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PTO Control Manifold Service

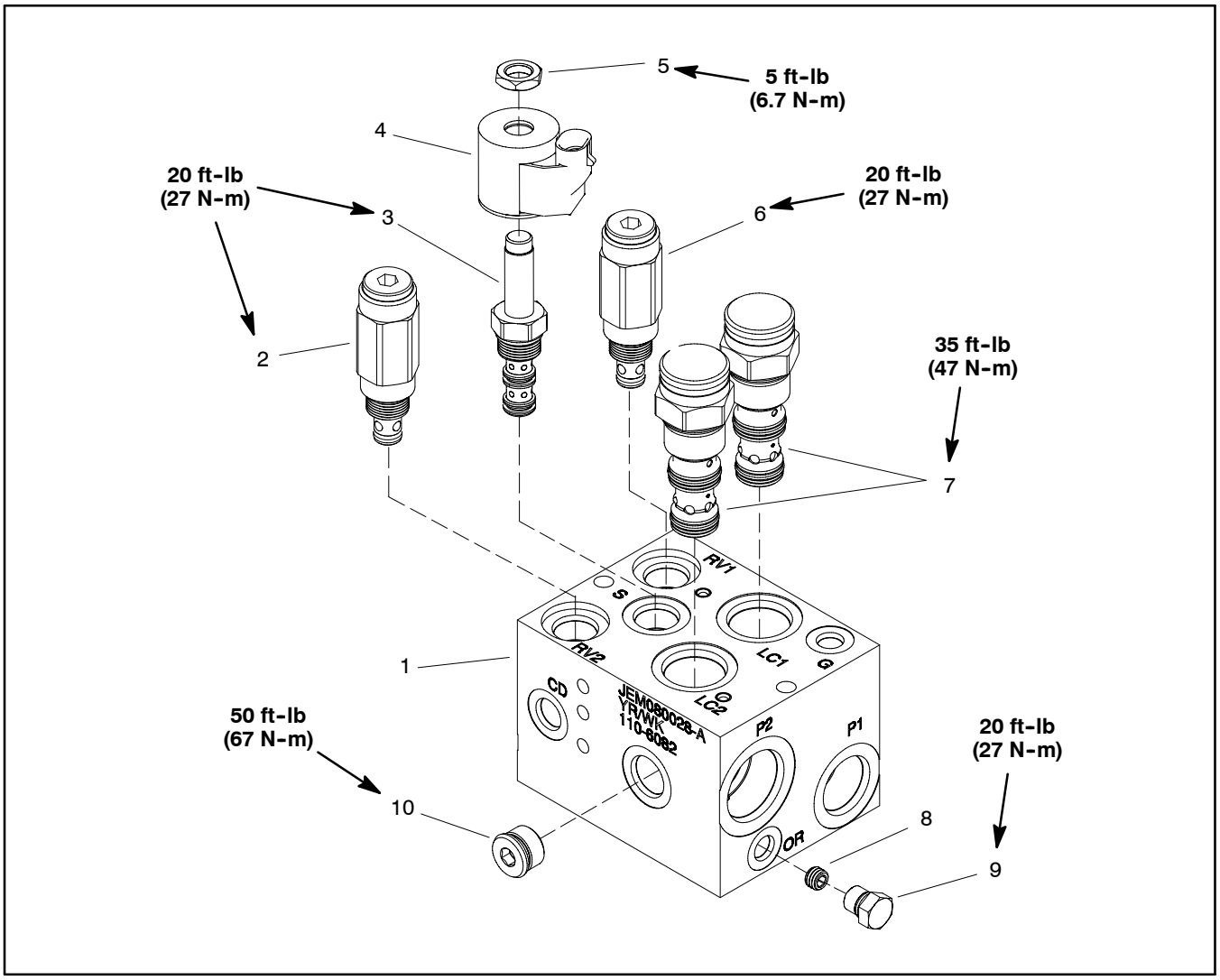


Figure 81

1. Manifold body
2. Relief valve (RV2)
3. Solenoid valve (S)
4. Solenoid coil
5. Nut
6. Relief valve (RV1)
7. Spool logic element (LC1 & LC2)
8. Orifice (OR) (RH and LH only)
9. NWD #4 plug with O-ring
10. NWD #8 plug with O-ring

NOTE: The ports on the PTO control manifolds are marked for easy identification of components. Example: S is the solenoid valve and M2 is the return from the deck motor (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location).

NOTE: The PTO control manifolds include several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using a wrench to remove the plug: the impact will allow plug removal with less chance of damage to the head of the plug. When installing plugs, refer to manifold illustration in Figure 81 for plug installation torque.

Valve Cartridge Service (Fig. 81)

The control manifolds for the three cutting deck sections are very similar. The manifold for the right and left side decks include an orifice (item 8) that is not used on the front deck manifold. Also, relief valve (RV1) on the right side manifold is set to a lower pressure (2000 PSI/138 bar) than the relief valve (RV1) pressure on the front and left side manifold (3000 PSI/207 bar). **Note:** When servicing the deck control manifolds, **DO NOT** interchange parts from one control manifold to another.

For solenoid and control valve service procedures, see Hydraulic Traction Control Manifold Service in this section. Refer to Figure 81 for PTO control manifold cartridge valve and plug installation torque.

Filter Manifold

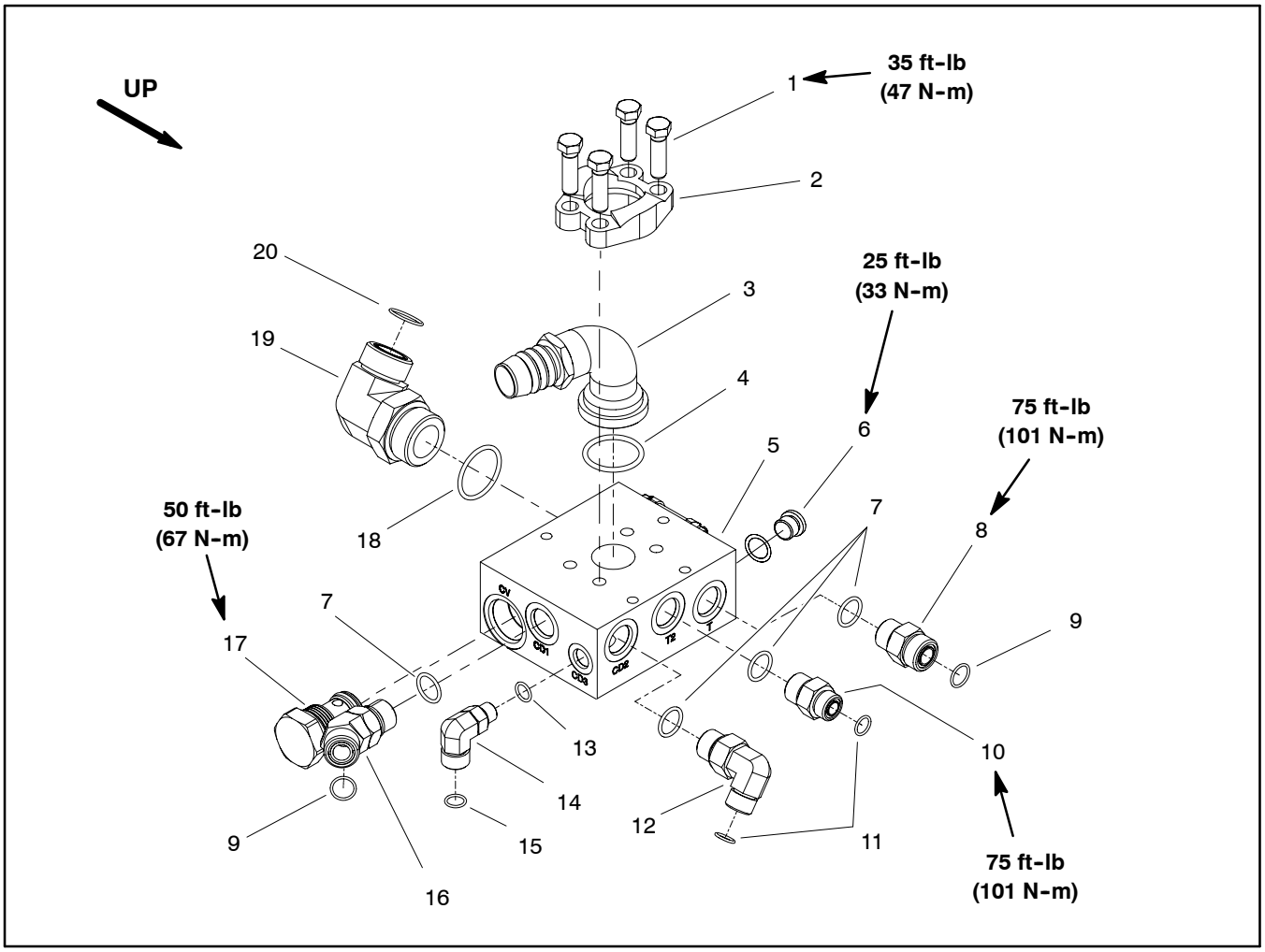


Figure 82

1. Cap screw & lock washer (4 used)
2. Split flange
3. Fitting
4. O-ring
5. Filter manifold
6. NWD #6 plug with O-ring
7. O-ring
8. Straight fitting (T)
9. O-ring
10. Straight fitting (T2)
11. O-ring
12. 90º hydraulic fitting (CD2)
13. O-ring
14. 90º hydraulic fitting (CD3)
15. O-ring
16. 45º hydraulic fitting (CD1)
17. Check valve (CV)
18. O-ring
19. 90º hydraulic fitting (CL)
20. O-ring

NOTE: The ports on the filter manifold are marked for easy identification of components. Example: CL is the connection port for the return from the oil cooler and CV is the check valve port (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Figs. 82 and 83)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. Raise hood to gain access to filter manifold.

3. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

4. Disconnect hydraulic lines from filter manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

5. Support filter manifold to prevent it from falling. Remove four (4) flange head screws that secure manifold to frame (Fig. 83). Remove filter manifold from the machine.

6. If hydraulic fittings are to be removed from filter manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O−rings.

Installation (Figs. 82 and 83)

1. If fittings were removed from manifold:

   A. Lubricate new o−rings with clean hydraulic oil. Install lubricated o−rings on fittings.

   B. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   C. Refer to Figure 82 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Refer to Figure 82 for check valve and plug installation torque.

3. Position filter manifold to the frame and secure with four (4) flange head screws (Fig. 83). Torque screws from **106 to 159 in−lb (12.0 to 17.9 N−m)**.

4. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Make sure hydraulic tank is full. Add correct oil if necessary.

6. Lower and secure hood.

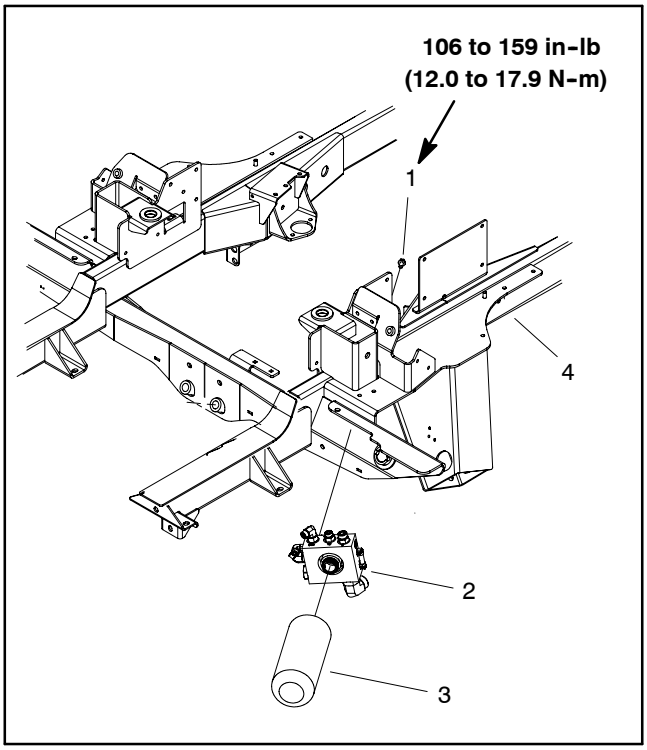


Figure 83

1. **Flange screw (4 used)**
2. **Filter manifold**
3. **Oil filter**
4. **Main frame**

Hydraulic Oil Cooler

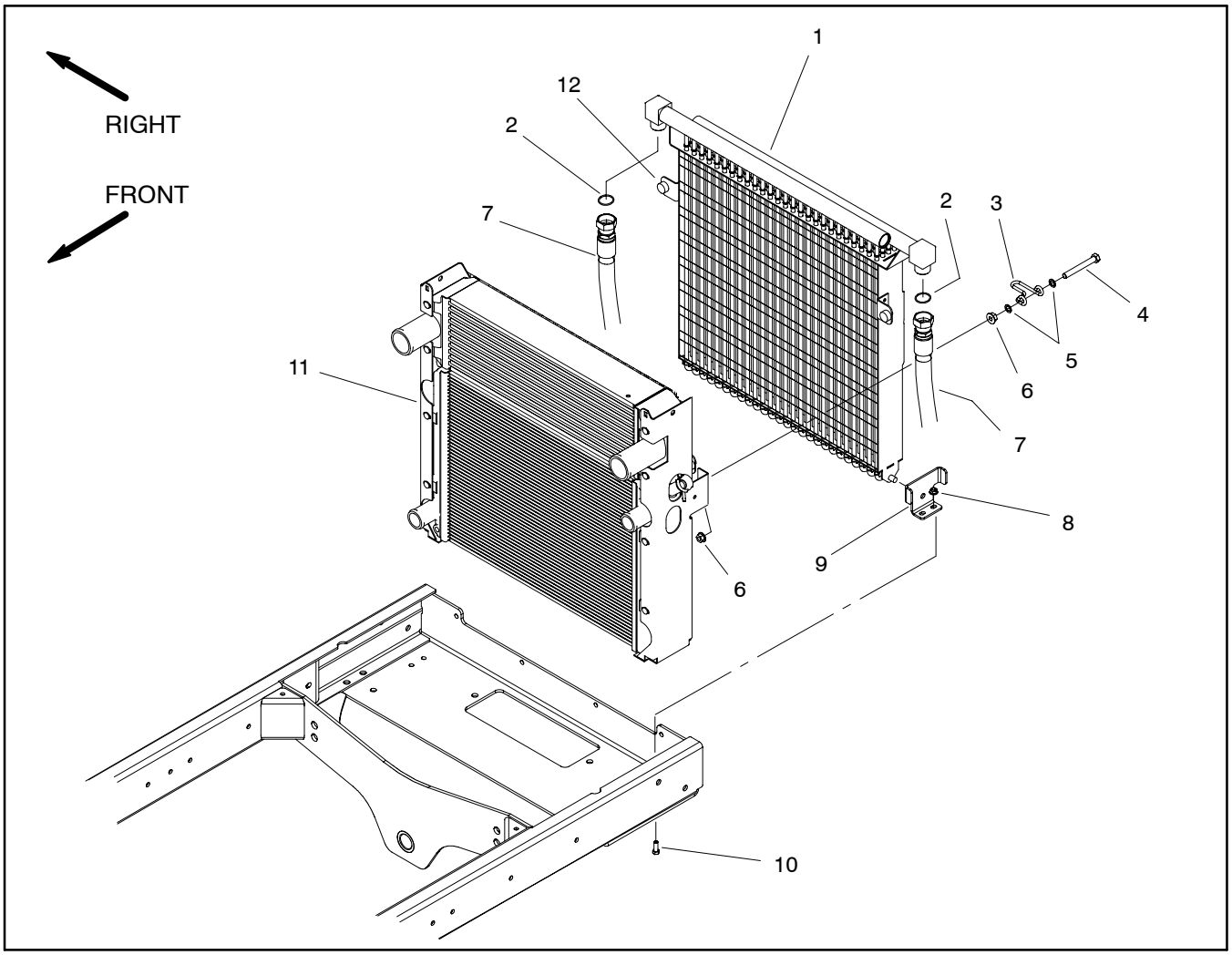


Figure 84

1. **Oil cooler**
2. **O-ring**
3. **Clamp (2 used)**
4. **Cap screw (2 used)**
5. **Washer (4 used)**
6. **Flange nut (4 used)**
7. **Hydraulic hose (2 used)**
8. **Flange nut (4 used)**
9. **Support plate (2 used)**
10. **Cap screw (4 used)**
11. **Radiator assembly**
12. **Bumper (2 used)**

Removal (Fig. 84)

CAUTION

The radiator and oil cooler may be hot. To avoid possible burns, allow the engine and cooling systems to cool before working on the oil cooler.

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Raise hood to gain access to oil cooler.

3. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

4. To prevent contamination of hydraulic system during oil cooler removal, thoroughly clean exterior of oil cooler and hydraulic hoses.

5. Remove oil cooler using Figure 84 as a guide. Use backup wrench on oil cooler fittings when removing hydraulic hoses from fittings. Put caps or plugs on oil cooler and hydraulic hose openings to prevent contamination.

Inspection

1. Back flush oil cooler with cleaning solvent. After cooler is clean, make sure all solvent is drained from the cooler.

CAUTION

Use eye protection such as goggles when using compressed air.

2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow.

3. Plug both ends of oil cooler. Clean exterior of cooler. Make sure all fins are clear of dirt and debris.

4. The oil cooler should be free of corrosion, cracked tubes and excessive pitting of tubes.

Installation (Fig. 84)

1. Remove caps or plugs placed during removal to prevent contamination. Install oil cooler using Figure 84 as a guide. Use backup wrench on oil cooler fittings when installing hydraulic hoses to fittings.

2. Fill reservoir with new hydraulic fluid as required.

3. Lower and support hood.

Cutting Deck Raise/Lower Circuit

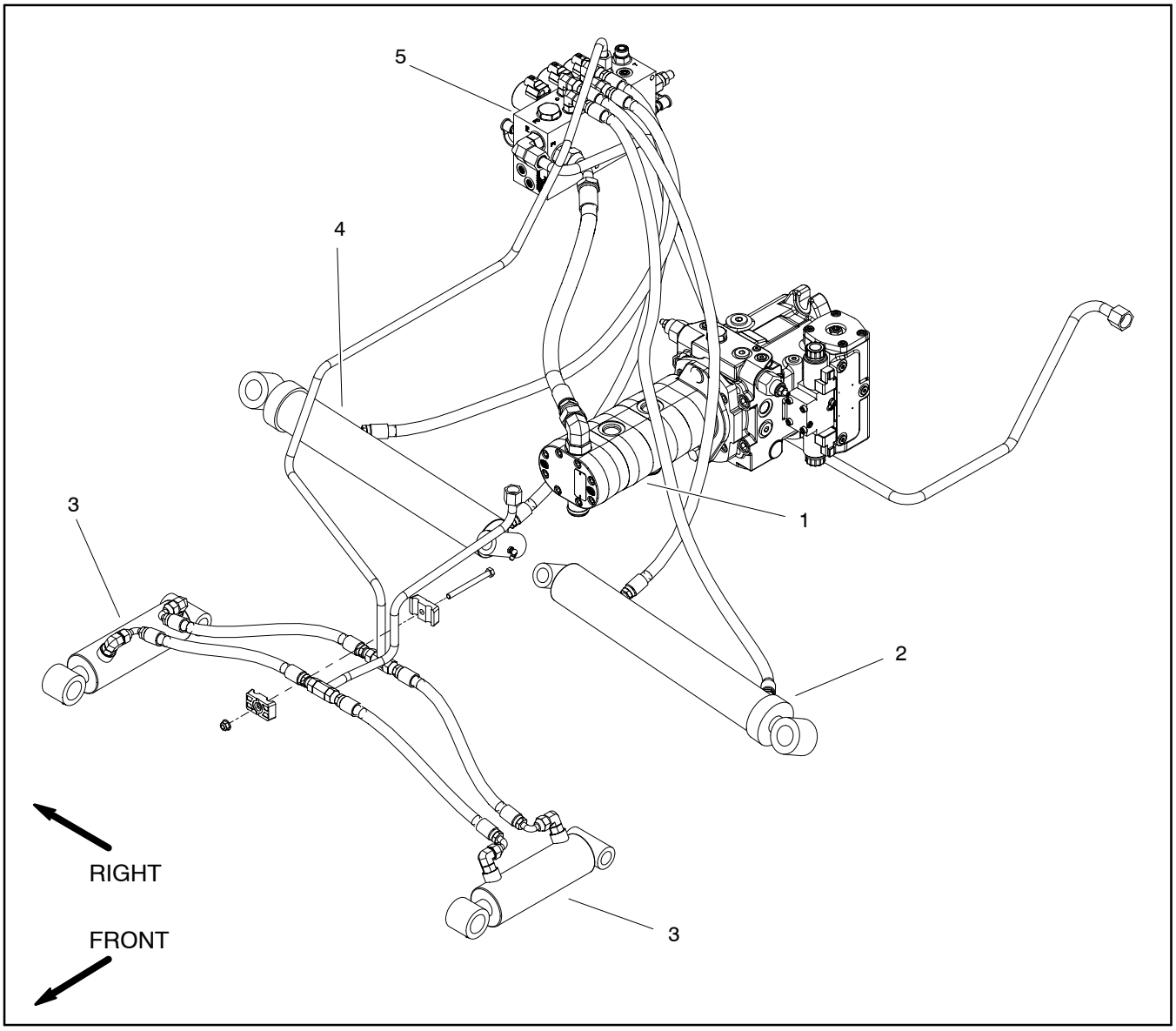


Figure 85

1. **Gear pump**
2. **LH cutting deck lift cylinder**
3. **Front cutting deck lift cylinder**
4. **RH cutting deck lift cylinder**
5. **Lift control manifold**

Figure 85 illustrates the components that are used in the Groundsmaster cutting deck raise/lower circuits. Procedures for removal, installation and disassembly/assembly of these components are provided in the following pages of this section.

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Front Deck Lift Cylinder

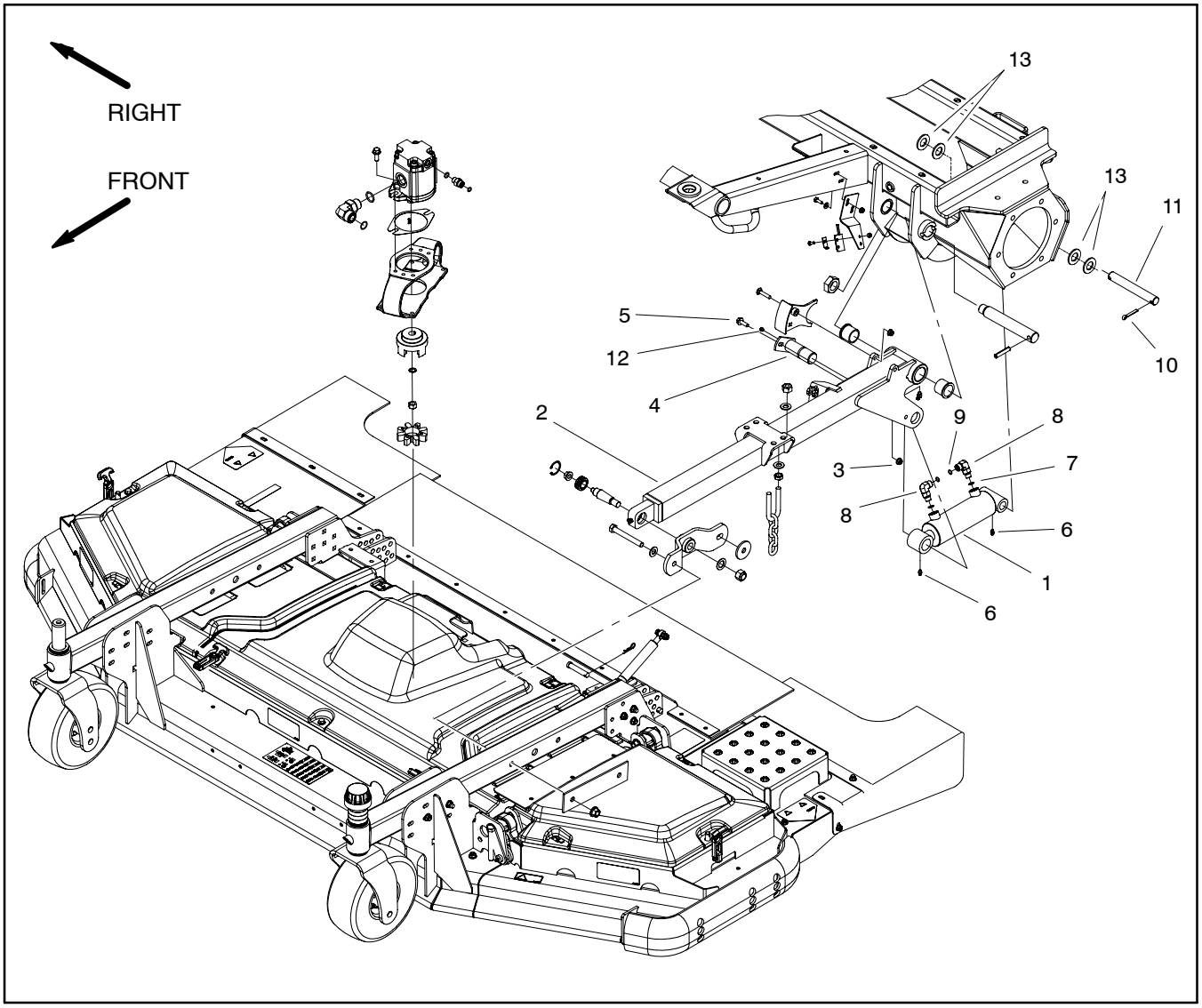


Figure 86

1. **Lift cylinder**
2. **Lift arm (LH shown)**
3. **Flange nut**
4. **Pin**
5. **Flange head screw**
6. **Grease fitting**
7. **O-ring**
8. **90º hydraulic fitting**
9. **O-ring**
10. **Cotter pin (2 used per pin)**
11. **Clevis pin**
12. **Plug**
13. **Flat washer (4 used per pin)**

Removal (Fig. 86)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

IMPORTANT: Make sure to relieve lift system pressure before removing lift cylinder. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

NOTE: To ease assembly, label all hydraulic hoses to identify their correct position on the lift cylinder.

4. Disconnect hydraulic hoses from lift cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

5. Remove flange head screw (item 5) and flange nut (item 3) that secure the pin (item 4) to the lift arm. Remove pin from lift arm and cylinder shaft clevis which will free lift cylinder from lift arm.

6. Remove cotter pin (item 10) and two (2) flat washers (item 13) from one end of the clevis pin (item 11). Pull clevis pin from frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

8. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O−rings.

Installation (Fig. 86)

1. If fittings were removed from lift cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Make sure that cotter pin (item 10) and two (2) flat washers (item 13) are installed on one end of clevis pin (item 11).

3. Position cylinder barrel clevis to frame and insert clevis pin (item 11) into frame and cylinder clevis. Secure lift pin with two (2) flat washers (item 13) and cotter pin (item 10).

4. Insert pin (item 4) through lift arm and cylinder shaft clevis. Secure pin to lift arm with flange head screw (item 5) and flange nut (item 3).

5. Remove caps or plugs placed during removal to prevent contamination.

6. Using tags placed during cylinder removal, correctly attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Fill reservoir with new hydraulic fluid as required.

8. Lubricate lift cylinder grease fittings.

9. After assembly is completed, operate lift cylinder to verify that hydraulic hoses and fittings are not contacted by any machine components.

Front Deck Lift Cylinder Service

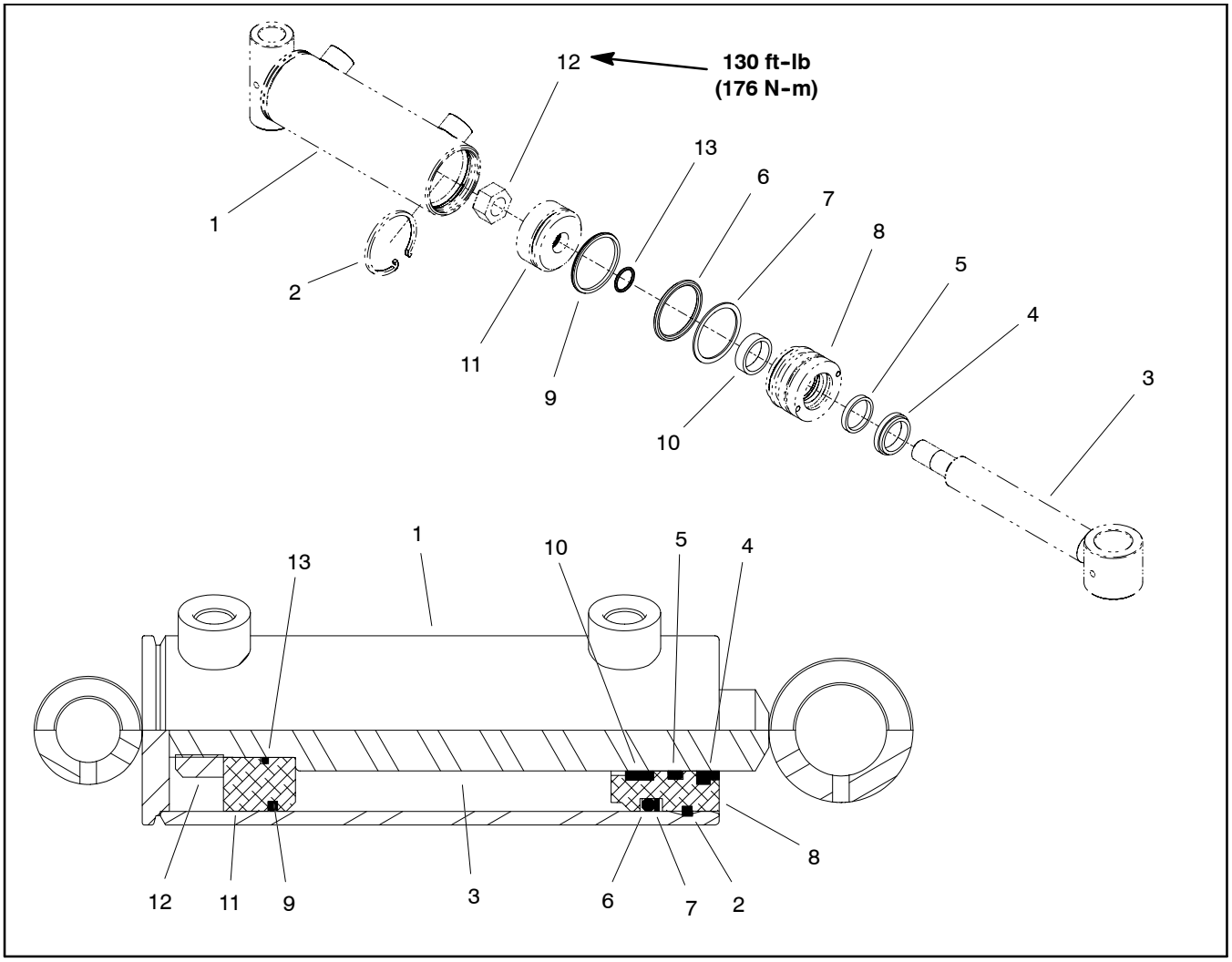


Figure 87

1. Barrel with clevis
2. Retaining ring
3. Shaft with clevis
4. Dust seal
5. Shaft seal
6. O-ring
7. Back-up ring
8. Head
9. Piston seal
10. Wear ring
11. Piston
12. Lock nut
13. O-ring

Disassembly (Fig. 87)

1. Remove oil from lift cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise on barrel.

2. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.

3. Remove retaining ring that secures head in barrel.

   A. Use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the barrel opening.

   B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening.

   C. Rotate the head counter-clockwise to remove retaining ring from barrel and head.

4. Extract shaft with head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut and piston from the shaft. Slide head from the shaft.

6. Remove piston seal and O-ring from the piston. Remove O-ring, back-up ring, wear ring, dust seal and shaft seal from the head.

7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in the hydraulic system will cause damage.

8. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect shaft and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Fig. 87)

1. Make sure all parts are clean before reassembly.

2. Coat new O-rings, piston seal, wear ring, shaft seal, back-up ring and dust seal with clean hydraulic oil.

   A. Install piston seal and O-ring to the piston.

   B. Install back-up ring, O-ring, wear ring, shaft seal and dust seal to the head.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

3. Mount shaft securely in a vise equipped with soft jaws by clamping on the shaft clevis.

   A. Coat shaft with clean hydraulic oil.

   B. Slide head and piston onto the shaft.

   C. Secure piston to shaft with lock nut. Torque lock nut to **130 ft-lb (176 N-m)**.

4. Lubricate head and piston with clean hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise on barrel.

5. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.

6. Secure head in barrel with retaining ring.

   A. Align retaining ring hole in the head with the access slot in the barrel.

   B. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

Wing Deck Lift Cylinder

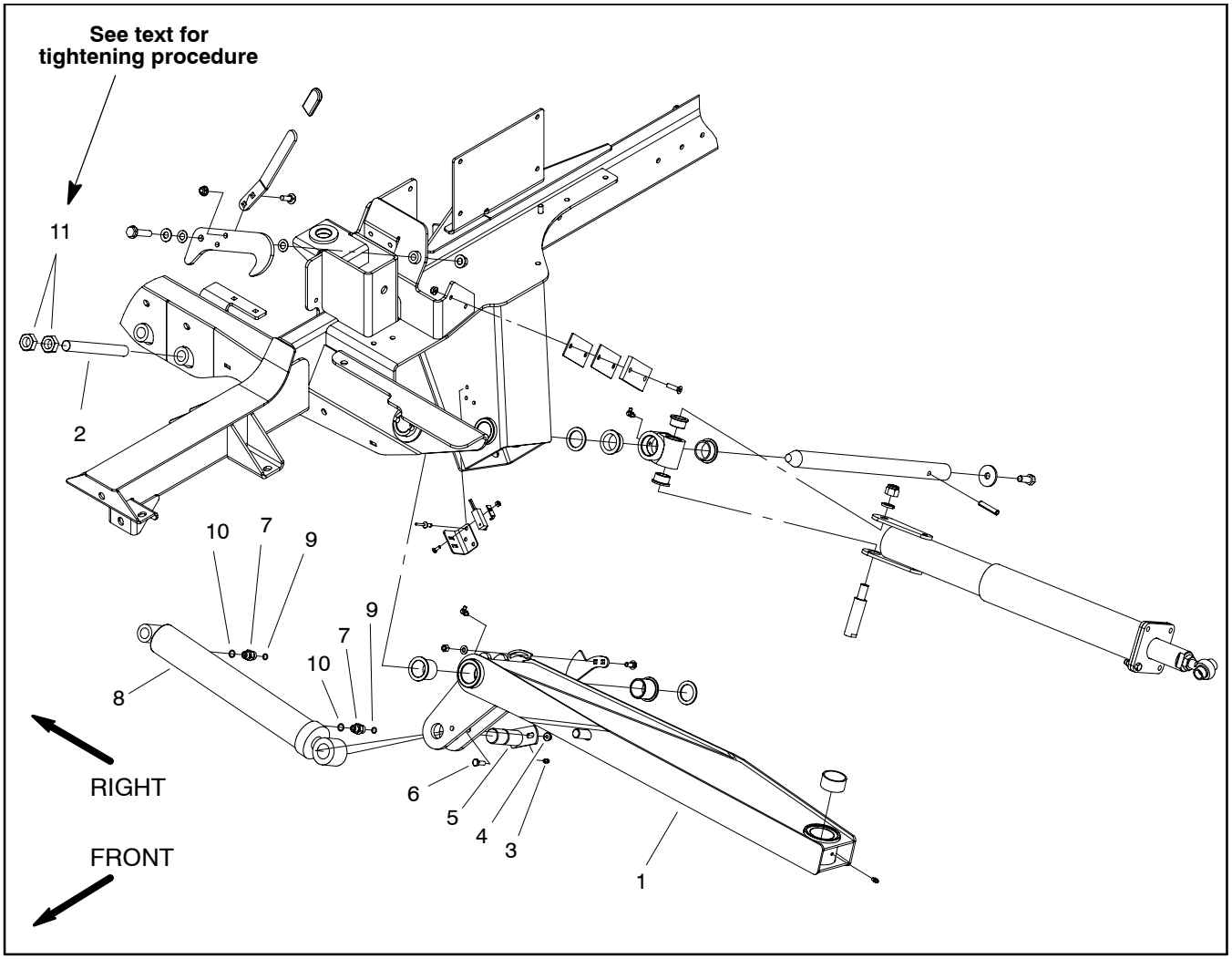


Figure 88

1. Wing deck lift arm (LH shown)
2. Pin
3. Grease fitting
4. Flange nut
5. Pin
6. Cap screw
7. Hydraulic fitting (2 used per cylinder)
8. Wing deck lift cylinder (LH shown)
9. O-ring
10. O-ring
11. Jam nut (4 used per pin)

Removal (Fig. 88)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

IMPORTANT: Make sure to relieve lift system pressure before removing lift cylinder. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

NOTE: To ease assembly, label all hydraulic hoses to identify their correct position on the lift cylinder.

4. Disconnect hydraulic hoses from lift cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

5. Remove cap screw (item 6) and flange nut (item 4) that secure the pin (item 5) to the lift arm. Remove pin from lift arm and cylinder shaft clevis which will free lift cylinder from lift arm.

6. Remove two (2) jam nuts (item 11) from one end of the pin (item 2). Pull pin from frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

8. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O−rings.

Installation (Fig. 88)

1. If fittings were removed from lift cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Make sure that two (2) jam nuts (item 11) are installed on one end of pin (item 2). Hold inner jam nut with wrench and torque outer jam nut from **60 to 70 ft−lb (82 to 94 N−m)**.

3. Position cylinder barrel clevis to frame.

4. Insert pin (item 2) through frame and cylinder clevis. Secure lift pin with two (2) jam nuts (item 11). Hand tighten first jam nut to take up as much free play as possible. While holding first jam nut with wrench, torque second jam nut from **60 to 70 ft−lb (82 to 94 N−m)**.

5. Insert pin (item 5) through lift arm and cylinder shaft clevis. Secure pin to lift arm with cap screw (item 6) and flange nut (item 4).

6. Remove caps or plugs placed during removal to prevent contamination.

7. Using tags placed during cylinder removal, correctly attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

8. Fill reservoir with new hydraulic fluid as required.

9. Lubricate lift cylinder grease fittings.

10. After assembly is completed, operate lift cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

Wing Deck Lift Cylinder Service

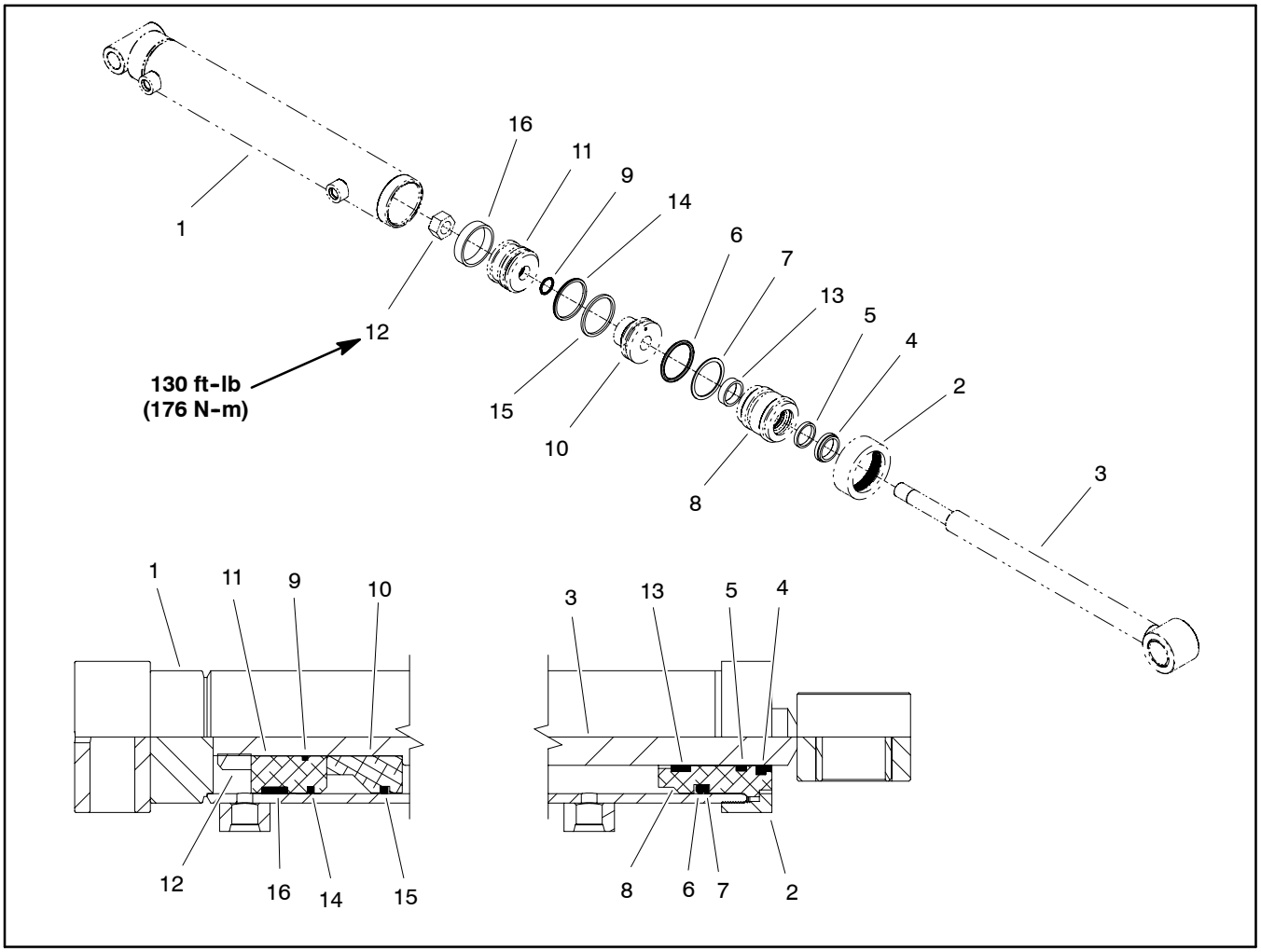


Figure 89

1. Barrel with clevis
2. External collar
3. Shaft with clevis
4. Dust seal
5. Shaft seal
6. O-ring
7. Back-up ring
8. Head
9. O-ring
10. Cushion
11. Piston
12. Lock nut
13. Wear ring
14. Piston seal
15. Steel ring
16. Wear ring

Disassembly (Fig. 89)

1. Remove oil from lift cylinder by slowly pumping the cylinder shaft. After removing oil from cylinder, plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the barrel clevis only. Do not close vise on barrel.

2. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.

3. Use a spanner wrench to loosen and remove collar from barrel.

4. Extract shaft with head, cushion and piston by carefully twisting and pulling on the shaft.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut from the shaft. Slide shaft, cushion and head off the shaft.

6. Remove piston seal, wear ring and O-ring from the piston. Remove O-ring, back-up ring, dust seal, wear ring and shaft seal from the head.

7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

8. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect shaft and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Fig. 89)

1. Make sure all parts are clean before assembly.

2. Coat new O-rings, piston seal, rod seal, back-up ring, wear rings and dust seal with clean hydraulic oil.

   A. Install piston seal, wear ring and O-ring to the piston.

   B. Install back-up ring, O-ring, shaft seal, wear ring and dust seal to the head.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

3. Mount shaft securely in a vise equipped with soft jaws by clamping on the shaft clevis.

   A. Coat shaft with clean hydraulic oil.

   B. Slide external collar, head, cushion and piston onto the shaft.

   C. Secure piston to shaft with lock nut. Torque lock nut to **130 ft-lb (176 N-m)**.

4. Lubricate head, cushion and piston with clean hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the barrel clevis only. Do not close vise on barrel.

5. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.

6. Use a spanner wrench to tighten collar onto barrel.

Lift Control Manifold

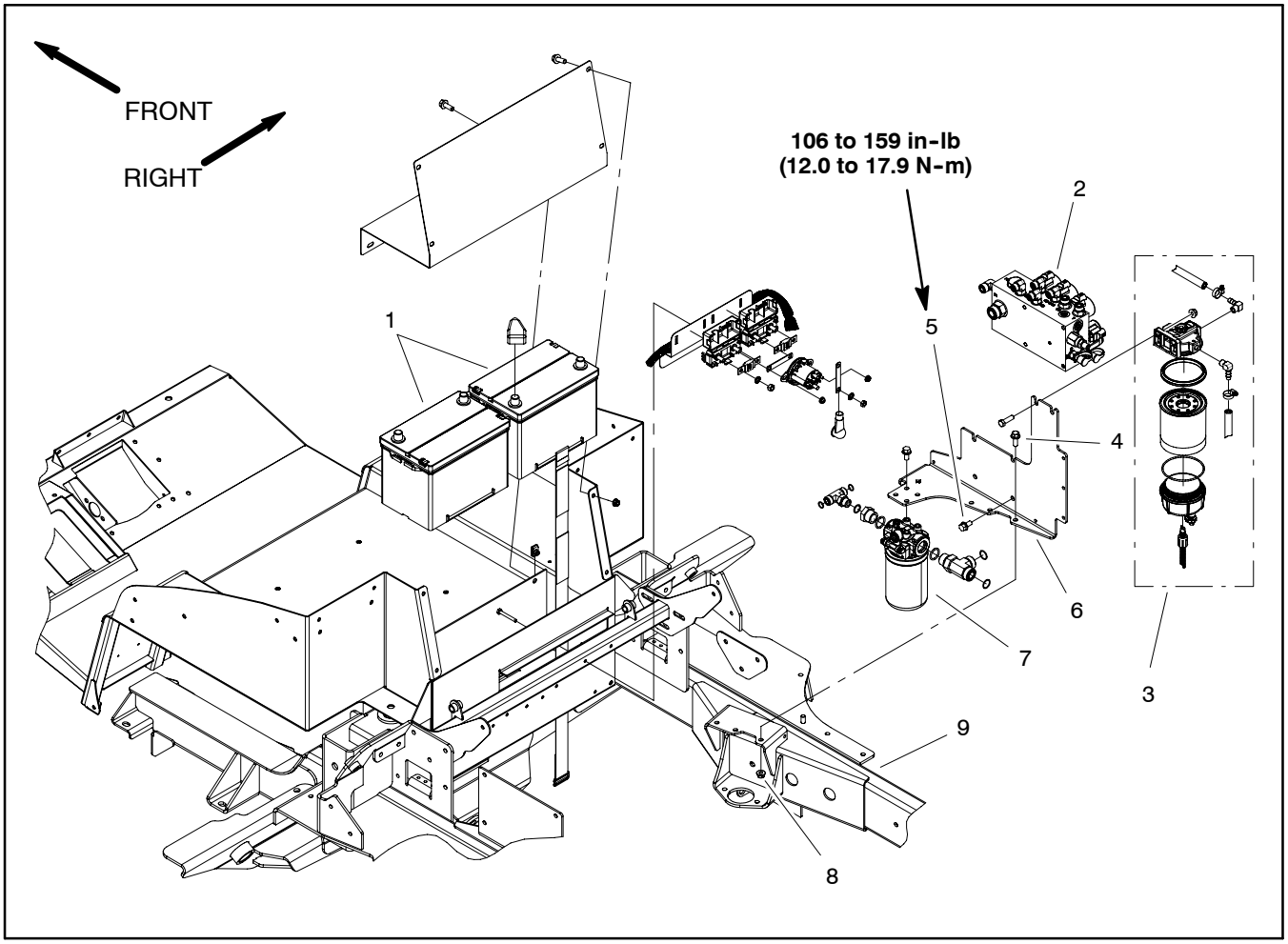


Figure 90

1. **Battery**
2. **Lift control manifold**
3. **Water separator assembly**
4. **Flange head screw (3 used)**
5. **Flange head screw (4 used)**
6. **Mounting plate**
7. **Hydraulic filter**
8. **Flange nut (3 used)**
9. **Frame**

NOTE: The ports on the lift control manifold are marked for easy identification of components. Example: P1 is the supply port from the gear pump and FD is the flow divider cartridge location (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 90)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. Raise hood and remove RH side panel to gain access to lift control manifold.

3. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

4. For assembly purposes, label wire harness leads for manifold solenoids. Disconnect wire harness connectors from solenoids on manifold.

5. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

6. Remove hydraulic manifold from the frame using Figure 90 as guide.

IMPORTANT: An orifice is placed beneath the 90º hydraulic fittings in the control manifold C1-OR1 and C5-OR2 ports. If either of these fittings is removed from manifold, make sure to remove orifice and label its position for assembly purposes.

7. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O−rings.

Installation (Fig. 90)

1. If fittings were removed from manifold:

   A. Lubricate new O−rings with clean hydraulic oil. Install lubricated O−rings on fittings.

   IMPORTANT: When installing the orifice in manifold port C1−OR1 or C5−OR2, make sure that orifice is flat in the base of the port cavity. Manifold damage is possible if the orifice is cocked in the cavity.

   B. If fitting was removed from manifold port C1−OR1 or C5−OR2, place orifice in port before installing fitting.

   C. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   D. Refer to Figure 91 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Install lift control manifold to the frame using Figure 90 as guide. Torque the four (4) flange head screws that secure manifold to frame from **106 to 159 in−lb (12.0 to 17.9 N−m)**.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Using labels placed during removal, correctly connect wire harness connectors to solenoids on lift control manifold.

5. Make sure hydraulic tank is full. Add correct oil if necessary.

6. Secure RH side panel to machine. Lower and secure hood.

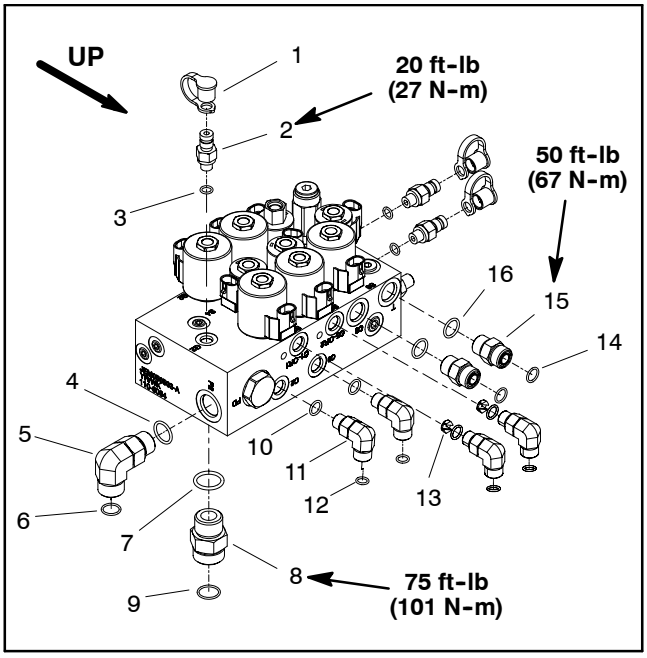


Figure 91

1. **Dust cap**
2. **Quick fitting (3 used)**
3. **O−ring**
4. **O−ring**
5. **90º fitting**
6. **O−ring**
7. **O−ring**
8. **Straight fitting**
9. **O−ring**
10. **O−ring**
11. **90º fitting (4 used)**
12. **O−ring**
13. **Orifice disc (2 used)**
14. **O−ring**
15. **Straight fitting (2 used)**
16. **O−ring**

Lift Control Manifold Service

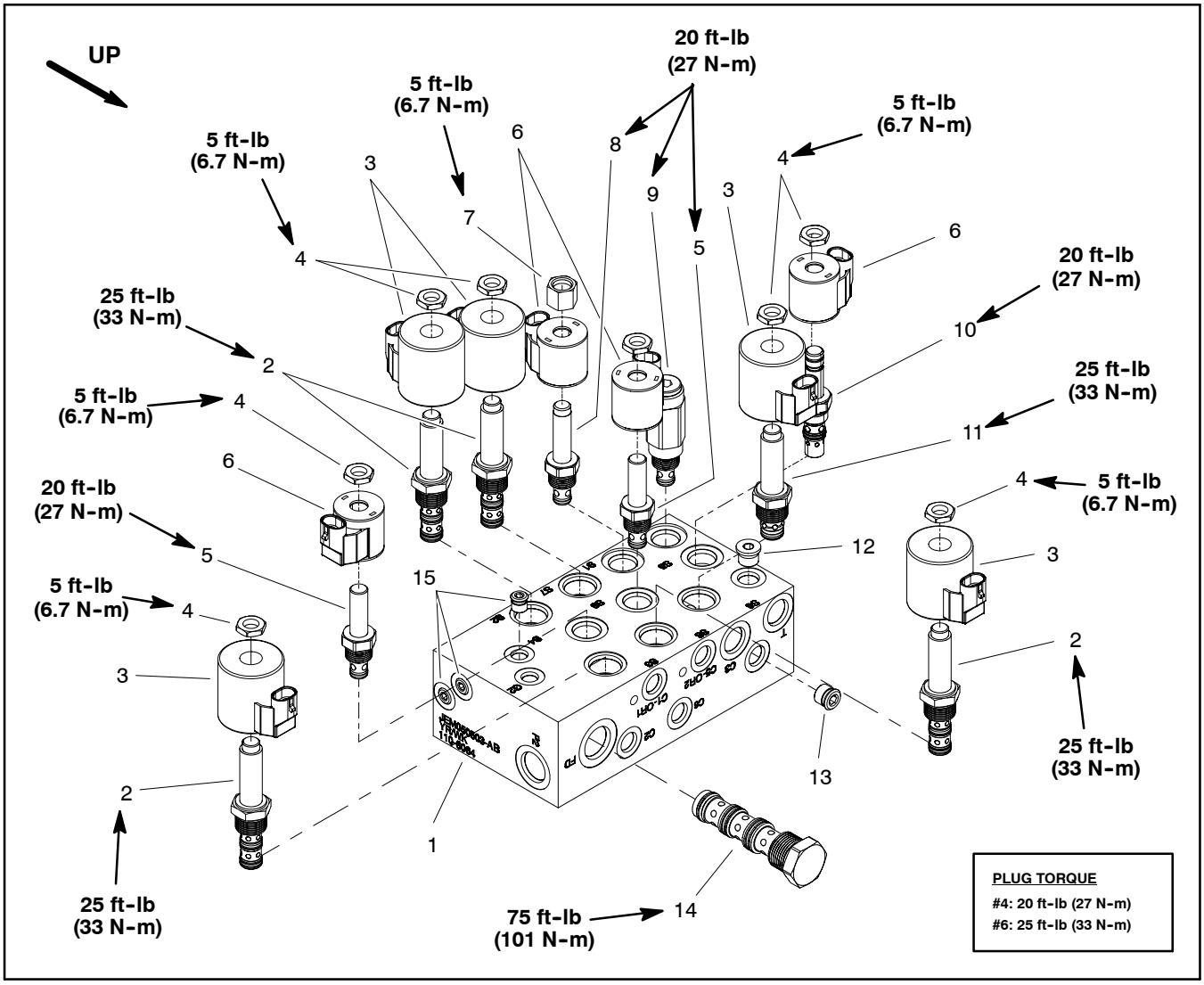


Figure 92

1. Lift manifold
2. Solenoid valve (S2, S3, S7 and S8)
3. Solenoid coil (5 used)
4. Solenoid nut
5. Solenoid valve (S4 and S9)
6. Solenoid coil (4 used)
7. Solenoid nut
8. Solenoid valve (S1)
9. Relief valve (RV)
10. Solenoid valve (S5)
11. Solenoid valve (S6)
12. SAE #6 plug with O-ring
13. NWD #6 plug with O-ring
14. Flow divider (FD)
15. SAE #4 plug with O-ring (7 used)

NOTE: The ports on the lift control manifold are marked for easy identification and assembly of components. Example: P1 is the supply port from the gear pump and FD is the flow divider cartridge location (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

NOTE: The lift control manifold includes several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to manifold illustration for plug installation torque.

Valve Cartridge Service (Figs. 92 and 93)

For cartridge valve service procedures, see Hydraulic Traction Control Manifold Service in this section. Refer to Figures 92 and 93 for lift control manifold cartridge valve and plug installation torque.

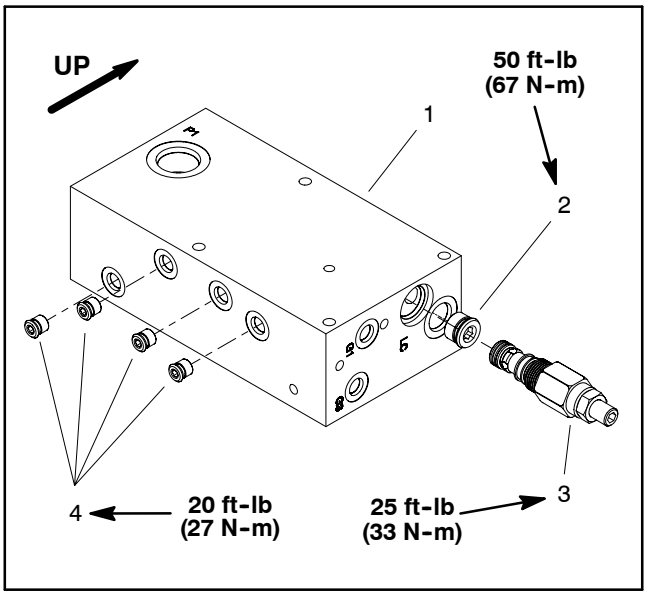


Figure 93

1. **Lift manifold**
2. **NWD #8 plug/O-ring**
3. **Logic valve (LC)**
4. **SAE #4 plug/O-ring**

Steering and Engine Cooling Fan Circuit

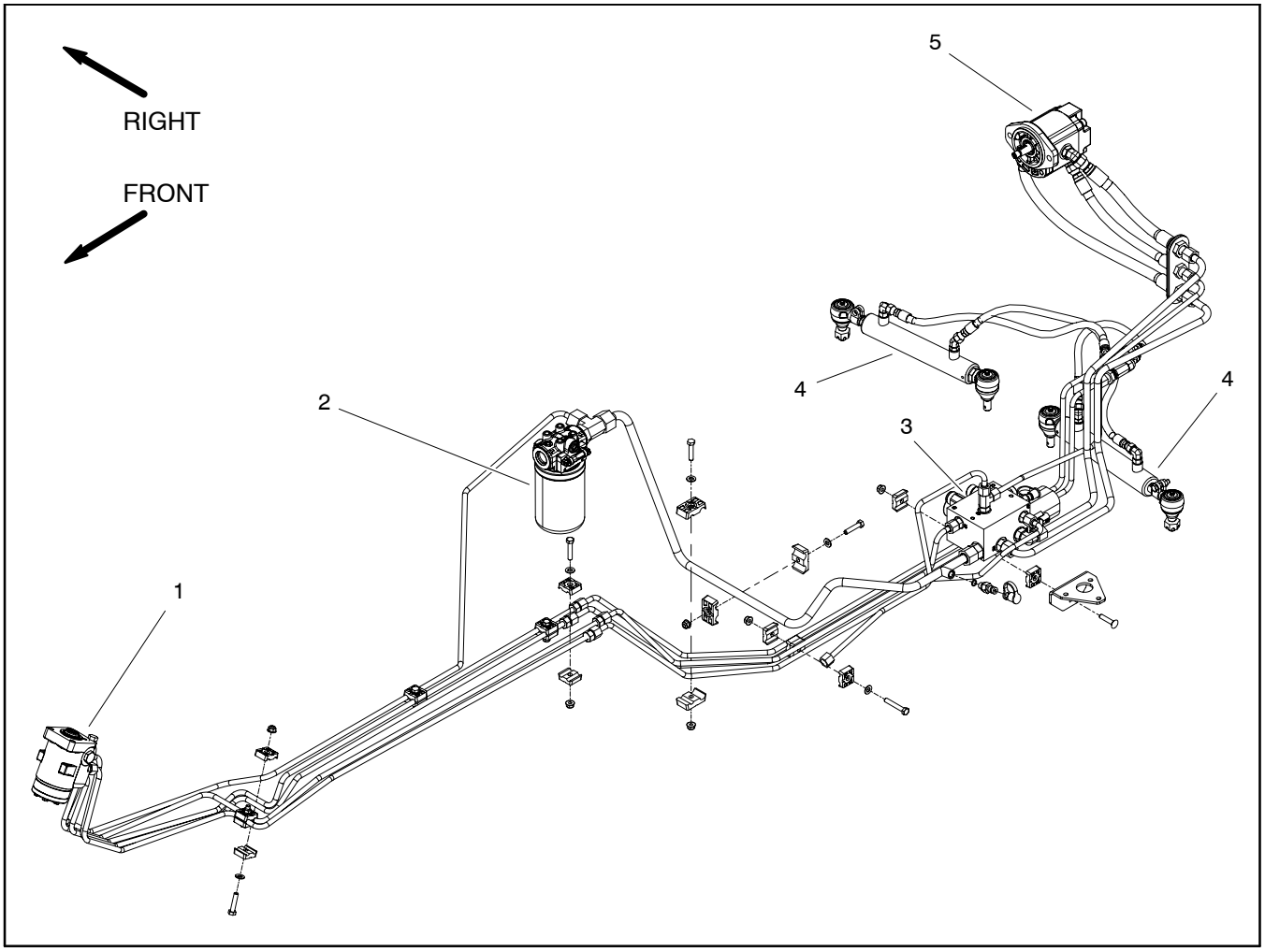


Figure 94

1. **Steering control valve**
2. **Oil filter**
3. **Steering/cooling fan control manifold**
4. **Steering cylinder (2 used)**
5. **Engine cooling fan motor**

Figure 94 illustrates the components that are used in the Groundsmaster steering and engine cooling fan circuit. Procedures for removal, installation and disassembly/ assembly of these components are provided in the following pages of this section.

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Steering Control Valve

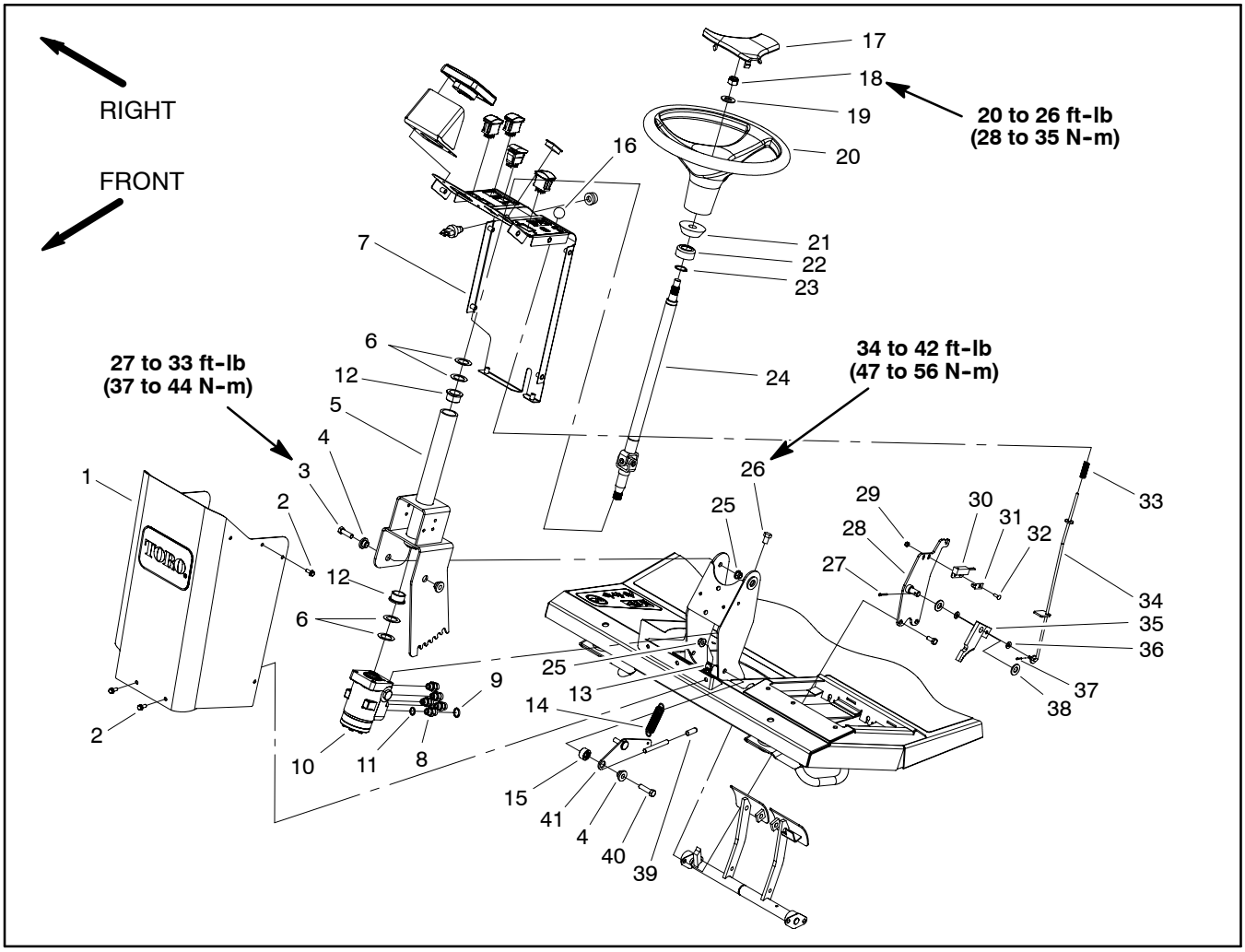


Figure 95

1. Steering tower cover
2. Flange head screw
3. Cap screw (2 used)
4. Pivot hub (3 used)
5. Steering column assembly
6. Thrust washer (4 used)
7. Steering tower
8. Hydraulic fitting (5 used)
9. O-ring
10. Steering control valve
11. O-ring
12. Flange bushing (2 used)
13. Clip (2 used)
14. Spring
15. Spacer
16. Knob
17. Steering wheel cover
18. Hex nut
19. Flat washer
20. Steering wheel
21. Foam collar
22. Steering seal
23. External snap ring (2 used)
24. Steering shaft assembly
25. Flange nut (3 used)
26. Cap screw (4 used)
27. Cotter pin
28. Parking brake pivot
29. Lock nut
30. Proximity switch
31. Switch plate
32. Carriage bolt
33. Compression spring
34. Parking brake rod
35. Parking brake rack
36. Flat washer (2 used)
37. Cotter pin
38. Flat washer (2 used)
39. Cap
40. Cap screw
41. Tilt lever

Removal (Fig. 95)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. Remove steering tower cover (item 1).

4. To prevent contamination of hydraulic system during steering valve removal, thoroughly clean exterior of steering valve, hydraulic tubes and fittings.

5. Disconnect hydraulic tubes from steering control valve. Put caps or plugs on fittings and tubes to prevent contamination. Tag hydraulic lines for proper assembly.

6. Support steering control valve to prevent it from falling.

7. Remove four (4) cap screws that secure steering control valve to machine. Slide steering control valve from lower end of steering shaft and remove from machine.

8. If necessary, remove fittings from control valve and discard fitting O−rings.

Installation (Fig. 95)

1. If fittings were removed from steering control valve, lubricate and place new O−rings onto fittings. Install fittings into control valve and tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Slide steering control valve onto lower end of steering shaft. Secure control valve to machine with four (4) cap screws. Torque screws from **34 to 42 ft−lb (47 to 56 N−m)**.

3. Remove caps or plugs placed during removal to prevent contamination.

4. Connect hydraulic tubes to fittings on steering valve using tags placed during control valve removal to identify correct tube placement (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Install steering tower cover (item 1).

6. Fill reservoir with new hydraulic fluid as required.

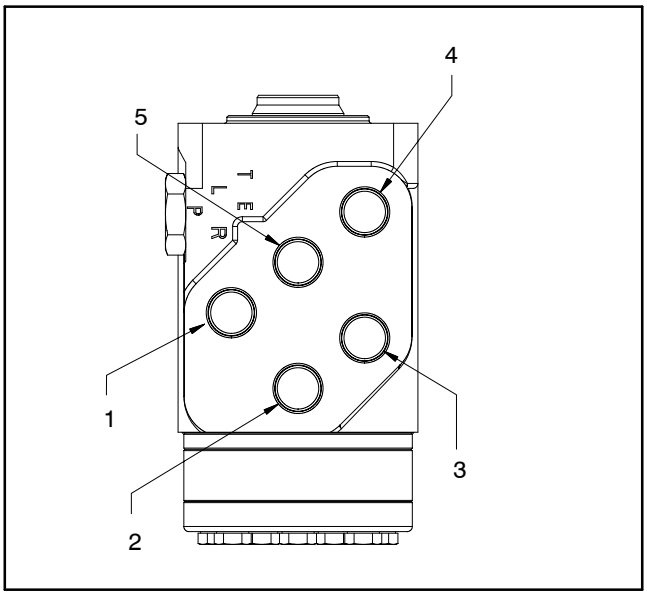


Figure 96

1. **In port (P)**
2. **Right turn port (R)**
3. **Load sensing port (LS)**
4. **Out port (T)**
5. **Left turn port (L)**

Steering Control Valve Service

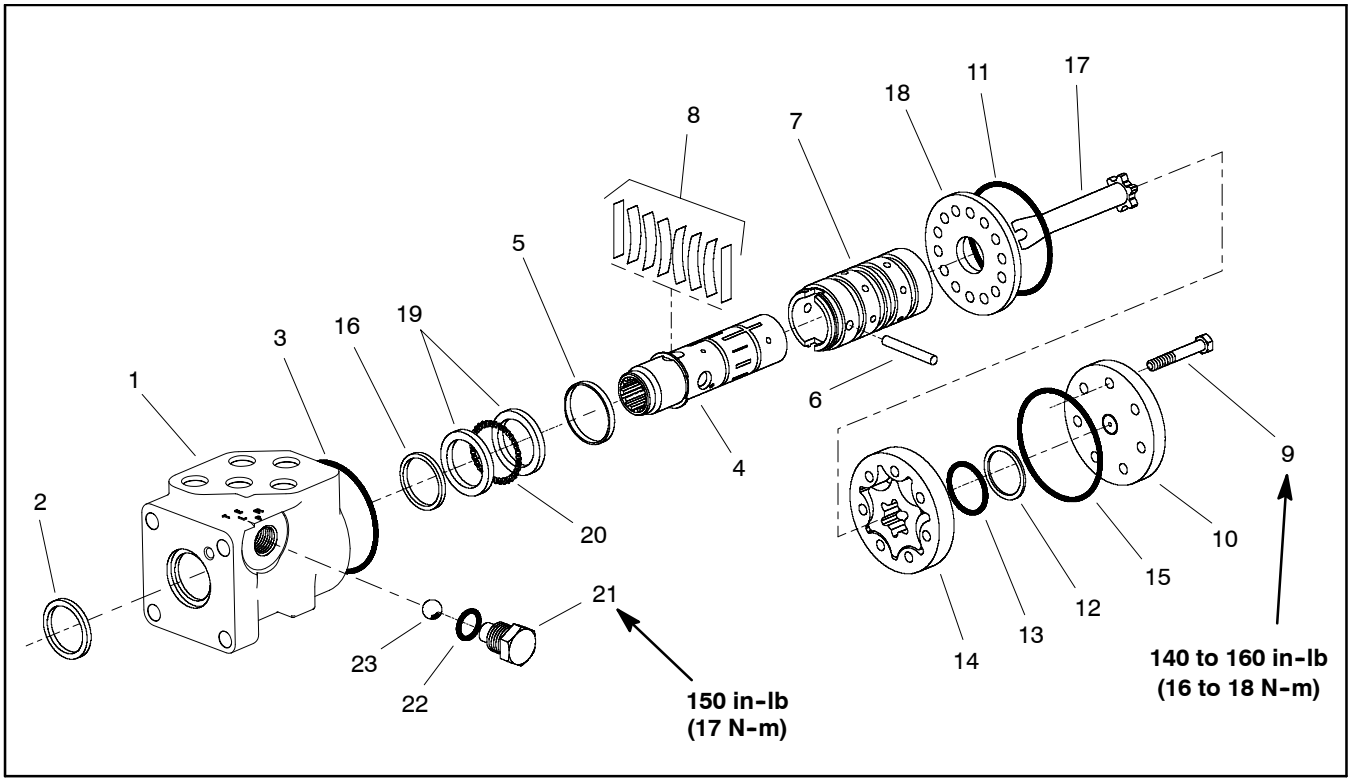


Figure 97

1. **Steering valve housing**
2. **Dust seal**
3. **O-ring**
4. **Spool**
5. **Spring retaining ring**
6. **Pin**
7. **Sleeve**
8. **Centering springs/spacers**
9. **Cap screw (7 used)**
10. **End cap**
11. **O-ring**
12. **Seal ring**
13. **O-ring**
14. **Geroter**
15. **O-ring**
16. **Quad seal**
17. **Geroter drive**
18. **Wear plate**
19. **Bearing race**
20. **Thrust bearing**
21. **Plug**
22. **O-ring**
23. **Check ball**

NOTE: For steering control valve repair procedures, see the Eaton Parts and Repair Information: 5 Series Steering Control Units at the end of this chapter.

