Form No. 10178SL Rev D

TORO®

Count on it.

Service Manual

# Groundsmaster® 4300-D

Original Instructions (EN)

# Revision History

| Revision | Date | Description |
|---|---|---|
| -- | 2010 | Initial Issue. |
| A | 03/2018 | Added revision history. |
| B | 03/2019 | Updated Chassis chapter. |
| C | 07/2020 | Updated Electrical chapter and Foldout Drawings. |
| D | 06/2021 | Updated Engine chapter. |
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# NOTES

Part No. 10178SL (Rev. D)

# Service Manual

# Groundsmaster® 4300–D

## Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing and repair of major systems and components on the Groundsmaster 4300–D.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manual and Parts Catalog for your machine. Additional copies of the Operator's Manual and Parts Catalog are available on the internet at www.Toro.com.

The Toro Company reserves the right to change product specifications or this publication without notice.

**This safety symbol means DANGER, WARNING, or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.**

**NOTE:** A **NOTE** will give general information about the correct operation, maintenance, service, testing or repair of the machine.

**IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.**

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# Chapter 1

# Safety

## Table of Contents

# Safety Instructions

Your Groundsmaster meets or exceeds safety standard specifications when weights are installed according to information in the Operator's Manual. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

**WARNING**

**To reduce the potential for injury or death, comply with the following safety instructions.**

## Before Operating

1. Review and understand the contents of the Operator's Manual and Operator Training DVD before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. A replacement Operator's Manual is available on the Internet at www.Toro.com.

2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine.

3. Tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

4. Assure interlock switches are adjusted correctly so engine cannot be started unless traction pedal is in NEUTRAL and PTO switch is OFF (disengaged).

5. Since diesel fuel is highly flammable, handle it carefully:

   A. Store fuel in containers specifically designed for this purpose.

   B. Do not remove machine fuel tank cap while engine is hot or running.

   C. Do not smoke while handling fuel.

   D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill.

   E. After refueling machine, install fuel tank and fuel container caps.

   F. If fuel is spilled, do not attempt to start the engine but move the machine away from the area of spillage. Avoid creating any source of ignition until fuel vapors have dissipated. Wipe up any spilled fuel.

## While Operating

1. Sit on the seat when starting and operating the machine.

2. Before starting the engine:

   A. Apply the parking brake.

   B. Make sure the traction pedal is in NEUTRAL and the PTO switch is OFF (disengaged).

   C. After engine is started, release parking brake and keep foot off traction pedal. Machine must not move. If movement is evident, the traction pedal linkage is adjusted incorrectly; therefore, shut engine off and adjust traction pedal linkage until machine does not move when traction pedal is released (see Operator's Manual).

3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.

4. Do not touch engine, radiator or exhaust system while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

5. Before getting off the seat:

   A. Ensure that traction pedal is in NEUTRAL.

   B. Lower and disengage cutting decks and wait for all movement to stop.

   C. Apply parking brake.

   D. Stop engine and remove key from ignition switch.

6. Anytime the machine is parked (short or long term), the cutting decks should be lowered to the ground. This relieves pressure from the hydraulic lift circuit and eliminates the risk of the cutting decks unexpectedly lowering to the ground.

7. Do not park on slopes unless wheels are chocked or blocked.

## Maintenance and Service

1. Before servicing or making adjustments, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.

3. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.

4. Make sure all hydraulic line connectors are tight, and all hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.

5. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

6. Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved by using all of the hydraulic controls (see Relieving Hydraulic Pressure in the General Information section of Chapter 4 – Hydraulic System).

7. Use care when checking or servicing the cutting decks. Wear gloves and use caution when servicing them.

8. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on machine frequently.

9. If engine must be running to perform maintenance or to make an adjustment, keep hands, feet, clothing and other parts of the body away from the cutting decks and other moving parts. Keep bystanders away.

10. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed with a tachometer.

11. Shut engine off before checking or adding oil to the crankcase.

12. Disconnect battery before servicing the machine. Disconnect negative battery cable first and positive cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive battery cable first and negative cable last.

13. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.

14. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

15. When changing attachments, tires or performing other service, use correct supports, hoists and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury (see Jacking Instructions in this section).

16. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.

17. When welding on machine, disconnect all battery cables to prevent damage to machine electronic equipment. Disconnect negative battery cable first and positive cable last. Also, disconnect the wire harness connector from the machine controller and disconnect the terminal connector from the alternator. Attach welder ground cable no more than two (2) feet (0.61 meters) from the welding location.

18. At the time of manufacture, your Groundsmaster conformed to the safety standards for riding mowers. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in nonconformance with the safety standards, and the warranty may be voided.

# Jacking Instructions



**CAUTION**

**When changing attachments, tires or performing other service, use correct supports, hoists and jacks. 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 jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.**

### Front End Jacking

1. Apply parking brake and chock both rear tires to prevent the machine from moving.

2. Position jack securely under the rectangular pad on the frame axle tube, just to the inside of the front wheel (Fig. 1).

3. Jack front of machine off the ground.

4. Position jack stands under the frame as close to the wheel as possible to support the machine.

### Rear End Jacking

1. Apply parking brake and chock both front tires to prevent the machine from moving.

2. Place jack securely at the center of the rear axle under the axle pivot bracket. Jack rear of machine off the ground.

3. Position jack stands under the frame to support the machine.

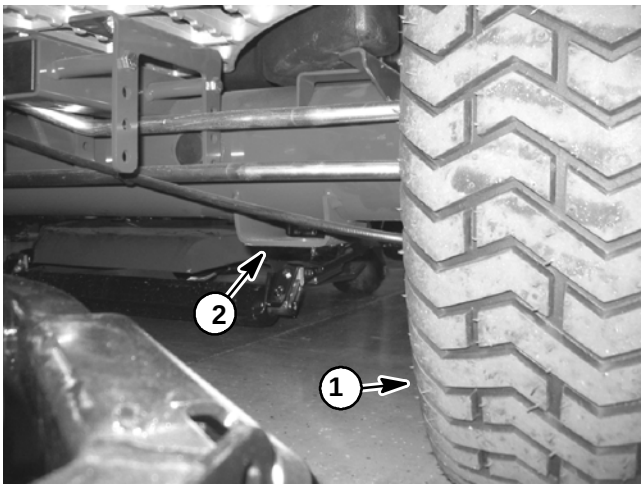


Figure 1

1. **Front wheel**
2. **Front jacking point**

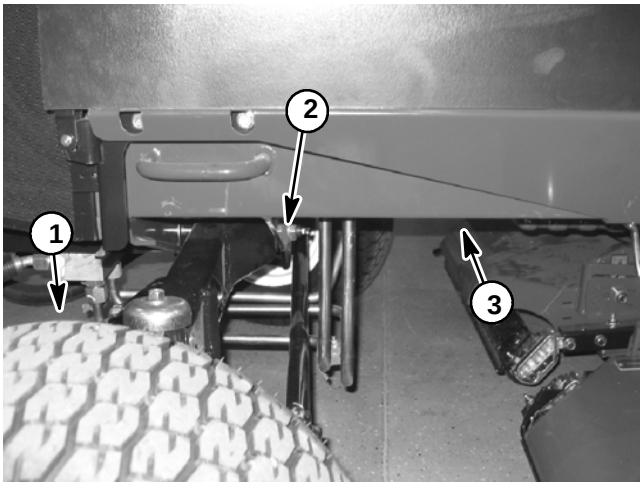


Figure 2

1. **Rear wheel**
2. **Rear axle pivot bracket**
3. **Jack stand location**

# Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the traction unit and cutting units of your Groundsmaster. If any decal becomes illegible or damaged, install a new decal. Part numbers for decals are listed in your Part Catalog. Order replacement decals from your Authorized Toro Distributor.

Chapter 2

# Product Records and Maintenance



## Table of Contents



## Product Records

Insert Operator's Manual and Parts Catalog for your Groundsmaster at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

## Maintenance

Maintenance procedures and recommended service intervals for your Groundsmaster are identified in the Operator's Manual. Refer to that publication when performing regular equipment maintenance.

