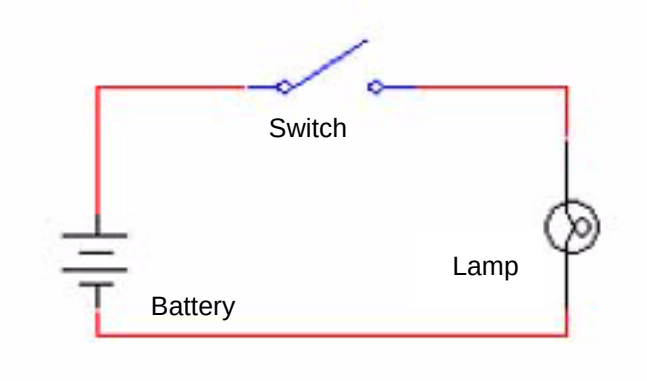


Figure 7.43

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 7.43.

Parallel

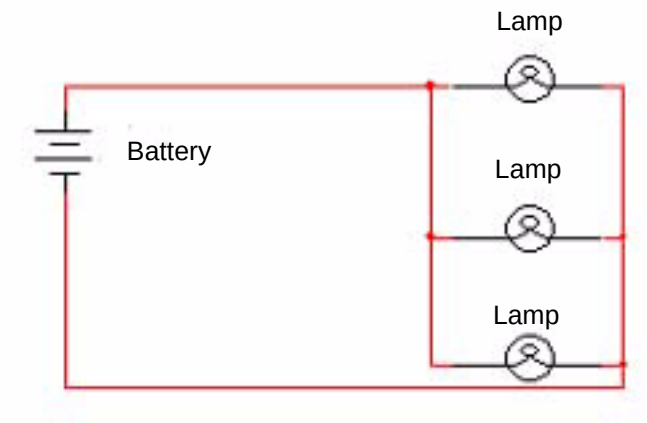


Figure 7.44

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 7.44.

Series/parallel

Series/parallel circuits have some sections wired in series and some in parallel. See Figure 7.45.

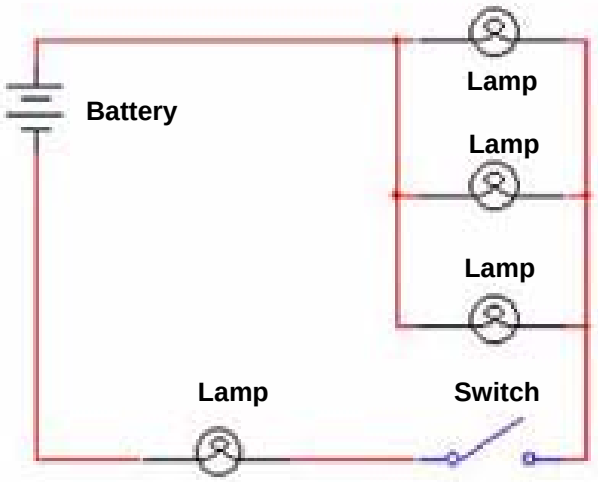


Figure 7.45

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 by-passing 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 lamp (light 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/phosphate or black oxide are bad conductors. Use bright fasteners (zinc coated).

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, increased resistance 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 Multi-Meter)
- 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 Multi-meter

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 7.46.

Figure 7.46

Uses

Voltage

Set meter 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 **meter 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 meter is connected with the **polarity** reversed, a "-" will appear in front of the voltage reading. It has no ill effects on the meter nor on accuracy.
- If the meter is set to Volts AC (~) it may not register any DC voltage, but no physical harm will be done to the meter 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 meters have an inductive "Amp clamp" accessory that can be used without breaking the circuit.

IMPORTANT: Testing amperage beyond the capacity of the meter can burn out an internal fuse in some meters. The fuses can be expensive.

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 straight 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, meaning is 1,000,000th (0.000001) of an Ohm
  - "**m**" is milli-Ohms, meaning is 1,000th (0.001) of an Ohm.
  - "**K**" is Kilo-Ohms, meaning 1,000 Ohms.
  - "**M**" is Meg-Ohms, meaning 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-off readings. False readings can 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 going through it will damage the meter (usually beyond repair).

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

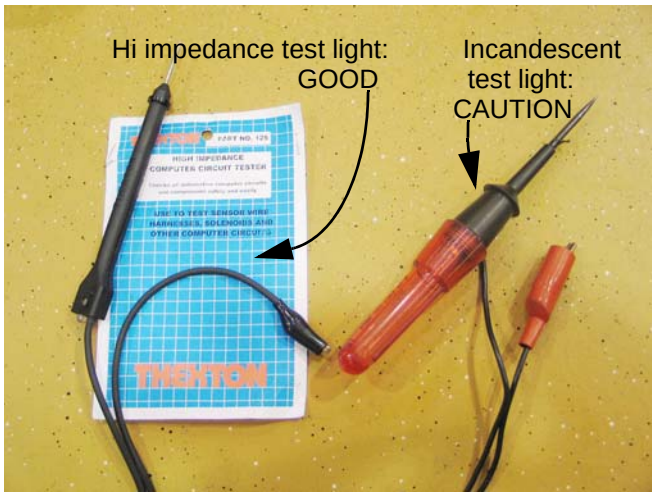


Figure 7.47

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 7.47.

IMPORTANT: Do not use a test light on a 2000 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 fuel injected Kohler-powered equipment.

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

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 7.48.

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 7.48

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 7.49.

NOTE: Usage of the DC Shunt tool is detailed in the 1995 and 1999 editions of their Update Seminar materials.

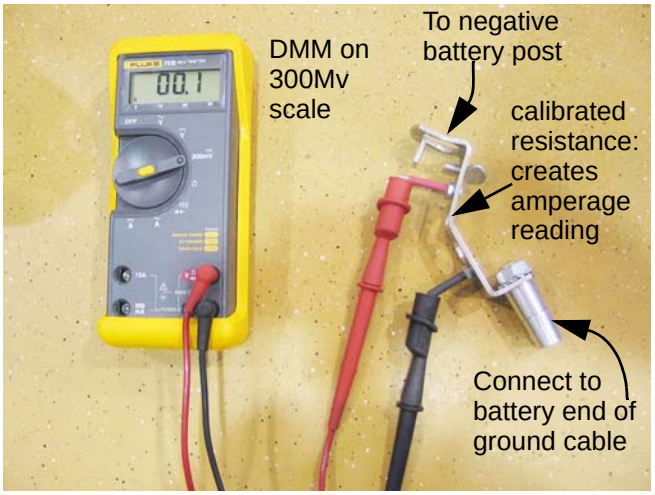


Figure 7.49

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 over heated and should be replaced.

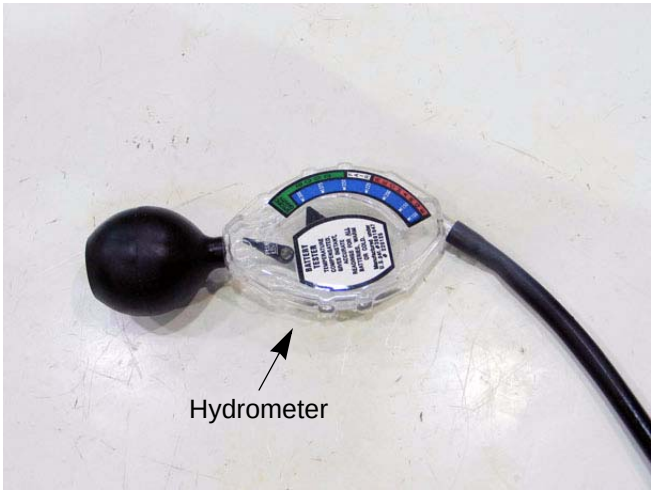


Figure 7.50

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 7.50.

⚠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. Variable 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.

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

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 2000 series tractor comes with a 230 CCA battery.

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 7.51.

Figure 7.51

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 7.52.

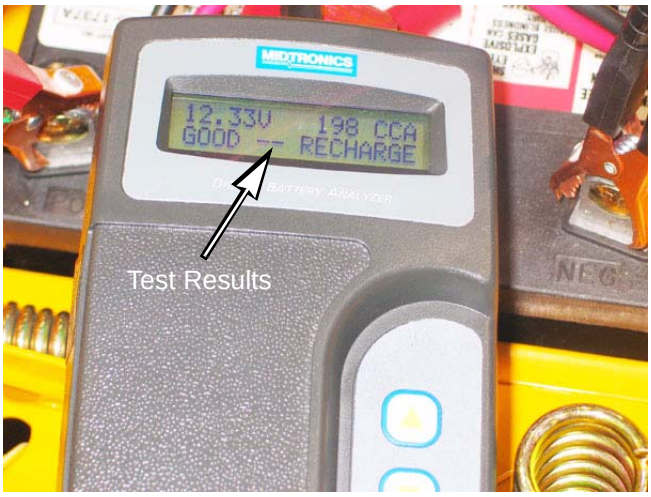


Figure 7.52

Battery discharge test

Figure 7.53

Occasionally a battery will discharge while sitting unused. To test for a battery that is “leaking” voltage:

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 7.53.
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 2000 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 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 diagnosis, 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.

Figure 7.54

6. Starting with a fully charged battery and battery cable connections that are clean and tight, measure the battery voltage. See Figure 7.54.
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 7.55.

Figure 7.55

NOTE: Ultimately, all current will find its way back to the negative post of the battery.

To check ground-side voltage drop: set-up a multimeter 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 that shows-up 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.

- 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 7.56.
- With the starter engaged, this machine exhibited a voltage-drop reading of 0.308 volts, indicating a poor ground connection.

Figure 7.56

Figure 7.57

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 7.57.

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).

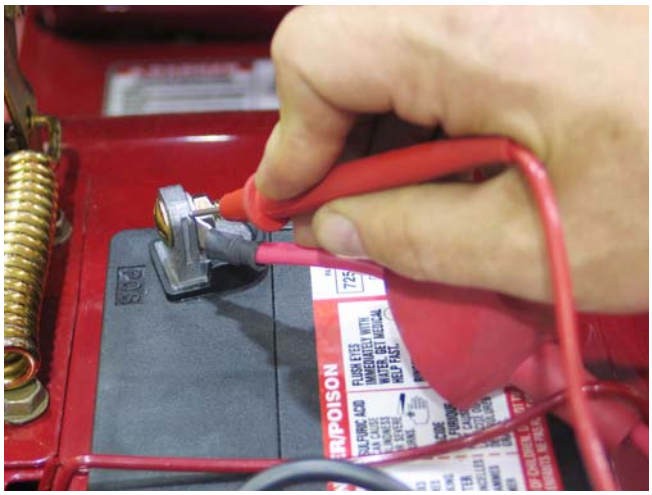


Figure 7.58

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-up a multi meter to measure 12V DC. See Figure 7.58.
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 that shows-up on the meter is the power that is not following the intended path back to the negative battery post.

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 7.59

- 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 7.59.
- 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 pin-point 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 up-stream.
- 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 up-stream, 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.

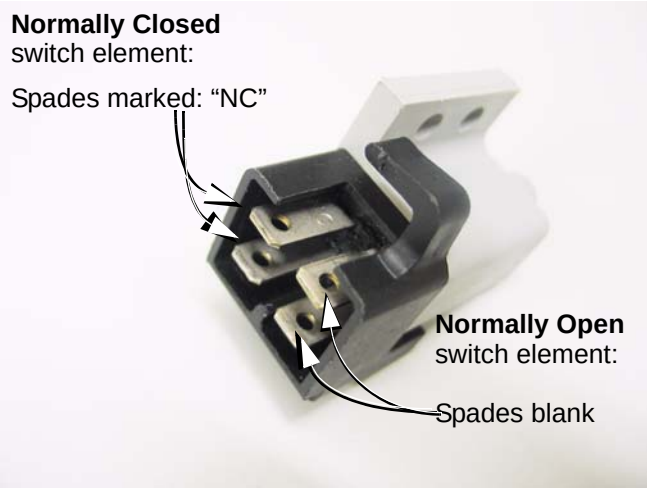


Figure 7.60

- 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 “N.C.”
- The male spade terminals that are associated with each-other face each-other broad-surface to broad surface. See Figure 7.60.

Diodes

- What is a diode? A diode acts like a one way valve, allowing current to flow in only one direction. See Figure 7.61.
- 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.

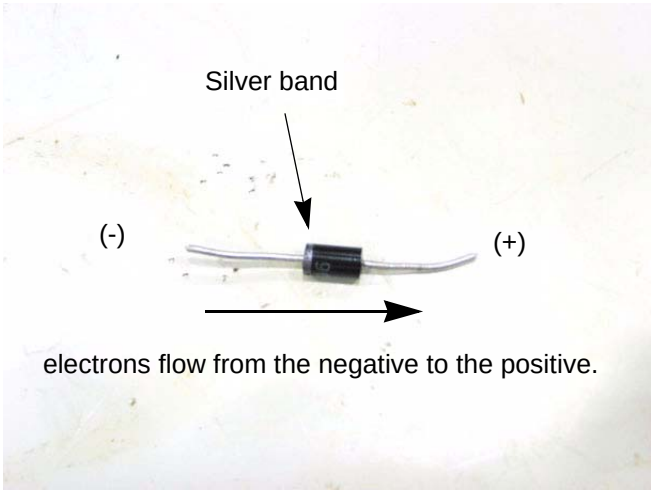


Figure 7.61

Testing a diode:

1. Isolate the diode in the circuit.
2. Set the DMM to the diode or Ω scale. See Figure 7.62.
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.

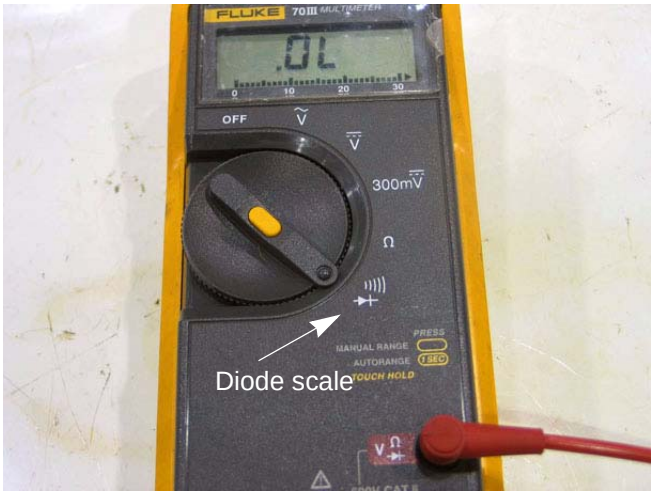


Figure 7.62

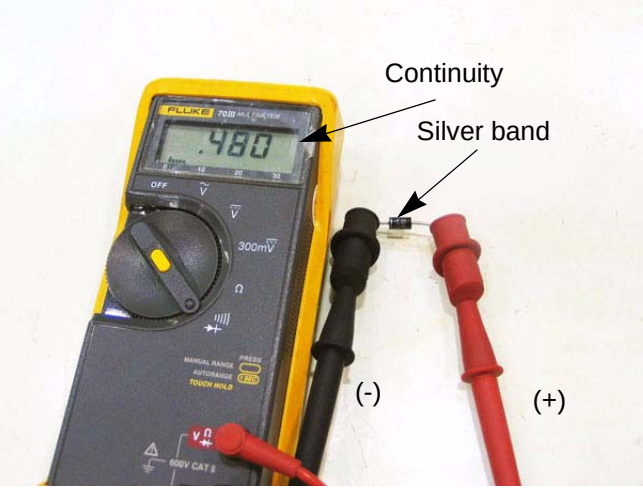


Figure 7.63

5. There should be continuity. See Figure 7.63.

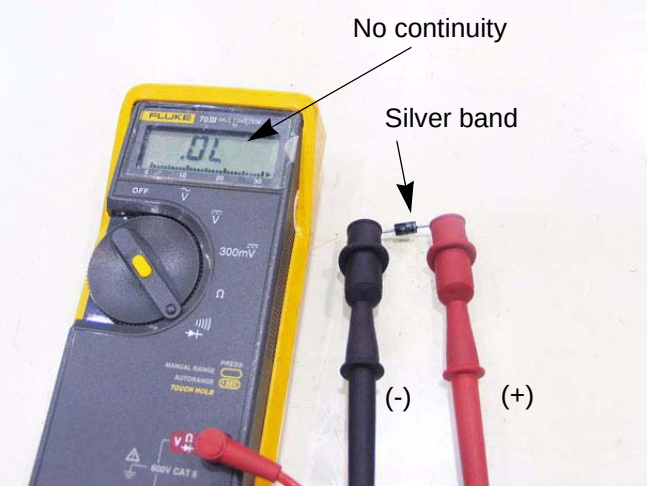


Figure 7.64

6. Switch the leads and repeat the test.
7. The meter should indicate no continuity. See Figure 7.64.
8. If the results do not match the above, replace the diode.

Relay

Most of the relays used by MTD or Cub Cadet have five pins. See Figure 7.65.

- 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.