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Steering Cylinders

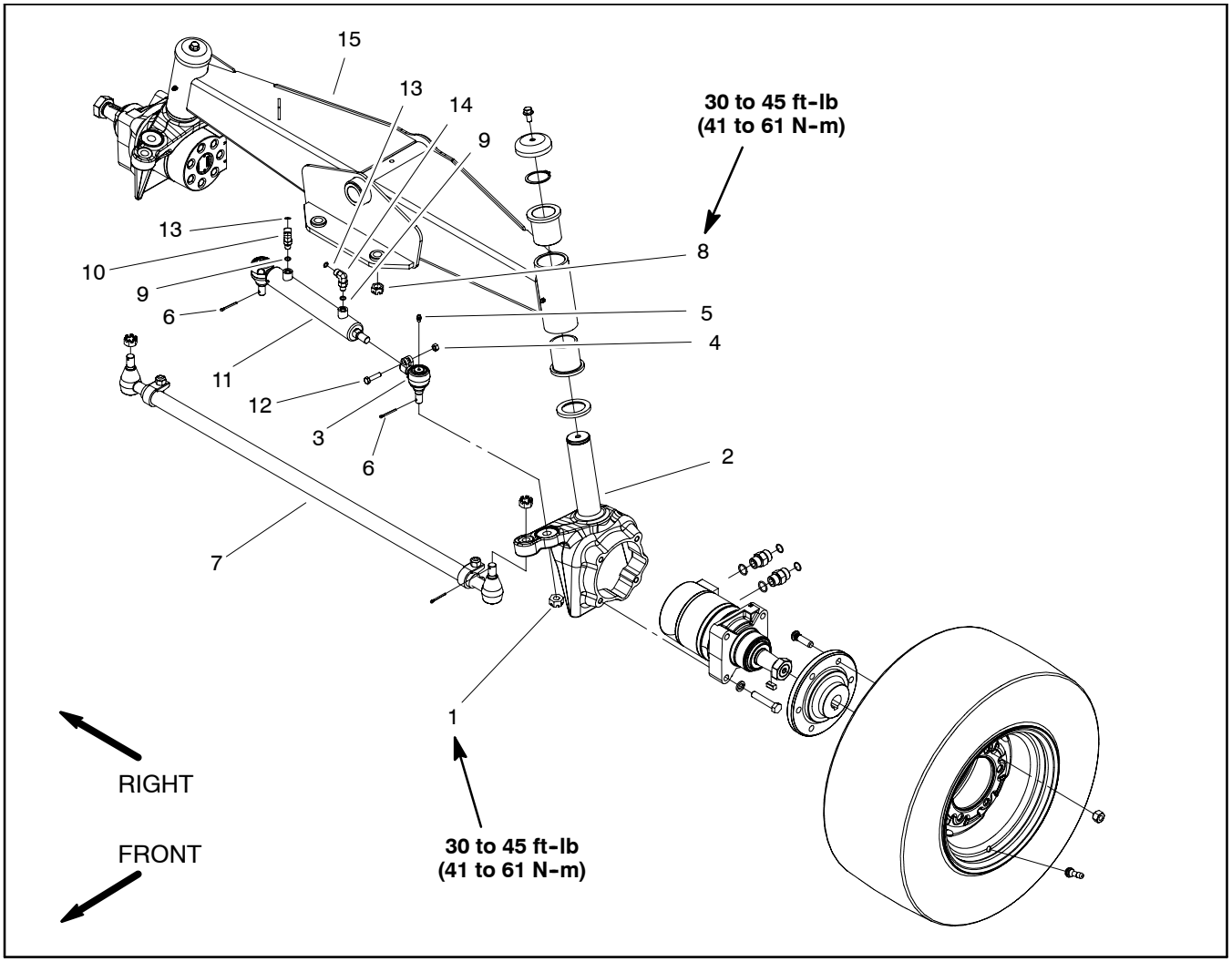


Figure 98

1. Slotted hex nut
2. LH steering spindle
3. Ball joint
4. Hex nut
5. Grease fitting
6. Cotter pin
7. Tie rod assembly
8. Slotted hex nut
9. O-ring
10. 45º hydraulic fitting
11. Steering cylinder
12. Cap screw
13. O-ring
14. 90º hydraulic fitting
15. Rear axle

Removal (Fig. 98)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during steering cylinder removal, thoroughly clean exterior of cylinder, fittings and hoses.

NOTE: To ease assembly, label all hydraulic hoses to identify their correct position on the steering cylinder.

4. Disconnect hydraulic hoses from steering cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

5. Remove cotter pins and slotted hex nuts (items 1 and 8) that secure the cylinder ball joints to rear axle and steering spindle.

6. Separate ball joints from rear axle and steering spindle. Remove steering cylinder from machine.

7. If hydraulic fittings are to be removed from steering cylinder, mark fitting orientation to allow correct assembly. Remove fittings from steering cylinder and discard O−rings from fittings.

Installation (Fig. 98)

1. If fittings were removed from steering cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Thoroughly clean tapers on steering cylinder ball joints. Also, clean ball joint bores of rear axle assembly and steering spindle.

3. Position steering cylinder to machine.

4. Secure steering cylinder to rear axle and steering spindle with slotted hex nuts (items 1 and 8). Torque slotted hex nuts from **30 to 45 ft−lbs (41 to 61 N−m)** while aligning ball joint hole with slot in nut. Insert cotter pins.

5. Remove caps or plugs placed during removal to prevent contamination.

6. Using tags placed during cylinder removal, correctly attach hydraulic hoses to steering cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Fill reservoir with new hydraulic fluid as required.

8. Lubricate cylinder ball joint grease fittings.

9. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings do not contact any machine components.

Steering Cylinder Service

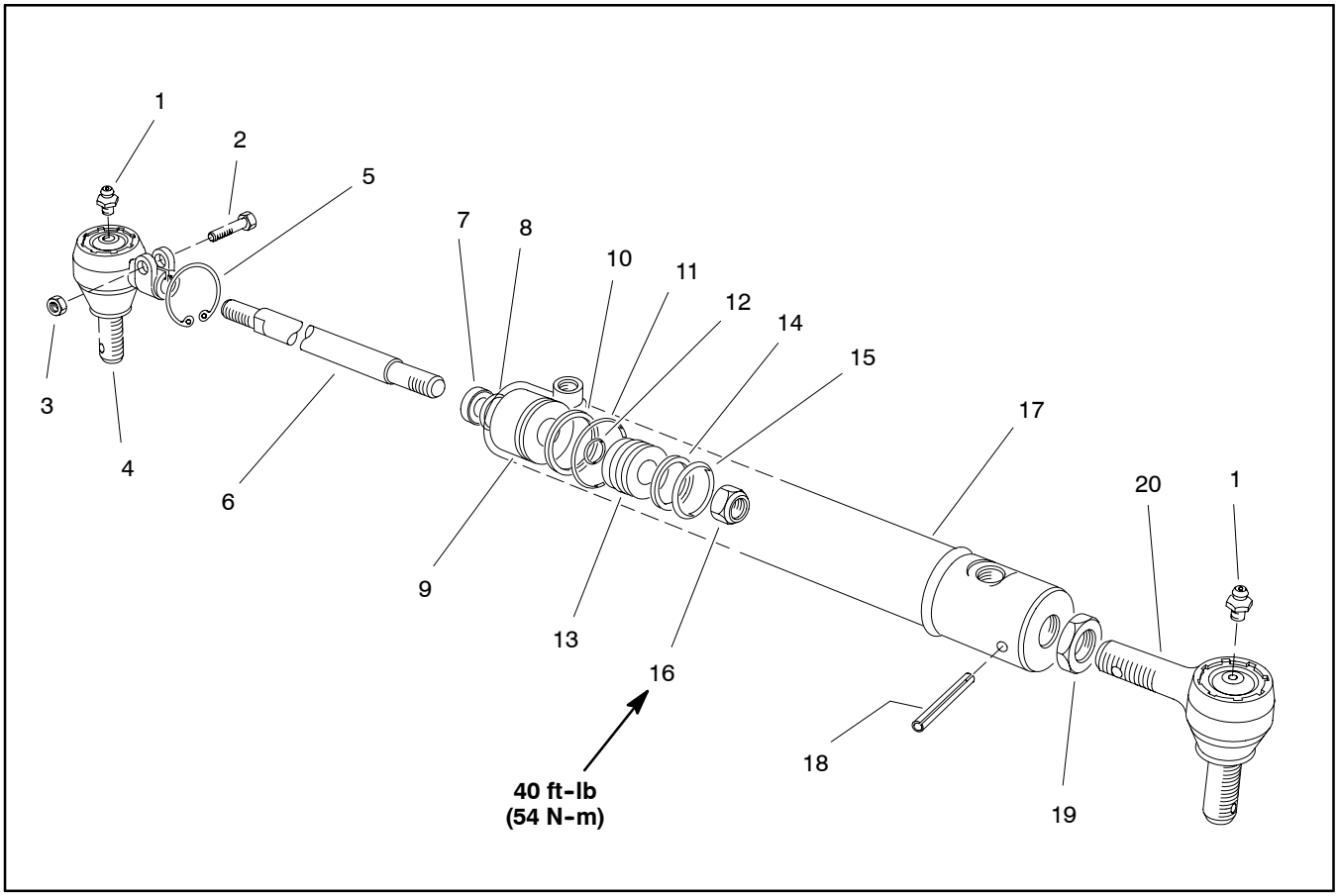


Figure 99

1. **Grease fitting**
2. **Cap screw**
3. **Lock nut**
4. **Ball joint**
5. **Snap ring**
6. **Piston rod**
7. **Rod wiper**
8. **Rod seal**
9. **Head**
10. **Back-up ring**
11. **O-ring**
12. **O-ring**
13. **Piston**
14. **Slipper seal**
15. **O-ring**
16. **Lock nut**
17. **Barrel**
18. **Roll pin**
19. **Jam nut**
20. **Ball joint**

Disassembly (Fig. 99)

1. Remove oil from steering cylinder by slowly pumping the piston rod. After removing oil from cylinder, plug both ports and thoroughly clean the outside of the cylinder.

2. Remove snap ring (item 5) that secures head in barrel.

3. Grasp end of piston rod and use a twisting and pulling motion to carefully extract piston, piston rod and head from cylinder barrel.

4. Using a wrench on the piston rod flats to prevent the rod from turning, remove lock nut (item 16) from rod. Remove piston and head from rod.

5. Remove all seals and O−rings from head and piston.

6. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

7. Carefully inspect internal surface of barrel for damage (deep scratches, out−of−round, etc.). Replace entire cylinder if barrel is damaged. Inspect piston rod and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

8. If piston rod ball joint (item 4) removal is necessary, loosen cap screw (item 2) and lock nut (item 3) and then unscrew ball joint from piston rod.

9. If necessary, remove barrel end ball joint (item 20) from barrel as follows:

   A. Loosen jam nut (item 19).

   B. Drive roll pin (item 18) from barrel.

   C. Unscrew ball joint from barrel.

Assembly (Fig. 99)

1. Use a complete repair kit when rebuilding the cylinder. Put a coating of clean hydraulic oil on all new seals and O−rings.

2. Install new O−rings and slipper seal to the piston and new O−ring, back−up ring, rod seal and rod wiper to head.

3. Lubricate shaft with clean hydraulic oil. Slide head and piston onto piston rod.

4. Using a wrench on the piston rod flats to prevent the rod from turning, install and tighten lock nut (item 16). Torque lock nut to **40 ft−lb (54 N−m)**.

5. Put a coating of clean hydraulic oil on all cylinder parts to ease assembly.

6. Carefully slide piston rod assembly into cylinder barrel taking care to not damage seals or O−rings.

7. Secure head in barrel with snap ring. Make sure that snap ring is fully seated in groove in barrel.

8. If barrel end ball joint (item 20) was removed, install ball joint to barrel as follows:

   A. Thread ball joint into barrel so that roll pin hole in joint aligns with hole in barrel.

   B. Drive roll pin into aligned holes in barrel and ball joint.

   C. Tighten jam nut.

9. If piston rod end ball joint (item 4) was removed, fully retract piston rod and thread ball joint onto rod so that center to center length is from 14.270” to 14.330” (362.5 to 363.9 mm) (Fig. 100). Tighten cap screw (item 2) and lock nut (item 3).

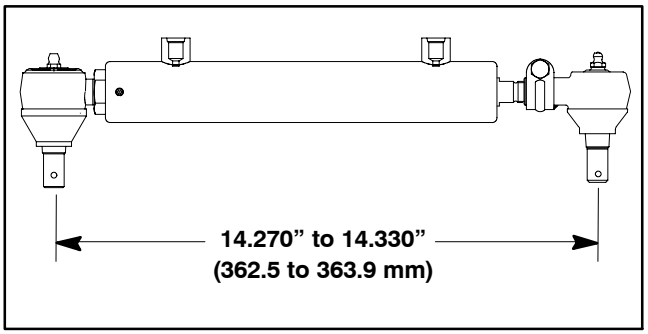


Figure 100

Engine Cooling Fan Motor

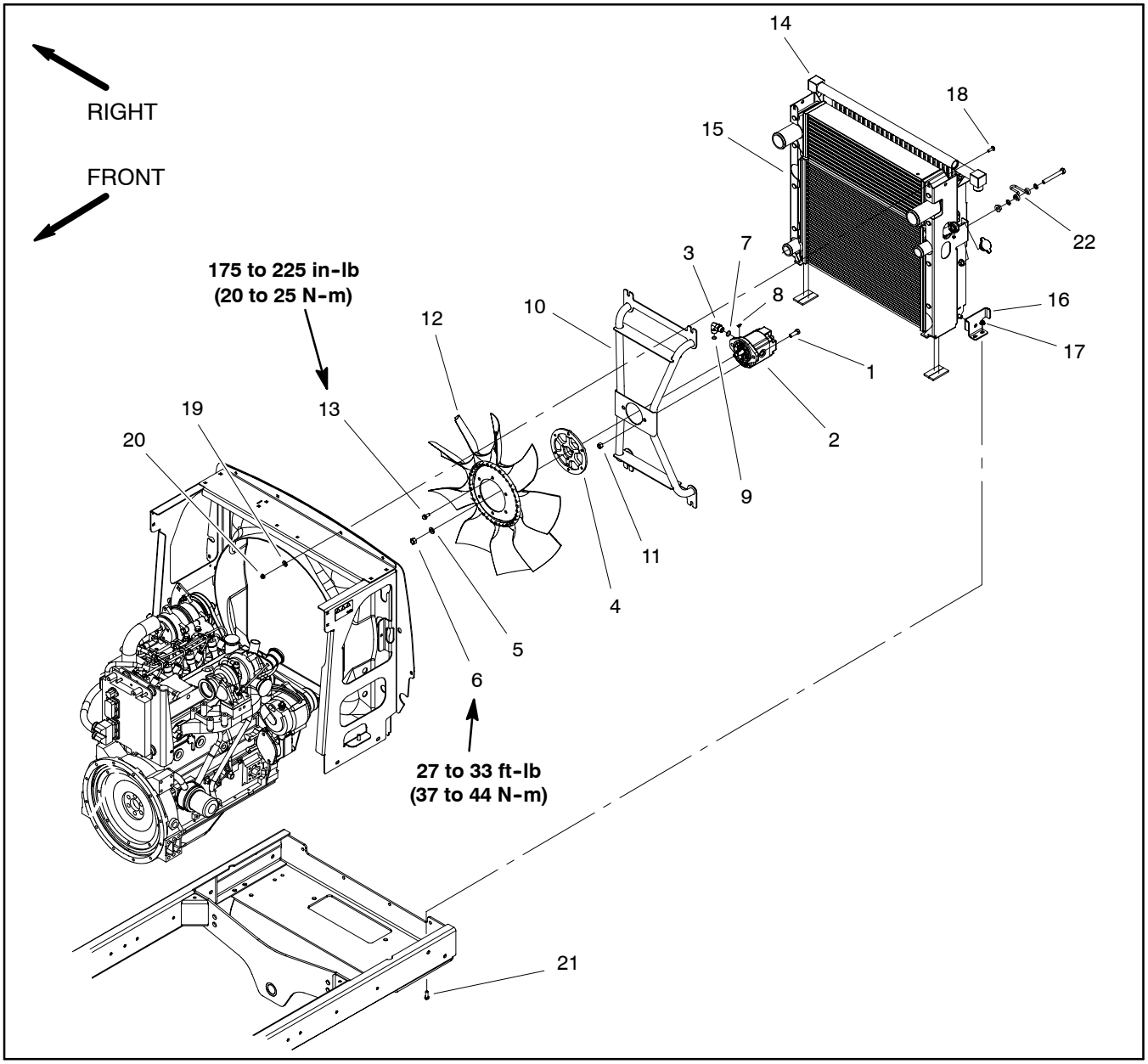


Figure 101

1. Socket head screw (2 used)
2. Cooling fan motor
3. 90º hydraulic fitting
4. Fan hub
5. Flat washer
6. Hex nut
7. O-ring
8. Woodruff key
9. O-ring
10. Fan motor bracket
11. Lock nut (2 used)
12. Cooling fan
13. Flange head screw (6 used)
14. Oil cooler
15. Radiator assembly
16. Oil cooler support plate (2 used)
17. Flange nut (4 used)
18. Carriage screw (2 used)
19. Flat washer (2 used)
20. Flange nut (2 used)
21. Cap screw (4 used)
22. Clamp (2 used)

Removal (Fig. 101)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. Unlatch and raise hood.

CAUTION

The radiator and oil cooler may be hot. To avoid possible burns, allow the engine and cooling systems to cool before working on the oil cooler.

IMPORTANT: Make sure to not damage the radiator, oil cooler or other machine components while loosening and removing the fan motor.

4. Remove air intake box from top of radiator assembly (see Air Cleaner Removal in the Service and Repairs section of Chapter 3 – Engine).

5. Remove hex nut (item 6) and flat washer (item 5) that secure fan hub and fan assembly to fan motor.

6. Use suitable puller to remove fan hub (with fan attached) from fan motor shaft taking care to not damage fan. Position fan assembly away from fan motor.

7. Disconnect hydraulic hoses from cooling fan motor. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

8. Support fan motor to prevent it from falling. Remove two (2) socket head screws (item 1) and lock nuts (item 11) that secure fan motor to fan motor bracket.

9. Carefully lower fan motor and remove from machine.

10. If hydraulic fittings are to be removed from fan motor, mark fitting orientation to allow correct assembly. Remove fittings from motor and discard O–rings.

Installation (Fig. 101)

1. If fittings were removed from fan motor, lubricate and place new O–rings onto fittings. Install fittings into motor ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

IMPORTANT: Make sure to not damage the radiator, oil cooler or other machine components while installing the fan motor.

2. Carefully position fan motor to fan motor bracket. Loosely attach motor to bracket with socket head screws (item 1) and lock nuts (item 11).

3. Remove caps or plugs placed during removal to prevent contamination. Connect hydraulic hoses to cooling fan motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Tighten socket head screws (item 1) and lock nuts (item 11) to secure fan motor to bracket.

5. Thoroughly clean tapered surfaces of fan motor shaft and fan hub. Position fan hub (with fan attached) onto motor shaft and secure with flat washer (item 5) and hex nut (item 6). Torque nut from **27 to 33 ft-lb (37 to 44 N-m)**.

6. Install air intake box to top of radiator assembly (see Air Cleaner Installation in the Service and Repairs section of Chapter 3 – Engine).

7. Lower and secure hood.

8. Fill reservoir with new hydraulic fluid as required.

Engine Cooling Fan Motor Service

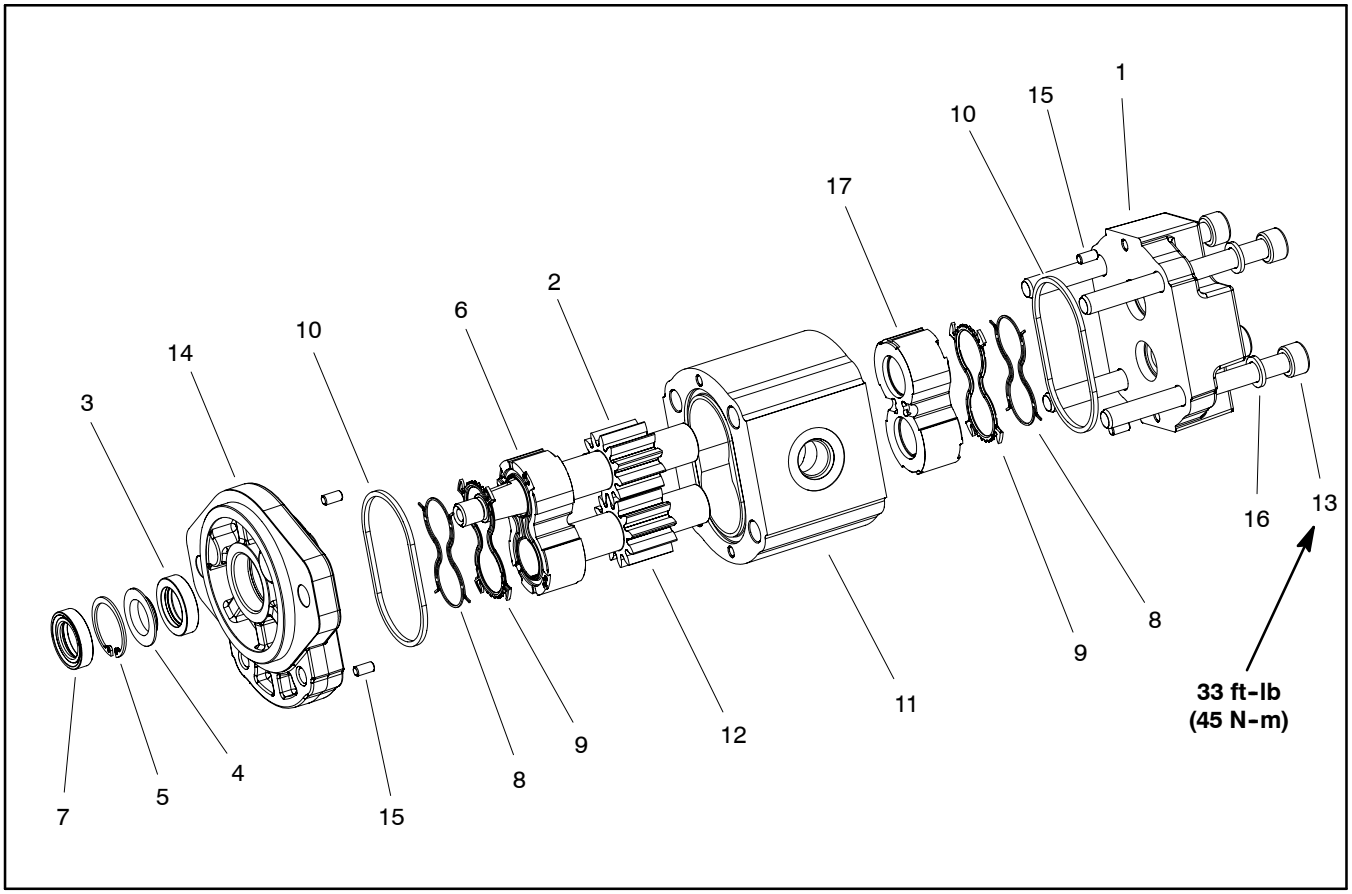


Figure 102

1. **Rear cover**
2. **Drive gear**
3. **Shaft seal**
4. **Flange washer**
5. **Retaining ring**
6. **Front wear plate**
7. **Dust seal**
8. **Pressure seal**
9. **Back-up gasket**
10. **O-ring**
11. **Body**
12. **Idler gear**
13. **Cap screw (4 used)**
14. **Front flange**
15. **Dowel pin (4 used)**
16. **Washer (4 used)**
17. **Rear wear plate**

For disassembly, inspection and assembly procedures of the cooling fan motor, see Cutting Deck Motor Service in this section.

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Steering/Engine Cooling Fan Control Manifold

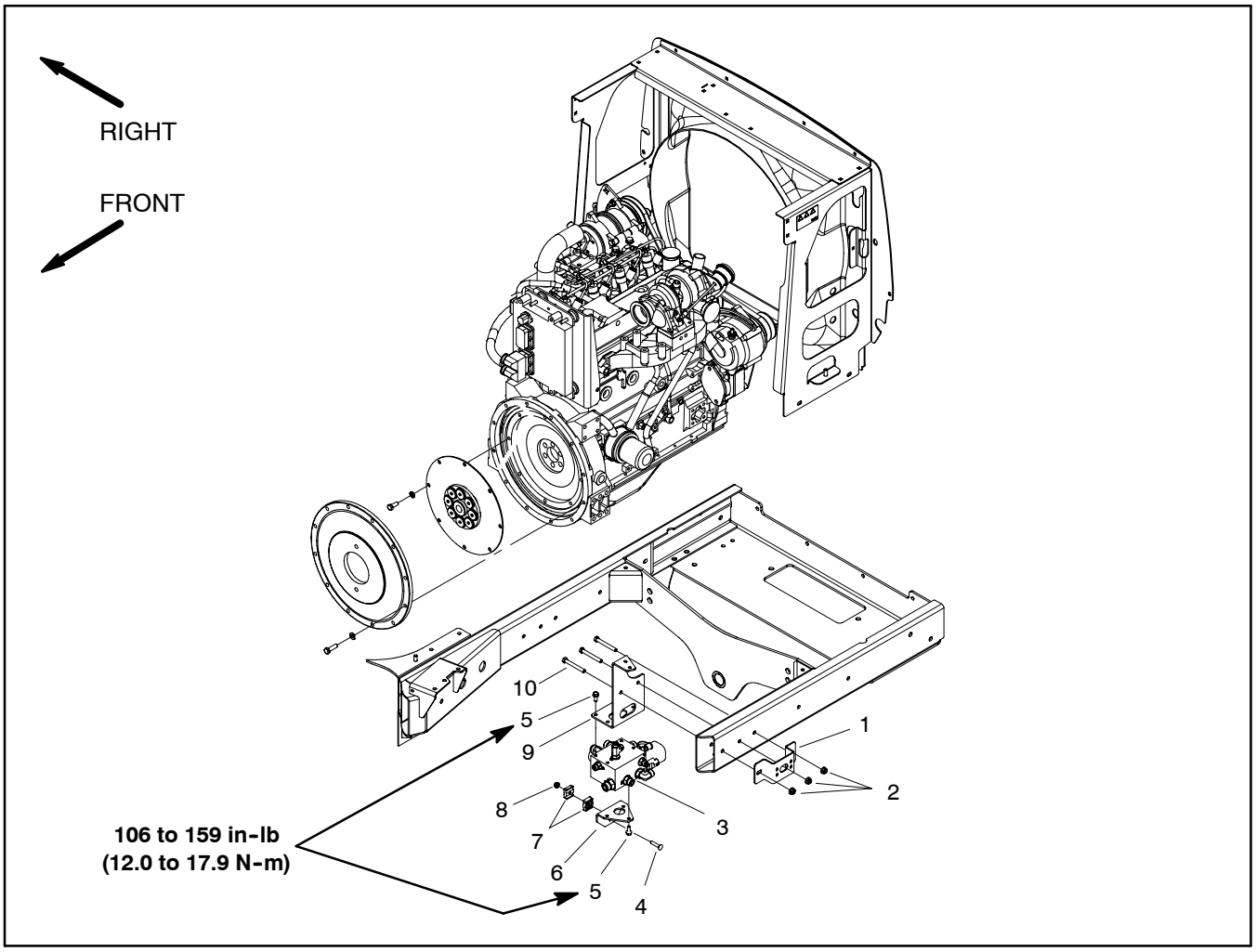


Figure 103

1. **Bulkhead mount plate**
2. **Flange nut (3 used)**
3. **Steering/cooling fan manifold**
4. **Carriage bolt**
5. **Flange head screw (7 used)**
6. **Tube mount plate**
7. **Tube clamp**
8. **Flange nut**
9. **Manifold mount plate**
10. **Cap screw (3 used)**

NOTE: The ports on the steering/cooling fan manifold are marked for easy identification of components. Example: P is the connection port for the supply from the lift control valve and RV is the relief cartridge valve port (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 103)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. Raise hood to gain access to steering/cooling fan control manifold.

3. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

4. For assembly purposes, label wire harness leads for manifold solenoids. Disconnect wire harness connectors from solenoids on manifold.

5. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

6. Remove steering/cooling fan manifold from the frame using Figure 103 as guide.

IMPORTANT: An orifice is placed beneath the hydraulic fitting in the control manifold LS port. If this fitting is removed from manifold, make sure to remove orifice and label its position for assembly purposes.

7. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O-rings.

Installation (Fig. 103)

1. If fittings were removed from manifold:

   A. Lubricate new O-rings with clean hydraulic oil. Install lubricated O-rings on fittings.

   IMPORTANT: When installing the orifice in manifold port LS, make sure that orifice is flat in the base of the port cavity. Manifold damage is possible if the orifice is cocked in the cavity.

   B. If fitting was removed from manifold port LS, install orifice in port.

   C. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   D. Refer to Figure 104 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Install steering/cooling fan manifold to the frame using Figure 103 as guide. Torque the flange head screws that secure manifold to mount plates from **106 to 159 in-lb (12.0 to 17.9 N-m)**.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Using labels placed during removal, correctly connect wire harness connectors to solenoids on manifold.

5. Make sure hydraulic tank is full. Add correct oil if necessary.

6. Lower and secure hood.

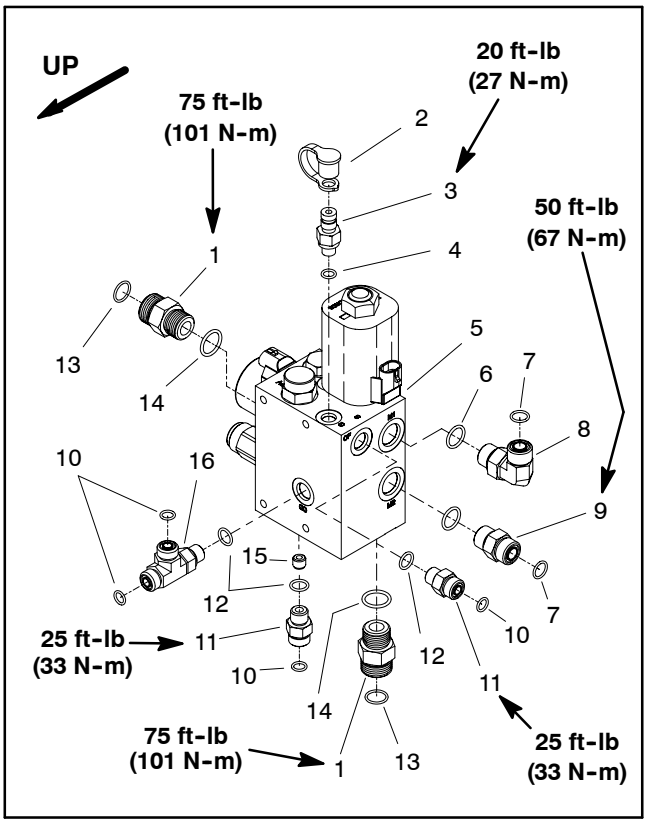


Figure 104

1. Straight fitting (P & CH)
2. Dust cap
3. Quick fitting (G)
4. O-ring
5. Manifold assembly
6. O-ring
7. O-ring
8. 90º fitting (M1)
9. Straight fitting (M2)
10. O-ring
11. Straight fitting (CF & LS)
12. O-ring
13. O-ring
14. O-ring
15. Orifice (LS)
16. Tee fitting (CD)

Steering/Engine Cooling Fan Control Manifold Service

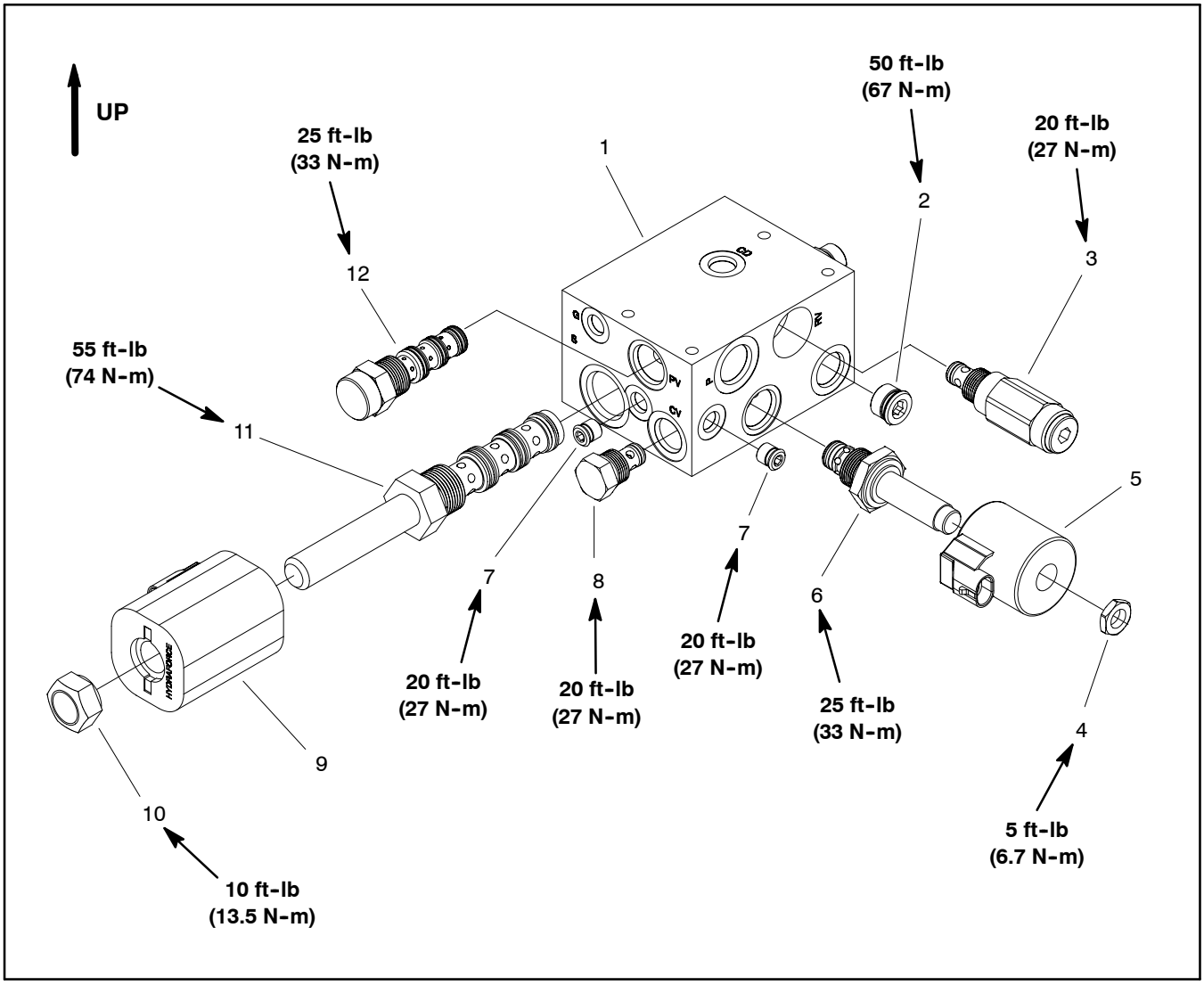


Figure 105

1. Steering/cooling fan manifold
2. NWD #8 plug with O-ring
3. Relief valve (RV)
4. Solenoid nut
5. Solenoid coil
6. Proportional relief valve (PRV)
7. NWD #4 plug with O-ring (2 used)
8. Check valve (CV)
9. Solenoid coil
10. Solenoid nut
11. Solenoid valve (S)
12. Compensator valve (PV)

NOTE: The ports on the steering/cooling fan manifold are marked for easy identification and assembly of components. Example: P is the connection port for the supply from the lift control valve and RV is the relief cartridge valve port (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Valve Cartridge Service (Fig. 105)

For cartridge valve service procedures, see Hydraulic Traction Control Manifold Service in this section. Refer to Figure 105 for steering/cooling fan manifold cartridge valve and plug installation torque.

NOTE: The steering/cooling fan control manifold includes several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to Figure 105 for plug installation torque.

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Chapter 5

Electrical System

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General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster machine. Refer to the Operator's Manual for additional information when servicing the machine.

Toro Electronic Controllers (TEC)

Groundsmaster 5900 and 5910 machines use two (2) Toro Electronic Controllers (TEC) to manage machine electrical functions. The controllers are microprocessor controlled that sense the condition of various switches (inputs) and direct electrical power to control appropriate machine functions (outputs) based on the inputs. Communication between the two Toro controllers, the Cummins engine controller and the Info Center Display is provided with a CAN bus system. The status of inputs to the controllers as well as outputs from the controllers can be monitored with the Info Center Display.

The controllers appear identical but they are different in terms of the connectors and internal hardware. They are arranged in "master / slave" configuration and therefore cannot be interchanged. The TEC−5002 master controller is responsible for powering up both the TEC−5001 slave controller and the Cummins engine controller. The TEC−5002 also controls the engine start circuit.

IMPORTANT: Before performing any welding on the machine, disconnect the battery cables from the batteries, disconnect the wire harness connectors from both Toro Electronic Controllers, disconnect the wire harness connectors from the engine controller and disconnect the terminal connector from the alternator to prevent damage to the machine electrical system.

Cummins Engine Electronic Control Module (ECM)

The Cummins engine that is used in the Groundsmaster 5900 and 5910 uses an electronic control module (ECM) for engine management and also to communicate with the TEC controllers and the Info Center Display on the machine. All engine ECM electrical connectors should be plugged into the controller before the machine ignition switch is moved from the OFF position to either the RUN or START position. If the engine ECM is to be disconnected for any reason, make sure that the ignition switch is in the OFF position with the key removed before disconnecting the engine ECM.

CAN-bus Communications

The two (2) TEC controllers (TEC-5001 and TEC-5002), the Cummins Engine Controller and the Info Center Display used on the Groundsmaster 5900 and 5910 communicate with each other on a CAN bus system. Using this system allows the traction unit to fully integrate all the different electrical components of the tractor and bring them together as one. The CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced. The integration of electrical functions also allows the Info Center Display to assist with electrical system diagnostics.

CAN identifies the Controller Area Network that is used between the controllers on the Groundsmaster. Two (2) specially designed, twisted cables form the bus. These wires provide the data pathways between the controllers (TEC-5001, TEC-5002 and the Cummins controller) and the Info Center Display used on the machine. The engineering term for these cables are CAN High and CAN Low. At the ends of the twisted pair of bus cables are 120 ohm termination resistors.

Each of the components that is controlled by the CAN bus link only needs four (4) wires to operate and communicate to the system: CAN High, CAN Low, B+ (power) and ground.

Electrical Drawings

The electrical schematic and wire harness drawings for the Groundsmaster 5900 and 5910 are located in Chapter 10 – Foldout Drawings.

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

The meter can test electrical components and circuits for current, resistance or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

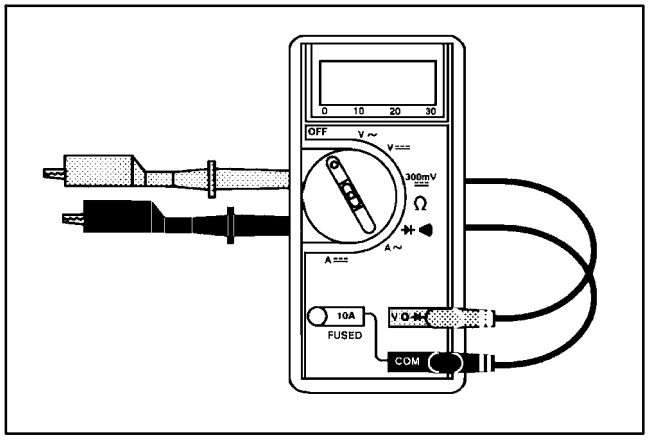


Figure 1

Skin-Over Grease

Special non-conductive grease which forms a light protective skin which helps waterproof electrical switches and contacts.

Toro Part Number: **505-165**



Figure 2

Dielectric Gel

Dielectric gel should be used to prevent corrosion of connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

Toro Part Number: **107-0342**



Figure 3

Battery Terminal Protector

Aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after the battery cable has been secured to the battery terminal.

Toro Part Number: **107-0392**



Figure 4

Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.



Figure 5

Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Chapter 10 – Foldout Drawings).

If the machine has any interlock switches by–passed, reconnect the switches for proper troubleshooting and safety.

NOTE: Use the Info Center Display when troubleshooting a Groundsmaster 5900 or 5910 electrical problem.

Starting Problems

Problem	Possible Causes
All electrical power is dead, including Info Center Display.	Batteries are discharged. Battery cables are loose or corroded. Fuse 1F1 (5 amp) to the ignition switch is faulty. Ignition switch or circuit wiring is faulty.
Starter solenoid clicks, but starter will not crank. **NOTE:** If the starter solenoid clicks, the problem is not in the interlock circuit.	Batteries are discharged. Battery cables are loose or corroded. Ground cable is loose or corroded. Wiring at the starter motor is faulty. Starter solenoid or starter motor is faulty.
Engine starts, but stops when the ignition switch is released from the START position.	Engine or fuel system is malfunctioning (see Chapter 3 - Cummins Diesel Engine).
Engine cranks, but does not start.	Engine and/or fuel may be too cold. Fuel tank is empty. Engine or fuel system is malfunctioning (see Chapter 3 - Cummins Diesel Engine). Hydraulic load is slowing engine cranking speed.
Engine cranks, but should not, when the traction pedal is depressed.	Traction pedal potentiometer is out of adjustment. Traction pedal potentiometer or circuit wiring is faulty.

Starting Problems (Continued)

Problem	Possible Causes
Nothing happens when start attempt is made. Info Center Display operates with the ignition switch in RUN. **NOTE:** Use Info Center Display to assist with identifying problem.	Traction pedal is not in neutral position. Operator seat is unoccupied OR the parking brake is not applied. PTO switch is engaged. Traction pedal potentiometer is out of adjustment. Traction pedal potentiometer or circuit wiring is faulty. Seat switch or circuit wiring is faulty. Parking brake switch or circuit wiring is faulty. Ignition switch or circuit wiring is faulty. Start relay or circuit wiring is faulty. TEC−5002 fuses (3F1, 3F2, 3F3, 3F4) are faulty. Maxi Fuse #1 is faulty Controller power relay is faulty. Wiring to start circuit components is loose, corroded or damaged (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Electrical Drawings). Engine coolant sensor or circuit wiring is faulty. Hydraulic temperature sender or circuit wiring is faulty. Starter solenoid or starter motor is faulty. Engine or fuel system is malfunctioning (see Chapter 3 - Diesel Engine). TEC−5002 controller is faulty.

General Run and Transport Problems

Problem	Possible Causes
Engine continues to run, but should not, when the ignition switch is turned off.	Ignition switch or circuit wiring is faulty. Engine or engine controller is malfunctioning (see Chapter 3 - Diesel Engine). TEC–5002 controller is faulty.
Engine continues to run, but should not, when the traction pedal is engaged with no operator in the seat.	Seat switch or circuit wiring is faulty. Traction pedal potentiometer is out of adjustment. Traction pedal potentiometer or circuit wiring is faulty. TEC–5002 controller is faulty.
The engine stops during operation, but is able to restart. **NOTE:** If excessive coolant temperature causes engine shutdown, the operator can restart the engine to allow the machine to be moved a short distance. After a restart in this condition, the engine will run for approximately 10 seconds before the engine shuts down again.	Parking brake is engaged. Operator is raising from the seat (seat switch not fully depressed). Seat switch or circuit wiring is faulty. Ignition switch or circuit wiring is faulty. Machine is being operated on a slope with a low fuel level. The parking brake switch or circuit wiring is faulty.
The engine kills when the traction pedal is depressed.	Parking brake is engaged. Operator is not fully depressing the seat switch. Seat switch or circuit wiring is faulty. Parking brake switch or circuit wiring is faulty. TEC–5002 controller is faulty.
Batteries do not charge.	Wiring to charging circuit components is loose, corroded or damaged (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings). Alternator belt is loose or damaged. Battery cables are loose or corroded. 125A Mega fuse is faulty. Alternator is faulty. Battery is faulty.

Cutting Deck (PTO) Operating Problems

Problem	Possible Causes
The PTO remains engaged, but should not, with no operator in the seat.	Seat switch or circuit wiring is faulty. TEC−5002 controller is faulty.
Cutting decks run, but should not, when raised. Cutting decks shut off with PTO switch.	Up limit switch or circuit wiring is faulty. TEC−5002 controller is faulty.
Cutting decks run, but should not, when raised. Cutting decks do not shut off with PTO switch.	Both the up limit switch (or circuit wiring) and PTO switch (or circuit wiring) are faulty. A hydraulic problem in the PTO circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
One cutting deck does not operate when lowered with the PTO engaged.	Up limit switch for affected deck is out of adjustment. Up limit switch or circuit wiring for affected deck is faulty. Control manifold solenoid coil S or circuit wiring for affected deck is faulty. A hydraulic problem in the PTO circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
None of the cutting decks operate. Cutting decks are able to raise and lower.	PTO switch is in the OFF position. High temperature of engine coolant or hydraulic oil has disabled the cutting decks. Seat switch or circuit wiring is faulty. PTO switch or circuit wiring is faulty. Cutting deck up limit switch or circuit wiring is faulty. Mow/transport switch or circuit wiring is faulty. Hydraulic temperature sender or circuit wiring is faulty. Coolant temperature sender or circuit wiring is faulty. A hydraulic problem in the PTO circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC−5002 controller is faulty.
Cutting decks run, but should not, when lowered with PTO switch in the disengaged (OFF) position.	The PTO switch or circuit wiring is faulty. TEC−5002 controller is faulty.

Cutting Deck Lift/Lower Problems

Problem	Possible Causes
None of the cutting decks will lower.	Mow/transport switch is in the transport position. Operator is not fully depressing the seat switch. TEC–5001 fuses (4F1, 4F2, 4F3, 4F4) are faulty. Seat switch or circuit wiring is faulty. Mow/transport switch or circuit wiring is faulty. Lift control manifold solenoid coil S1 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
None of the cutting units will raise.	Lift control manifold solenoid coil S1 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
Front cutting deck **will not** raise or lower, but both wing cutting decks **will** raise and lower.	Front deck lift switch or circuit wiring is faulty. Lift control manifold solenoid coils S5 or S6 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
RH wing cutting deck **will not** raise or lower, but the front and LH wing cutting decks **will** raise and lower.	RH deck lift switch or circuit wiring is faulty. Lift control manifold solenoid coils S7, S8 or S9 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
LH wing cutting deck **will not** raise or lower, but the front and RH wing cutting decks **will** raise and lower.	LH deck lift switch or circuit wiring is faulty. Lift control manifold solenoid coils S2, S3 or S4 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.

Info Center Display

The Groundsmaster Info Center Display is a LCD device that is located on the steering tower. The Info Center provides information for the machine operator during machine operation, provides electrical system diagnostic assistance for technicians and allows inputs for adjustable machine settings.

Power for the Info Center is available when the main power relay is energized (ignition switch is in the START or RUN position). Fuse 1F3 protects the Info Center power circuit. A CAN bus system involving the TEC−5001 controller, the TEC−5002 controller, the Cummins ECM and the Info Center is used to provide necessary machine communication for the Info Center.

NOTE: The TEC controllers and the Info Center Display used on the Groundsmaster 5900 and 5910 are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

Operator Information

The Info Center replaces traditional gauges by displaying engine and machine status. This information is displayed on two (2) screens that can be selected by the operator.

Info Center Screen 1 (Fig. 6) is the default screen that is displayed when the ignition switch is in either the RUN or START position. Screen 1 displays engine coolant temperature, fuel level, machine hours and whether the traction speed is in LO or HI speed range. Indicator icons will also appear on this screen when the PTO is engaged, when the parking brake is applied, when the engine cooling fan reverses direction, when the cruise control is engaged, when the air intake heater is energized and when traction assist is engaged.

The Info Center navigation menu (Fig. 7) can be accessed by pressing and releasing any of the left four (4) buttons on the display. The navigation menu will automatically close after a short display time or it can be closed by pressing the button under the opened door.

Info Center Screen 2 (Fig. 8) can be viewed by accessing the Info Center navigation menu and pressing the button below SCREEN TWO. Screen 2 displays engine RPM, hydraulic oil temperature, battery voltage and operating time until the next service.

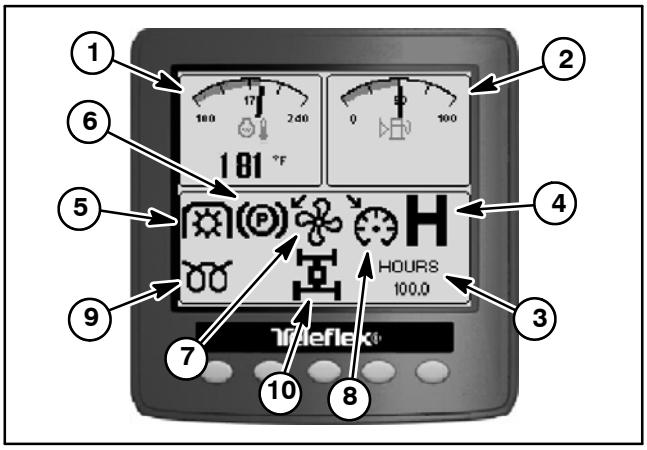


Figure 6

1. **Coolant temperature**
2. **Fuel level**
3. **Machine hours**
4. **Traction speed**
5. **PTO icon**
6. **Parking brake icon**
7. **Cooling fan icon**
8. **Cruise icon**
9. **Intake heater icon**
10. **Traction assist icon**

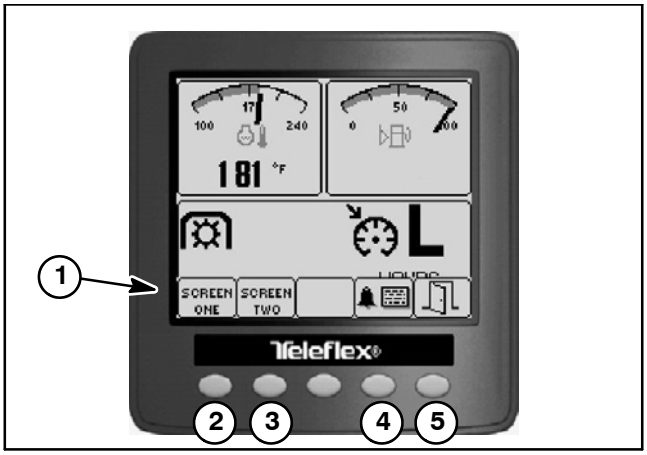


Figure 7

1. **Navigation menu**
2. **Screen 1 access button**
3. **Screen 2 access button**
4. **Fault access button**
5. **Exit menu button**

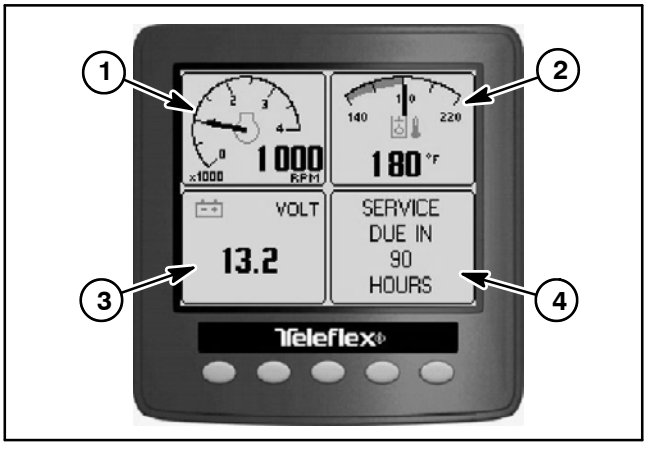


Figure 8

1. **Engine RPM**
2. **Hydraulic oil temperature**
3. **Battery voltage**
4. **Time until next service**

Info Center controls for brightness and contrast can be accessed by pressing and releasing the right button on the Info Center (Fig. 9). Use the display buttons to change the screen image and to exit the control screen.

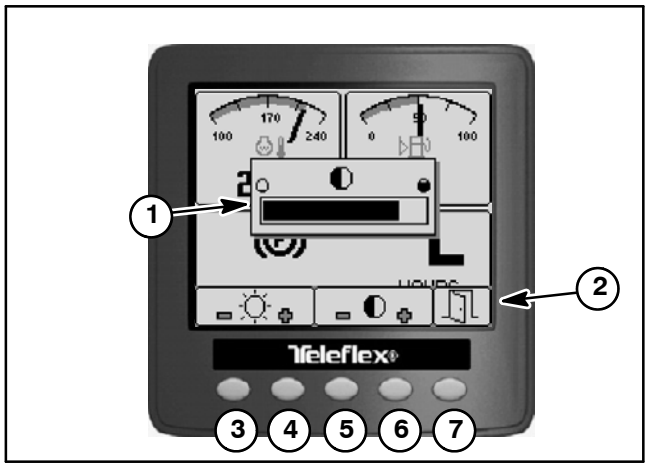


Figure 9

1. **Indicator bar**
2. **Menu**
3. **Brightness - button**
4. **Brightness + button**
5. **Contrast - button**
6. **Contrast + button**
7. **Exit button**

Operator Advisories

Operator advisories are automatically displayed by the Info Center when a machine function requires additional action. For example, if the operator attempts to start the engine when the traction pedal is depressed, an advisory is identified on the Info Center Display that the traction pedal needs to be in neutral. An advisory will not be logged into any fault log.

Displayed advisories can be cleared from the display by pressing any of the Info Center buttons.

Advisories are available for the following functions:

1. The TO START advisory identifies that the engine starter will not engage after the ignition switch is turned to START (Fig. 10):

   A. ENGINE RUNNING. Engine is already running.

   B. WAIT. Engine signalling wait due to air intake heater being energized.

   C. RESET TEACH PLUG. Traction pedal teach wires are connected.

   D. DISENGAGE PTO. The PTO switch is pulled out (engaged) and must be disengaged before starter will operate.

   E. MOVE TP TO NEUTRAL. The traction pedal is not in the neutral position.

   F. SEAT OPERATOR OR SET PARKING BRAKE. Operator needs to be in seat or parking brake needs to be applied to engage starter.

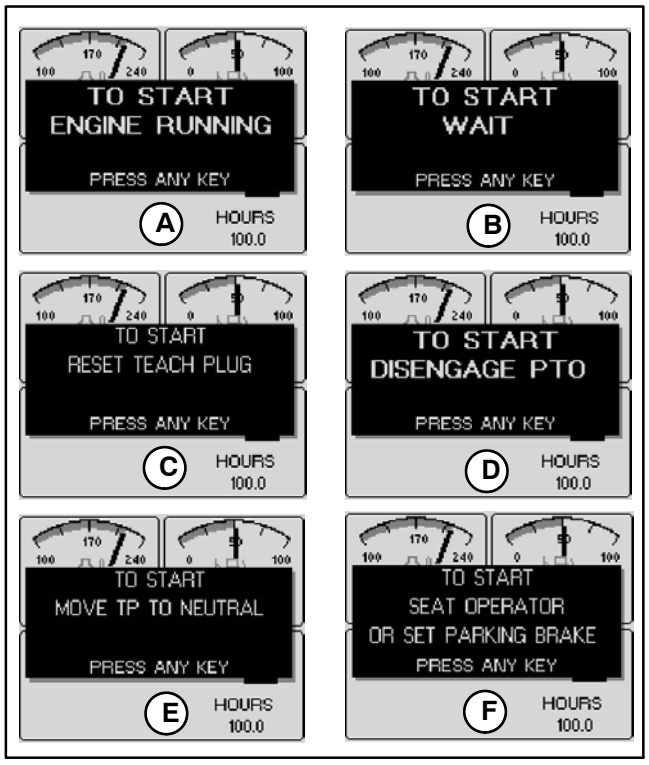


Figure 10

2. The TO LOWER DECK advisory identifies that the cutting deck will not lower when a lower deck switch is pressed (Fig. 11):

A. SET LOW RANGE. Machine is set to high speed range and needs to be in low speed before decks will lower.

B. SEAT OPERATOR. Operator needs to be in seat to lower cutting decks.

C. SET PARKING BRAKE. Parking brake needs to be applied to lower cutting deck.

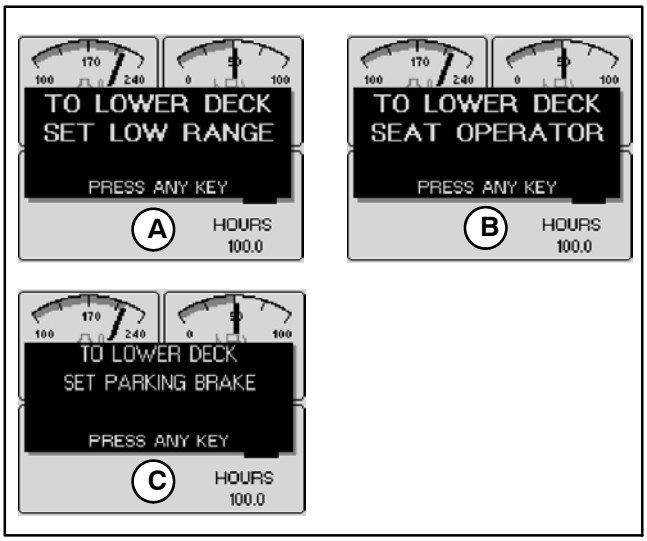


Figure 11

3. The FOR TRACTION advisory identifies that the traction drive will not engage when the traction pedal is pressed (Fig. 12):

A. SEAT OPERATOR. Operator needs to be in seat to engage traction.

B. MOVE TP TO NEUTRAL. The traction pedal is not in the neutral position.

C. RELEASE PARKING BRAKE. Parking brake is applied and needs to be released before traction drive will engage.

D. FIX CRITICAL SENSOR ERROR. Critical traction pedal sensor error exists.

E. FIX CRITICAL VOLTAGE ERROR. Critical traction pedal voltage error exists.

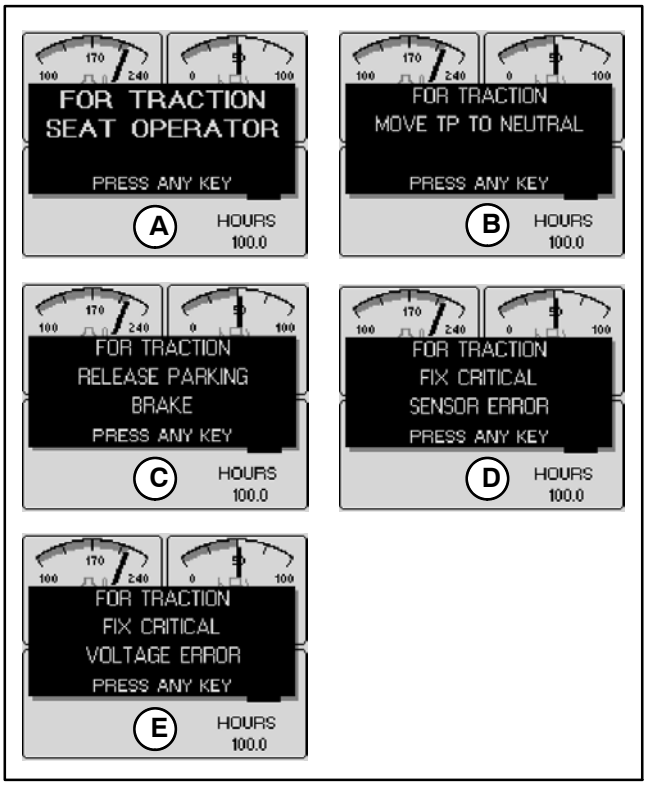


Figure 12

4. The FUEL LEVEL advisory identifies that the fuel remaining in the tank is low (Fig. 13).

A. LOW FUEL LEVEL. Less than 5 gallons of fuel remain in the fuel tank.

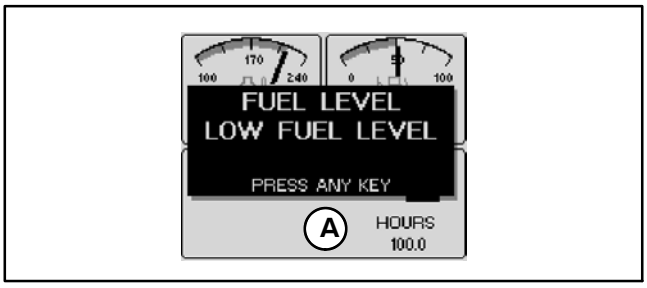


Figure 13

5. The FOR TRACTION ASSIST advisory identifies that the the traction assist system will not engage when the traction assist switch is pressed (Fig. 14).

A. SEAT OPERATOR. Operator needs to be in seat to engage traction assist.

B. MUST BE IN LOW RANGE. Machine is set to high speed range and needs to be in low speed to engage traction assist.

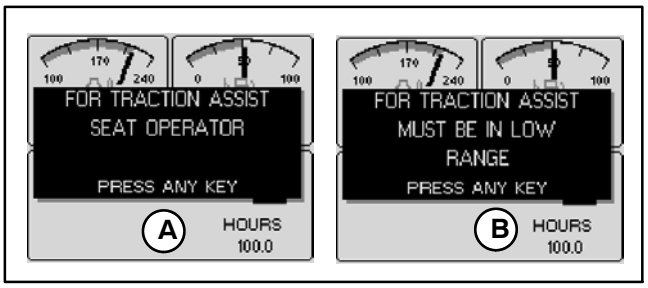


Figure 14

6. The TO ENGAGE PTO advisory identifies that the PTO will not engage when the PTO switch is pulled out (Fig. 15):

A. SEAT OPERATOR. Operator needs to be in seat to engage PTO.

B. MUST BE IN LOW RANGE. Machine is set to high speed range and needs to be in low speed before PTO will engage.

C. LET ENGINE WARM. Engine needs to reach operating temperature before PTO will engage.

D. LOWER DECKS. No cutting decks are lowered. At least one deck must be fully lowered before the PTO will engage.

E. SOLVE ENGINE TORQUE LIMIT. Engine torque is limited.

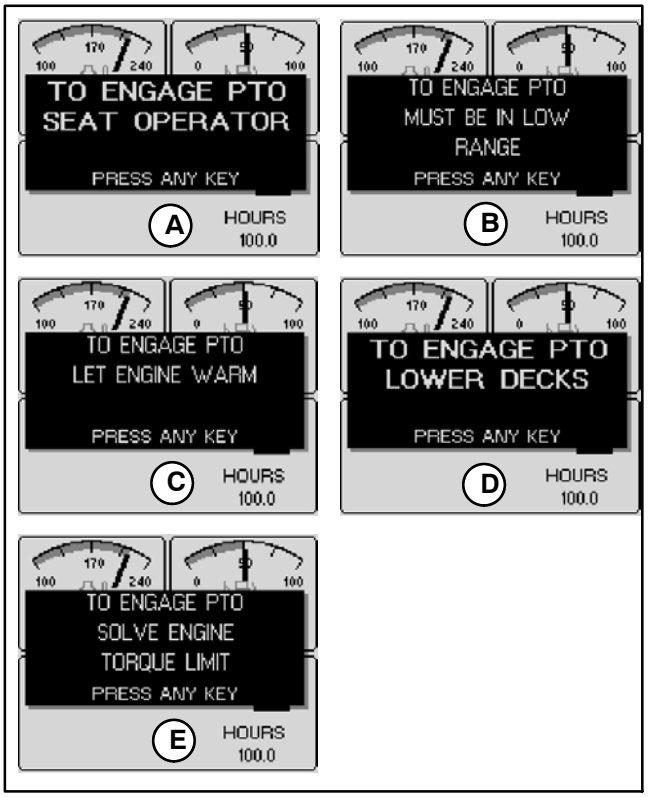


Figure 15

7. The TO SET CRUISE CONTROL advisory identifies that the cruise control will not engage when the cruise control switch is pressed (Fig. 16):

A. INCREASE TRACTION. Forward ground speed is too low to engage cruise control.

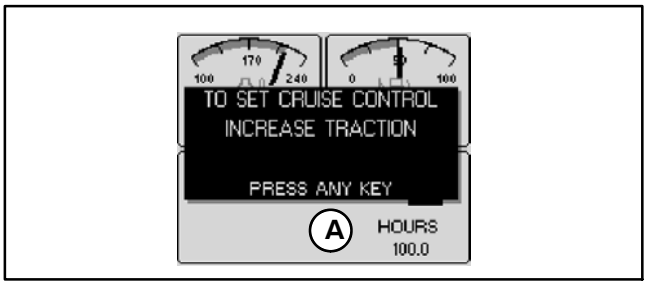


Figure 16

8. The TO FLOAT DECK advisory identifies that the cutting decks are not in float mode (Fig. 17):

A. LOWER DECKS. Press deck lower switch(es) to fully lower the decks and engage the float position.

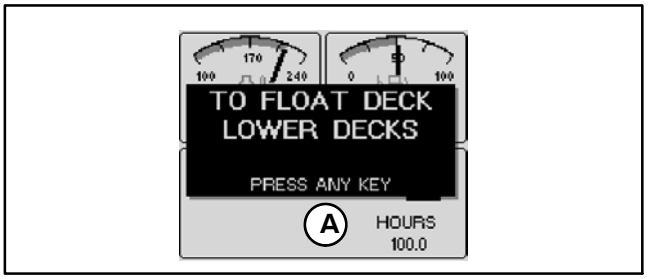


Figure 17

9. The TO SET RANGE LOW advisory identifies that low speed range will not engage when the Hi−Lo speed switch is pressed (Fig. 18).

A. REDUCE GROUND SPEED. Ground speed needs to be less than 2 MPH in order to engage low speed range.

B. DISENGAGE CRUISE. Cruise control is engaged and needs to be disengaged in order to engage low speed range.

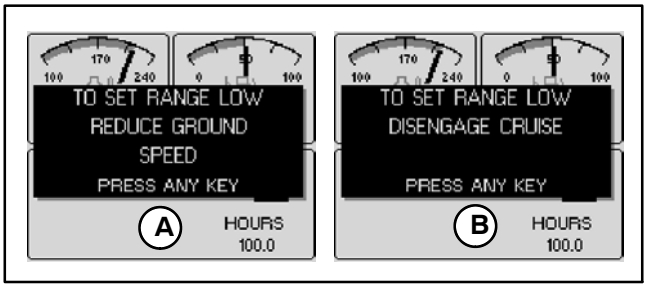


Figure 18

10. The FAN REVERSED BECAUSE advisory identifies that the engine cooling fan reversed direction (Fig. 19).

A. HIGH HYDRAULIC OIL TEMP. Hydraulic oil temperature above 203º F (95º C) is causing the cooling fan motor to reverse.

B. HIGH ENG COOLANT TEMP. Engine coolant temperature above 199º F (93º C) is causing the cooling fan motor to reverse.

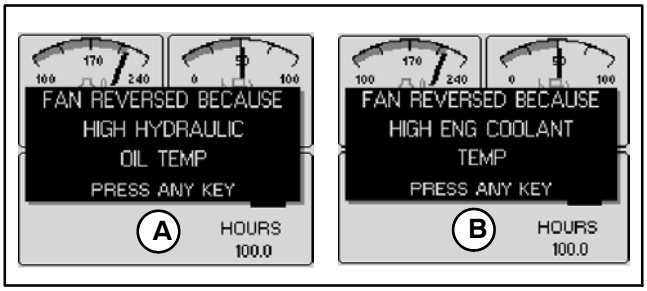


Figure 19

11. The FOR TEACH advisory identifies that the traction pedal teach function is not accessible.

A. TURN KEY SWITCH OFF THEN ON. To access the traction pedal teach function, cycle the ignition switch OFF and then to RUN.

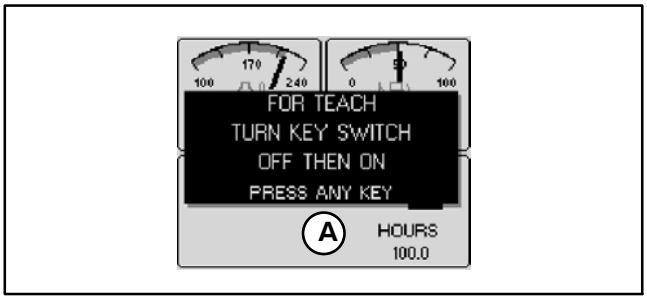


Figure 20

12. The TO SET RANGE HIGH advisory identifies that high speed range will not engage when the Hi-Lo speed switch is pressed (Fig. 21).

A. LIFT LEFT DECK. Left cutting deck is lowered and needs to be raised before high speed range can be engaged.

B. LIFT LEFT DECK FULLY. Left cutting deck is lowered below the up limit switch and needs to be raised before high speed range can be engaged.

C. LIFT CENTER DECK. Center (front) cutting deck is lowered and needs to be raised before high speed range can be engaged.

D. LIFT CENTER DECK FULLY. Center (front) cutting deck is lowered below the up limit switch and needs to be raised before high speed range can be engaged.

E. LIFT RIGHT DECK. Right cutting deck is lowered and needs to be raised before high speed range can be engaged.

F. LIFT RIGHT DECK FULLY. Right cutting deck is lowered below the up limit switch and needs to be raised before high speed range can be engaged.

G. DISENGAGE PTO. PTO is engaged and must be shut off before high speed range can be engaged.

H. DISENGAGE CRUISE. Cruise control is engaged and must be shut off before high speed range can be engaged.

I. REDUCE GROUND SPEED. Ground speed needs to be less than 2 MPH in order to engage high speed range.

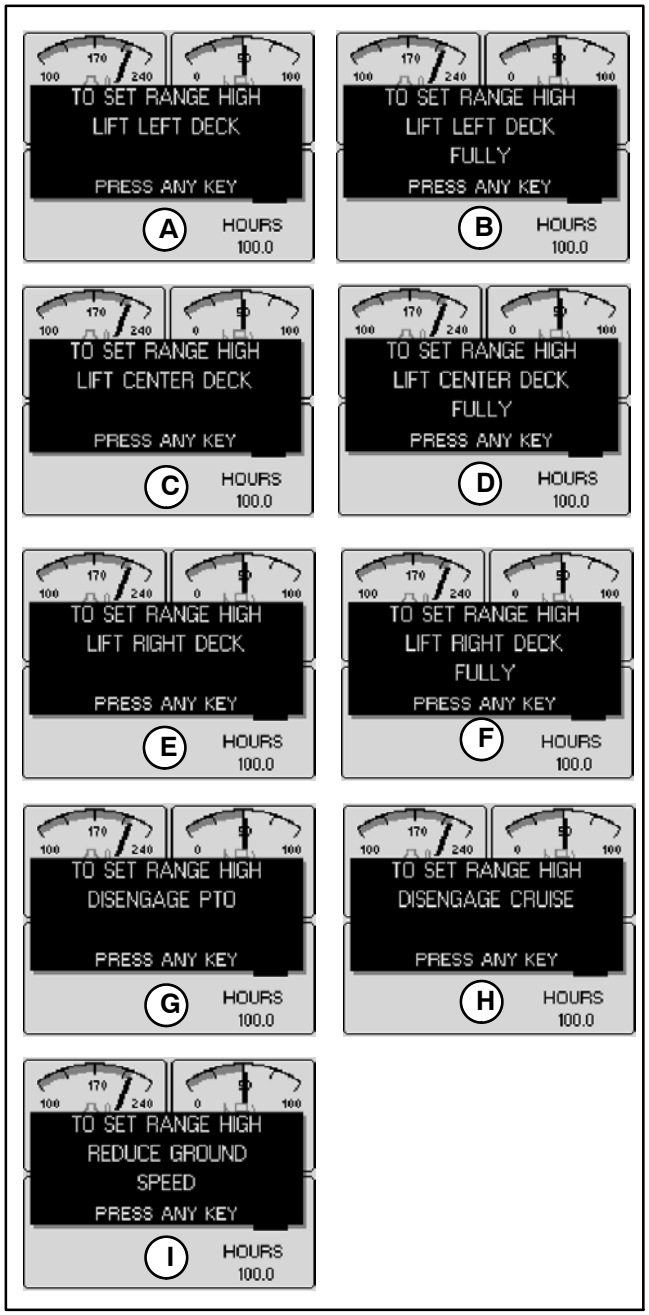


Figure 21

Engine Faults

The Info Center monitors critical engine electrical functions (e.g. engine oil pressure, engine operating temperature) and alerts the operator if potential issues arise. If an engine electrical fault is identified by the Cummins controller, the Info Center will alternately display a warning icon and information about the fault (Fig. 22).

If a STOP fault is displayed on the Info Center, the operator should cease operation of the machine and the engine as quickly and as safely as possible to reduce damage to the engine.

If a CHECK ENGINE fault is displayed on the Info Center, the operator should take the machine to a service center as soon as possible.

In order to clear the displayed fault, the engine problem has to be resolved.

NOTE: All engine electrical faults are stored in the Cummins controller and can be accessed by using the Cummins diagnostic software.

To access additional information regarding the displayed fault:

1. Access the Info Center navigation menu by pressing and holding any of the buttons on the display (Fig. 23).

2. Press the button under the fault access icon.

3. The fault description will be displayed on the Info Center (Fig. 24). If there are multiple faults, they can be reviewed using the navigation arrows.

4. To exit the fault description screen, press the button under the alarm icon.

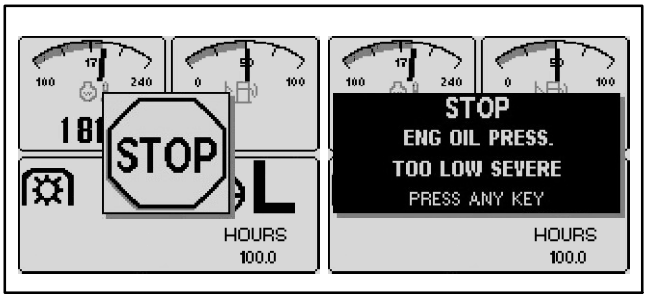


Figure 22

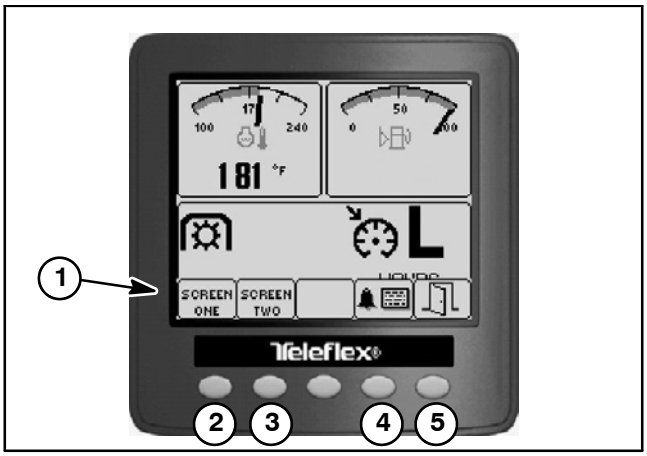


Figure 23

1. **Navigation menu**
2. **Screen 1 access button**
3. **Screen 2 access button**
4. **Fault access button**
5. **Exit menu button**

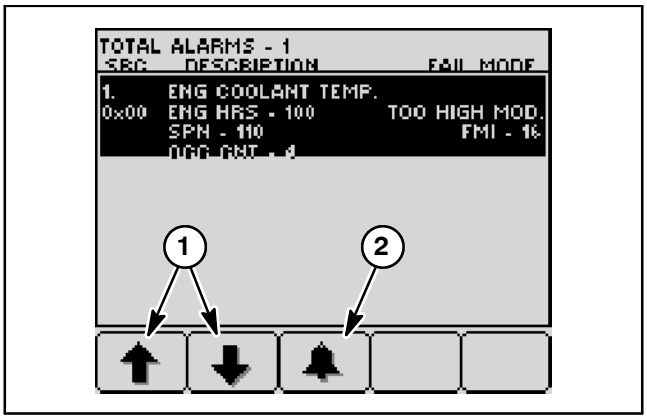


Figure 24

1. **Navigation arrows**
2. **Alarm icon**

Diagnostics

The Info Center DIAGNOSTICS screens allow TEC controller electrical inputs and outputs to be tested. No separate code reader or computer is needed to access the information. Use of the DIAGNOSTICS screens can be used to identify and troubleshoot machine electrical functions.