# Equivalents and Conversions

## Decimal and Millimeter Equivalents

| Fractions | Decimals | mm | Fractions | Decimals | mm |
|---|---|---|---|---|---|
| 1/64 | 0.015625 | — 0.397 | 33/64 | 0.515625 | — 13.097 |
| 1/32 | 0.03125 | — 0.794 | 17/32 | 0.53125 | — 13.494 |
| 3/64 | 0.046875 | — 1.191 | 35/64 | 0.546875 | — 13.891 |
| 1/16 | 0.0625 | — 1.588 | 9/16 | 0.5625 | — 14.288 |
| 5/64 | 0.078125 | — 1.984 | 37/64 | 0.578125 | — 14.684 |
| 3/32 | 0.09375 | — 2.381 | 19/32 | 0.59375 | — 15.081 |
| 7/64 | 0.109275 | — 2.778 | 39/64 | 0.609375 | — 15.478 |
| **1/8** | 0.1250 | — 3.175 | **5/8** | 0.6250 | — 15.875 |
| 9/64 | 0.140625 | — 3.572 | 41/64 | 0.640625 | — 16.272 |
| 5/32 | 0.15625 | — 3.969 | 21/32 | 0.65625 | — 16.669 |
| 11/64 | 0.171875 | — 4.366 | 43/64 | 0.671875 | — 17.066 |
| 3/16 | 0.1875 | — 4.762 | 11/16 | 0.6875 | — 17.462 |
| 13/64 | 0.203125 | — 5.159 | 45/64 | 0.703125 | — 17.859 |
| 7/32 | 0.21875 | — 5.556 | 23/32 | 0.71875 | — 18.256 |
| 15/64 | 0.234375 | — 5.953 | 47/64 | 0.734375 | — 18.653 |
| **1/4** | 0.2500 | — 6.350 | **3/4** | 0.7500 | — 19.050 |
| 17/64 | 0.265625 | — 6.747 | 49/64 | 0.765625 | — 19.447 |
| 9/32 | 0.28125 | — 7.144 | 25/32 | 0.78125 | — 19.844 |
| 19/64 | 0.296875 | — 7.541 | 51/64 | 0.796875 | — 20.241 |
| 5/16 | 0.3125 | — 7.938 | 13/16 | 0.8125 | — 20.638 |
| 21/64 | 0.328125 | — 8.334 | 53/64 | 0.828125 | — 21.034 |
| 11/32 | 0.34375 | — 8.731 | 27/32 | 0.84375 | — 21.431 |
| 23/64 | 0.359375 | — 9.128 | 55/64 | 0.859375 | — 21.828 |
| **3/8** | 0.3750 | — 9.525 | **7/8** | 0.8750 | — 22.225 |
| 25/64 | 0.390625 | — 9.922 | 57/64 | 0.890625 | — 22.622 |
| 13/32 | 0.40625 | — 10.319 | 29/32 | 0.90625 | — 23.019 |
| 27/64 | 0.421875 | — 10.716 | 59/64 | 0.921875 | — 23.416 |
| 7/16 | 0.4375 | — 11.112 | 15/16 | 0.9375 | — 23.812 |
| 29/64 | 0.453125 | — 11.509 | 61/64 | 0.953125 | — 24.209 |
| 15/32 | 0.46875 | — 11.906 | 31/32 | 0.96875 | — 24.606 |
| 31/64 | 0.484375 | — 12.303 | 63/64 | 0.984375 | — 25.003 |
| **1/2** | 0.5000 | — 12.700 | **1** | 1.000 | — 25.400 |

**1 mm = 0.03937 in.** **0.001 in. = 0.0254 mm**

## U.S.to Metric Conversions

| | To Convert | Into | Multiply By |
|---|---|---|---|
| **Linear Measurement** | Miles | Kilometers | 1.609 |
| | Yards | Meters | 0.9144 |
| | Feet | Meters | 0.3048 |
| | Feet | Centimeters | 30.48 |
| | Inches | Meters | 0.0254 |
| | Inches | Centimeters | 2.54 |
| | Inches | Millimeters | 25.4 |
| **Area** | Square Miles | Square Kilometers | 2.59 |
| | Square Feet | Square Meters | 0.0929 |
| | Square Inches | Square Centimeters | 6.452 |
| | Acre | Hectare | 0.4047 |
| **Volume** | Cubic Yards | Cubic Meters | 0.7646 |
| | Cubic Feet | Cubic Meters | 0.02832 |
| | Cubic Inches | Cubic Centimeters | 16.39 |
| **Weight** | Tons (Short) | Metric Tons | 0.9078 |
| | Pounds | Kilograms | 0.4536 |
| | Ounces (Avdp.) | Grams | 28.3495 |
| **Pressure** | Pounds/Sq. In. | Kilopascal | 6.895 |
| | Pounds/Sq. In. | Bar | 0.069 |
| **Work** | Foot-pounds | Newton-Meters | 1.356 |
| | Foot-pounds | Kilogram-Meters | 0.1383 |
| | Inch-pounds | Kilogram-Centimeters | 1.152144 |
| **Liquid Volume** | Quarts | Liters | 0.9463 |
| | Gallons | Liters | 3.785 |
| **Liquid Flow** | Gallons/Minute | Liters/Minute | 3.785 |
| **Temperature** | Fahrenheit | Celsius | 1. Subract 32°<br>2. Multiply by 5/9 |

# Torque Specifications

Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (e.g. Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature (e.g. Nylock nut), hardness of the surface underneath the fastener's head or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.



## Fastener Identification

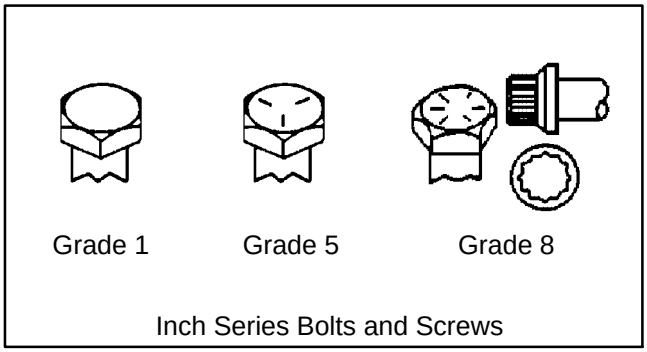


Figure 1

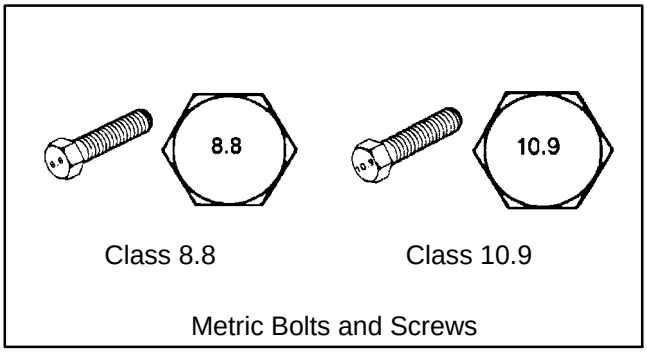


Figure 2

## Using a Torque Wrench with an Offset Wrench

Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective change of torque wrench length. When using a torque wrench with an offset wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Fig. 3) to determine proper tightening torque. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed torque recommendation.

**Example:** The measured effective length of the torque wrench (distance from the center of the handle to the center of the square drive) is 18".

The measured effective length of the torque wrench with the offset wrench installed (distance from the center of the handle to the center of the offset wrench) is 19".

The calculated torque conversion factor for this torque wrench with this offset wrench would be 18 / 19 = 0.947.

If the listed torque recommendation for a fastener is from 76 to 94 ft-lb, the proper torque when using this torque wrench with an offset wrench would be from 72 to 89 ft-lb.