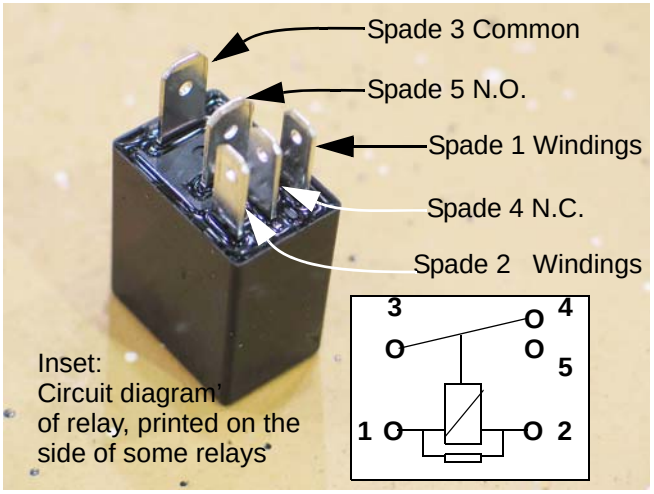


Figure 7.65

To test a relay

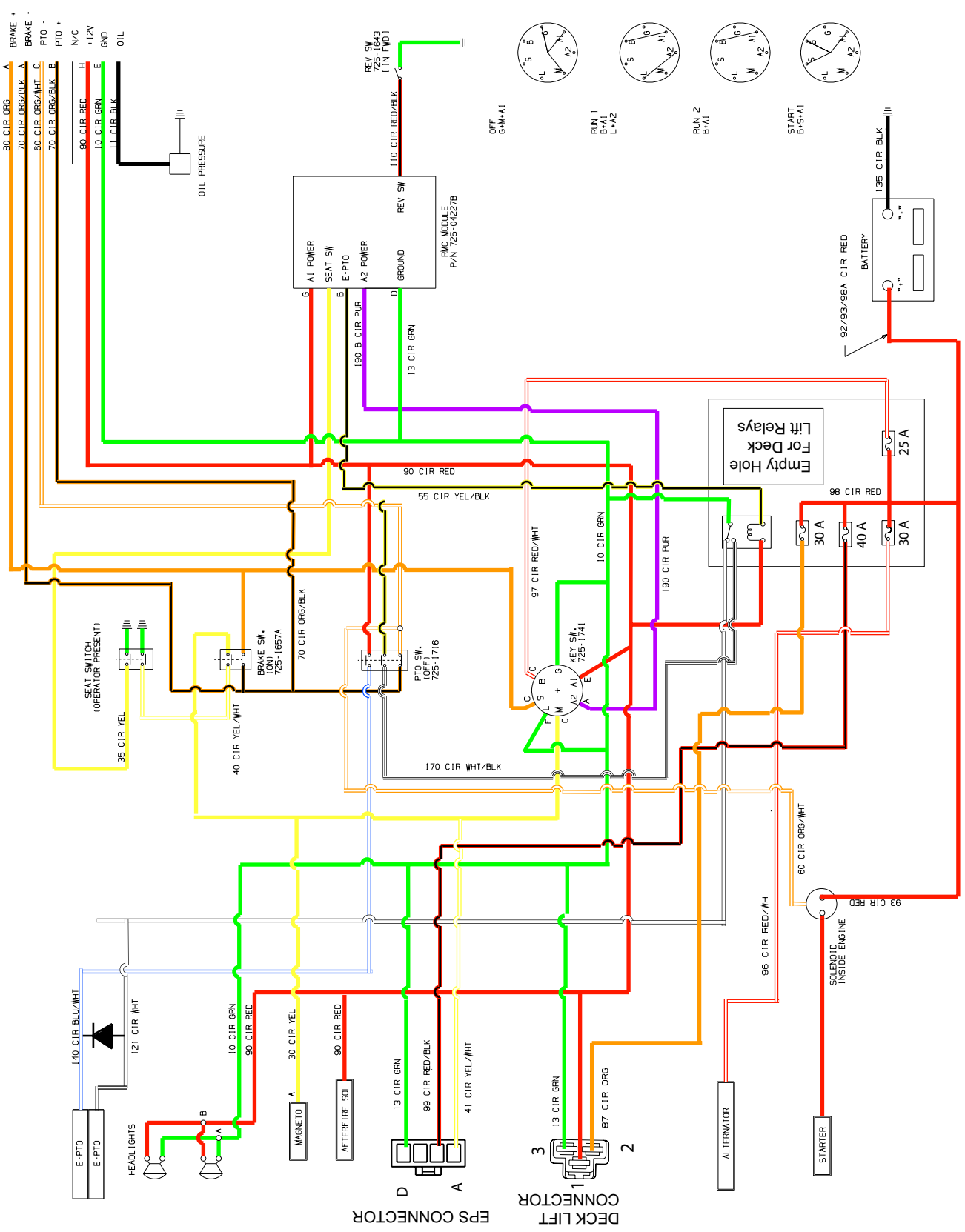
1. Test for continuity between the common and the NC terminals using a DMM.
2. Test for continuity between the common and the NO terminals using a DMM.

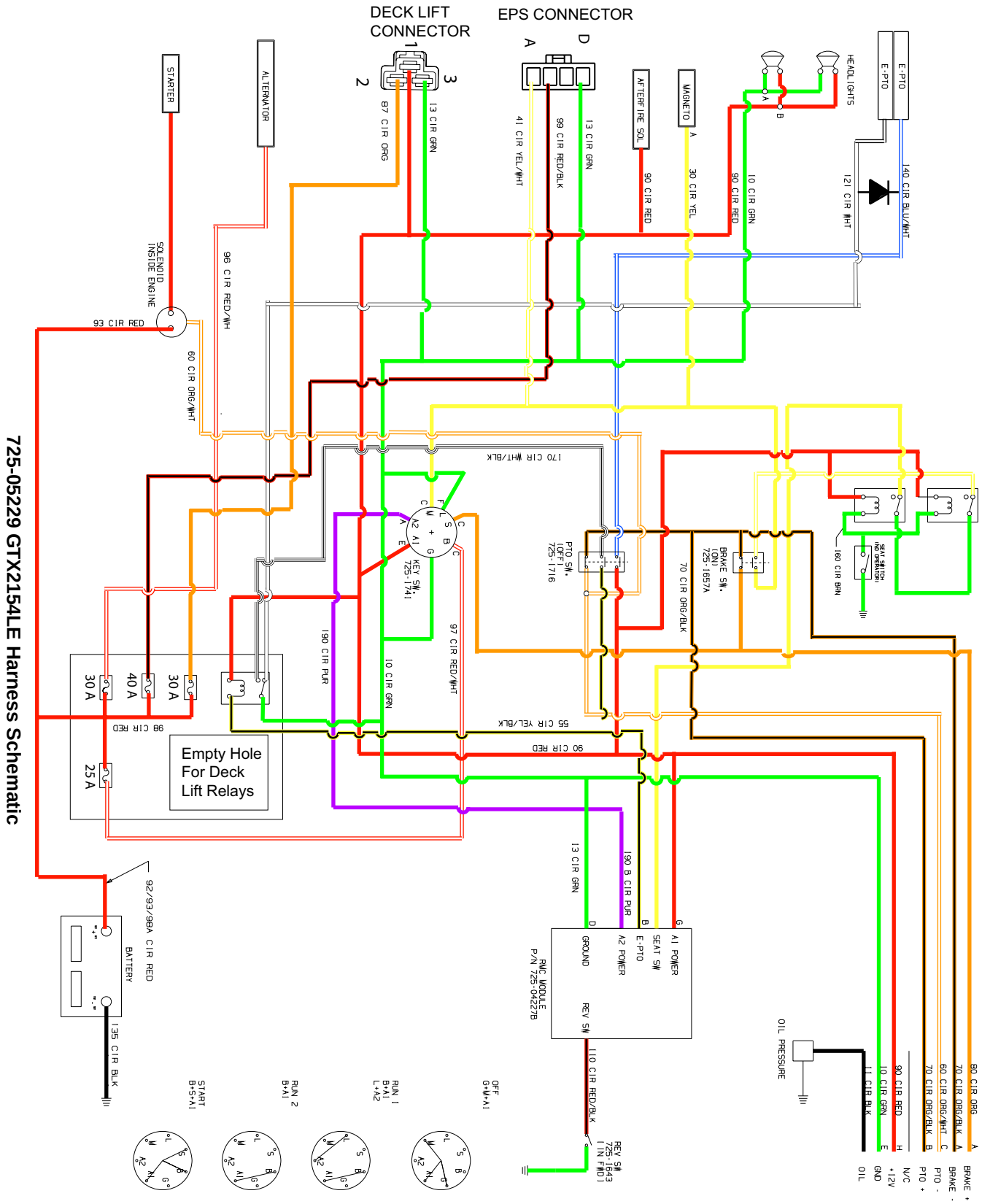
   NOTE: There should be continuity with the NC terminal and no continuity for the NO terminal. If the results vary from this the relay is bad.
3. Apply 12 volts to terminals 1 and 2. This will active the relay.
4. Test for continuity between the common and the NC terminals.
5. Test for continuity between the common and the NO terminals.

   NOTE: There should be no continuity with the NC terminal and continuity with the NO terminal. If the results vary from this, the relay is bad.

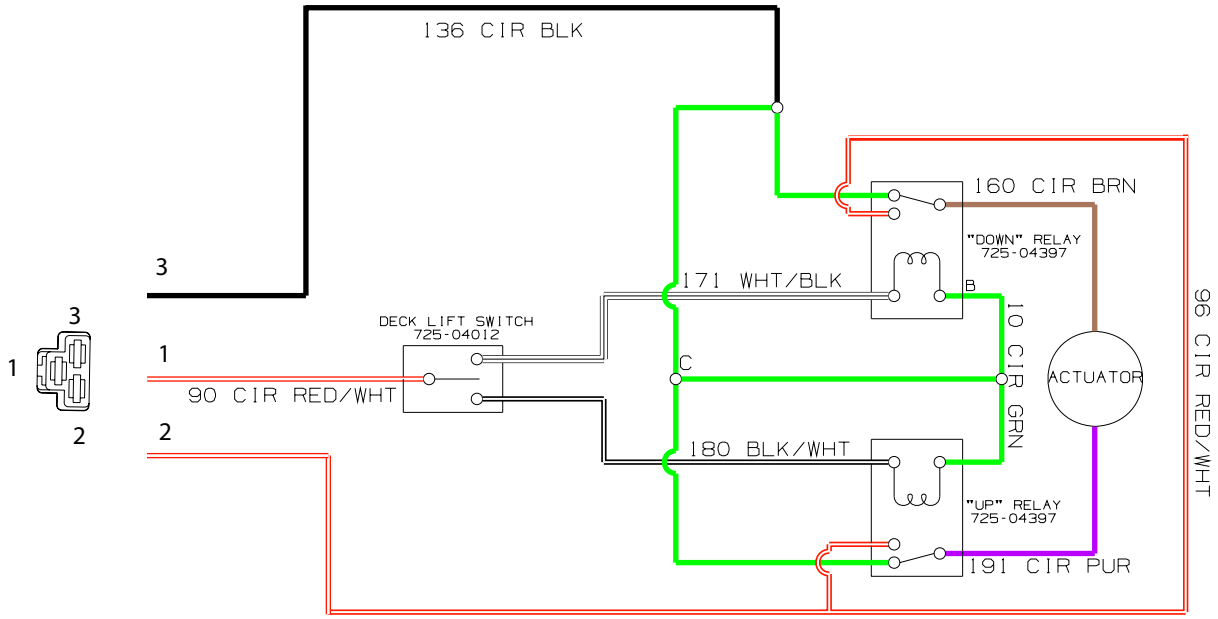
   NOTE: To test the relay for burned contacts, do a voltage drop test across the relay contacts while the circuit is being used.

Schematics


725-05181 Main Harness Schematic
Empty Hole For Deck Lift Relays
25 A
30 A
40 A
30 A
98 CIR RED
90 CIR RED
55 CIR YEL/BLK
97 CIR RED/WHT
10 CIR GRN
190 CIR PUR
190 B CIR PUR
13 CIR GRN
110 CIR RED/BLK
REV SW 725-1643 (IN FWD)
RMC MODULE P/N 725-04227B
A1 POWER
SEAT SW
E-PTO
A2 POWER
GROUND
REV SW
92/93/98A CIR RED
BATTERY
135 CIR BLK
OIL PRESSURE
80 CIR ORG
70 CIR ORG/BLK
60 CIR ORG/WHT
70 CIR ORG/BLK
90 CIR RED
10 CIR GRN
11 CIR BLK
BRAKE +
BRAKE -
PTO -
PTO +
N/C
+12V
GND
OIL
OFF G+M+A1
RUN 1 B+A1 L+A2
RUN 2 B+A1
START B+S+A1
SEAT SWITCH (OPERATOR PRESENT)
35 CIR YEL
BRAKE SW. (ON) 725-1657A
40 CIR YEL/WHT
70 CIR ORG/BLK
PTO SW. (OFF) 725-1716
KEY SW. 725-1741
170 CIR WHT/BLK
140 CIR BLU/WHT
121 CIR WHT
10 CIR GRN
90 CIR RED
30 CIR YEL
90 CIR RED
13 CIR GRN
99 CIR RED/BLK
41 CIR YEL/WHT
13 CIR GRN
87 CIR ORG
96 CIR RED/WH
60 CIR ORG/WHT
93 CIR RED
E-PTO
E-PTO
HEADLIGHTS
MAGNETO
AFTERFIRE SOL
EPS CONNECTOR
DECK LIFT CONNECTOR
ALTERNATOR
STARTER
SOLENOID INSIDE ENGINE



725-05229 GTX2154LE Harness Schematic



725-05190 Deck Lift Harness

CHAPTER 8: DECKS AND LIFT SYSTEMS

Cutting decks

2000 series tractors (2011 and newer) are sold without a mowing deck. There are a variety of decks available as an attachment for the 2000 series tractor.

GTX2100		GT2000	
19A40012100	42” Staggered deck	19A40012100	42” Staggered deck
19A40015100	48” Fabricated deck	19A40013100	50” Stamped deck
19A40013100	50” Stamped deck	19A40014100	54” Stamped deck
19A40016100	54” Fabricated deck		
19A40014100	54” Stamped deck		

NOTE: The GTX2154LE (50th Anniversary Edition) tractor comes equipped with a 54” fabricated deck and it is the only 2000 series tractor that comes with a deck.

Deck removal/installation

NOTE: The procedure to remove the deck is the same for all of the deck options available for these tractors.

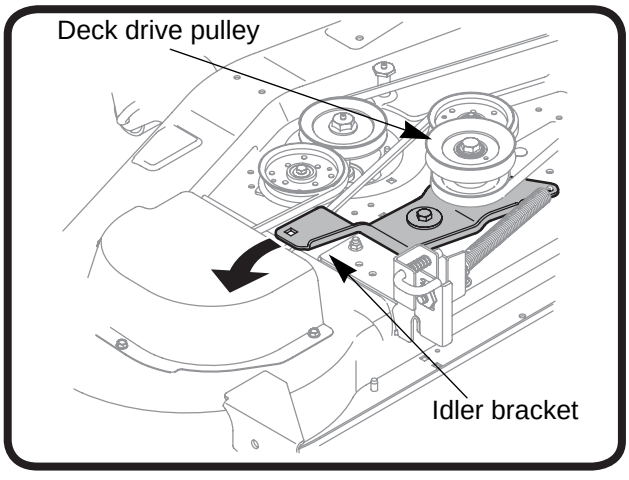


Figure 8.1

To remove the deck:

1. Place the tractor on firm level ground and set the parking brake.
2. Turn off the engine.
3. Lower the deck to its lowest cutting height.

NOTE: Positioning a 2x4 block under the center of the rear edge of the cutting will raise it slightly. This will make disengaging the lift links easier.

4. Insert a 1/2” drive breaker bar into the square hole in the deck idler bracket on the left side of the deck. See Figure 8.1.
5. Pull the breaker bar towards the rear of the tractor to remove some of the belt tension.
6. Slide the belt off of the deck drive pulley.

7. Carefully route the PTO belt so that it clears the deck.
8. Pull the deck support pin outward to release the deck from the lift link on both sides of the deck. See Figure 8.2.
9. Move the deck lift lever to the highest cutting position.

   NOTE: On tractors with an electric lift, use the lift switch to raise the lift links to their highest position.
10. Slide the cutting deck forward, while guiding the hooks on the front of the deck off of the front hanger.
11. Slide the deck to the right, out from underneath the tractor.

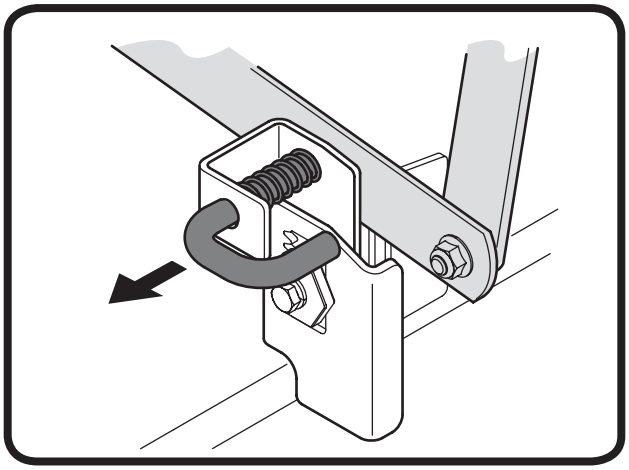


Figure 8.2

12. Install the deck by following the above steps in reverse order except the belt. The belt goes on the deck drive pulley last.

    IMPORTANT: Inspect the discharge chute, spindle covers and excluder bars before installing the deck. Repair or replace any damaged or removed safety device. Do not put an unsafe deck back into service.