To access the DIAGNOSTICS screen (Fig. 25):

- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose DIAGNOSTICS.
- Use navigation arrows to choose TORO DIAG.
- Use navigation arrows to choose machine function that is to be evaluated.

Each DIAGNOSTICS screen is separated into three (3) areas of information (Fig. 26). The top section identifies the controller inputs that are necessary for the function that is being evaluated. The middle section identifies additional inputs that are involved with the chosen function. The bottom section identifies the TEC outputs.

For troubleshooting purposes, the DIAGNOSTICS screens can be used to identify whether a switch and it's circuit wiring are functioning correctly. As an example, if the ENGINE RUN diagnostic screen is displayed and the key switch is in the RUN position (ON), the PTO switch can be engaged and disengaged while the screen is viewed. The PTO ENABLED item should indicate the change in status of the PTO switch. If there is no change on the screen when the switch changes state, a switch or circuit wiring problem should be investigated.

When the correct inputs are received by the TEC controllers, the outputs identified on the DIAGNOSTICS screen should show as ON. If the inputs are properly positioned and the output remains OFF, a problem with TEC controller power (circuit wiring or fuse) or the controller itself should be suspected.

It should be noted that a faulty output component may not be identified by the DIAGNOSTICS screen. As an example, if the starter solenoid is faulty, the ENGINE RUN screen could show that all inputs and outputs are correct for the function selected. The controller output occurs but the faulty solenoid will prevent the engine from starting.

DIAGNOSTICS screens are available for the functions listed on the following pages.

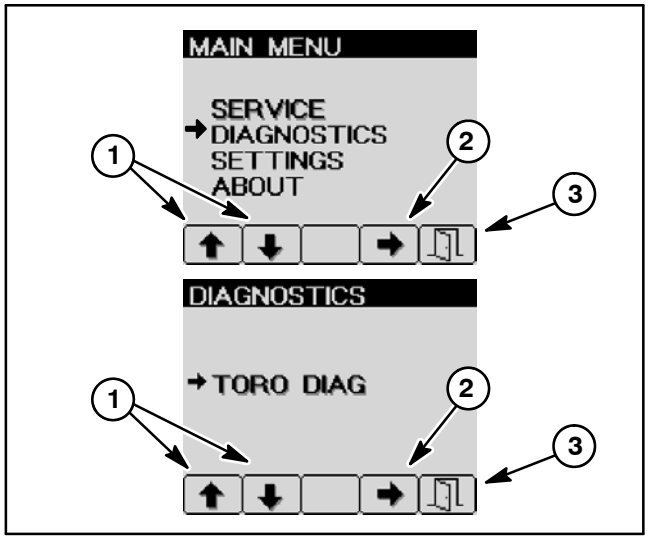


Figure 25

1. **Navigation arrows**
2. **Enter (accept)**
3. **Exit from menu**

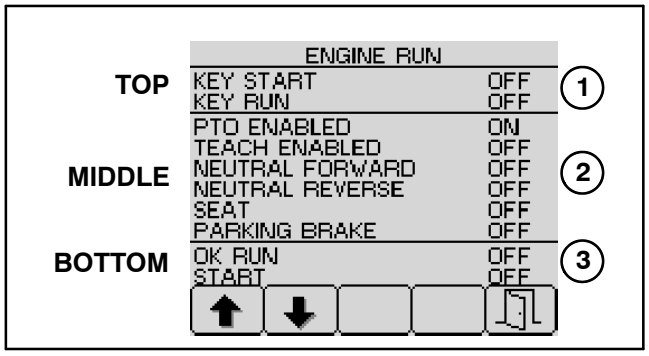


Figure 26

1. **Function inputs**
2. **Additional inputs**
3. **Outputs**

1. LEFT DECK and RIGHT DECK controls (Fig. 27)

   NOTE: The cutting decks will not lower when the high speed range is selected. Also, the decks will not raise or lower if the operator is not in the seat while the engine is running.

   To **lower** the left or right cutting deck, the following inputs have to be initiated:
   - Left or right lift/lower switch pressed to lower (DECK LOWER ON)
   - Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
   - Seat needs to be occupied (SEAT ON)

   If the proper inputs exist, the following outputs should occur:
   - Left or right deck lower (MASTER LIFT SOLENOID ON and DECK LOWER ON)

   Once the deck is fully lowered, the following outputs should occur:
   - Left or right deck in float mode (DECK FLOAT ON)

   NOTE: If a deck is already fully lowered when the ignition switch is moved from OFF to RUN, the deck will not be in float until the deck lift/lower switch is momentarily pressed to lower.

   To **raise** a left or right cutting deck, the following inputs have to be initiated:
   - Left or right deck lift/lower switch pressed to raise (DECK RAISE ON)
   - Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
   - Seat needs to be occupied (SEAT ON)

   If the proper inputs exist, the following outputs should occur:
   - Left or right deck raise (MASTER LIFT SOLENOID ON and DECK RAISE ON)

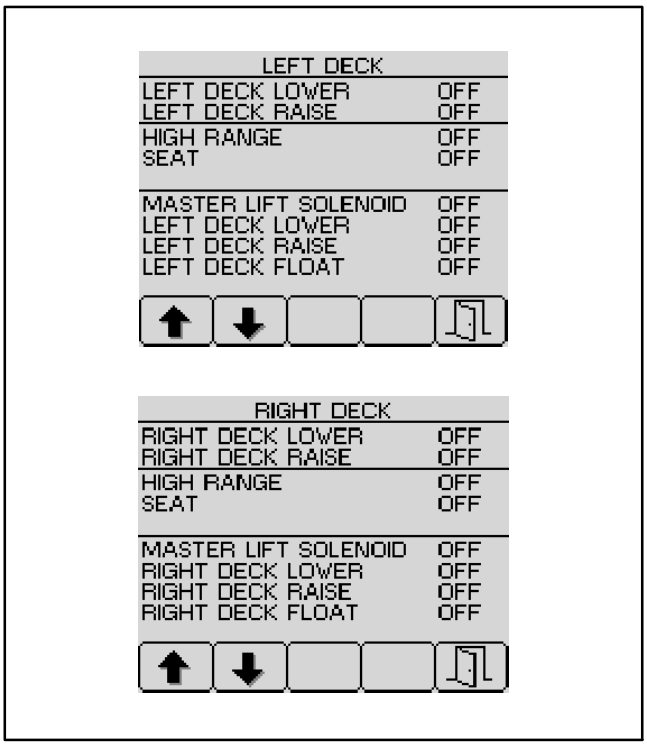


Figure 27

2. CENTER DECK controls (Fig. 28)

NOTE: The cutting decks will not lower when the high speed range is selected. Also, the decks will not raise or lower if the operator is not in the seat while the engine is running.

To **lower** the center (front) cutting deck, the following inputs have to be initiated:

- Center deck lift/lower switch pressed to lower (CENTER DECK LOWER ON)
- Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
- Seat needs to be occupied (SEAT ON)

If the proper inputs exist, the following outputs should occur:

- Center deck lower (CENTER DECK LOWER/FLO ON)

To **raise** the center (front) cutting deck, the following inputs have to be initiated:

- Center deck lift/lower switch pressed to raise (CENTER DECK RAISE ON)
- Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
- Seat needs to be occupied (SEAT ON)

If the proper inputs exist, the following outputs should occur:

- Center deck raise (MASTER LIFT SOLENOID ON and CENTER DECK RAISE ON)

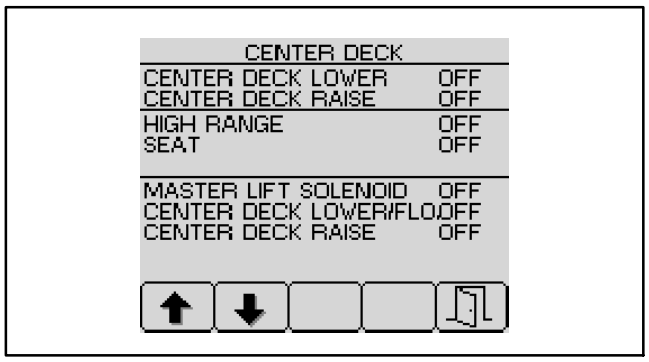


Figure 28

3. TRACTION PEDAL sensor function (Fig. 29)

The traction pedal DIAGNOSTIC screen identifies the state of the traction pedal potentiometer

- An indicator bar shows the relative location of the traction pedal range
- The voltages for the neutral position state change
- The present state of the forward and reverse neutral switches

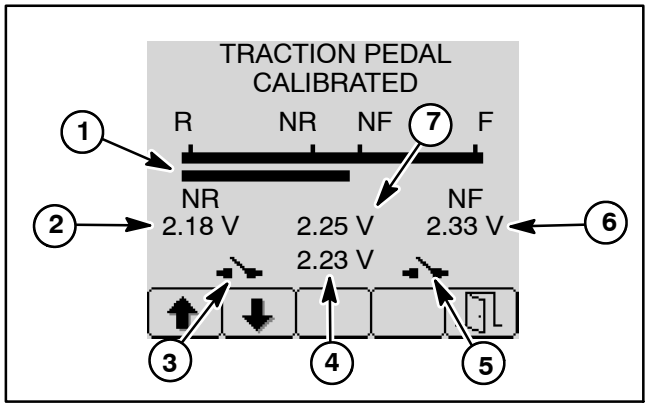


Figure 29

1. **Indicator bar**
2. **Neutral close/open voltage (reverse)**
3. **Neutral switch state change voltage (reverse)**
4. **Voltage for pedal in present position**
5. **Neutral switch state change voltage (forward)**
6. **Neutral close/open voltage (forward)**
7. **Neutral center target voltage**

4. TRACTION (Fig. 30)

   To engage forward traction, the following inputs have to be initiated:
   - Traction pedal pushed to forward (FWD NEUTRAL ON and REV NEUTRAL OFF)
   - Seat needs to be occupied (SEAT ON)
   - Parking brake not applied (PARKING BRAKE OFF)

   If the listed inputs exist, the following output should occur:
   - Forward traction engaged (HYDROSTAT FORWARD ON)

   The reverse traction diagnostic inputs and outputs are similar to the forward direction.

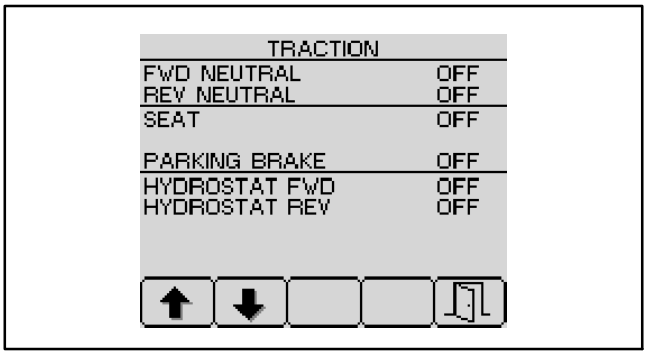


Figure 30

5. HIGH/LOW RANGE (Fig. 31)

   To engage traction high range speed, the following inputs have to be initiated:
   - PTO needs to be OFF (PTO SWITCH OFF)
   - All cutting decks need to be raised (All DECK DOWN OFF and all DECK FLOAT OFF)
   - Hi-Lo speed switch pressed to HI (HIGH RANGE REQUEST ON)

   If the listed inputs exist, the following outputs should occur:
   - High range speed engaged (HIGH RANGE ACTIVE ON)

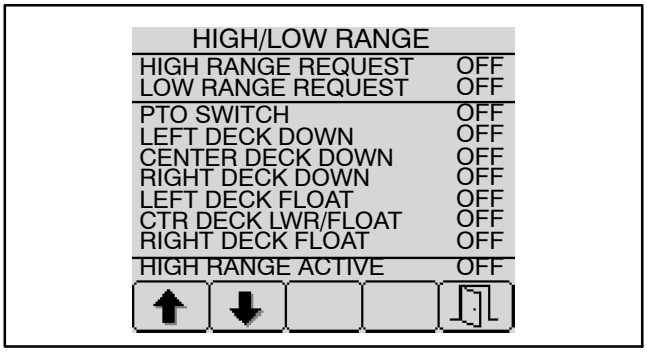


Figure 31

6. PTO (Fig. 32)

   To engage the PTO, the following inputs have to be initiated:
   - PTO switch pulled out (PTO ON)
   - Seat needs to be occupied (SEAT ON)
   - Cutting deck(s) need to be fully lowered into float position (LEFT, CENTER and/or RIGHT DECK FLOAT ON)
   - Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)

   If the proper inputs exist, the following outputs should occur:
   - Left deck engaged (LEFT PTO ON)
   - Center deck engaged (CENTER PTO ON)
   - Right deck engaged (RIGHT PTO ON)

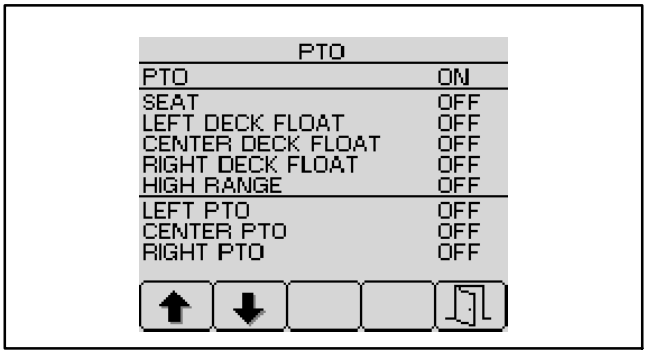


Figure 32

7. TRACTION ASSIST (Fig. 33)

NOTE: Traction assist only engages when low speed range is selected and the traction pedal is pressed in the forward direction.

To engage forward traction assist, the following inputs have to be initiated:

- Traction assist switch depressed to engage traction assist (TRACTION ASSIST INPUT ON)
- Seat needs to be occupied (SEAT ON)
- Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)

If the listed inputs exist, the following output should occur:

- Traction assist will be engaged (TRACTION ASSIST OUTPUT ON)

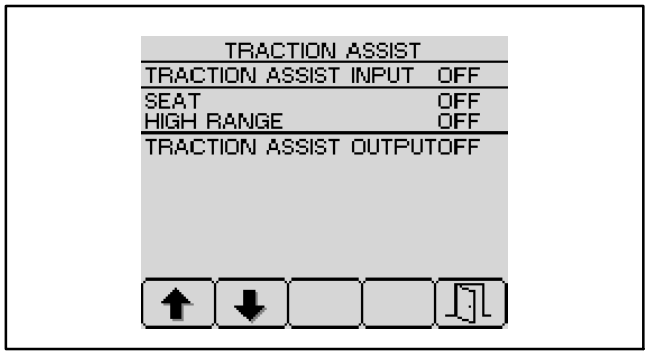


Figure 33

8. CRUISE CONTROL (Fig. 34)

To engage cruise control, the following inputs have to be initiated:

- Cruise control switch in the ON position (CRUISE ON/OFF ON)
- Cruise control switch depressed to engage cruise control (CRUISE ENGAGE ON)

If the listed inputs exist, the following output should occur:

- Cruise control will be engaged (CRUISE ACTIVE ON)

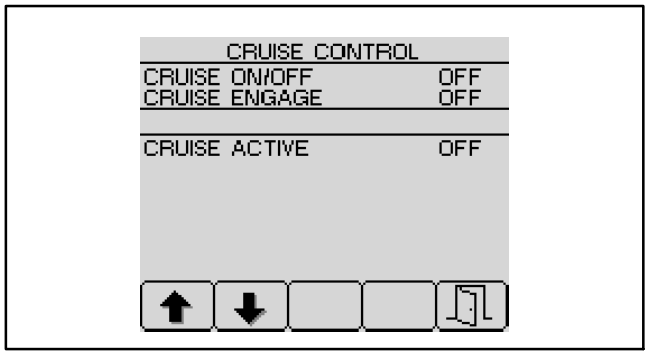


Figure 34

9. ENGINE RUN (Fig. 35)

When the ignition switch is in the ON position, the ENGINE RUN Diagnostic screen should show:

- KEY RUN input ON
- OK RUN output ON

To allow the engine to start, the following inputs have to be initiated:

- Ignition switch needs to be turned to START (KEY START and KEY RUN both ON)
- PTO disengaged (PTO ENABLED OFF)
- Traction pedal not in TEACH mode (TEACH ENABLED OFF)
- Traction pedal in neutral (NEUTRAL FORWARD and NEUTRAL REVERSE both OFF)
- Seat occupied or parking brake applied (either SEAT ON or PARKING BRAKE ON)

If the listed inputs exist, the following outputs should occur:

- The engine starter motor should engage (OK RUN and START both ON)

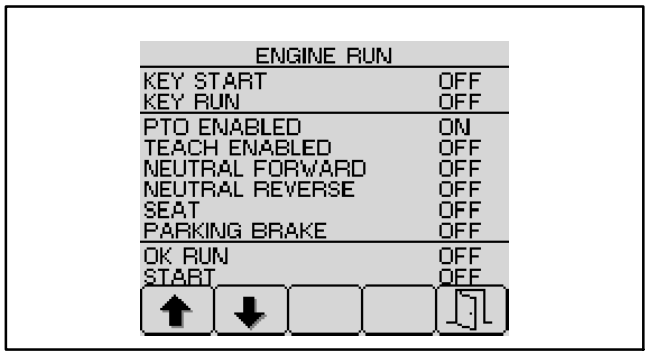


Figure 35

10. LIGHT KIT operation (Fig. 36)

To have the left hazard and turn signals operate, the following inputs have to be initiated:

- Headlight switch depressed to turn lights on (LIGHTS ON)
- Left turn signal switch depressed (LEFT TURN SIGNAL ON)

If the listed inputs exist, the following outputs should occur:

- Left turn signal and hazard lights will be on (LEFT HAZARD SIGNAL and LEFT TURN SIGNAL ON)

The right hazard and right turn signal diagnostic inputs and outputs are similar to the left direction.

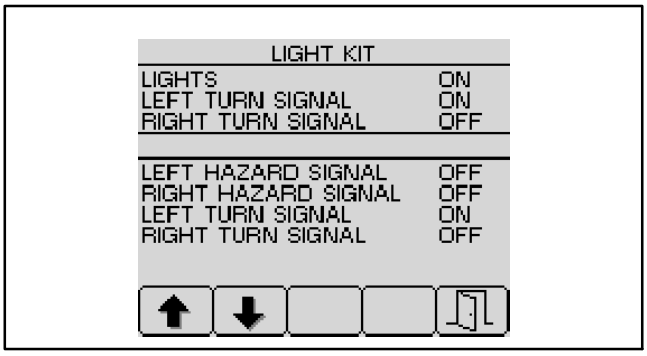


Figure 36

Administration Settings

The administration SETTINGS screens provide display choices for the Info Center Display.

To access the administration SETTINGS screen (Fig. 37):

- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose SETTINGS.
- Use navigation arrows to choose which of the SETTINGS menu items is to be viewed or changed.

SETTINGS choices are available for the following items:

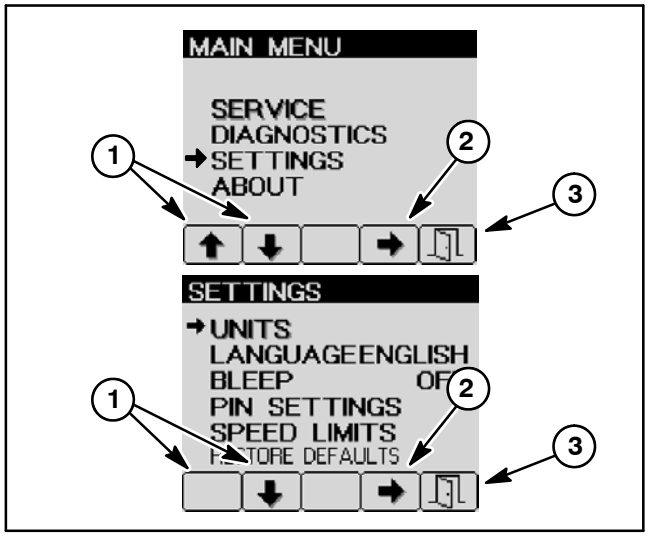


Figure 37

1. **Navigation arrows**
2. **Enter (accept)**
3. **Exit from menu**

1. UNITS (Fig. 38)

   The UNITS settings allow the display to show speed, distance, pressure, volume and temperature in U.S. or Metric units.

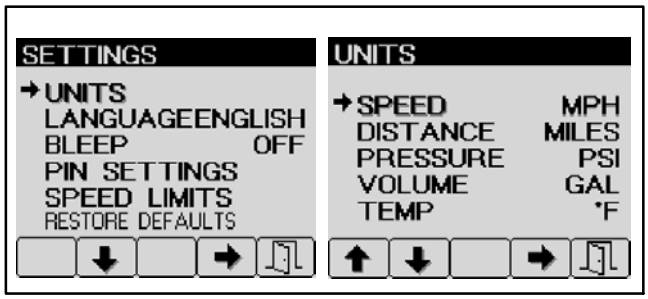


Figure 38

2. LANGUAGE options (Fig. 39)

   The LANGUAGE settings allows the Info Center Display language to be chosen. Use the navigation arrows to choose a language and use the enter arrow to accept the chosen language.

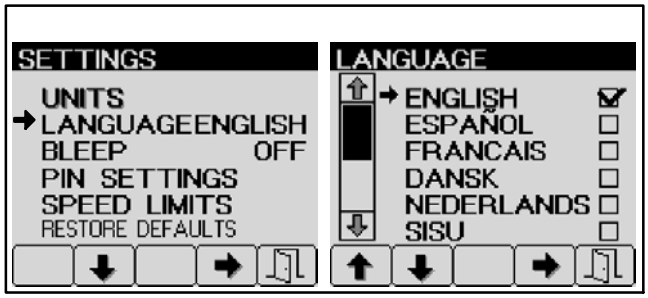


Figure 39

3. BLEEP (Fig. 40)

   When BLEEP is ON, a tone from the Info Center will sound whenever a button on the Info Center is pressed. When BLEEP is OFF, no tone will sound.

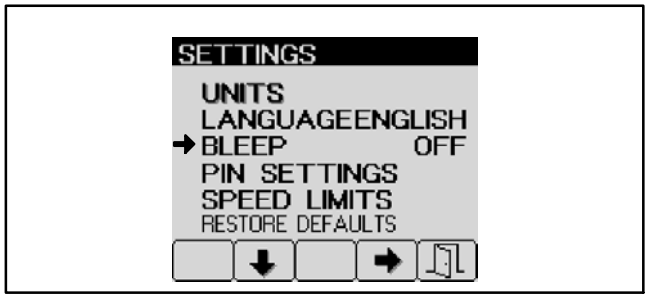


Figure 40

4. PIN SETTINGS (Fig. 41)

   Use of a PIN allows the ability to password protect access to Info Center SETTINGS screens.

   If a PIN is desired for Info Center access, use the navigation buttons to change the PIN ENTRY to ON.

   To enter PIN, use navigation buttons to accept PIN CHANGE. Use the Info Center Display buttons to enter the desired four (4) digit PIN and accept the PIN.

   NOTE: If PIN use is chosen (PIN ENTRY ON), make sure to record PIN so future Info Center Display access is available. If PIN reset is necessary (e.g. PIN has been forgotten), contact your Toro Distributor.

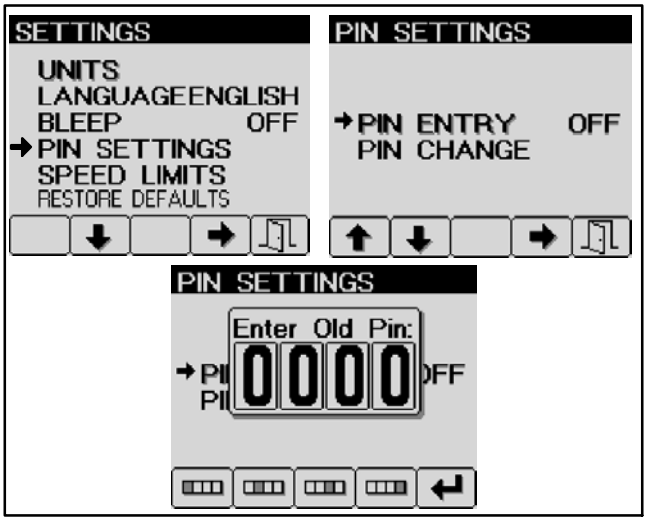


Figure 41

5. SPEED LIMITS (Fig. 42)

   Use the SPEED LIMITS settings to adjust the maximum ground speed for the machine. Speed adjustments are available for forward and reverse in both high and low speed range settings.

   After using the navigation buttons to choose the speed to be adjusted, the current speed limit will be identified with an indicator mark. Press the Info Center button under the + or – to change the speed limits. Exit the screen after ground speed adjustments are complete.

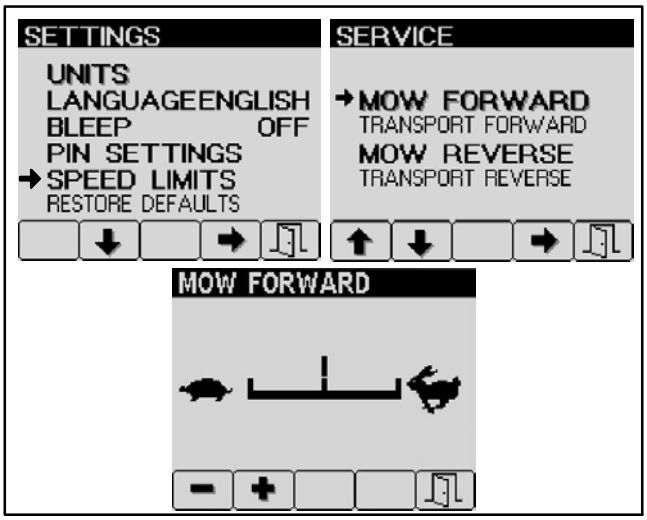


Figure 42

6. RESTORE DEFAULTS (Fig. 43)

   Use the RESTORE DEFAULTS settings to accept the Info Center defaults.

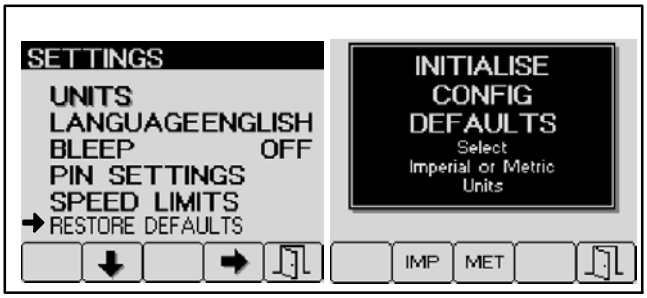


Figure 43

Administration Service

To access the administration SERVICE screens (Fig. 44):
Access the MAIN MENU screen by pressing and holding the right button on the Info Center.
Use the buttons under the navigation arrows to choose SERVICE
Select SERVICE by pressing the button under enter (right arrow)

To access the administration SERVICE screen (Fig. 44):
- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose SERVICE.
- Use navigation arrows to choose which of the SERVICE items is to be viewed or changed.

SERVICE choices are available for the following items:

1. Hours (Fig. 45)

The hours screen identifies the time that the machine has been operated in different functions.

2. Traction Pedal (Fig. 46)

The traction pedal screen lists the calibration values stored in the TEC-5002 controller for different pedal positions. This screen also identifies that the traction pedal calibration has been completed.

3. Fan Override (Fig. 47)

The fan override screen allows the direction and speed of the cooling fan motor to be tested if necessary. The engine must be running to allow the fan override option to be available.

NOTE: The parking brake needs to be applied for the fan override to be operational.

4. Fan Test (Fig. 48)

The fan test screen gives the opportunity to put the cooling fan motor through a demonstration mode. The fan motor will change speed and direction when the FAN DEMO is ON. The engine must be running to allow the fan test option to be available.

NOTE: The parking brake needs to be applied for the fan test to be operational.

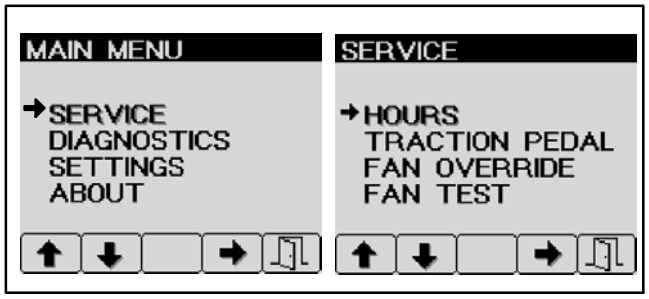


Figure 44

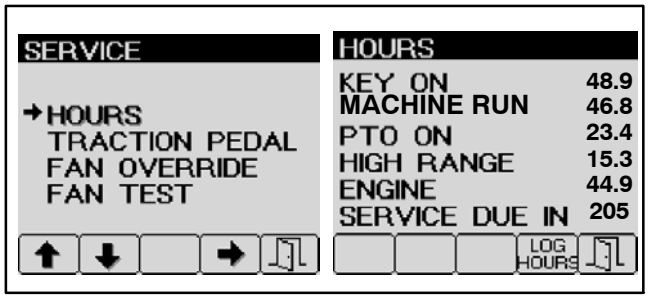


Figure 45

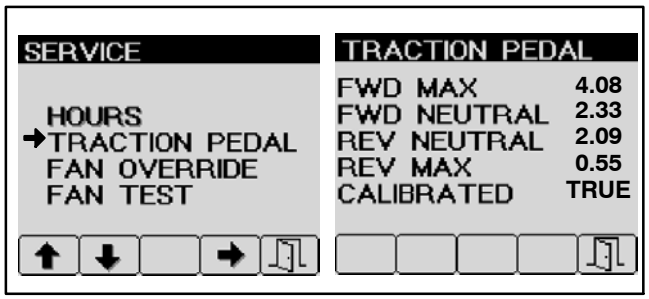


Figure 46

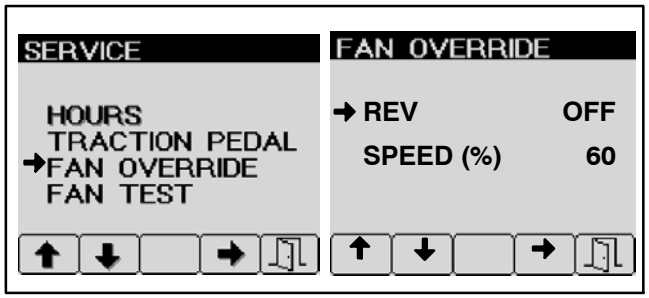


Figure 47

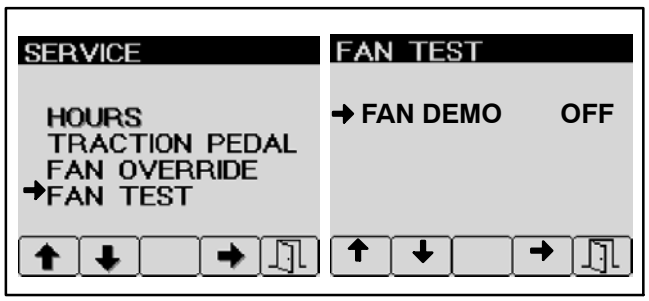


Figure 48

Administration About

The Administration ABOUT screens provide information about the machine, the Info Center Display, the two (2) Toro controllers and the Cummins engine controller.

To access the administration ABOUT screen (Fig. 49):

- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose ABOUT.
- Information about the Machine (model and serial number), Info Center, TEC−5001, TEC−5002 and Cummins engine controller can be chosen and viewed on the different ABOUT screens (Fig. 50). Use navigation arrows to move between the screens.

NOTE: The TEC controllers and the Info Center Display are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

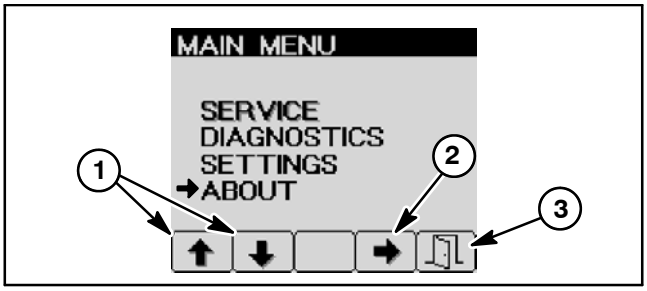


Figure 49

1. **Navigation arrows**
2. **Enter (accept)**
3. **Exit from menu**

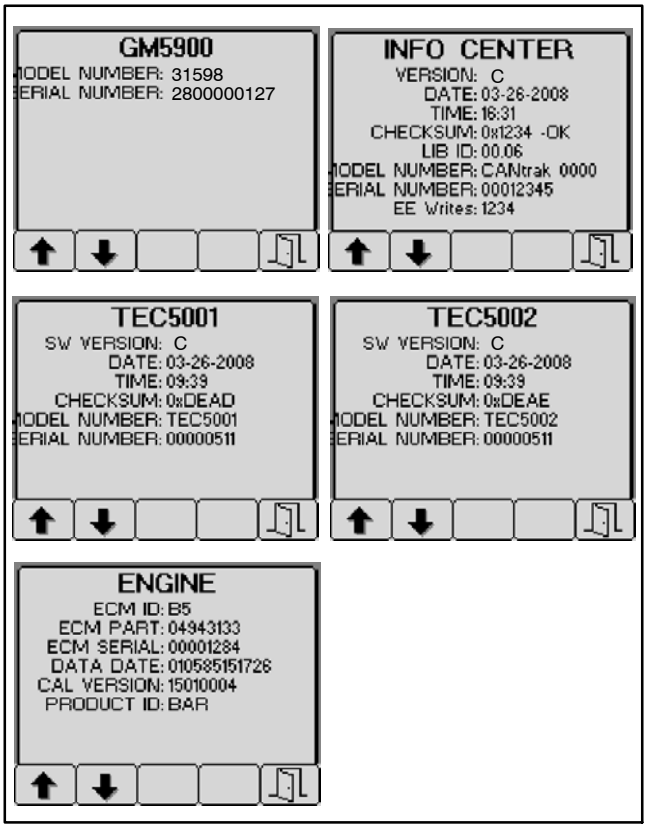


Figure 50

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set multimeter to the DC volts setting. The battery should be at a temperature of 60°F to 100°F (16°C to 38°C). The ignition key should be OFF and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information (see Battery Service in the Service and Repairs section of this chapter).

Voltage Measured	Battery Charge Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

Use a digital multimeter set to DC volts. Connect the positive (+) multimeter lead to the positive battery post and the negative (–) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the battery voltage will increase at different rates as the battery charges.

Start the engine and run at high idle **(3450 RPM)**. Allow the battery to charge for at least 3 minutes. Record the battery voltage.

After running the engine for at least 3 minutes, battery voltage should be at least 0.50 volt higher than initial battery voltage.

An example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.85 v
Difference	= +0.55 v

Check Operation of Interlock Switches

CAUTION

Do not disconnect safety switches. They are for the operator's protection. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

Interlock switch operation is described in the Operator's Manual. Your Groundsmaster is equipped with two (2) Toro Electronic Controllers (TEC) which monitor interlock switch operation. Information on the TEC is described in the Operator's Manual and in the Component Testing section of this Chapter.

The interlock system used on your Groundsmaster includes the seat switch, the traction pedal potentiometer, the parking brake switch, the cutting deck position switches, the mow/transport switch and the PTO switch. Testing of individual interlock switches is included in the Component Testing section of this Chapter.

NOTE: Use the Info Center Display to test Toro Electronic Controller inputs and outputs before further troubleshooting of an electrical problem on your Groundsmaster.

Traction Pedal Calibration

IMPORTANT: A properly installed and calibrated traction pedal potentiometer is critical to accurate traction system response and for reliable sensor life. Use care when removing, installing and calibrating the traction pedal potentiometer.

1. Park machine on a level surface, lower cutting decks, stop engine and apply parking brake.

2. Make sure that wire harness connector is plugged into traction pedal potentiometer.

3. Turn ignition switch to ON but do not start engine. Use the Info Center Display Diagnostic menu (see Info Center Display in the Service and Repairs section) to obtain the Traction Pedal Calibrated screen on the display (Fig. 51).

4. On the bar graph in the screen, the indicator bar should be between the NR and the NF. Also, the two (2) switch icons on the screen should both be open. To change the indicator bar location:

   A. Remove traction pedal cover and spring cover from front platform (see Traction Pedal Disassembly in the Service and Repairs section of Chapter 6 – Chassis).

   B. Loosen hex nut that secures neutral spring adjustment (Fig. 52).

   C. Slowly rotate the spring shaft while watching the switch icons (Fig. 52). When one of the switch icons close, stop rotating and mark the shaft position. Then slowly rotate the shaft in the opposite direction until the second switch icon closes and mark the shaft position.

   D. Rotate the spring shaft to the mid–point of the two shaft positions. Tighten the hex nut to secure the adjustment. At this setting, the indicator bar should be between the NR and the NF. Also, the neutral voltage value should be within 0.02 V of the midpoint voltage.

   NOTE: When adjusting traction pedal, voltage values should be similar to values shown in Figure 51. If spring shaft is rotated too quickly during adjustment, voltage values could be considerably different than the values shown.

5. Test traction system operation.

6. Install traction pedal cover and spring cover to front platform (see Traction Pedal Assembly in the Service and Repairs section of Chapter 6 – Chassis).

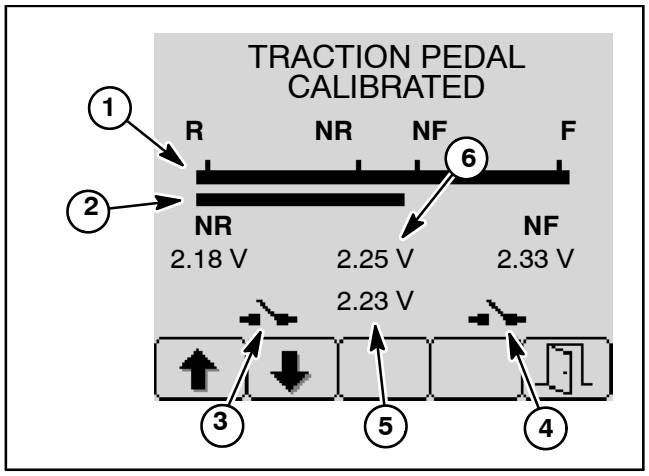


Figure 51

1. **Bar graph**
2. **Indicator bar**
3. **Reverse switch icon**
4. **Forward switch icon**
5. **Neutral voltage**
6. **Midpoint voltage**

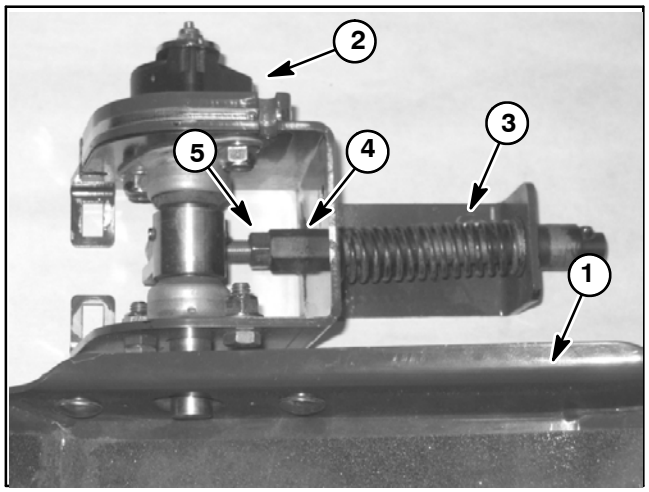


Figure 52

1. **Traction pedal**
2. **Pedal potentiometer**
3. **Compression spring**
4. **Spring shaft**
5. **Hex nut**

Traction Pedal Teach

1. Remove the power center console located to the right of the operator seat.

2. Locate wire harness termination cap that connects the two (2) traction pedal Teach wires (Fig. 53).

3. Remove termination cap and connect the two (2) Teach wires together (Fig. 54).

4. Turn ignition switch to ON but do not start engine. The Info Center Display will be in the "Teach Mode." Follow the screen prompts to calibrate the traction potentiometer valves to the TEC–5002 controller.

5. After calibration is complete, turn ignition switch to OFF. Separate the two (2) Teach wires and connect the wire harness termination cap to the wires.

6. Install and secure power center console.

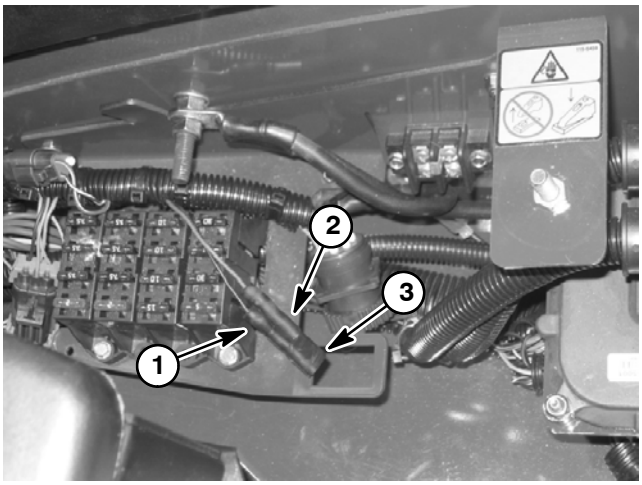


Figure 53

1. **Male teach wire**
2. **Female teach wire**
3. **Termination cap**

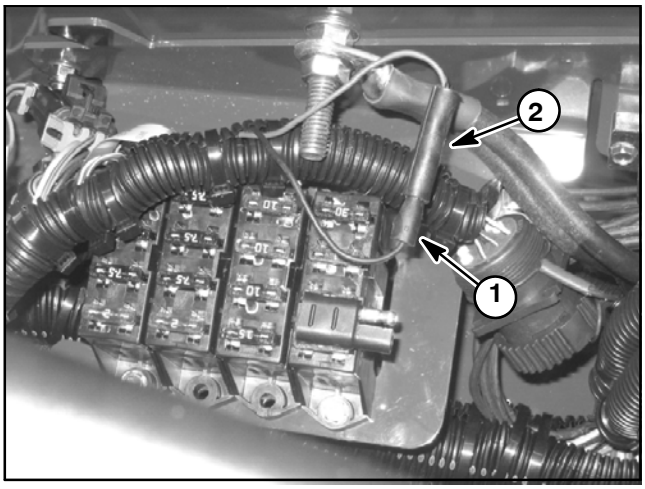


Figure 54

1. **Male teach wire**
2. **Female teach wire**

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the wire harness connector from the ignition switch before doing a continuity check of the switch).

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch

The ignition (key) switch has three positions (OFF, RUN and START). The ignition switch is located on the console arm (Fig. 55).

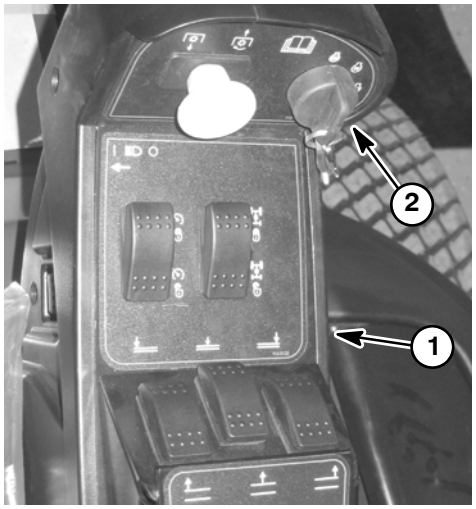


Figure 55

1. **Console arm** 2. **Ignition switch**

Testing

1. Before disconnecting the ignition switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that ignition switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that ignition switch and circuit wiring **are not** functioning correctly, test ignition switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to ignition switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. The switch terminals are marked as shown in Figure 56. The circuit logic of the ignition switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

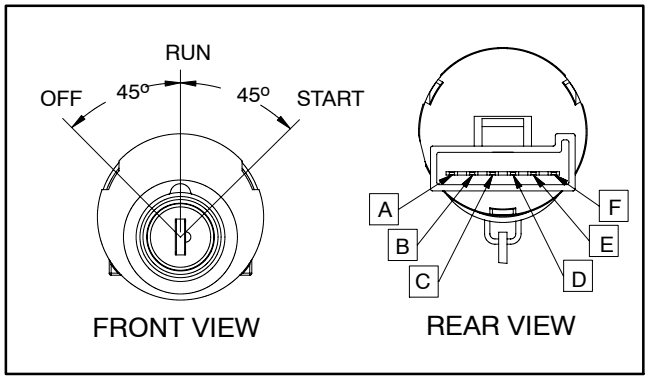


Figure 56

POSITION	CIRCUIT
OFF	NONE
RUN	B + C + F, D + E
START	A + B + C

7. Connect the wire harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Fuses

The fuse blocks are located to the right of the operator seat under the power center console.

Identification and Function (Figs. 57 and 58)

Fuse 1F1 (5 Amp) supplies power to ignition switch terminal B.

Fuse 1F2 (30 Amp) supplies power to the starter solenoid circuit.

Fuse 1F3 (1 Amp) supplies power to the Info Center Display.

Fuse 1F4 (30 Amp) supplies power to the Cummins Engine Controller.

Fuse 2F1 (15 Amp) supplies power to the road and brake light circuits.

Fuse 2F2 (10 Amp) supplies power to the air ride seat suspension seat compressor.

Fuse 2F3 (10 Amp) supplies power to the power point.

Fuse 2F4 (10 Amp) supplies power to the horn circuit.

Fuse 3F1 (2 Amp) supplies logic power for the TEC−5002 Master Controller.

Fuse 3F2 (7.5 Amp) supplies power to the TEC−5002 Master Controller.

Fuse 3F3 (7.5 Amp) supplies power to the TEC−5002 Master Controller.

Fuse 3F4 (7.5 Amp) supplies power to the TEC−5002 Master Controller.

Fuse 4F1 (2 Amp) supplies logic power for the TEC−5001 Slave Controller.

Fuse 4F2 (7.5 Amp) supplies power to the TEC−5001 Slave Controller.

Fuse 4F3 (7.5 Amp) supplies power to the TEC−5001 Slave Controller.

Fuse 4F4 (7.5 Amp) supplies power to the TEC−5001 Slave Controller.

Fuse Testing

1. Make sure that ignition switch is OFF and key is removed from switch.

2. Remove power center cover from operator platform to access fuses.

3. Remove fuse from fuse block for testing. Fuse should have continuity across the terminals.

4. After fuse testing is completed, install and secure power center cover.

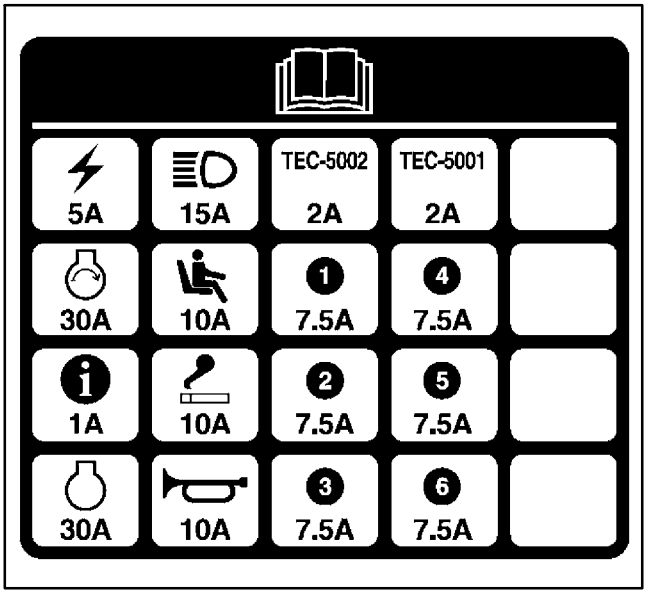


Figure 57

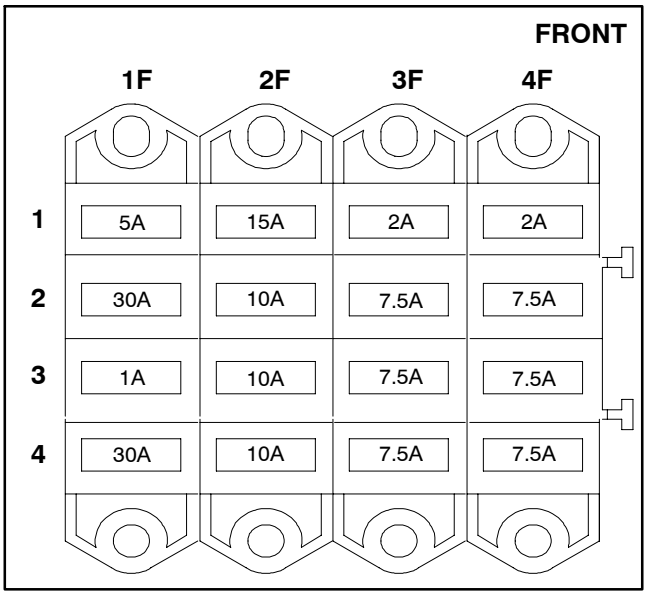


Figure 58

Maxi Fuses

Three (3) 60 amp maxi fuses are used on the Groundsmaster for protection of main electrical circuits. The maxi fuse block is located to the right of the operator seat under the power center console (Fig. 59).

Identification and Function (Fig. 60)

Maxi Fuse #1 protects the controller power circuit.

Maxi Fuse #2 protects the main power circuit.

Maxi Fuse #3 protects the cab power circuit.

Testing

1. Make sure that ignition switch is OFF and key is removed from switch.

2. Remove power center cover from operator platform to access maxi fuses.

3. Remove fuse from fuse block for testing. Fuses should have continuity across the terminals.

4. After fuse testing is completed, install and secure power center cover.

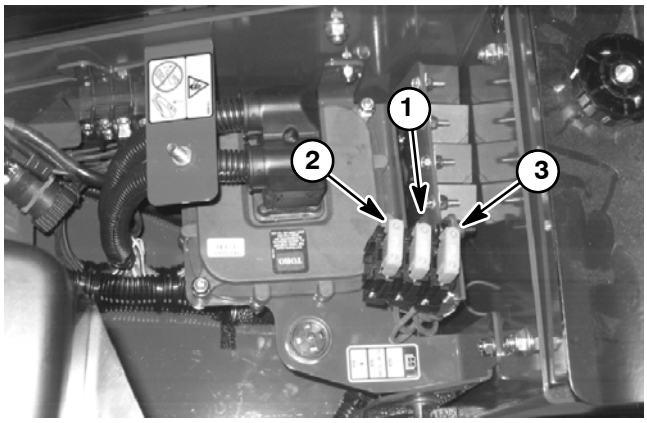


Figure 59

1. **Maxi fuse #1**
2. **Maxi fuse #2**
3. **Maxi fuse #3**

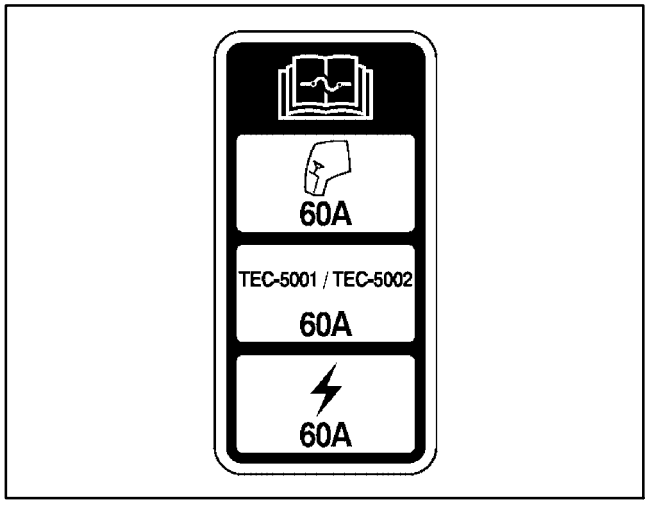


Figure 60

Mega Fuses

Two (2) mega fuses are used on the Groundsmaster for protection of high amperage circuits. One of the mega fuses is a 125 amp fuse and protects the alternator circuit. The other mega fuse is a 300 amp fuse that is a component in the intake air heater circuit. The mega fuse blocks are attached to a hood support frame behind the batteries (Fig. 61).

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Disconnect battery cables from battery terminals (see Battery Service in the Service and Repairs section of this chapter).

3. Raise hood to gain access to fuse holders.

4. Press latch that retains fuse holder cover and raise cover.

5. Remove flange nuts and lock washers that secure fuse to holder (Fig. 62). Remove fuse for testing.

6. Fuse should have continuity across the terminals.

7. After testing, slide fuse onto fuse holder studs. Place removed cables and jumper straps onto studs.

8. Secure fuse and conductors with lock washers and flange nuts. Torque nuts from **9 to 13 ft-lb (12.3 to 17.6 N-m)**.

9. Close and secure fuse holder cover.

10. Lower and secure hood.

11. Connect battery cables to battery terminals (see Battery Service in the Service and Repairs section of this chapter).

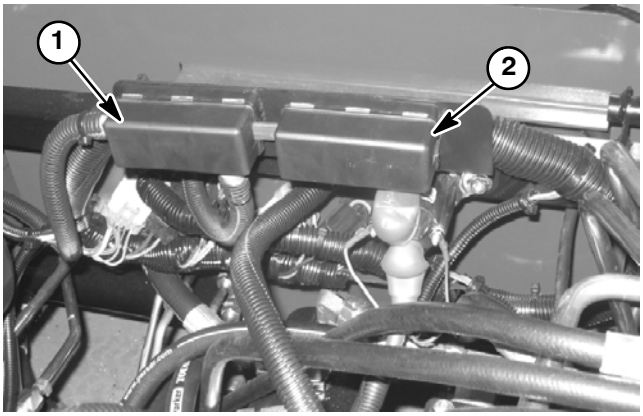


Figure 61

1. **Alternator mega fuse**
2. **Intake heater mega fuse**

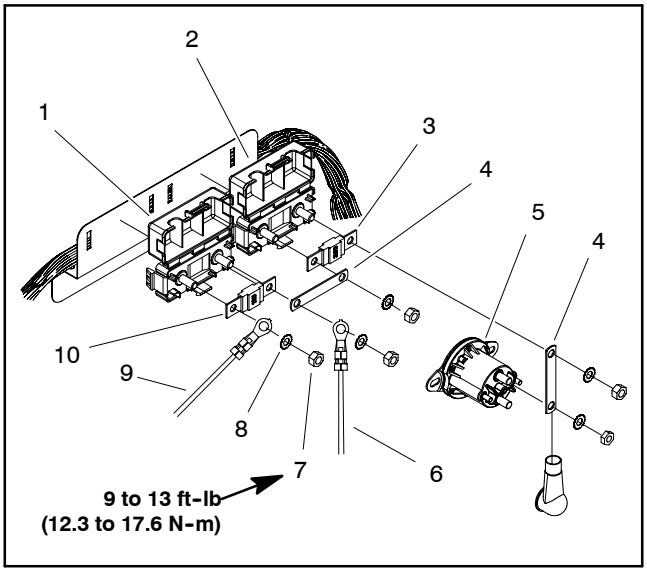


Figure 62

1. **Alternator fuse holder**
2. **Heater fuse holder**
3. **300 amp mega fuse**
4. **Jumper strap**
5. **Contactor**
6. **Battery cable**
7. **Flange nut**
8. **Lock washer**
9. **Alternator cable**
10. **125 amp mega fuse**

Cab Fuses (Groundsmaster 5910)

The cab fuse blocks are located in the cab headliner.

Identification and Function (Figs. 63 and 64)

Fuse 1F1 (15 Amp) supplies power to the windshield wiper.

Fuse 1F2 (15 Amp) supplies power to the heater circuit.

Fuse 1F3 (25 Amp) supplies power to the air conditioner circuit.

Fuse 2F1 (15 Amp) supplies power to the optional cab work lights.

Fuse 2F2 (15 Amp) supplies power to the cab dome light.

Fuses 1F4, 2F3 and 2F4 are available for optional equipment.

Testing

Make sure that ignition switch is OFF and key is removed from switch. Remove fuse from fuse block for testing. Fuse should have continuity across the fuse terminals.

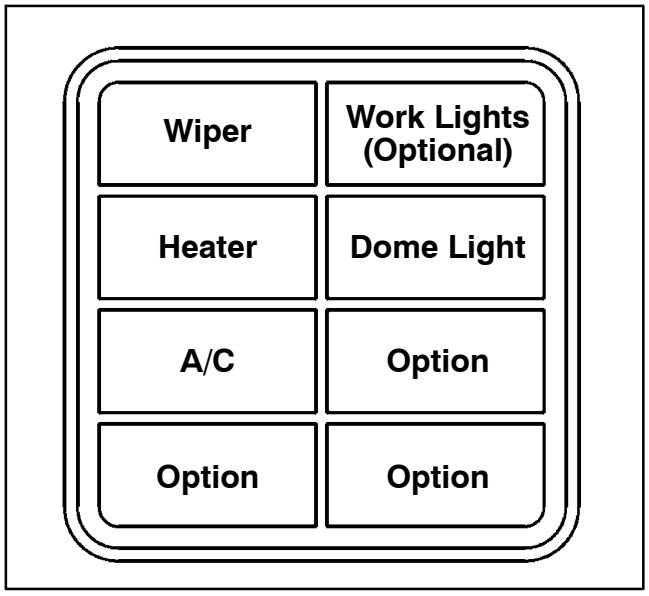


Figure 63

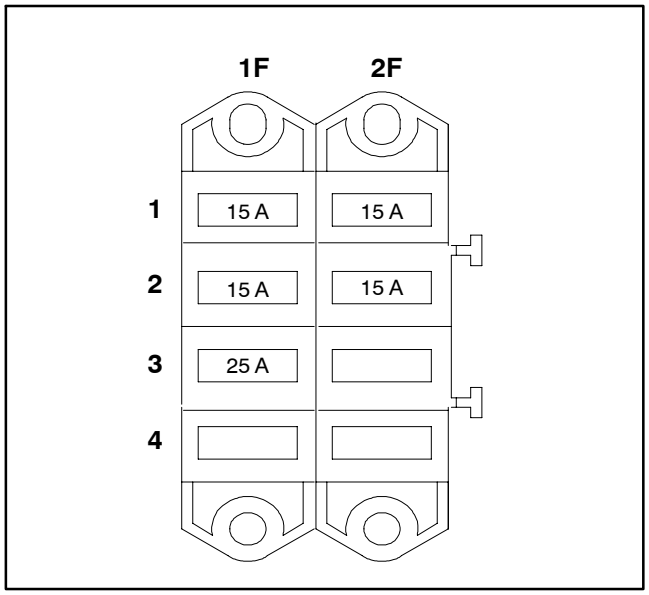


Figure 64

PTO Switch

The PTO switch is located on the console arm (Fig. 65). The PTO switch is pulled up to engage the PTO (cutting decks or implement).

The TEC−5002 controller monitors the position of the PTO switch (up or down). Using inputs from the PTO switch and other switches in the interlock system, the TEC controller controls the energizing of the hydraulic solenoid valves used to drive the cutting deck motors.

IMPORTANT: During machine operation, if the PTO shuts down and the Info Center indicates excessive engine coolant temperature, avoid shutting off the engine. Under this condition, the operator should disengage the PTO, slowly drive to a safe flat area, lower the engine speed to the SLOW position and engage the parking brake. The engine should be allowed to idle for several minutes while it cools to a safe level. Then, the cooling system should be checked before returning the machine to service.

Testing

1. Before disconnecting the PTO switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the PTO switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the PTO switch and circuit wiring **are not** functioning correctly, test PTO switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to PTO switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 − Chassis).

6. The switch terminals are marked as shown in Figure 66. The circuit logic of the PTO switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the wire harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Wiring Schematic and Circuit Drawings in Chapter 10 − Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 − Chassis).



Figure 65

1. **Console arm**
2. **PTO switch**

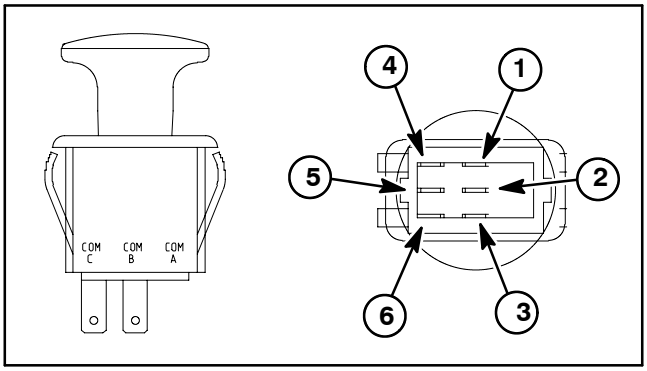


Figure 66

1. **COM B terminal**
2. **NO B terminal**
3. **NC B terminal**
4. **COM C terminal**
5. **NO C terminal**
6. **NC C terminal**

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF (DOWN)	COM B + NC B COM C + NC C	COM B + NO B COM C + NO C
ON (UP)	COM B + NO B COM C + NO C	COM B + NC B COM C + NC C

Cutting Deck Lift Switches

The cutting deck lift switches are used as inputs for the TEC−5001 controller to raise or lower the cutting decks. When the front of a lift switch is depressed and held, the controlled deck (left, front or right) will lower. When the rear of a lift switch is depressed and held, the controlled deck will raise. The deck will remain in position when the switch is released. The lift switches are located on the console arm (Fig. 67).

Testing

1. Before disconnecting a cutting deck lift switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the lift switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the lift switch and circuit wiring **are not** functioning correctly, test lift switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to cutting deck lift switches (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 − Chassis).

6. The switch terminals are marked as shown in Figure 68. The circuit logic of the lift switches is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 − Chassis).

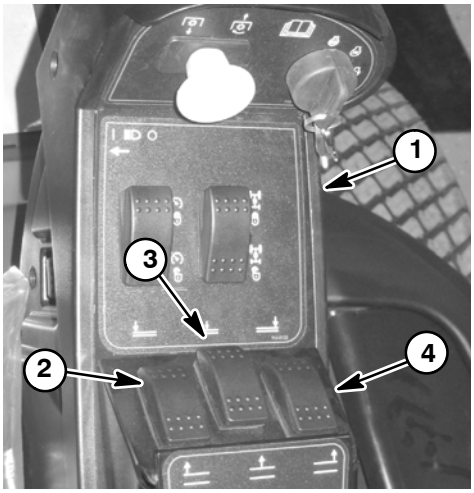


Figure 67

1. **Console arm**
2. **LH lift switch**
3. **Front lift switch**
4. **RH lift switch**

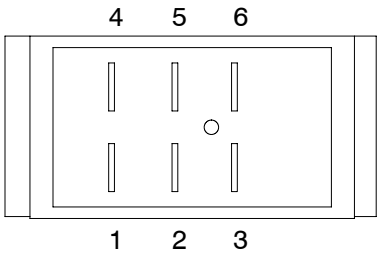


Figure 68

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
DECK RAISE	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
DECK LOWER	2 + 1 5 + 4	2 + 3 5 + 6

Traction Assist Switch

The traction assist switch is used as an input for the TEC–5001 controller to energize the solenoid valve in the traction control manifold. When the traction assist switch is depressed, hydraulic flow is split equally between front and rear wheels for enhanced traction. The traction assist switch only functions when the machine is in low speed range and in the forward direction. The traction assist switch is located on the console arm (Fig. 69).

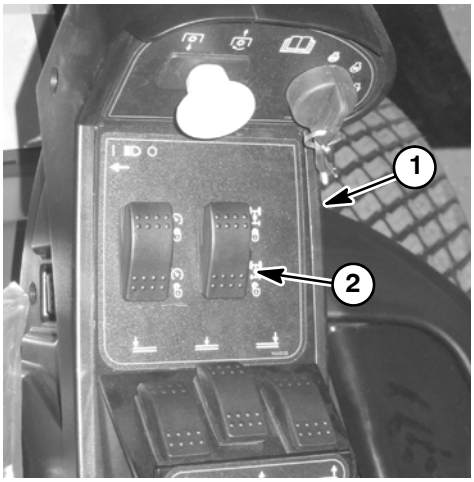


Figure 69

1. **Console arm**
2. **Traction assist switch**

Testing

1. Before disconnecting the traction assist switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the traction assist switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the traction assist switch and circuit wiring **are not** functioning correctly, test traction assist switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to traction assist switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. The switch terminals are marked as shown in Figure 70. The circuit logic of the traction assist switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

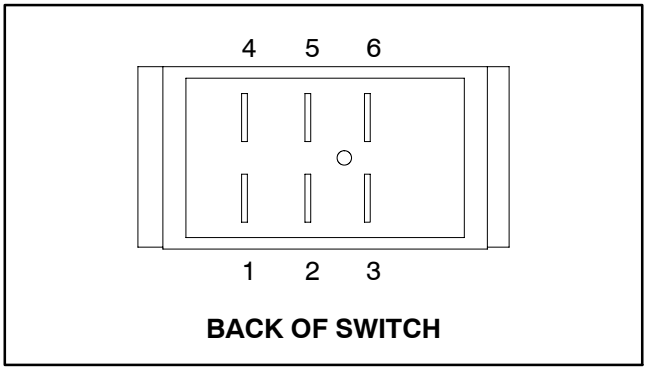


Figure 70

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
NORMAL	2 + 3 5 + 6	2 + 1 5 + 4
TRACTION ASSIST	2 + 1 5 + 4	2 + 3 5 + 6

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Cruise Control Switch

The cruise control switch is used as an input for the TEC–5002 controller to maintain ground speed. The cruise control function is engaged (set) when the front of the cruise control switch is depressed. The cruise control function is disengaged when the rear of the cruise control switch is depressed. The cruise control switch is located on the console arm (Fig. 71).

NOTE: The cruise function is also disengaged if the brake pedal is applied or if the traction pedal is pressed to the reverse direction.

Testing

1. Before disconnecting the cruise control switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the cruise control switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the cruise control switch and circuit wiring **are not** functioning correctly, test cruise control switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to cruise control switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. The switch terminals are marked as shown in Figure 72. The circuit logic of the cruise control switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

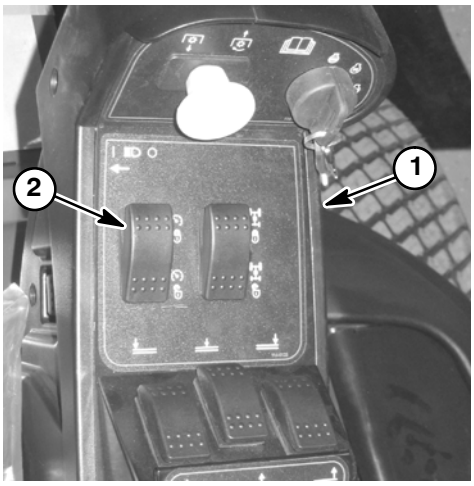


Figure 71

1. **Console arm**
2. **Cruise control switch**

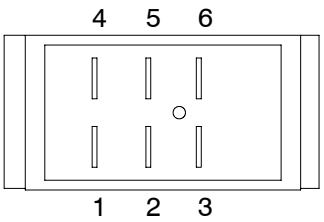


Figure 72

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
NORMAL	2 + 3	5 + 6
CRUISE ENGAGE	2 + 3 5 + 6	NONE
CRUISE DISENGAGE	NONE	ALL

Throttle Control Switch

The throttle control switch is used as an input for the engine control module to adjust the engine speed to one of three (3) RPM settings: low idle (1350 RPM), mid idle (2400 RPM) or high idle (2750 RPM). The throttle control switch is located on the steering tower (Fig. 73).

Testing

1. Before disconnecting the throttle control switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the throttle control switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the throttle control switch and circuit wiring **are not** functioning correctly, test throttle control switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis). Locate throttle control switch and unplug wire harness connector from switch.

6. The switch terminals are marked as shown in Figure 74. The circuit logic of the throttle control switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

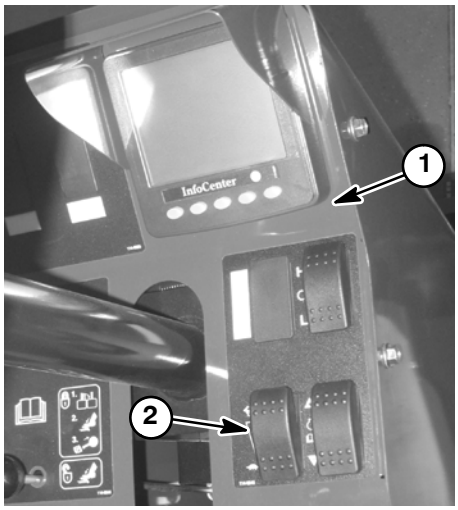


Figure 73

1. **Steering tower**
2. **Throttle control switch**

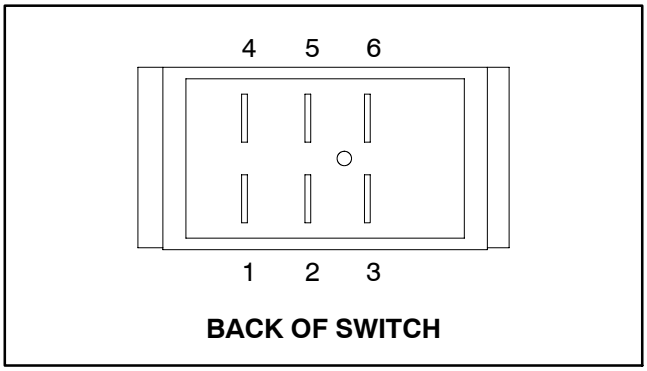


Figure 74

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
LOW IDLE	2 + 1 5 + 4	2 + 3 5 + 6
MID IDLE	2 + 3 5 + 4	2 + 1 5 + 6
HIGH IDLE	2 + 3 5 + 6	2 + 1 5 + 4

Increment/Decrement Switch

The increment/decrement switch is used as an input for the engine control module to raise or lower the engine speed in small amounts. When the switch is depressed and held in the forward position, the engine speed will increase. Conversely, when the rear of the switch is depressed, engine speed will decrease. The increment/decrement switch is located on the steering tower (Fig. 75).

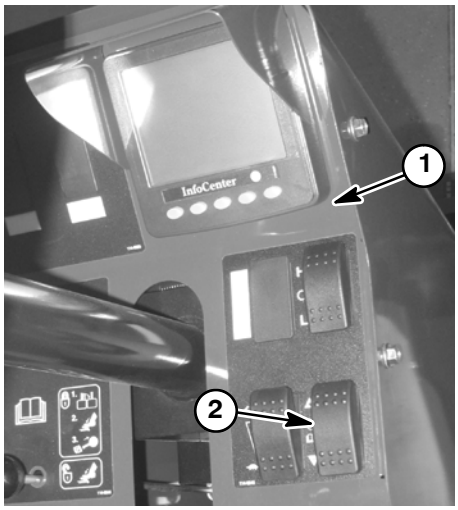


Figure 75

1. **Steering tower**
2. **Increment/decrement switch**

Testing

1. Before disconnecting the increment/decrement switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the increment/decrement switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the increment/decrement switch and circuit wiring **are not** functioning correctly, test increment/decrement switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis). Locate increment/decrement switch and unplug wire harness connector from switch.

6. The switch terminals are marked as shown in Figure 76. The circuit logic of the increment/decrement switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

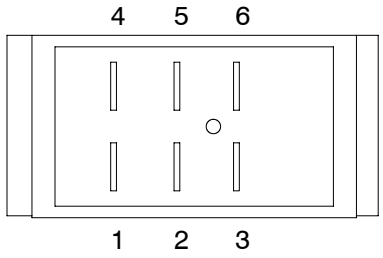


Figure 76

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
SPEED INCREASE	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
SPEED DECREASE	2 + 1 5 + 4	2 + 3 5 + 6

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Hi-Lo Speed Switch

The hi-lo speed switch is used as an input for the TEC-5001 controller to set the machine traction speed for high speed range (transport) or low speed range (mow). To change speed range settings with the speed switch, the machine must be stopped or moving very slowly. The hi-lo speed switch is located on the steering tower (Fig. 77).

Testing

1. Before disconnecting the mow/transport switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the mow/transport switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the mow/transport switch and circuit wiring **are not** functioning correctly, test mow/transport switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 - Chassis). Locate mow/transport switch and unplug wire harness connector from switch.

6. The switch terminals are marked as shown in Figure 78. The circuit logic of the mow/transport switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 - Foldout Drawings).

9. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 - Chassis).

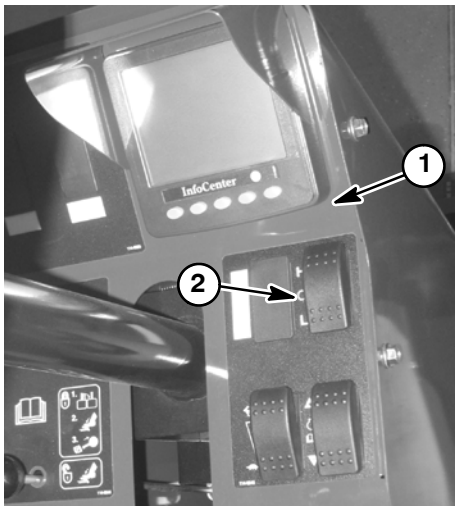


Figure 77

1. **Steering tower** 2. **Hi-Lo speed switch**

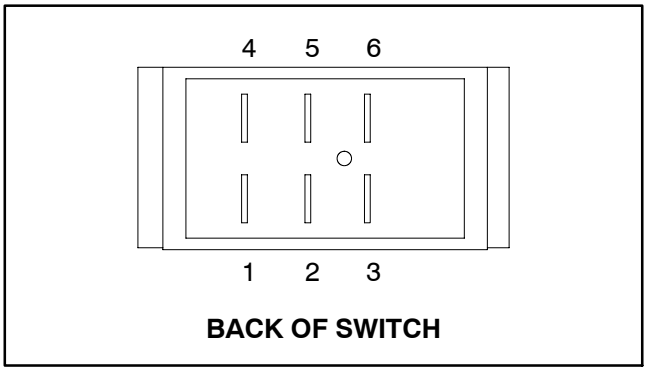


Figure 78

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
MOW SPEED	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
TRANSPORT SPEED	2 + 1 5 + 4	2 + 3 5 + 6

Headlight Switch

The headlight switch is used as an input for the TEC−5002 controller to provide power for the headlights and taillights. The headlight switch is located on the operator side of the control console.

Testing

1. Before disconnecting the headlight switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the headlight switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the headlight switch and circuit wiring **are not** functioning correctly, test headlight switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove inside control arm cover to gain access to headlight switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. Locate headlight switch and unplug wire harness connector from switch.