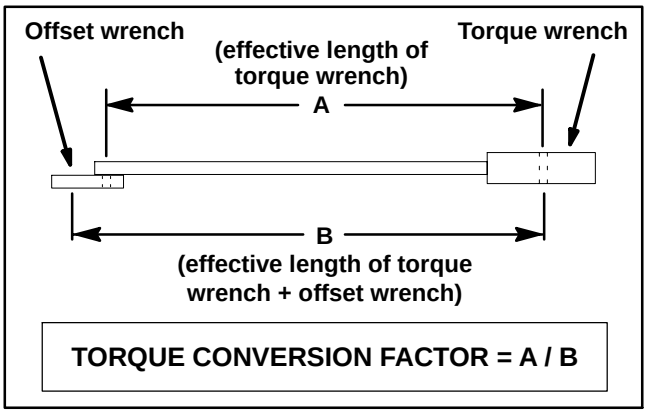


Figure 3

## Standard Torque for Dry, Zinc Plated and Steel Fasteners (Inch Series)

| Thread Size | Grade 1, 5 & 8 with Thin Height Nuts | SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts) | | SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts) | | SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts) | |
|---|---|---|---|---|---|---|---|
| | **in-lb** | **in-lb** | **N-cm** | **in-lb** | **N-cm** | **in-lb** | **N-cm** |
| # 6 - 32 UNC | 10 ± 2 | 13 ± 2 | 147 ± 23 | 15 ± 2 | 169 ± 23 | 23 ± 3 | 262 ± 34 |
| # 6 - 40 UNF | | | | 17 ± 2 | 192 ± 23 | 25 ± 3 | 282 ± 34 |
| # 8 - 32 UNC | 13 ± 2 | 25 ± 5 | 282 ± 30 | 29 ± 3 | 328 ± 34 | 41 ± 5 | 463 ± 56 |
| # 8 - 36 UNF | | | | 31 ± 4 | 350 ± 45 | 43 ± 5 | 486 ± 56 |
| # 10 - 24 UNC | 18 ± 2 | 30 ± 5 | 339 ± 56 | 42 ± 5 | 475 ± 56 | 60 ± 6 | 678 ± 68 |
| # 10 - 32 UNF | | | | 48 ± 5 | 542 ± 56 | 68 ± 7 | 768 ± 79 |
| 1/4 - 20 UNC | 48 ± 7 | 53 ± 7 | 599 ± 79 | 100 ± 10 | 1130 ± 113 | 140 ± 15 | 1582 ± 169 |
| 1/4 - 28 UNF | 53 ± 7 | 65 ± 10 | 734 ± 113 | 115 ± 12 | 1299 ± 136 | 160 ± 17 | 1808 ± 192 |
| 5/16 - 18 UNC | 115 ± 15 | 105 ± 15 | 1186 ± 169 | 200 ± 25 | 2260 ± 282 | 300 ± 30 | 3390 ± 339 |
| 5/16 - 24 UNF | 138 ± 17 | 128 ± 17 | 1446 ± 192 | 225 ± 25 | 2542 ± 282 | 325 ± 33 | 3672 ± 373 |
| | **ft-lb** | **ft-lb** | **N-m** | **ft-lb** | **N-m** | **ft-lb** | **N-m** |
| 3/8 - 16 UNC | 16 ± 2 | 16 ± 2 | 22 ± 3 | 30 ± 3 | 41 ± 4 | 43 ± 5 | 58 ± 7 |
| 3/8 - 24 UNF | 17 ± 2 | 18 ± 2 | 24 ± 3 | 35 ± 4 | 47 ± 5 | 50 ± 6 | 68 ± 8 |
| 7/16 - 14 UNC | 27 ± 3 | 27 ± 3 | 37 ± 4 | 50 ± 5 | 68 ± 7 | 70 ± 7 | 95 ± 9 |
| 7/16 - 20 UNF | 29 ± 3 | 29 ± 3 | 39 ± 4 | 55 ± 6 | 75 ± 8 | 77 ± 8 | 104 ± 11 |
| 1/2 - 13 UNC | 30 ± 3 | 48 ± 7 | 65 ± 9 | 75 ± 8 | 102 ± 11 | 105 ± 11 | 142 ± 15 |
| 1/2 - 20 UNF | 32 ± 4 | 53 ± 7 | 72 ± 9 | 85 ± 9 | 115 ± 12 | 120 ± 12 | 163 ± 16 |
| 5/8 - 11 UNC | 65 ± 10 | 88 ± 12 | 119 ± 16 | 150 ± 15 | 203 ± 20 | 210 ± 21 | 285 ± 28 |
| 5/8 - 18 UNF | 75 ± 10 | 95 ± 15 | 129 ± 20 | 170 ± 18 | 230 ± 24 | 240 ± 24 | 325 ± 33 |
| 3/4 - 10 UNC | 93 ± 12 | 140 ± 20 | 190 ± 27 | 265 ± 27 | 359 ± 37 | 375 ± 38 | 508 ± 52 |
| 3/4 - 16 UNF | 115 ± 15 | 165 ± 25 | 224 ± 34 | 300 ± 30 | 407 ± 41 | 420 ± 43 | 569 ± 58 |
| 7/8 - 9 UNC | 140 ± 20 | 225 ± 25 | 305 ± 34 | 430 ± 45 | 583 ± 61 | 600 ± 60 | 813 ± 81 |
| 7/8 - 14 UNF | 155 ± 25 | 260 ± 30 | 353 ± 41 | 475 ± 48 | 644 ± 65 | 667 ± 66 | 904 ± 89 |

**NOTE:** Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as engine oil or thread sealant such as Loctite.

**NOTE:** Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

**NOTE:** The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

## Standard Torque for Dry, Zinc Plated and Steel Fasteners (Metric Series)

| Thread Size | Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts) | | Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts) | |
|---|---|---|---|---|
| M5 X 0.8 | 57 ± 6 in–lb | 644 ± 68 N–cm | 78 ± 8 in–lb | 881 ± 90 N–cm |
| M6 X 1.0 | 96 ± 10 in–lb | 1085 ± 113 N–cm | 133 ± 14 in–lb | 1503 ± 158 N–cm |
| M8 X 1.25 | 19 ± 2 ft–lb | 26 ± 3 N–m | 28 ± 3 ft–lb | 38 ± 4 N–m |
| M10 X 1.5 | 38 ± 4 ft–lb | 52 ± 5 N–m | 54 ± 6 ft–lb | 73 ± 8 N–m |
| M12 X 1.75 | 66 ± 7 ft–lb | 90 ± 10 N–m | 93 ± 10 ft–lb | 126 ± 14 N–m |
| M16 X 2.0 | 166 ± 17 ft–lb | 225 ± 23 N–m | 229 ± 23 ft–lb | 310 ± 31 N–m |
| M20 X 2.5 | 325 ± 33 ft–lb | 440 ± 45 N–m | 450 ± 46 ft–lb | 610 ± 62 N–m |

**NOTE:** Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as engine oil or thread sealant such as Loctite.

**NOTE:** Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

**NOTE:** The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

## Other Torque Specifications

**SAE Grade 8 Steel Set Screws**

| Thread Size | Recommended Torque | |
|---|---|---|
| | Square Head | Hex Socket |
| 1/4 – 20 UNC | 140 ± 20 in–lb | 73 ± 12 in–lb |
| 5/16 – 18 UNC | 215 ± 35 in–lb | 145 ± 20 in–lb |
| 3/8 – 16 UNC | 35 ± 10 ft–lb | 18 ± 3 ft–lb |
| 1/2 – 13 UNC | 75 ± 15 ft–lb | 50 ± 10 ft–lb |

**Wheel Bolts and Lug Nuts**

| Thread Size | Recommended Torque** | |
|---|---|---|
| 7/16 – 20 UNF Grade 5 | 65 ± 10 ft–lb | 88 ± 14 N–m |
| 1/2 – 20 UNF Grade 5 | 80 ± 10 ft–lb | 108 ± 14 N–m |
| M12 X 1.25 Class 8.8 | 80 ± 10 ft–lb | 108 ± 14 N–m |
| M12 X 1.5 Class 8.8 | 80 ± 10 ft–lb | 108 ± 14 N–m |

** For steel wheels and non–lubricated fasteners.

**Thread Cutting Screws (Zinc Plated Steel)**

| Type 1, Type 23 or Type F | |
|---|---|
| **Thread Size** | **Baseline Torque*** |
| No. 6 – 32 UNC | 20 ± 5 in–lb |
| No. 8 – 32 UNC | 30 ± 5 in–lb |
| No. 10 – 24 UNC | 38 ± 7 in–lb |
| 1/4 – 20 UNC | 85 ± 15 in–lb |
| 5/16 – 18 UNC | 110 ± 20 in–lb |
| 3/8 – 16 UNC | 200 ± 100 in–lb |

**Thread Cutting Screws (Zinc Plated Steel)**

| Thread Size | Threads per Inch | | Baseline Torque* |
|---|---|---|---|
| | Type A | Type B | |
| No. 6 | 18 | 20 | 20 ± 5 in–lb |
| No. 8 | 15 | 18 | 30 ± 5 in–lb |
| No. 10 | 12 | 16 | 38 ± 7 in–lb |
| No. 12 | 11 | 14 | 85 ± 15 in–lb |

* Hole size, material strength, material thickness and finish must be considered when determining specific torque values. All torque values are based on non–lubricated fasteners.

## Conversion Factors

*in–lb X 11.2985 = N–cm*
**ft–lb X 1.3558 = N–m**

*N–cm X 0.08851 = in–lb*
**N–m X 0.7376 = ft–lb**

# Chapter 3

# Kubota Diesel Engine

## Table of Contents





## General Information

This Chapter gives information about specifications, troubleshooting, testing and repair of the Kubota diesel engine used in the Groundsmaster 4300–D.

Most repairs and adjustments require tools which are commonly available in many service shops. The use of some specialized test equipment is explained in the engine workshop manual included at the end of this chapter. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kubota diesel engines are supplied through your local Toro Distributor. If a parts list is not available, be sure to provide your distributor with the Toro model and serial number.

### Operator's Manual

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

### Stopping the Engine

**IMPORTANT: The engine used on the Groundsmaster 4300–D is turbo–charged. Before stopping the engine after mowing or full load operation, cool the turbo-charger by allowing the engine to idle at low speed for five (5) minutes. Failure to do so may lead to turbo-charger trouble.**

# Specifications

| Item | Description |
|---|---|
| Make / Designation | Kubota V1505–T–E3B, 4–stroke,<br>Liquid Cooled, OHV, Turbocharged Diesel |
| Number of Cylinders | 4 |
| Bore x Stroke | 3.07 in x 3.09 in (78 mm x 78.4 mm) |
| Total Displacement | 91.4 $in^3$ (1498 cc) |
| Compression Ratio | 23:1 |
| Firing Order | 1 (fan end) – 3 – 4 (flywheel end) – 2 |
| Fuel | No. 2–D Diesel Fuel (ASTM D975) |
| Fuel Injection Pump | Bosch MD Type Mini |
| Fuel Injector Nozzle | Mini Nozzle (DNOPD) |
| Fuel Tank Capacity | 14 U.S. gallons (53 liters) |
| Governor | Centrifugal Mechanical |
| Low Idle Speed (no load) | 1250 to 1350 RPM |
| High Idle Speed (no load) | 3050 to 3250 RPM |
| Engine Oil | API Classification CI–4 or Higher<br>(see Operator's Manual for viscosity recommendations) |
| Oil Pump | Gear Driven Trochoid Type |
| Crankcase Oil Capacity | 5.5 U.S. quarts (5.2 liters) with Filter |
| Cooling System Capacity (including reserve tank) | 10 U.S. quarts (9.5 liters) |
| Starter | 12 VDC 1.2 KW |
| Alternator/Regulator | 12 VDC 40 Amp |
| Engine Dry Weight (approximate) | 251 lbs (114 kg) |

# Adjustments

## Adjust Throttle Control

Proper throttle operation is dependent upon proper adjustment of throttle control.