Cleaning the deck

Cleaning debris off of the deck should be done 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 over-heat.

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 the debris from building up on the underside of the deck.

Smart Jet

All of the decks available for the 2000 series tractor come with the Smart Jet feature. The Smart Jet is a water nozzle (or two) that is mounted to the deck. The nozzles can be identified by the quick connect coupling on the top side of the deck. The quick connect coupling(s) allow a garden hose to be attached to the deck to rinse the underside of the deck after each mowing.

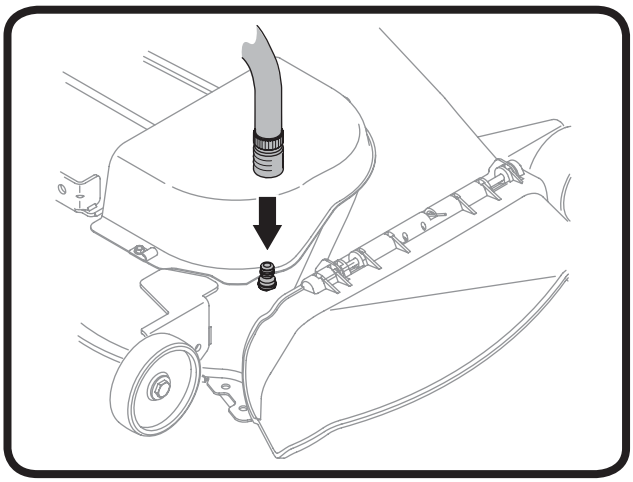


Figure 8.3

To use the Smart Jet feature:

1. Start the tractor.
2. Drive the tractor to a level spot on your lawn, near enough for your garden hose to reach.

CAUTION

Make certain the mower's discharge chute is directed away from the house, garage, vehicles, etc.

3. Turn off the PTO switch.
4. Thread the quick connect coupling onto a garden hose that is attached to a water source.
5. Attach the hose with the quick connect coupling to the deck. See Figure 8.3.
6. Turn on the water source.
7. Sit on the tractor in the operator's position.
8. Engage the PTO for a minimum of two minutes.
9. Turn off the PTO.
10. Turn off the engine.
11. Turn off the water source.
12. Disconnect the hose from the deck

    NOTE: If the mowing deck has more than one nozzle on the deck, repeat steps 4 - 12 on the other nozzles.
13. Start the tractor.
14. Engage the PTO and let the blades run until the deck is dry (minimum of two minutes).
15. Inject grease into each spindle using a grease gun.

Blades

The condition of the blades will greatly effect 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, combination, there are even de-thatching blades on the market. The decks available for the 2000 series comes with what Cub Cadet calls 3 in 1 blades. This means they can side discharge, bag and mulch.

The cutting deck on a 2000 series tractor is mounted with a slight rake, meaning that the front of the deck is a 1/4” - 3/8” lower than the rear of the deck. This is very important to get the proper air flow in the deck so that the blades can make the grass blades stand up to get 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.

To remove the blades:

1. Remove the deck as described in the deck removal section of this chapter or lift the mower using a professional grade lift.
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 8.4.

490-850-0005

Figure 8.4

3. Remove the blade nuts using a 1 1/8” wrench. See Figure 8.5.

⚠CAUTION Use care around the blade while removing or tightening the nut. The blade can spin and cause an injury to the technician.

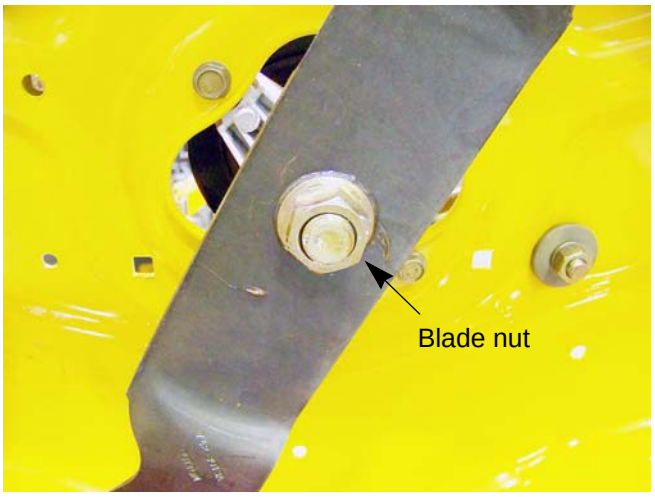


Figure 8.5

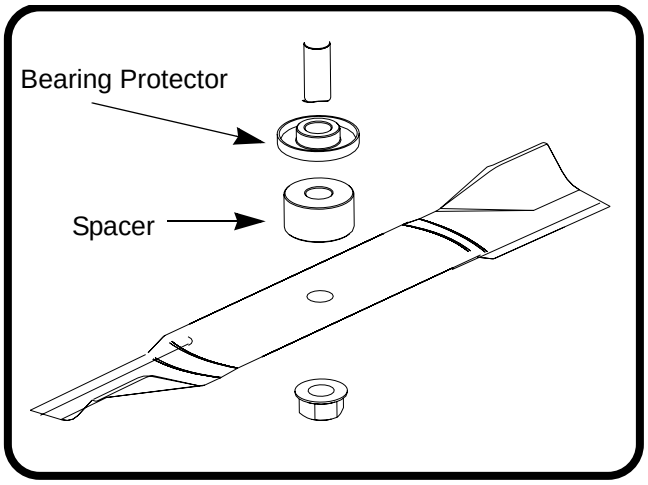


Figure 8.6

4. Remove the blade.

NOTE: The blade spacer and a bearing protector will come off with the blade. The bearing protector and the spacer must be installed in the same order when installing the blade. See Figure 8.6.

5. Install the blade by following the above steps in reverse order. Tighten the blade nut to a torque of 100 - 130 ft-lbs (136 - 176 Nm).

NOTE: A 1 1/8” wrench can be used to hold the top of the spindle shaft.

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: 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.

- The blade can be tested by using a blade balancer. Grind metal from the heavy side until it balances evenly.

⚠CAUTION A poorly balanced blade will cause excessive vibration and may cause damage to the mower and result in personal injury.

PTO belt

Some cutting deck designs use a single belt to transfer power from the engine crankshaft directly to the blade spindles.

Other cutting deck designs use one belt to transfer power from the engine crankshaft to a second belt that drives the blade spindles.

On decks with two belts, the belt that goes around the crankshaft or PTO clutch is referred to in this text as the PTO belt. The second belt is called a deck belt.

The function of the PTO belt is to transfer the mechanical force from the engine to the blades. The belt faces a lot of different forces.

- Internal friction from the bending forces.
- The friction between the belt and the pulleys creates heat. The compression of the belt as it bends around the pulleys also creates heat. All of this heat softens the belt which weakens it.
- Every time the electric PTO is engaged, the PTO belt is subjected to a tensile impact load. When the electric PTO is engaged, it goes from 0 to 3,600 RPM instantly.

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 hits an object like a rock or a tree root, the belt is subjected to an impact load similar to, but greater than 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. The 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.

NOTE: If a belt has failed prematurely, find and correct the cause of the failure.

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 properly.

To replace the PTO belt:

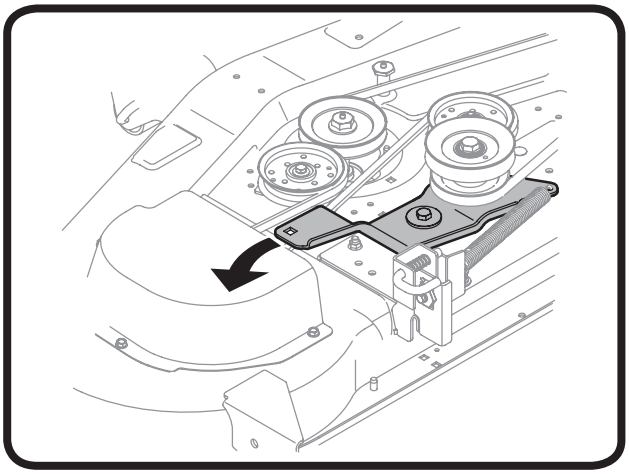


Figure 8.7

1. Insert a 1/2” drive breaker bar into the square hole in the deck idler bracket on the left side of the deck. See Figure 8.7.
2. Pull the breaker bar towards the rear of the mower to remove some of the belt tension.
3. Slide the belt off of the deck drive pulley.

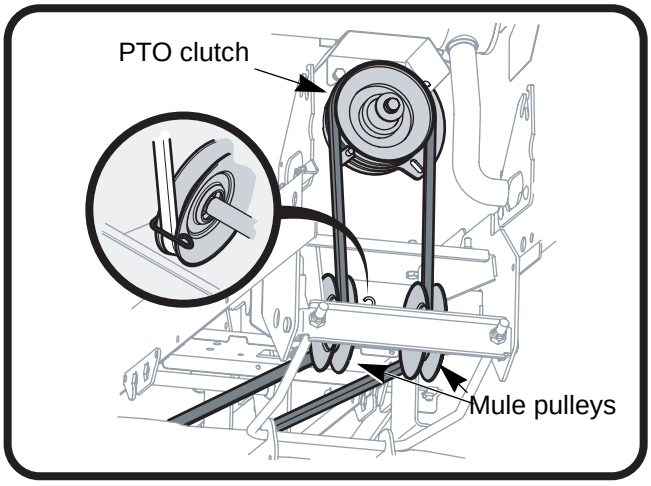


Figure 8.8

4. Gently bend the belt keeper enough to allow the belt to be removed from the mule pulley. See Figure 8.8.
5. Slide the belt off of the PTO clutch.
6. Remove the belt from the tractor.
7. Install the PTO belt by following the previous steps in reverse order.
8. Test drive the tractor before returning it to service.

Deck Belt

NOTE: The procedure to replace the deck belt is basically the same for all five options available for the 2000 series.

To replace the deck belt:

1. Remove the deck as described at the beginning of this chapter.
2. Remove the spindle covers.

   NOTE: A 1/2” wrench can be used to remove the spindle cover screws for all five deck options available.
3. Grab the single idler bracket with a large pair of pliers. See Figure 8.9.

   NOTE: A 1 3/8” open end wrench can also be used.
4. Swing the idler bracket to the left side of the deck enough to slip the belt off of the right spindle pulley.

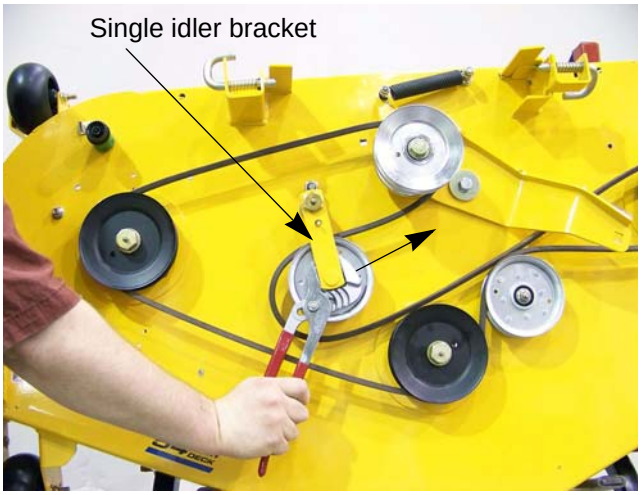


Figure 8.9

NOTE: On the 54” stamped deck and the 42” staggered deck, A 1/2” breaker bar with a 1/2” socket can be used on the pulley nut to swing the idler bracket. See Figure 8.10.

NOTE: When using the breaker bar, make sure it is in line with the idler bracket to help keep the pulley nut from loosening.

5. Remove the belt.
6. Route the new belt around the pulleys.
7. Swing the idler bracket to the left side of the deck enough to slip the belt on to the right spindle pulley.
8. Install the spindle covers.
9. Install the deck as describe at the beginning of this chapter.
10. Test run the mower before returning to service.

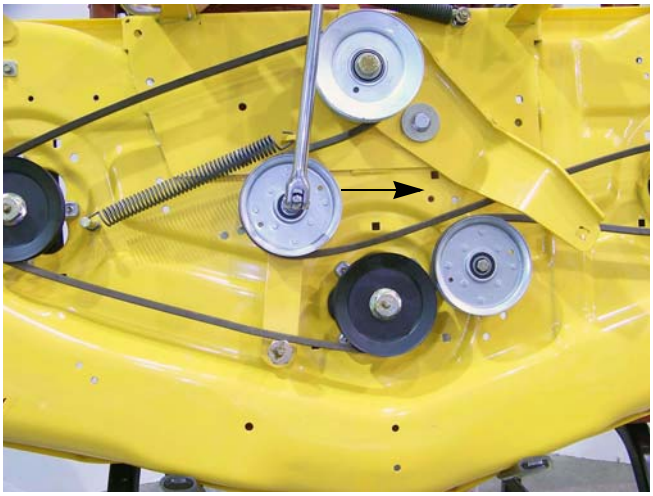
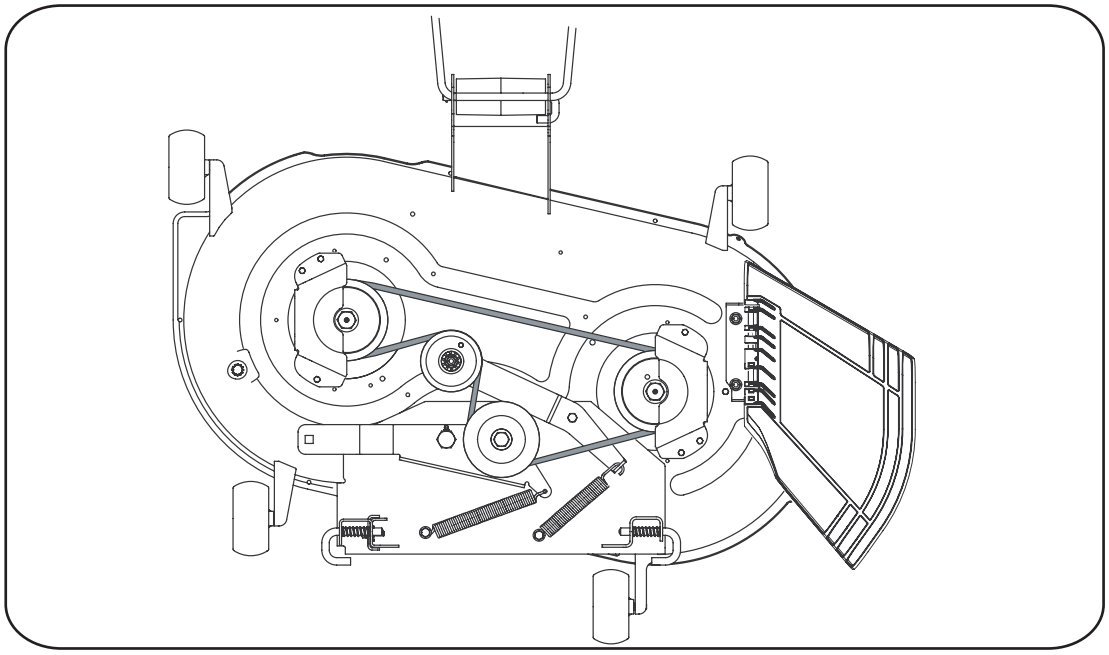
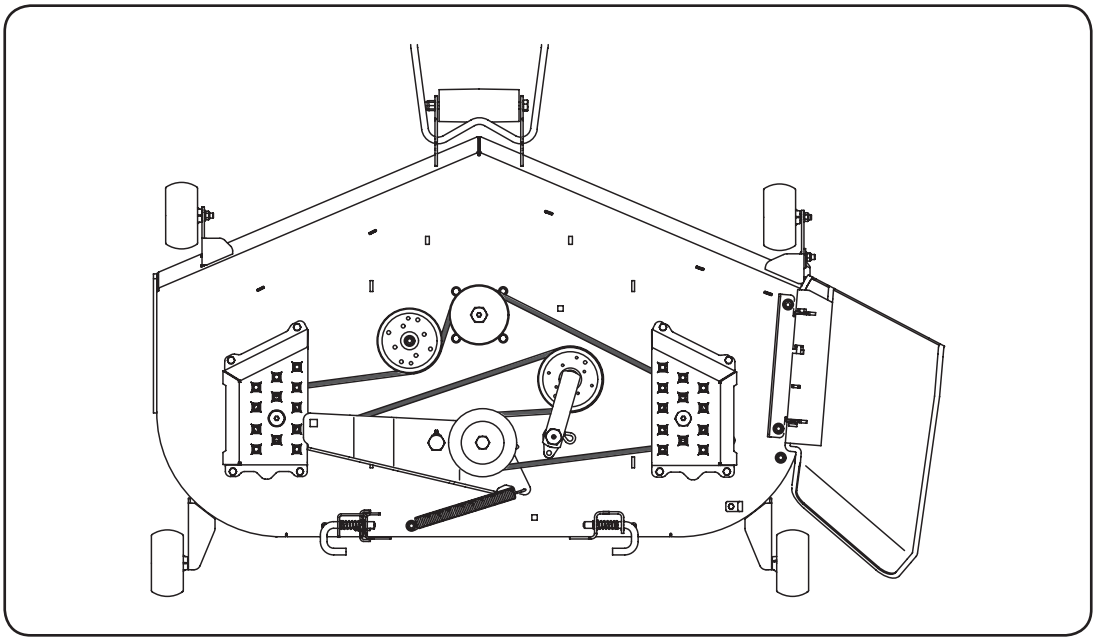