7. The switch terminals are marked as shown in Figure 80. The circuit logic of the headlight switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

8. Connect the harness connector to the switch after testing.

9. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

10. Install inside control arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

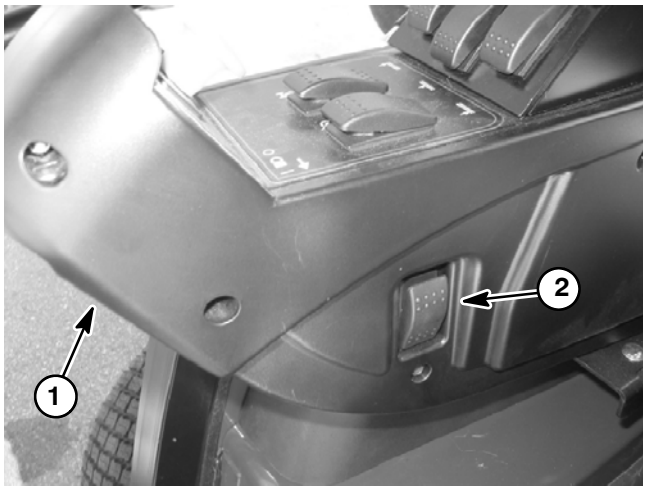


Figure 79

1. **Console arm**
2. **Headlight switch**

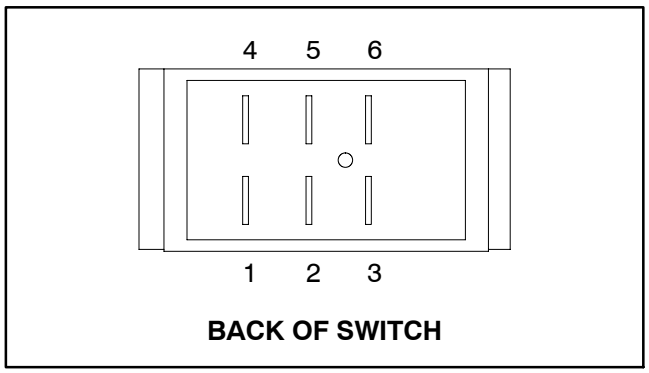


Figure 80

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 3	5 + 6
ON	2 + 1	5 + 4

Turn Signal Switch

The turn signal switch is used as an input for the TEC–5002 controller to provide power for the turn signals. The switch is located on the steering tower (Fig. 81).

Testing

1. Before disconnecting the turn signal switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the turn signal switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the turn signal switch and circuit wiring **are not** functioning correctly, test turn signal switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. Locate turn signal switch and unplug wire harness connector from switch.

7. The switch terminals are marked as shown in Figure 82. The circuit logic of the turn signal switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

8. Connect the harness connector to the switch after testing.

9. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

10. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

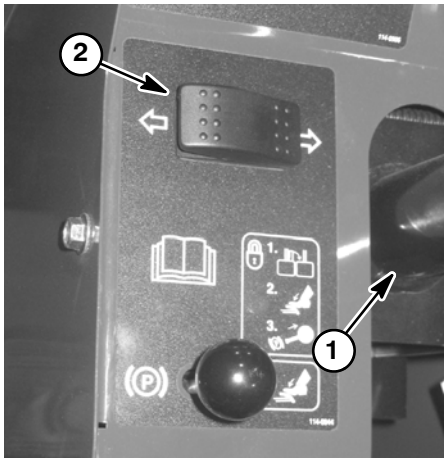


Figure 81

1. **Steering column**
2. **Turn signal switch**

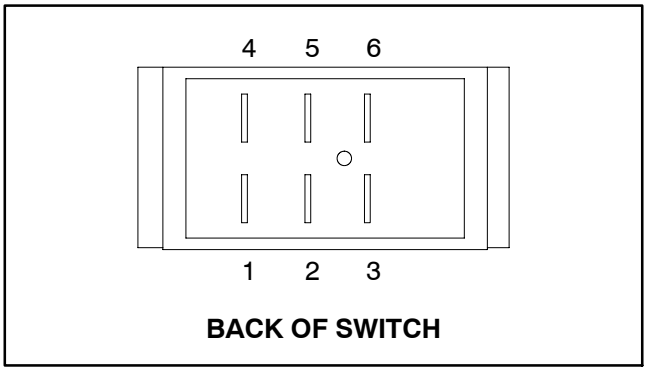


Figure 82

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
RIGHT TURN	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
LEFT TURN	2 + 1 5 + 4	2 + 3 5 + 6

Windshield Wiper/Washer Switch (Groundsmaster 5910)

The windshield wiper/washer switch is used to control operation of the windshield wiper and washer pump. The windshield wiper/washer switch is located in the cab headliner (Fig. 83).

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove switch plate from cab headliner.

3. Locate windshield wiper/washer switch and unplug wire harness connector from switch.

4. The switch terminals are marked as shown in Figure 84. The circuit logic of the wiper/washer switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

5. Connect the harness connector to the switch after testing.

6. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

7. Install switch plate to cab headliner.

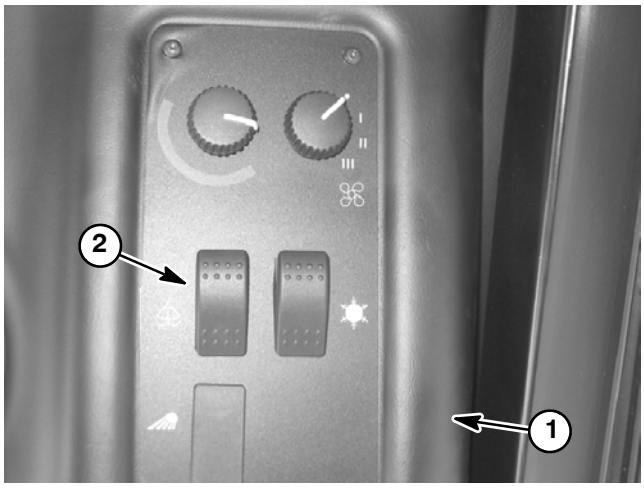


Figure 83

1. Cab headliner
2. Wiper/washer switch

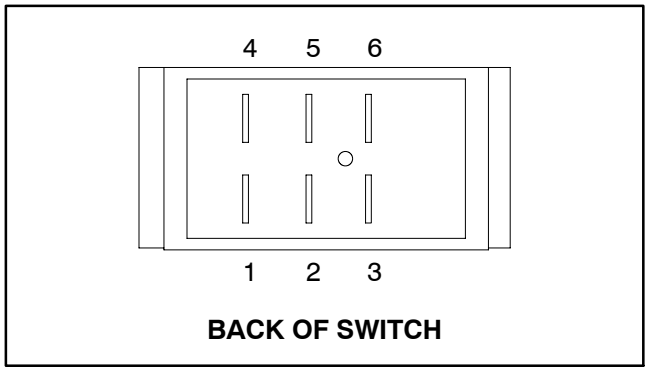


Figure 84

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF	NONE	ALL
WIPER ON	2 + 3	5 + 6
WASHER ON	2 + 3 5 + 6	NONE

Air Conditioning Switch (Groundsmaster 5910)

The air conditioning switch is used to control operation of the air conditioning system. The switch is located in the cab headliner (Fig. 85).

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove switch plate from cab headliner.

3. Locate air conditioning switch and unplug wire harness connector from switch.

4. The switch terminals are marked as shown in Figure 86. The circuit logic of the air conditioning switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

5. Connect the harness connector to the switch after testing.

6. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

7. Install switch plate to cab headliner.

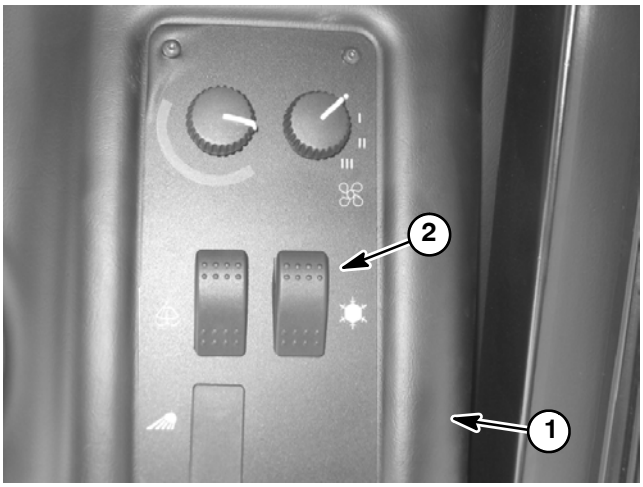


Figure 85

1. **Cab headliner**
2. **Air conditioning switch**

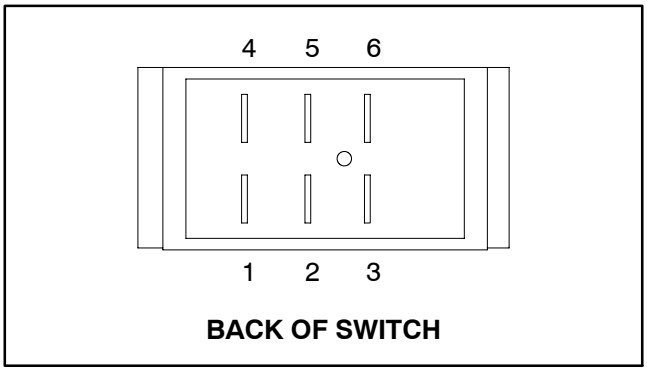


Figure 86

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
AC OFF	2 + 3 5 + 6	2 + 1 5 + 4
AC ON	2 + 1 5 + 4	2 + 3 5 + 6

Intake Air Heater Contactor

The intake air heater contactor is used on the Groundsmaster 5900 and 5910 to provide current for the engine intake air heater. The contactor is attached to a frame bracket behind the batteries (Fig. 87). The contactor is energized by the engine ECM when low temperatures are detected prior to starting the engine.

Testing

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less) that is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Park machine on a level surface, lower cutting decks, stop engine, engage parking brake and remove key from the ignition switch. Raise and support hood to access intake air heater solenoid.

2. Disconnect battery cables from battery terminals (see Battery Service in the Service and Repairs section of this chapter).

3. Locate contactor. Note wire connector locations on contactor for assembly purposes. Disconnect all harness electrical connectors from contactor.

4. Using jumper wires, apply 12 VDC directly across the contactor coil posts (Fig. 88). The contactor should click. With the contactor coil energized, resistance across the contactor main posts should be less than **1 ohm**.

5. Remove voltage from contactor coil posts. The contactor should click. With the contactor coil not energized, resistance across the contactor main posts should be **infinite ohms**.

6. With voltage removed from all contactor posts, measure resistance across the contactor coil posts (Fig. 88). Resistance of the coil should be approximately 13.5 ohms.

7. With voltage removed from all contactor posts, measure resistance across the contactor main posts (Fig. 88). Resistance should be **infinite ohms**.

8. If testing determines that contactor is faulty, replace contactor.

9. After testing, connect harness connectors to contactor.

10. Connect battery cables to battery terminals (see Battery Service in the Service and Repairs section of this chapter).

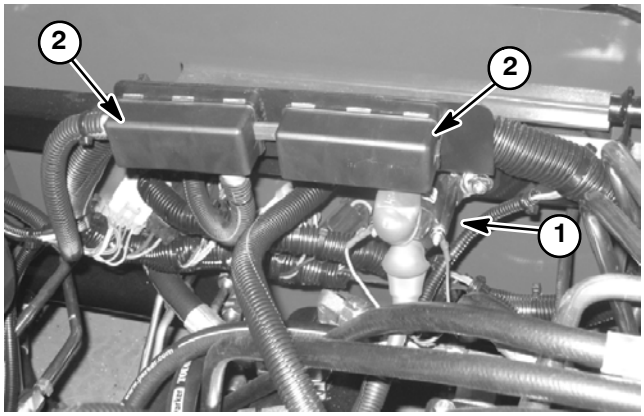


Figure 87

1. **Air heater contactor**
2. **Mega fuse holder**

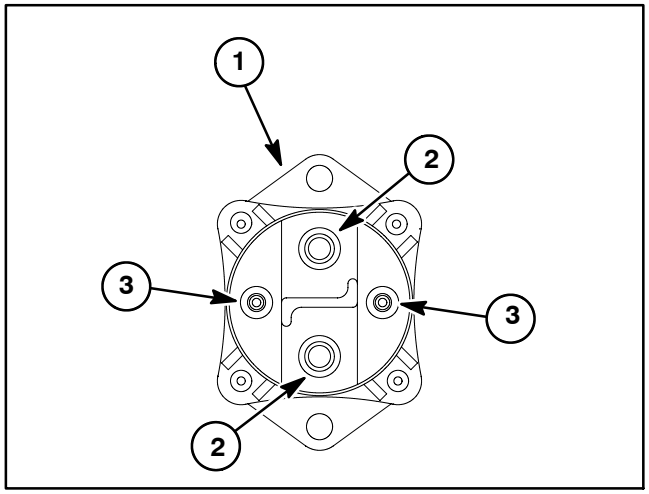


Figure 88

1. **Contactor**
2. **Main post**
3. **Coil posts**

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. The seat switch is an input for the TEC−5002 controller. If the traction system or PTO switch is engaged when the operator raises out of the seat, the traction system or PTO operation will cease. The seat switch and its electrical connector are located in the seat assembly.

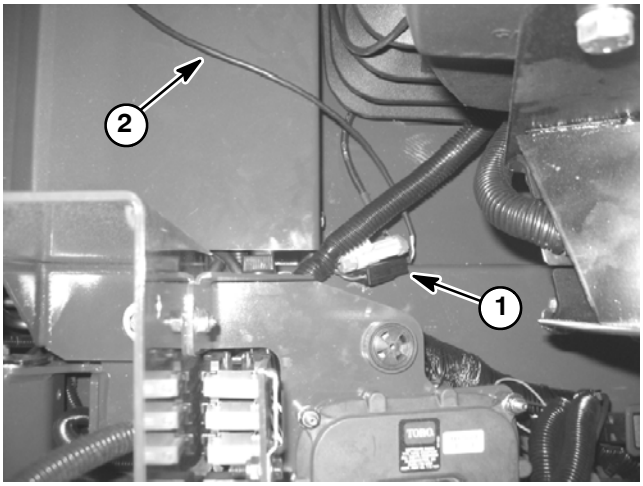


Figure 89

1. Electrical connector
2. Seat switch wire

Testing

1. Before disconnecting the seat switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the seat switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the seat switch and circuit wiring **are not** functioning correctly, test seat switch.

NOTE: Testing of the seat switch can be done without seat removal by disconnecting the seat wire from the machine wiring harness (Fig. 89).

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disconnect seat switch electrical connector from the machine wire harness.

6. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

7. With no pressure on the seat, there should be **no continuity** (infinite resistance) between the seat switch terminals.

8. Press directly onto the seat switch through the seat cushion. There should be **continuity** (zero resistance) as the seat cushion approaches the bottom of its travel.

9. If testing determines that seat switch is faulty, replace seat switch (see Operator Seat Service in the Service and Repairs section of Chapter 7 − Chassis).

10. Connect switch connector to the machine wire harness.

11. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings).

Parking Brake Switch

The switch used for the parking brake is a normally open proximity switch that is located under the steering tower cover (Fig. 90). The parking brake switch is an input for the TEC–5002 controller. When the parking brake **is not** applied, a tab on the brake rod is positioned near the switch sense zone which causes the switch to close. When the parking brake **is** applied, the brake rod tab is positioned away from the switch allowing the switch to be in its normal, open position (no continuity).

Testing

1. Before disconnecting the parking brake switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the parking brake switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the parking brake switch and circuit wiring **are not** functioning correctly, test brake switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. Locate parking brake switch and unplug wire harness connector from switch.

7. Disconnect switch electrical connector from the machine wire harness.

8. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

9. When the parking brake is not applied (brake rod tab away from brake switch), there should be **no continuity** (infinite resistance) between the switch terminals.

10. When the parking brake is applied (brake rod tab close to brake switch), there should be **continuity** (zero resistance) between the switch terminals.

11. Replace switch if necessary.

12. Correctly connect the wire harness connector to the parking brake switch after testing is completed.

13. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

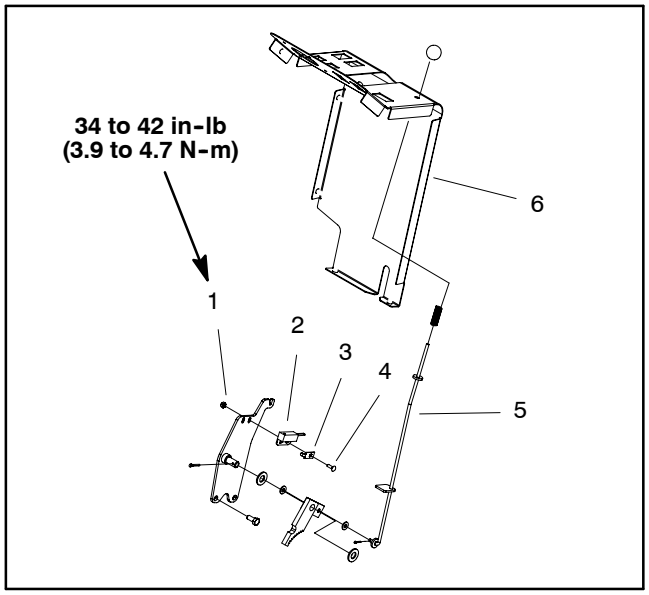


Figure 90

1. **Lock nut**
2. **Parking brake switch**
3. **Switch plate**
4. **Carriage bolt**
5. **Parking brake rod**
6. **Steering tower cover**

Adjustment

With the parking brake not applied (brake rod tab near the switch), there should be a 0.062” (1.6 mm) gap between the switch and the brake rod tab.

Service Brake Switches

The two (2) switches used for the service brakes are normally open switches that are located under the footrest panel (Fig. 90). The service brake switches provide inputs for the TEC–5002 controller. When a brake pedal is not depressed, the brake pedal assembly contacts the switch plunger to close the switch. When a brake is applied, the brake pedal assembly moves away from the switch plunger, allowing the switch plunger to extend and the switch to open.

Testing

1. Before disconnecting a service brake switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the service brake switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the service brake switch and circuit wiring **are not** functioning correctly, test seat switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch. Locate service brake switch for testing.

5. Disconnect switch electrical connector from the machine wire harness.

6. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

7. When the service brake is not applied (service brake switch plunger depressed), there should be **continuity** (zero resistance) between the switch terminals.

8. When the service brake is applied (service brake switch plunger extended), there should be **no continuity** (infinite resistance) between the switch terminals.

9. Replace switch if necessary.

10. Reconnect switch electrical connector to the machine wire harness after testing.

Adjustment

Adjust the service brake switch so that the switch plunger always makes full contact with the brake pedal. Tighten fasteners from **13 to 17 in–lb (1.5 to 1.9 N–m)**.

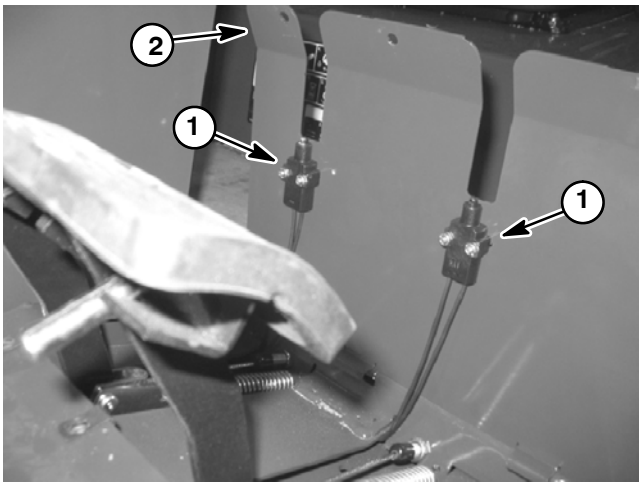


Figure 91

1. **Service brake switch**
2. **Footrest panel**

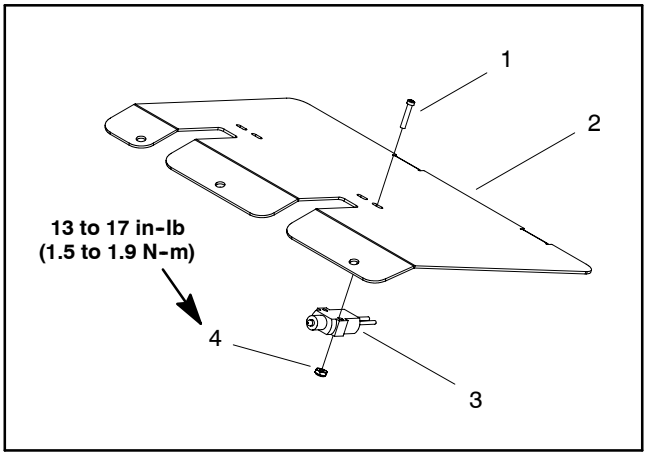


Figure 92

1. **Screw (2 per switch)**
2. **Footrest panel**
3. **Switch (2 used)**
4. **Lock nut (2 per switch)**

Main Power, Controller, Start and Cab (Groundsmaster 5910) Relays

The Groundsmaster 5900 and 5910 use three (3) identical relays to control electrical power circuits. The Groundsmaster 5910 uses an additional relay for the cab electrical components. The relays are attached to the operator platform under the power center cover (Fig. 93).

The main power relay supplies electrical power for the Info Center Display, operator seat, power point receptacle, horn, road lights, brake lights and optional electrical equipment. The main power relay is energized when the ignition switch is in the START or RUN position.

The controller relay supplies electrical input power for the two (2) electrical controllers (TEC−5001 and TEC−5002). The controller relay is energized when the ignition switch is in the START or RUN position.

The start relay supplies electrical power for the engine starter solenoid. The start relay is energized by the TEC−5002 controller when the correct start functions are initiated (ignition switch to RUN, traction pedal in neutral, PTO switch OFF).

The cab relay used on the Groundsmaster 5910 supplies power for cab electrical functions (air conditioning, fan, windshield washer/wiper, cab work lights). This relay is energized when the ignition switch is in the START or RUN position.

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove power center cover from operator platform to access relays.

3. Disconnect the machine wire harness connector from the relay to be tested.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value for the tested component.

4. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 94). Resistance should be between 70 and 100 ohms.

5. Verify infinite resistance (no continuity) between terminals 30 and 87.

6. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

7. Disconnect meter leads and jumper wires from the relay terminals. Reconnect machine wire harness connector to relay.

8. Install and secure power center cover.

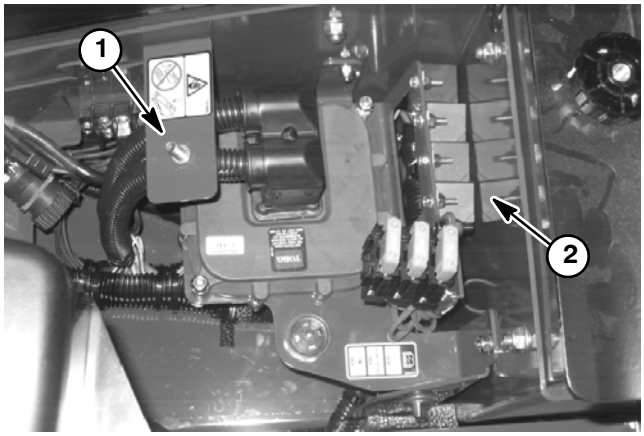


Figure 93

1. Cover attachment screw **2. Relay location**

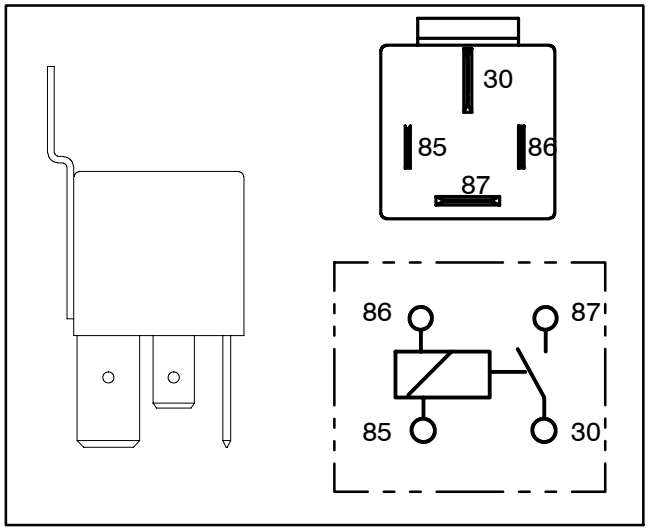


Figure 94

Air Conditioning Relay (Groundsmaster 5910)

A relay is used to control the air conditioning electrical power circuit on the Groundsmaster 5910. When energized by the air conditioning switch, the relay provides current for the air conditioning components. The relay is attached to the cab headliner above the switch panel.

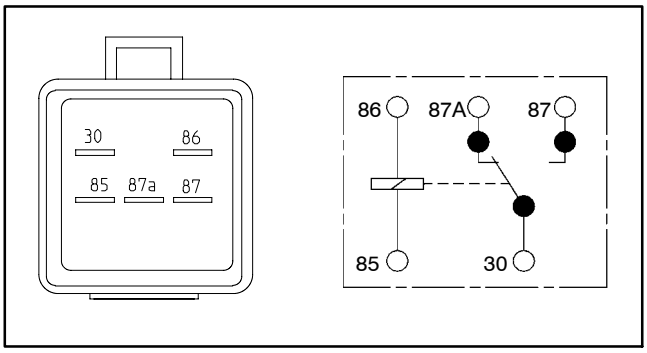


Figure 95

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove screws that secure switch panel to headliner in cab. Locate relay and disconnect the machine wire harness connector from the relay. Remove relay for easier testing.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value for the tested component.

3. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 95). Resistance should be between 70 and 90 ohms.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should have continuity between terminals 30 and 87 as +12 VDC is applied to terminal 85. The relay should not have continuity between terminals 30 and 87 as +12 VDC is removed from terminal 85.

5. Disconnect voltage and multimeter leads from the relay terminals.

6. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should not have continuity between terminals 30 and 87A as +12 VDC is applied to terminal 85. The relay should have continuity between terminals 30 and 87A as +12 VDC is removed from terminal 85.

7. Disconnect voltage and multimeter leads from the relay terminals.

8. Secure relay to machine and connect machine wire harness connector to relay.

Toro Electronic Controller (TEC)

Groundsmaster 5900 and 5910 machines use two (2) Toro Electronic Controllers (TEC). The controllers are attached to the operator platform under the power center cover (Fig. 96). The Info Center Display should be used when checking inputs and outputs of the TEC used on your Groundsmaster (see Troubleshooting in this chapter).

Logic power is provided to both of the controllers as long as the battery cables are connected to the batteries. A 2 amp fuse provides circuit protection for this logic power to each of the controllers.

The TEC−5002 master controller (lower) monitors the states of the following components as inputs: ignition switch, seat switch, parking brake switch, service brake switches, traction pedal potentiometer, hydraulic temperature sender, fuel level sender, PTO switch and cruise control switch.

The TEC−5002 controller controls electrical output to the following components: TEC−5001, traction pump solenoid coils, engine cooling fan hydraulic valve solenoid coils, PTO circuit hydraulic valve solenoid coils, start relay and turn signals. Circuit protection for TEC−5002 outputs is provided by fuses 3F2, 3F3 and 3F4.

The TEC−5001 slave controller (upper) monitors the states of the following components as inputs: ignition switch, cutting deck lift switches, traction assist switch, mow/transport switch and cutting deck position sensors.

The TEC−5001 controller controls electrical output to the following components: lift circuit hydraulic valve solenoid coils, traction assist hydraulic valve solenoid coil, mow/transport hydraulic valve solenoid coil and audio alarm. Circuit protection for TEC−5001 outputs is provided by fuses 4F2, 4F3 and 4F4.

Because of the solid state circuitry built into the TEC, there is no method to test the controllers directly. The controllers may be damaged if an attempt is made to test them with an electrical test device (e.g. digital multimeter).

NOTE: The TEC controllers and the Info Center Display used on the Groundsmaster 5900 and 5910 are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

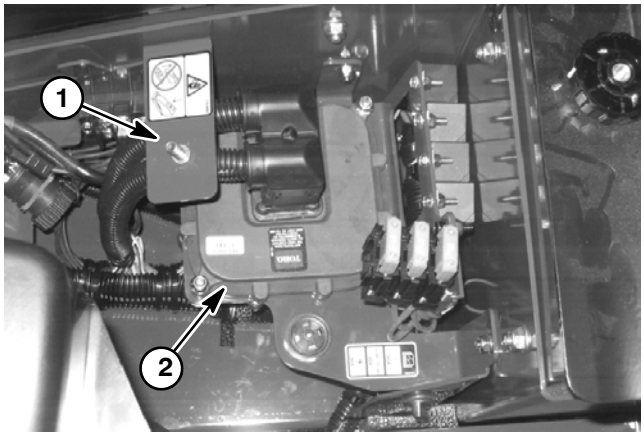


Figure 96

1. **Cover attachment point**
2. **Controller location**

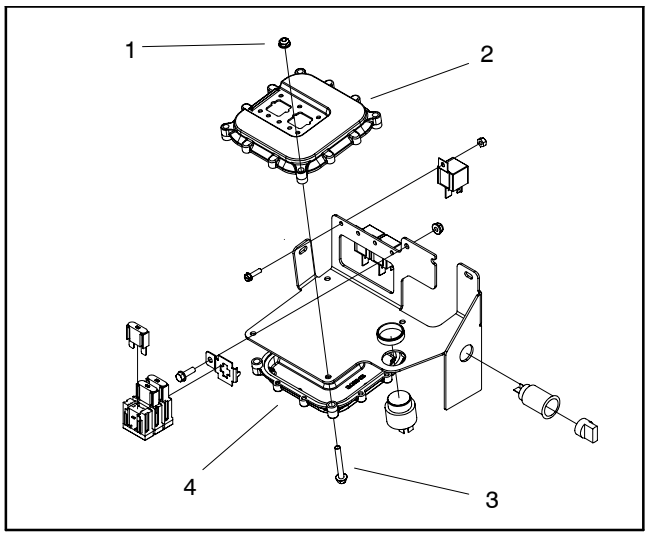


Figure 97

1. **Flange nut (4 used)**
2. **TEC−5001**
3. **Flange screw (4 used)**
4. **TEC−5002**

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Hydraulic Valve Solenoid Coils

There are numerous hydraulic valve solenoid coils on the Groundsmaster hydraulic manifolds. When the solenoid coils are energized, hydraulic valve shift occurs to control hydraulic flow. Testing of these solenoid coils can be done with the solenoid coil on the hydraulic valve.

Testing

NOTE: A faulty solenoid coil or solenoid circuit wiring problem will not be identified by the Info Center Display. The Info Center Display can be used to verify that output current from the TEC is available for the solenoid coil but the Display will not verify that the solenoid coil and circuit wiring is functioning correctly.

1. Identify the solenoid coil that is to be tested.

2. Disconnect wire harness electrical connector from hydraulic solenoid valve coil that is to be tested.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter may display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

3. Using a multimeter (ohms setting), measure resistance between the two (2) connector terminals on the solenoid coil. The resistance for the solenoid coils is identified below:

A. The solenoid coils at the following control manifold ports are the same. Resistance of these coils should be approximately 8.8 ohms.
PTO manifold port S (Figs. 98, 99 and 100)
Traction manifold port S (Fig. 101)
4WD manifold port SV (Fig. 102)
Lift manifold ports S1, S4, S5 and S9 (Fig. 103)

B. The solenoid coils at the following control manifold ports are the same. Resistance of these coils should be approximately 7.1 ohms.
Lift manifold ports S2, S3, S6, S7 and S8 (Fig. 103)
Steering/cooling fan manifold port PRV (Fig. 104)

C. Resistance of the solenoid coil at steering/cooling fan manifold port S should be approximately 4.6 ohms (Fig. 104).

4. If solenoid coil resistance is incorrect, replace coil (see Hydraulic Valve Solenoid Coil Removal and Installation in the Service and Repairs section of this chapter).

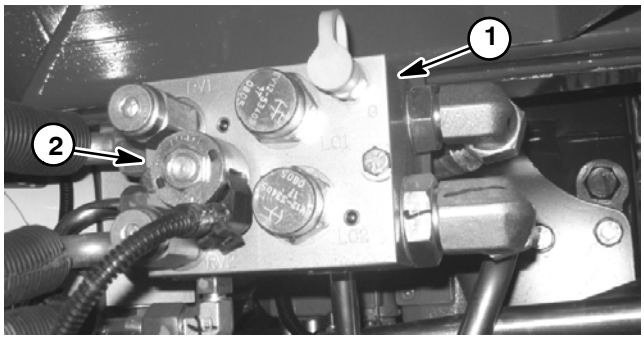


Figure 98

1. **LH PTO manifold** 2. **Solenoid coil (port S)**

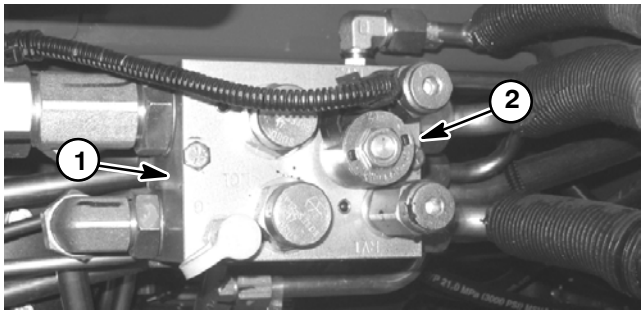


Figure 99

1. **RH PTO manifold** 2. **Solenoid coil (port S)**

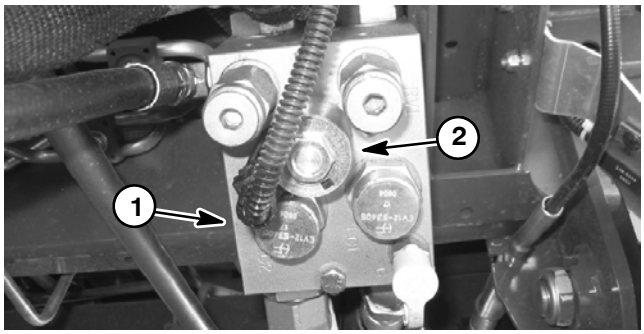


Figure 100

1. **Center PTO manifold** 2. **Solenoid coil (port S)**

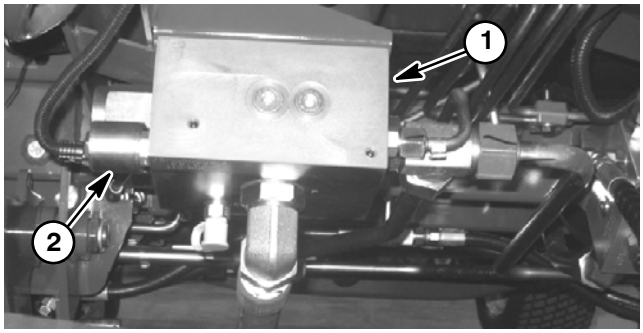


Figure 101

1. **Traction control manifold** 2. **Solenoid coil (port S)**

NOTE: To assist in troubleshooting, identical solenoid coils can be exchanged. If the machine problem follows the exchanged coil, an electrical problem likely exists. If the problem remains unchanged, something other than the solenoid coil is the likely problem source (e.g. switch, circuit wiring, hydraulic problem).

5. After testing is complete, connect wire harness electrical connector to the solenoid coil.

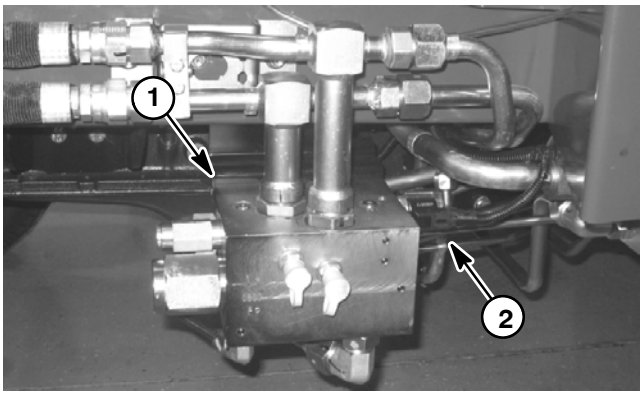


Figure 102

1. **4WD control manifold**
2. **Solenoid coil (port SV)**

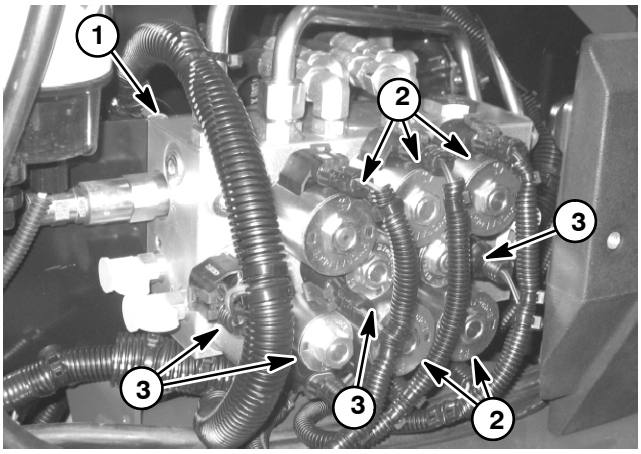


Figure 103

1. **Lift control manifold**
2. **Solenoid coil (ports S2, S3, S6, S7 and S8)**
3. **Solenoid coil (ports S1, S4, S5 and S9)**

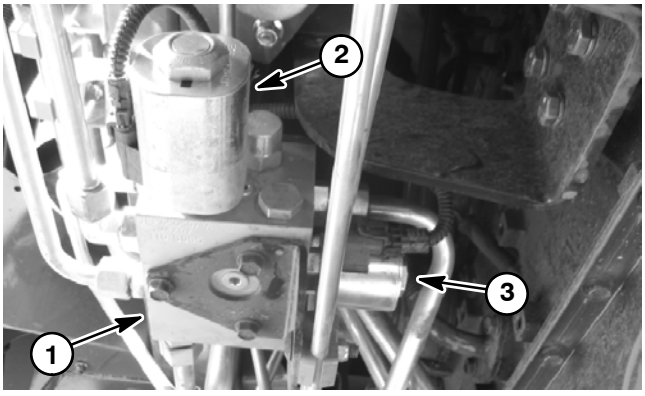


Figure 104

1. **Steering/fan manifold**
2. **Solenoid coil (port S)**
3. **Solenoid coil (port PRV)**

Fuel Sender

The fuel sender is located on top of the fuel tank.

Testing

1. Remove blue/red wire and black ground wire from the fuel sender.

CAUTION

When testing circuit wiring and fuel gauge, make sure wire connections are secure before turning ignition switch RUN to prevent an explosion or fire from sparks.

2. To test the circuit wiring and Info Center Display fuel gauge, connect blue/red and black wires and turn ignition switch to RUN. Fuel gauge should indicate a full fuel tank. Turn ignition switch OFF and continue testing fuel sender if circuit wiring and gauge are acceptable.

3. Remove screws and lock washers that secure the sender to the fuel tank.

4. Remove sender and gasket from the fuel tank. Clean any fuel from the sender.

NOTE: Before taking small resistance readings with a digital multimeter, short meter test leads together. The meter will display a small resistance value. This internal resistance of the meter and test leads should be subtracted from the measured value of the component.

CAUTION

Make sure sending unit is completely dry (no fuel on it) before testing. Perform test away from the tank to prevent an explosion or fire from sparks.

5. Check resistance of the sender with a multimeter (Fig. 105).

   A. Resistance with the float in the full position should be from 27.5 to 39.5 ohms.

   B. Resistance with the float in the empty position should be from 240 to 260 ohms.

6. Replace sender as necessary. Reinstall sender into fuel tank.

7. Reconnect wires to fuel sender. Apply skin–over grease (Toro Part No. 505–165) to sender terminals.

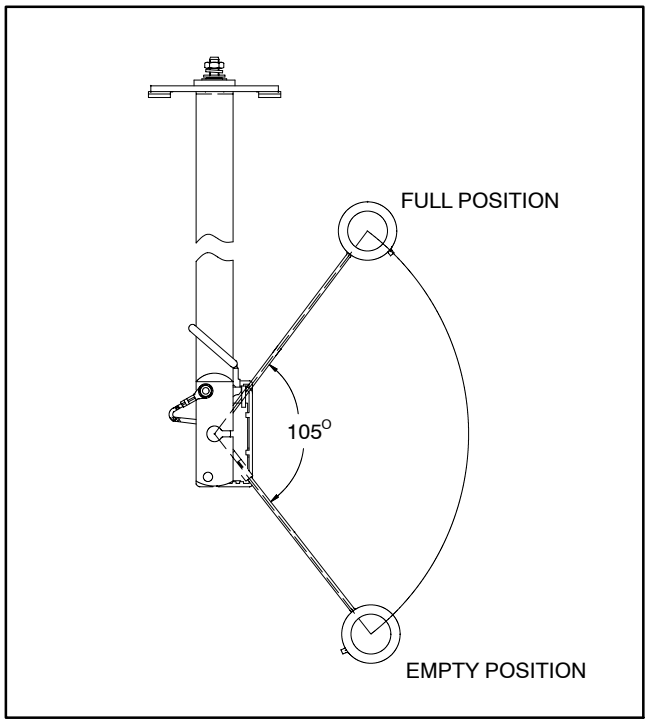


Figure 105

Hydraulic Oil Temperature Sender

The hydraulic oil temperature sender is attached to the hydraulic flush manifold in port TS (Fig. 106).

Testing

1. Locate oil temperature sender on hydraulic flush manifold. Disconnect wire harness connector from temperature sender.

2. Thoroughly clean hydraulic flush manifold around temperature sender. Remove sender from manifold.

3. Put sensing end of sender in a container of oil with a thermometer and slowly heat the oil (Fig. 107).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

NOTE: Prior to taking resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

4. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases.

   A. The meter should indicate from 11.6 to 13.5 ohms at 68º F (20º C).

   B. The meter should indicate from 2.3 to 2.5 ohms at 140º F (60º C).

   C. The meter should indicate from 0.6 to 0.7 ohms at 212 º F (100º C).

   D. Replace sender if specifications are not met.

5. After allowing the sender to cool, install sender to the flush control manifold.

   A. Install new O−ring on sender.

   B. Install sender into the hydraulic flush manifold. Torque sender to **12 ft−lb (16.3 N−m)**.

   C. Reconnect harness wire to sender.

6. Check and fill hydraulic system to proper level.

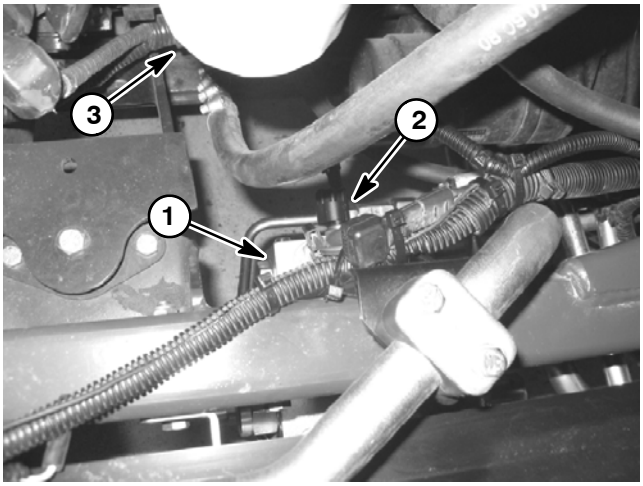


Figure 106

1. **Hydraulic flush manifold**
2. **Oil temperature sender**
3. **Fuel water separator**

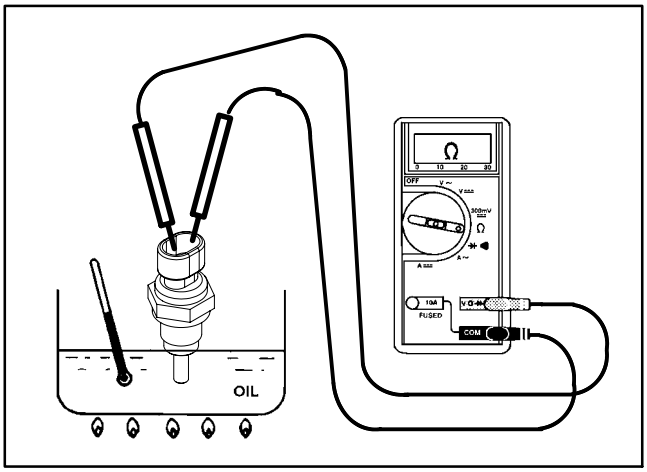


Figure 107

Diode Assembly

A diode assembly is used in the Groundsmaster 5900 wire harness (Fig. 109). The diode is used for circuit protection from voltage spikes that occur when the starter solenoid is de−energized. The diode plugs into the wire harness near the fuel water separator.

Testing

The diode can be tested using a digital multimeter (diode test or ohms setting) and the table below.

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

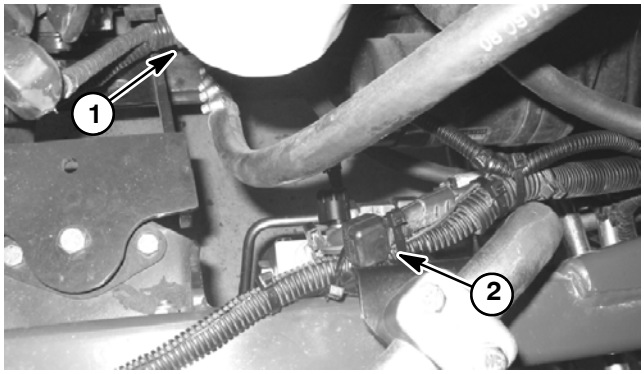


Figure 108

1. Fuel water separator
2. Diode

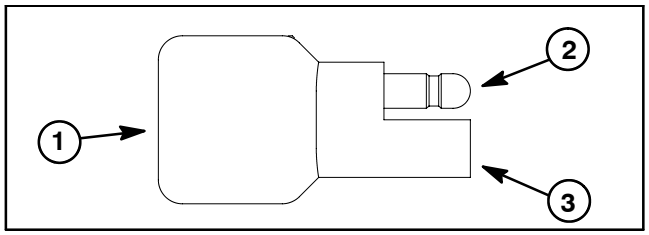


Figure 109

1. Diode
2. Male terminal
3. Female terminal

Audible Alarm

The audible alarm sounds to notify the operator when a machine problem exists. Electrical current for the alarm is provided as an output from the slave Toro Electronic Controller. The audible alarm is located to the right of the operator seat under the power center console (Fig. 110).

Testing

IMPORTANT: Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.

1. Make sure ignition switch is OFF. Remove key from ignition switch.

1. Remove power center cover from operator platform to access audible alarm.

2. Isolate alarm from the circuit. Correctly connect 12VDC source to the terminals (Fig. 111).

3. Alarm should sound. Remove voltage source from the alarm. Reconnect alarm to the circuit.

4. Install and secure power center cover.

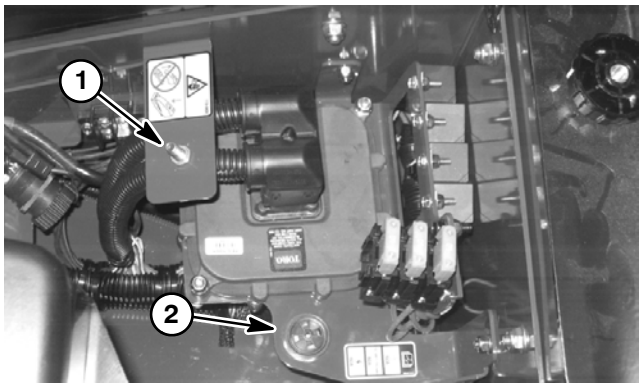


Figure 110

1. Cover attachment screw
2. Audible alarm

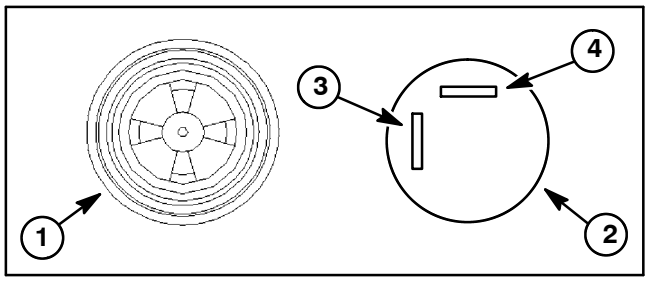


Figure 111

1. Top view
2. Bottom view
3. Positive (+) terminal
4. Negative (-) terminal

Traction Pedal Potentiometer

The traction pedal potentiometer is connected to the traction pedal assembly (Fig. 112). This potentiometer determines the neutral band for the traction pedal, the direction of travel desired by the operator and the traction speed. The potentiometer is a single analog, dual digital signal electronic device. The potentiometer portion is a variable resistor that provides an analog signal for the TEC−5002 controller to determine the desired ground speed based on how far the traction pedal is moved. The traction pedal potentiometer also houses two (2) switches that are used to determine the neutral position (deadband) and the indicated direction of travel (forward or reverse). As the traction pedal is depressed, the internal wiper of the potentiometer moves and sends the analog signal to the TEC−5002 controller to determine machine direction and speed.

The traction pedal potentiometer must be calibrated with the TEC−5002 controller to determine the neutral and full speed set points for both the forward and reverse directions.

A properly installed and calibrated traction pedal potentiometer is critical to accurate traction response and potentiometer life. Use care when installing and calibrating the potentiometer.

Before suspecting a faulty potentiometer, follow calibration procedures for the traction pedal potentiometer found in the Adjustments section of this chapter. If potentiometer replacement is necessary, see Traction Pedal in the Service and Repairs section of Chapter 6 − Chassis.

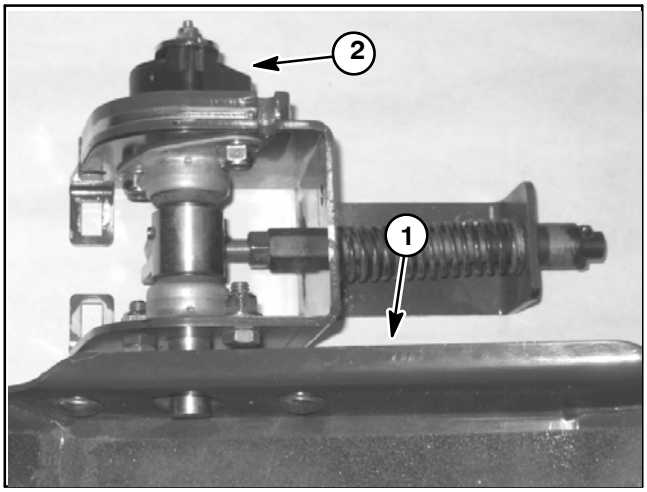


Figure 112

1. **Traction pedal**
2. **Traction potentiometer**

Up Limit Switches

The cutting deck up limit switches are normally open proximity switches that are attached to brackets located on the traction unit frame (Fig. 113). The sensing plates used for the switches are located on the cutting deck lift arms.

When a cutting deck is in the lowered position, the sensing plate will be near the up limit switch and the switch will be closed. This closed switch is used as an input for the controller to provide current flow to the cutting deck hydraulic solenoid valve when the PTO is engaged, allowing the cutting deck to operate.

When a cutting deck is raised, the sensing plate is moved away from the up limit switch and the switch opens. This open switch is used as an input for the controller to prevent current flow to the cutting deck hydraulic solenoid valve, preventing the cutting deck from operating.

Switch Testing

NOTE: Operation of a up limit switch and its circuit wiring should be monitored with the Info Center before disconnecting the switch for testing (see Info Center Display in the Troubleshooting section of this chapter). If the Info Center Display verifies that the up limit switch and circuit wiring **are** functioning correctly, switch testing is not necessary.

1. Verify with the Info Center Display that the deck position switch and circuit wiring **are not** functioning correctly.

2. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

3. Disconnect up limit switch that requires testing from machine wire harness.

4. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.

5. With the cutting unit in the lowered position, there should be **continuity (zero resistance)** across the switch terminals.

6. Raise the cutting unit. There should be **no continuity (infinite resistance)** across the switch terminals.

7. Replace switch as needed. Reconnect switch to machine wire harness.

Switch Adjustment

1. Adjust up limit switch to have from 0.070” to 0.130” (1.8 to 3.3 mm) clearance between switch and sensing plate on the lift arm.

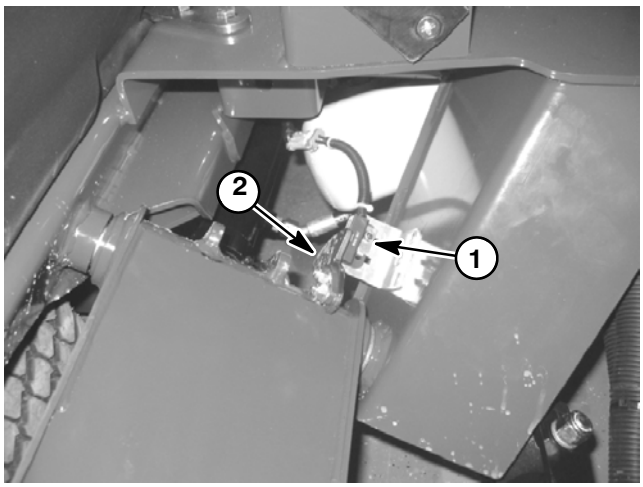


Figure 113

1. **Up limit switch (LH shown)**
2. **Sensing plate**

Battery Storage

If the machine will be stored for more than 30 days:

1. Remove the batteries and charge them fully (see Battery Service).

2. Either store batteries on a shelf or on the machine.

3. Leave cables disconnected if the batteries are stored on the machine.

4. Store batteries in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the batteries from freezing, make sure they are fully charged (see Battery Service).

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

IMPORTANT: Do not remove fill caps while cleaning.

2. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

B. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107–0392) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on terminals to provide good electrical contact.

WARNING

Connecting cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at battery terminals, disconnect cables. Always disconnect negative (–) cables first. Clean clamps and terminals separately. Reconnect cables with positive (+) cables first. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107–0392) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.

6. Maintain cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The batteries are the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Battery Specifications
BCI Group Size 34
690 CCA at 0º F (-17.8º C)
Reserve Capacity of 110 minutes at 80º F (26.7º C)

Battery Dimensions (including terminal posts)

Length	10.2 inches (259 mm)
Width	6.6 inches (168 mm)
Height	8.0 inches (203 mm)

Battery Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80º F (26.7º C)
Discharged: less than 1.240

Battery Removal and Installation (Figs. 114 and 115)

1. Remove fasteners that secure battery panel to machine. Remove panel to access the batteries.

2. Loosen and remove the negative cables from the batteries. After both negative cables are removed, loosen and remove positive cables.

3. Loosen battery straps that secures batteries to machine.

4. Carefully remove batteries from machine.

5. Install batteries in reverse order making sure to connect and tighten both positive cables to batteries before connecting the negative cables.

NOTE: Before connecting the negative (ground) cables to the battery, connect a digital multimeter (set to DC Amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the machine's electrical system should be tested for short circuits or faulty components and repaired.

6. Secure batteries with battery straps.

7. Position battery panel in place and secure with removed fasteners.

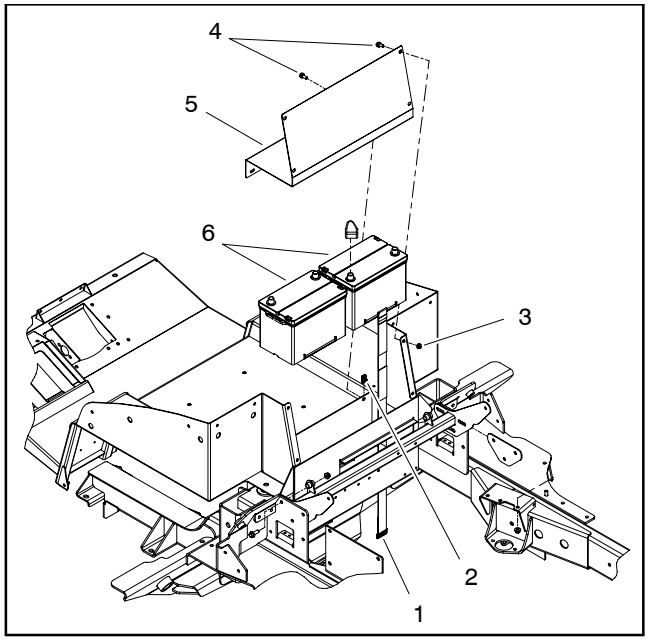


Figure 114

1. **Battery strap (2 used)**
2. **U-nut (2 used)**
3. **Flange nut (4 used)**
4. **Flange screw (6 used)**
5. **Battery panel**
6. **Battery (2 used)**

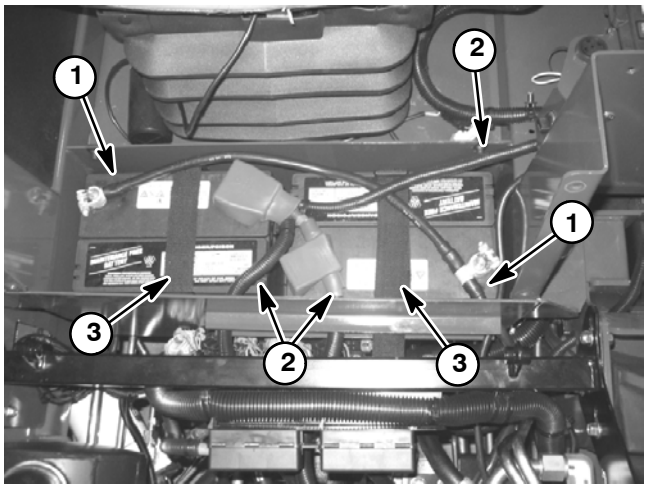


Figure 115

1. **Negative (-) cable**
2. **Positive (+) cable**
3. **Battery strap**

Battery Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

   A. Check battery case for cracks. Replace battery if cracked or leaking.

   B. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

   IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

   C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

   D. Check that the cover seal is not broken. Replace the battery if the seal is broken or leaking.

   E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

   A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm–up the hydrometer. At the same time take the temperature of the cell.

   B. Temperature correct each cell reading. For each 10º F (5.5º C) above 80º F (26.7º C) add 0.004 to the specific gravity reading. For each 10º F (5.5º C) below 80º F (26.7º C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100ºF
Cell Specific Gravity	1.245
100º F minus 80º F equals 20º F	
(37.7º C minus 26.7º C equals 11.0º C)	
20º F multiply by 0.004/10º F equals 0.008	
(11º C multiply by 0.004/5.5º C equals 0.008)	
ADD (conversion above)	0.008
Correction to 80º F (26.7º C)	1.253

   C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Battery Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high–discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold–cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the load tester manufacturer's instructions when using a battery load tester.

   A. Check the voltage across the battery terminals prior to load testing the battery. If the voltage is less than 12.4 VDC, charge the battery.

   B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

   C. Make sure battery terminals are free of corrosion.

   D. Measure the electrolyte temperature of the center battery cell.

   E. Connect a battery load tester to the battery terminals **following the load tester manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

   F. Apply a test load of 345 amps (one half the Cranking Performance rating of the battery) for 15 seconds.

   G. Take a battery voltage reading at 15 seconds, then remove the test load. This reading is the test voltage.

H. Using the table below, determine the minimum voltage for the electrolyte temperature of the center battery cell:

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70º F (and up)	21.1º C (and up)
9.5	60ºF	15.6ºC
9.4	50ºF	10.0ºC
9.3	40ºF	4.4ºC
9.1	30ºF	-1.1ºC
8.9	20ºF	-6.7ºC
8.7	10ºF	-12.2ºC
8.5	0ºF	-17.8ºC

I. If the test voltage is below the minimum voltage shown in the chart, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery Charging

To minimize possible damage to the battery and to allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is readily available.

CAUTION

Follow the battery charger manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the battery charger manufacturer's instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	**5.3 hrs @ 4 amps**	**10.5 hrs @ 4 amps**	**15.8 hrs @ 4 amps**	**21 hrs @ 4 amps**
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60º F (16º C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the battery charger manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125º F (52º C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three consecutive readings.

Hydraulic Valve Solenoid Coil

A hydraulic valve solenoid coil on a hydraulic control manifold can be replaced without opening the hydraulic system.

Removal (Figs. 116 and 117)

1. Park machine on a level surface, lower cutting decks, stop engine and engage parking brake. Remove key from ignition switch.

2. Locate the solenoid valve coil that is to be replaced.

3. Disconnect the wire harness electrical connector from the solenoid valve coil to be replaced.

4. Remove the nut from the hydraulic valve.

5. Slide the solenoid coil from the valve.

6. Clean any corrosion or dirt from the valve stem.

Installation (Figs. 116 and 117)

1. Slide new coil assembly onto the hydraulic valve.

2. Install the nut onto the valve and torque nut as follows (do not over tighten):

   A. For solenoid valve S on the steering/engine cooling fan control manifold, torque the coil retaining nut to **10 ft-lb (13.5 N-m)**.

   B. For all other solenoid valves on the machine, torque the coil retaining nut to **5 ft-lb (6.7 N-m)**.

3. Connect the machine wire harness connector to the solenoid coil.

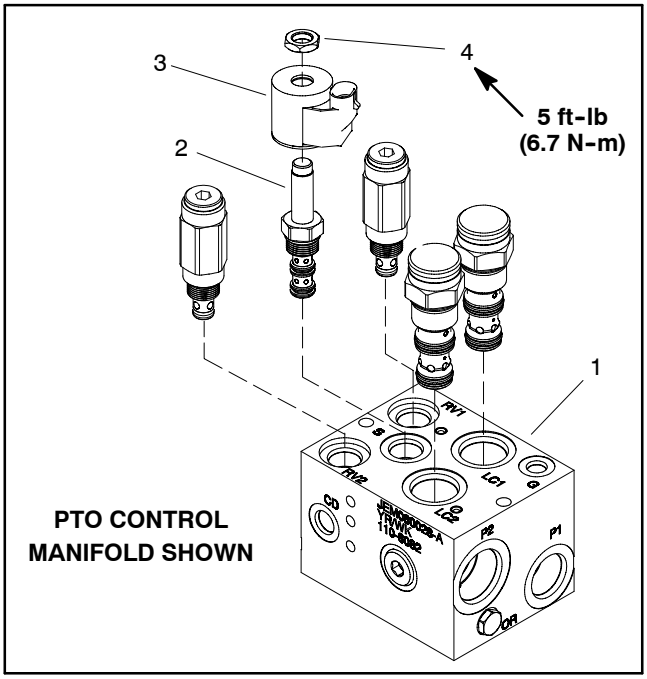


Figure 116

1. **Hydraulic manifold**
2. **Solenoid valve**
3. **Solenoid valve coil**
4. **Nut**

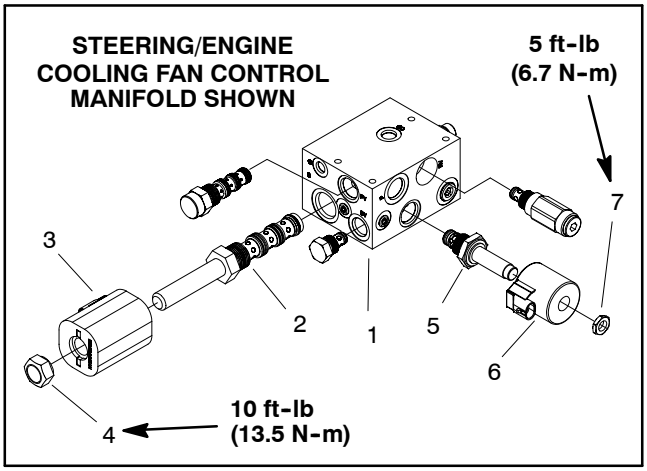


Figure 117

1. **Steering/fan manifold**
2. **Solenoid valve S**
3. **Solenoid valve coil**
4. **Nut**
5. **Solenoid valve PRV**
6. **Solenoid valve coil**
7. **Nut**

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Chapter 6

Axles, Planetaries and Brakes

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Specifications

Item	Specification
Tire pressure Front tire Rear tire	 50 psi (345 kPa) 30 psi (207 kPa)
Rear wheel toe-in	0 to 0.125 in (0 to 3.18 mm)
Planetary gear drive oil Capacity (each planetary)	SAE 85W-140 wt. gear lube 16 fluid ounces (0.47 liters)
Wheel lug nut torque (front and rear)	70 to 90 ft-lb (95 to 122 N-m)
Steering cylinder slotted hex nut torque	30 to 45 ft-lb (41 to 61 N-m)
Steering tie rod slotted hex nut torque	35 to 50 ft-lb (48 to 67 N-m)
Planetary mounting screw torque	75 to 85 ft-lb (102 to 115 N-m)
Brake housing mounting screw torque	75 to 85 ft-lb (102 to 115 N-m)
Front wheel motor mounting screw torque	75 to 85 ft-lb (102 to 115 N-m)
Rear wheel motor mounting screw torque	67 to 83 ft-lb (91 to 112 N-m)
Rear wheel hub nut torque	315 to 385 ft-lb (428 to 522 N-m)

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster. Refer to the Operator's Manual for additional information when servicing the machine.

Wheels

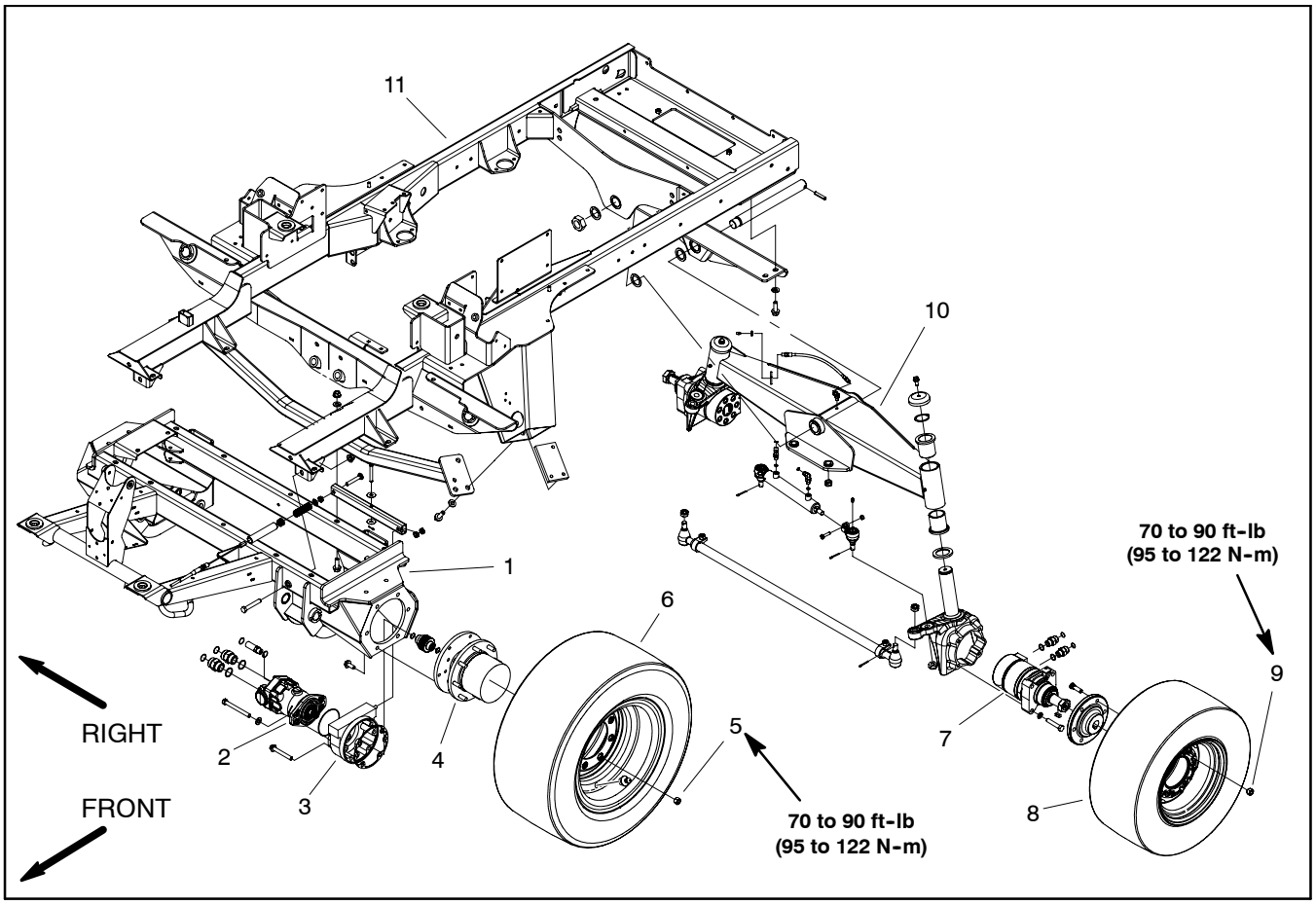


Figure 1

1. Front axle frame
2. Front wheel motor
3. Brake assembly
4. Planetary assembly
5. Lug nut (8 used per front wheel)
6. Front wheel assembly
7. Rear wheel motor
8. Rear wheel assembly
9. Lug nut (6 used per rear wheel)
10. Rear axle
11. Main frame

Wheel Removal (Fig. 1)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Chock wheels to prevent machine from shifting.

3. Loosen, but do not remove, lug nuts that secure wheel to machine.

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks to raise and support machine. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

4. Using a jack, raise machine so wheel to be removed is off ground (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

5. Remove lug nuts and then remove wheel from machine.

Wheel Installation (Fig. 1)

NOTE: The front wheels use eight (8) lug nuts. The rear wheels use six (6) lug nuts.

1. Install wheel and secure with lug nuts.

2. Lower machine to ground.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

3. Torque wheel lug nuts evenly in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

Brake Assembly

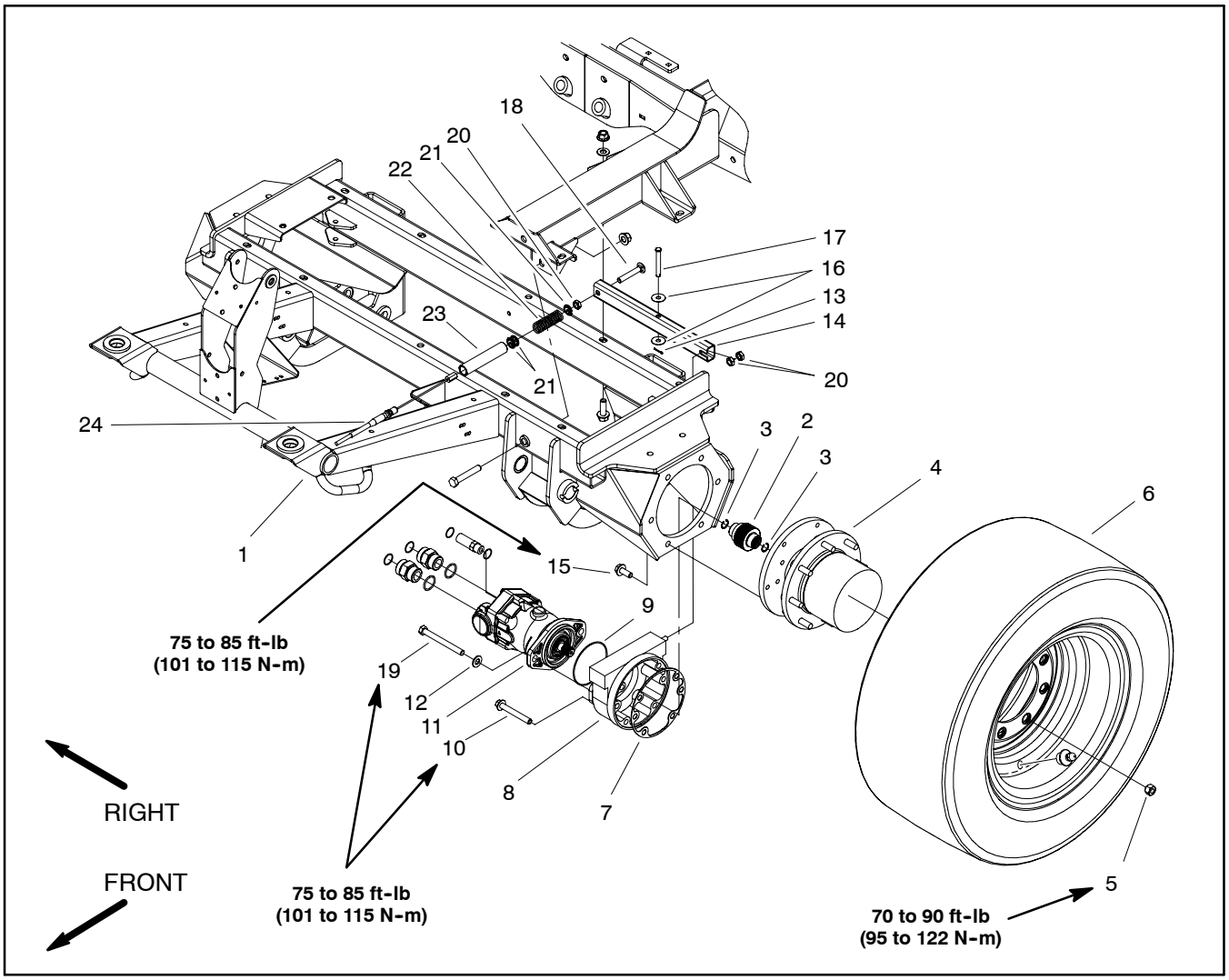


Figure 2

1. Front axle frame
2. Splined brake shaft
3. Retaining ring
4. Planetary assembly (2 used)
5. Lug nut (8 used per wheel)
6. Front wheel assembly
7. Gasket
8. Brake assembly (LH shown)
9. O-ring
10. Flange head screw (4 used per side)
11. Front wheel motor (2 used)
12. Flat washer (2 used per motor)
13. Cotter pin
14. Brake lever (2 used)
15. Flange head screw (6 used per side)
16. Washer
17. Clevis pin
18. Carriage screw
19. Cap screw (2 used per motor)
20. Jam nut
21. Spring plate
22. Compression spring
23. Spacer
24. Brake cable (LH shown)

Remove Brake Assembly (Fig. 2)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the ignition switch. Do not apply parking brake.