**NOTE:** The throttle cable swivel should be positioned in the lowest hole in the speed control lever.

1. Move throttle control lever on control console to **FAST** position.

2. Check position of the engine speed control lever on fuel injection pump. The speed control lever should be contacting the high speed screw when the throttle control lever is in the **FAST** position.

3. If necessary, throttle control can be adjusted by loosening cable clamp screw and repositioning control cable until speed control lever contacts high speed screw when the throttle control lever is in the **FAST** position. Tighten cable clamp screw after adjustment has been completed.

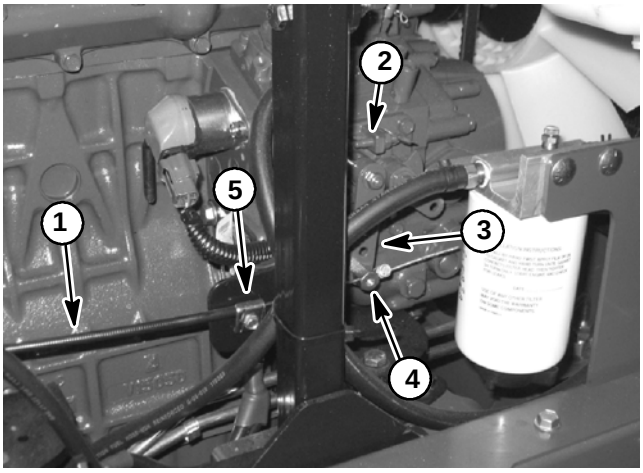


Figure 1

1. **Throttle cable**
2. **High speed screw**
3. **Speed control lever**
4. **Swivel**
5. **Cable clamp**

## Fuel System

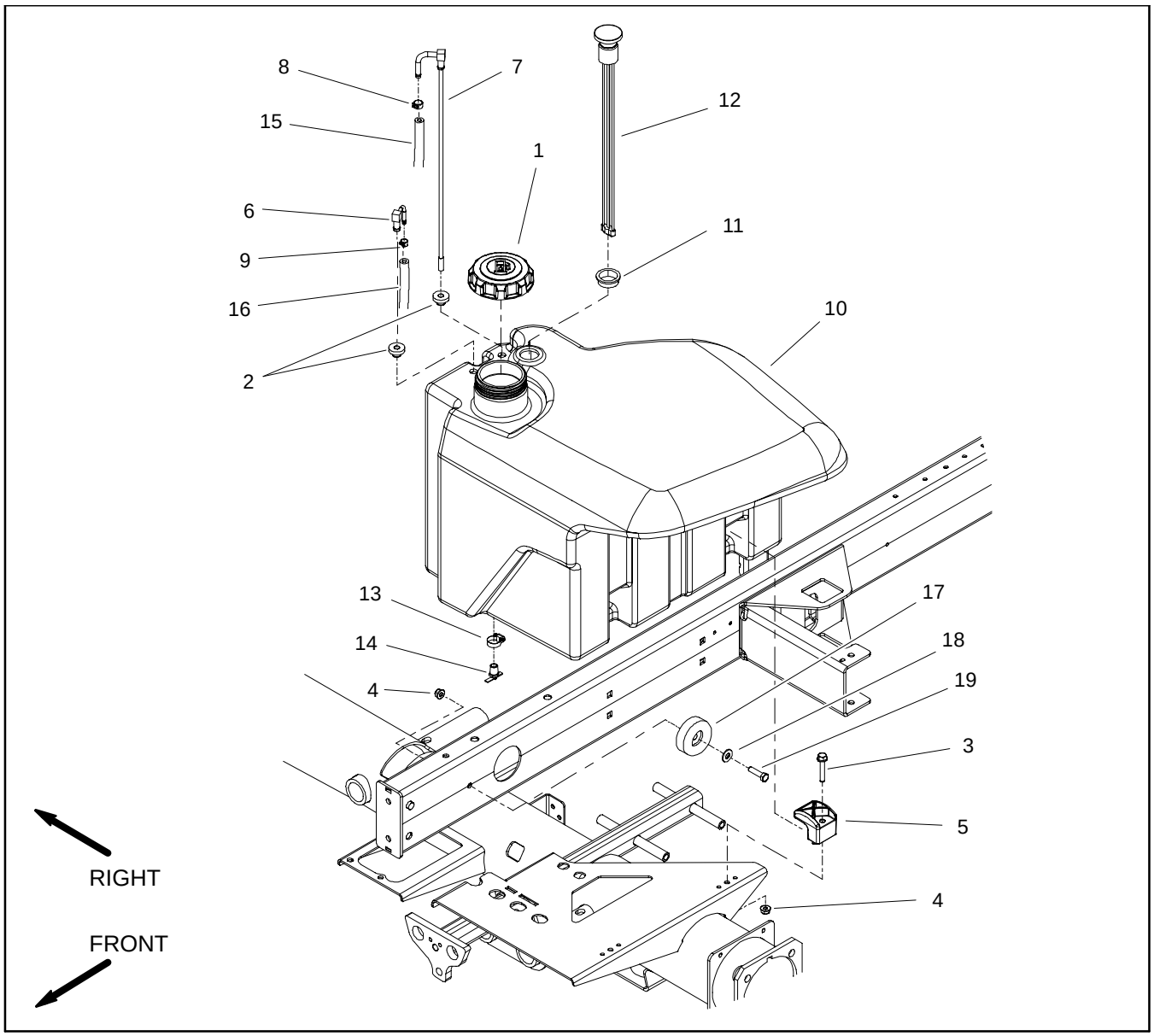


Figure 2

1. **Fuel cap**
2. **Bushing**
3. **Washer head screw (2 used)**
4. **Flange nut (3 used)**
5. **Clamp (2 used)**
6. **Return fitting**
7. **Suction fitting**
8. **Hose clamp**
9. **Hose clamp**
10. **Fuel tank**
11. **Grommet**
12. **Fuel gauge**
13. **Hose clamp**
14. **Draincock**
15. **Fuel supply hose**
16. **Fuel return hose**
17. **Bumper**
18. **Flat washer**
19. **Cap screw**

## DANGER

**Because diesel fuel is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, when engine is hot or when machine is in an enclosed area. Always fill fuel tank outside and wipe up any spilled diesel fuel before starting the engine. Store fuel in a clean, safety–approved container and keep container cap in place. Use diesel fuel for the engine only; not for any other purpose.**

### Check Fuel Hoses and Connections

Check fuel hoses and connections periodically as recommended in the Operator's Manual. Check fuel hoses for deterioration, damage, leakage or loose connections. Replace fuel hoses, clamps and connections as necessary.

### Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the Operator's Manual. Also, drain and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

To clean fuel tank, flush tank out with clean diesel fuel. Make sure tank is free of all contaminates and debris.

### Fuel Tank 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. Place drain pan under fuel tank. Make sure that drain pan is large enough to hold fuel tank contents (see Specifications in this chapter).

3. Open draincock on bottom of fuel tank and allow tank to fully drain. Close draincock.

**NOTE:** Before removing fuel hoses from tank fittings, label hoses for assembly purposes.

4. Loosen hose clamps and disconnect fuel hoses from suction (item 7) and return (item 6) fittings on the top of the fuel tank.

5. Remove fuel tank using Figure 2 as a guide.

### Fuel Tank Installation (Fig. 2)

1. Install fuel tank to frame using Figure 2 as a guide.

2. Using labels placed during fuel tank removal, correctly connect fuel hoses to suction (item 7) and return (item 6) fittings on the top of the fuel tank. Secure fuel hoses with hose clamps.