Figure 8.10

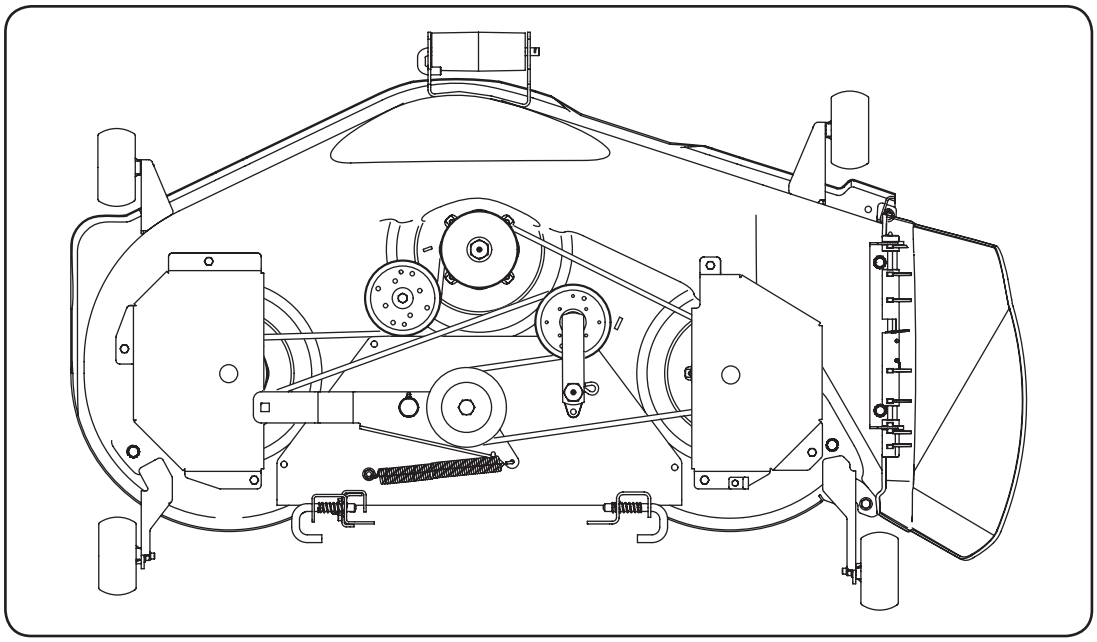
Deck Belt Routings



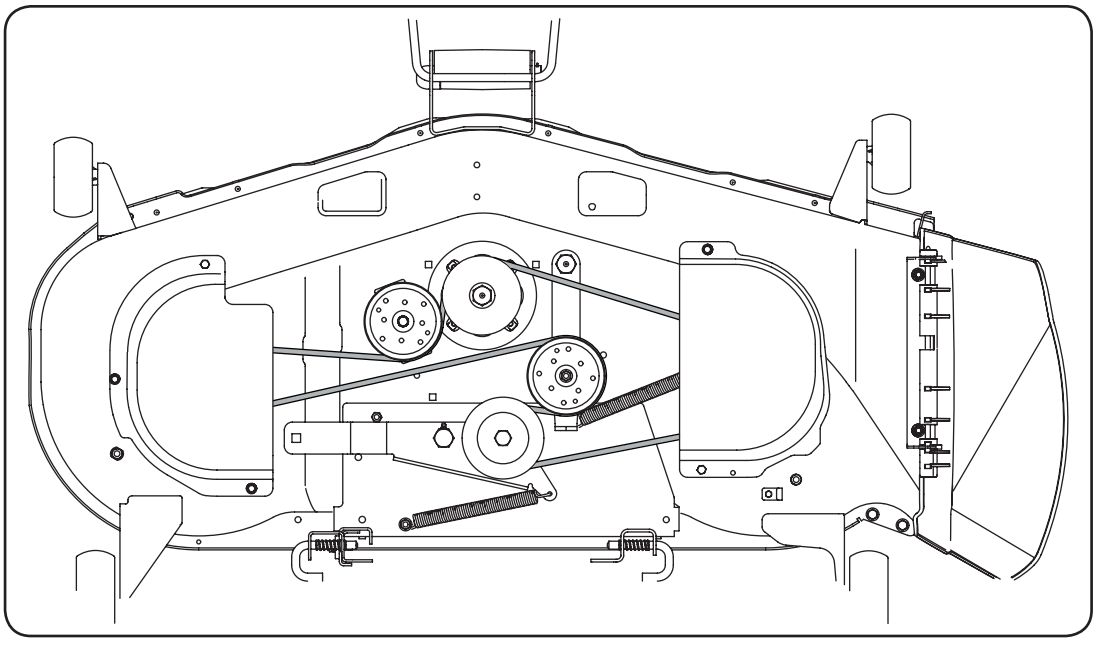
42” staggered deck



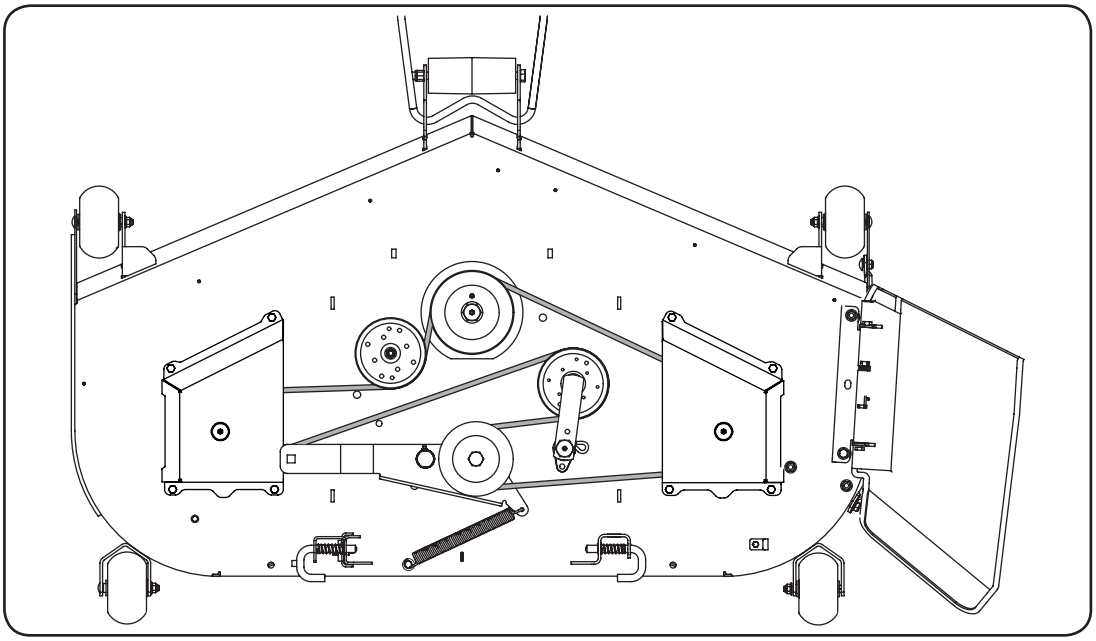
48” Fabricated deck



50” Stamped deck



54” Stamped deck



54” Fabricated deck

Spindle pulleys and spindle shafts

To replace a pulley or spindle shaft:

1. Remove the deck as described at the beginning of this chapter.
2. Slip the deck belt off of the spindle pulley that is to be serviced.

   NOTE: To reach the outer spindles, remove the spindle covers. See Figure 8.11.

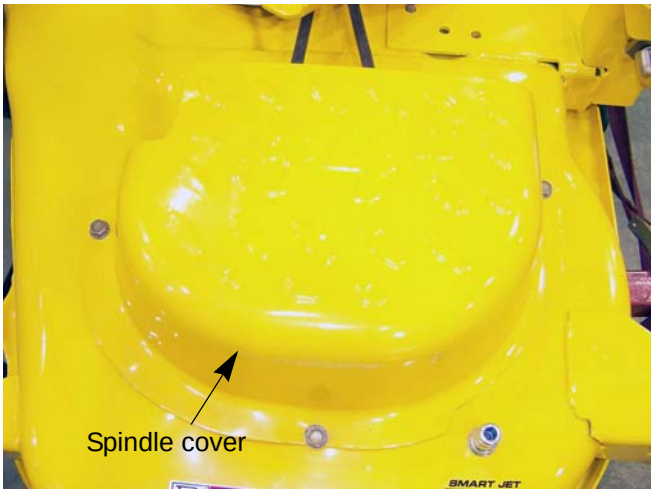


Figure 8.11

3. Remove the blade following the steps described in the blade section of this chapter.
4. Lift the spindle pulley and shaft out of the spindle housing. See Figure 8.12.

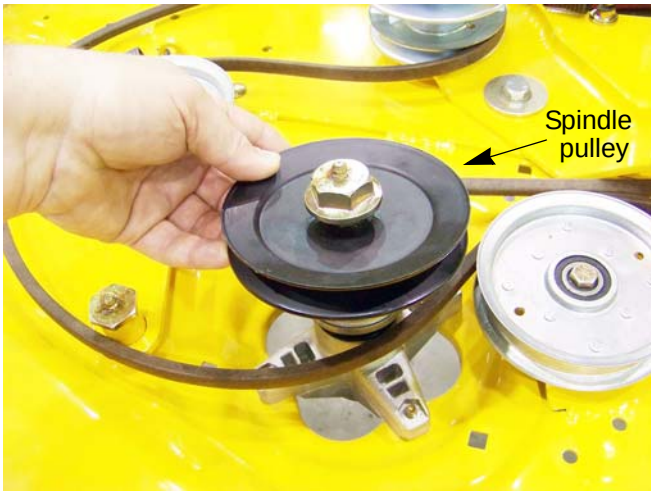


Figure 8.12

5. Remove the pulley. See Figure 8.13.
6. Install the spindle pulleys by following the above steps in reverse order.

   NOTE: Tighten the blade nut to a torque of 100 - 130 ft-lbs (136 - 176 Nm).

7. Test run the mower before returning to service.

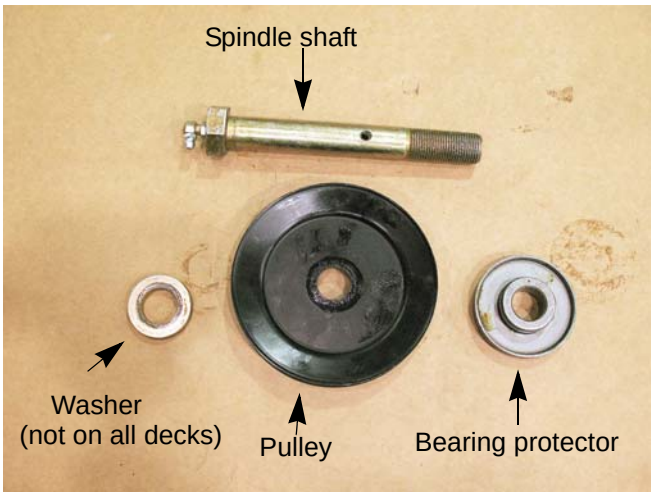


Figure 8.13

Spindle removal/installation

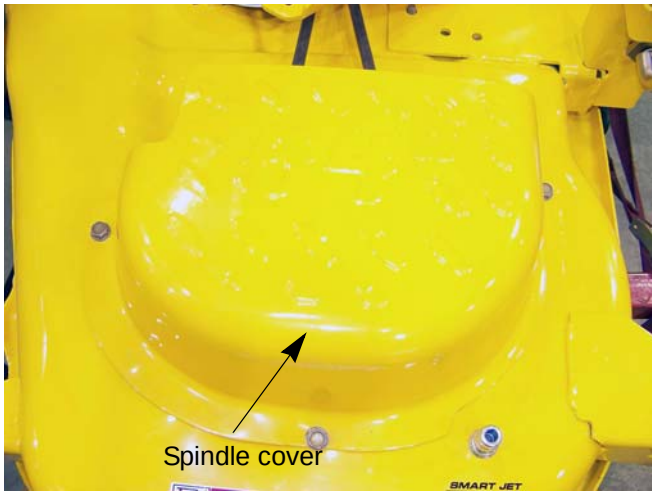


Figure 8.14

To remove/rebuild a spindle:

NOTE: If a spindle has failed prematurely, find and correct the cause of the failure.

1. Remove the deck as described at the beginning of this chapter.
2. Remove the blade following the steps described in the blade section of this chapter.
3. Remove the spindle covers. See Figure 8.14.
4. Slip the deck belt off of the spindle pulley that is to be serviced.

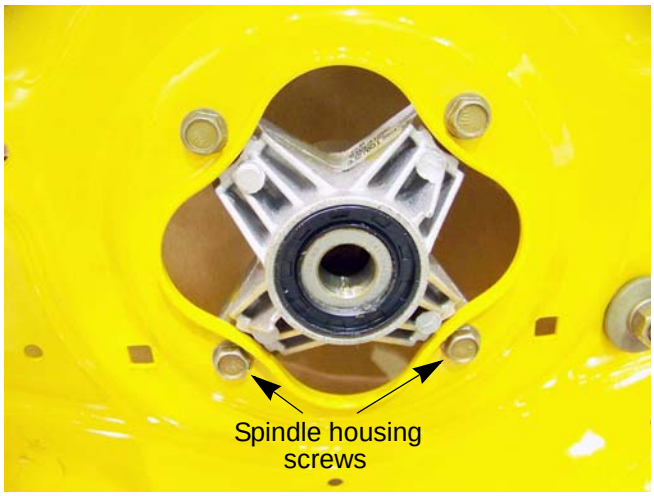


Figure 8.15

5. Remove the spindle shaft and the pulley.
6. Remove the four screws fastening the spindle to the deck. See Figure 8.15.
7. Lift the spindle out of the deck shell.
8. Install the spindle by following the above steps in reverse order.

NOTE: The four spindle screws are self tapping. The new spindle housing will not have threads in it.

NOTE: Tighten the spindle screws to a torque of 200 - 300 in-lbs (23 - 34 Nm).

Spindle overhaul

To rebuild a spindle:

1. Remove the spindle by following the procedures described in the spindle removal section of this chapter.
2. Remove the upper bearing protector.
3. Remove the upper bearing seal. See Figure 8.16.

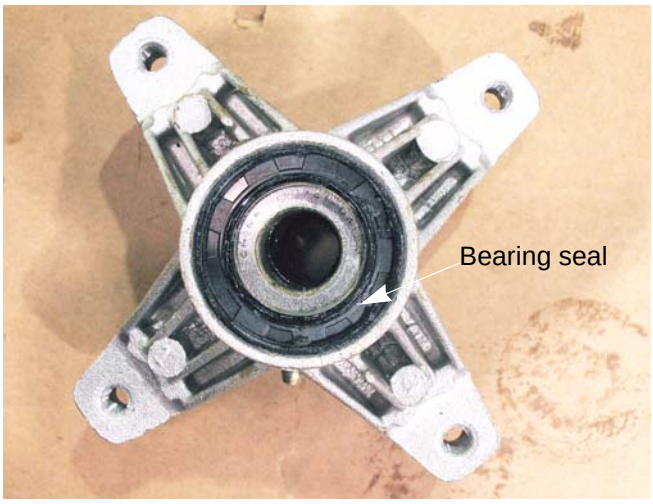


Figure 8.16

4. Remove the upper bearing.

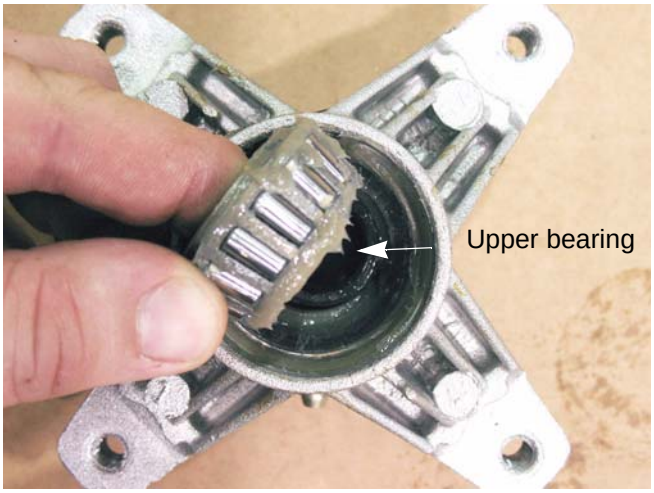


Figure 8.17

5. Remove the spacer. See Figure 8.18.

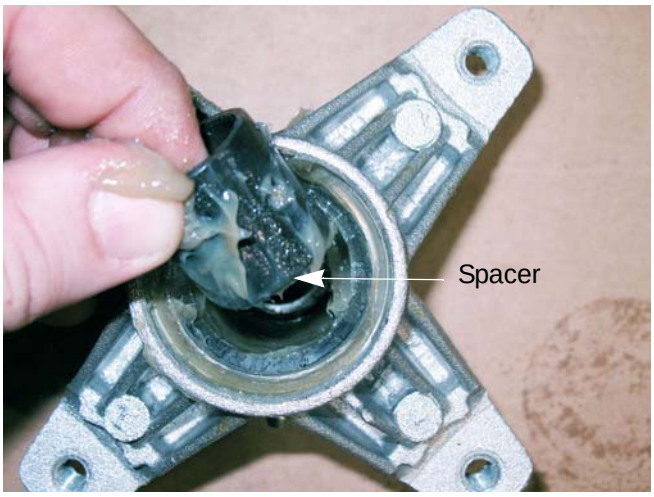


Figure 8.18

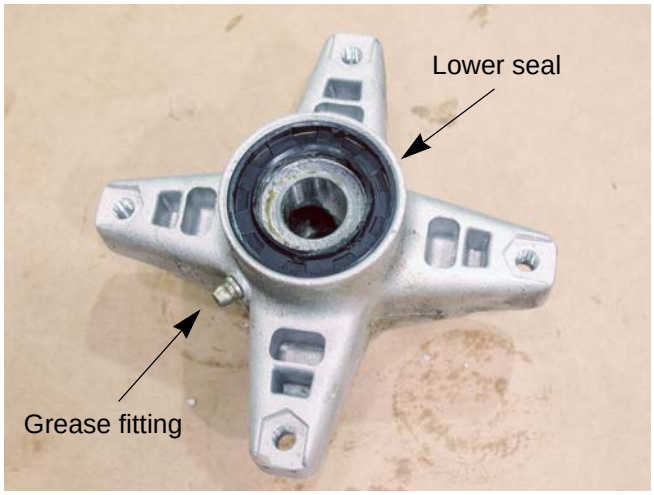


Figure 8.19

6. Remove the lower bearing seal. See Figure 8.19.
7. Remove the lower bearing.

NOTE: The grease fitting in the spindle housing and the grease fitting on the spindle shaft send grease to the same spot. Only one of the fittings needs to be used when greasing a spindle.