2. Drain oil from planetary/brake assembly.

3. Chock rear wheels to prevent machine from shifting.

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks to raise and support machine. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

4. Jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

5. Remove front wheel assembly.

6. Remove hydraulic wheel motor (see Front Wheel Motor Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

7. Disengage brake lever (item 14) from brake assembly pull rod:

   A. Remove tension on brake cable.

   B. Remove cotter pin (item 13) that secures brake lever to front axle frame.

   C. Slide clevis pin (item 17) from axle frame bracket and brake lever. Remove two (2) washers (item 16) from between brake lever and frame bracket (Fig. 5).

   D. Shift brake lever toward the center of the machine to disengage lever slot from pull rod on brake assembly.

8. Remove four (4) flange head screws (item 9) that secure brake assembly to machine. Remove brake assembly from machine. Take care to not drop splined brake coupler (item 2) as brake assembly is removed.

9. Remove and discard gasket (item 7). Make sure that all gasket material is removed from both brake and planetary assemblies.

10. Remove splined brake coupler (item 2).

11. Complete brake inspection and repair (see Brake Service in this section).

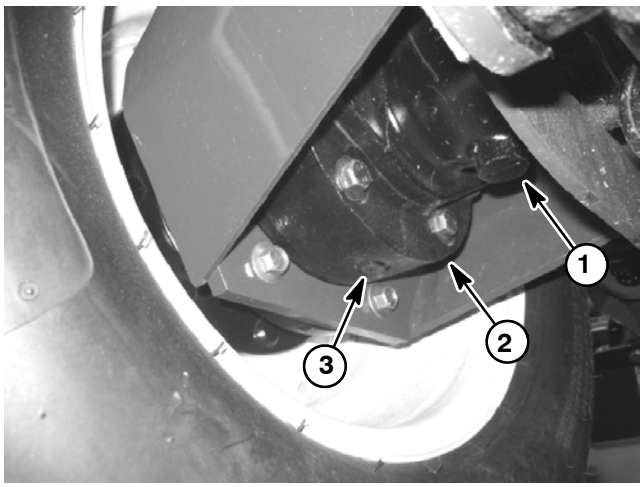


Figure 3

1. Wheel motor
2. Brake assembly
3. Drain plug

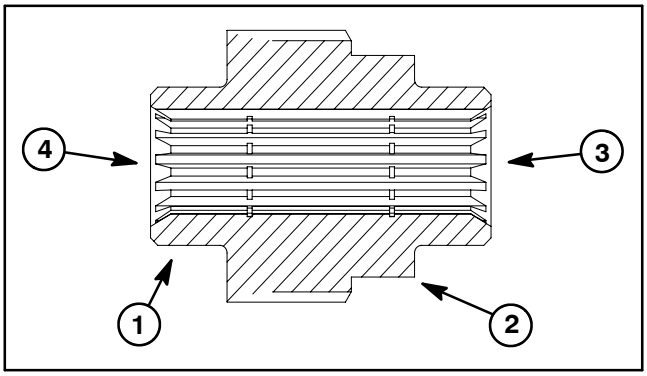


Figure 4

1. Splined brake coupler
2. Brake coupler step
3. Hydraulic motor end
4. Planetary assembly end

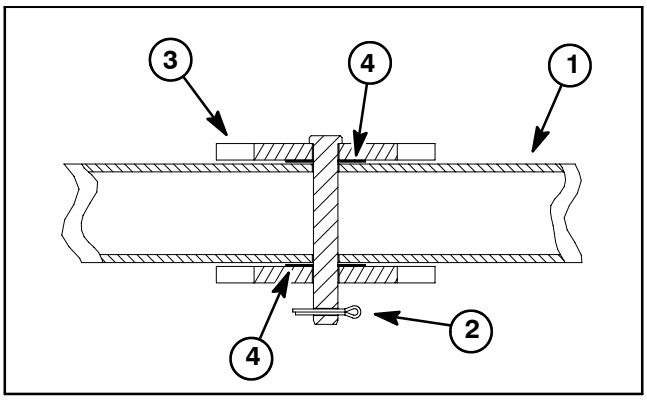


Figure 5

1. Brake lever
2. Cotter pin
3. Frame bracket
4. Washer

Install Brake Assembly (Fig. 2)

1. Make sure that internal retaining rings are fully seated in grooves inside splined brake coupler (item 2). Slide splined brake coupler into brake assembly. **Note:** The stepped end of the coupler must be installed toward the hydraulic wheel motor (Fig. 4).

2. Apply Loctite Gasket Sealant #2 (or equivalent) to sealing surfaces of new gasket (item 7). Apply gasket to brake assembly.

3. Position brake assembly to frame, aligning splined brake coupler with input shaft on planetary wheel drive.

4. Install four (4) flange head screws to secure brake assembly to frame. Torque screws in a crossing pattern from **75 to 85 ft-lb (101 to 115 N-m)**.

5. Secure brake lever (item 14) to brake pull rod:

   A. Position brake lever so that brake lever slot fits around pull rod on brake assembly (Fig. 6).

   B. Place two (2) washers (item 16) between brake lever and frame bracket (Fig. 5).

   C. Slide clevis pin (item 17) through frame bracket, washers and brake lever.

   D. Secure brake lever to front axle frame with cotter pin (item 13).

   E. Make sure that brake lever rotates freely after assembly.

6. Install new o-ring on hydraulic wheel motor. Install wheel motor and torque cap screws from **75 to 85 ft-lb (101 to 115 N-m)** (see Front Wheel Motor Installation in the Service and Repairs section of Chapter 4 - Hydraulic System).

7. Install front wheel assembly.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

8. Lower machine to ground. Torque wheel lug nuts in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

9. Make sure drain plug is installed in bottom of brake assembly. Fill planetary wheel drive/brake assembly with SAE 85W-140 gear lube to proper level. Capacity is approximately 16 fl. oz. (0.47 l) per wheel.

10. Check and adjust brake cable for proper brake operation. Brake lever should be from 0.470" to 0.530" (12.0 to 13.4 mm) from brake casting surface when brake is disengaged (Fig. 6).

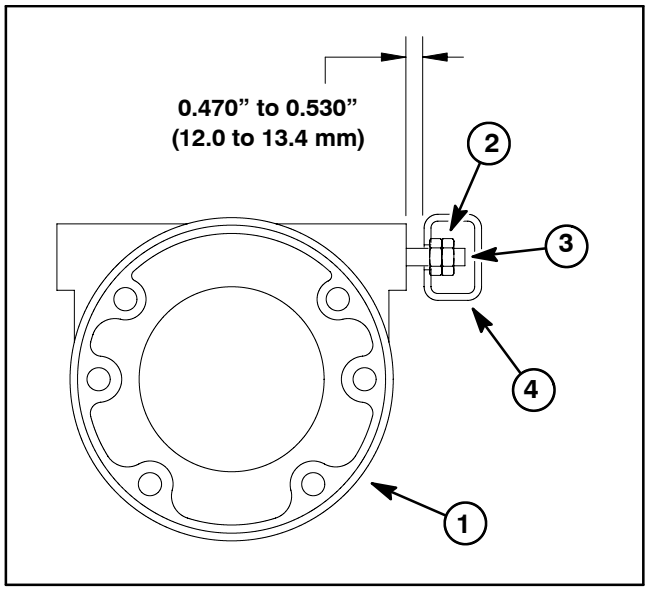


Figure 6

1. **Brake assembly**
2. **Jam nut (2 used)**
3. **Brake pull rod**
4. **Brake lever**

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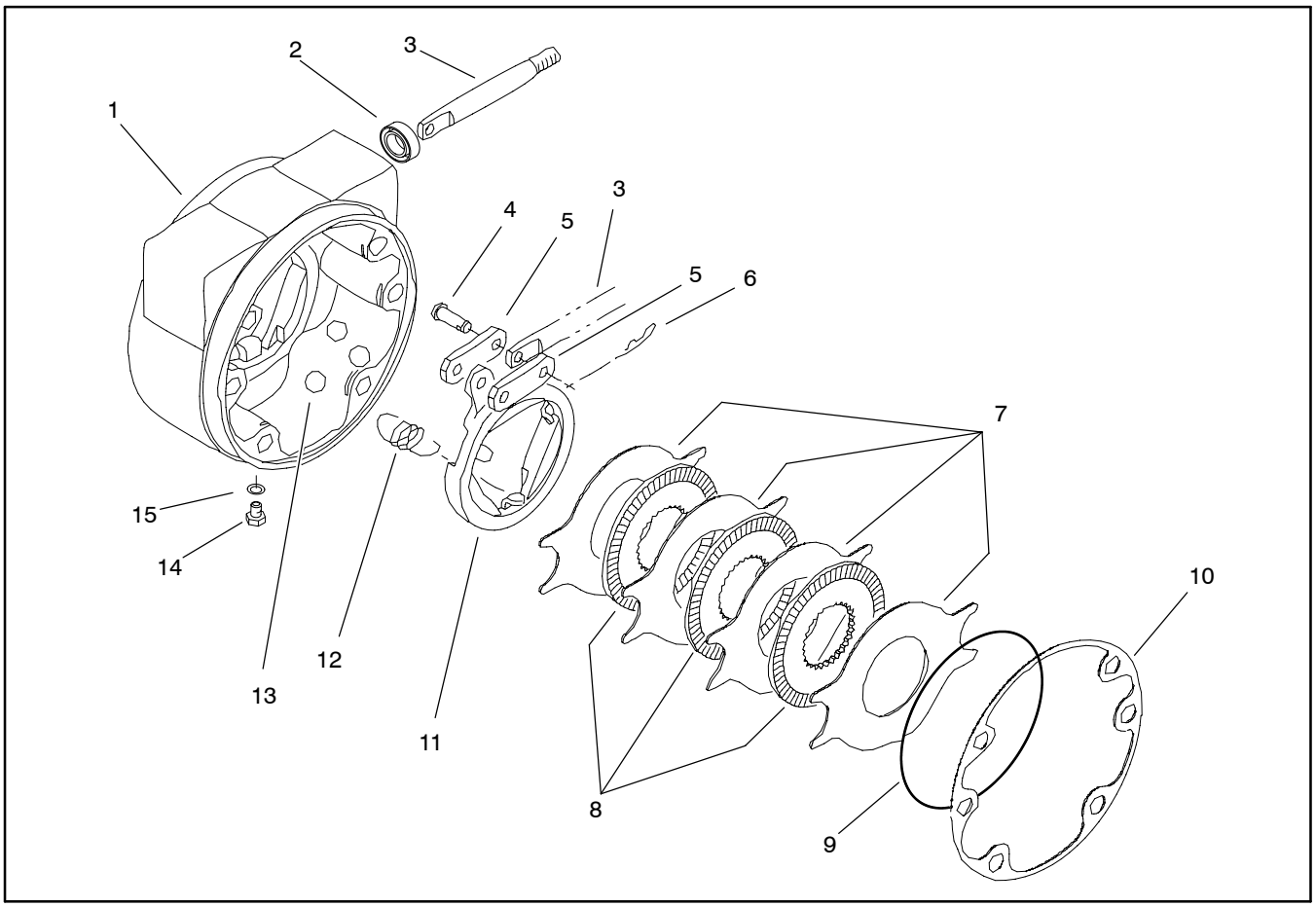


Figure 7

1. **Brake housing (LH shown)**
2. **Seal**
3. **Pull rod**
4. **Clevis pin (2 used)**
5. **Link (2 used)**
6. **Hitch pin (2 used)**
7. **Stationary disc (4 used)**
8. **Rotating disc (3 used)**
9. **Retaining ring**
10. **Gasket**
11. **Rotating actuator**
12. **Extension spring (3 used)**
13. **Ball (3 used)**
14. **Plug**
15. **O-ring**

Brake Disassembly (Fig. 7)

1. Scrape gasket material (item 10) from brake housing and planetary wheel drive mounting surfaces.

2. Remove retaining ring (item 9) from brake housing.

3. Remove four (4) stationary discs (item 7) and three (3) rotating discs (item 8).

4. Remove three (3) extension springs (item 12).

5. Remove actuator assembly (items 11, 6, 5, 4 and 3) and balls (item 13).

6. Remove seal (item 2) from brake housing. Discard seal.

Brake Inspection

1. Wash parts in cleaning solvent. Inspect components for wear or damage.

2. The stack of four (4) stationary and three (3) rotating discs should have a minimum thickness of 0.440" (11.2 mm).

Brake Assembly (Fig. 7)

1. Reverse steps 2 through 6 to assemble brakes, installing new parts as necessary. Make sure to install a new seal (item 2).

2. When installing jam nuts onto brake pull rod, position inner jam nut so that it is 0.120" (3.0 mm) from step in brake pull rod (Fig. 8). From that point, loosen inner jam nut 3 flats. While holding inner jam nut with a wrench, install and tighten outer jam nut.

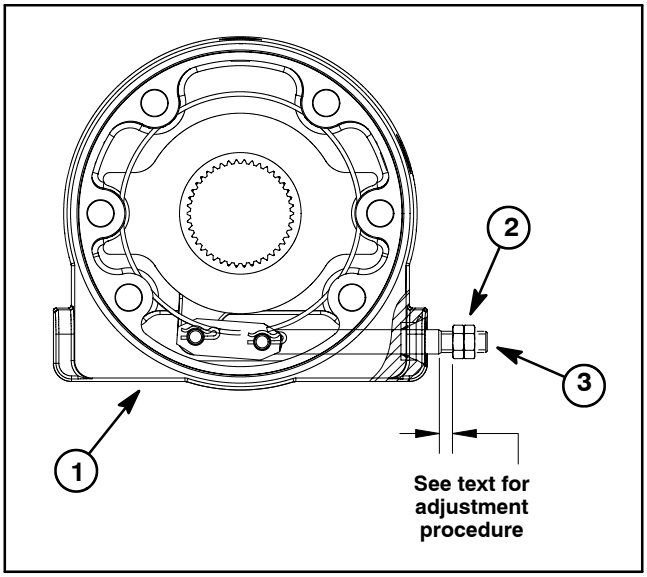


Figure 8

1. **Brake assembly**
2. **Jam nut (2 used)**
3. **Brake pull rod**

Planetary Wheel Drive Assembly

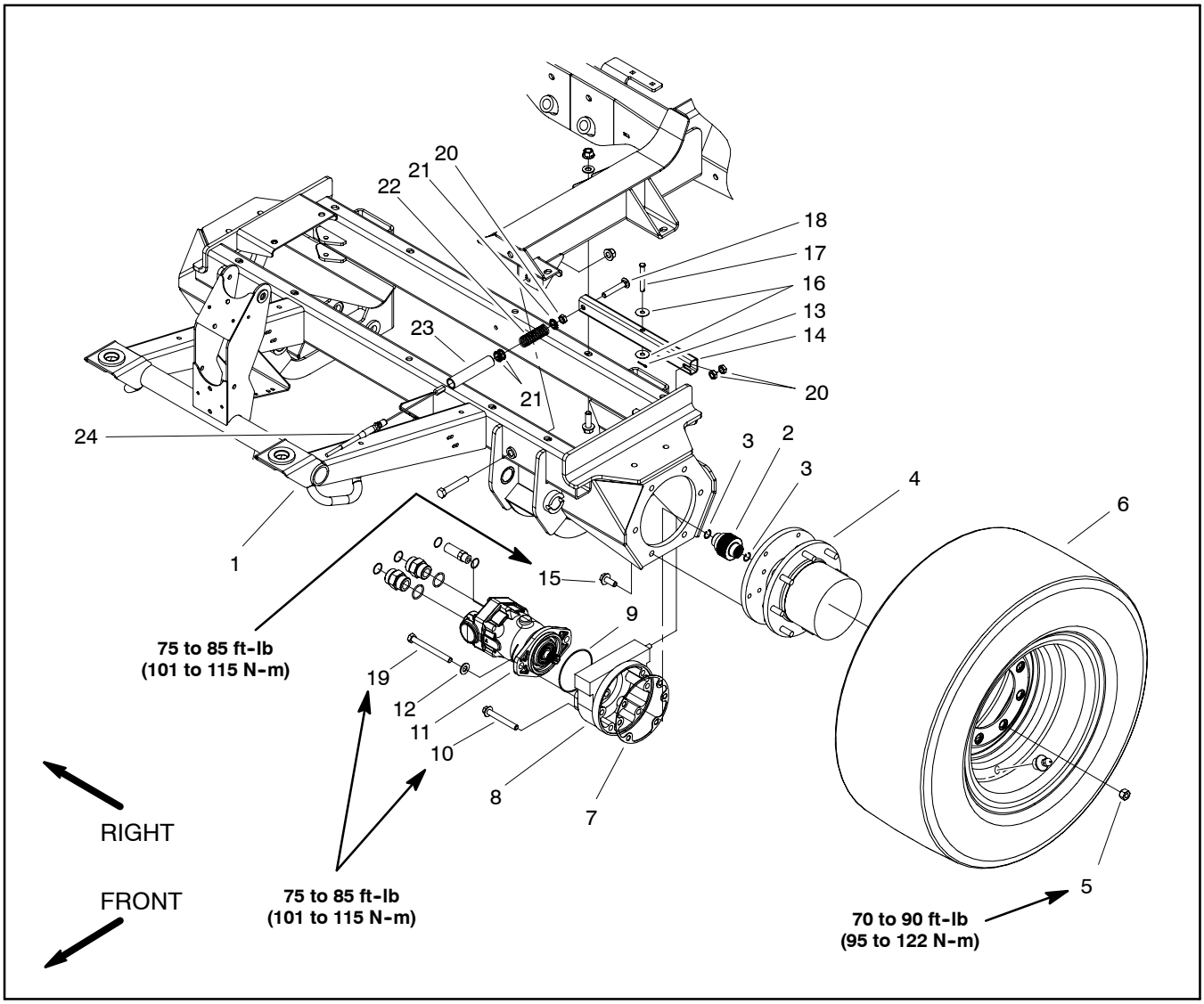


Figure 9

1. Front axle frame
2. Splined brake shaft
3. Retaining ring
4. Planetary assembly (2 used)
5. Lug nut (8 used per wheel)
6. Front wheel assembly
7. Gasket
8. Brake assembly (LH shown)
9. O-ring
10. Flange head screw (4 used per side)
11. Front wheel motor (2 used)
12. Flat washer (2 used per motor)
13. Cotter pin
14. Brake lever (2 used)
15. Flange head screw (6 used per side)
16. Washer
17. Clevis pin
18. Carriage screw
19. Cap screw (2 used per motor)
20. Jam nut
21. Spring plate
22. Compression spring
23. Spacer
24. Brake cable (LH shown)

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine (see Planetary Wheel Drive Service in this section). Use the following procedure to remove and install planetary wheel drive assembly from machine.

Planetary Wheel Drive Removal (Fig. 9)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the ignition switch. Do not apply parking brake.

2. Drain oil from planetary wheel drive/brake assembly.

3. Chock rear wheels to prevent machine from shifting.

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks to raise and support machine. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

4. Jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

5. Remove front wheel assembly.

6. Remove hydraulic wheel motor (see Front Wheel Motor Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

7. Remove brake assembly (see Brake Assembly Removal in this section).

8. Support planetary assembly to prevent it from falling. Loosen and remove six (6) flange head screws that secure planetary assembly to frame. Remove planetary assembly from machine.

9. Remove and discard gasket (item 7). Make sure that all gasket material is removed from both brake and planetary assemblies.

Planetary Wheel Drive Installation (Fig. 9)

1. Apply Loctite Gasket Sealant #2 (or equivalent) to sealing surfaces of new gasket (item 7). Apply gasket to brake assembly.

2. Position planetary assembly to machine frame. Install six (6) flange head screws that secure planetary assembly to frame. Torque screws in a crossing pattern from **75 to 85 ft-lb (101 to 115 N-m)**.

3. Install brake assembly (see Brake Assembly Installation in this section).

4. Install hydraulic wheel motor (see Front Wheel Motor Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

5. Install front wheel assembly.

6. Lower machine from jack stands. Torque wheel lug nuts in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

7. Make sure drain plug is installed in bottom of brake assembly (Fig. 10). Fill planetary wheel drive/brake assembly with SAE 85W-140 gear lube to proper level. Capacity is approximately 16 oz. (0.47 l) per wheel.

8. Check for proper brake operation.

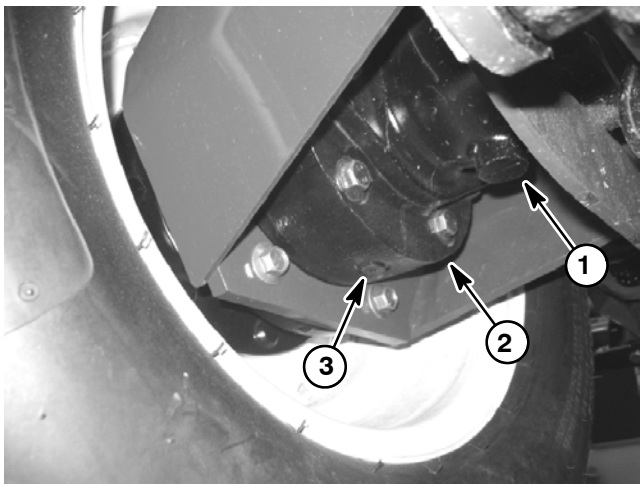


Figure 10

1. **Wheel motor**
2. **Brake assembly**
3. **Drain plug**

Planetary Wheel Drive Service

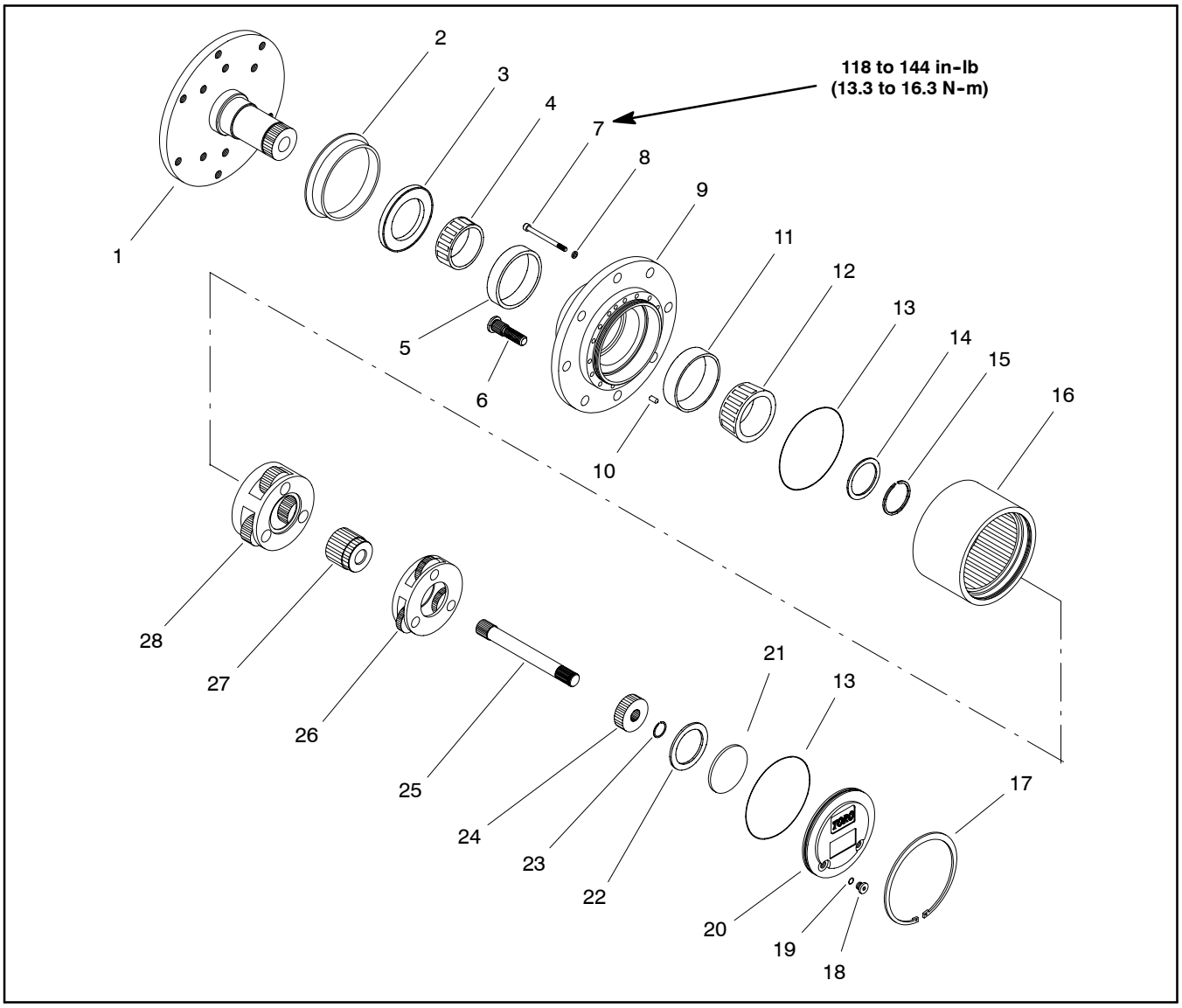


Figure 11

1. Spindle
2. Boot seal
3. Oil seal
4. Inner bearing cone
5. Inner bearing cup
6. Wheel stud (8 used)
7. Socket head screw (16 used)
8. Lock washer (16 used)
9. Housing
10. Dowel pin (2 used)
11. Outer bearing cup
12. Outer bearing cone
13. O-ring
14. Thrust washer
15. Retaining ring (external)
16. Ring gear
17. Retaining ring (internal)
18. Plug (2 used)
19. O-ring (2 used)
20. End cap
21. Thrust plug
22. Thrust washer
23. Retaining ring
24. Primary gear
25. Drive shaft
26. Primary carrier assembly
27. Secondary gear
28. Secondary carrier assembly

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine. If the spindle (item 1) needs to be removed from machine, see Planetary Wheel Drive Assembly in this section.

Disassembly (Figs. 11 and 12)

1. If planetary wheel drive assembly is installed on machine:

   A. Park machine on a level surface, lower cutting decks, stop engine and remove key from the ignition switch.

   B. Drain oil from planetary wheel drive/brake assembly.

   C. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands.

   D. Remove front wheel assembly.

2. Remove retaining ring (item 17).

3. Remove end cap (item 20). Thrust plug (item 21) and thrust washer (item 22) usually remain in end cap bore and should be removed for cleaning and inspection.

4. Remove drive shaft assembly (items 23, 24 and 25) If necessary, remove retaining ring and primary gear from shaft.

5. Remove primary carrier (item 26), secondary gear (item 27) and secondary carrier (item 28).

NOTE: Steps 6 through 10 are necessary only if inspecting or replacing bearings and/or seals.

IMPORTANT: Do not reuse retaining ring (item 10) after it has been removed.

6. Remove retaining ring (item 15) and thrust washer (item 14). Discard retaining ring.

7. Carefully remove housing (item 9) from spindle (item 1). Remove outer bearing cone (item 12).

8. Remove and discard seals (items 2 and 3) and O–rings (item 13) from housing.

9. Remove inner bearing cone (item 4) from housing. If necessary, remove bearing cups (items 5 and 11) from housing.

10. If wheel stud (item 6) removal is necessary, use press to extract stud(s) from housing.

11. If necessary, remove socket head screws (item 7) with lock washers (item 8) that secure ring gear (item 16) to housing. Remove ring gear and two (2) dowel pins (item 10) from housing.

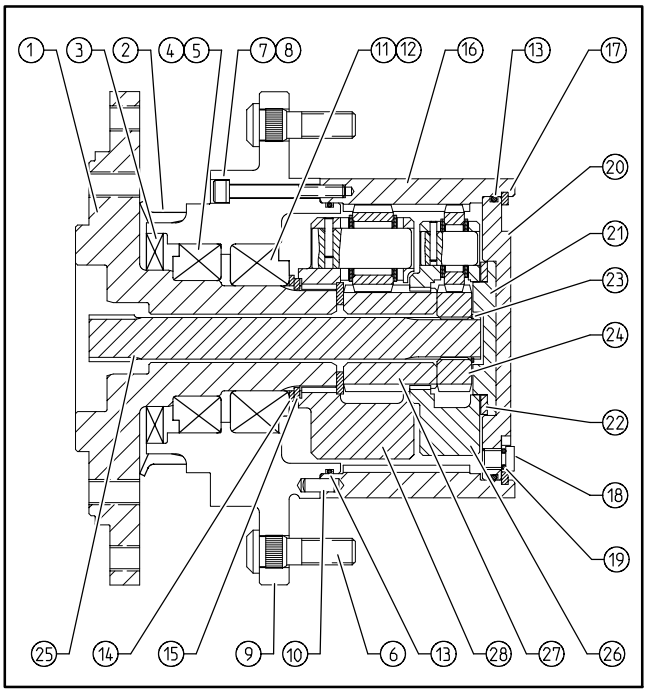


Figure 12

Assembly (Figs. 11 and 12)

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

NOTE: Use new seal and shim kits when assembling planetary wheel drive.

3. If spindle and housing were separated:

   A. Press bearing cups (items 5 and 11) into housing (item 9). Cups should be pressed fully to shoulder of the housing bore.

   B. Set inner bearing cone (item 4) into inner bearing cup.

   C. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal (item 3) is not rubber or does not have a sealant coating, apply light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face. Lightly grease seal lips.

   D. Pack boot seal (item 2) with grease and install on housing.

   E. If ring gear was removed from housing, place dowel pins (item 10) in housing. Secure ring gear to housing with lock washers (item 8) and socket head screws (item 7). Torque socket head screws from **118 to 144 in-lb (13.3 to 16.3 N-m)**.

F. Lightly oil bearing journals on spindle shaft. Slide housing assembly onto spindle (item 1) taking care to not damage seal or spindle. Make sure that inner bearing in housing fully seats against spindle shaft shoulder.

G. Install outer bearing cone (item 12) onto spindle.

NOTE: The planetary shim kit includes the retaining ring and several thrust washers with thickness in incremental steps of 0.004 in. (0.10 mm).

H. Measure thickness of thrust washer (item 14) that was removed during disassembly. Choose new thrust washer of equal thickness or the next available thickness from thrust washers in the shim kit.

I. Apply a light coating of oil to spindle shaft, thrust washer (item 14) and new retaining ring (item 15). Install thrust washer onto spindle shaft.

WARNING

If retaining ring (item 15) is not fully installed in spindle groove, loss of wheel and personal injury may result.

J. Carefully install new retaining ring (item 15) into the spindle shaft groove taking care to not distort ring. If the proper thrust washer has been installed, the retaining ring should fit tightly between the thrust washer and spindle groove. Tap the OD of the retaining ring starting in the center and working out toward each end to ensure that the retaining ring is properly seated into the spindle groove. Make sure that retaining ring ID is fully seated to spindle shaft groove.

K. After retaining ring is installed, make sure that there is no endplay in assembly. If required, remove retaining ring and install a thrust washer of different thickness to adjust endplay.

L. Install new O−ring (item 13) into groove in housing.

4. Install secondary carrier (item 28), secondary gear (item 27) and primary carrier (item 26) making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

5. If primary gear (item 24) was removed from drive shaft, slide gear onto shaft and secure with retaining ring (item 23).

6. Install drive shaft assembly (items 25, 24 and 23) making sure that drive shaft spline aligns with carrier gears.

7. Install thrust plug (item 21) and thrust washer (item 22) into end cap (item 20). Make sure that thrust plug and thrust washer are captive on inside of end cap (item 20).

8. Install new O−ring (item 13) to end cap and then install end cap. Secure cap with retaining ring (item 17).

9. Check operation of planetary wheel drive. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

10. If planetary wheel drive assembly is installed on machine:

A. Install front wheel assembly.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

B. Lower machine from jack stands. Torque wheel lug nuts in a crossing pattern from **70 to 90 ft−lb (95 to 122 N−m)**.

C. Make sure drain plug is installed in bottom of brake assembly. Fill planetary wheel drive/brake assembly with SAE 85W−140 gear lube to proper level. Capacity is approximately 16 oz. (0.47 l) per wheel.

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Rear Axle

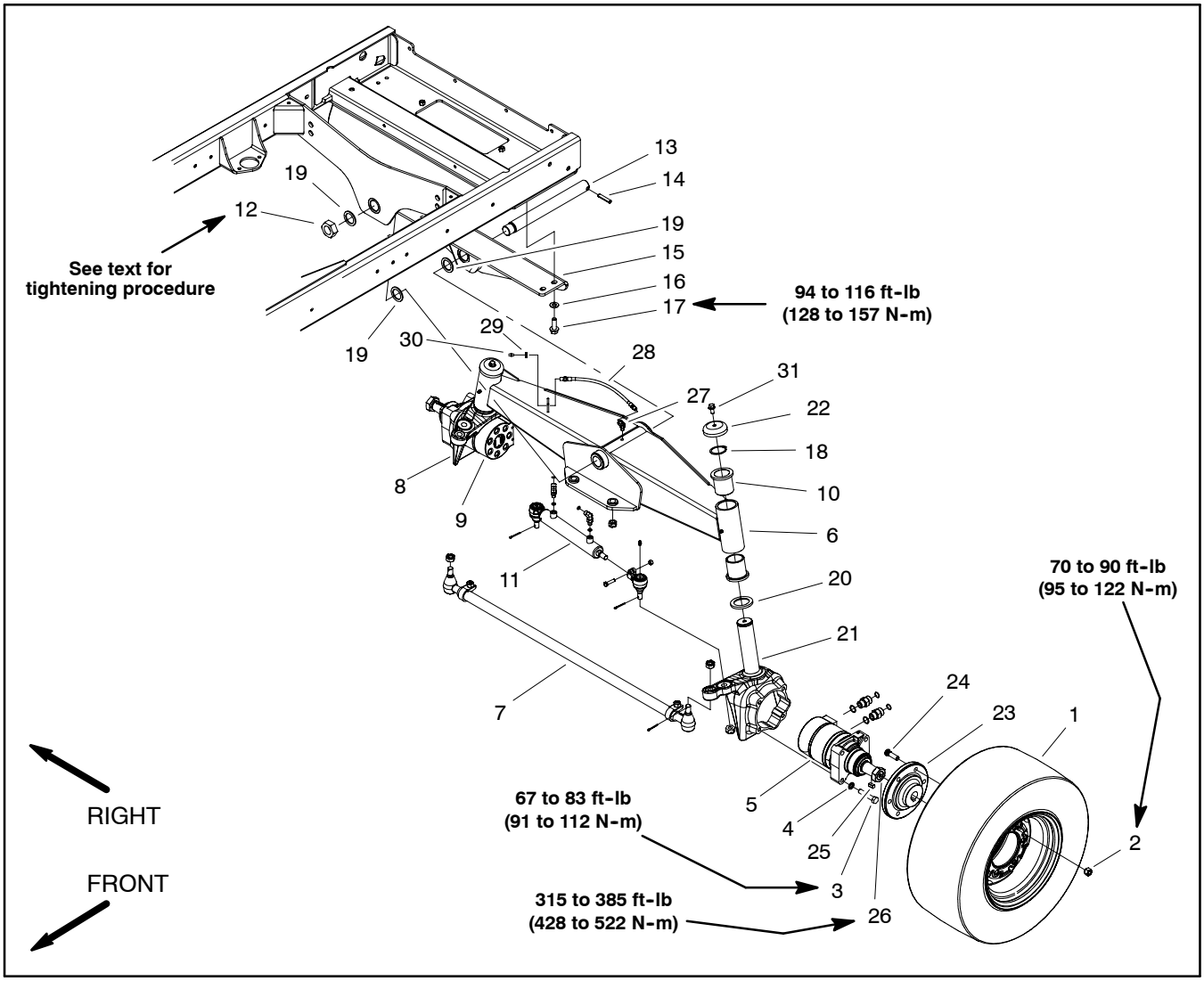


Figure 13

1. Rear wheel assembly
2. Lug nut (6 used per wheel)
3. Cap screw (4 used per motor)
4. Lock washer (4 used per motor)
5. LH wheel motor
6. Rear axle
7. Tie rod
8. RH spindle
9. RH wheel motor
10. Flange bushing (4 used)
11. Steering cylinder (2 used)
12. Lock nut
13. Pivot shaft
14. Roll pin
15. Axle support
16. Flat washer (4 used)
17. Flange head screw (4 used)
18. Retaining ring
19. Thrust washer (3 used)
20. Thrust washer
21. LH spindle
22. Spindle cap
23. Wheel hub
24. Wheel stud (6 used per hub)
25. Square key
26. Hex nut
27. Elbow
28. Hose
29. Nut
30. Grease fitting
31. Flange head screw

Removal (Fig. 13)

1. Park machine on a level surface, lower cutting decks, stop engine, engage parking brake and remove key from the ignition switch.

2. Chock front wheels to prevent machine from shifting.

3. Thoroughly clean hydraulic hose ends and fittings on steering cylinders and rear wheel motors to prevent hydraulic system contamination.

NOTE: To ease assembly, label hydraulic hoses to show their correct position on the steering cylinders and rear wheel motors.

4. Disconnect the hydraulic hoses from the steering cylinders and rear wheel motors. Put caps or plugs on all fittings and hoses to prevent contamination.

5. Remove the lock nut (item 12) and thrust washer (item 19) that secures the axle pivot shaft (item 13) to the frame.

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks to raise and support machine. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

6. Jack up the machine (just ahead of the rear wheels) until clearance exists to allow rear axle removal. Support the machine with appropriate jack stands prevent it from falling.

7. Support rear axle to prevent it from falling.

8. Pull the axle pivot shaft from frame and rear axle. This will release the rear axle and two (2) thrust washers (item 19) from the frame. Carefully lower the entire axle assembly and remove it from under the machine.

NOTE: If service to the rear wheel motors or steering cylinders is required, refer to the Service and Repairs section of Chapter 4 – Hydraulic System.

Installation (Fig. 13)

1. Thoroughly clean the rear axle pivot shaft. Inspect the shaft for wear or damage and replace if necessary.

2. Position the rear axle assembly to the frame. Install thrust washer (item 19) between each side of axle and frame. Raise axle assembly to frame and slide pivot shaft through frame, thrust washers and axle. Make sure that roll pin on pivot shaft is positioned in frame reliefs.

3. Install thrust washer (item 19) and lock nut (item 12) onto pivot shaft. Tighten lock nut to eliminate any axial movement of rear axle. Make sure that axle can still pivot freely after lock nut is tightened.

4. Lower the machine to the ground.

5. Correctly install the hydraulic hoses to the steering cylinders and rear wheel motors.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

6. Make sure that wheel lug nuts are properly torqued from **70 to 90 ft-lb (95 to 122 N-m)**.

7. Check oil level in hydraulic reservoir.

8. Lubricate the rear axle pivot bushings through the grease fitting on the rear axle.

9. Operate machine and check hydraulic connections at steering cylinders and wheel motors for leaks.

10. After assembly and adjustments have been completed, make sure that no contact is made between any machine components as the rear wheels are moved from steering lock to lock. Readjust if necessary.

Rear Axle Service

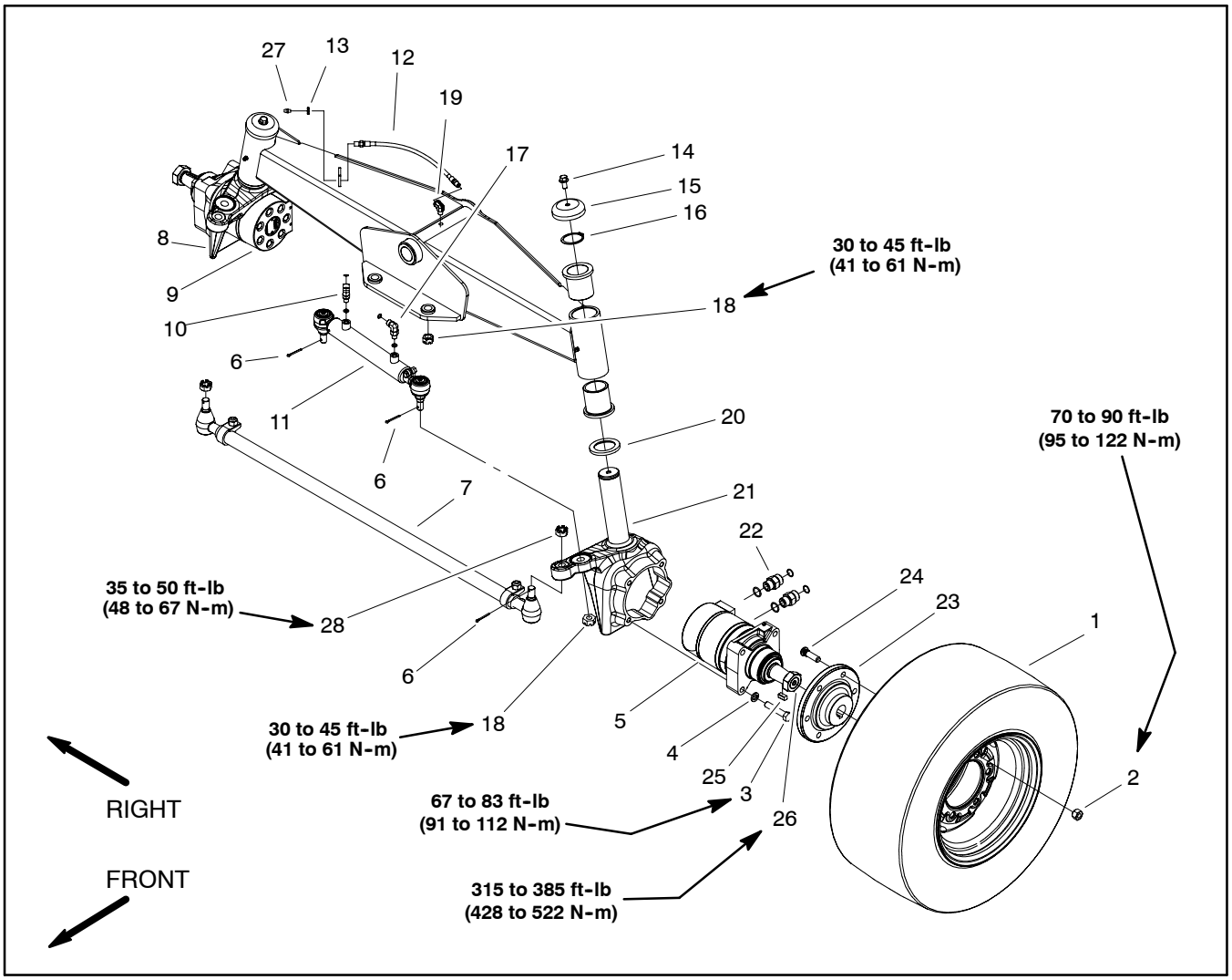


Figure 14

1. Rear wheel assembly
2. Lug nut (6 used per wheel)
3. Cap screw (4 used per motor)
4. Lock washer (4 used per motor)
5. LH wheel motor
6. Cotter pin
7. Tie rod assembly
8. RH spindle
9. RH wheel motor
10. 45º hydraulic fitting
11. Steering cylinder (2 used)
12. Hose
13. Nut
14. Flange head screw
15. Spindle cap
16. Retaining ring
17. 90º hydraulic fitting
18. Slotted hex nut
19. Elbow
20. Thrust washer
21. LH spindle
22. Hydraulic fitting (2 used per motor)
23. Wheel hub (2 used)
24. Wheel stud (6 used per wheel)
25. Square key
26. Hex nut
27. Grease fitting
28. Slotted hex nut

NOTE: If service to the rear wheel motors or steering cylinders is required, refer to the Service and Repairs section of Chapter 4 – Hydraulic System.

Tie Rod Assembly (Figs. 14 and 15)

1. Remove cotter pin and slotted hex nut that secure the tie rod ends to the steering spindles. Separate the tie rod ends from the spindle and remove tie rod from machine.

NOTE: One of the tie rod ball joints has left hand threads.

2. Loosen cap screw and lock nut and then unscrew ball joint from tie rod.

3. Thread ball joints equally into tie rod so that center to center length is from 41.080" to 41.200" (1043.5 to 1046.4 mm) (Fig. 16).

4. Thoroughly clean the tapered surfaces of the tie rod ball joints and steering spindles.

5. Connect the tie rod ends to the steering spindles with slotted hex nuts. Torque nut from **35 to 50 ft-lb (48 to 67 N-m)**. Install cotter pin.

6. Check and adjust rear wheel toe-in. After toe-in is correct, tighten cap screw and lock nut.

7. Lubricate the tie rod ball joints.

8. After assembly and adjustments have been completed, make sure that no contact is made between any machine components as the rear wheels are moved from steering lock to lock. Adjust if necessary.

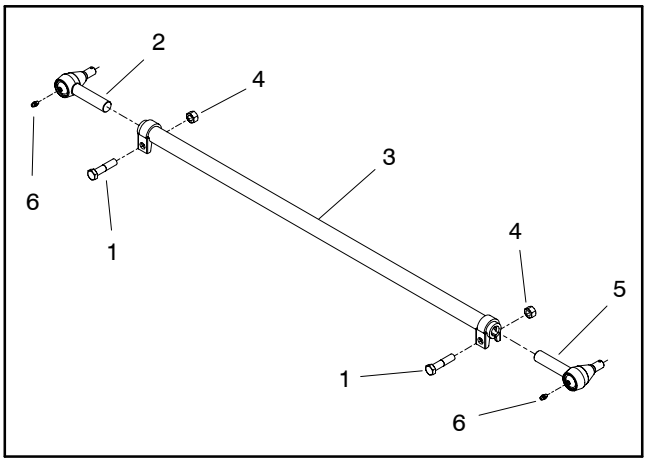


Figure 15

1. **Cap screw**
2. **Tie rod end**
3. **Tie rod tube**
4. **Lock nut**
5. **Tie rod end**
6. **Grease fitting**

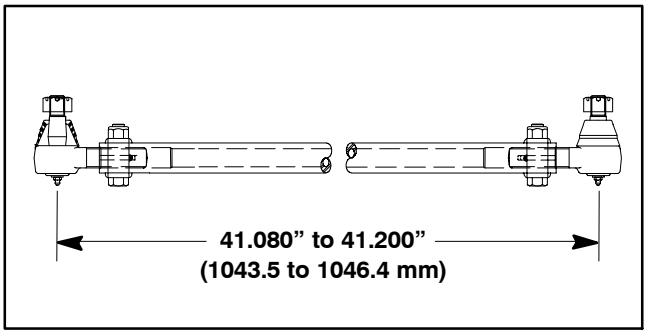


Figure 16

Rear Axle Spindle Bushings (Fig. 14)

The rear wheel spindles must fit snugly in the rear axle. Excessive movement of the spindle in the axle might indicate that the rear axle spindle bushings (Fig. 17) are worn and must be replaced.

1. Loosen, but do not remove, lug nuts that secure rear wheels to axle.

2. Remove rear axle from machine (see Rear Axle Removal in this section).

3. Remove rear wheels from axle.

4. Remove cotter pin and slotted hex nut that secure the tie rod end to the steering spindle. Separate the tie rod end from the spindle.

5. Remove cotter pin and slotted hex nut that secure steering cylinder ball joint to steering spindle. Separate steering cylinder from spindle.

6. If necessary, remove wheel motor from steering spindle (see Rear Wheel Motor Removal in the Service and Repairs section of Chapter 4 - Hydraulic System).

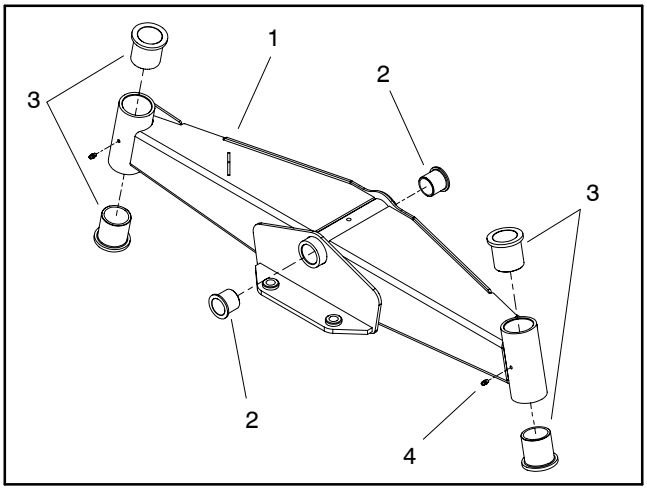


Figure 17

1. **Rear axle**
2. **Pivot bushing**
3. **Spindle bushing**
4. **Grease fitting**

7. Remove the flange head screw, spindle cap and retaining ring that secure the steering spindle into the axle tube. Slide the spindle out of the axle tube to expose the spindle bushings. Locate and retrieve thrust washer (item 20) from steering spindle shaft.

8. Use a bushing removal tool to extract both spindle bushings from the axle tube. Take care to not damage the bore of the axle tube. Clean the inside of the axle tube to remove any dirt or foreign material.

9. Apply grease to the inside and outside of the new bushings. Use a press to install the bushings into the top and bottom of the axle tube. Press bushings into tube until bushing flange shoulder bottoms on tube.

10. Thoroughly clean the steering spindle shaft. Inspect the spindle for wear and replace if worn or damaged.

11. Install thrust washer (item 20) onto the spindle shaft and slide the shaft up through the axle tube. Hold the spindle shaft assembly in place and install the retaining ring (item 16) into the groove in the spindle shaft.

12. Install the spindle cap and flange head screw.

13. Thoroughly clean the tapered surfaces of the tie rod ends, steering cylinder ball joints and steering spindle.

14. Connect the tie rod end to the steering spindle with slotted hex nut and cotter pin. Torque nut from **35 to 50 ft-lb (48 to 67 N-m)**.

15. Secure steering cylinder ball joint to steering spindle with slotted hex nut and cotter pin. Torque nut from **30 to 45 ft-lb (41 to 61 N-m)**.

16. If removed, install rear wheel motor (see Rear Wheel Motor Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

17. Secure rear wheels to axle with lug nuts (see Wheel Installation in this section).

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

18. Install rear axle to machine (see Rear Axle Installation in this section). After lowering machine to ground, torque wheel lug nuts from **70 to 90 ft-lb (95 to 122 N-m)**.

19. Lubricate the steering spindles through the grease fittings on the rear axle.

20. Check rear wheel toe-in and adjust if necessary.

21. Operate machine and check hydraulic connections at steering cylinders and wheel motors for leaks.

22. After assembly and adjustments have been completed, make sure that no contact is made between any machine components as the rear wheels are moved from steering lock to lock. Adjust if necessary.

Axle Pivot Bushings (Fig. 14)

The rear axle must be held in place snugly by the axle pivot shaft. Excessive movement of the axle, which is often characterized by erratic steering, might indicate worn axle pivot bushings. To correct the problem, replace the rear axle pivot bushings (Fig. 17).

1. Loosen, but do not remove, lug nuts that secure rear wheels to axle.

2. Remove rear axle from machine (see Rear Axle Removal in this section).

3. Remove rear wheels from axle (see Wheel Removal in this section).

4. Use a bushing removal tool to extract both axle pivot bushings from the axle pivot tube. Take care to not damage bore of pivot tube during bushing removal.

5. Clean the inside of the tube to remove all dirt and foreign material.

6. Apply grease to the inside and outside of the new bushings. Use a press to install the bushings into the front and back of the axle pivot tube. Press bushings into tube until bushing flange shoulder bottoms on tube.

7. Secure rear wheels to axle with lug nuts (see Wheel Installation in this section).

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

8. Install rear axle to machine (see Rear Axle Installation in this section). After lowering machine to ground, torque wheel lug nuts from **70 to 90 ft-lb (95 to 122 N-m)**.

Chapter 7

Chassis

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General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster machine. Refer to the Operator's Manual for additional information when servicing the machine.

Steering Tower

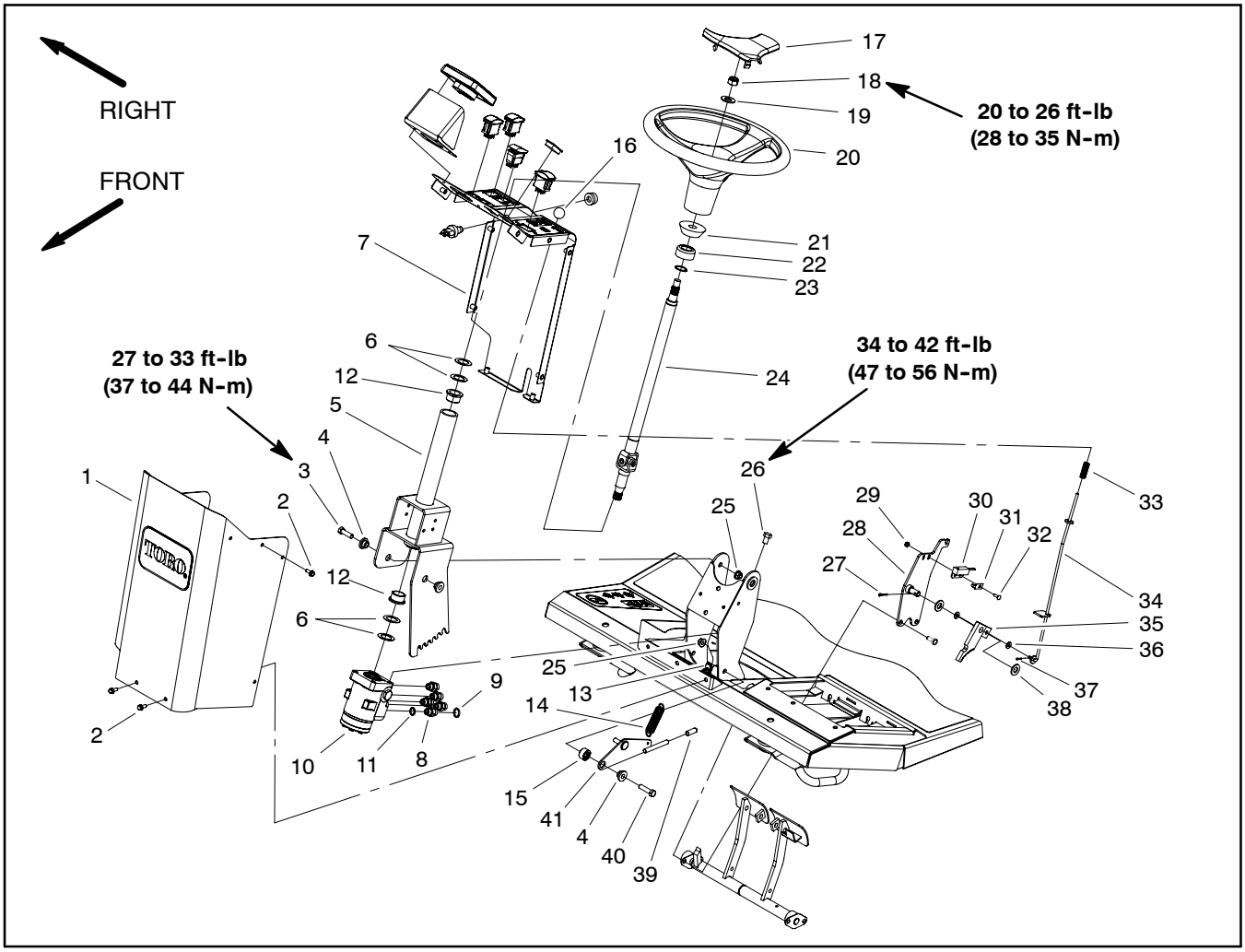


Figure 1

1. Steering tower cover
2. Flange head screw
3. Cap screw (2 used)
4. Pivot hub (3 used)
5. Steering column assembly
6. Thrust washer (4 used)
7. Steering tower
8. Hydraulic fitting (5 used)
9. O-ring
10. Steering control valve
11. O-ring
12. Flange bushing (2 used)
13. Clip (2 used)
14. Spring
15. Spacer
16. Knob
17. Steering wheel cover
18. Hex nut
19. Flat washer
20. Steering wheel
21. Foam collar
22. Steering seal
23. External snap ring (2 used)
24. Steering shaft assembly
25. Flange nut (3 used)
26. Cap screw (4 used)
27. Cotter pin
28. Parking brake pivot
29. Lock nut
30. Proximity switch
31. Switch plate
32. Carriage bolt
33. Compression spring
34. Parking brake rod
35. Parking brake rack
36. Flat washer (2 used)
37. Cotter pin
38. Flat washer (2 used)
39. Cap
40. Cap screw
41. Tilt lever

NOTE: If steering control valve (item 10) is to be removed, see Steering Control Valve in the Service and Repairs section of Chapter 4 – Hydraulic System.

Disassembly

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Disassemble steering tower as needed using Figure 1 as a guide.

Assembly

1. Assemble steering tower using Figure 1 as a guide.

   A. If steering wheel was removed, torque hex nut (item 18) from **20 to 26 ft-lb (28 to 35 N-m)**.

   B. If steering column (item 5) was removed, torque cap screw (item 3) from **27 to 33 ft-lb (37 to 44 N-m)**.

   C. Thrust washers (item 6) on steering column are used as needed to remove end play of steering shaft.

Wing Deck Rear Impact Arm Assembly

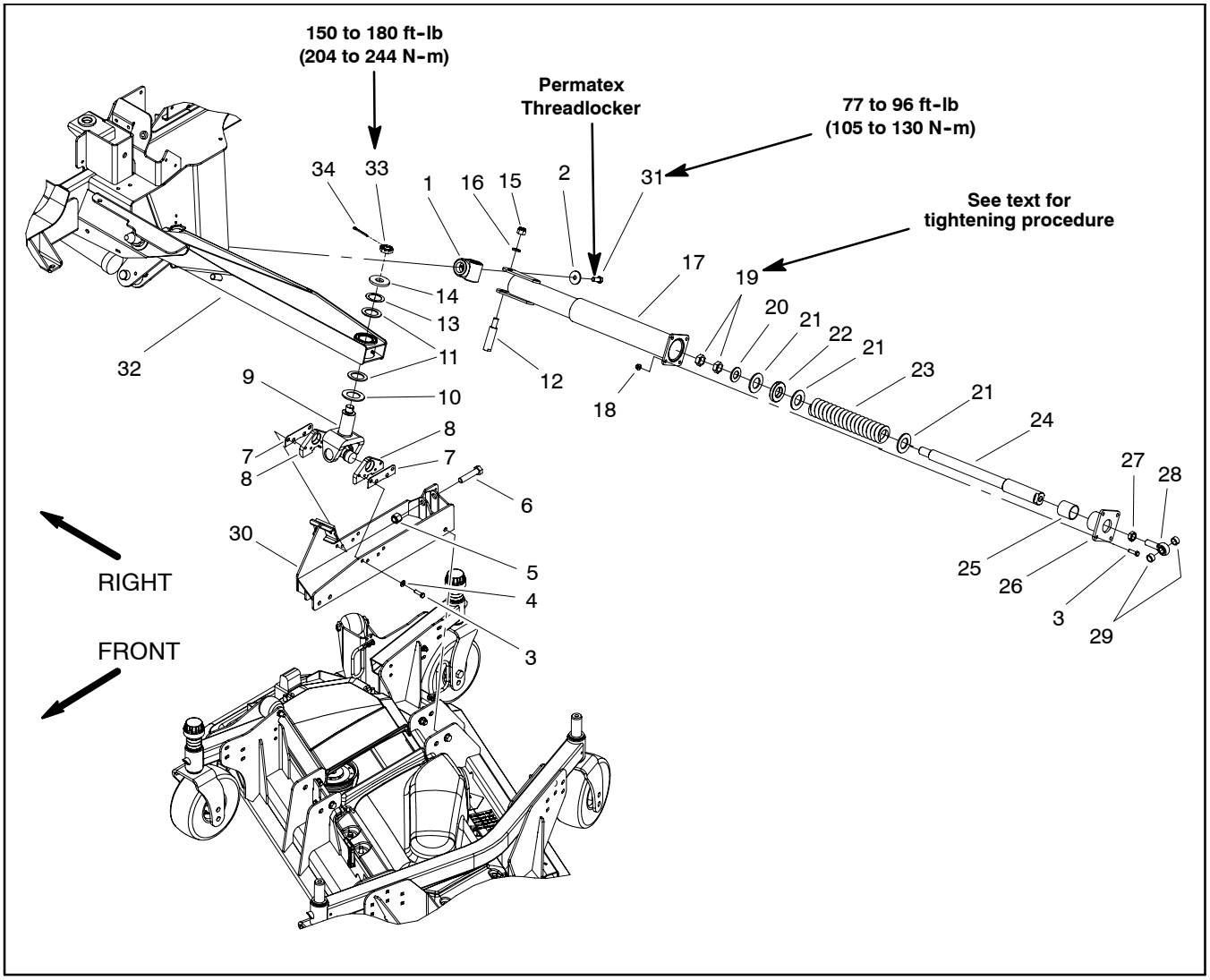


Figure 2

1. Pivot hub
2. Thrust washer
3. Cap screw
4. Flat washer
5. Lock nut
6. Cap screw
7. Shim
8. Base mount
9. Joint yoke
10. Spacer
11. Thrust washer
12. Pivot shaft
13. Thrust washer (as required)
14. Hardened washer
15. Lock nut
16. Lock washer
17. Rear impact arm housing
18. Flange nut (4 used per impact arm)
19. Jam nut
20. Flat washer
21. Plain washer
22. Plastic bearing
23. Compression spring
24. Spring shaft
25. Plain bushing
26. Housing
27. Jam nut
28. Rod end
29. Spacer
30. Deck connection
31. Cap screw
32. Lift arm (LH shown)
33. Slotted hex nut
34. Cotter pin

Removal (Fig. 2)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove cap screw (item 6) and lock nut (item 5) that secures rod end of rear impact arm to cutting deck connection. Locate and remove spacer (item 29) from each side of rod end.

3. Remove lock nut (item 15) and lock washer (item 16) that secures rear impact arm pivot shaft (item 12). Slide pivot shaft from pivot hub and impact arm clevis. Remove rear impact arm assembly from machine.

Disassembly (Fig. 2)

1. Disassemble wing deck rear impact arm assembly using Figure 2 as a guide.

2. Thoroughly clean rear impact arm components and inspect for worn parts. Replace components as needed.

Assembly (Fig. 2)

1. Slide plain washer (item 21), compression spring (item 23), second plain washer (item 21), plastic bearing (item 22), third plain washer (item 21) and then flat washer (item 20) onto spring shaft. Thread one jam nut (item 19) onto shaft and tighten so that spring length is 12.000" (304.8 mm).

2. Slide the housing (item 26) onto rod end of assembled spring shaft.

3. Insert assembly into rear impact arm housing (item 17).

4. Temporarily secure housing (item 26) to rear impact arm housing with two (2) cap screws (item 3) and lock nuts (item 18).

IMPORTANT: All endplay must be removed from spring shaft assembly to allow proper operation and ensure long life.

5. Grasp end of spring shaft. Push inward and pull outward on shaft to determine if endplay exists in spring shaft assembly.

6. If endplay in spring shaft assembly exists, insert a 3/4" socket onto jam nut (item 19) on spring shaft. Access to jam nut can be obtained through the open end of rear impact arm housing. Loosen jam nut until all endplay in shaft is removed.

7. When no endplay exists in spring shaft assembly, remove two (2) cap screws and nuts securing housing (item 26) to rear impact arm housing. Remove spring shaft assembly from housing.

8. Thread second jam nut (item 19) onto end of spring shaft. While holding first jam nut with a wrench to prevent it from turning, torque second jam nut from **135 to 165 ft-lb (184 to 223 N-m)** to secure spring adjustment.

9. Thoroughly pack spring with grease. Apply approximately 40 oz (1.1 kg) of grease to a clean spring.

10. Install spring shaft assembly into rear impact arm housing and secure housing (item 26) with four (4) cap screws (item 3) and lock nuts (item 18).

11. Thread rod end (item 28) with jam nut (item 27) into end of spring shaft so that distance from center of rod end to center of pivot shaft mounting hole is from 34.890" to 35.010" (886.3 to 889.2 mm) (Fig. 3). Do not tighten jam nut until alignment of cutting deck to traction unit is checked (see below).

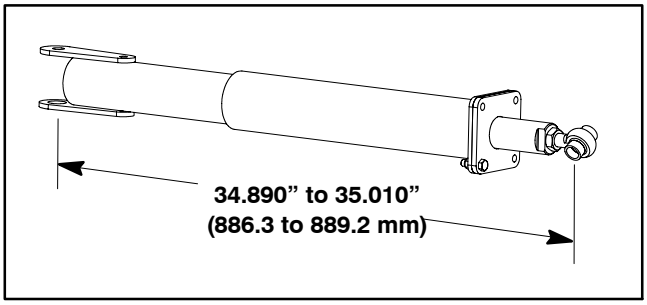


Figure 3

Installation (Fig. 2)

1. Position rear impact arm assembly to cutting deck connection and frame.

2. Slide pivot shaft (item 12) through rear impact arm clevis and hub. Secure pivot shaft with lock washer and lock nut.

3. Position spacers on both sides of rod end of rear impact arm assembly. Secure rod end of rear impact arm to deck connection with cap screw (item 6) and lock nut (item 5).

4. Lubricate rear impact arm grease fittings.

5. After installation is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

NOTE: Due to differences in grass conditions and the counterbalance setting of traction unit, it is advised that grass be cut and appearance checked before formal cutting is started. Refer to Operator's Manual for correcting cutting deck mismatch procedures.

Lift Arm Joint Yoke

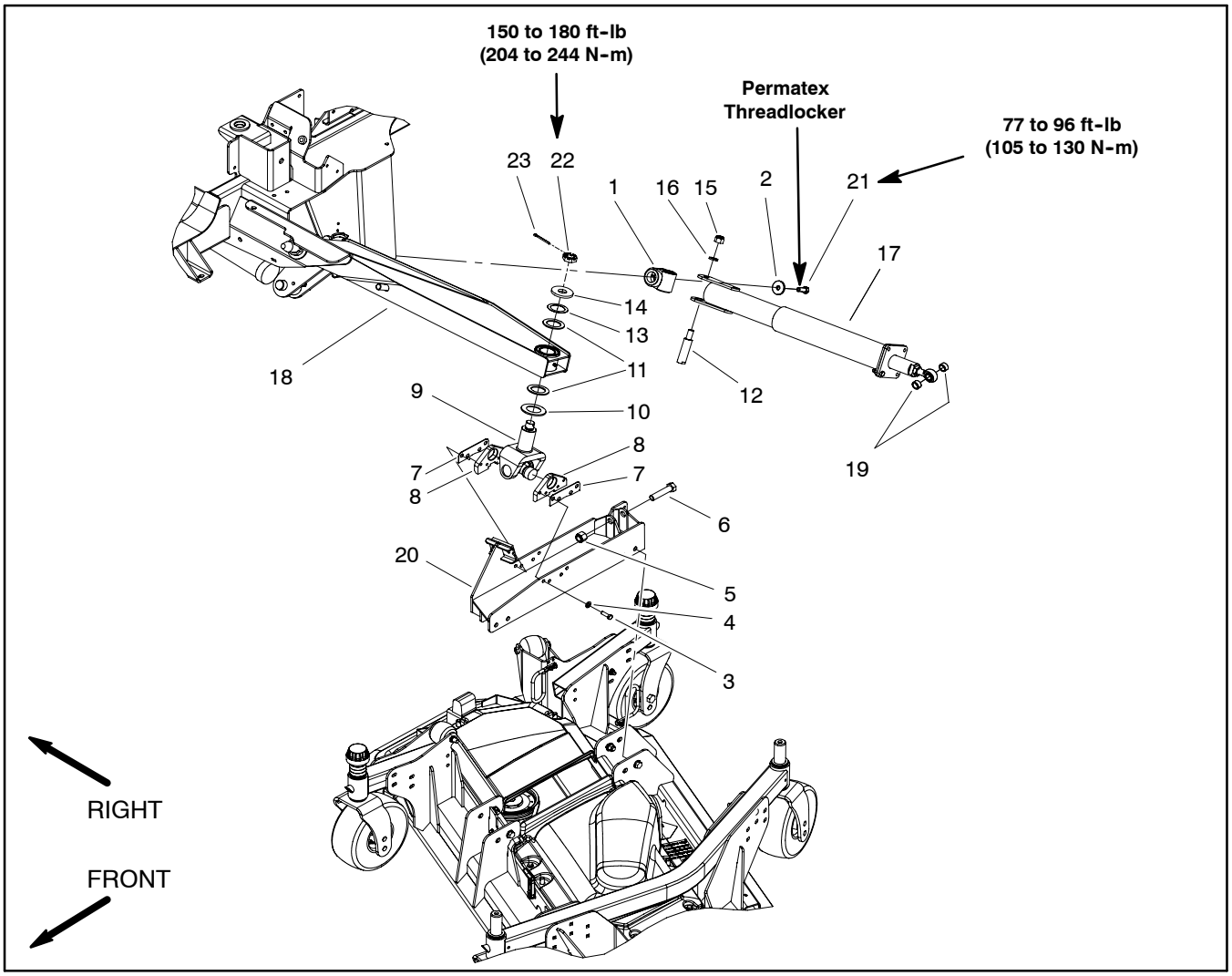


Figure 4

1. **Pivot hub**
2. **Thrust washer**
3. **Cap screw (8 used per yoke)**
4. **Flat washer (8 used per yoke)**
5. **Lock nut**
6. **Cap screw**
7. **Shim**
8. **Base mount**
9. **Joint yoke**
10. **Spacer**
11. **Thrust washer**
12. **Pivot shaft**
13. **Thrust washer (as required)**
14. **Hardened washer**
15. **Lock nut**
16. **Lock washer**
17. **Rear impact arm assembly**
18. **Lift arm (LH shown)**
19. **Spacer**
20. **Deck connection**
21. **Cap screw**
22. **Slotted hex nut**
23. **Cotter pin**

Joint Yoke Removal (Fig. 4)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove cotter pin (item 23) and then slotted hex nut (item 22) from joint yoke shaft. Remove hardened washer (item 14) and thrust washers (items 11 and 13, if equipped) from joint yoke shaft.

3. Remove eight (8) cap screws (item 3) and flat washers (item 4) that secure base mounts (item 8) to cutting deck connection.

4. Raise lift arm enough to free joint yoke from lift arm. Remove thrust washer (item 11) and spacer (item 10) from yoke shaft.

5. Lift joint yoke and base mounts from deck mount. Locate and retrieve shim (item 7) from between each base mount and deck mount.

Joint Yoke Disassembly

1. Remove snap rings from yoke.

IMPORTANT: Support yoke when removing cross and bearings to prevent yoke damage.

2. Press base mounts from joint yoke. Slide bearings from joint yoke.

3. Use a press to remove cross and remaining bearings from yoke:

A. Place a small socket against one bearing and a large socket against the yoke on the opposite side.

B. While supporting the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.

C. Remove yoke from press, grasp partially removed bearing and tap on yoke to completely remove the bearing.

D. Repeat process for remaining bearing.

E. Thoroughly clean and inspect all components.

Joint Yoke Assembly

1. Apply a coating of grease to bearing bores of yoke. Also, apply grease to bearings and seal of bearing assembly.

2. Press one bearing partially into yoke.

IMPORTANT: Take care when installing cross into bearing to avoid damaging bearing seal.

3. Carefully insert cross into bearing and yoke.

4. Hold cross in alignment and press bearing in until it hits the yoke.

5. Carefully place second bearing into yoke bore and onto cross shaft. Press bearing into yoke.

6. Install snap rings to bearings to secure bearings in place.

7. Press base mounts to joint yoke with the angled edge of the mounts assembled away from the joint (Fig. 5). The outside of the yoke bearing cups should be flush with the base mount surfaces.

8. Make sure that assembled joint yoke moves without binding. Slight binding can usually be eliminated by lightly rapping the yoke lugs with a soft faced hammer. If binding continues, disassemble joint yoke to identify and eliminate source of binding.

Joint Yoke Installation (Fig. 4)

1. Install joint yoke to lift arm:

A. Place spacer (item 10) and then thrust washer (item 11) onto joint yoke shaft.

B. Insert yoke shaft up through lift arm bushings.

C. Place second thrust washer (item 11) onto joint yoke shaft and then place washer(s) (item 13) as needed to remove as much clearance as possible between second thrust washer and hardened washer (item 14) location.

D. Install slotted hex nut to secure joint yoke to lift arm. Torque nut from **150 to 180 ft-lb (204 to 244 N-m)**. Make sure that joint yoke rotates in lift arm without binding and that excessive clearance does not exist in yoke assembly.