3. Make sure that fuel tank draincock is closed. Fill fuel tank.

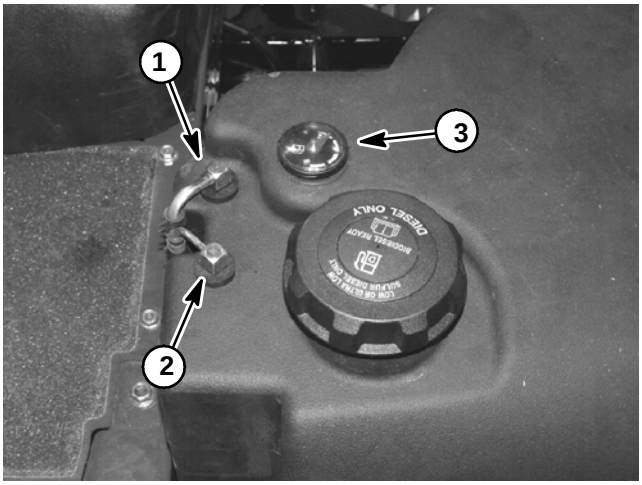


Figure 3

1. **Fuel supply hose**
2. **Fuel return hose**
3. **Fuel gauge**

## Air Cleaner

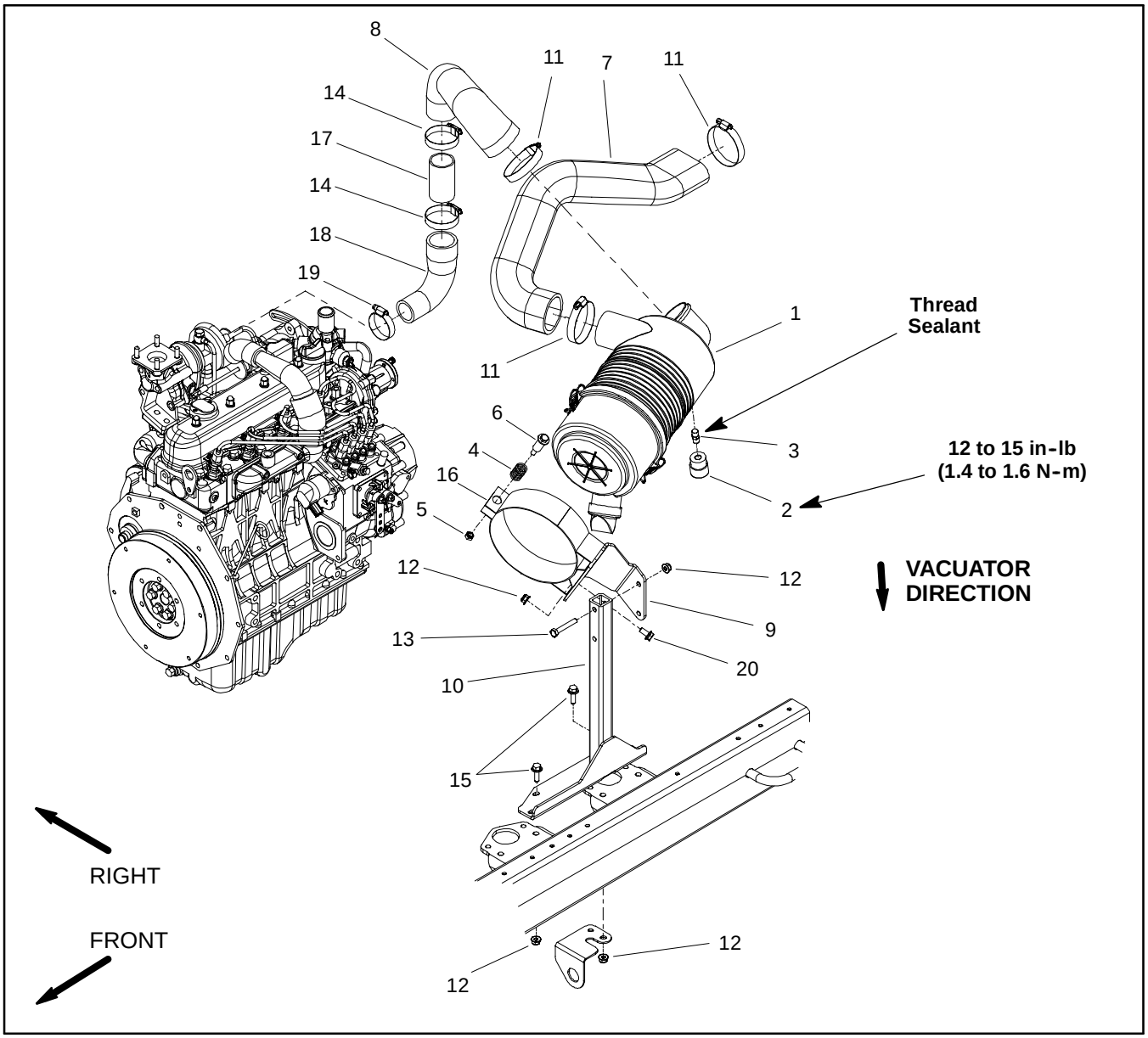


Figure 4

1. Air cleaner assembly
2. Indicator
3. Adapter
4. Spring
5. Hex nut
6. Bolt
7. Hose
8. Hose
9. Mount bracket
10. Air cleaner stand
11. Hose clamp (3 used)
12. Flange nut (8 used)
13. Cap screw (2 used)
14. Hose clamp (2 used)
15. Flange head screw (4 used)
16. Air cleaner mounting band
17. Spacer
18. Hose
19. Hose clamp
20. Flange head screw (2 used)

**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. Raise and support hood.

2. Remove air cleaner components as needed using Figures 4 as a guide.

3. See Operator's Manual for air cleaner service and maintenance procedures.

**Installation (Fig. 4)**

**IMPORTANT: Any leaks in the air filter system will allow dirt into engine and will cause serious engine damage. Make sure that all air cleaner components are in good condition and are properly secured during assembly.**

1. Assemble air cleaner system using Figure 4 as a guide.

   A. If service indicator (item 2) and adapter (item 3) were removed from air cleaner housing, apply thread sealant to adapter threads before installing adapter and indicator to housing. Install adapter so that grooves in adapter hex and adapter filter element are installed toward service indicator (Fig. 5). Torque indicator from **12 to 15 in-lb (1.4 to 1.6 N-m)**.

   B. Make sure that vacuator valve is pointed down after assembly.

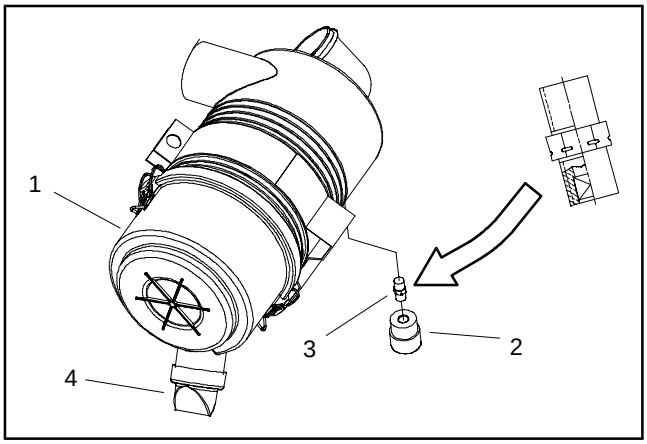


Figure 5

1. **Air cleaner assembly**
2. **Service indicator**
3. **Adapter**
4. **Vacuator valve**

## Exhaust System

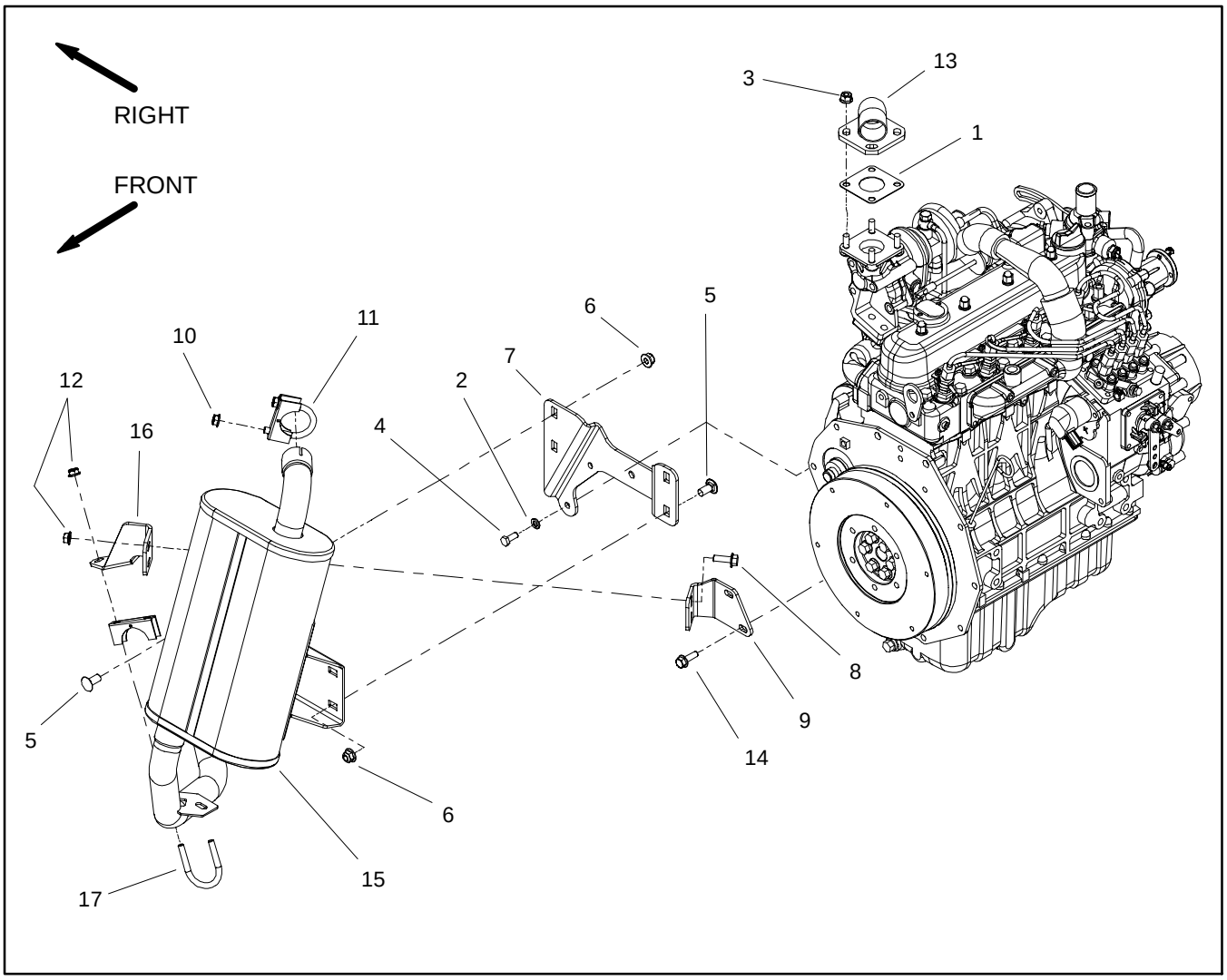


Figure 6

1. **Gasket**
2. **Lock washer (2 used)**
3. **Flange nut (4 used)**
4. **Cap screw (2 used)**
5. **Carriage screw (4 used)**
6. **Flange nut (4 used)**
7. **Muffler support bracket**
8. **Flange head screw (2 used)**
9. **Tail pipe bracket**
10. **Hex nut (2 used)**
11. **Upper clamp**
12. **Flange nut (4 used)**
13. **Exhaust header**
14. **Flange head screw (2 used)**
15. **Muffler**
16. **Tail pipe bracket**
17. **Lower clamp**

**Removal (Fig. 6)**

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.