NOTE: Bearing races and cones must be kept as a matched set once they have been run.

- If a bearing race or cone is to be re-used, it must be re-used with its original mate.
- If a bearing race or cone is to be replaced, its mate must be replaced as well.

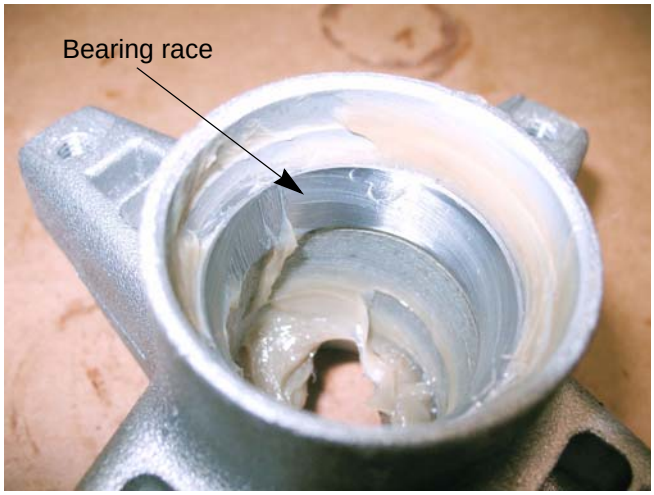


Figure 8.20

8. Inspect the bearing races. If they show signs of wear or damage, they must be replaced.

NOTE: A bearing race can be driven out using a drift or a pin punch.

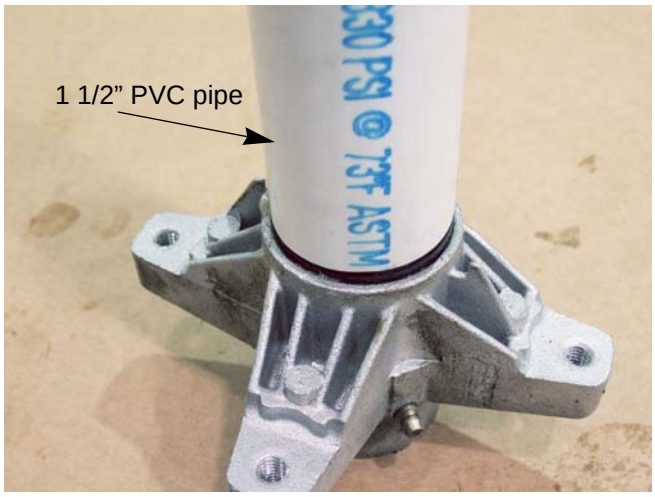


Figure 8.21

9. Re-assemble the spindle by following the previous steps in reverse order.

NOTE: Pack the bearings with a high quality lithium grease before installing them.

NOTE: The seals are installed with the lips facing out.

NOTE: A piece of 1 1/2” PVC pipe can be used as a seal driver. See Figure 8.21.

10. Test run the mower in a safe area before returning it to service.

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: Deck leveling is part of initial mower setup. Before adjusting an out of level deck on a mower that has been used, inspect all of the deck lift and suspension linkages. Move the deck through its full range of travel while checking linkage movement. Repair any damaged or binding linkage before leveling the deck.

NOTE: Check the mower’s tire pressure before performing any deck leveling adjustments. The recommended operating tire pressure is:

- Approximately 10 psi for the rear tires
- Approximately 12 psi for the front tires

NOTE: When either deck level or pitch are adjusted, check both level and pitch after the adjustment has been made.

Side to Side Leveling

1. With the mower parked on a firm, level surface, move the deck to the mid height or most commonly used position.
2. Rotate the outside blades so that they are perpendicular with the mower frame.
3. 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 8.22.

   NOTE: If the measurement is suspiciously uneven, rotate the blades 180° and recheck. A change in the measurement indicates a bent blade or spindle shaft.

Figure 8.22

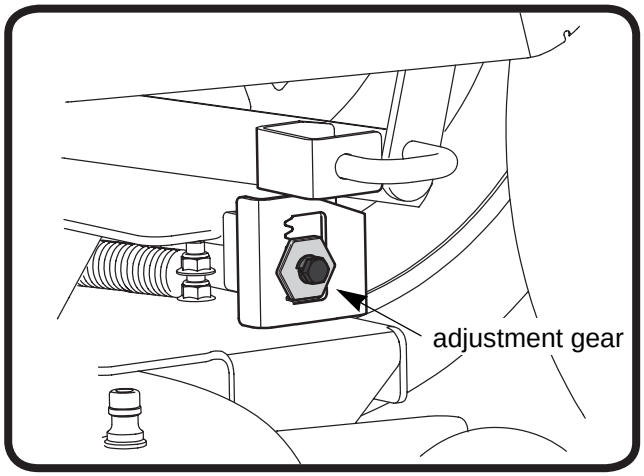


Figure 8.23

4. Loosen, but do NOT remove, the hex bolt on the left deck hanger link. See Figure 8.23.
5. To level the deck, turn the adjustment gear located immediately behind the bolt. Turn the gear clockwise (rearward) to raise the left side of the deck. Turn the gear counter-clockwise (toward front) to lower the left side of the deck. See Figure 8.23.
6. The deck is properly leveled when both blade tip height measurements, as described earlier, are equal.
7. Tighten the bolt on the left deck hanger bracket when proper adjustment is achieved.

Front To Rear (pitch) Leveling

1. With the tractor parked on a firm, level surface, move the deck to the mid height or most commonly used position using the deck lift pedal.
2. Rotate the blade nearest the discharge chute so that it is parallel with the mower frame.

   NOTE: Check the tractor's tire pressure before performing any deck leveling adjustments. The recommended operating tire pressure is:

   - Approximately 10 psi for the rear tires
   - Approximately 12 psi for the front tires

3. Measure the distance from the front of the blade tip to the ground and the rear of the blade tip to the ground.

   NOTE: Use of Cub Cadet deck leveling gauge, part number 490-900-0041, will make measuring the blade tip height easier.

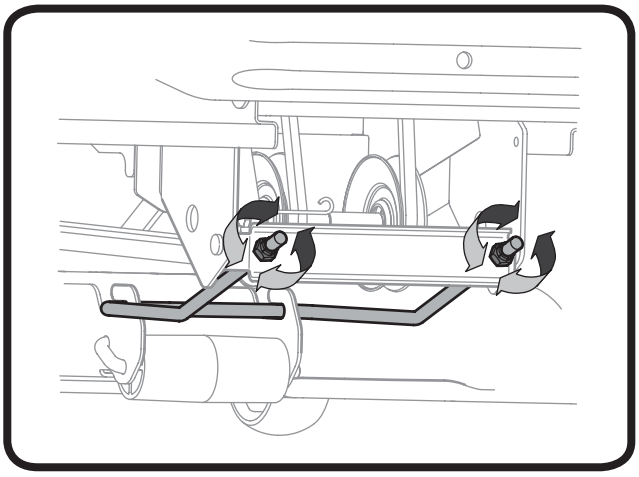


Figure 8.24

4. 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.
5. Adjust the two lock nuts on the front hanger bracket as necessary to get the front of the deck 1/4" - 3/8" lower than the rear.
   - Tighten the nuts to raise the front of the deck.
   - Loosen the nuts to lower the front of the deck.

NOTE: Both nuts need to be tightened or loosened evenly (same number of turns).

6. Re-measure the distance from the front of the blade tip to the ground and the rear of the blade tip to the ground.

Deck Gauge 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 prevents scalping damage to the turf and to the deck.

Adjust the gauge wheels as follows:

1. Place the tractor on a smooth, flat surface and move the deck to the desired mowing height.

   NOTE: Check the tractor’s tire pressure before performing any deck leveling adjustments. The recommended operating tire pressure is:

   - Approximately 10 psi for the rear tires
   - Approximately 12 psi for the front tires

2. Check gauge wheels distance from the flat surface below. The deck wheels should have between 1/4” - 1/2 “ clearance above the ground.
3. Remove the shoulder bolt securing the ball wheel to the index bracket.
4. Reposition the ball wheel to align with the one of the index holes that places the wheel 1/4" to 1/2" above the ground. See Figure 8.25.
5. Secure the ball wheel to the index bracket with the shoulder bolt.

   NOTE: Both front wheels should use the same index hole and both rear wheels should use the same index hole.

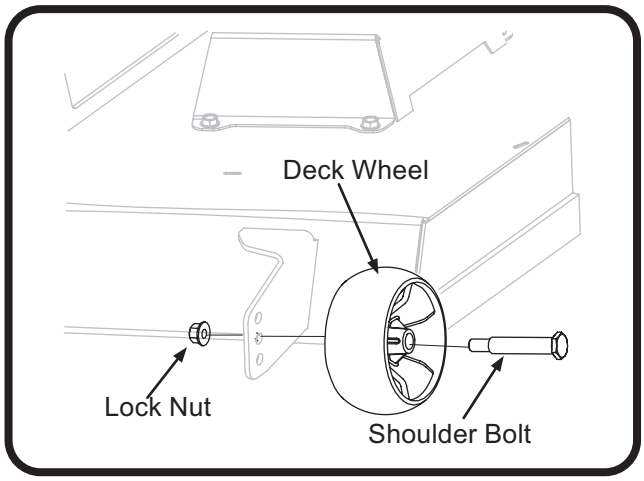


Figure 8.25

Deck lift shaft bushings

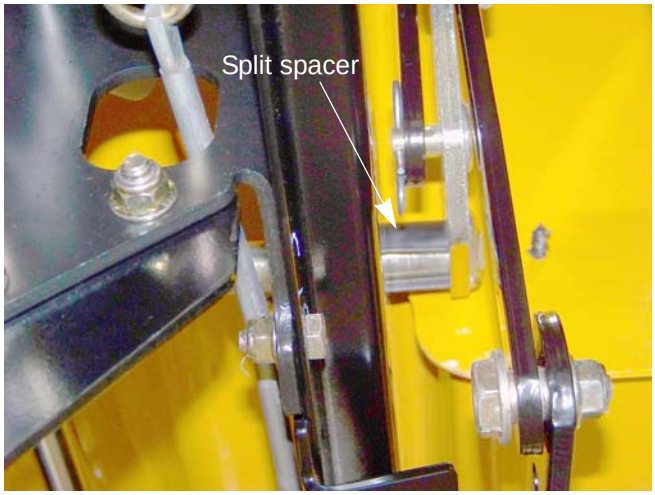


Figure 8.26

The lift shaft bushings on the 2000 series tractor can be replaced without removing the lift shaft.

To remove/replace the lift shaft bushings:

1. Remove the deck by following the procedures described in the deck removal section of this chapter.
2. Remove one of the split spacers from the deck lift shaft. See Figure 8.26.

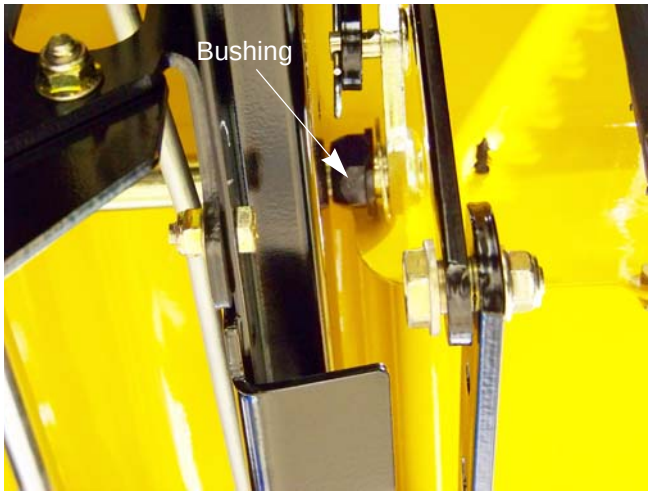


Figure 8.27

3. Slide the bushing out of the frame. See Figure 8.27.
4. Remove the bushing from the lift shaft.
5. Install a new bushing onto the lift shaft.
6. Slide the bushing into the frame, aligning the opening of the bushing with the notches in the frame.

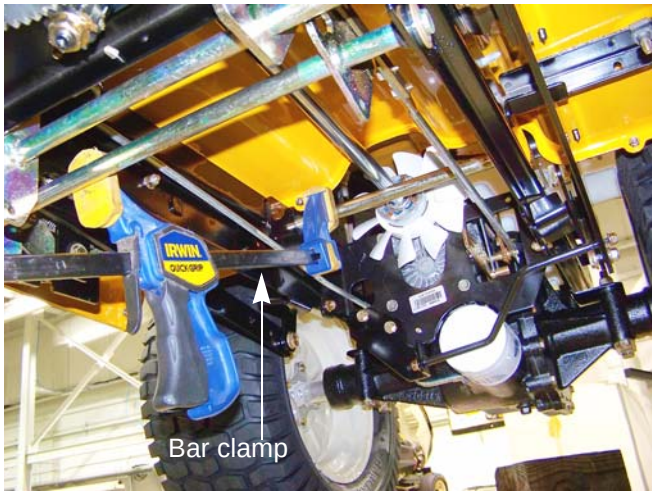


Figure 8.28

7. Install the split bushing.

NOTE: On tractors with a manual deck lift, the lift shaft will have a spring pulling on it. A bar clamp can be used to counter-act the spring force and hold the lift shaft centered in the opening of the frame while sliding the bushing into place. See Figure 8.28.

8. Repeat steps 2 - 7 on the other side.
9. Install the deck by following the procedures described in the deck removal section of this chapter.

Deck lift shaft assembly (manual)

To remove/replace the lift shaft:

1. Remove the deck by following the steps described at the beginning of this chapter.
2. Remove the fender and running board by following the procedures described in Chapter 4: Body.
3. Remove the split spacers. See Figure 8.29.
4. Slide the split bushings out of the notches in the frame
5. Remove the split bushings from the lift shaft.

   NOTE: The washers were installed onto the lift shaft before the bell cranks were welded in place and can not be removed or replaced.

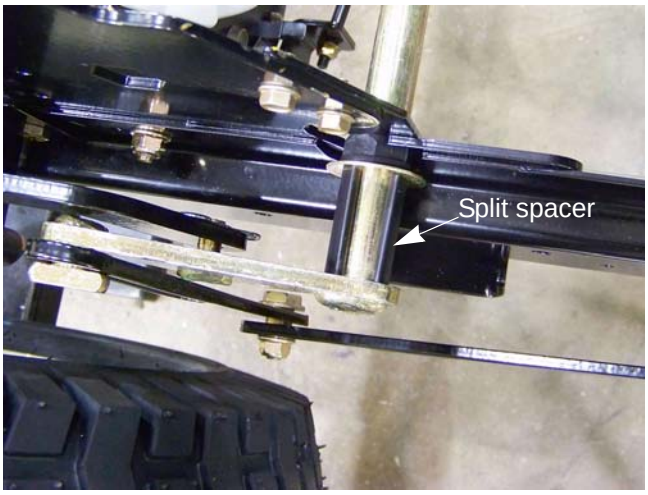


Figure 8.29

6. On each side, remove the shoulder bolt and nut that holds the slotted link to the lift link using a 3/4" wrench and a 9/16" wrench. See Figure 8.30.

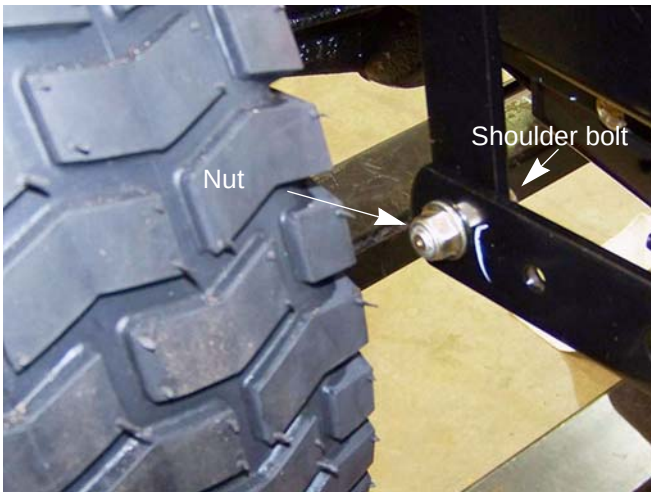


Figure 8.30

7. Remove the bowtie clip that holds the lift lever link to the lift shaft bell crank. See Figure 8.31.
8. Slide the lift shaft towards the right side of the tractor far enough to slide the lift lever link off of the pin on the lift shaft bell crank.