2. Carefully lower lift arm to position base mounts to deck connection.

3. Install shims between deck connection and base mounts. Secure base mounts with eight (8) cap screws and flat washers.

4. Grease joint yoke and lift arm bushing after installation on machine.

5. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

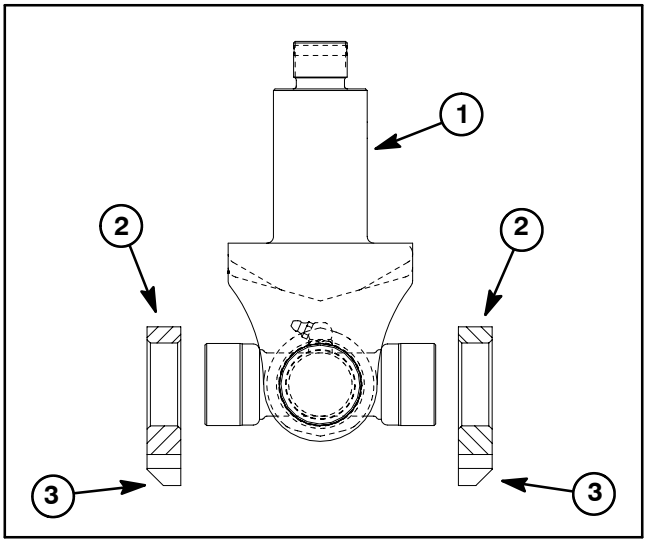


Figure 5

1. **Joint yoke**
2. **Base mount**
3. **Angled edge**

Front Deck Lift Arms

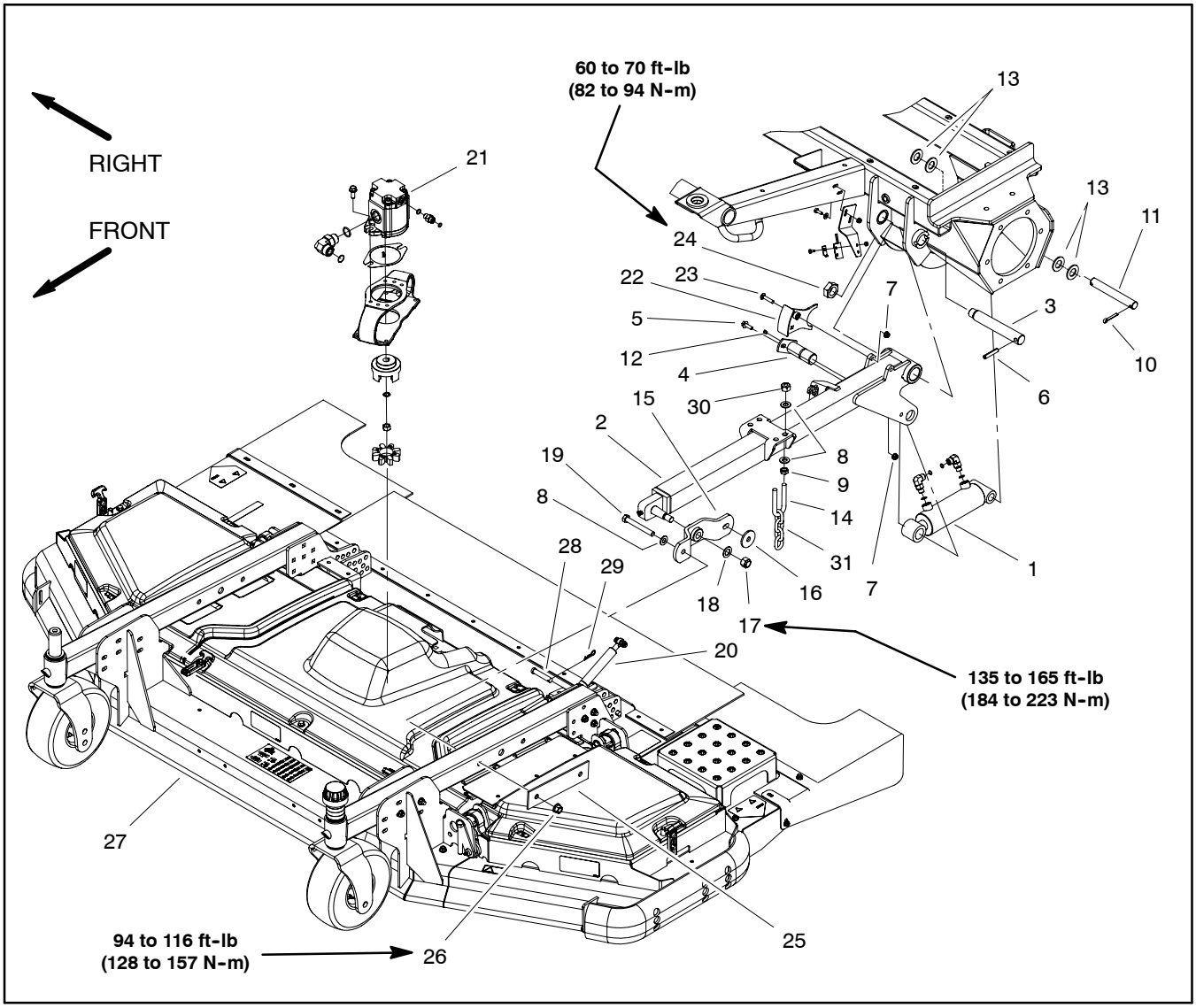


Figure 6

1. Lift cylinder (LH shown)
2. Lift arm (2 used)
3. Lift arm pin
4. Pin
5. Flange head screw
6. Roll pin
7. Flange nut
8. Flat washer
9. Jam nut (2 used per u-bolt)
10. Cotter pin (2 used per clevis pin)
11. Clevis pin
12. Plug
13. Flat washer (4 used per pin)
14. U-bolt (2 used)
15. Support hub (2 used)
16. Thrust washer
17. Lock nut
18. Flat washer
19. Cap screw (2 used per hub)
20. Damper assembly
21. Front deck motor
22. Trigger sensor
23. Carriage screw
24. Lock nut
25. Plate
26. Lock nut
27. Front deck assembly
28. HOC clevis pin (2 used)
29. Hair pin (2 used)
30. Lock nut (2 used per u-bolt)
31. HOC chain

NOTE: If lift cylinder (item 1) is to be removed, see Front Deck Lift Cylinder in the Service and Repairs section of Chapter 4 – Hydraulic System.

Removal (Fig. 6)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove front cutting deck (see Cutting Deck Removal in Chapter 8 – Cutting Units).

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks to raise and support machine. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

3. Chock rear wheels and jack up front of machine. Support machine on jack stands. Remove front wheel next to lift arm that is being removed (see Wheel Removal in the Service and Repairs section of Chapter 6 – Axles, Planetaries and Brakes).

4. Remove flange head screw and flange nut that secure lift cylinder pin (item 4) to lift arm. Remove pin and separate lift cylinder from lift arm.

5. Remove lock nut (item 24) that secures lift arm pin (item 3).

6. Support lift arm and slide pin from frame and lift arm. Remove lift arm from frame.

7. As needed, disassemble lift arm (Fig. 7):

   A. Remove height–of–cut chain.

   B. Remove lock nut, flat washer and support hub from tapered stud in lift arm.

   C. Remove retaining ring that secures spherical bearing in lift arm. Remove tapered stud with spherical bearing from lift arm. Separate flange nut and spherical bearing from stud.

   D. Press flange bushings from lift arm. Thoroughly clean lift arm bore.

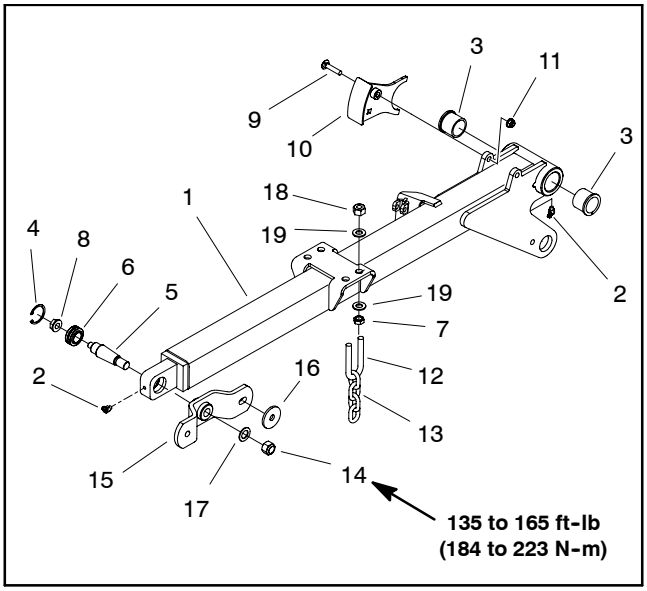


Figure 7

1. Lift arm (LH shown)
2. Grease fitting
3. Flange bushing
4. Retaining ring
5. Tapered stud
6. Spherical bearing
7. Jam nut (2 used)
8. Flange nut
9. Carriage screw
10. Trigger sensor
11. Flange nut
12. U-bolt
13. HOC chain
14. Lock nut
15. Support hub
16. Thrust washer
17. Flat washer
18. Lock nut (2 used)
19. Flat washer (4 used)

Installation (Fig. 6)

1. If removed, install components to lift arm (Fig. 7):

   A. Assemble height–of–cut chain u–bolt so that threaded portion of u–bolt extends 1.200" (30.5 mm) above mounting plate on lift arm.

   B. Lightly lubricate new flange bushings and press bushings into lift arm. Make sure that bushing flange is pressed fully to lift arm surface.

   C. Install spherical bearing on tapered stud and secure with flange nut. Install stud with spherical bearing into lift arm and secure with retaining ring.

   D. Thoroughly clean tapered surfaces of stud and mounting boss of support hub. Secure support hub (position slotted hole in hub toward rear of deck) to tapered stud with flat washer and lock nut. Tighten lock nut from **135 to 165 ft-lb (184 to 223 N-m)**.

2. Position lift arm to frame and insert lift arm pin. Engage roll pin into frame slots and install lock nut on pin. Torque lock nut from **60 to 70 ft-lb (82 to 94 N-m)**.

3. Align lift cylinder with lift arm. Slide lift cylinder pin through lift arm and cylinder end. Secure pin with flange head screw and flange nut.

4. Install front wheel assembly (see Wheel Installation in the Service and Repairs section of Chapter 6 – Axles, Planetaries and Brakes). Lower machine to the ground.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

5. Torque wheel lug nuts evenly in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

6. Install cutting deck (see Cutting Deck Installation in Chapter 8 – Cutting Deck).

7. Lubricate lift arm grease fittings.

8. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

9. When lift arms are fully raised, check that gap between lift arms and bumper pads on bottom of operator platform is approximately 0.100" (2.5 mm) (Fig. 8). If necessary, add or remove shim pads so that gap is correct.

10. Verify correct operation of front deck proximity switch.

11. Check height-of-cut and deck pitch adjustment. Adjust if necessary.

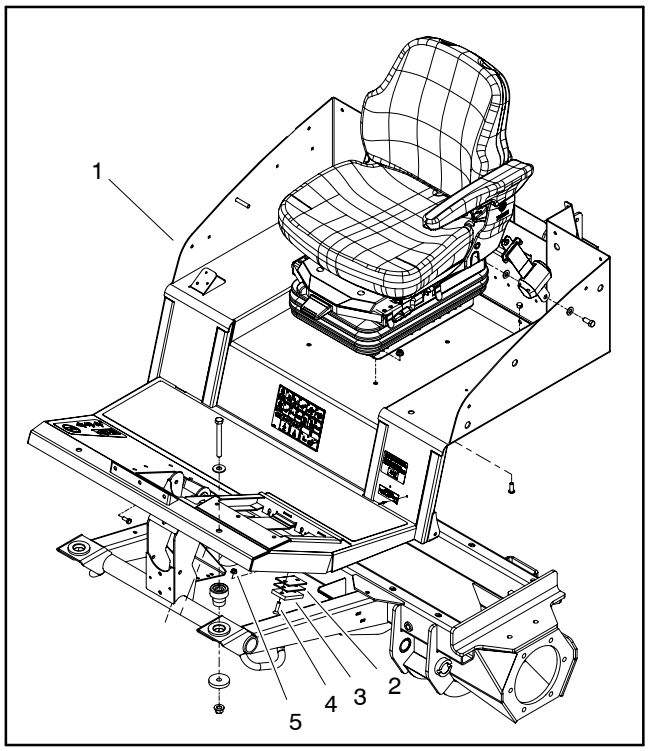


Figure 8

1. **Operator platform**
2. **Shim pad**
3. **Bumper pad**
4. **Flange head screw**
5. **Flange nut**

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Wing Deck Lift Arms

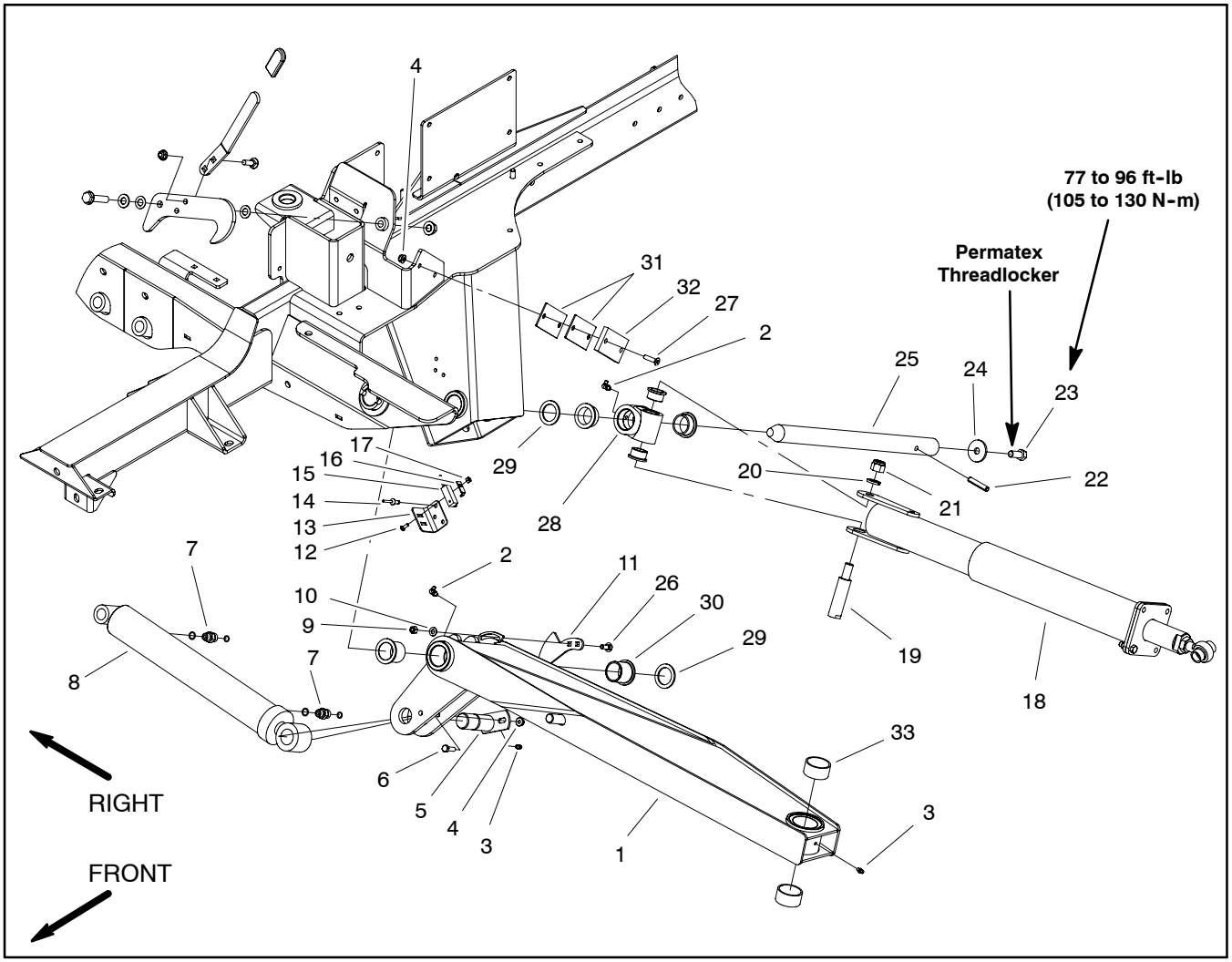


Figure 9

1. Lift arm (LH shown)
2. Grease fitting
3. Grease fitting
4. Flange nut
5. Cylinder pin
6. Cap screw
7. Hydraulic fitting
8. Lift cylinder
9. Lock nut (2 used per plate)
10. Flat washer (2 used per plate)
11. Sensing plate
12. Carriage bolt
13. Aluminum plate
14. Rivet (3 used per plate)
15. Proximity sensor
16. Switch plate
17. Lock nut
18. Impact arm assembly
19. Pivot shaft
20. Lock washer
21. Lock nut
22. Roll pin
23. Cap screw
24. Thrust washer
25. Lift arm pivot shaft
26. Carriage screw (2 used per plate)
27. Screw (2 used per pad)
28. Pivot hub assembly
29. Thrust washer
30. Flange bushing (2 used per arm)
31. Shim pad
32. Bumper pad
33. Straight bushing (2 used per arm)

NOTE: If wing deck lift cylinder (item 8) is to be removed, see Wing Deck Lift Cylinder in the Service and Repairs section of Chapter 4 – Hydraulic System.

Removal (Fig. 9)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove wing deck from lift arm (see Wing Cutting Deck in Chapter 8 – Cutting Decks).

3. Remove wing deck impact arm assembly from pivot hub (see Wing Deck Impact Arm Assembly in this section).

4. Remove joint yoke and cutting deck connection from lift arm (Fig. 12):

   A. Support cutting deck connection to prevent it from falling.

   B. Remove cotter pin, slotted hex nut, hardened washer and thrust washers from joint yoke shaft.

   C. Lower joint yoke, cutting deck connection and wing deck impact arm assembly from lift arm.

5. Remove cap screw and flange nut that secure lift cylinder pin (item 5) to lift arm. Slide cylinder pin from lift cylinder and lift arm. Separate lift cylinder from lift arm.

6. Remove cap screw (item 23) and flat washer (item 24) from lift arm pivot shaft.

7. Slide wing deck impact arm pivot hub and thrust washer (item 29) from lift arm pivot shaft.

8. Drive out roll pin (item 22) that retains lift arm pivot shaft to frame. Discard roll pin.

9. Support lift arm to prevent it from shifting or falling. Pull lift arm pivot shaft from lift arm and frame. Locate and remove thrust washer (item 29) during pivot shaft removal.

NOTE: If pivot shaft is difficult to remove, fabricate a puller as shown in Figure 10. Attach puller to end of pivot shaft with the pictured bolt and flat washer. Drive pivot shaft from lift arm and frame with hammer.

10. Remove lift arm from machine.

11. If necessary, press bushings from lift arm (Fig. 11). Thoroughly clean lift arm bores.

Installation (Fig. 9)

1. If bushings were removed from lift arm, press new bushings into lift arm bores. Make sure that bushings are pressed fully to lift arm surface.

2. Apply anti–seize lubricant to lift arm pivot shaft.

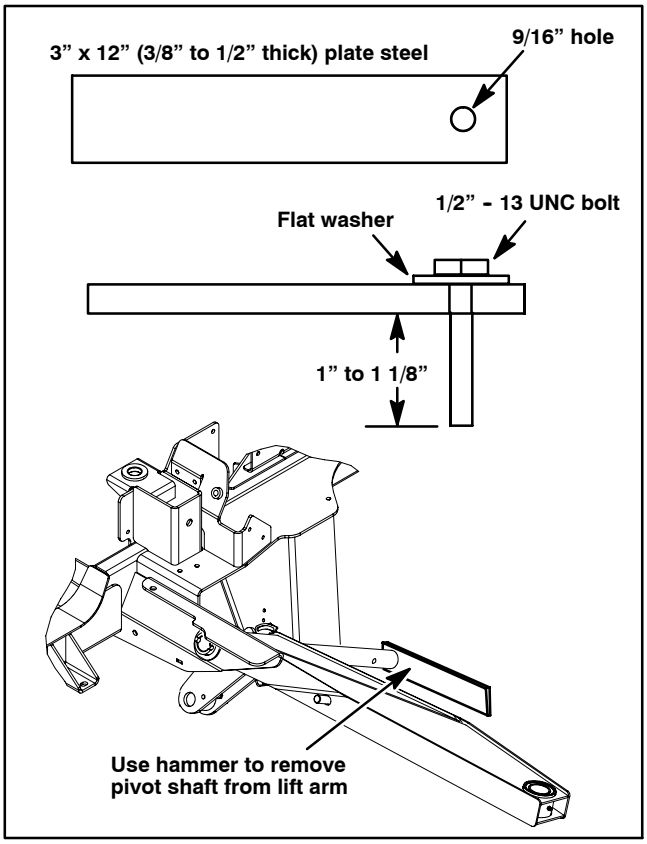


Figure 10

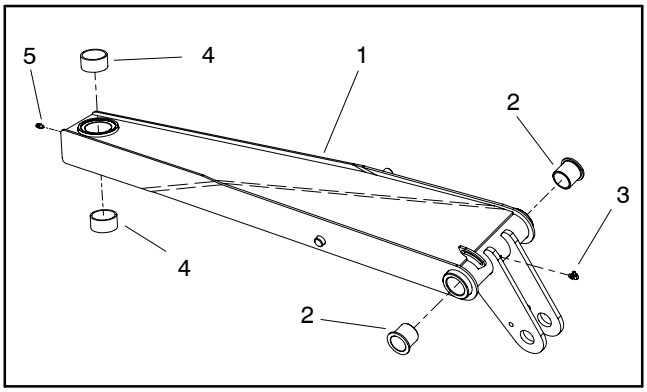


Figure 11

1. Lift arm (LH shown)
2. Flange bushing
3. Grease fitting
4. Straight bushing
5. Grease fitting

3. Position lift arm to frame with thrust washer (item 29) properly placed between rear of lift arm pivot hub and frame. Slide pivot shaft into frame, thrust washer and lift arm until roll pin holes in pivot shaft and frame align.

4. Install new roll pin (item 22) to secure lift arm pivot shaft to frame.

5. Slide thrust washer (item 29) and then wing deck impact arm pivot hub onto pivot shaft. Make sure that thrust washer is between frame and pivot hub.

6. Apply Permatex Blue Gel medium strength threadlocker (or equivalent) to threads of cap screw (item 23). Secure pivot hub to pivot shaft with washer (item 24) and cap screw. Torque cap screw from **77 to 96 ft-lb (105 to 130 N-m)**.

7. Install joint yoke and cutting deck connection to lift arm (Fig. 12):

A. Make sure that spacer and thrust washer are installed on joint yoke.

B. Raise joint yoke, cutting deck connection and wing deck impact arm assembly to lift arm. Slide joint yoke into lift arm bore.

C. Place second thrust washer onto joint yoke shaft and then place washer(s) (item 5 in Figure 12) as needed to remove as much clearance as possible between second thrust washer and hardened washer (item 4) location.

D. Install slotted hex nut to secure joint yoke to lift arm. Torque hex nut from **150 to 180 ft-lb (204 to 244 N-m)**. Make sure that joint yoke rotates in lift arm without binding and that excessive clearance does not exist in yoke assembly.

8. Secure wing deck rear impact arm assembly to pivot hub (see Wing Deck Rear Impact Arm Assembly in this section).

9. Position and install wing cutting deck to machine (see Wing Cutting Unit in Chapter 8 – Cutting Units).

10. Lubricate lift arm grease fittings after assembly is complete.

11. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

12. When lift arm is fully raised, check that gap between lift arm and bumper pad (item 32) is approximately 0.100" (2.5 mm). If necessary, add or remove shim pads (item 31) so that gap is correct.

13. When lift arm is fully raised, the bumper on the stop bracket should be contacted slightly by the lift arm (Fig. 13). There should be less than one (1) bumper shim of interference. If necessary, add or remove bumper shims so that slight contact exists.

14. Verify correct operation of wing deck proximity switch.

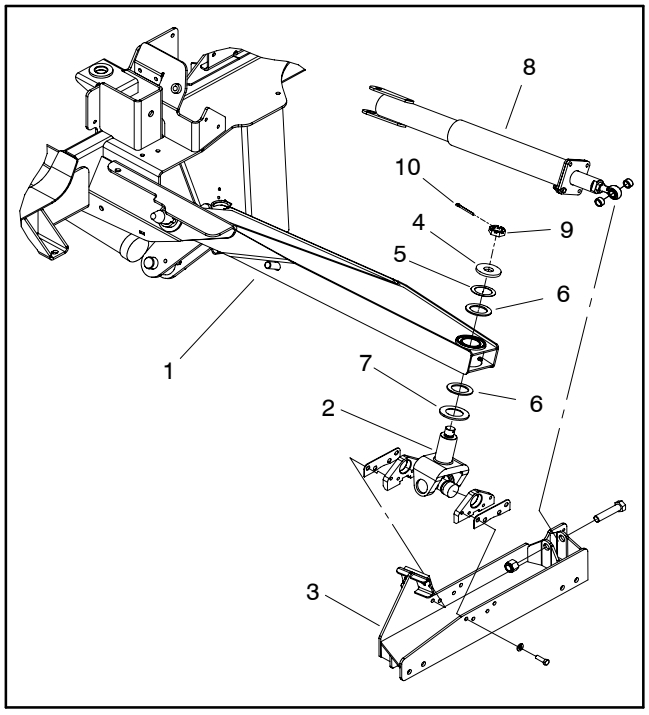


Figure 12

1. **Lift arm (LH shown)**
2. **Joint yoke**
3. **Deck connection**
4. **Hardened washer**
5. **Thrust washer**
6. **Thrust washer**
7. **Spacer**
8. **Rear impact arm**
9. **Slotted hex nut**
10. **Cotter pin**

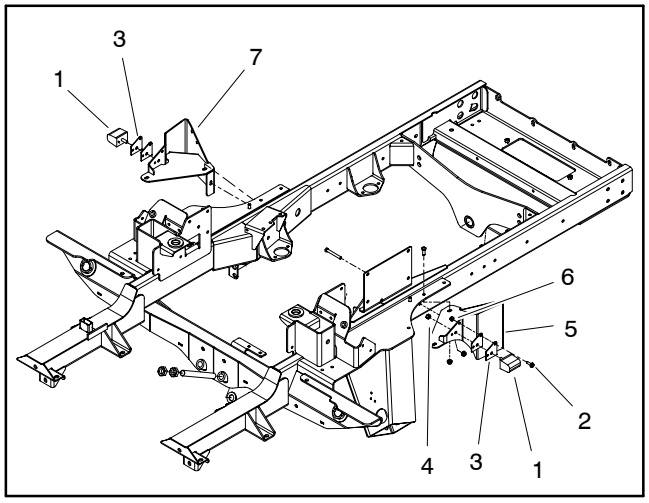


Figure 13

1. **Bumper**
2. **Flange head screw**
3. **Bumper shim**
4. **Lock nut**
5. **LH stop bracket**
6. **Flange nut**
7. **RH stop bracket**

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Console Arm

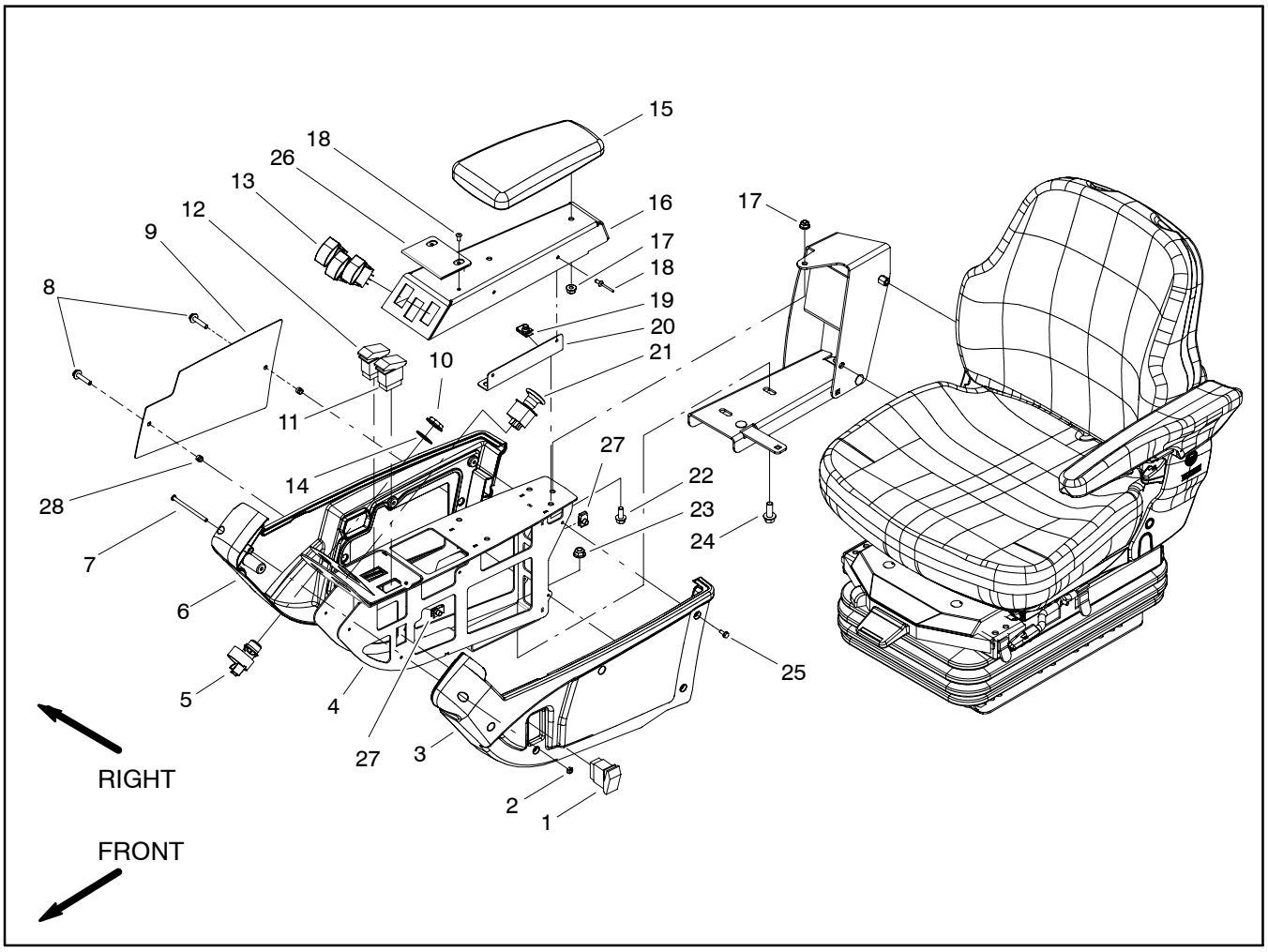


Figure 14

1. **Headlight switch**
2. **Lock nut**
3. **LH cover**
4. **Console arm panel**
5. **Ignition switch**
6. **RH cover**
7. **Screw**
8. **Cap screw (2 used)**
9. **Cover plate**
10. **Nut**
11. **Cruise switch**
12. **4WD traction assist switch**
13. **Lift/lower switch (3 used)**
14. **Lock washer**
15. **Arm rest**
16. **Arm panel**
17. **Flange nut (3 used)**
18. **Rivet (4 used)**
19. **U-nut (4 used)**
20. **Mounting angle**
21. **PTO switch**
22. **Flange head screw (5 used)**
23. **Flange nut (2 used)**
24. **Flange head screw (2 used)**
25. **Washer head screw (10 used)**
26. **Switch guard**
27. **Clip (2 used)**
28. **Flange spacer (2 used)**

Disassembly (Fig. 14)

1. Park machine on a level surface, lower cutting units, stop engine and engage parking brake. Remove key from ignition switch.

2. Remove two (2) cap screws (item 8) and then cover plate (item 9) from outside of console arm. Locate and retrieve two (2) flange spacers (item 28).

3. At front of console arm, remove screw (item 7) and lock nut (item 2) that secure console arm covers to each other.

4. Remove five (5) washer head screws (item 25) that secure each cover to console arm panel.

5. Remove console arm covers from machine. As LH cover (item 3) is removed from console arm, unplug wire harness connector from headlight switch.

6. Remove electrical components from console arm as needed using Figure 14 as a guide.

7. If necessary, remove console panel and supports from machine using Figures 14 and 15 as guides.

Assembly (Fig. 14)

1. Install all removed electrical and console arm components using Figure 14 and 15 as guides.

2. Position covers to console arm. As LH cover (item 3) is placed, plug wire harness connector to headlight switch.

3. Secure each cover to console arm with five (5) washer head screws (item 25). Install screw (item 7) and lock nut (item 2) to secure covers at front of console arm.

4. Position cover plate and flange spacers to outside of console arm. Secure with two (2) cap screws.

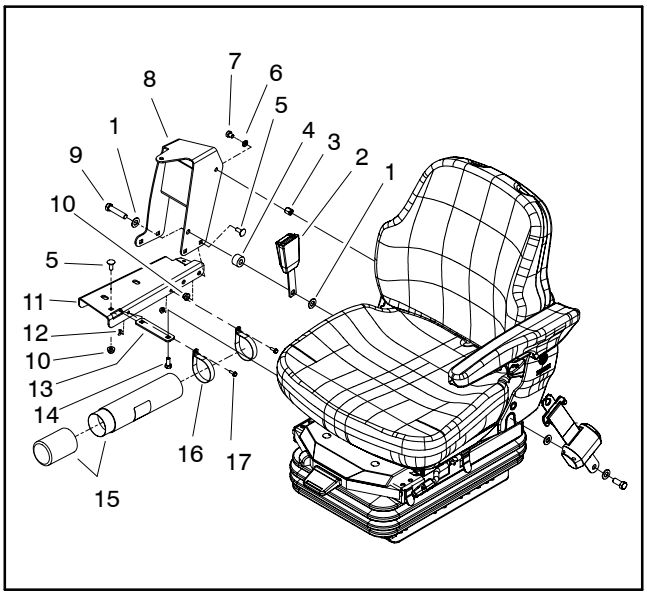


Figure 15

1. **Flat washer**
2. **Seat belt buckle**
3. **Coupling nut**
4. **Spacer**
5. **Carriage screw (5 used)**
6. **Lock washer**
7. **Cap screw**
8. **Arm support**
9. **Cap screw**
10. **Flange nut**
11. **Support channel**
12. **Flange nut (2 used)**
13. **Support bracket**
14. **Cap screw**
15. **Manual tube**
16. **R-clamp (2 used)**
17. **Screw (2 used)**

Traction Pedal

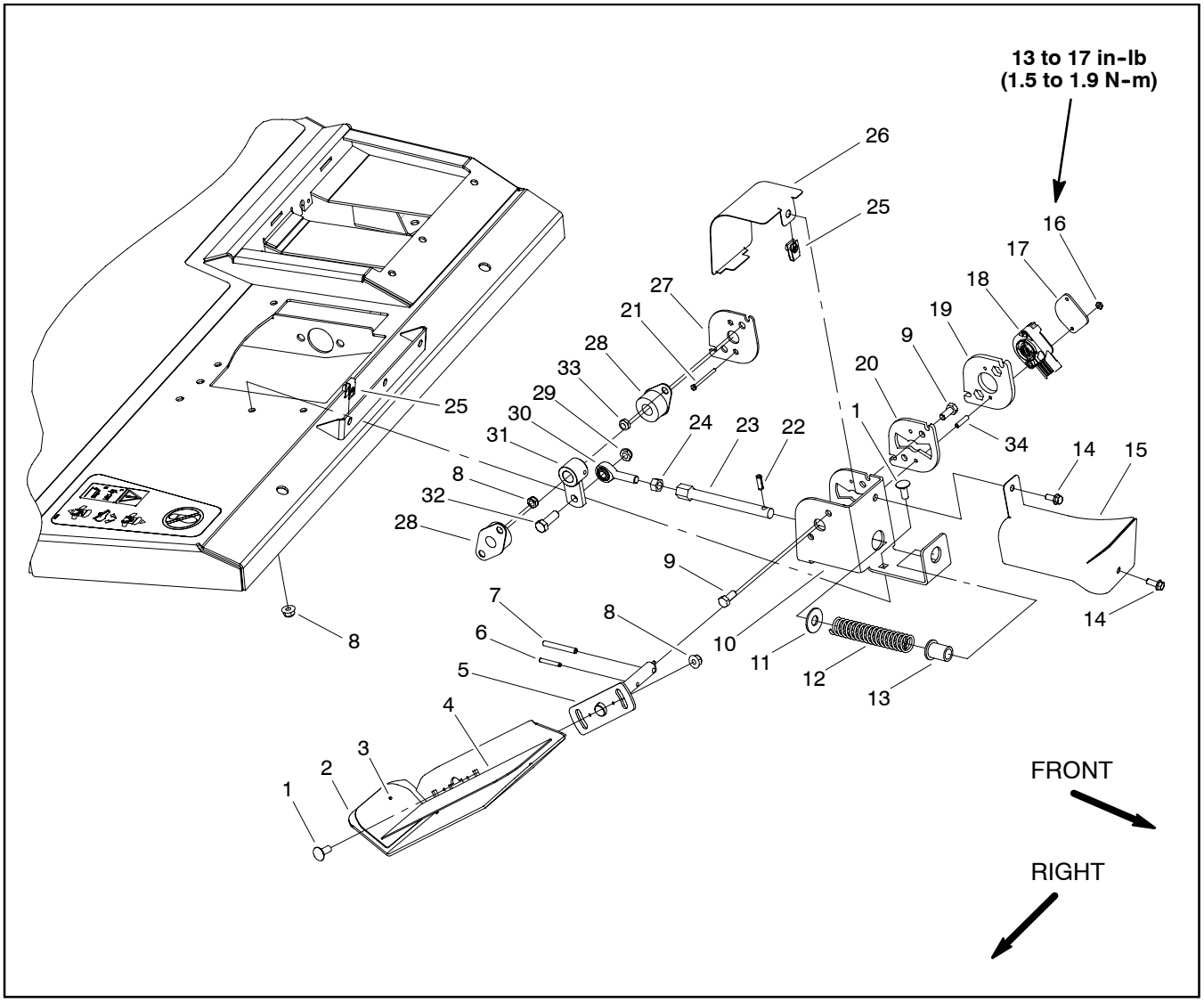


Figure 16

1. Carriage screw (6 used)
2. Traction pedal
3. Pedal abrasive
4. Pedal abrasive
5. Traction pedal shaft
6. Slotted roll pin
7. Roll pin
8. Flange nut (6 used)
9. Cap screw (4 used)
10. Mounting bracket
11. Flat washer
12. Compression spring
13. Spring retainer
14. Flange head screw (2 used)
15. Spring cover
16. Lock nut (2 used)
17. Capture plate
18. Traction pedal potentiometer
19. Mounting plate
20. Shim plate
21. Screw (2 used)
22. Roll pin
23. Spring shaft
24. Hex nut
25. Clip (2 used)
26. Traction pedal cover
27. Cover plate
28. Flange mount bearing (2 used)
29. Lock nut
30. Rod end bearing
31. Traction pedal hub
32. Cap screw
33. Lock nut (4 used)
34. Standoff spacer (2 used)

IMPORTANT: A properly installed and calibrated traction pedal potentiometer is critical to accurate traction system response and for reliable potentiometer life. Use care when removing, installing and calibrating the traction pedal potentiometer.

Disassembly (Fig. 16)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Disconnect machine wire harness connector from potentiometer (item 18) on traction pedal.

3. If the traction pedal is to be removed from the traction pedal shaft, use a marker or paint pen on pedal and shaft to identify location of pedal for assembly purposes.

4. Disassemble traction pedal as needed using Figures 16 and 17 as guides. When removing roll pins (items 6, 7 and 22), make sure to support shaft to prevent component damage.

Assembly (Fig. 16)

1. Assemble traction pedal using Figures 16 and 17 as guides noting the following items:

   A. Apply antiseize lubricant to spring shaft (item 23) between hex head and roll pin hole.

   B. The bracket of the traction pedal hub (item 31) should be closer to the traction pedal than the slotted roll pin (Fig. 17).

   C. Use a press to install slotted roll pin (item 6) and roll pin (item 7). DO NOT distort roll pins during assembly.

   D. Make sure that roll pin (item 7) is fully inside the groove of the shim plate (item 20). The roll pin should not contact the shim plate throughout the operating range.

   E. To install the traction pedal potentiometer (item 18), press and hold the traction pedal in the reverse direction slightly. Align the slot on the end of the pedal shaft with the slot in the potentiometer. Slide potentiometer onto screws and release pedal. Hold potentiometer in position while installing capture plate (item 17) and lock nuts (item 16).

   F. Torque lock nuts (item 16) from **13 to 17 in-lb (1.5 to 1.9 N-m)**.

   G. Leave the hex nut (item 24) loose so that the potentiometer can be calibrated. Also, do not install spring cover (item 15) and traction pedal cover (item 26) until after calibration of potentiometer.

2. Plug machine wire harness connector into traction pedal potentiometer (item 18).

3. After assembly of the traction pedal, calibrate the traction pedal potentiometer using the Info Center Display (see Traction Pedal Calibration in the Adjustments section of Chapter 5 – Electrical System).

4. Make sure that hex nut (item 24) is tightened after potentiometer adjustment.

5. Install spring cover (item 15) and traction pedal cover (item 26).

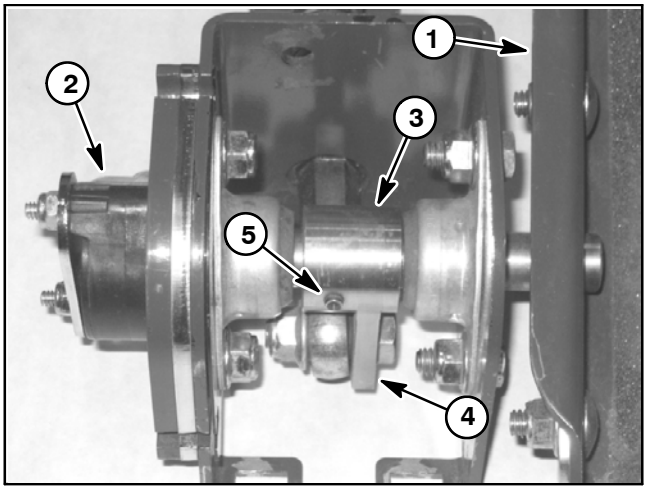


Figure 17

1. **Traction pedal**
2. **Pedal potentiometer**
3. **Traction pedal hub**
4. **Pedal hub bracket**
5. **Slotted roll pin**

Operator Seat

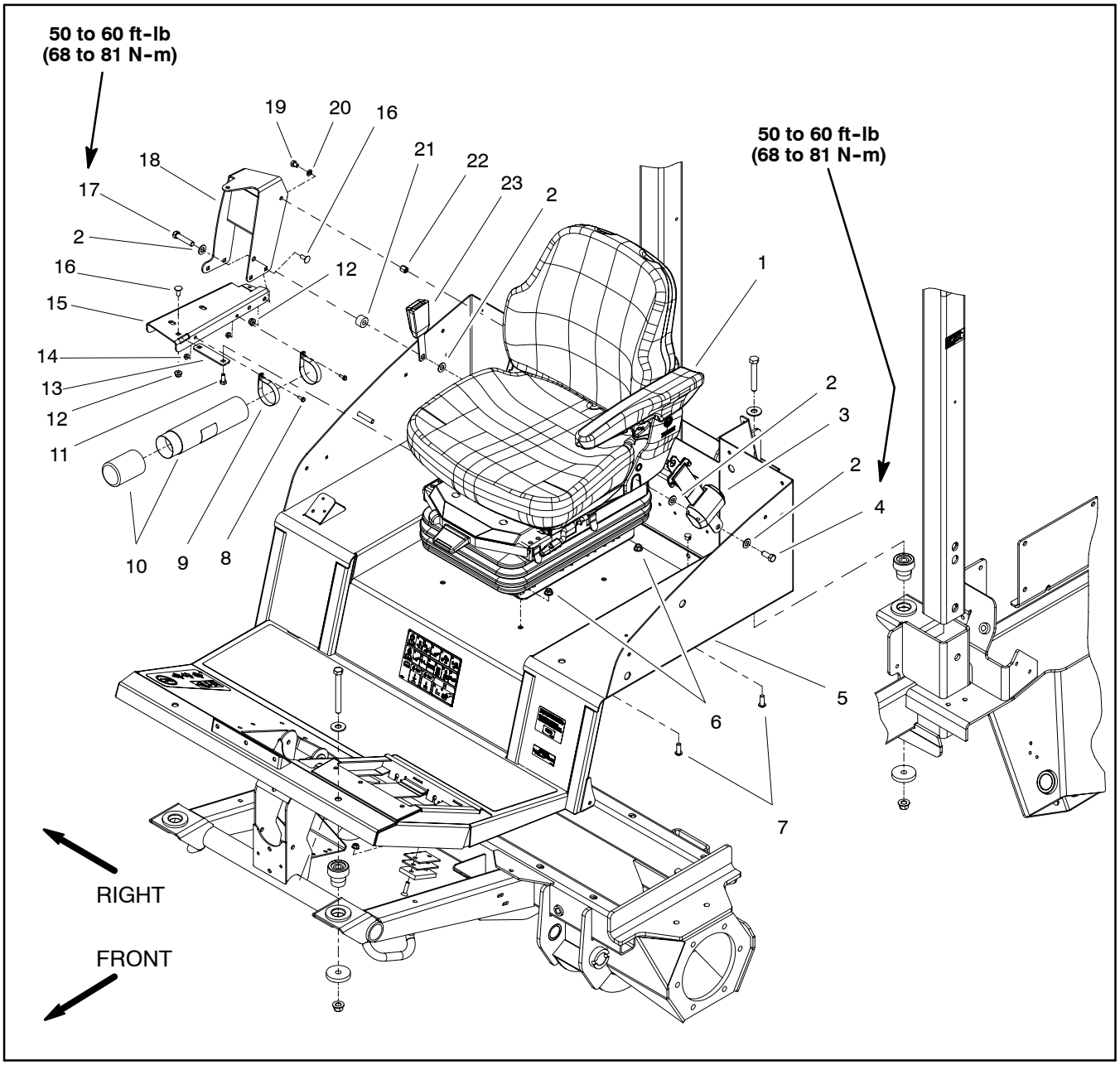


Figure 18

1. **Seat assembly**
2. **Flat washer (4 used)**
3. **Seat belt**
4. **Cap screw**
5. **Seat platform**
6. **Flange nut (4 used)**
7. **Carriage screw (4 used)**
8. **Screw (2 used)**
9. **R-clamp (2 used)**
10. **Manual tube**
11. **Cap screw**
12. **Flange nut**
13. **Support bracket**
14. **Flange nut (2 used)**
15. **Support channel**
16. **Carriage screw (5 used)**
17. **Cap screw**
18. **Arm support**
19. **Cap screw**
20. **Lock washer**
21. **Spacer**
22. **Coupling nut**
23. **Seat belt buckle**

Removal (Fig. 18)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Disconnect seat electrical connector from machine wire harness.

3. Support control arm assembly to prevent it from shifting.

4. Remove flange nut (item 12) and carriage screw (item 16) that secure support bracket (item 13) to support channel (item 15).

5. Remove cap screw (item 19) and lock washer (item 20) that secure console arm support (item 18) to coupling nut (item 22).

6. Remove cap screw (item 17), two (2) flat washers (item 2), spacer (item 21) and seat belt buckle (item 23) from seat and console arm support (item 18).

7. Carefully move console arm assembly away from seat.

8. Remove four (4) Torx head screws (Fig. 19) that secure seat to seat suspension. Note that the screw near the seat adjustment handle is longer than the other three screws.

9. Lift seat from seat suspension and remove from machine.

Installation (Fig. 18)

1. Carefully position seat to seat suspension.

2. Secure seat to seat suspension with four (4) Torx head screws (Fig. 19). Make sure that longer screw is positioned near the seat adjustment handle. Torque screws **18 ft-lb (25 N-m)**.

3. Position and secure console arm assembly to seat. Install all fasteners before fully tightening them.

   A. Secure support bracket (item 13) and support channel (item 15) with flange nut (item 12) and carriage screw (item 16).

   B. Secure console arm support (item 18) to coupling nut with cap screw (item 19) and lock washer (item 20).

   C. Place flat washer (item 2), seat belt buckle (item 23) and spacer (item 21) between seat and console arm support (item 18) and secure with flat washer (item 2) and cap screw (item 17). Torque cap screw from **50 to 60 ft-lb (68 to 81 N-m)**.

   D. Fully tighten all fasteners to secure console arm assembly to seat.

4. Connect seat electrical connector to machine wire harness.

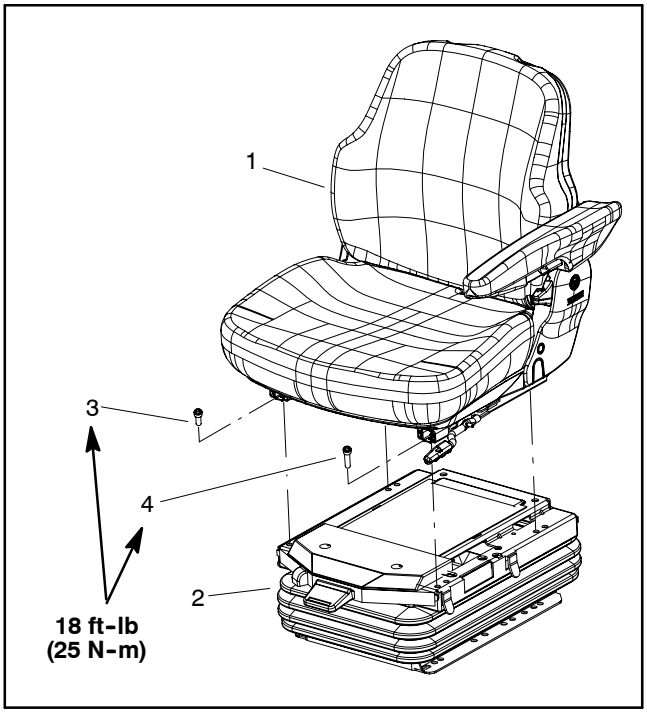


Figure 19

1. **Seat**
2. **Suspension assembly**
3. **Screw (M8x12) (3 used)**
4. **Screw (M8x16)**

Operator Seat Service

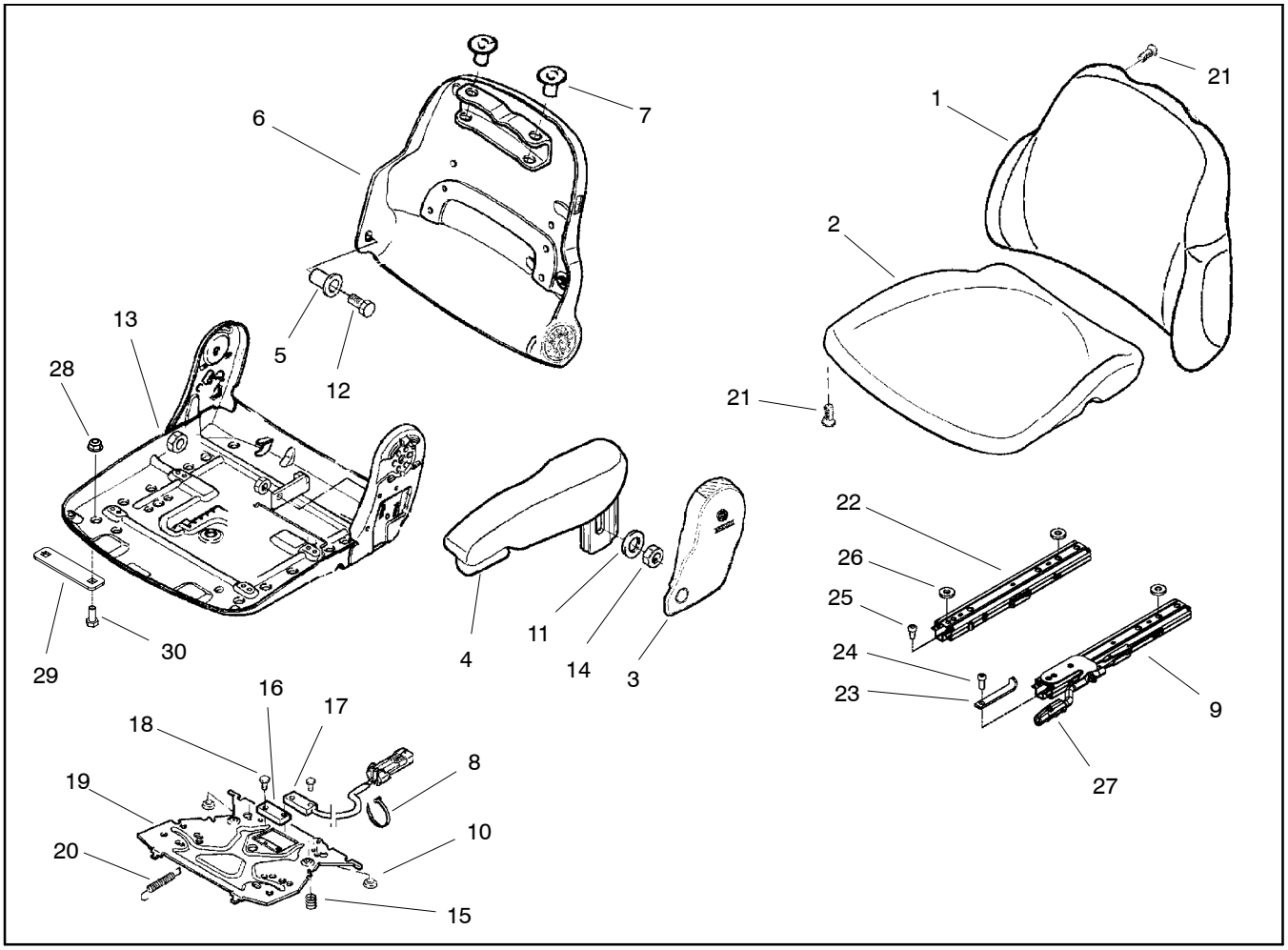


Figure 20

1. **Backrest cushion**
2. **Seat cushion**
3. **Armrest cover**
4. **LH armrest**
5. **Bushing (2 used)**
6. **Backrest**
7. **Plug (2 used)**
8. **Cable tie (3 used)**
9. **LH adjustment rail**
10. **Bumper (2 used)**
11. **Washer**
12. **Cap screw (2 used)**
13. **Seat**
14. **Nut**
15. **Spring (2 used)**
16. **Magnet**
17. **Seat switch**
18. **Rivet (4 used)**
19. **Mounting plate**
20. **Return spring**
21. **Torx screw (5 used)**
22. **RH adjustment rail**
23. **Rail stop**
24. **Torx screw**
25. **Torx screw (3 used)**
26. **Washer (3 used)**
27. **Handle**
28. **Nut**
29. **Support bracket**
30. **Cap screw**

Disassembly (Fig. 20)

1. Remove seat from machine for service (see Operator Seat Removal in this section).

2. Disassemble operator seat as necessary using Figure 20 as a guide.

Assembly (Fig. 20)

1. Assemble operator seat using Figure 20 as a guide.

2. Install seat to machine (see Operator Seat Installation in this section).

Operator Seat Suspension

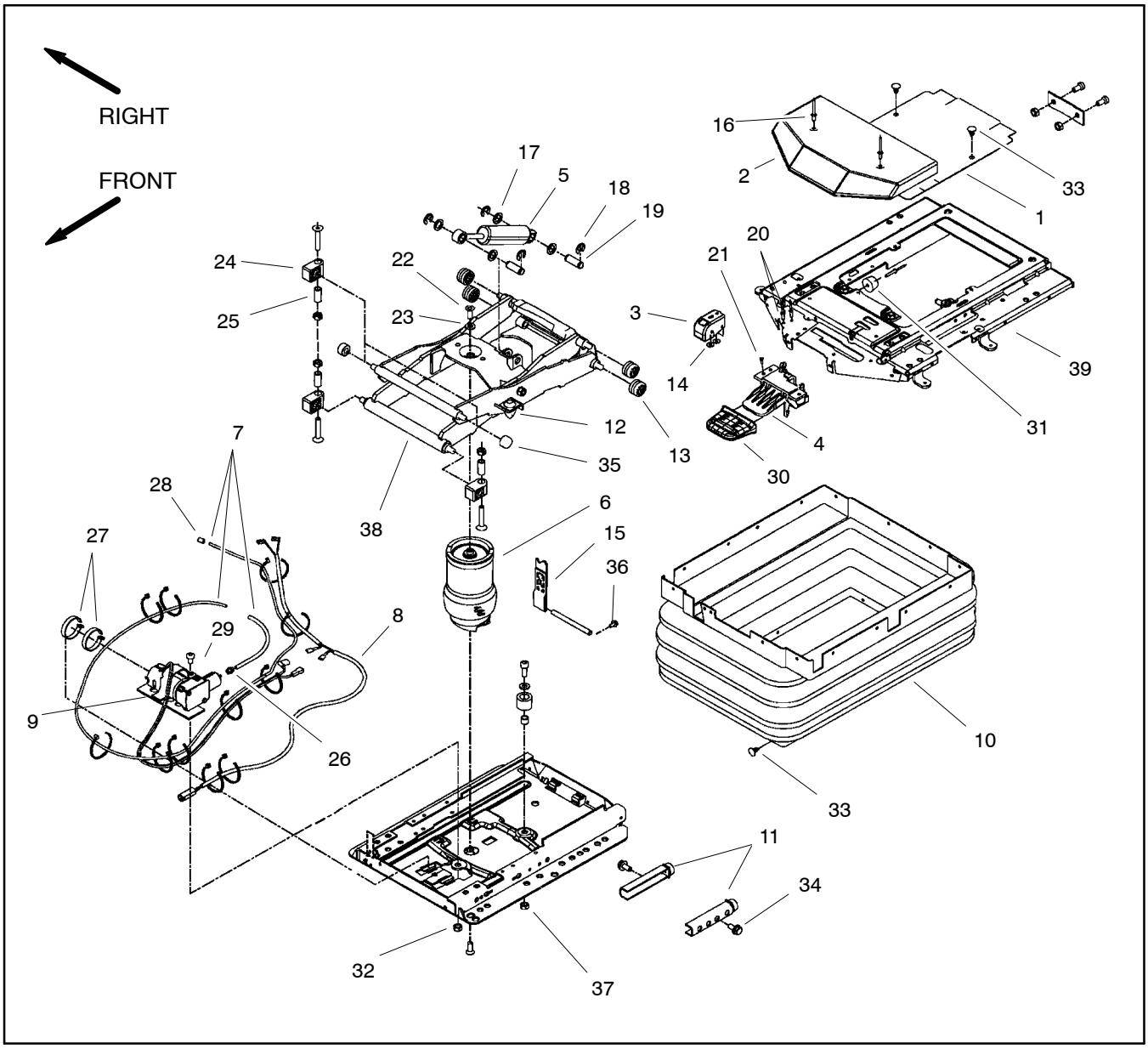


Figure 21

1. Cover
2. Cover
3. Level control
4. Air control valve
5. Shock absorber
6. Air spring
7. Air tube assembly
8. Wire harness
9. Compressor
10. Bellows
11. Stop
12. Bumper set (2 used)
13. Roller (4 used)
14. Washer (2 used)
15. Tether
16. Rivet (2 used)
17. Washer (4 used)
18. C-clip (4used)
19. Pin (2 used)
20. Rivet (2 used)
21. Washer (3 used)
22. Screw (2 used)
23. Washer
24. Housing support (4 used)
25. Spacer (4 used)
26. Hose nipple
27. Clamp (2 used)
28. Hose nipple
29. Screw
30. Handle
31. Bumper
32. Nut
33. Plastic plug (23 used)
34. Screw (2 used)
35. Roller (2 used)
36. Screw (4 used)
37. Base plate
38. Suspension frame
39. Upper plate

NOTE: Most of the seat suspension components can be serviced with the seat suspension base mounted to the frame platform. If the air spring assembly (item 6) requires removal, the seat suspension base will have to be removed from the seat platform.

Disassembly (Fig. 21)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove operator seat from seat suspension (see Operator Seat Removal in this section).

3. Disconnect seat suspension electrical connector from machine wire harness.

4. If the air spring assembly (item 6) or base plate (item 37) requires removal, remove seat suspension from seat platform (Fig. 22):

   A. To gain access to seat suspension mounting screws, slide fuel tank toward left side of machine (see Fuel Tank Removal in the Service and Repairs section of Chapter 3 – Engine). Support tank to prevent it from shifting.

   B. Remove four (4) screws and flange nuts that secure seat suspension to seat platform.

   C. Lift seat suspension from machine.

5. Remove seat suspension components as needed using Figure 21 as a guide.

Assembly (Fig. 21)

1. Install all removed seat suspension components using Figure 21 as a guide.

2. If seat suspension was removed from seat platform (Fig. 22):

   A. Position seat suspension onto seat platform.

   B. Secure seat suspension to seat platform with four (4) screws and flange nuts.

   C. Slide fuel tank toward right side of machine (see Fuel Tank Installation in the Service and Repairs section of Chapter 3 – Engine). Make sure that fuel tank and front wheel are properly secured.

3. Install operator seat to seat suspension (see Operator Seat Installation in this section).

4. Make sure that seat electrical connectors are secured to machine wire harness.

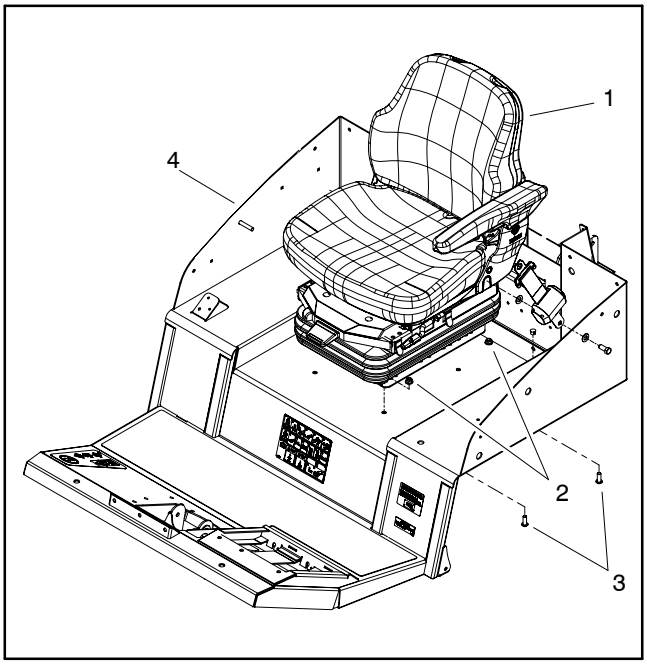


Figure 22

1. **Operator seat assembly**
2. **Flange nut (4 used)**
3. **Screw (4 used)**
4. **Seat platform**

Hood

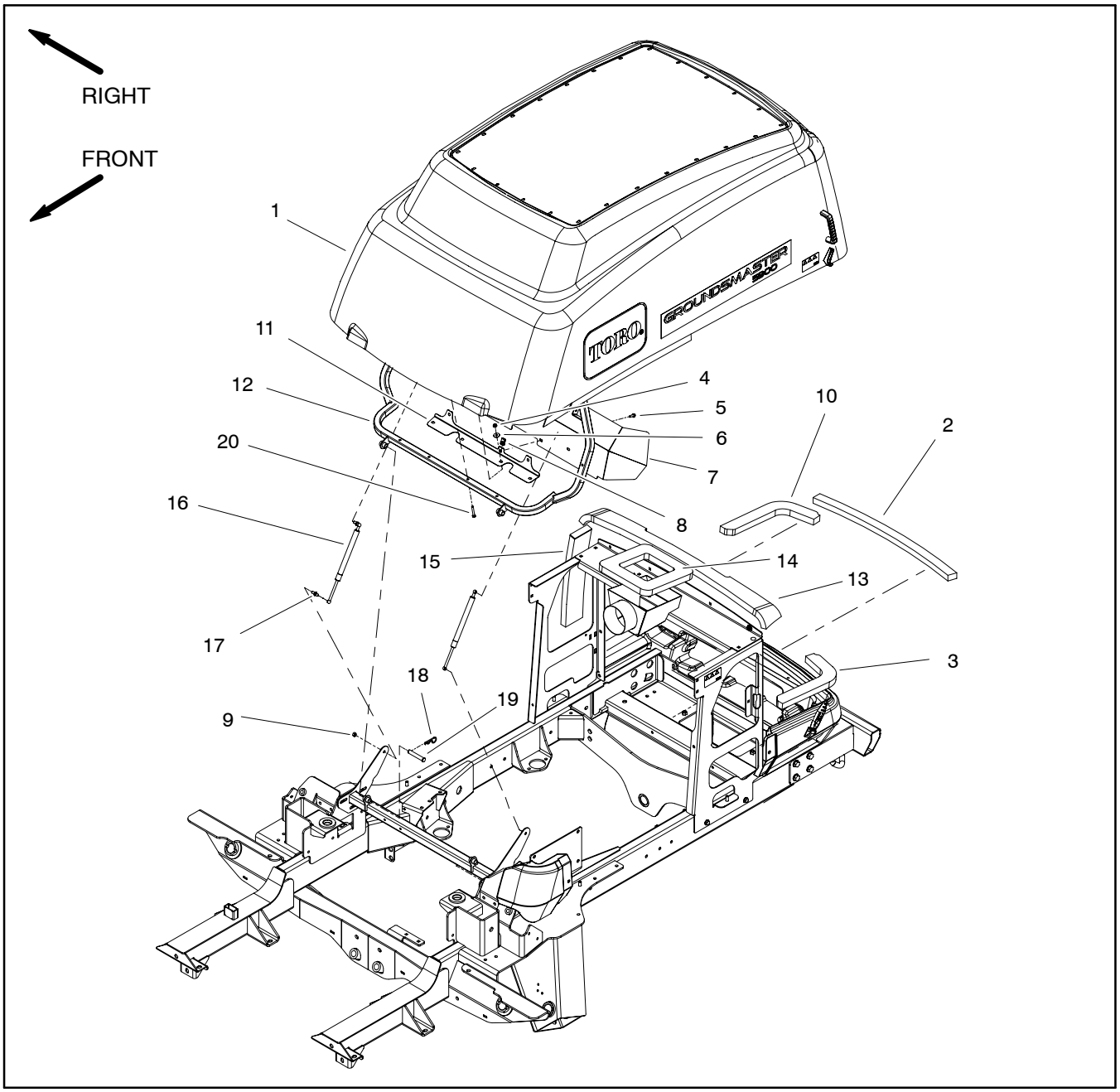


Figure 23

1. **Hood**
2. **Rear hood foam seal**
3. **LH rear foam seal**
4. **Flange nut (8 used)**
5. **Flange head screw (3 used)**
6. **Washer (8 used)**
7. **Heat shield**
8. **Clip (3 used)**
9. **Hex nut (2 used per cylinder)**
10. **RH rear foam seal**
11. **Support plate**
12. **Hood frame**
13. **Top foam seal**
14. **Air box foam seal**
15. **Side foam seal (2 used)**
16. **Gas spring (2 used)**
17. **Ball stud (2 used per cylinder)**
18. **Hair pin (2 used)**
19. **Clevis pin (2 used)**
20. **Cap screw (8 used)**

NOTE: Hood removal and installation requires two people.

Removal (Fig. 23)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Unlatch and raise hood.

3. Have one person support the rear of the raised hood.

4. Have a second person disengage gas springs from front ball. Lift up on flat clip until ball is released from spring socket.

5. Remove the two (2) hair pins (item 18) that secure the clevis pins to the frame.

6. While supporting hood on both sides, remove two (2) clevis pins (item 19) that secure hood to machine. Lift hood and remove from rear of machine.

7. Inspect all foam seals for damage. Also, make sure that foam seals show evidence of effective sealing with hood. Remove and replace foam seals if necessary.

8. If necessary, remove hood components using Figures 23 and 24 as guides.

Installation (Fig. 23)

1. Replace all removed hood components using Figures 23 and 24 as guides.

2. While supporting hood on both sides, position hood to align clevis pin holes in hood and machine frames. Install two (2) clevis pins to secure hood to machine.

3. Have one person support the rear of the raised hood.

4. Have a second person secure the gas springs to the machine frame. Align ball and socket and press together to engage.

5. Lower hood and check that hood makes a continuous seal around air cleaner system airbox. If necessary, use shim(s) to adjust location of airbox for proper sealing with hood (Fig. 25).

6. Lower and secure hood.

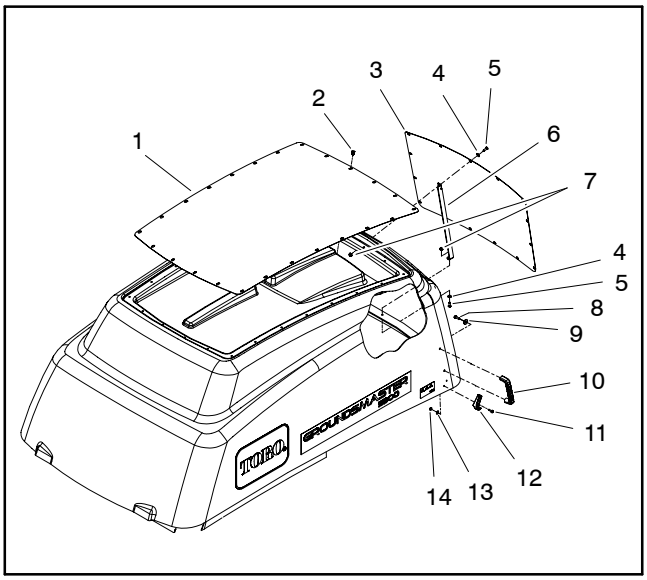


Figure 24

1. **Top screen**
2. **Plug**
3. **Rear screen**
4. **Flat washer (2 used)**
5. **Screw (2 used)**
6. **Hood strap**
7. **Flange nut (2 used)**
8. **Screw (4 used)**
9. **Washer (4 used)**
10. **Handle (2 used)**
11. **Screw (4 used)**
12. **Latch (2 used)**
13. **Flat washer (4 used)**
14. **Lock nut (4 used)**

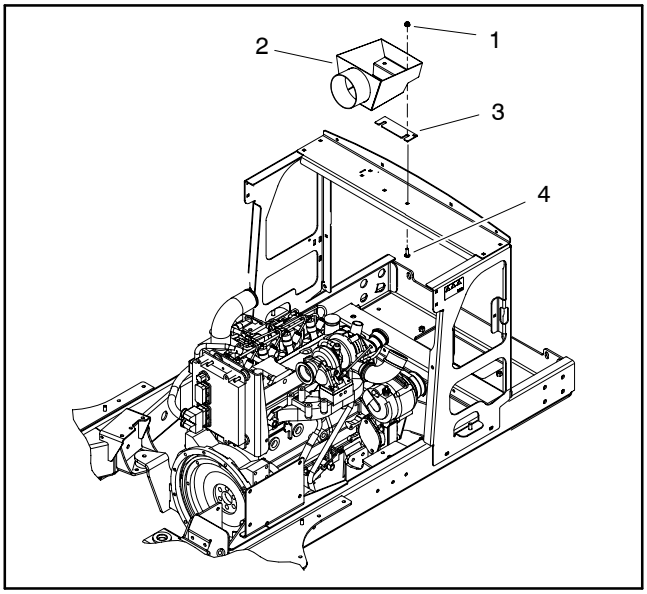


Figure 25

1. **Flange nut (2 used)**
2. **Air box**
3. **Shim (as needed)**
4. **Carriage screw (2 used)**

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Chapter 8

Cutting Decks

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Specifications



MOUNTING: Cutting decks are supported by lift arms controlled with hydraulic lift cylinders.

CONSTRUCTION: Deck chambers are welded steel construction reinforced with channels and plates.

HEIGHT-OF-CUT RANGE: 1" to 6" (25.4 mm to 152 mm) adjustable in 1/2" (12.7 mm) increments. Center deck height-of-cut adjustment is achieved by changing spacers on castor wheels, re-positioning the castor arms in the deck brackets, re-positioning the castor wheel axles in the castor forks and adjusting length of deck support chains. Wing deck adjustment is achieved by changing spacers on castor wheels, re-positioning the castor arms in the deck brackets and re-positioning the castor wheel axles in the castor forks.

DECK DRIVE: Closed loop hydraulic system operates hydraulic motor on each cutting deck. Motor drives one spindle directly with remaining deck section spindle(s) driven by B section kevlar v-belt(s). Blade spindles are 1-1/4" (31.7 mm) shafts supported by greaseable, tapered roller bearings.

CUTTING BLADE: Cutting blade dimensions are 20" (508 mm) long, 2.500" (64 mm) wide and 0.250" (6.4 mm) thick. Anti-scalp cup installed on each cutting blade. Center deck includes five blades and each wing deck includes three blades.

WIDTH OF CUT: Front deck provides 92" (2337 mm) width of cut. Each wing deck has 57" (1448 mm) width of cut. Total width of cut is 192" (4877 mm).

DISCHARGE: Clippings are discharged from the rear of the cutting deck.

SUSPENSION SYSTEM: A fully floating suspension with hydraulic counterbalance. Front deck suspended from lift arms and has two castor wheels, two adjustable skids and three anti-scalp rollers. Wing decks suspended from lift arms and have four castor wheels, two adjustable skids and two anti-scalp rollers.

Troubleshooting

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, uneven ground conditions, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the machine.

Remember that the “effective” or actual height−of−cut depends on cutting unit weight, tire pressures, hydraulic counterbalance settings and turf conditions. Effective height−of−cut will be different than the bench set height−of−cut.

Factors That Can Affect Quality of Cut

Factor	Possible Problem/Correction
1. Maximum governed engine speed.	Make sure that throttle control is placed in the fast position when mowing. Check maximum governed engine speed (see Chapter 3 − Diesel Engine).
2. Blade speed.	All deck blades should rotate at the same speed. See items in Troubleshooting Section of Chapter 4 − Hydraulic System.
3. Tire pressure.	Check air pressure of all machine tires including cutting deck castor tires. Adjust to pressures specified in Operator’s Manual.
4. Blade condition.	Sharpen blades if their cutting edges are dull or nicked. Inspect blade sail for wear or damage. Replace blade if needed.
5. Mower housing condition.	Make sure that cutting chambers are in good condition. Keep underside of deck clean. Debris buildup will reduce cutting performance.
6. Height−of−cut.	Make sure all deck height−of−cut adjustments are the same. Adjust deck as specified in the Operator’s Manual.
7. Cutting deck alignment and ground following.	Check lift arms and cutting deck pivot pins for wear, damage or binding.
8. Roller and castor wheel condition.	All rollers and caster wheels should rotate freely. Replace bearings if worn or damaged.
9. Grass conditions.	Mow when grass is dry for best cutting results. Also, remove only 1” (25.4 mm) or 1/3 of the grass blade when cutting.

General Information

CAUTION

Never install or work on the cutting deck or lift arms with the engine running. Always stop engine and remove ignition key first.

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster. Refer to the Operator's Manual for additional information when servicing the machine.

Castor Wheel Tire Pressure

Castor tires on the cutting deck should be inflated to 50 PSI (345 kPa).

Blade Stopping Time

The blades of the cutting deck should come to a complete stop in approximately five (5) seconds after the PTO switch is shut off.

NOTE: Make sure the decks are lowered onto a clean section of turf or hard surface to avoid dust and debris.

To verify blade stopping stopping time, have a second person stand back from the deck at least twenty (20) feet (6.1 meters) and watch one of the cutting deck blades. Have the operator shut the cutting deck off and record the time it takes for the blades to come to a complete stop. If this stopping time is greater than seven (7) seconds, the braking valve (RV2) on the deck drive hydraulic control manifold may need adjustment.

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CAUTION

Never install or work on a cutting deck or lift arm with the engine running. Always stop engine and remove ignition key first.