**CAUTION**

**The muffler and exhaust pipe may be hot. To avoid possible burns, allow the engine and exhaust system to cool before working on the exhaust system.**

2. Remove exhaust system using Figure 6 as a guide.

**Installation (Fig. 6)**

**NOTE:** Make sure muffler flange and exhaust manifold sealing surfaces are free of debris or damage that may prevent a tight seal.

1. Place new muffler gasket on the exhaust manifold.

2. If muffler support bracket (item 7) was removed, secure it to engine with removed fasteners.

**IMPORTANT: Finger tighten all exhaust system fasteners before tightening so that there is no preload on the exhaust system due to exhaust system assembly.**

3. Install exhaust system components to the engine using Figure 6 as a guide. Finger tighten all fasteners until all exhaust system components have been installed.

4. Tighten exhaust system fasteners in the following order:

A. Lift muffler as much as holes in muffler support bracket (item 7) will allow. Tighten flange nuts (item 6) to secure muffler to support bracket.

B. Tighten flange nuts (item 3) to secure exhaust header (item 13) to engine flange using order shown in Figure 7.

C. Tighten hex nuts (item 10) to secure upper clamp (item 11).

D. If tail pipe bracket (item 9) was removed, tighten flange head screws (item 14) to secure bracket to engine.

E. Tighten flange nuts (item 12) to secure lower clamp (item 17).

F. Tighten fasteners (items 8 and 12) to secure tail pipe brackets (items 9 and 16).

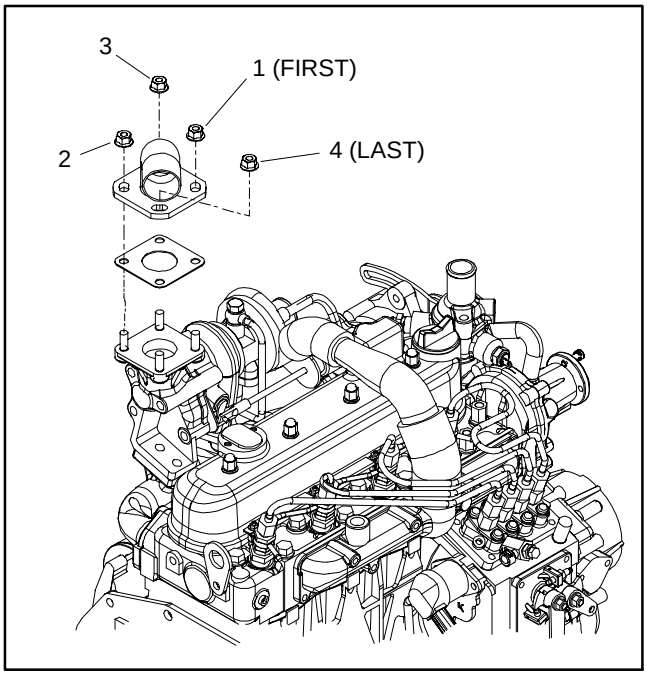


Figure 7

## Radiator

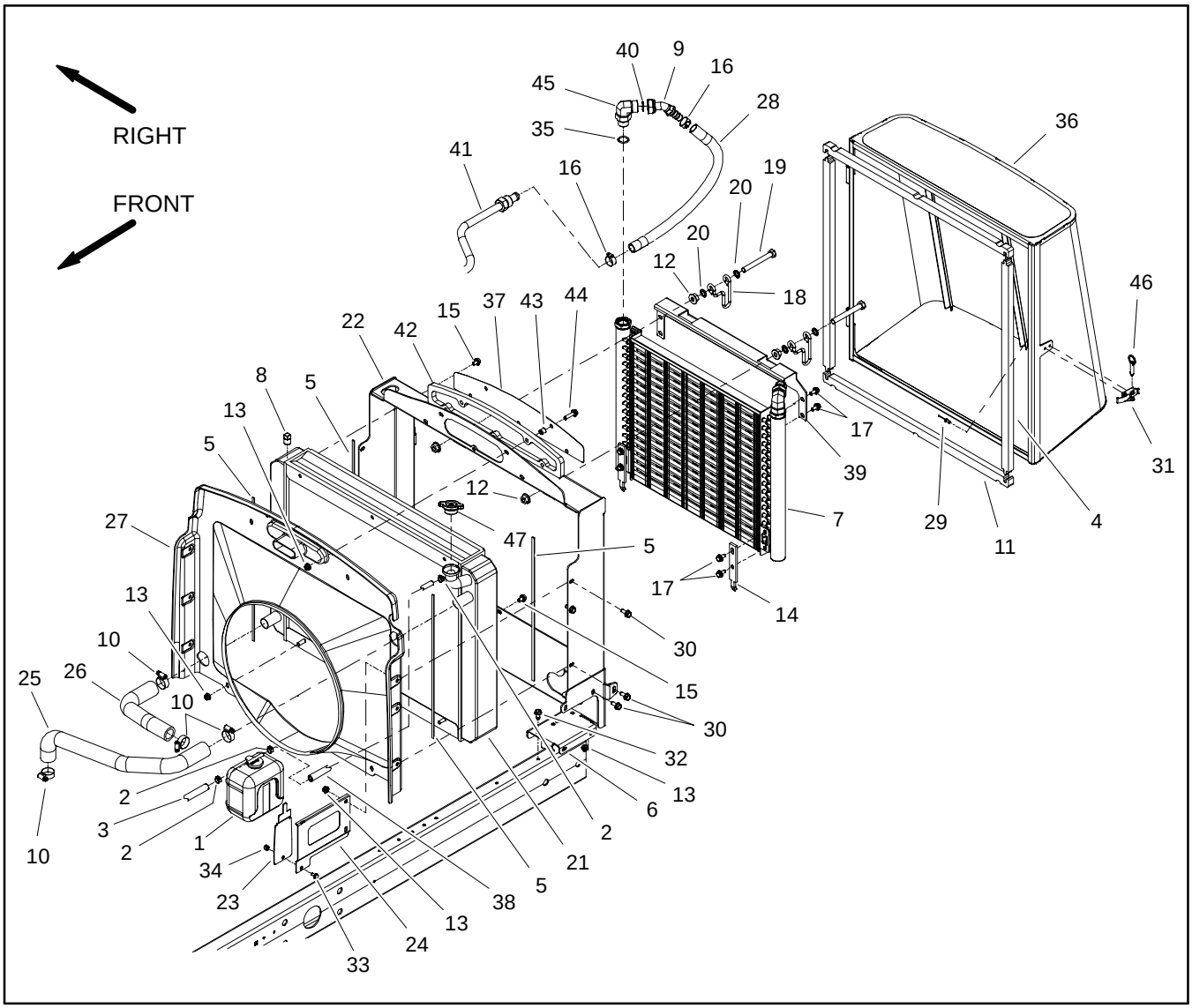


Figure 8

1. **Overflow bottle**
2. **Hose clamp (3 used)**
3. **Hose**
4. **Foam seal (2 used)**
5. **Foam seal (4 used)**
6. **Mounting bracket (2 used)**
7. **Oil cooler**
8. **Pipe plug**
9. **Hydraulic fitting (2 used)**
10. **Hose clamp (4 used)**
11. **Foam seal (2 used)**
12. **Flange nut (4 used)**
13. **Flange nut (17 used)**
14. **Oil cooler mount plate (2 used)**
15. **Flange head screw (6 used)**
16. **Hose clamp (4 used)**
17. **Flange head screw (8 used)**
18. **Clamp (2 used)**
19. **Cap screw (2 used)**
20. **Washer (4 used)**
21. **Radiator**
22. **Radiator frame**
23. **Reservoir bracket**
24. **Reservoir bracket**
25. **Upper radiator hose**
26. **Lower radiator hose**
27. **Fan shroud**
28. **Hydraulic hose (2 used)**
29. **Rivet (2 used)**
30. **Flange head screw (10 used)**
31. **Draw latch**
32. **Washer head screw (6 used)**
33. **Flange head screw**
34. **Lock nut**
35. **O-ring**
36. **Screen**
37. **Intake screen**
38. **Hose**
39. **Oil cooler bracket**
40. **O-ring**
41. **Hydraulic tube**
42. **Foam seal**
43. **Spacer (5 used)**
44. **Flange head screw (5 used)**
45. **Hydraulic fitting (2 used)**
46. **Pin**
47. **Radiator cap**

**Removal (Fig. 8)**

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

2. Raise and support the hood.

**CAUTION**

**Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.**

**Ethylene–glycol antifreeze is poisonous. Dispose of coolant properly, or store it in a properly labeled container away from children and pets.**

3. Drain coolant from radiator.

   A. Slowly remove radiator cap from the radiator.

   B. Place drain pan below the radiator draincock located on the bottom of the radiator. Make sure that drain pan is large enough to hold cooling system contents (10 U.S. quarts (9.5 liters)).