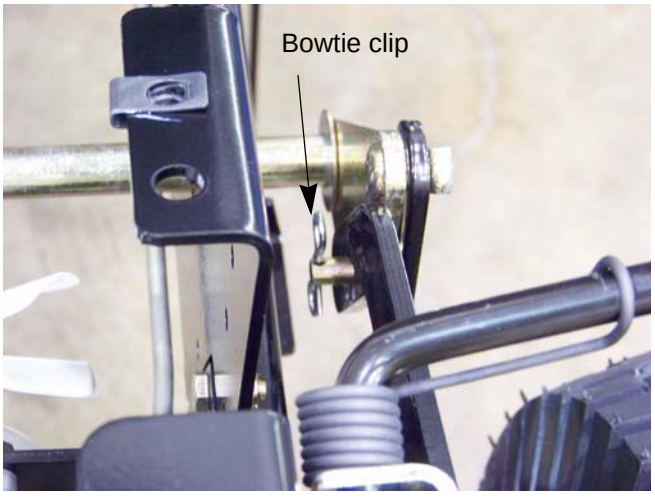


Figure 8.31

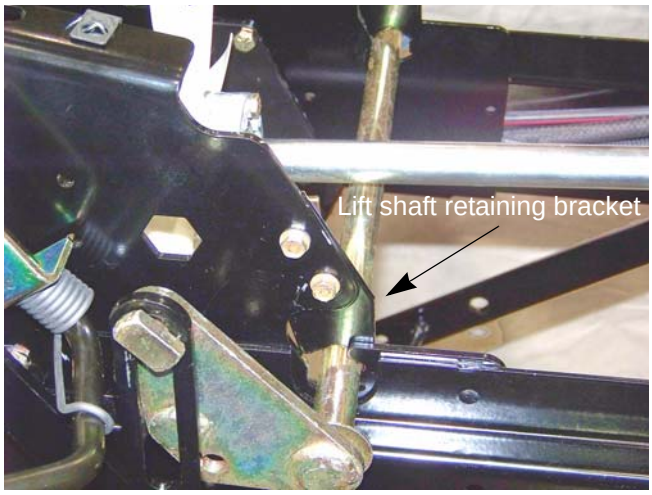


Figure 8.32

9. Remove the two screws that hold the lift shaft retaining bracket, on each side of the frame, using a 3/8" wrench. See Figure 8.32.

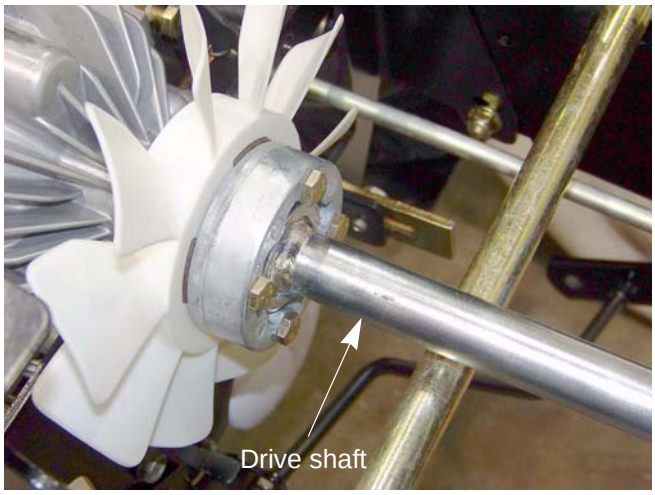


Figure 8.33

10. Remove the four bolts that connect the drive shaft to the hydro pump. See Figure 8.33.
11. Carefully lift up on the drive shaft.

NOTE: If the drive shaft slips out of the front (engine) coupling, the engine will have to be removed in order to get the drive shaft rollers out of the blower housing.

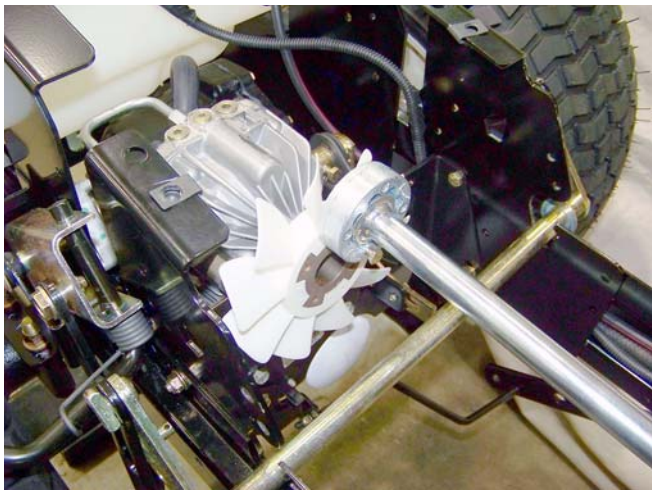


Figure 8.34

12. Line up the bottom hole of the drive shaft coupling with the top hole of the hydro pump input coupling.
13. Install one of the drive shaft bolts to hold the drive shaft in place. See Figure 8.34.

14. Slide the lift shaft out of the notches in the frame.
15. Disconnect the helper spring link from the lift shaft. See Figure 8.35.
16. Remove the slotted links.
17. Slide the lift shaft out from under the drive shaft.

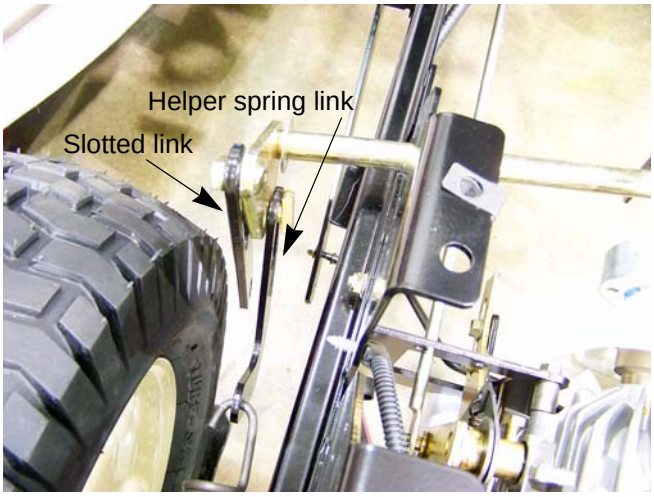


Figure 8.35

18. Install the deck lift shaft and bushings by following the previous steps in reverse order.

    NOTE: Do not put grease on the lift shaft or bushings. Grease will hold dirt and accelerate the wear of the bushings.

    NOTE: When installing the bushings, the lift shaft will be spring loaded. A bar clamp can be used to counter act the spring force and hold the lift shaft centered in the notches of the frame while installing the bushings. See Figure 8.36.
19. Operate the deck through its full range of travel.
20. Check the deck for levelness and pitch.
21. Test run the tractor in a safe area before returning it to service.

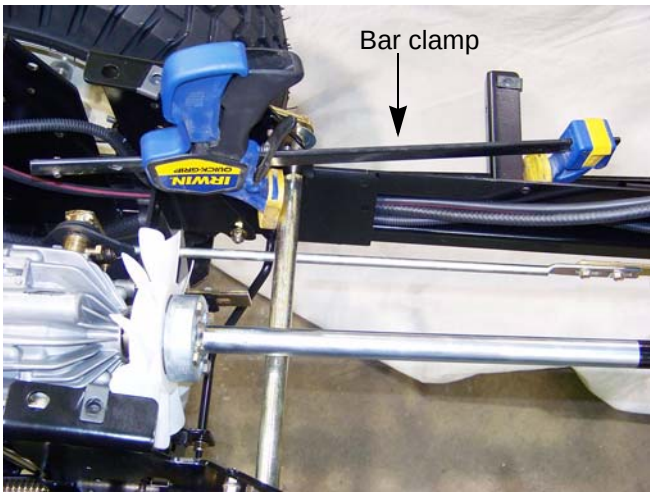


Figure 8.36

Deck lift shaft assembly (electric)

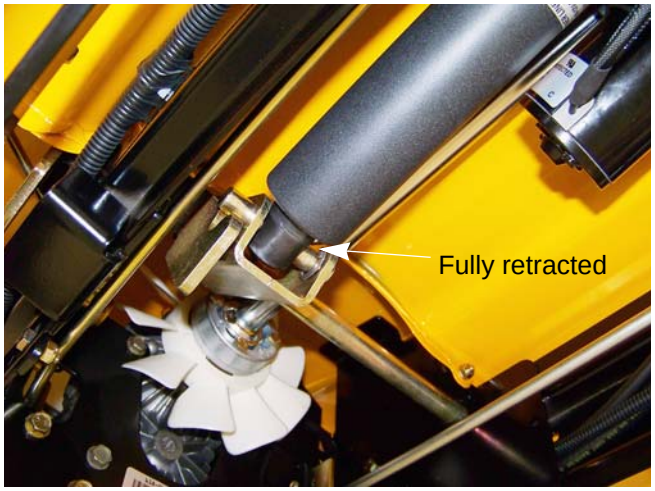


Figure 8.37

To remove/replace the lift shaft:

1. Remove the deck by following the steps described at the beginning of this chapter.
2. Set the cutting height to its lowest setting.
3. Operate the deck lift switch until the deck lift actuator if fully retracted. See Figure 8.37.
4. Remove the fender and running board by following the procedures described in Chapter 4: Body.

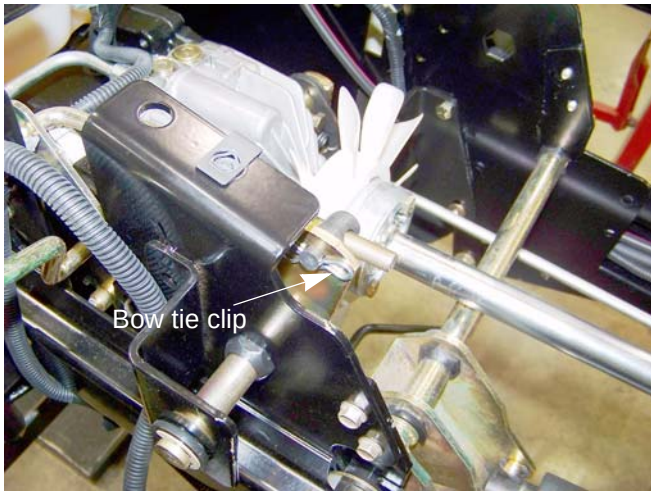


Figure 8.38

5. Disconnect the deck height lever link from the latch by removing the bowtie clip from the ferrule. See Figure 8.38.

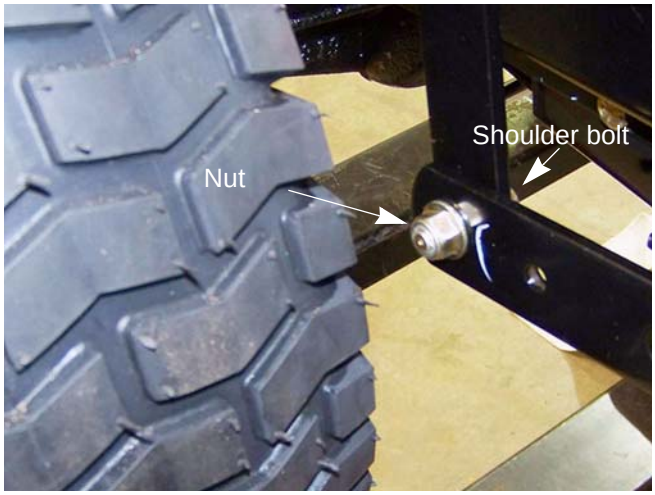


Figure 8.39

6. On each side, remove the shoulder bolt and nut that hold the slotted link to the lift link using a 3/4” wrench and a 9/16” wrench. See Figure 8.39.

7. Disconnect the deck lift actuator:

   7a. Remove the inboard E-ring from the pin that connects the lift actuator to the lift shaft connecting arm.

   7b. Remove the pin by sliding it out to the left.

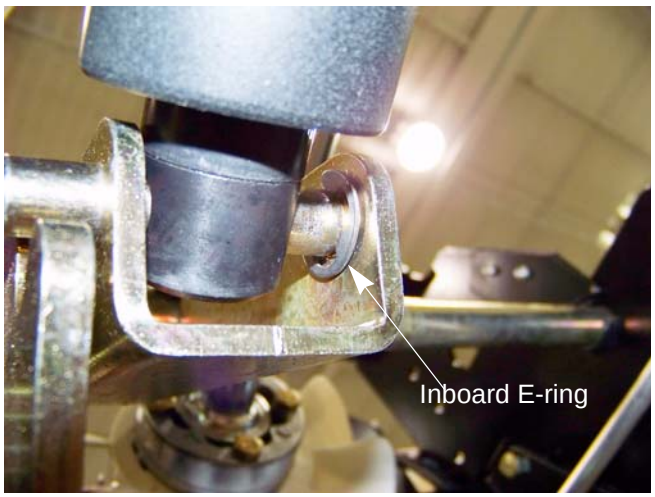


Figure 8.40

8. Remove the split spacers. See Figure 8.29.

9. Slide the split bushings out of the notches in the frame

10. Remove the split bushings from the lift shaft.

    NOTE: The washers were installed onto the lift shaft before the bell cranks were welded in place and can not be removed or replaced.

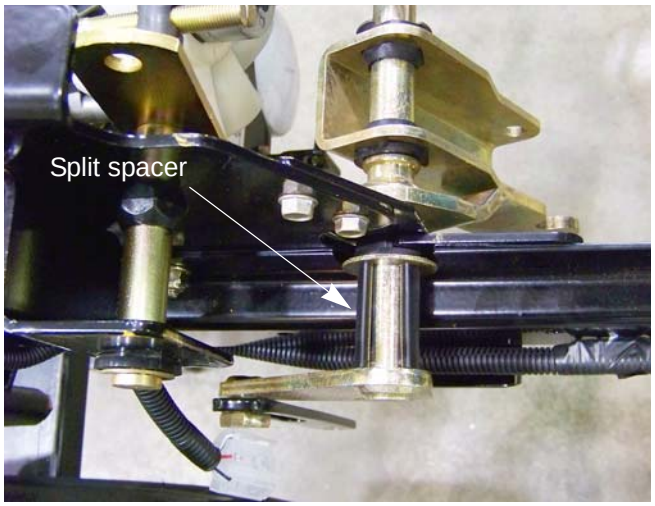


Figure 8.41

11. Remove the two screws that hold the lift shaft retaining bracket, on each side of the frame, using a 3/8” wrench. See Figure 8.32.

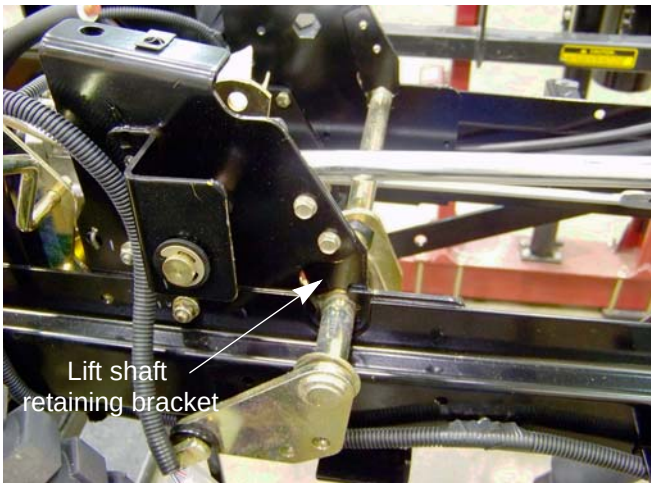


Figure 8.42

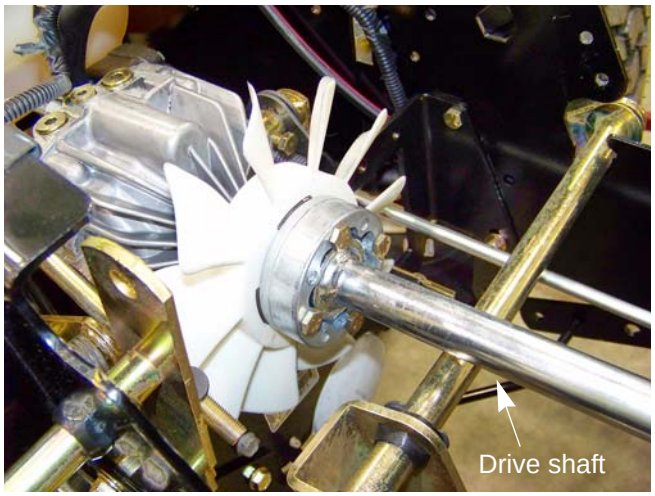


Figure 8.43

12. Remove the four bolts that connect the drive shaft to the hydro pump. See Figure 8.33.
13. Carefully lift up on the drive shaft.