Front Cutting Deck

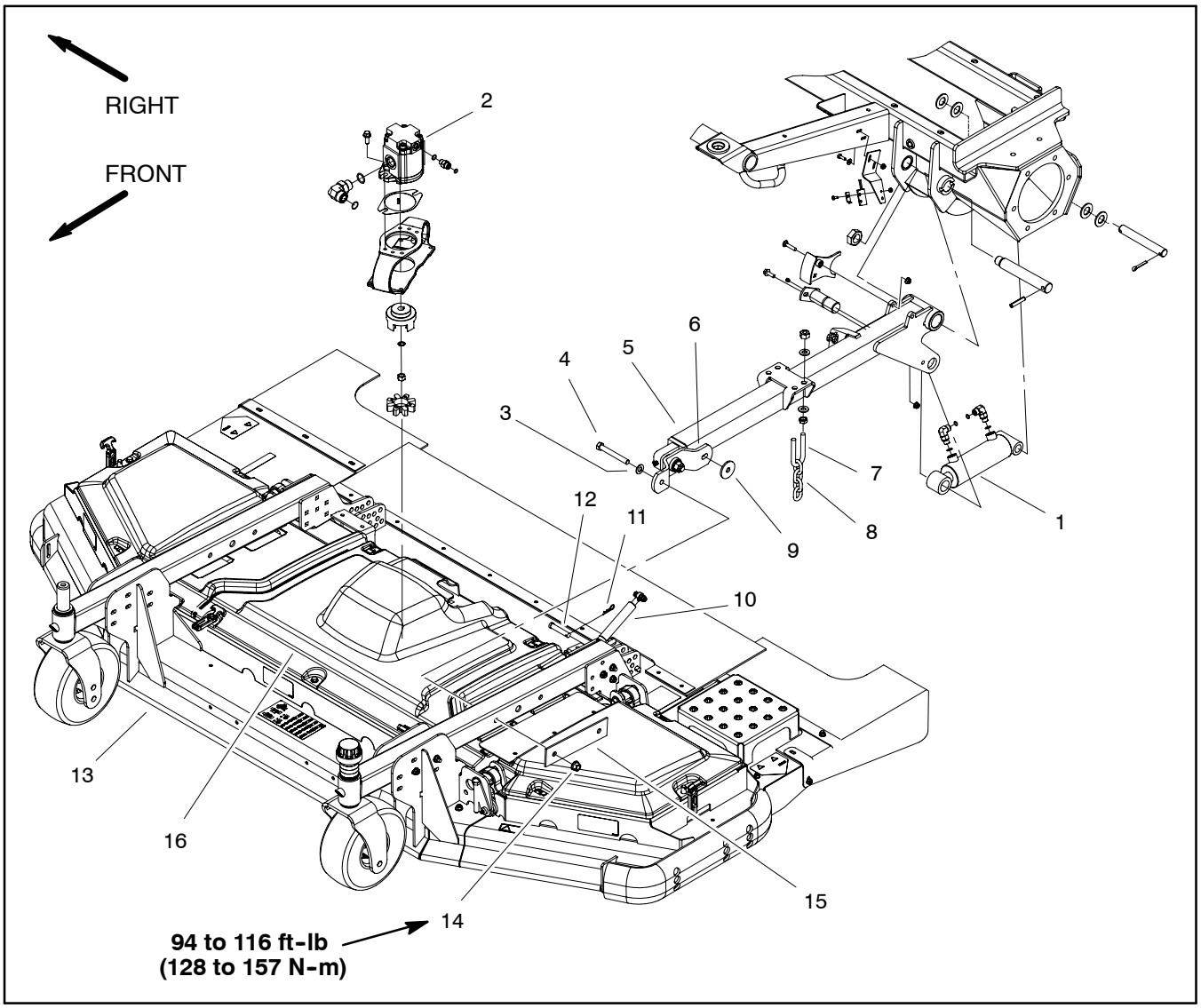


Figure 1

1. Lift cylinder (LH shown)
2. Hydraulic deck motor
3. Flat washer (2 used per lift arm)
4. Cap screw (2 used per lift arm)
5. Lift arm assembly (LH shown)
6. Support hub (1 used per lift arm)
7. U-bolt (1 used per lift arm)
8. HOC chain (1 used per lift arm)
9. Thrust washer (1 used per lift arm)
10. Damper assembly
11. Hairpin (1 used per lift arm)
12. Clevis pin (1 used per lift arm)
13. Front cutting deck
14. Lock nut (2 used per lift arm)
15. Plate (1 used per lift arm)
16. Center deck cover

Removal (Fig. 1)

1. Position machine on a clean, level surface. Lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove center deck cover to access hydraulic deck motor.

3. Remove hydraulic motor from cutting deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 – Hydraulic Systems). Position and support motor away from cutting deck.

4. Start engine and raise deck slightly. Stop engine and remove key from the ignition switch.

5. Remove hairpins (item 11) and clevis pins (item 12) that secure the height–of–cut chains to the rear of the cutting deck.

6. Remove spring pin and spacer that secure damper to damper mount on deck (Figs. 2 and 3). Position damper away from cutting deck.

7. Start engine and lower deck to ground. Stop engine and remove key from the ignition switch.

8. Remove cap screws (item 4), flat washers (item 3), plate (item 15) and lock nuts (item 14) that secure lift arm support hubs to cutting deck. Remove thrust washer (item 9) from between the lift arm and the rear, slotted hole in the support hub.

9. Slide the cutting deck away from the traction unit.

Installation (Fig. 1)

1. Position machine on a clean, level surface. Lower front lift arms, stop engine, engage parking brake and remove key from the ignition switch.

2. Position the cutting deck to the lift arms.

3. Align lift arm support hub to cutting deck. Make sure that slotted hole in the support hub is toward the rear of the deck.

4. Place thrust washer (item 9) between the lift arm and the rear, slotted hole in the support hub.

5. Secure lift arm support hub to deck with cap screws (item 4), flat washers (item 3), plate (item 15) and lock nuts (item 14). Torque fasteners from **94 to 116 ft–lb (128 to 157 N–m)**.

6. Start engine and raise deck slightly. Stop engine and remove key from the ignition switch.

7. Install clevis pins and hairpins that secure the height–of–cut chains to the rear of the cutting deck.

8. Position damper to mount on cutting deck. Install spacer and spring pin to secure damper to deck (Figs. 2 and 3).

9. Start engine and lower deck to ground. Stop engine and remove key from the ignition switch.

10. Install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 – Hydraulic Systems).

11. Install all removed cutting deck covers.

12. Lubricate grease fittings on cutting deck and lift arm assemblies (see Operator's Manual).

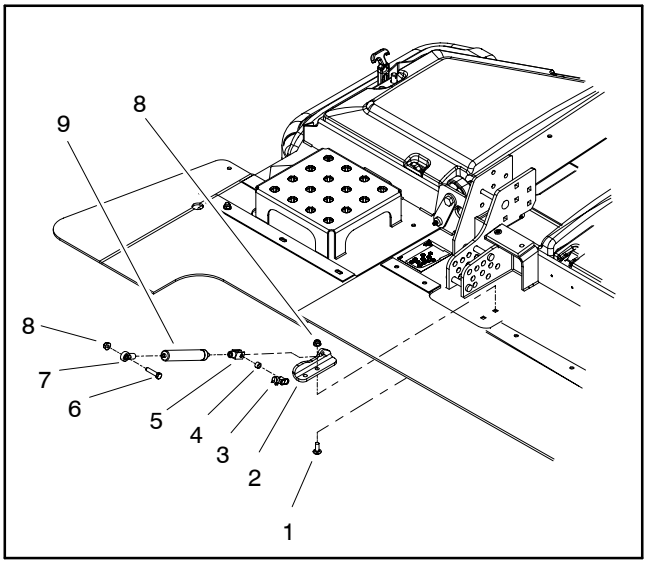


Figure 2

1. **Carriage screw (2 used)**
2. **Damper mount**
3. **Spring pin**
4. **Spacer**
5. **Clevis rod end**
6. **Cap screw**
7. **Bearing rod end**
8. **Flange nut (3 used)**
9. **Damper**

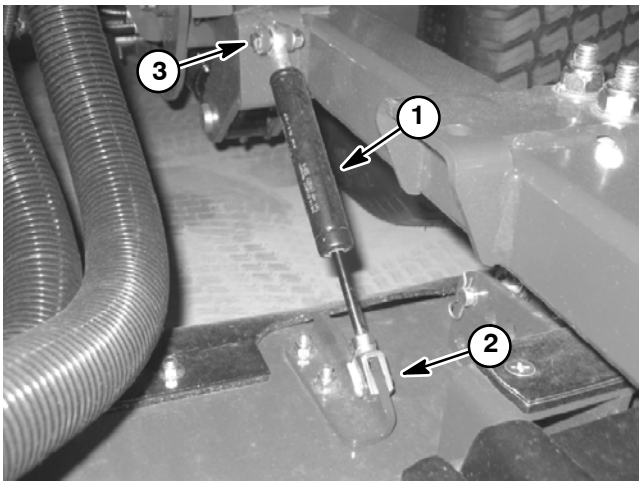


Figure 3

1. **Damper**
2. **Clevis rod end**
3. **Bearing rod end**

Wing Cutting Deck

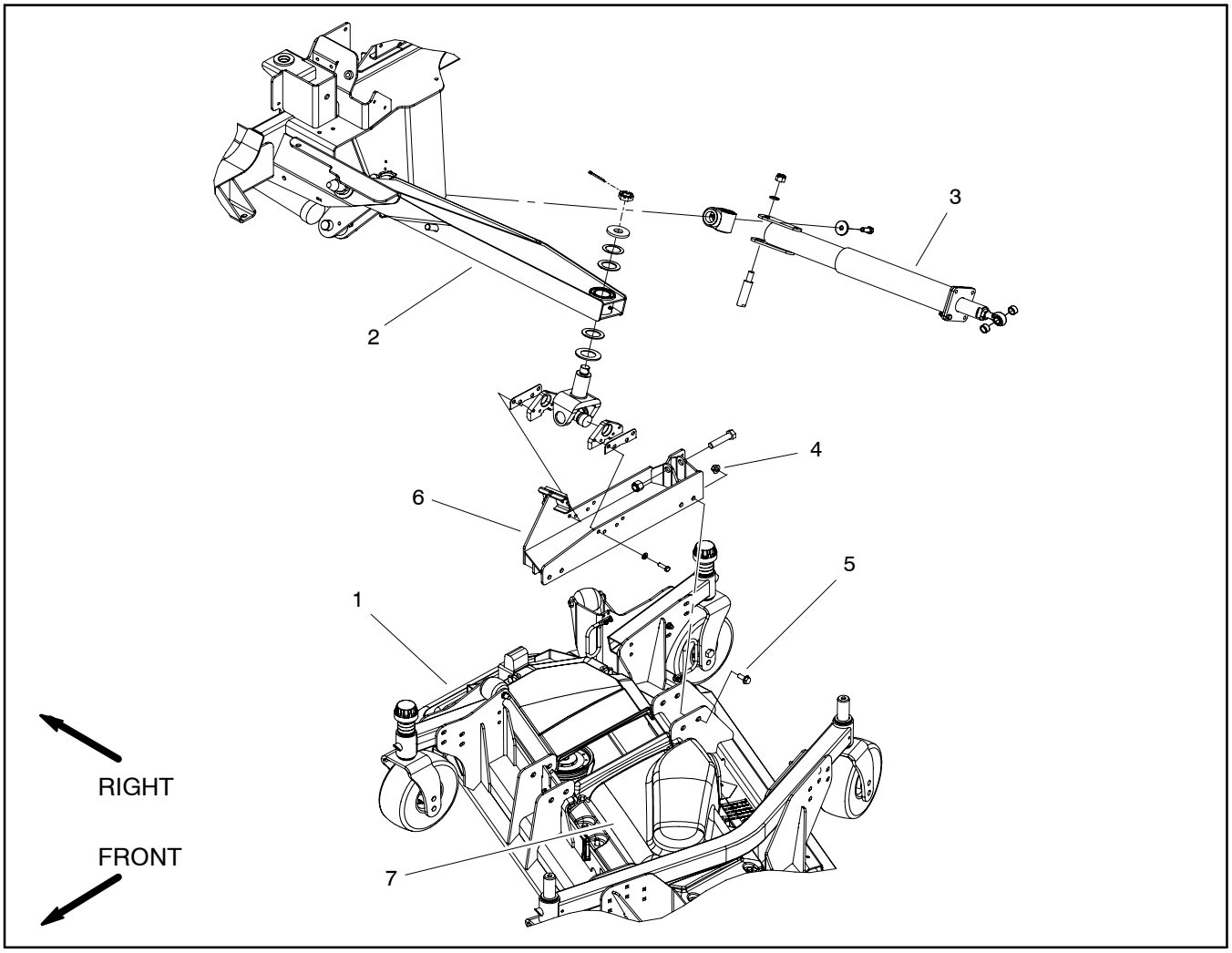


Figure 4

1. **Wing cutting deck (LH shown)**
2. **Lift arm (LH shown)**
3. **Rear impact arm assembly**
4. **Lock nut (8 used)**
5. **Flange head screw (8 used)**
6. **Deck connection (LH shown)**
7. **Deck outer cover**

Removal (Fig. 4)

1. Position machine on a clean, level surface. Lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove cutting deck outer cover to access hydraulic deck motor.

3. Remove three (3) hose guides from cutting deck (Fig. 5). Leave two (2) loop guides (Fig. 5, item 6) on hydraulic hoses.

4. Remove hydraulic motor from cutting deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 – Hydraulic Systems). Position and support motor away from cutting deck.

5. Remove eight (8) flange head screws (item 5) and lock nuts (item 4) that secure deck connection (item 6) to cutting deck.

6. Raise lift arm enough to separate deck connection from cutting deck.

7. Slide the cutting deck away from the traction unit.

Installation (Fig. 4)

1. Position machine on a clean, level surface. Lower wing deck lift arm, stop engine, engage parking brake and remove key from the ignition switch.

2. Position the wing cutting deck to the raised lift arm.

3. Lower lift arm while aligning deck connection to cutting deck.

4. Install deck connection to cutting deck with eight (8) flange head screws (item 5) and lock nuts (item 4). Tighten fasteners.

5. Install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 – Hydraulic Systems).

6. Position and secure three (3) hose guides to cutting deck (Fig. 5).

7. Install all removed cutting deck covers.

8. Lubricate grease fittings on cutting deck and lift arm assemblies (see Operator's Manual).

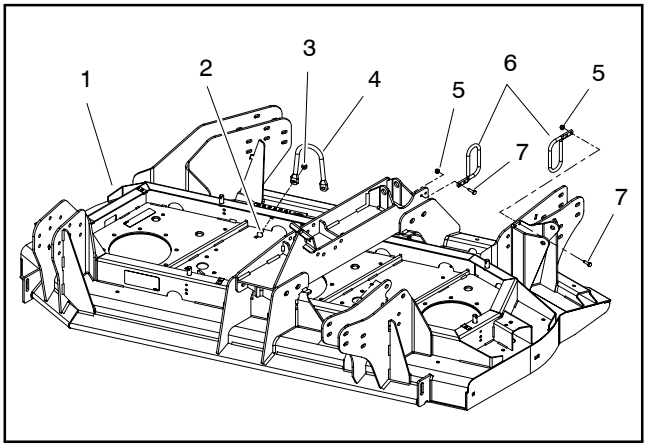


Figure 5

1. **Wing deck (RH shown)**
2. **Carriage screw (2 used)**
3. **Flange nut (2 used)**
4. **Hose guide**
5. **Flange nut (4 used)**
6. **Hose guide**
7. **Cap screw (4 used)**

Idler Assembly

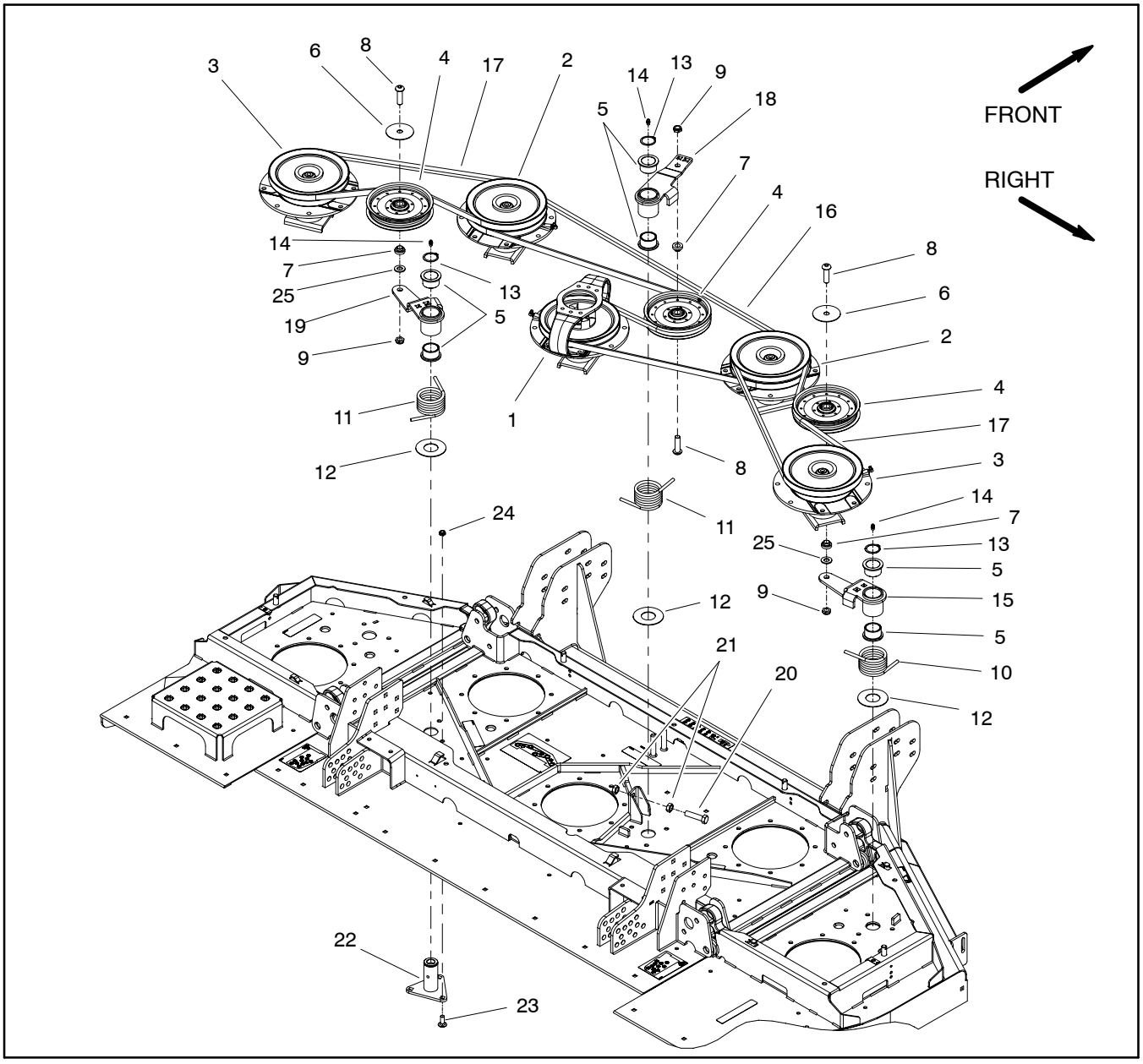


Figure 6

1. **Drive spindle assembly**
2. **Driven spindle assembly (double)**
3. **Driven spindle assembly (single)**
4. **Idler pulley**
5. **Flange bushing**
6. **Flat washer**
7. **Idler spacer**
8. **Screw**
9. **Lock nut**
10. **Torsion spring**
11. **Torsion spring**
12. **Washer**
13. **Snap ring**
14. **Grease fitting**
15. **Low idler arm**
16. **V-belt**
17. **V-belt**
18. **High idler arm**
19. **Low idler arm**
20. **Cap screw**
21. **Jam nut**
22. **Idler pivot post**
23. **Carriage screw (3 used per post)**
24. **Lock nut (3 used per post)**
25. **Flat washer**

NOTE: The front deck is shown in Figure 6. The idler assemblies used on the wing decks are very similar.

Removal (Fig. 6)

1. Park machine on a level surface with cutting deck lowered. Stop engine, engage parking brake and remove key from the ignition switch.

2. Remove deck covers from top of cutting deck.

3. If removing high idler assembly on front deck, loosen jam nuts (item 21) that secure idler stop bolt (item 20) to cutting deck to allow clearance between high idler arm and stop bolt.

4. Using appropriate socket wrench, rotate idler arm away from drive belt to release belt tension. Remove drive belt(s) from deck pulleys.

5. Insert nut driver or small piece of pipe onto the end of the torsion spring for the idler arm.

CAUTION

Be careful when removing tension from the idler arm torsion spring. The spring is under heavy load and may cause personal injury.

6. Carefully push the torsion spring end down and away from the idler arm to unhook the spring from the arm.

7. Remove snap ring that retains idler arm assembly to cutting deck.

8. Remove idler components as needed using Figure 6 as a guide. Note location of washer(s), idler spacer, lock nut and screw as idler assemblies are being removed (Figs. 6 and 7).

Installation (Fig. 6)

1. Install removed idler components using Figure 6 as a guide. Secure idler arm assembly to cutting deck with snap ring.

2. Insert nut driver or small piece of pipe onto the end of the torsion spring for the idler arm.

CAUTION

Be careful when applying tension to the idler arm torsion spring. The spring is under heavy load and may cause personal injury.

3. Carefully push down on the torsion spring end to get the spring under the idler arm mounting plate. Then release the spring slowly to lock it into place.

4. Using appropriate socket wrench on idler arm to release drive belt tension, position drive belt(s) to deck pulleys. Make sure that idler pulley tensions the back side of the belt.

5. On front deck, make sure that clearance between high idler arm and stop bolt is from 0.100" to 0.160" (2.5 to 4.0 mm) (Fig. 8). If necessary, adjust jam nut location on stop bolt to allow proper clearance.

6. Install deck covers to cutting deck.

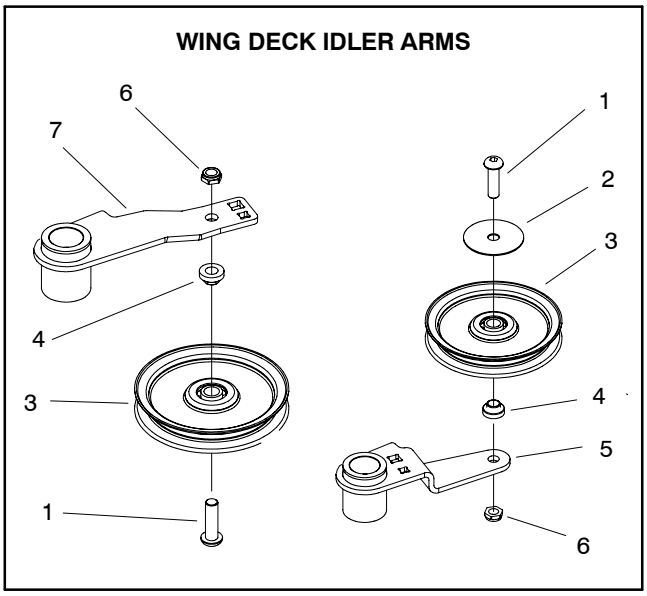


Figure 7

1. **Screw**
2. **Flat washer**
3. **Idler pulley**
4. **Idler spacer**
5. **Low idler arm**
6. **Lock nut**
7. **High idler arm**

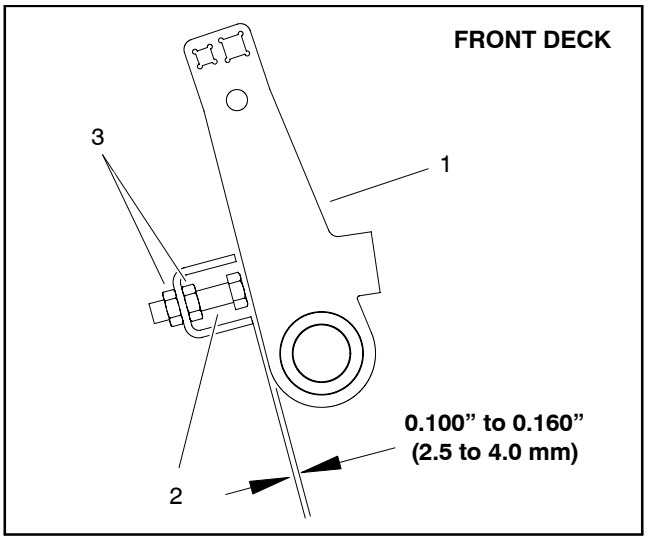


Figure 8

1. **High idler arm**
2. **Stop bolt**
3. **Jam nut**

Front Deck Winglets

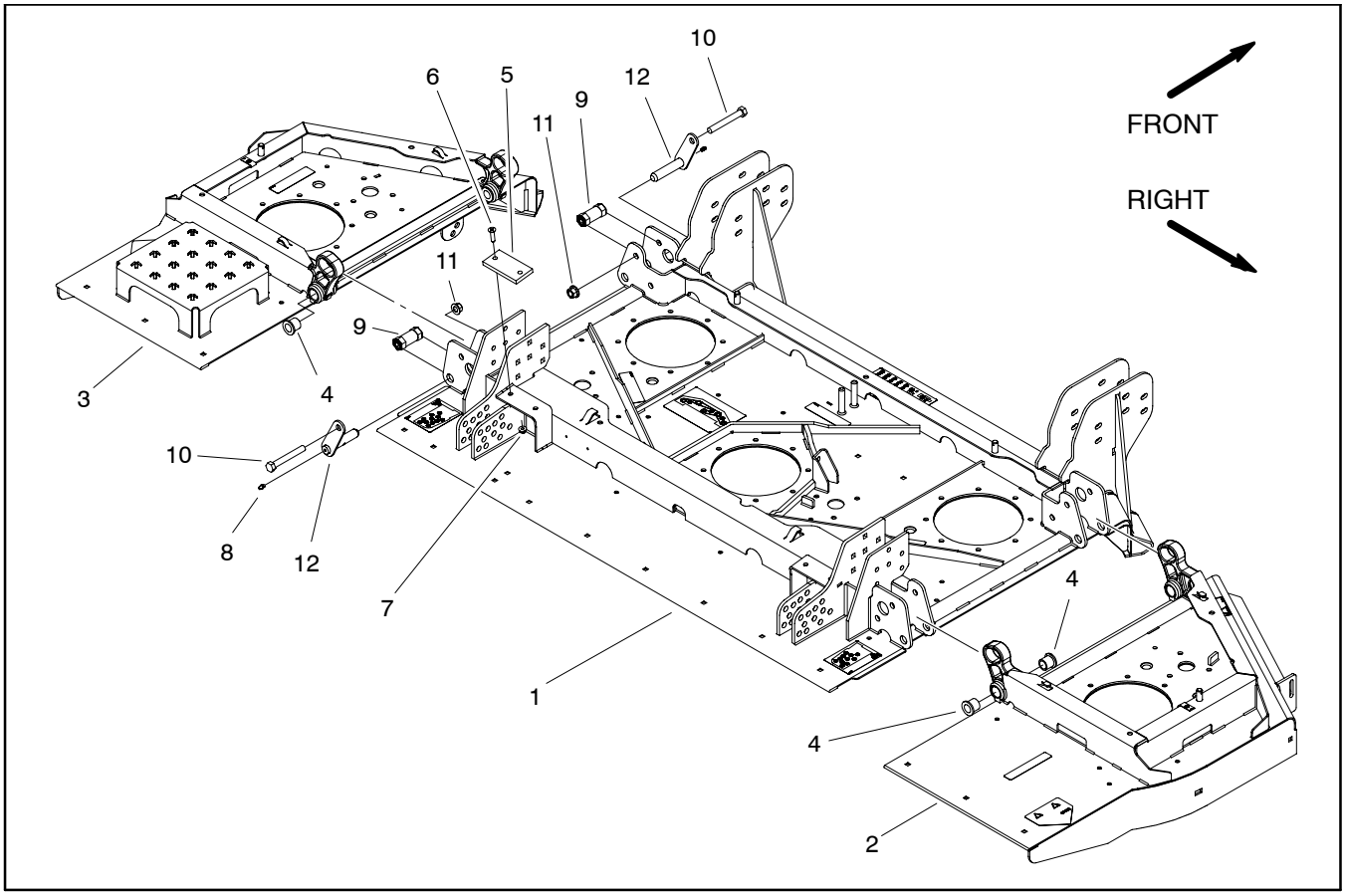


Figure 9

1. **Center deck**
2. **RH deck winglet**
3. **LH deck winglet**
4. **Flange bushing (4 used per winglet)**
5. **Bumper pad (2 used)**
6. **Screw (4 used)**
7. **Flange nut (4 used)**
8. **Grease fitting**
9. **Eccentric (2 used per winglet)**
10. **Cap screw (2 used per winglet)**
11. **Lock nut (2 used per winglet)**
12. **Hinge pin (2 used per winglet)**

Disassembly (Fig. 9)

1. Park machine on a level surface, lower front cutting deck, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove covers from front cutting deck.

3. Using appropriate socket wrench, rotate idler arm away from drive belt to release belt tension. Remove drive belt from deck winglet spindle.

4. For assembly alignment purposes, use a marker or paint pen on eccentric and deck brackets to identify location of eccentric (Fig. 10).

5. Remove lock nut, cap screw, eccentric and hinge pin from front and rear winglet hinges. Use hole in deck bracket to remove eccentric from deck. Slide winglet away from front deck.

6. Inspect hinge pin, eccentric and flange bushings in deck winglet. Replace worn or damaged components.

Assembly (Fig. 9)

1. Position winglet to front deck.

2. Secure deck winglet to center deck with hinge pin.

3. Position eccentrics in center frame brackets and install cap screw and lock nut. Do not fully tighten fasteners.

4. Using appropriate socket wrench on idler arm to release drive belt tension, position drive belt to deck winglet spindle. Make sure that idler pulley tensions the back side of the belt.

5. Use the marker or paint pen line made during disassembly to position the eccentric (Fig. 10). Check front deck blade plane and adjust as needed. Refer to Operator's Manual for additional adjustment information. After blade plane is adjusted correctly, tighten lock nut to secure eccentric in position.

6. Lubricate hinge pin grease fittings.

7. Install and secure all removed covers to front cutting deck.

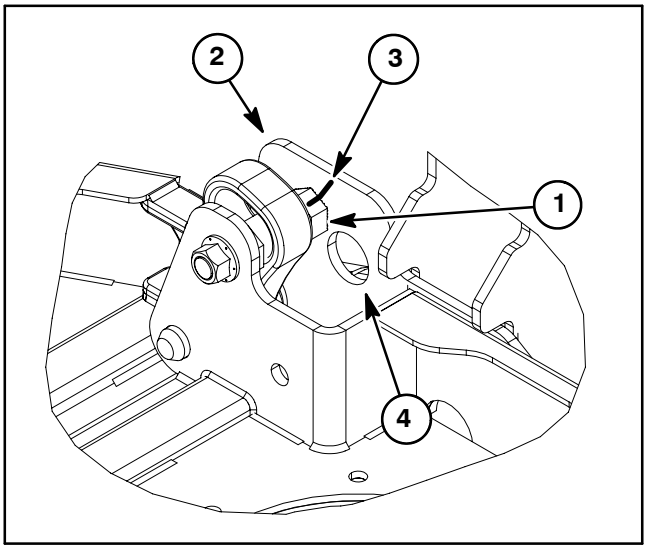


Figure 10

1. **Eccentric**
2. **Deck bracket**
3. **Marker/paint line**
4. **Eccentric removal hole**

Blade Spindle

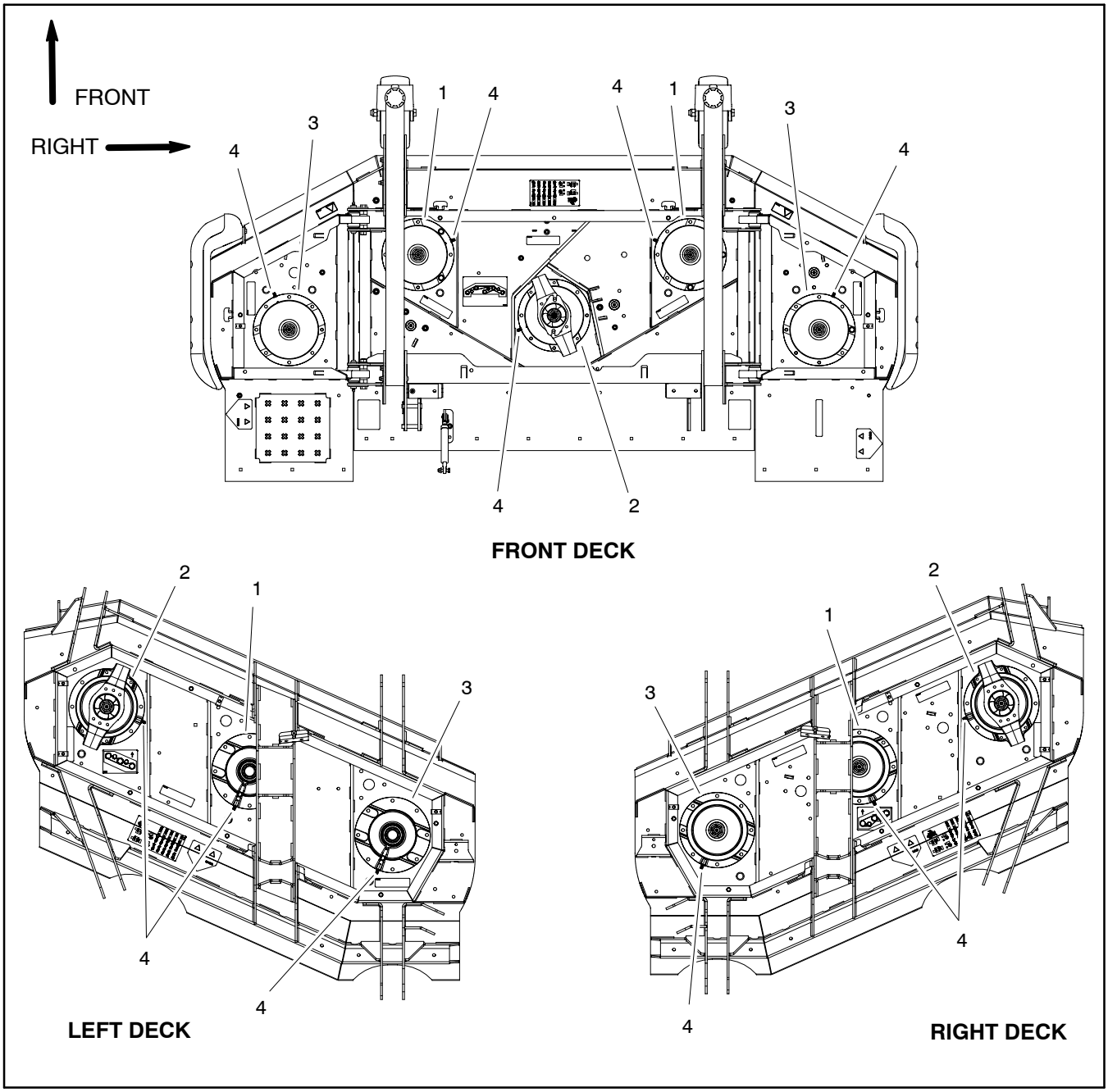


Figure 11

1. **Driven spindle (double pulley)**
2. **Drive spindle**
3. **Driven spindle (high pulley)**
4. **Grease fitting**

Removal (Figs. 11 and 13)

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove covers from cutting deck to allow access to blade spindle.

3. If drive spindle is to be serviced, remove hydraulic motor from cutting deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 – Hydraulic Systems). Position motor away from spindle.

4. Using appropriate socket wrench, loosen idler pulley to release belt tension. Remove drive belt from spindle to be serviced.

5. Start the engine and raise the cutting deck. Stop engine and remove key from the ignition switch. Latch or block up the cutting deck so it cannot fall accidentally.

6. Remove cutting blade, anti–scalp cup and blade bolt from spindle to be serviced.

7. Remove spindle housing assembly from deck.

   A. For driven spindle assemblies, remove eight (8) flange head screws with flange nuts that secure spindle to deck.

   B. For drive spindle assemblies, loosen and remove four (4) flange head screws with flange nuts that secure spindle to deck. Then, remove four (4) cap screws with washers that secure spindle and hydraulic motor mount to deck.

   C. Lift spindle assembly from deck.

Installation (Figs. 11 and 13)

1. Position spindle on cutting deck noting orientation of grease fitting (Fig. 11). Secure spindle assembly to deck with correct fasteners.

2. Install cutting blade, anti–scalp cup and blade bolt to spindle. Tighten blade bolt from **88 to 108 ft–lb (119 to 146 N–m)**.

3. Slowly rotate cutting blades to verify that blades do not contact any deck components.

4. Install drive belt to spindle pulleys and idler pulley(s).

5. If drive spindle was removed, install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 – Hydraulic Systems).

6. Install covers to cutting deck.

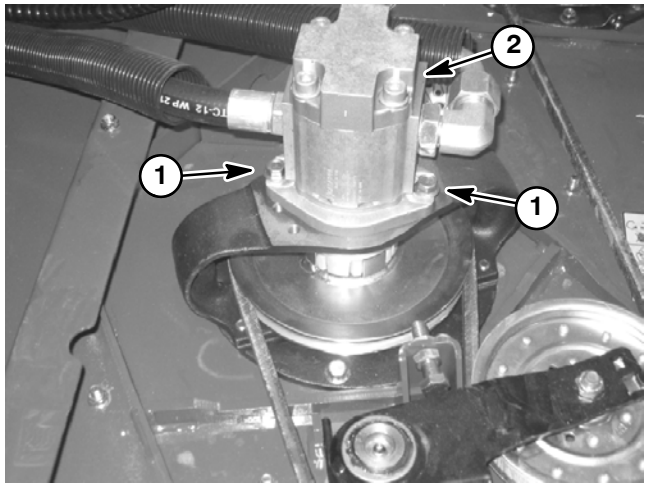


Figure 12

1. **Flange head screw**
2. **Hydraulic motor**

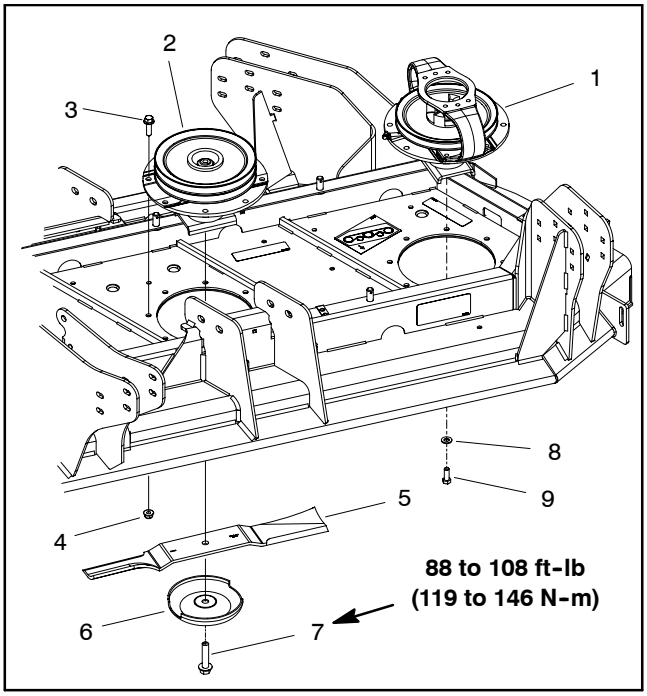


Figure 13

1. **Drive spindle**
2. **Driven spindle**
3. **Flange head screw**
4. **Flange nut**
5. **Cutting blade**
6. **Anti–scalp cup**
7. **Blade bolt**
8. **Flat washer**
9. **Cap screw**

Blade Spindle Service

Disassembly (Fig. 14)

1. Loosen and remove lock nut from top of spindle shaft. Remove hardened washer and pulley from spindle. For drive spindle, remove hydraulic motor mount.

2. Remove the spindle shaft from the spindle housing which may require the use of an arbor press. The spindle shaft spacer should remain on the spindle shaft as the shaft is being removed.

3. Carefully remove oil seals from spindle housing.

4. Allow the bearing cones, inner bearing spacer and spacer ring to drop out of the spindle housing.

5. Using an arbor press, remove both of the bearing cups and the outer bearing spacer from the housing.

6. The large snap ring can remain inside the spindle housing. Removal of this snap ring is very difficult.

Assembly (Fig. 14)

NOTE: A replacement spindle bearing set contains two (2) bearings, a spacer ring and a large snap ring (items 1, 2 and 3 in Fig. 15). These parts cannot be purchased separately. Also, do not mix bearing set components from one deck spindle to another.

NOTE: A replacement bearing spacer set includes the inner spacer and outer spacer (items 4 and 5 in Fig. 15). Do not mix bearing spacers from one deck spindle to another.

IMPORTANT: If new bearings are installed into a used spindle housing, it may not be necessary to replace the original large snap ring. If the original snap ring is in good condition with no evidence of damage (e.g. spun bearing), leave the snap ring in the housing and discard the snap ring that comes with the new bearings. If the large snap ring is found to be damaged, replace the snap ring.

1. If large snap ring was removed from spindle housing, install snap ring into housing groove. Make sure snap ring is fully seated in housing groove.

2. Install outer bearing spacer into top of spindle housing. The spacer should fit against the snap ring.

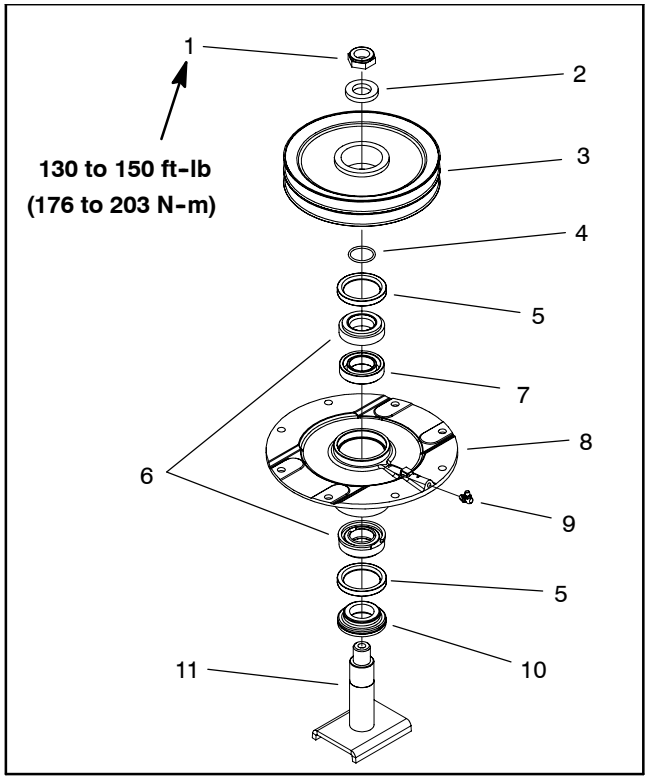


Figure 14

1. **Lock nut**
2. **Hardened washer**
3. **Pulley**
4. **O-ring**
5. **Oil seal**
6. **Bearing set**
7. **Spacer set**
8. **Spindle housing**
9. **Grease fitting**
10. **Shaft spacer**
11. **Spindle shaft**

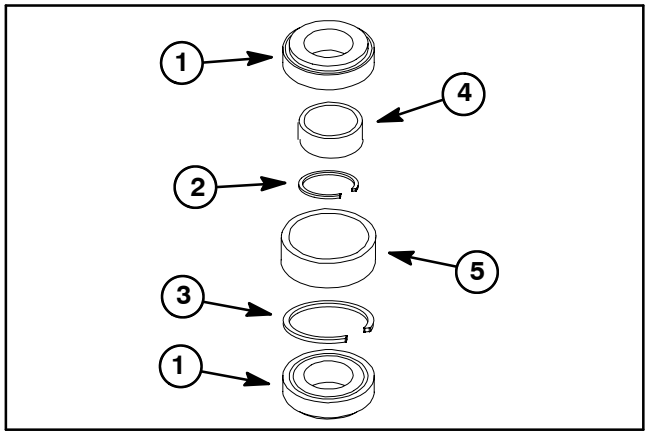


Figure 15

1. **Bearing**
2. **Spacer ring**
3. **Large snap ring**
4. **Inner bearing spacer**
5. **Outer bearing spacer**

3. Using an arbor press, push the bearing cups into the top and bottom of the spindle housing. The top bearing cup must contact the outer bearing spacer previously installed, and the bottom bearing cup must contact the snap ring. Make sure that the assembly is correct by supporting the first bearing cup and pressing the second cup against it (Fig 16).

4. Pack the bearing cones with grease. Apply a film of grease on lips of oil seals and O−ring.

5. Install lower bearing cone and greased oil seal into bottom of spindle housing. **Note:** The bottom seal must have the lip facing out (down) (Fig. 17). This seal installation allows grease to purge from the spindle during the lubrication process.

IMPORTANT: If bearings are being replaced, make sure to use the spacer ring that is included with new bearing set (Fig. 15).

6. Slide spacer ring and inner bearing spacer into spindle housing, then install upper bearing cone and greased oil seal into top of housing. **Note:** The upper seal must have the lip facing in (down) (Fig. 17). Make sure upper seal is flush to 0.060" (1.5 mm) recessed to housing surface.

7. Inspect the spindle shaft and shaft spacer to make sure there are no burrs or nicks that could possibly damage the oil seals. Lubricate the shaft and spacer with grease.

8. Install spindle shaft spacer onto shaft. Place thin sleeve or tape on spindle shaft splines to prevent seal damage during shaft installation.

9. Carefully slide spindle shaft with spacer up through spindle housing. The bottom oil seal and spindle spacer fit together when the spindle is fully installed.

10. Install greased O−ring to top of spindle shaft.

11. Install pulley (hub down), hardened washer and lock nut to spindle shaft. Tighten lock nut from **130 to 150 ft−lb (176 to 203 N−m)**.

IMPORTANT: Pneumatic grease guns can produce high pressure inside spindle housing that can damage spindle seals. Pneumatic grease guns, therefore, are not recommended to be used for greasing of spindle housings.

12. Attach a hand pump grease gun to grease fitting on housing and fill housing cavity with grease until grease starts to come out of lower seal.

13. Rotate spindle shaft to make sure that it turns freely.

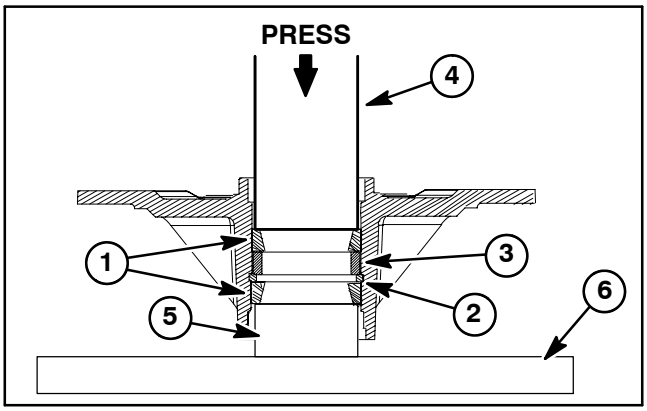


Figure 16

1. **Bearing cups**
2. **Large snap ring**
3. **Large outer spacer**
4. **Arbor press**
5. **Support**
6. **Arbor press base**

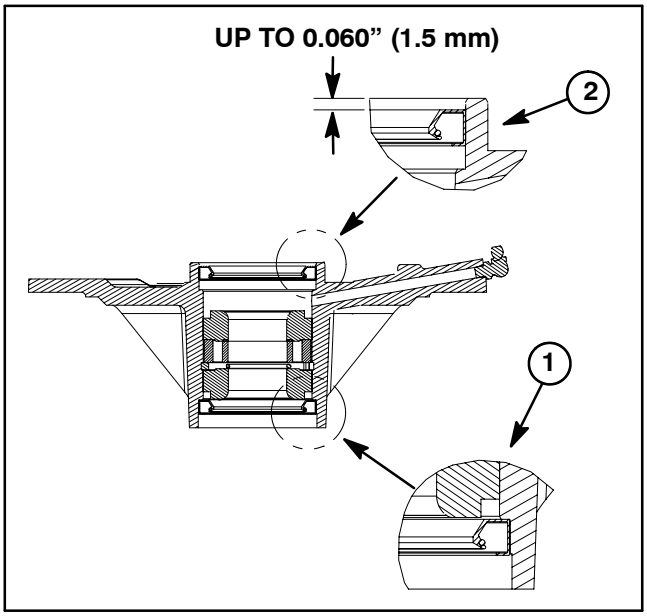


Figure 17

1. **Bottom seal installation**
2. **Upper seal installation**

Castor Forks and Wheels

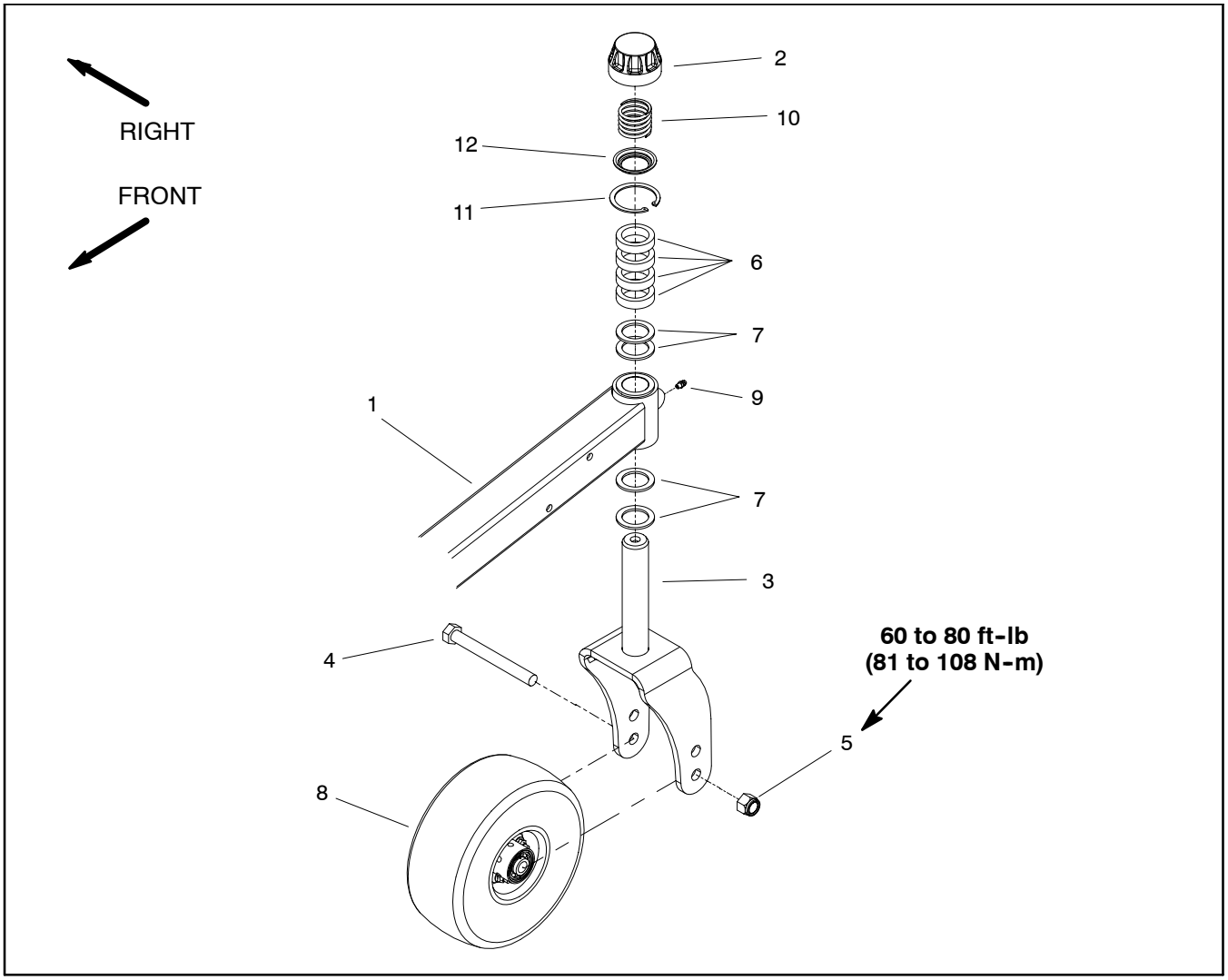


Figure 18

1. **Castor arm (wing deck shown)**
2. **Cap**
3. **Castor fork**
4. **Castor wheel bolt**
5. **Lock nut**
6. **Castor spacer**
7. **Thrust washer**
8. **Castor wheel**
9. **Grease fitting**
10. **Compression spring**
11. **Retaining ring**
12. **Cap washer**

Disassembly

1. Disassemble castor forks and wheels using Figures 18 and 19 as guides.

Assembly

1. Assemble castor forks and wheels using Figures 18 and 19 as guides.

   A. Install castor wheels so that valve stem extends toward left side of machine.

   B. Insert castor wheel bolt (item 4) from the right side of the machine.

   C. Torque castor wheel lock nut from **60 to 80 ft-lb (81 to 108 N-m)**.

2. Lubricate castor fork grease fitting.

3. Check height-of-cut setting and adjust if necessary.

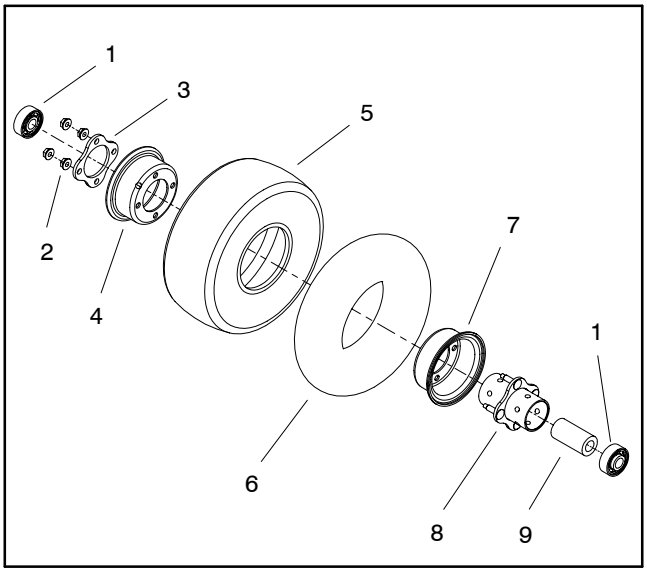


Figure 19

1. **Bearing**
2. **Flange nut (4 used)**
3. **Plate**
4. **Rim half**
5. **Tire**
6. **Inner tube**
7. **Rim half**
8. **Hub**
9. **Bearing spacer**

Deck Skids and Rollers

Removal (Fig. 20 and 21)

1. Remove skids and rollers from deck using Figures 20 and 21 as guides.

Installation (Fig. 20 and 21)

1. Install skids and rollers to deck using Figures 20 and 21 as guides.

   A. Make sure to install skids (item 7) in the same mounting hole height position (lower, middle or upper).

   B. Make sure to install all deck rollers (items 2 and 9) in the same mounting hole height position (lower or upper).

   C. When installing roller (item 2) on the front deck winglets (Fig. 20), install cap screw with the threads orientated toward the centerline of the deck. Install and tighten lock nut so that nylon locking insert in nut is fully engaged by bolt threads and roller rotates freely.

   D. When installing roller (item 2) on a wing deck (Fig. 21), install cap screw with the threads orientated away from the centerline of the machine. Install and tighten lock nut so that nylon locking insert in nut is fully engaged by bolt threads and roller rotates freely.

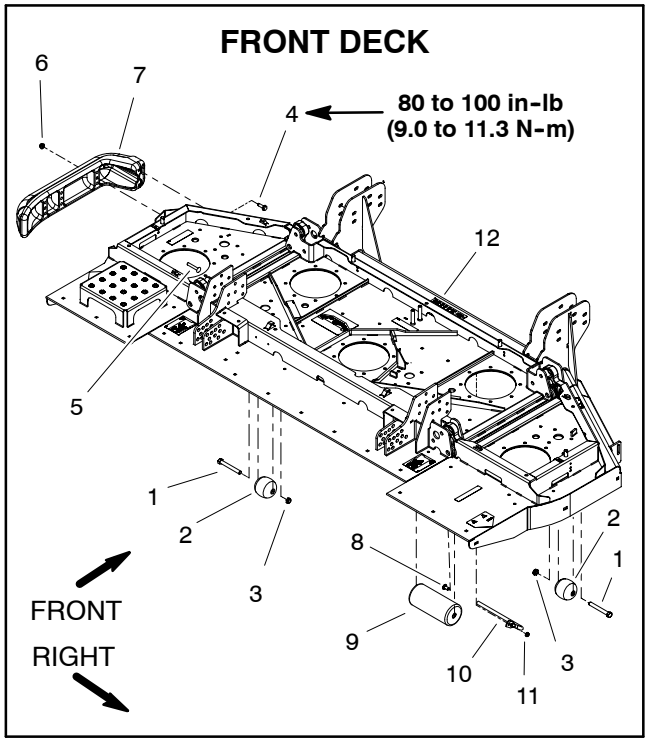


Figure 20

1. **Cap screw**
2. **Roller**
3. **Lock nut**
4. **Washer head screw**
5. **Carriage screw**
6. **Flange nut**
7. **Bumper skid (2 used)**
8. **Carriage screw**
9. **Roller**
10. **Roller shaft**
11. **Flange nut**

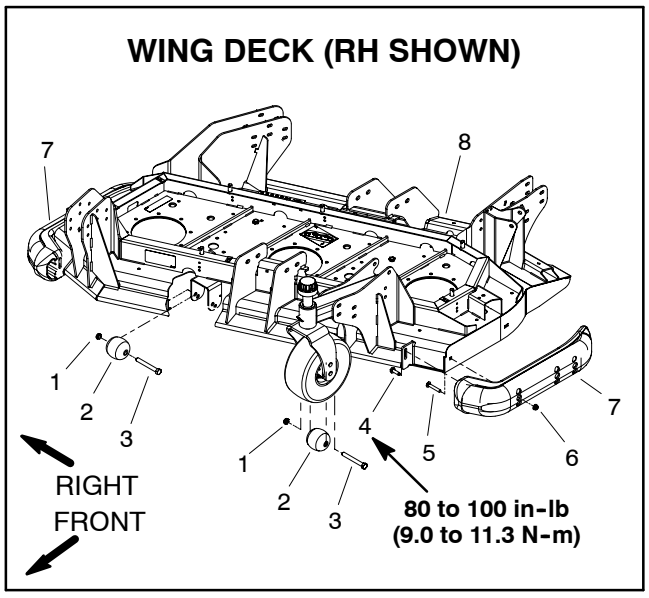


Figure 21

1. **Lock nut**
2. **Roller**
3. **Cap screw**
4. **Washer head screw**
5. **Carriage screw**
6. **Flange nut**
7. **Bumper skid**

Chapter 9

Operator Cab

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ICE COMPRESSOR SERVICE MANUAL

General Information

The information in this chapter pertains to the operator cab on the Groundsmaster 5910.

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster. Refer to the Operator's Manual for additional information when servicing the machine.

Electrical Components and Schematic

Information regarding Groundsmaster 5910 electrical cab components (switches and relay) is included in Chapter 5 – Electrical System. The electrical schematic and harness drawings for the operator cab are included in Chapter 10 – Foldout Drawings.

Air Conditioning System

The air conditioning system used on the Groundsmaster 5910 consists of the following components:

1. A compressor mounted on the engine and driven by a v–belt.

2. A condenser and condenser fan located on the top of the cab.

3. A drier–receiver, an expansion valve and an evaporator (combined with the heater core) mounted in the headliner of the cab.

4. The necessary hoses and tubes that connect the system components.

5. A fan motor that provides air movement through the evaporator and into the cab. The fan motor is located in the cab headliner and is also used for the cab heating system.

6. Operator controls to turn the air conditioning on, to adjust the fan speed and to control the cab air temperature.

Cab Heater System

The cab heater system used on the Groundsmaster 5910 consists of the following components:

1. A heater core located in the cab headliner.

2. Hoses to allow a circuit for engine coolant to circulate through the heater core. The heater core (combined with the A/C evaporator) is located in the headliner of the cab.

3. A fan motor that provides air movement through the heater core and into the cab. The fan motor is located in the cab headliner and is also used for the air conditioning system.

4. Operator controls to adjust the fan speed and to control the cab air temperature.

General Precautions for Removing and Installing Air Conditioning System Components

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

WARNING

Always wear safety goggles or a face shield when working with air conditioning system components. Also, do not allow refrigerant contact with your skin or eyes as there would be the possibility of serious injury.

CAUTION

Never use compressed air to leak test or pressure test the air conditioning system. Under certain conditions, pressurized mixtures of refrigerant and air can be combustible.

1. Before servicing any air conditioning system components, park machine on a level surface, apply parking brake, lower cutting decks or attachments and stop engine. Remove key from the ignition switch.

2. Clean machine before disconnecting, removing or disassembling any air conditioning system components. Thorough cleaning will prevent system contamination while performing service procedures.

3. Put caps or plugs on any lines, fittings or components left open or exposed to prevent system contamination.

4. Before loosening or removing any air conditioning system hose or other component, have a certified air conditioning service technician recover the system refrigerant and then evacuate the air conditioning system completely. It is illegal to vent refrigerant to the atmosphere.

5. Put labels on disconnected lines and hoses for proper installation after repairs are completed.

6. If compressor is removed from machine, keep compressor in the same orientation as the installed position. This will prevent compressor oil from filling the compressor cylinders.

7. Note the position of fittings (especially elbow fittings) before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hoses and tubes.

8. Always use a DOT approved tank for storing used and recycled refrigerants.

9. The Groundsmaster 5910 air conditioning system uses R134a refrigerant. DO NOT use other refrigerants in the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

10. Refrigerant containers (either full or empty) are under pressure that will increase if the containers are heated. DO NOT expose refrigerant containers to high heat sources or flame.

11. Be sure the work area is properly ventilated to prevent any accumulation of refrigerant or other fumes.

12. Make sure that caps are always placed on the pressure hose ports. These caps prevent refrigerant leakage from the system.

13. The drier–receiver component is used to collect moisture that will reduce air conditioning performance. If the air conditioning system is opened for component repair or replacement, drier–receiver replacement is recommended.

14. After installing air conditioning components, have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system.

Air Conditioning Compressor

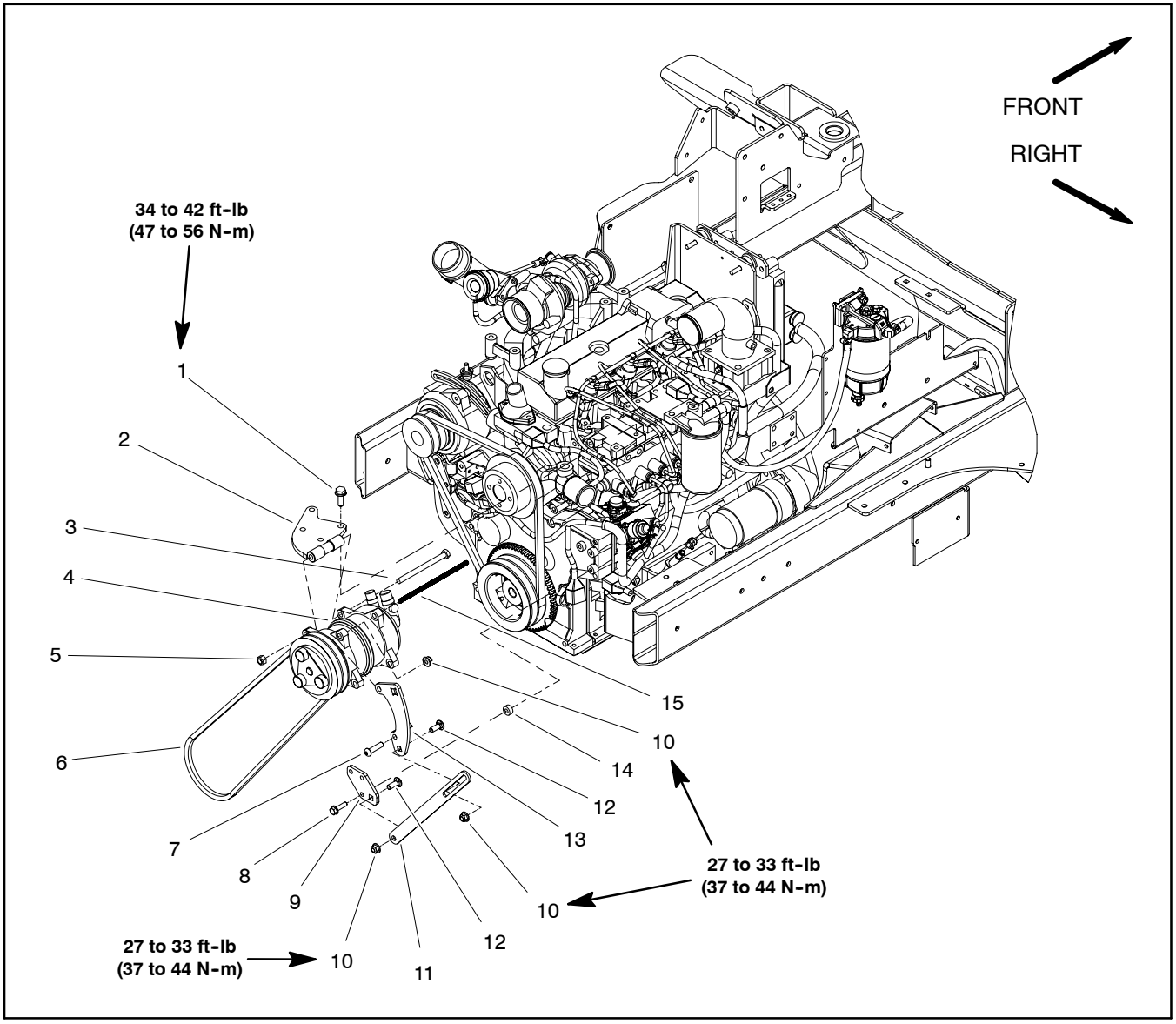


Figure 1

1. **Flange head screw (4 used)**
2. **Pivot plate**
3. **Cap screw**
4. **Air conditioning compressor**
5. **Lock nut**
6. **Belt**
7. **Button head screw (2 used)**
8. **Flange head screw (3 used)**
9. **Mount plate**
10. **Flange nut (4 used)**
11. **Tensioner arm**
12. **Carriage screw (2 used)**
13. **Mount plate**
14. **Spacer (3 used)**
15. **Conduit**

Removal (Fig. 1)

1. Park machine on a level surface, lower cutting decks, stop engine, engage parking brake and remove key from the ignition switch.

2. Raise hood to allow access to engine.

3. Loosen carriage screws and flange nuts that secure A/C compressor and tensioner arm (Fig. 2). Rotate compressor to loosen drive belt. Remove belt from A/C compressor pulley.

4. Inspect compressor drive belt for glazing or damage. Replace belt if necessary.

5. Disconnect compressor electrical connector from machine wire harness.

6. Read the General Precautions for Removing and Installing Air Conditioning System Components at the beginning of the Service and Repairs section of this chapter.

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

7. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.

8. Label and remove hoses from compressor. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.

9. Support compressor to prevent it from shifting or falling.

NOTE: There may be shims mounted between compressor and pivot plate. When removing compressor, note shim location and quantity for assembly purposes.

10. Remove carriage screw and flange nut that secure compressor to tensioner arm. Remove cap screw and lock nut that secure compressor to pivot plate.

IMPORTANT: To prevent compressor oil from filling the compressor cylinders, keep compressor in the same orientation as the installed position.

11. Carefully remove compressor from engine and machine.

12. If necessary, remove compressor mounting brackets from engine.

NOTE: The replacement of the drier−receiver is recommended whenever A/C compressor is removed from the system (see Heater and Evaporator Assembly in this section).

Installation (Fig. 1)

1. If removed, secure compressor mounting brackets to engine.

2. Position compressor to pivot plate and tensioner arm on engine.

3. The clearance between the compressor mounting flanges and pivot plate must be less than 0.004" (0.10 mm). If necessary, install shims between compressor flanges and pivot plate to adjust clearance. See Parts Catalog for shim kit.

4. Secure compressor to pivot plate and tensioner arm with removed fasteners and nuts. Do not fully tighten fasteners.

IMPORTANT: After the compressor has been installed, make sure to rotate the compressor drive shaft several times to properly distribute oil in the compressor. Compressor damage due to oil slugging can occur if this procedure is not performed.

5. Manually rotate the compressor drive shaft at least ten (10) revolutions to make sure that no compressor oil is in the compressor cylinders.

6. Place drive belt onto compressor pulley.

7. Tension compressor drive belt:

   A. Insert torque wrench in square hole on compressor mount plate (Fig. 2).

   B. Rotate compressor with torque wrench from **27 to 33 ft-lb (37 to 44 N-m)**.

   C. Hold compressor in position and tighten fasteners to secure compressor in place. Torque flange nuts that secure tensioner arm from **27 to 33 ft-lb (37 to 44 N-m)**.

8. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to compressor.

9. Connect compressor electrical connector to machine wire harness.

10. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

11. Lower and secure hood.

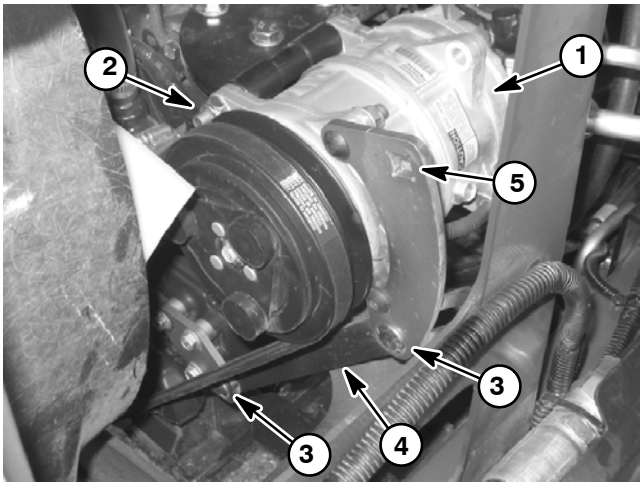


Figure 2

1. **Compressor**
2. **Cap screw & lock nut**
3. **Carriage screw & nut**
4. **Tensioner arm**

Air Conditioning Compressor Service

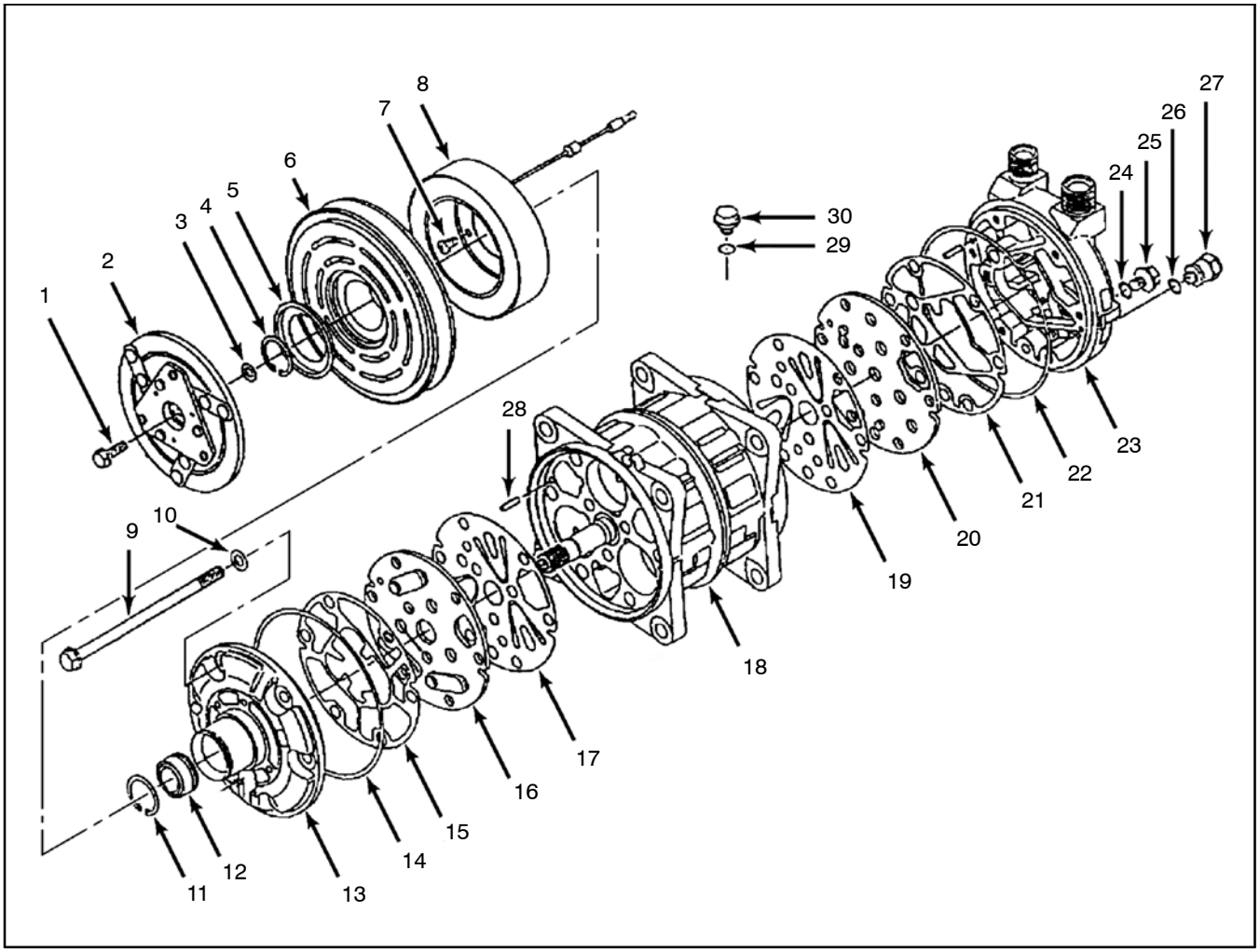


Figure 3

1. **Armature bolt**
2. **Armature plate**
3. **Shim**
4. **Snap ring**
5. **Cover**
6. **Pulley assembly**
7. **Coil screw (3 used)**
8. **Coil**
9. **Body bolt (6 used)**
10. **Washer (6 used)**
11. **Snap ring**
12. **Shaft seal**
13. **Front cylinder head**
14. **Body O-ring**
15. **Front gasket**
16. **Front valve plates**
17. **Front suction valve**
18. **Cylinder shaft assembly**
19. **Rear suction valve**
20. **Rear valve plate**
21. **Rear gasket**
22. **Body O-ring**
23. **Rear cylinder head**
24. **O-ring**
25. **Drain plug**
26. **O-ring**
27. **Pressure relief valve**
28. **Alignment pin**
29. **O-ring**
30. **Oil fill plug**

NOTE: The air conditioning compressor used on the Groundsmaster 5910 is an International Components Engineering (ICE) model TM-16. For air conditioning compressor repair procedures, see the ICE Compressor Service Manual at the end of this chapter.