   C. Loosen radiator draincock (threaded in) and allow coolant to drain from radiator.

4. Remove screen from machine.

5. Disconnect radiator hoses (upper and lower) from the radiator.

6. Loosen hose clamp and remove overflow hose from radiator fill opening.

7. Remove two (2) flange head screws and flange nuts that secure coolant reservoir and brackets to fan shroud. Carefully position reservoir and brackets away from the fan shroud.

8. Remove five (5) flange head screws and flange nuts that secure air intake screen (item 37) to machine. Remove screen and foam seal (item 42). Locate and retrieve five (5) spacers (item 43).

9. Remove flange head screws and flange nuts that secure fan shroud and radiator to radiator frame. Position fan shroud away from the radiator.

10. Carefully pull radiator assembly from the machine. Plug radiator and hose openings to prevent contamination.

11. Inspect all foam seals placed between radiator, fan shroud and radiator frame. Replace damaged foam seals.

**Installation (Fig. 8)**

1. Remove plugs placed in radiator and hose openings during the removal procedure.

2. Carefully position radiator assembly to the radiator support. Position fan shroud to the radiator.

3. Secure fan shroud and radiator to radiator frame with removed flange head screws and flange nuts. Make sure that at least 0.250” (6.4 mm) clearance exists at all points between shroud opening and fan.

4. Position coolant reservoir and brackets to the fan shroud. Secure reservoir to fan shroud and radiator frame with two (2) flange head screws and flange nuts.

5. Place spacers (item 43) into holes in foam seal (item 42). Position foam seal and air intake screen (item 37) to radiator frame. Secure intake screen to machine with five (5) flange head screws and flange nuts.

6. Connect upper and lower radiator hoses to radiator and secure with clamps.

7. Connect overflow hose to radiator fill opening and secure with hose clamp.

8. Make sure radiator draincock is closed (threaded out fully).

9. To allow air to escape during radiator filling, remove pipe plug (item 8) from top of radiator. Fill radiator with coolant. Make sure to install plug once all air is bled from radiator.

10. After radiator has been properly filled with coolant, install radiator cap.

11. Lower and secure hood.

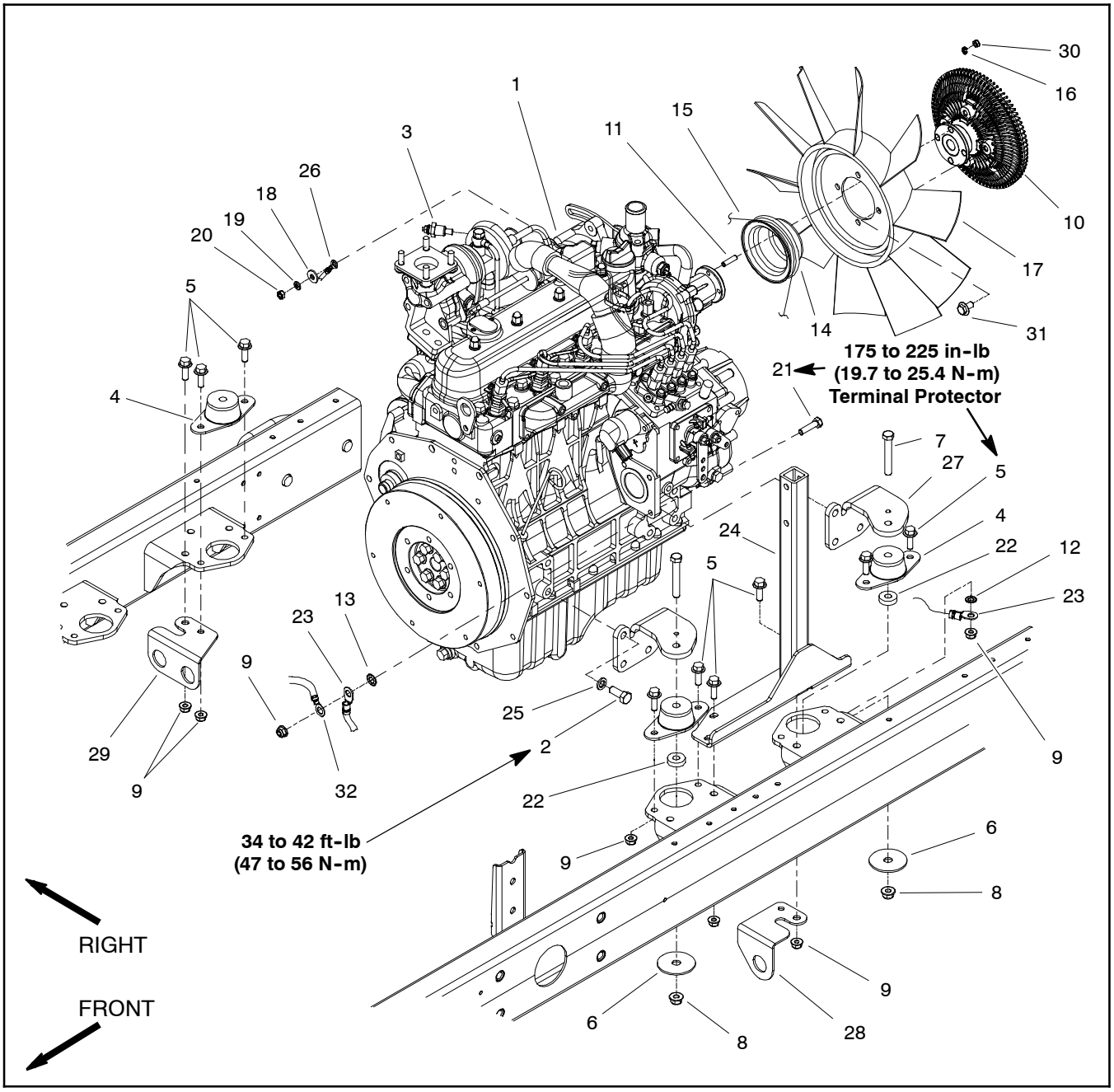


Figure 9

1. Engine assembly
2. Cap screw (12 used)
3. Temperature sender
4. Engine mount (4 used)
5. Flange head screw (13 used)
6. Snubbing washer (4 used)
7. Cap screw (4 used)
8. Flange nut (4 used)
9. Flange nut (14 used)
10. Fan clutch
11. Stud (4 used)
12. Lock washer
13. Lock washer
14. Pulley
15. V-belt
16. Lock washer (4 used)
17. Cooling fan
18. Flat washer
19. Spring washer
20. Hex nut
21. Cap screw
22. Spacer (4 used)
23. Negative battery cable
24. Air cleaner stand
25. Lock washer (12 used)
26. Fusible link harness
27. Engine mount (4 used)
28. Bracket
29. Bracket
30. Hex nut
31. Flange head screw (4 used)
32. Wire harness ground

**Removal (Fig. 9)**

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the ignition switch. Chock wheels to keep the machine from moving.

2. Open and support hood.

3. Disconnect negative (–) cable and then positive (+) cable from the battery.

**CAUTION**

**Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.**

**Ethylene-glycol antifreeze is poisonous. Dispose of coolant properly, or store it in a properly labeled container away from children and pets.**

4. Drain coolant from radiator (see Radiator Removal in this section).

5. Remove air cleaner from machine (see Air Cleaner Removal in this section).

6. Remove exhaust system from machine (see Exhaust System Removal in this section).

7. Remove throttle cable from injector pump (Fig. 10):

   A. Remove cap screw that secures throttle cable end to swivel in speed control lever.

   B. Loosen throttle cable clamp and remove cable from clamp. Slide throttle cable end from swivel.

   C. Position throttle cable away from the engine.

8. Disconnect hoses from engine:

   A. Loosen clamps and remove upper and lower radiator hoses from the engine.

   B. At injector pump, loosen hose clamp and disconnect supply fuel hose from the injector pump fitting (Fig. 11).

   C. Loosen hose clamp and disconnect fuel return hose from front injector body (Fig. 11).

   D. Plug disconnected hoses and engine openings to prevent leakage and contamination. Position disconnected hoses away from engine.