NOTE: If the drive shaft slips out of the front (engine) coupling, the engine will have to be removed in order to get the drive shaft rollers out of the blower housing.

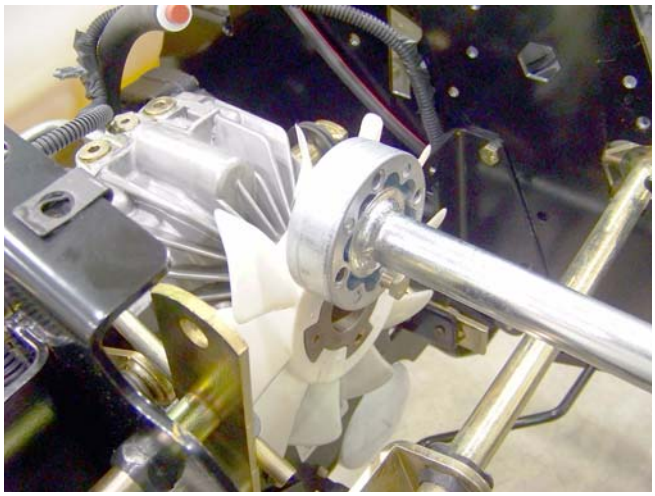


Figure 8.44

14. Line up the bottom hole of the drive shaft coupling with the top hole of the hydro pump input coupling.
15. Install one of the drive shaft bolts to hold the drive shaft in place. See Figure 8.34.
16. Slide the lift shaft out of the notches in the frame.
17. Remove the slotted links.
18. Slide the lift shaft out from under the drive shaft.

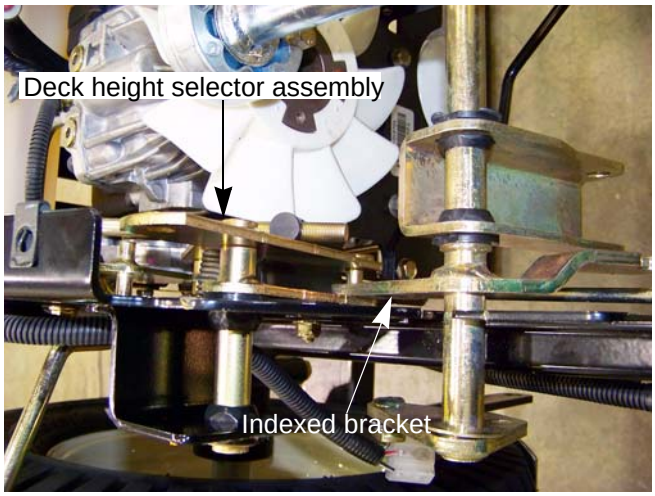


Figure 8.45

19. Install the deck lift shaft and bushings by following the previous steps in reverse order.

NOTE: Do not put grease on the lift shaft or bushings. Grease will hold dirt and accelerate the wear of the bushings.

NOTE: When installing the lift shaft, make sure the indexed bell crank of the lift shaft is inserted into the slot of the deck height selector assembly. See Figure 8.45.

20. Operate the deck through its full range of travel.
21. Check the deck for levelness and pitch.
22. Test run the tractor in a safe area before returning it to service.

Deck lift actuator (electric lift)

To remove/replace the lift shaft:

1. Remove the deck by following the steps described at the beginning of this chapter.
2. Disconnect the lift actuator harness. See Figure 8.46.

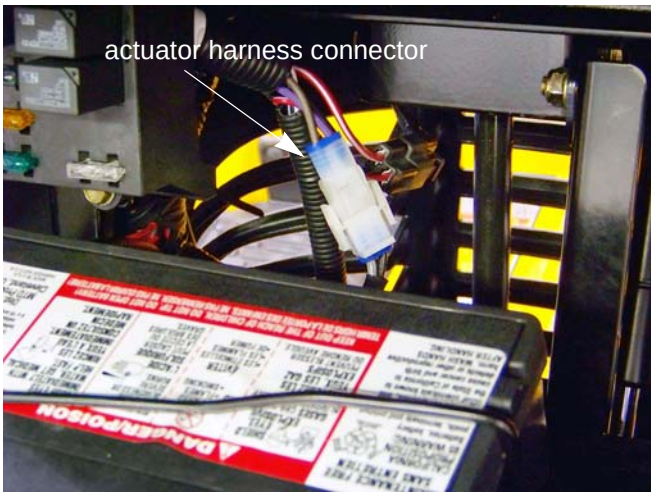


Figure 8.46

3. Insert the end of a piece of string or light rope, at least 3' (1 M) long in between the two wire in the electric lift harness connector.

   NOTE: The string is going to be used to fish the actuator harness back up through the dash.

4. Loop the string over the connector and tie a figure eight knot so that the knot sits between the two legs of the connector. See Figure 8.47.
5. Lift and safely support the tractor.

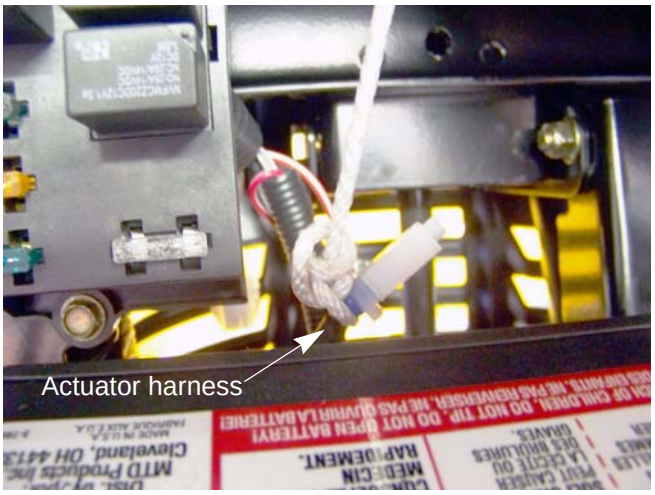


Figure 8.47

6. Pull the lift actuator harness out of the frame rail from underneath the tractor, but leaving the string in place.

   NOTE: It may be necessary to reach in behind the dash from the left side of the tractor and guide the harness connector into the hole between the frame and the dash support on the right side of the tractor.

7. Untie the string.

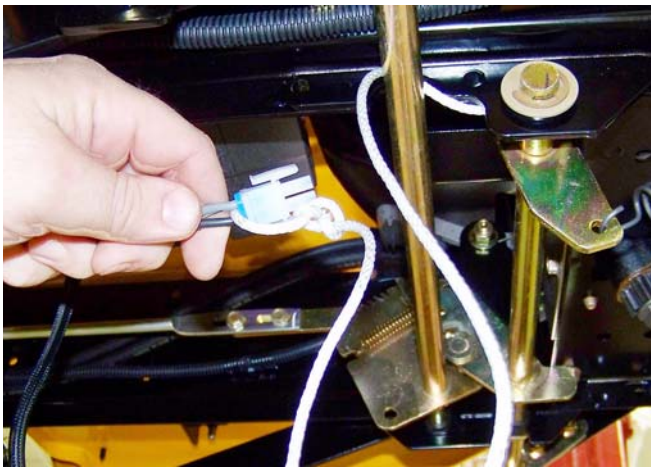


Figure 8.48

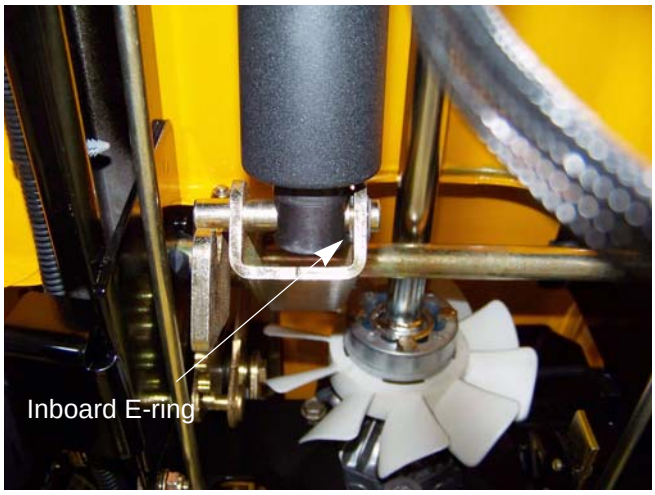


Figure 8.49

8. Disconnect the deck lift actuator from the deck lift shaft:
   - 8a. Remove the inboard E-ring from the pin that connects the lift actuator to the lift shaft connecting arm. See Figure 8.49.
   - 8b. Remove the pin by sliding it out to the left.

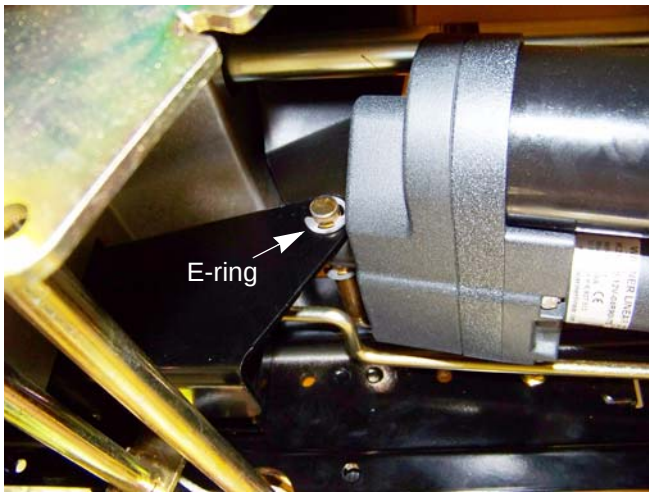


Figure 8.50

9. Disconnect the deck lift actuator from the frame:
   - 9a. Remove the left E-ring from the pin that connects the lift actuator to the frame. See Figure 8.50.
   - 9b. While supporting the actuator, slide the pin far enough to the right for the actuator to clear it.
10. Install the actuator by following steps 8 and 9 in reverse order.
11. Tie the end of the string that was fished through the dash onto the actuator harness.
12. Pull the string until the harness has been routed back through the dash.

NOTE: It may be necessary to reach in behind the dash from the left side of the tractor and guide the harness connector out of the hole between the frame and the dash support on the right side of the tractor.

13. Connect the actuator harness to the main harness.
14. Operate the deck lift through its full range of travel.
15. Install the deck by following the procedures described in the deck removal section of this chapter.
16. Check the deck for levelness and pitch.
17. Test run the tractor in a safe area before returning it to service.

Electric PTO clutch

To remove/replace the PTO clutch:

1. Remove the hood by following the procedures described in Chapter 4: Body.
2. Remove the PTO belt by following the procedures described in the PTO belt section of this chapter.
3. Disconnect the harness from the PTO clutch. See Figure 8.51.

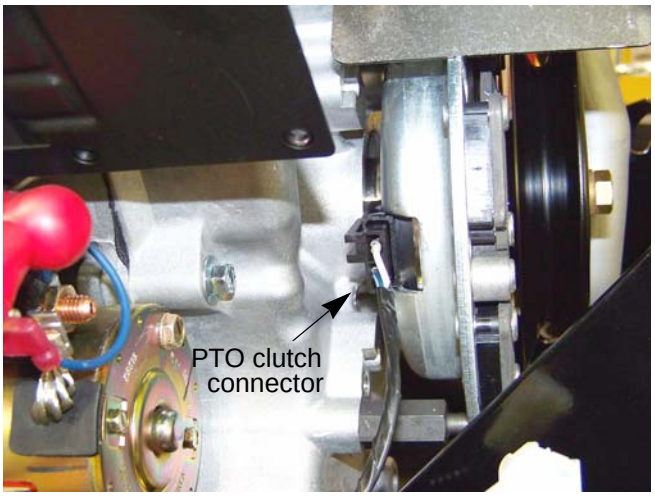


Figure 8.51

NOTE: Some of the GTX2154LE tractors have a diode jumper between the harness and the PTO clutch. See Figure 8.52.

NOTE: When the PTO clutch dis-engages, it can produce voltage spikes. The diode can help minimize these spikes.

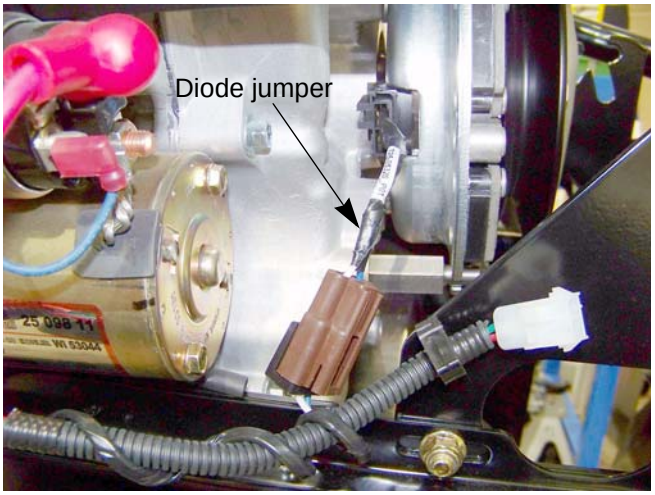


Figure 8.52

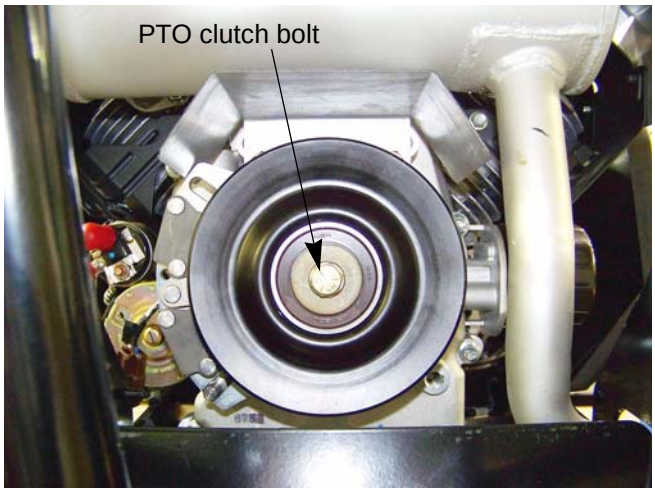


Figure 8.53

4. Remove the PTO clutch bolt using an impact wrench with a 5/8” socket. See Figure 8.53.
5. Install the PTO clutch by following the previous steps in reverse order.

NOTE: Coat the crankshaft with an anti-seizing compound before installing the clutch.

NOTE: Tighten the PTO clutch bolt to a torque of 50 - 60 ft lbs (68 - 81 Nm).

IMPORTANT: A new electric PTO clutch must be burnished before it is placed into service.

To burnish the clutch:

- Start the engine.
- Move the throttle to the 50 percent position.
- Engage and disengage the clutch 5 times, ten seconds on and ten seconds off.
- Move the throttle to 75 the percent position.
- Engage and disengage the clutch 5 more times, ten seconds on and ten seconds off.

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

Evaluating the PTO clutch

To evaluate a PTO clutch:

NOTE: most of the evaluation can be preformed while the clutch is still mounted to the engine.

1. Disconnect the harness from the PTO clutch.
2. Measure the clutch coil resistance:

   2a. Set the meter to check ohms.

   2b. Disconnect the harness from the PTO clutch.

   NOTE: On tractors with the diode jumper, disconnect the jumper from the PTO clutch

   2c. Measure clutch coil's resistance across the clutch contacts. See Figure 8.54.

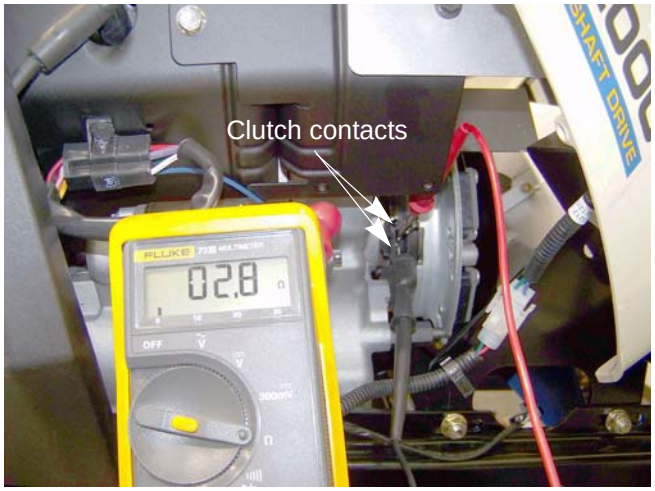


Figure 8.54

- If the meter reads below 2.70 ohms or above 2.98 ohms, the clutch has failed and needs to be replaced.
- If the meter reads between 2.40 and 3.40 ohms, proceed to measuring clutch current draw.

3. By-pass the seat switch:

   3a. Lift up the seat.

   3b. Press in on the lower section of the seat until the tabs on the seat switch extend out of the switch.

   3c. Clamp onto the tabs with a pair of spring clamps.

Figure 8.55

Figure 8.56

4. Measure the PTO clutch's current draw

   4a. Set the DMM to check amps using the 10 amp scale.

   4b. Connect one meter lead wire to one wire in the clutch connector and the other lead wire to the corresponding wire in the mating connector. See Figure 8.55.

NOTE: It does not matter which contact in the harness connector is used.

   4c. Connect a short wire to the second wire in both connectors.

   4d. Turn the PTO switch on.

- If the meter reads below 4.0 amps, the problem would most likely be in the electrical system leading to the clutch such as a bad ground, a relay, or a switch.
- If the meter reads 4.0 amps or above, the clutch should be operating properly.