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Roof Assembly

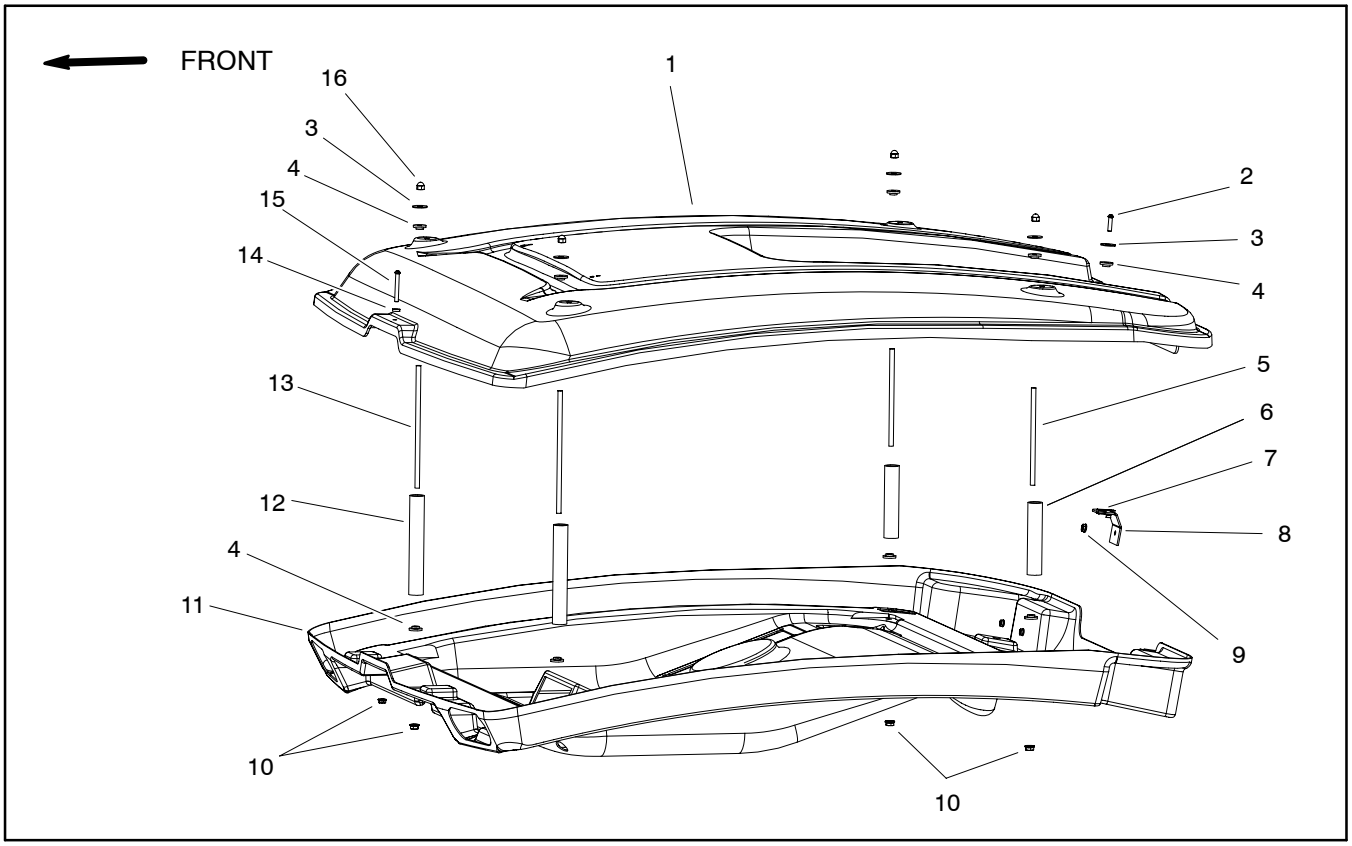


Figure 4

1. **Roof**
2. **Screw (2 used)**
3. **Flat washer (6 used)**
4. **Bushing**
5. **Rear fastener (2 used)**
6. **Rear spacer (2 used)**
7. **Panel nut**
8. **Roof mount**
9. **Flange nut**
10. **Flange nut (4 used)**
11. **Headliner**
12. **Front spacer (2 used)**
13. **Front fastener (2 used)**
14. **Rubber washer**
15. **Cap screw**
16. **Hex nut (4 used)**

To gain access to the heater core and air conditioning components that are located under the cab roof, the roof panel can be loosened, raised and supported.

Removal (Fig. 4)

1. Park machine on a level surface, lower cutting decks, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove two (2) screws (item 2), flat washers (item 3) and bushings (item 4) that secure the rear of the roof to the roof mount.

3. Remove the cap screw (item 15) and rubber washer (item 14) that secure the front of the roof.

4. Remove four (4) hex nuts (item 16), flat washers (item 3) and bushings (item 4) that secure roof to front and rear fasteners.

5. Carefully lift front of roof while leaving rear of roof against headliner. Support front of roof in the raised position to allow access to heater and air conditioning components.

Installation (Fig. 4)

1. Make sure that all components in headliner and roof are installed and secure.

2. Remove support and carefully tilt roof into position.

3. Secure roof to headliner with all removed fasteners.

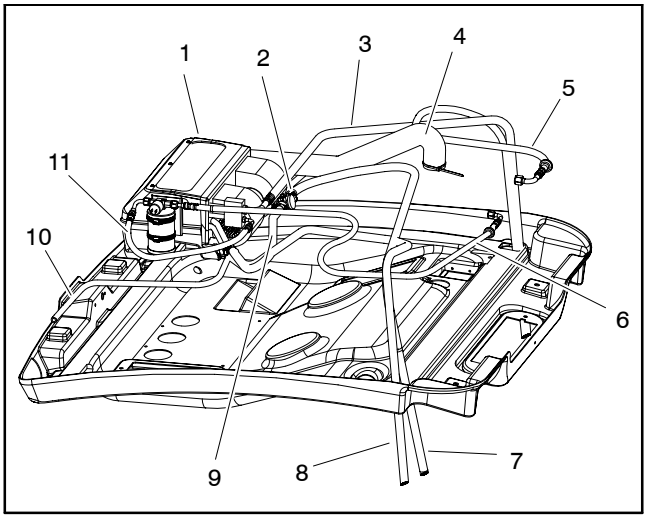


Figure 5

1. **Heater evaporator assembly**
2. **Heater valve**
3. **A/C hose: evaporator to compressor**
4. **Air duct hose**
5. **A/C hose: compressor to condenser**
6. **A/C hose: condenser to drier**
7. **Heater hose: thermostat to heater valve**
8. **Heater hose: heater core to water pump**
9. **Heater hose: heater valve to heater core**
10. **Condensation drain hose (2 used)**
11. **A/C hose: drier to evaporator**

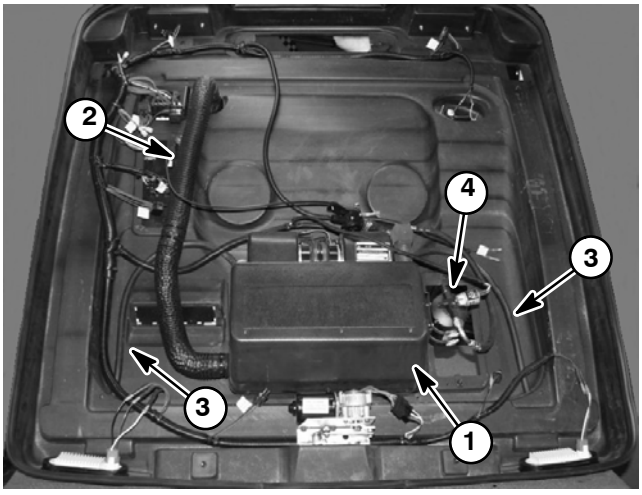


Figure 6

1. **Heater evaporator**
2. **Air duct hose**
3. **Drain hose**
4. **Drier-receiver**

Air Conditioning Condenser Assembly

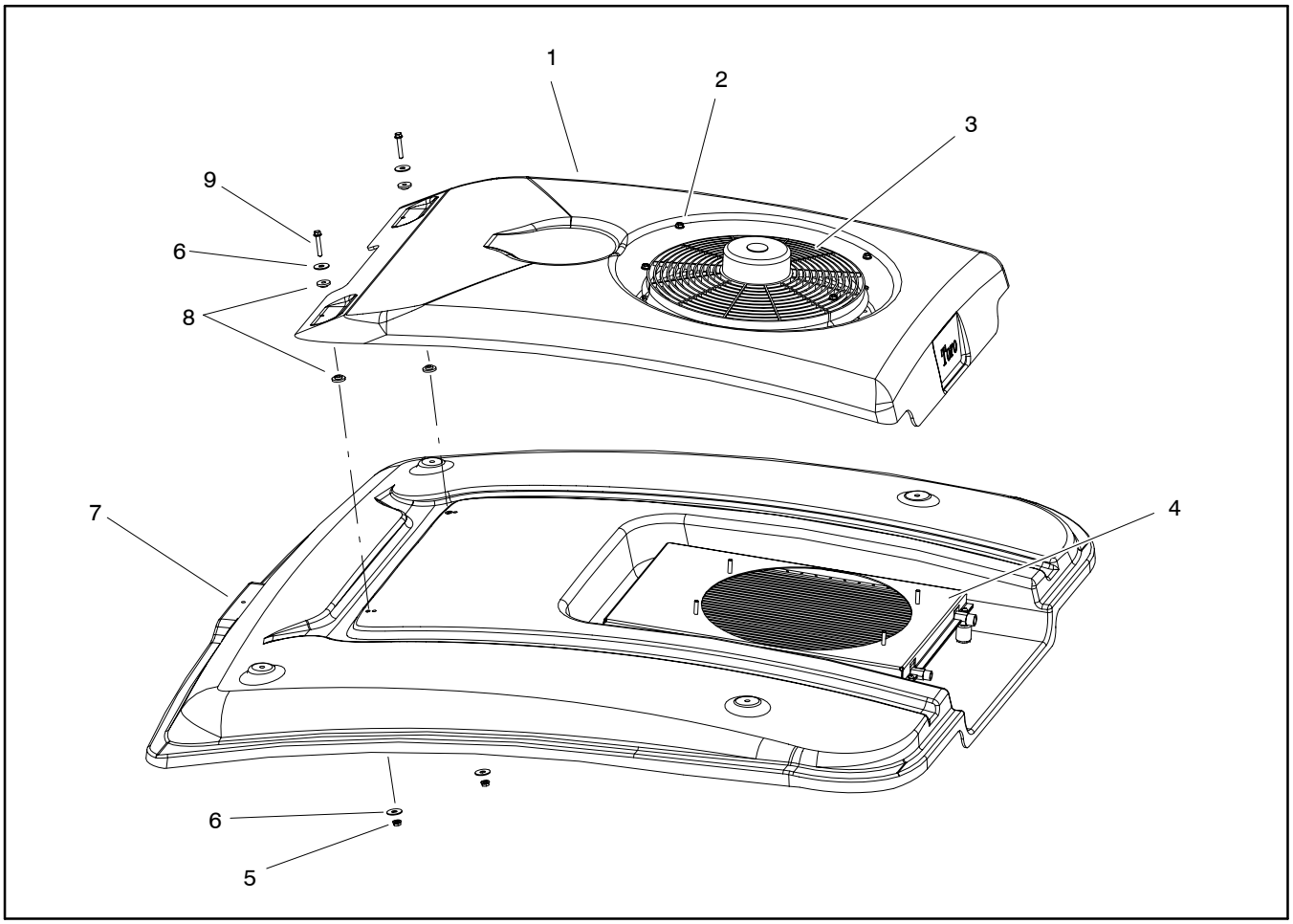


Figure 7

1. **Condenser cover**
2. **Flange nut (4 used)**
3. **Condenser fan**
4. **Condenser coil assembly**
5. **Flange nut (2 used)**
6. **Flat washer (4 used)**
7. **Roof**
8. **Bushing (4 used)**
9. **Flange head screw (2 used)**

Removal (Fig. 7)

1. Park machine on a level surface, lower cutting decks, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove fasteners that secure roof in place. Raise and support roof to allow access to condenser assembly (see Roof Assembly Removal in this section).

3. Disconnect wire harness connector from condenser fan motor.

4. Remove flange nuts (item 2) that secure condenser fan and cover to condenser coil.

5. Remove fasteners (items 5, 6, 8 and 9) that secure condenser cover to roof. Lift cover and condenser fan from roof.

6. Read the General Precautions for Removing and Installing Air Conditioning System Components at the beginning of the Service and Repairs section of this chapter.

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

7. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.

8. Label and remove hoses from condenser coil. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.

9. Remove condenser coil from roof using Figure 8 as a guide.

NOTE: The replacement of the drier–receiver is recommended whenever the air conditioning system is opened (see Heater and Evaporator Assembly in this section).

Installation (Fig. 7)

1. Install condenser coil to roof using Figure 8 as a guide.

2. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to condenser coil.

3. Position condenser cover and condenser fan to roof. Secure cover and fan with removed fasteners (items 5, 6, 8 and 9).

4. Secure condenser fan to condenser coil with flange nuts (item 2).

5. Connect wire harness connector to condenser fan motor.

6. Make sure that all machine air conditioning components are installed and secure.

7. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

8. Lower and secure roof assembly (see Roof Assembly Installation in this section).

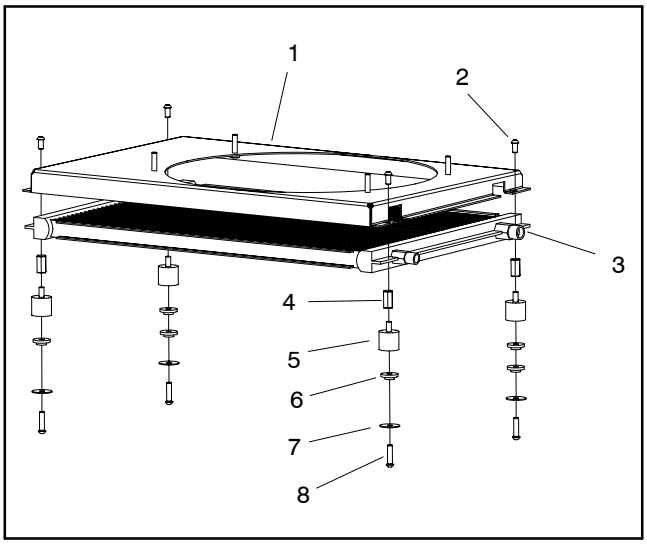


Figure 8

1. **Condenser fan mount**
2. **Screw (4 used)**
3. **Condenser coil**
4. **Coupler nut (4 used)**
5. **Isolator mount (4 used)**
6. **Bushing (6 used)**
7. **Flat washer (4 used)**
8. **Screw (4 used)**

Heater and Evaporator Assembly

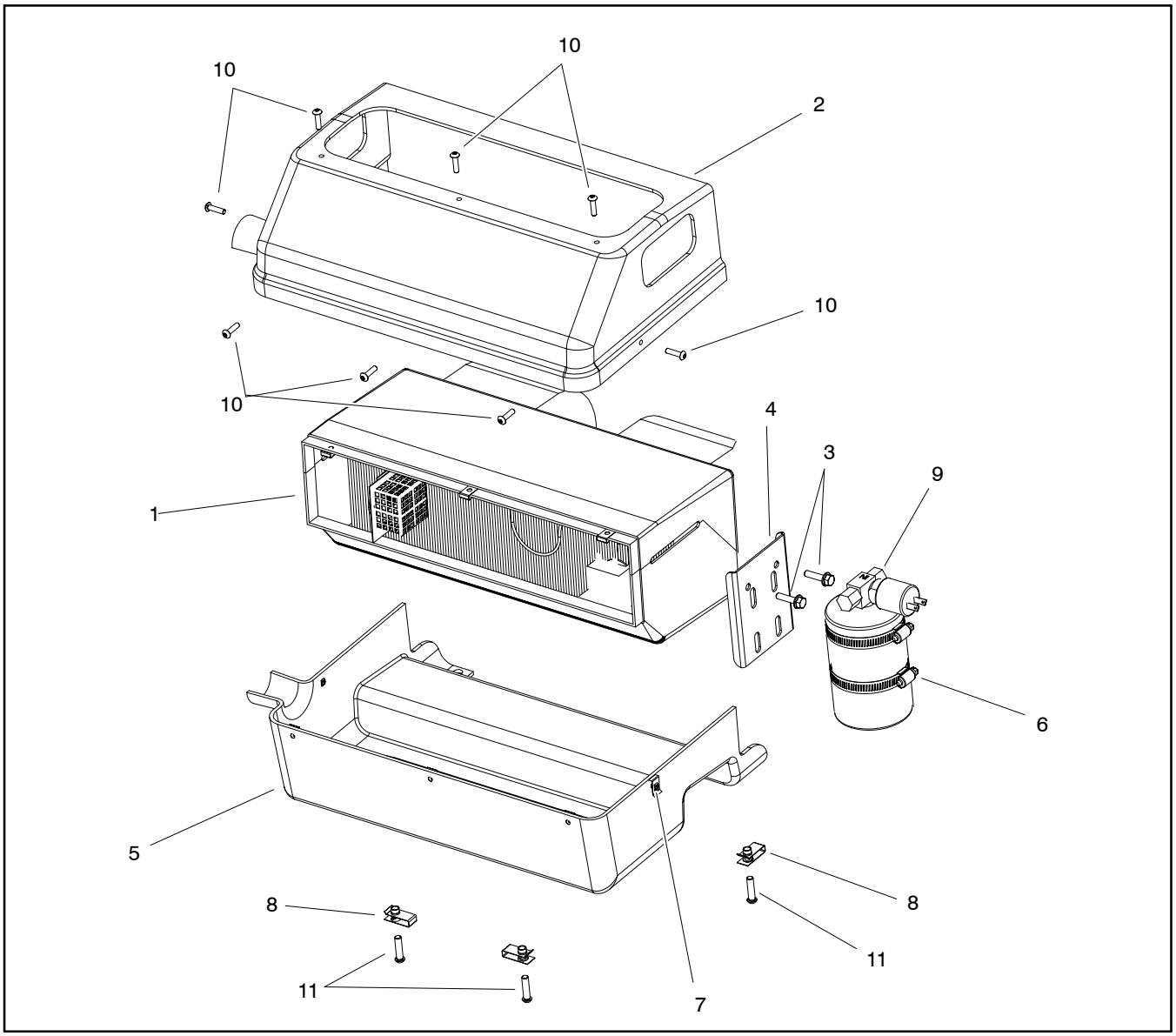


Figure 9

1. **Heater and evaporator assembly**
2. **Top cover**
3. **Flange head screw (2 used)**
4. **Drier-receiver mount**
5. **Bottom cover**
6. **Hose clamp (2 used)**
7. **Speed nut (8 used)**
8. **Panel nut (4 used)**
9. **Drier-receiver**
10. **Screw (8 used)**
11. **Screw (5 used)**

Removal (Fig. 9)

1. Park machine on a level surface, lower cutting decks, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove fasteners that secure roof in place. Raise and support roof to allow access to condenser assembly (see Roof Assembly Removal in this section).

3. Disconnect wire harness connectors from fan motor and binary switch on drier−receiver.

4. Read the General Precautions for Removing and Installing Air Conditioning System Components at the beginning of the Service and Repairs section of this chapter.

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

5. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.

6. Label and remove hoses from heater core, evaporator and drier−receiver. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.

7. Loosen hose clamp that secures air duct hose to heater and evaporator assembly covers. Slide hose from covers.

8. Remove screws that secure top cover to bottom cover. Remove top cover to access heater and evaporator assembly.

9. Disassemble heater and evaporator assembly using Fig. 12 as a guide.

NOTE: The replacement of the drier−receiver is recommended whenever the air conditioning system is opened.

Installation (Fig. 9)

1. Assemble heater and evaporator assembly using Fig. 12 as a guide. Make sure that expansion valve is covered with insulating tape to prevent condensation issues.

2. Position heater and evaporator assembly into bottom cover in headliner. Secure top cover to bottom cover with removed screws.

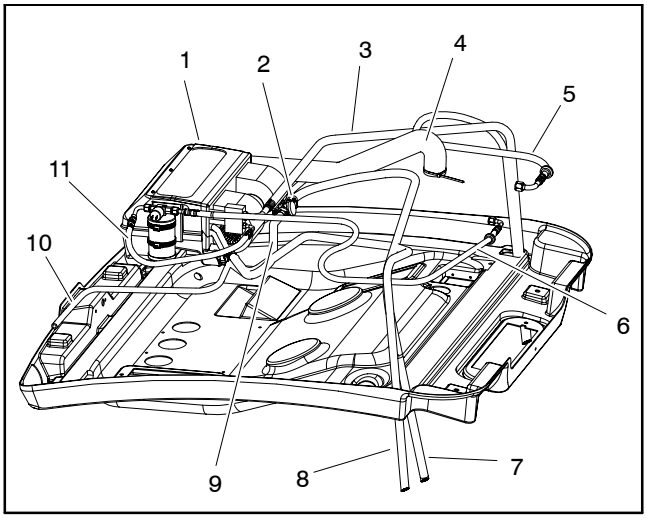


Figure 10

1. **Heater evaporator assembly**
2. **Heater valve**
3. **A/C hose: evaporator to compressor**
4. **Air duct hose**
5. **A/C hose: compressor to condenser**
6. **A/C hose: condenser to drier**
7. **Heater hose: thermostat to heater valve**
8. **Heater hose: heater core to water pump**
9. **Heater hose: heater valve to heater core**
10. **Condensation drain hose (2 used)**
11. **A/C hose: drier to evaporator**

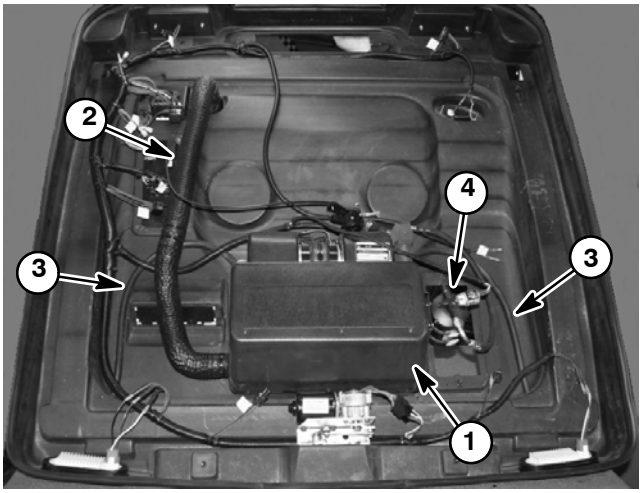


Figure 11

1. **Heater evaporator**
2. **Air duct hose**
3. **Drain hose**
4. **Drier−receiver**

3. Slide air duct hose onto heater and evaporator assembly covers and secure with hose clamp.

4. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to heater core, evaporator and drier−receiver.

5. Make sure that condensation hoses are secured to bottom housing of heater and evaporator assembly and are routed to cab frame for proper draining of condensate.

6. Connect wire harness connectors to fan motor and binary switch on drier−receiver.

7. Make sure that all machine air conditioning components are installed and secure.

8. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

9. Operate the heater system to make sure that no coolant leaks exist.

10. Lower and secure roof assembly (see Roof Assembly Installation in this section).

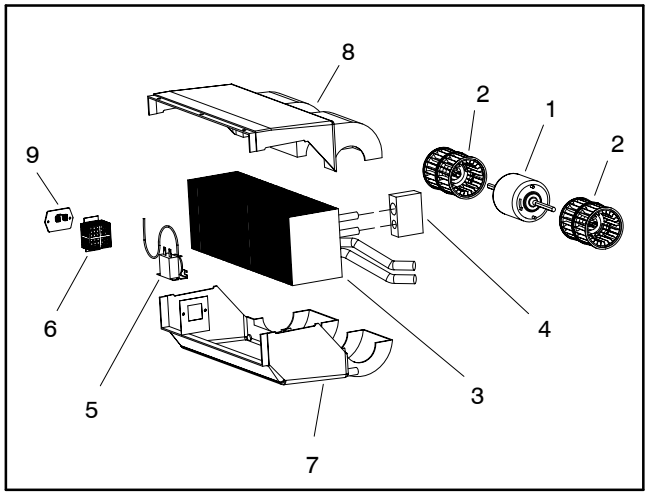


Figure 12

1. **Fan motor**
2. **Blower wheel**
3. **Evaporator/heater core**
4. **Expansion valve**
5. **Freeze switch**
6. **Resistor guard**
7. **Bottom housing**
8. **Top housing**
9. **Resistor**

Chapter 10

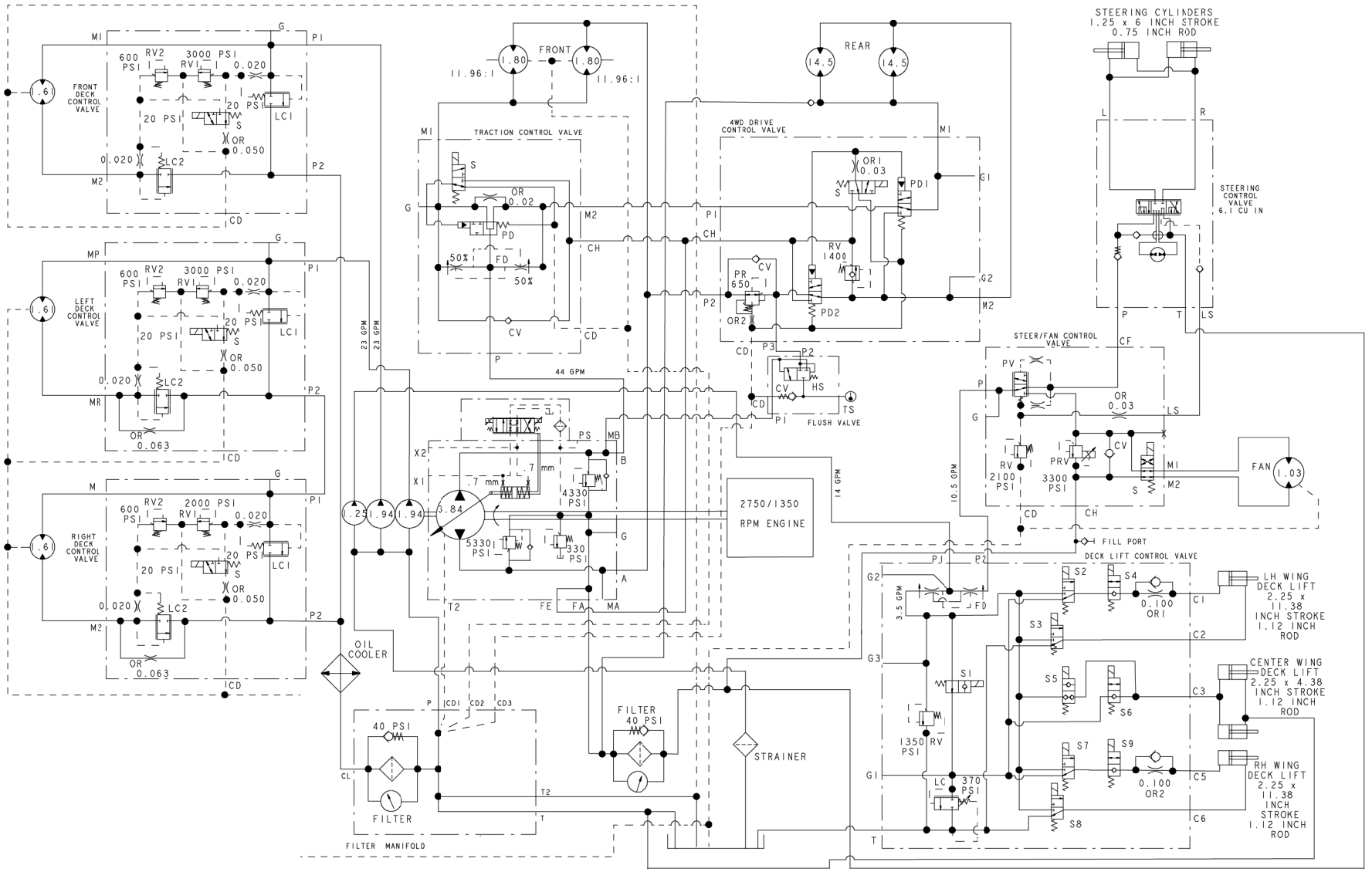
Foldout Drawings

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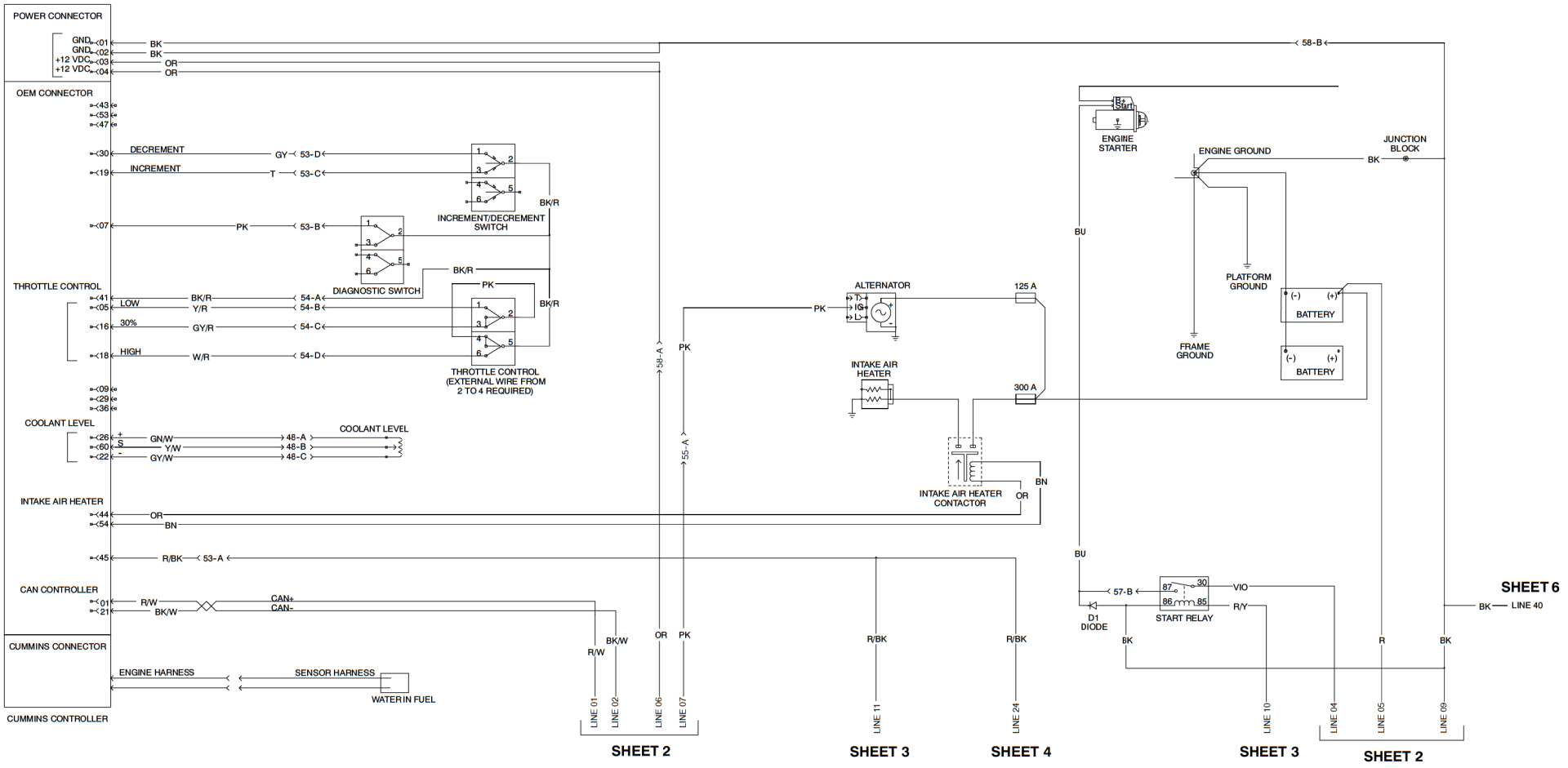
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Groundsmaster 5900/5910
Hydraulic Schematic



Groundsmaster 5900/5910

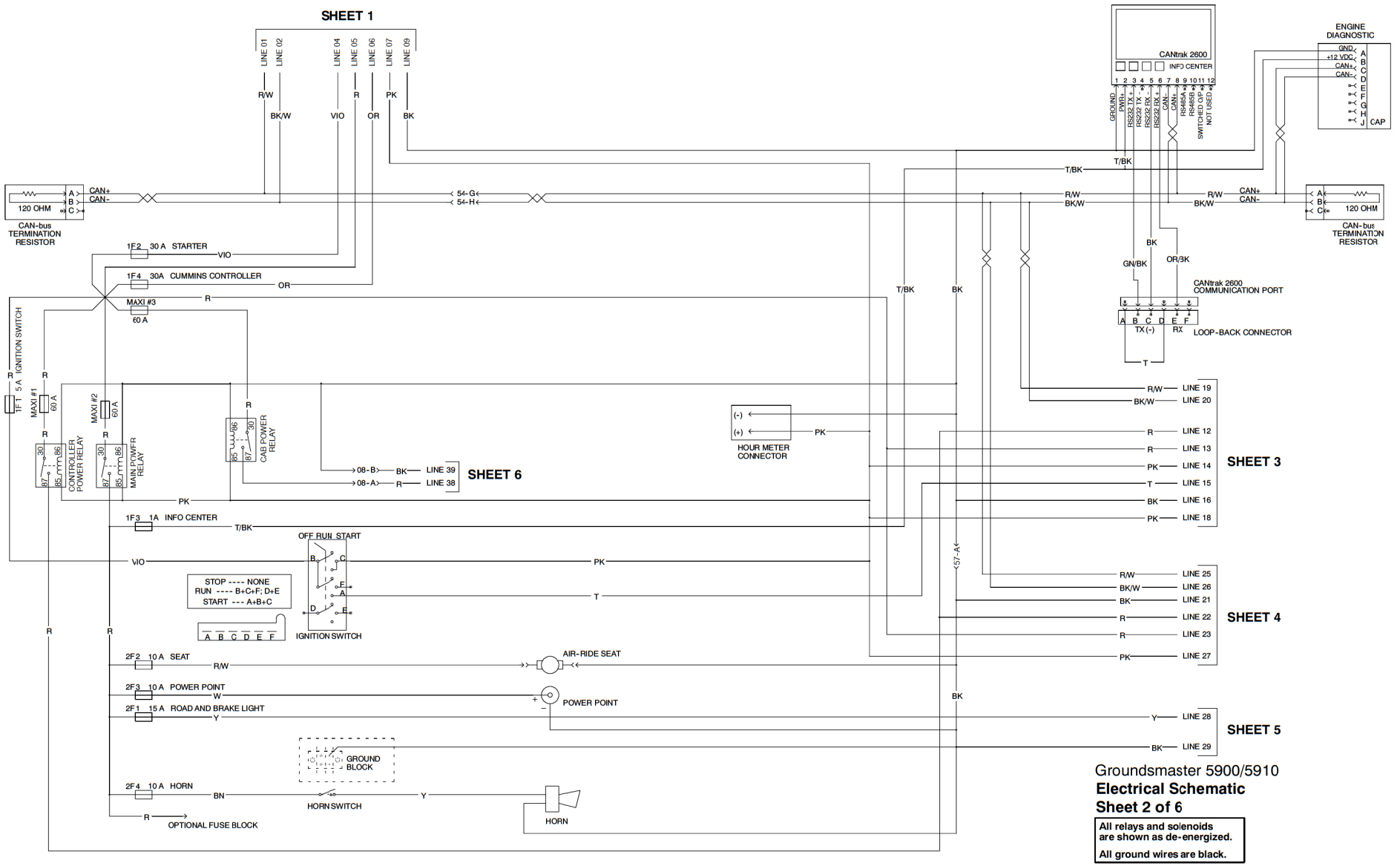
Electrical Schematic

Sheet 1 of 6

All relays and solenoids are shown as de-energized.

All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

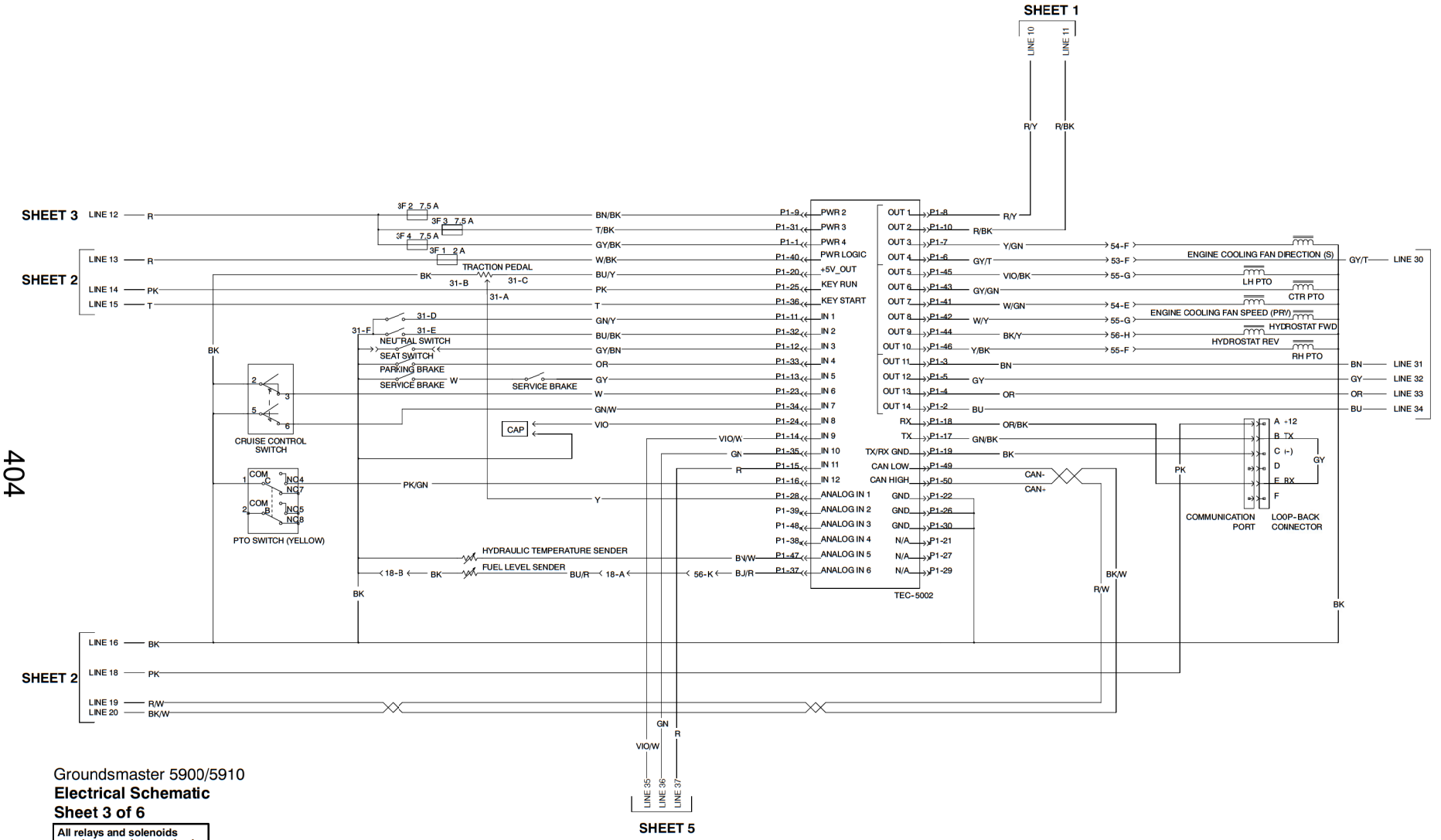
Electrical Schematic

Sheet 2 of 6

All relays and solenoids are shown as de-energized.

All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

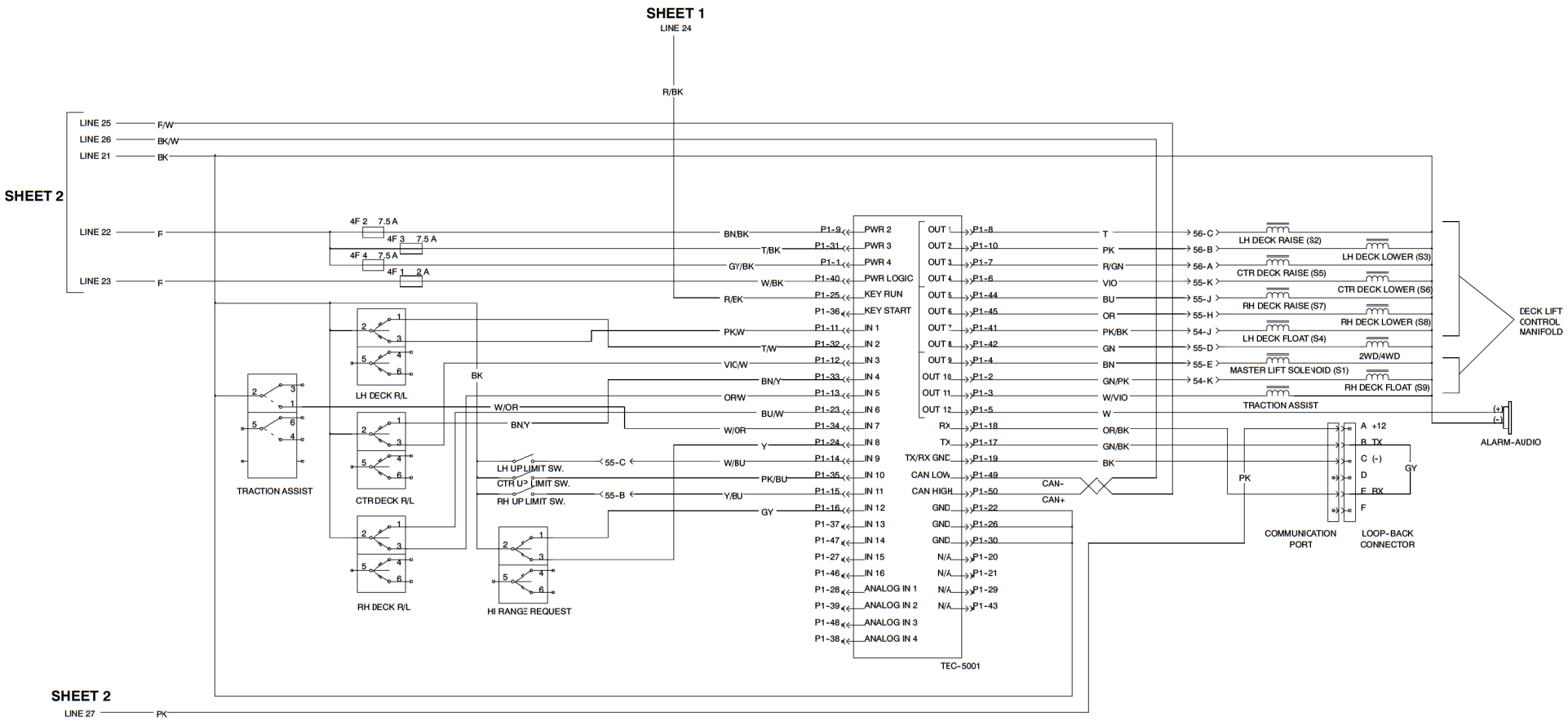
Electrical Schematic

Sheet 3 of 6

All relays and solenoids are shown as de-energized.

All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



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Groundsmaster 5900/5910

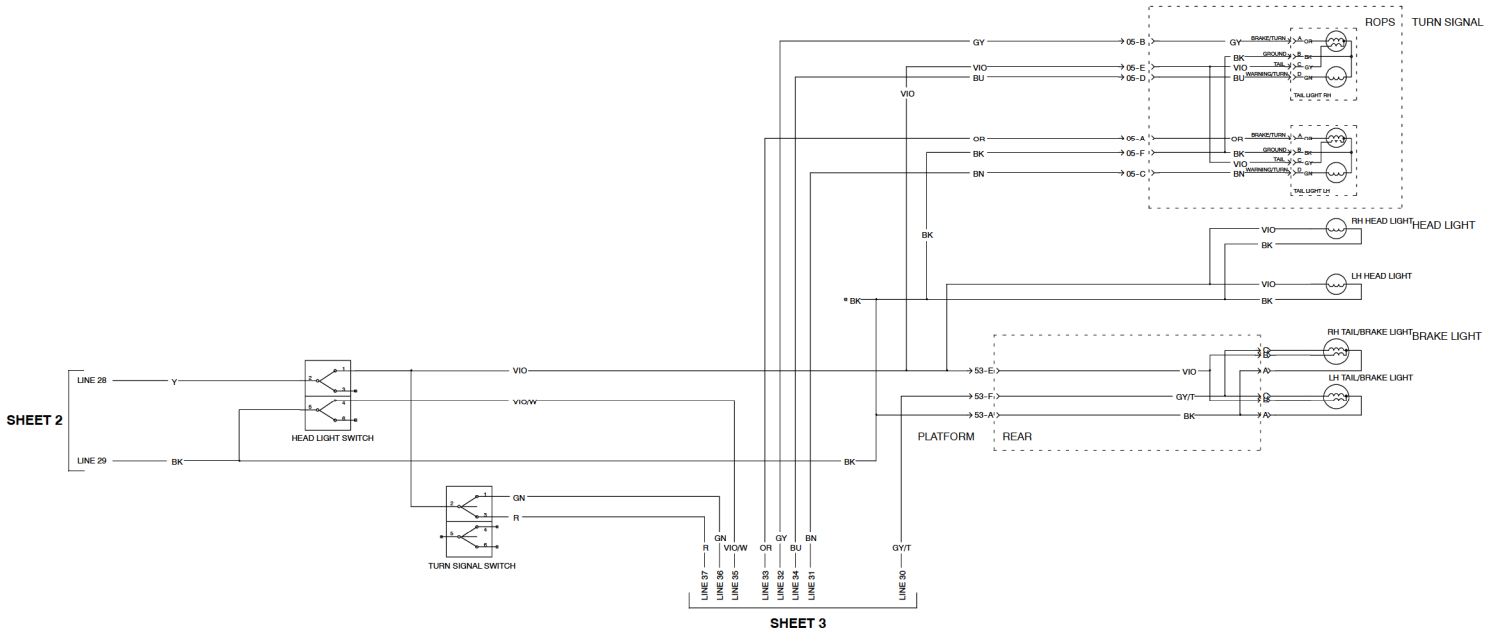
Electrical Schematic

Sheet 4 of 6

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All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

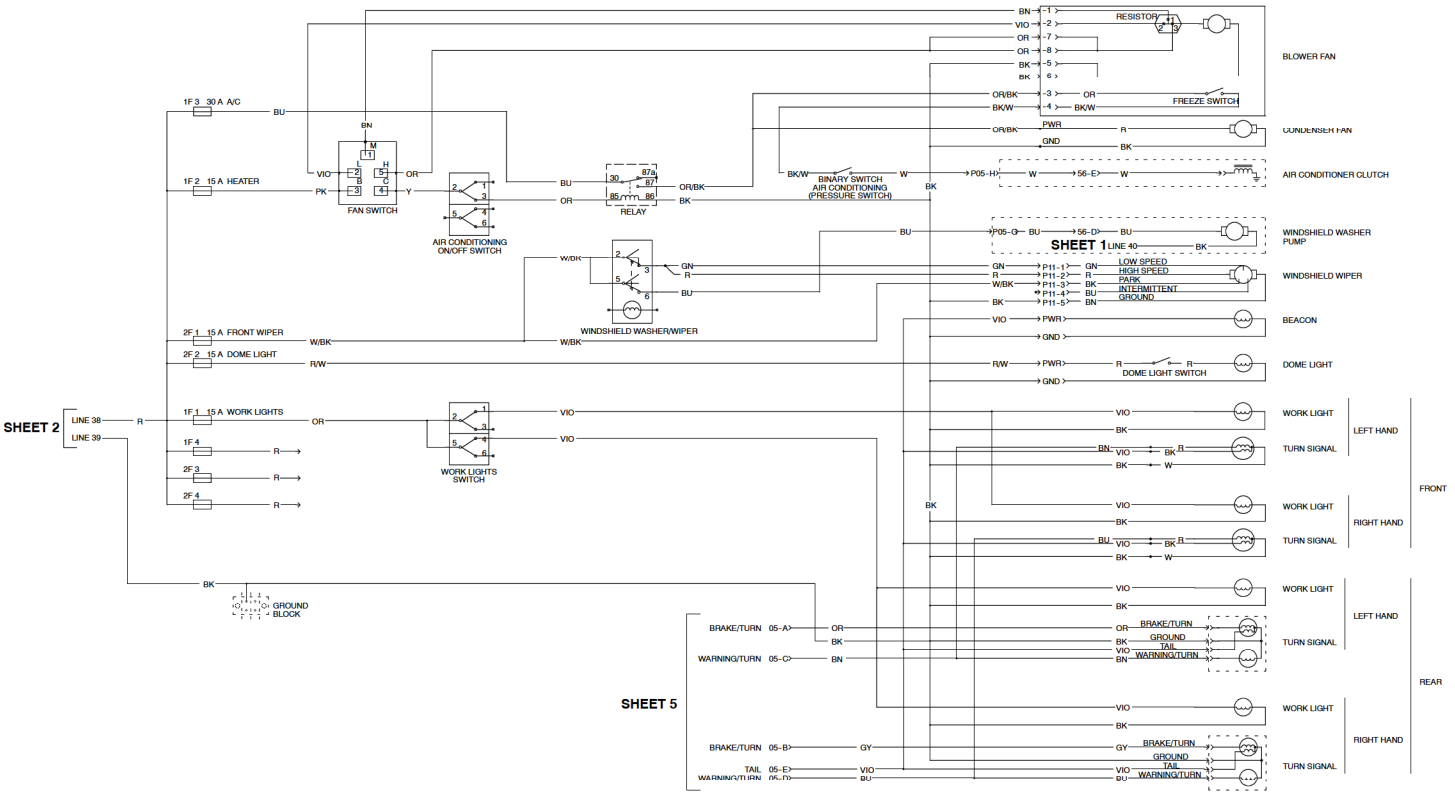
Electrical Schematic

Sheet 5 of 6

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All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

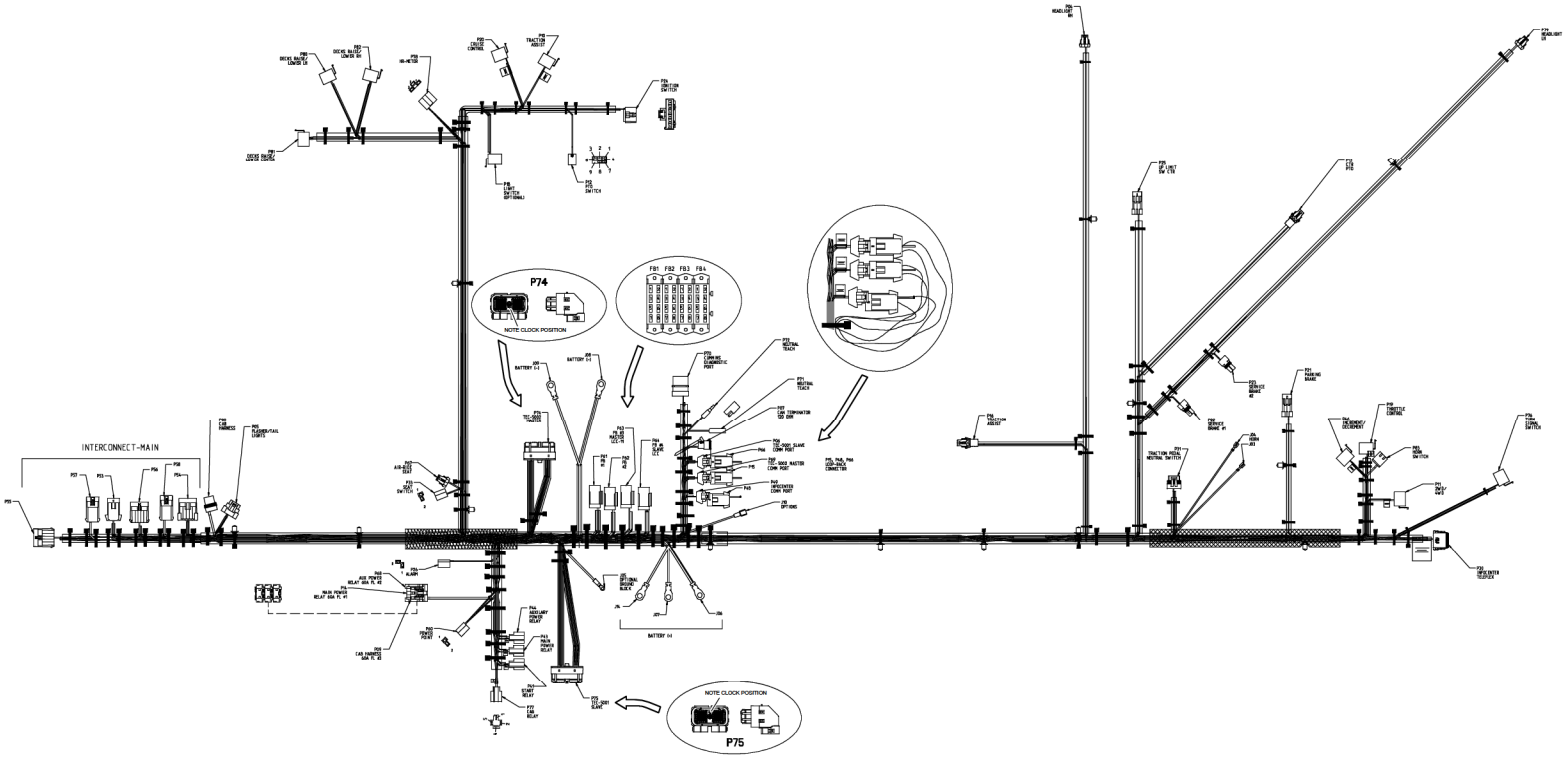
Electrical Schematic

Sheet 6 of 6 (Operator Cab)

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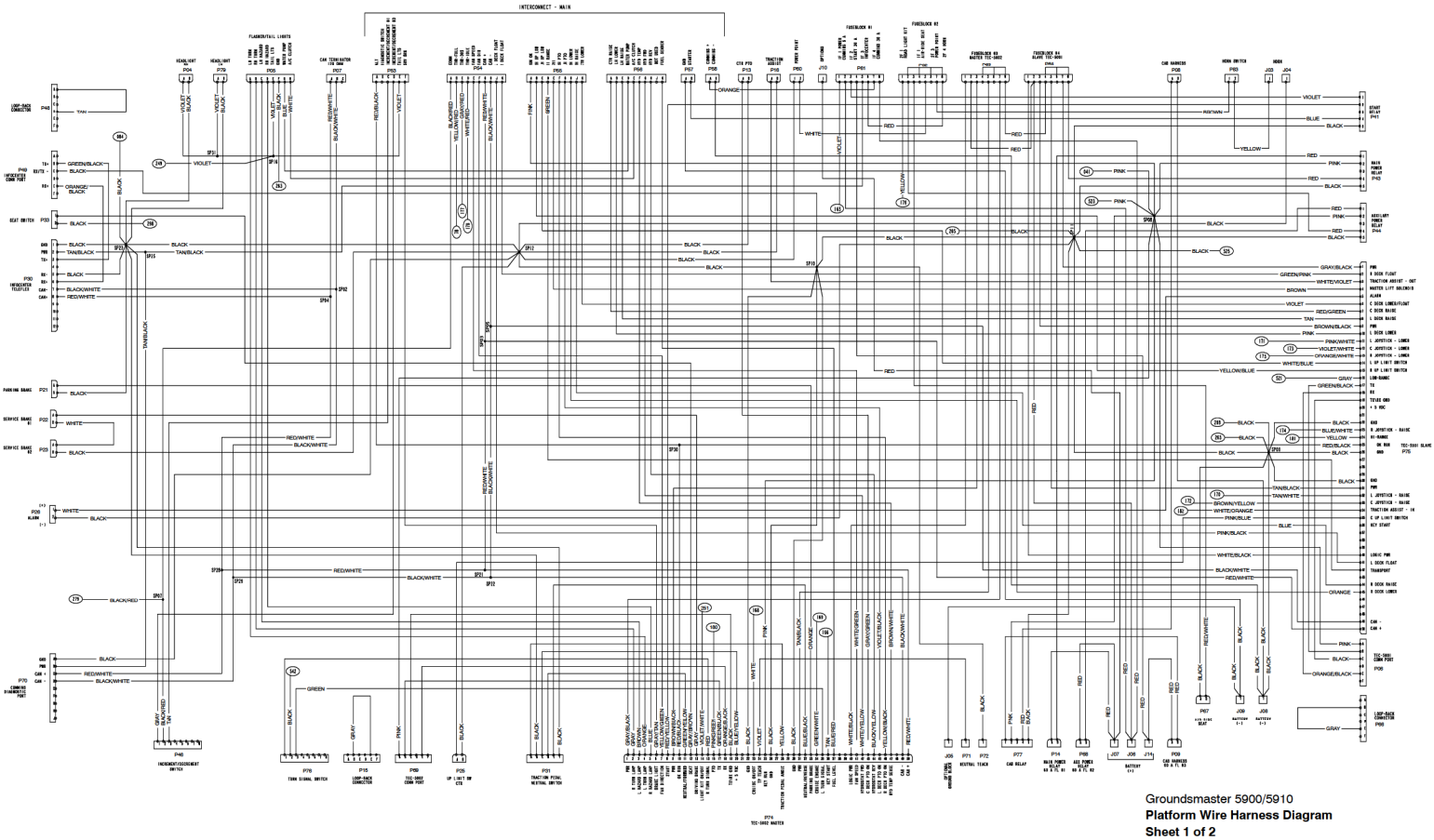
All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910
Platform Wire Harness Drawing

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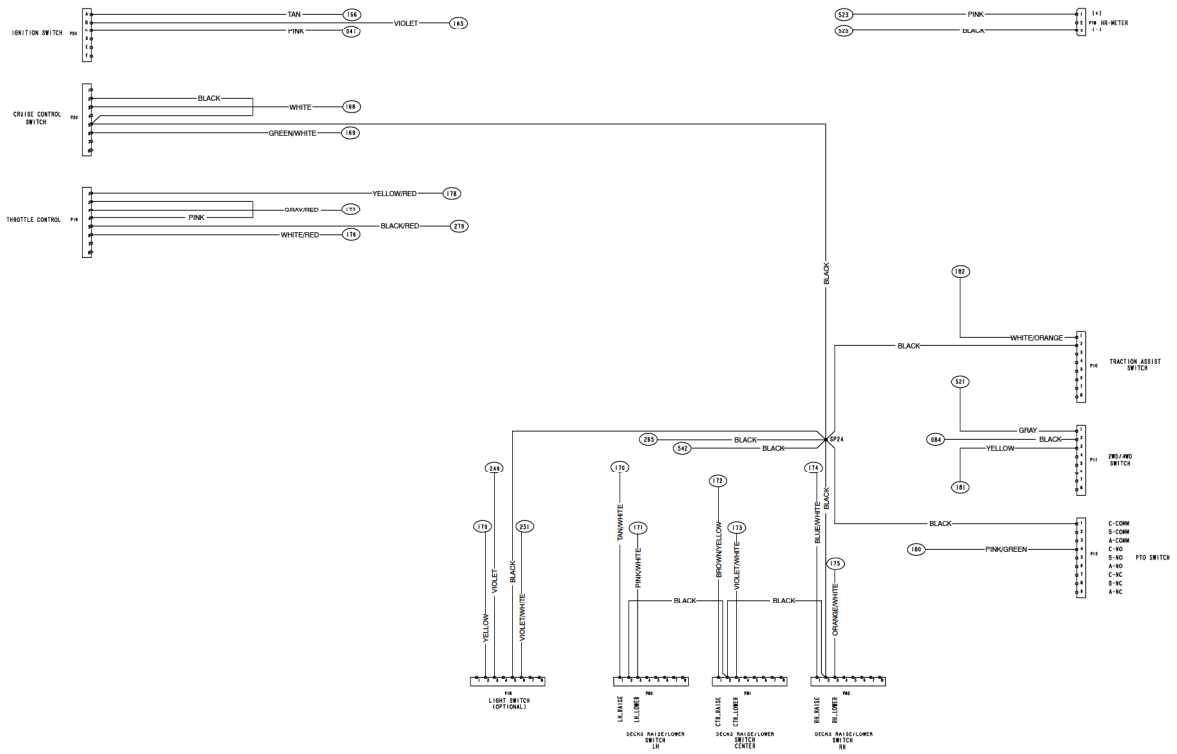
Groundsmaster 5900/5910

Platform Wire Harness Diagram

Sheet 1 of 2

NOTE: THE PLATFORM WIRE HARNESS DIAGRAM IS SHOWN ON TWO (2) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, A REFERENCE NUMBER WILL BE IDENTIFIED.

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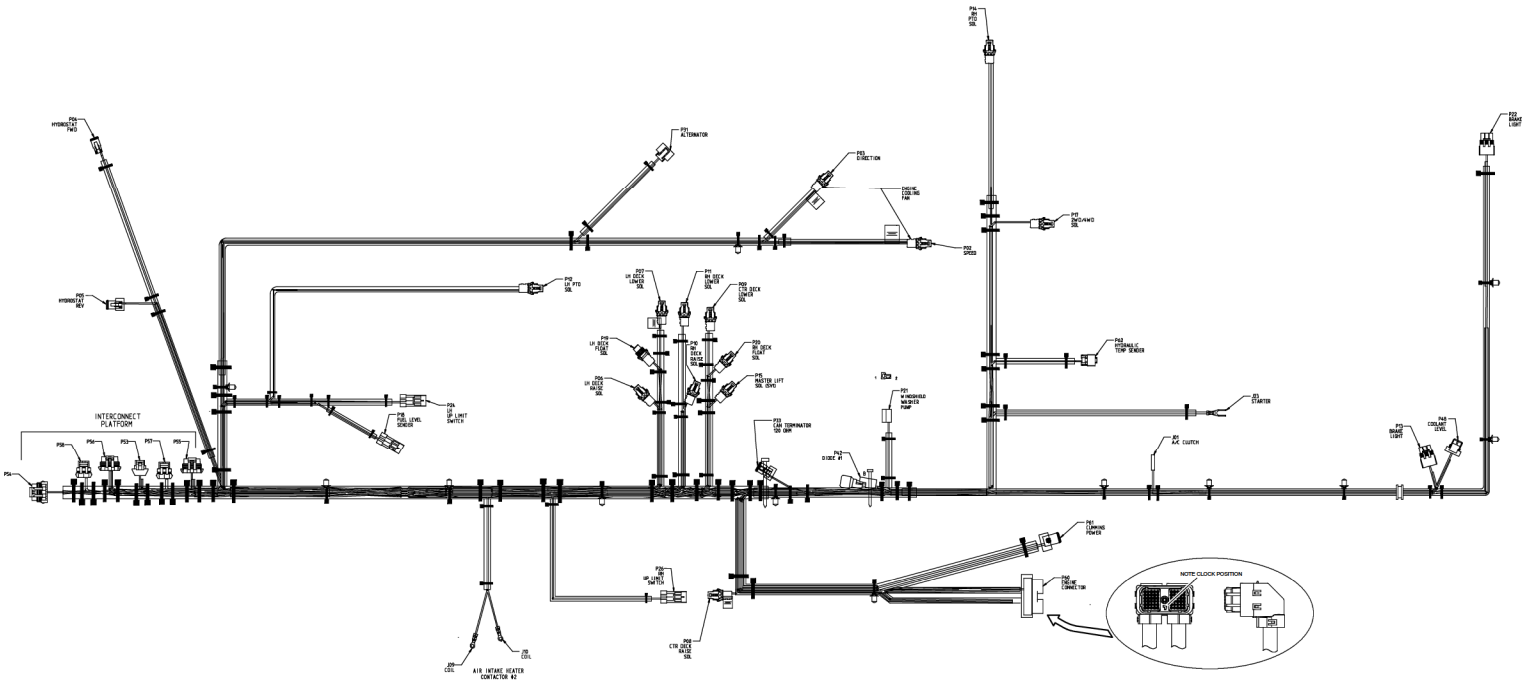
Groundsmaster 5900/5910

Platform Wire Harness Diagram

Sheet 2 of 2

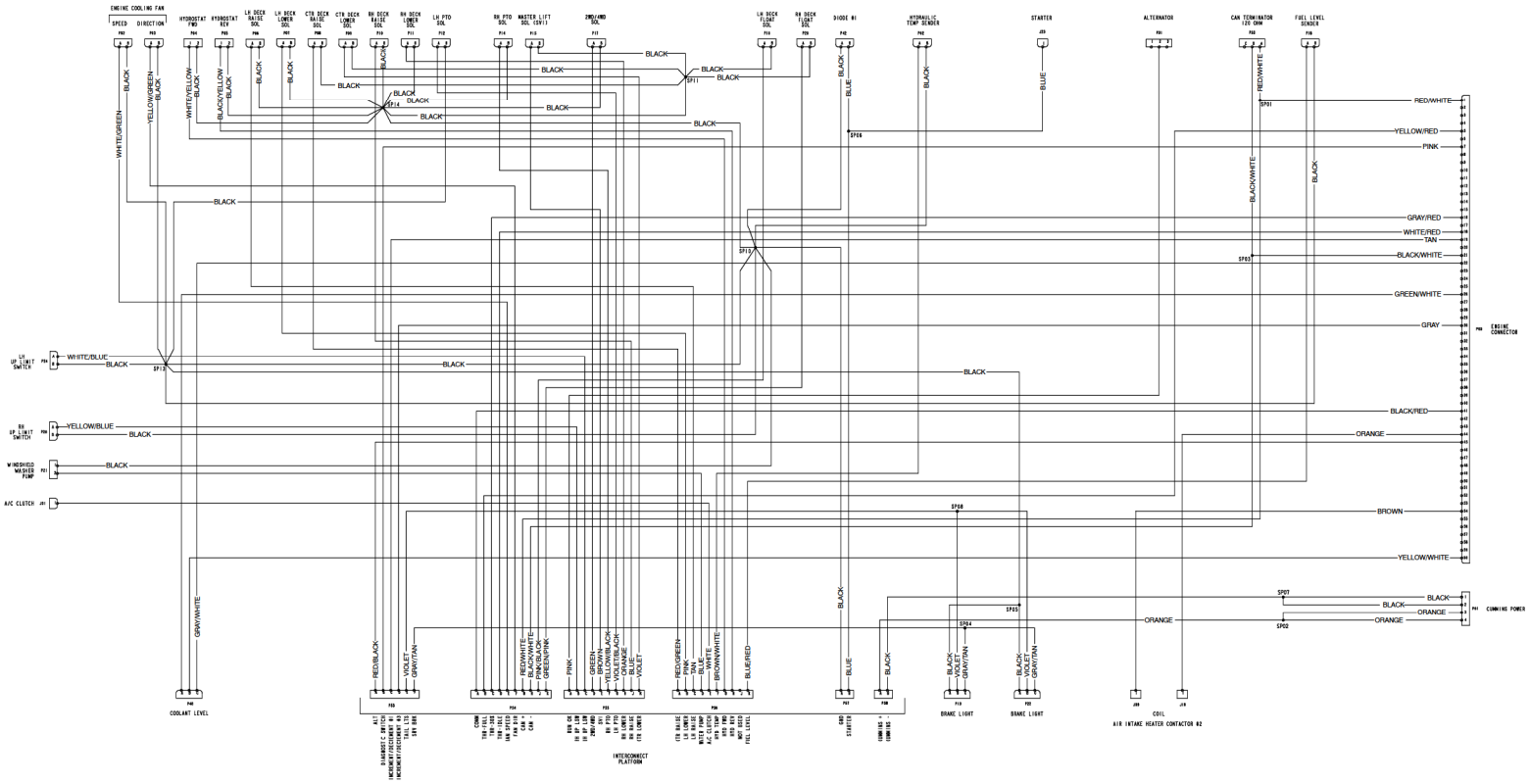
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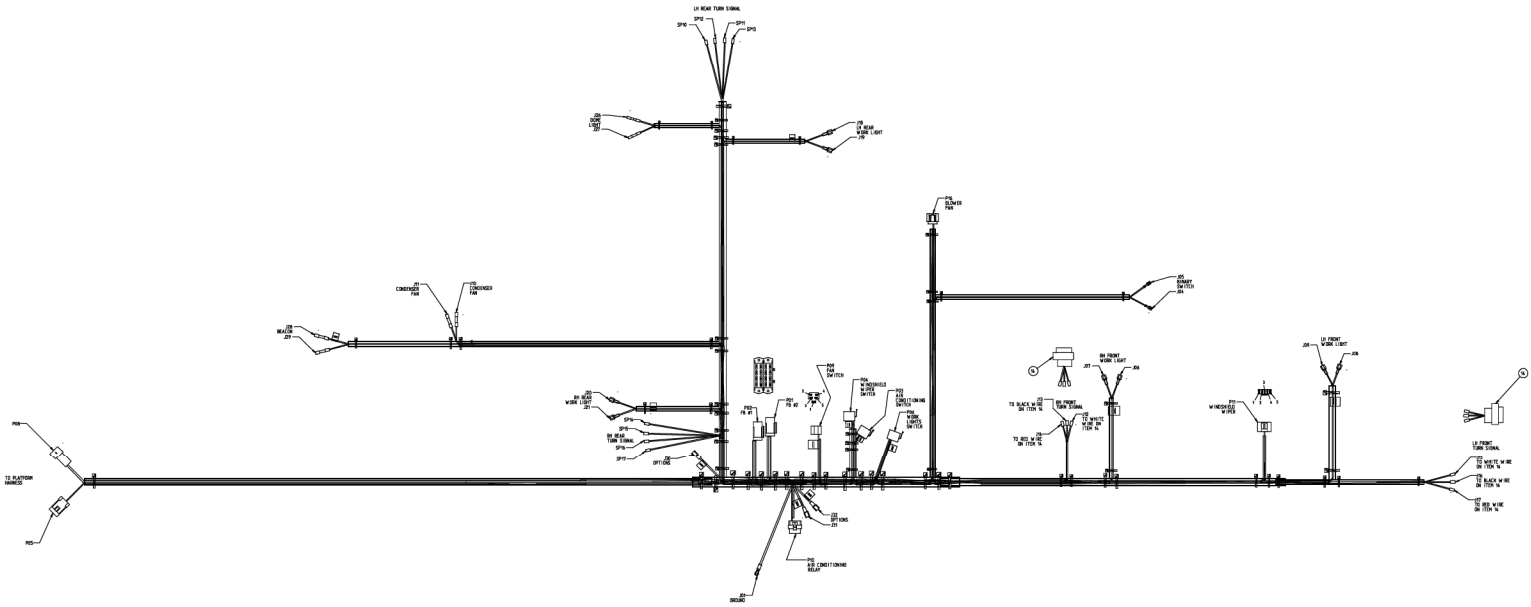
Groundsmaster 5900/5910
Rear Wire Harness Drawing

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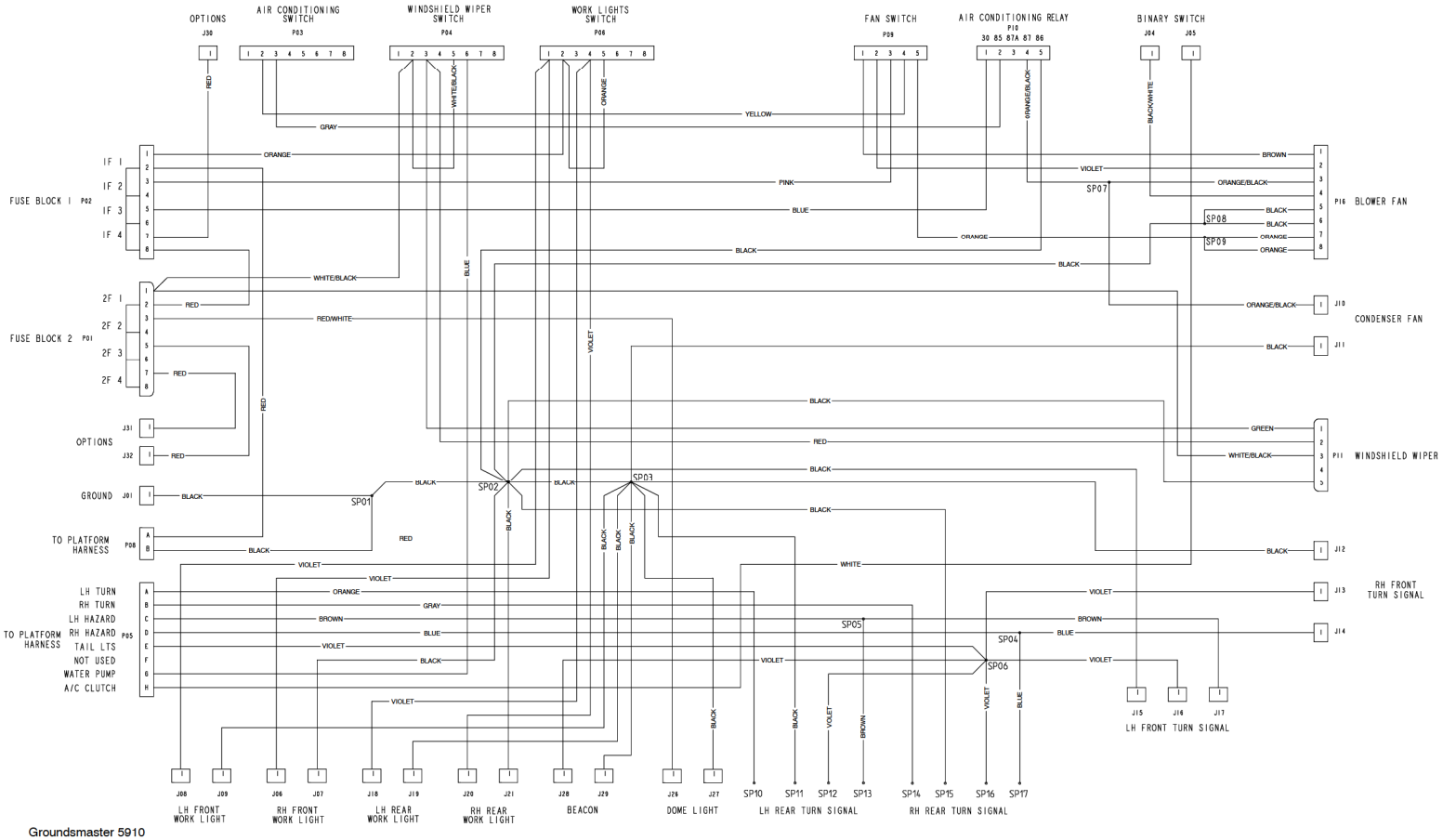
Groundsmaster 5900/5910
Rear Wire Harness Diagram

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Groundsmaster 5910
Cab Wire Harness Drawing

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Groundsmaster 5910
Cab Wire Harness Diagram

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