NOTE: Unlike older PTO clutches, the PTO clutch air gap on 2000 series tractors can not be adjusted.

5. If an electric PTO clutch passes these tests, but will not hold as it should in the engaged position:

- Check the battery condition.
- Check the charging system's performance.
- Check the clutch power and ground circuits using the voltage drop technique.

CHAPTER 9: MAINTENANCE INTERVALS

Lubrication

To help keep the 2000 series in proper running order, Cub Cadet recommends the following lubrication intervals be used (adjustable to local conditions). Lubricate with 251H EP grease or an equivalent NGLI grade 2 lithium based multi-purpose grease.

Lube Point	Number of fittings	Interval
Front wheel bearings	2	25 hours
Pivot bar	3	25 hours
Steering housing	2	25 hours
Lube pedal pivot points	-	10 hours
Spindles	*	25 hours

NOTE: Lubricate all of the pivot points with a light coating of oil once a season.

***** Refer to Chapter 8: Decks and Lift Systems for the number of spindle grease fittings and there locations.

NOTE: Refer to Chapter 5: Drive System for the transmission maintenance intervals.

Engine maintenance

The recommended maintenance intervals listed in this manual are a guideline. They are adjustable for local conditions.

Maintenance items	Interval
Oil Change	100 hrs
Oil filter	200 hours
Clean the air filter pre-cleaner	25 hrs
Replace the air filter	100 hrs
Spark plugs	200 hrs
Fuel filter	200 hrs
Clean the engine	100 hours

The spark plugs

The spark plugs should be checked, cleaned and re-gapped every 200 hours of use. The plugs should be replaced when the electrode is worn out.

When checking the spark plugs, 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.

There should be a dry tan coating on the plugs. This would indicate the proper mixture.

To remove/replace the spark plugs:

1. Disconnect the spark plug wires on each side. See Figure 9.1.

   NOTE: Do not use metal pliers on spark plug wires. Damage to the wire can result.

2. Clean the area around the spark plug to prevent debris from entering the engine.

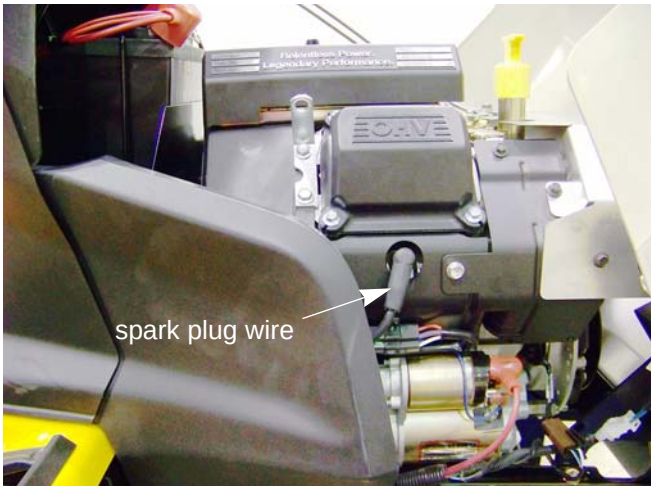


Figure 9.1

3. Remove the spark plugs with a 13/16” spark plug socket. See Figure 9.2.
4. Clean the Spark plugs with carburetor cleaner or replace them with two Champion RC12YC spark plugs (Kohler #25 132 02-S).

   NOTE: Do not clean the spark plugs mechanically (sand blasting or scraping). This will damage the insulator.

5. Gap the electrodes to 0.030” (0.76mm).
6. Thread the spark plugs into the spark plug holes.
7. Tighten the spark plugs to a torque of 18 - 22 ft - lbs (24.4 - 29.8 Nm).

   NOTE: Refer to the Kohler engine manual for more detailed instructions.

8. Push the spark plug wires onto the spark plugs until they snap into place.
9. Test drive the mower in a safe area before returning it to service.

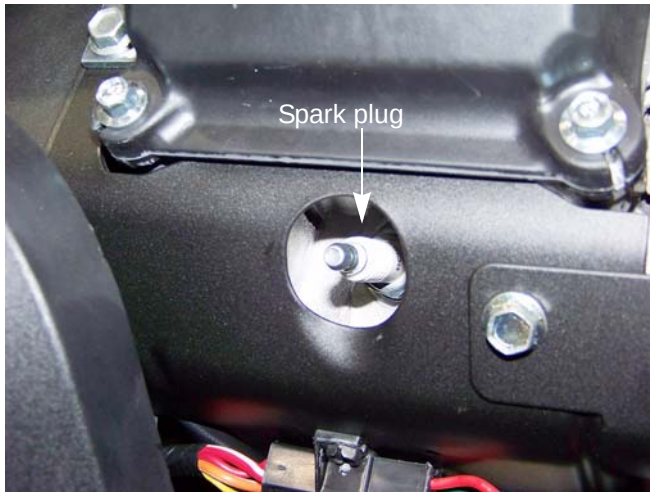


Figure 9.2

Air filter and pre-cleaner

Figure 9.3

The Kohler engines used by Cub Cadet are equipped with a foam pre-cleaner and a pleated paper air filter.

A dirty air filter can reduce engine power, increase fuel consumption and make starting more difficult. The pre-cleaner should by cleaned every 25 hours. The air filter should be cleaned every 100 hours and replaced every 200 hours of use.

To clean the pre-filter:

1. Open the hood of the tractor. See Figure 9.3.
2. Remove the air filter cover by loosening the cover retaining wing nut and lifting the cover off.

NOTE: The wing nut is attached to the cover and does not come off.

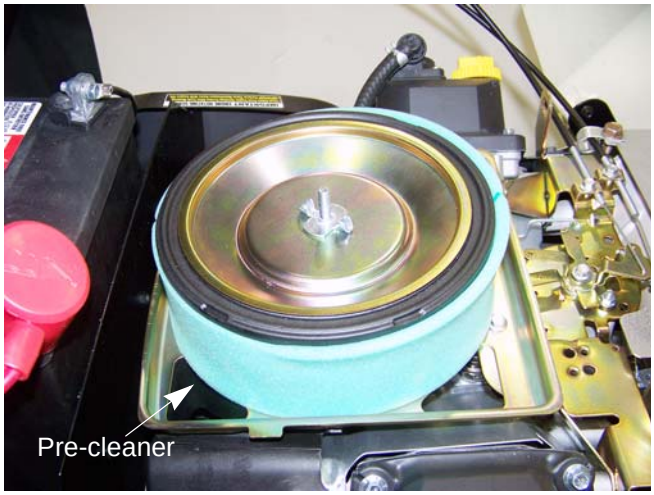


Figure 9.4

3. Slide the foam filter off of the paper air filter.
4. Wash the filter with warm soapy water. Let the filter air dry. **DO NOT** wring the filter out.

NOTE: Wringing the filter can tear it. Squeeze the filter, but do not twist it.

NOTE: If the pre-filter is crumbling or brittle, replace it.

5. Pour a couple of teaspoons of motor oil on the pre-filter.
6. Work the oil through the pre-filter until it is completely saturated.
7. Squeeze the excess oil out of the pre-filter.
8. Slide the pre-filter over the air filter.
9. Re-install the air filter cover.
10. Hand tighten the air filter cover wing nut.

To service the air filter:

1. Open the hood of the tractor.
2. Remove the air filter cover by loosening the cover retaining wing nut and lifting the cover off.
3. Remove and clean the foam pre-clear by following the procedures described in the previous section of this chapter.
4. Remove the element cover nut. See Figure 9.5.
5. Remove the air filter
6. The air filter can be cleaned by lightly tapping it on a hard surface.

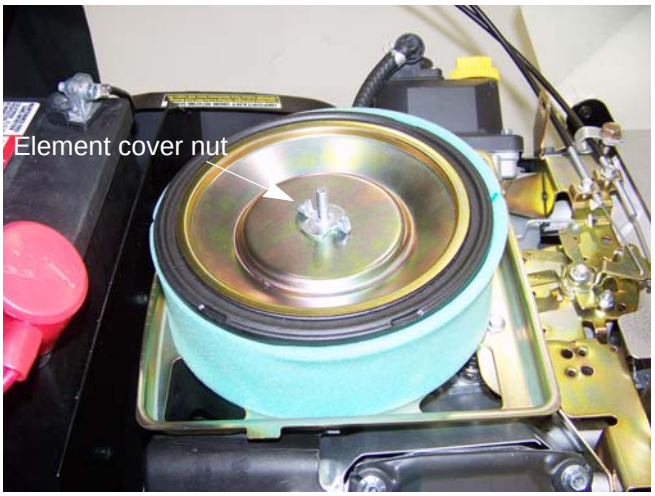


Figure 9.5

NOTE: Never blow compressed air through a paper air filter. The force of the air moving through the air filter will remove the tiny paper particles that trap the microscopic particles of dirt from the air.

NOTE: The paper element should be white in color. If the dirt does not come out of the filter with gentle tapping, replace the filter.

7. Install the filter by following the previous steps in reverse order.

Oil change

Figure 9.6

The oil change interval is every 100 hrs.

To change the oil:

1. Open the hood.
2. Clean around the fill plug.
3. Remove the oil fill plug. See Figure 9.6.

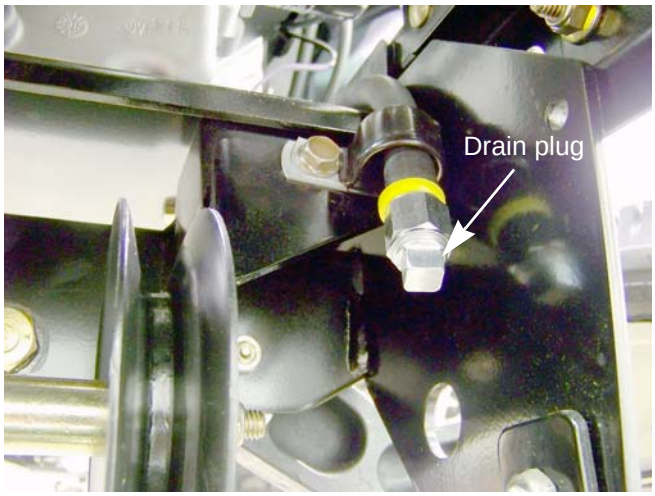


Figure 9.7

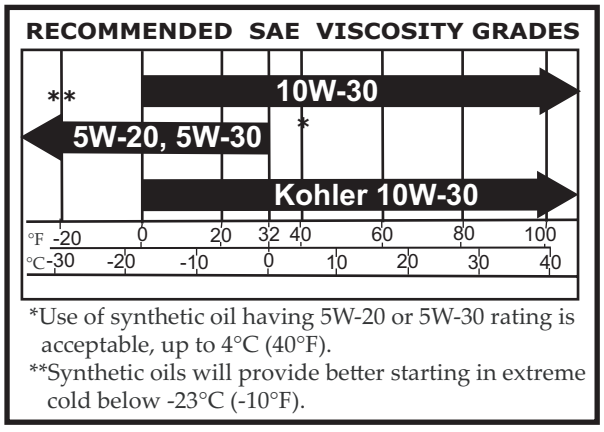
4. Place a suitable container under the oil drain at the front of the tractor. See Figure 9.7.
5. Remove the drain plug using a 7/16” wrench.
6. After all of the oil has been drained, re-install the oil drain plug.

NOTE: Apply Loctite 545 or a similar thread sealant to the threads of the drain plug. Tighten the drain plug finger tight, then tighten it 2.5 additional turns.

7. Fill engine with new oil. Use a good quality oil motor oil that meets the specifications recommended by Kohler.

NOTE: Refer to the oil chart to determine the proper weight of oil to use.

8. Check the dip stick to verify that the oil is at the proper level before returning to service.



Oil Chart

Oil filter

The oil filter should be change at every other oil change or 200 hours.

To replace the oil filter:

1. Drain the oil by following the steps described in the previous section of this chapter.

   NOTE: If replacing a damaged filter, the filter can be removed without draining the oil.

2. Clean the area around the oil filter
3. Remove the oil filter by turning it counter-clockwise, as seen from the right side of the mower. See Figure 9.8.
4. Place a light coating of oil on the O-ring of the new filter.
5. Pre-fill the new filter with fresh, clean oil.
6. Thread the new filter on to the engine. Hand tighten only.
7. Fill the engine with oil.
8. Test run the engine and check for leaks.
9. Re-check the oil level after running the engine.

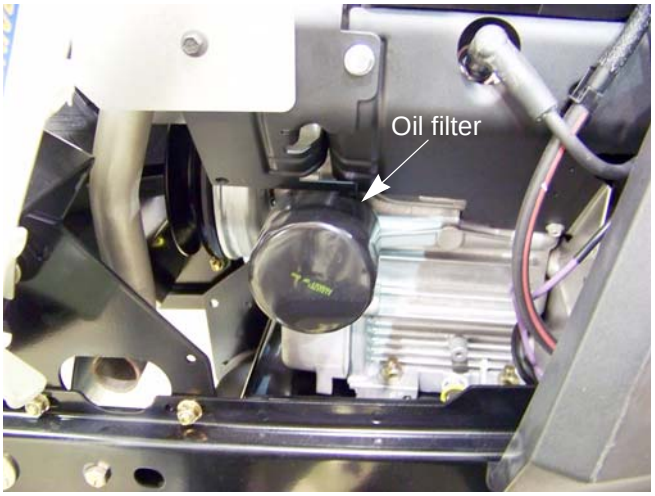


Figure 9.8

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.

Methanol is another type of alcohol that is used to oxygenate fuel. Fuel that contains 5% methanol can be used as long as it also contains cosolvents and corrosion inhibitors to protect the fuel system. Fuel with more than 5% methanol will cause starting and/or performance problem. It will also cause damage to the metal, rubber and plastic components of the fuel system.

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 storage, all fuel should be run out of the tank and engine. Anti-oxidation additives will help keep the fuel fresher.

Servicing the fuel system

Inspect the fuel system every time the mower is operated. If dirty fuel is found in the fuel tank or fuel that does not smell “right”, 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, responsible and legal manner.

⚠CAUTION Gasoline and it vapors are extremely flammable. Use common sense when working around the fuel system. Avoid sparks, open flames or heat sources that can ignite the fuel vapors.

Fuel filter

A dirty fuel filter can result in a lean run condition. The fuel filter should be replaced every 200 hours.

Figure 9.9

To replace the fuel filter:

NOTE: Only use the OEM fuel filter, part number KH-24-050-13-S.

1. Open the hood of the tractor.
2. Remove the two screws from the inside of the left side panel that attaches it to the dash using a 3/8” wrench. See Figure 9.9.

Figure 9.10

3. Remove the two screws, indicated by the arrows in Figure 9.10, that holds the base of the left side panel to the frame using a 1/2” wrench
4. Slide the left side panel off of the tractor.

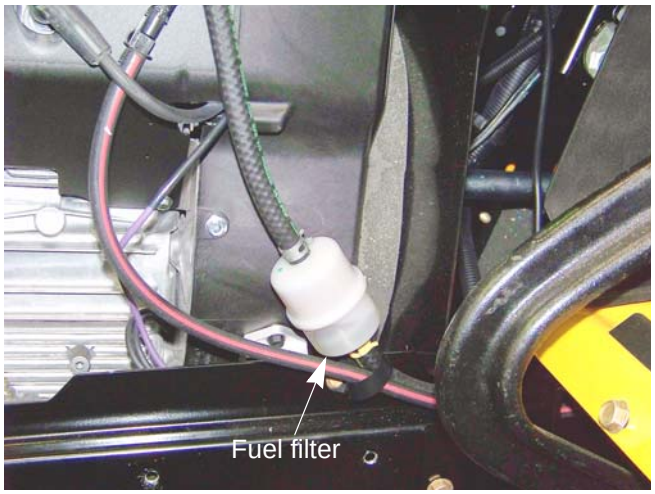


Figure 9.11

5. Clamp off the fuel lines.

   IMPORTANT: Take care that the fuel lines are not damaged 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.

6. Squeeze the tabs on the fuel line clamps and slide them away from the filter.

7. 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 2000 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.

8. Install the new filter by following the previous steps in reverse order.

9. Test run the engine and check for leaks before returning to service.

Clean the engine

Air cooled engines cool better if they are clean. Check for nesting or signs of nesting especially after dormant season storage. See Figure 9.12.

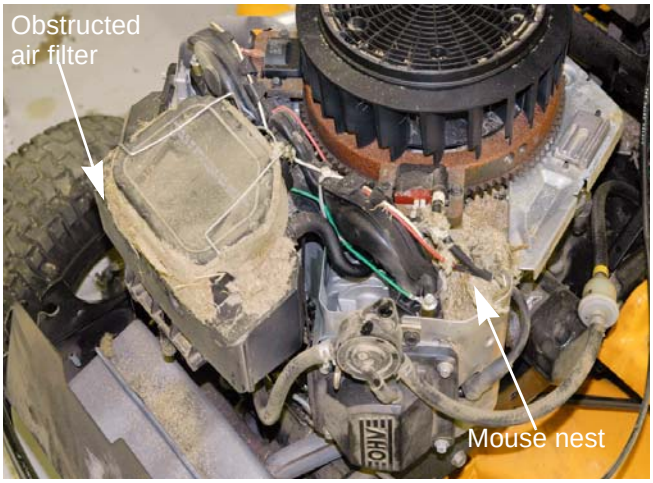


Figure 9.12

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