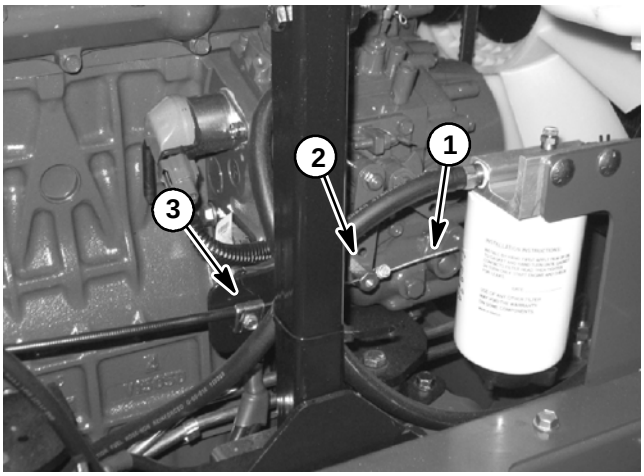


Figure 10

1. **Throttle cable end**
2. **Swivel**
3. **Cable clamp**

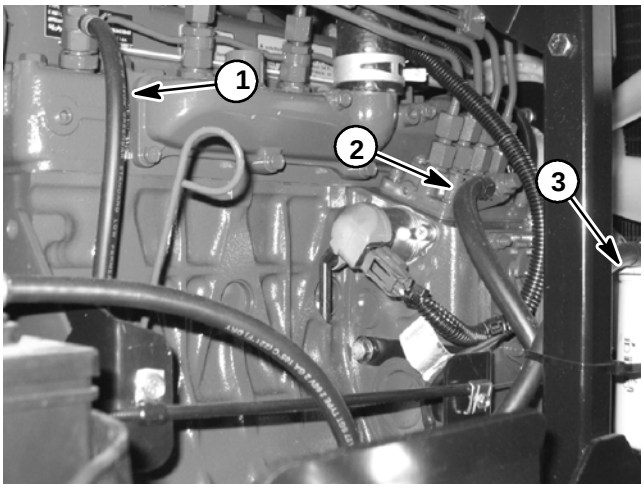


Figure 11

1. **Fuel return hose**
2. **Fuel supply hose**
3. **Fuel/water filter**

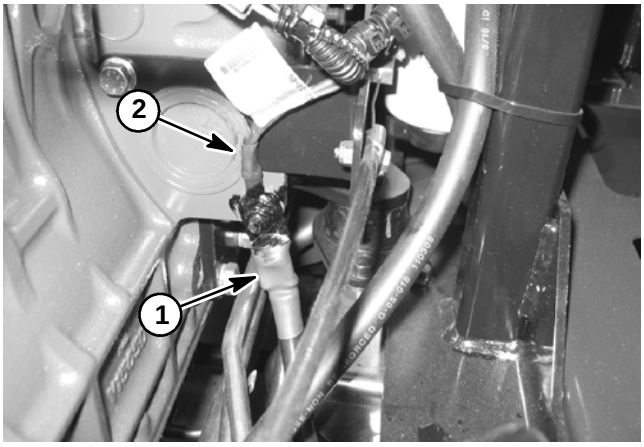


Figure 12

1. **Negative battery cable**
2. **Wire harness ground**

9. Disconnect hydraulic transmission drive shaft from engine (see Hydraulic Transmission Drive Shaft Removal in the Service and Repairs section of Chapter 4 – Hydraulic System). Support drive shaft away from engine.

10. Disconnect wire harness connectors from the following engine components:

**NOTE:** Before disconnecting wire harness connectors, label all electrical leads for assembly purposes.

A. Alternator connector and stud.

B. Oil pressure switch located near the engine oil filter.

C. Connector, fusible link connector and positive battery cable from the starter motor.

D. High temperature shut down switch and temperature sender located on the water pump housing.

E. Fuel stop solenoid on injector pump.

F. Negative battery cable and wire harness ground from injector pump (Fig. 12).

G. Glow plug strip.

11. Remove engine from machine:

A. Attach short section of chain between lift tabs located on each end of the cylinder head.

B. Connect a hoist or lift at the center of the short section of chain. Apply enough tension on the short chain so that the engine will be supported.

C. Remove fasteners that secure the engine (with brackets) to the engine mounts.

**CAUTION**

**One person should operate hoist or lift while a second person guides the engine out of the machine.**

**IMPORTANT: Make sure to not damage the engine, fuel hoses, hydraulic lines, electrical harness, radiator, battery or other parts while removing the engine.**

D. Raise engine and remove toward front of machine.

12. If necessary, remove engine brackets (item 27) from engine.

**Installation (Fig. 9)**

1. Locate machine on a level surface with cutting decks lowered and key removed from the ignition switch. Chock wheels to keep the machine from moving.

2. Make sure that all parts removed from the engine during maintenance or rebuilding are installed to the engine.

3. If engine brackets were removed from the engine, secure brackets to engine with lock washers and cap screws. Torque cap screws from **34 to 42 ft–lb (47 to 56 N–m)**.

4. Install engine to machine.

A. Attach short section of chain between lift tabs located on each end of the cylinder head

B. Connect a hoist or lift at the center of the short section of chain. Apply enough tension on the short chain so that the engine can be supported.

**CAUTION**

**One person should operate hoist or lift while a second person guides the engine into the machine.**

**IMPORTANT: Make sure to not damage the engine, fuel hoses, hydraulic lines, electrical harness, radiator, battery or other parts while installing the engine.**

C. Lower engine to the machine frame. Make sure fastener holes of the engine brackets are aligned with the holes in the engine mounts.

D. Insert cap screw down through each engine bracket and mount. Place spacer, snubbing washer and then flange nut on four (4) cap screws. Tighten fasteners to secure engine to engine mounts.

5. Connect hydraulic transmission drive shaft to engine (see Hydraulic Transmission Drive Shaft Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

6. Connect all wire harness connectors to correct engine components.

7. Remove plugs installed in hoses during disassembly. Connect hoses to the engine:

   A. Connect fuel supply and fuel return hoses to engine fittings (Fig. 11). Secure with hose clamps.

   B. Connect upper and lower radiator hoses to the engine. Secure with hose clamps.

8. Connect throttle cable to injector pump (Fig. 10):

   A. Route throttle cable to injector pump on engine.

   B. Install the throttle cable end into the swivel in speed control lever. Secure cable end with cap screw.

   C. Position cable under cable clamp.

   D. Adjust throttle control (see Adjust Throttle Control in the Adjustments section of this chapter).

9. Install air cleaner (see Air Cleaner Installation in this section).

10. Install exhaust system to machine (see Exhaust System Installation in this section).

11. Make sure radiator draincock is closed (threaded out fully). Fill radiator with coolant and install radiator cap (see Radiator Installation in this section).

12. Check engine oil level and adjust if needed.

13. Connect positive (+) battery cable to the battery and then connect negative (–) cable. Torque the engine and frame ground bolts to **175 to 225 in-lbs (19.7 to 25.4 N-m)** and apply a coat of terminal protector.

**Note:** Make sure that the engine and frame ground surfaces are free from corrosion, oil and paint.

14. Bleed fuel system.

15. Close and secure hood.

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# Chapter 4

# Hydraulic System

## Table of Contents

# Specifications

| Item | Description |
|---|---|
| Piston (Traction) Pump<br>Maximum Pump Displacement (per revolution) | Sauer−Danfoss, LPV Closed Circuit Axial Piston Design<br>2.14 $in^3$ (35 cc) |
| Gear Pump<br>Section P1/P2 Displacement (per revolution)<br>Section P3 Displacement (per revolution)<br>Section P4 Displacement (per revolution) | Casappa 4 section, positive displacement gear type pump<br>1.03 $in^3$ (16.84 cc)<br>0.37 $in^3$ (6.1 cc)<br>0.24 $in^3$ (3.9 cc) |
| Charge Circuit Relief (R5) Pressure | 200 PSI (14 bar) |
| Traction Circuit Relief Pressure<br>Forward (R3)<br>Reverse (R4) | <br>3625 PSI (250 bar)<br>3625 PSI (250 bar) |
| Front Wheel Motors<br>Displacement (per revolution) | Parker orbital rotor motor, TG Series<br>24.7 $in^3$ (405 cc) |
| Rear Wheel Motors<br>Displacement (per revolution) | Parker orbital rotor motor, TL Series<br>18.9 $in^3$ (310 cc) |
| Mow Circuit Relief Pressure<br>Rear Mow Circuit (PRV1)<br>Front Mow Circuit (PRV2) | <br>2500 PSI (175 bar)<br>3500 PSI (241 bar) |
| Cutting Deck Motor<br>Displacement (per revolution)<br>Cross Over Relief Valve Pressure | Casappa gear motor<br>1.05 $in^3$ (17.16 cc)<br>1813 PSI (125 bar) |
| Steering Valve<br>Displacement (per revolution) | Sauer−Danfoss Steering Unit, Type OSPMS<br>6.1 $in^3$ (100 cc) |
| Steering Circuit Relief (R10) Pressure | 1000 PSI (70 bar) |
| Lift Circuit Relief (PRV) Pressure | 2000 PSI (138 bar) |
| Hydraulic Filter (Charge and Steering Circuits) | Spin−on Cartridge Type with 50 PSI (3.4 bar) Relief in Adapter |
| Hydraulic Filter (Mow and Lift Circuits) | Spin−on Cartridge Type with 50 PSI (3.4 bar) Relief in Adapter<br>(filter adapter includes filter change indicator) |
| Hydraulic Oil | See Operator's Manual |
| Hydraulic Reservoir Capacity | 14 U.S. Gallons (53 Liters) |

# General Information

## Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster 4300–D. Refer to that publication for additional information when servicing the machine.

## Check Hydraulic Fluid

The hydraulic system on your Groundsmaster is designed to operate on high quality hydraulic fluid. The hydraulic system reservoir holds approximately 14 U.S. gallons (53 liters) of hydraulic fluid. **Check level of hydraulic fluid daily.** See Operator's Manual for fluid level checking procedure and hydraulic oil recommendations.

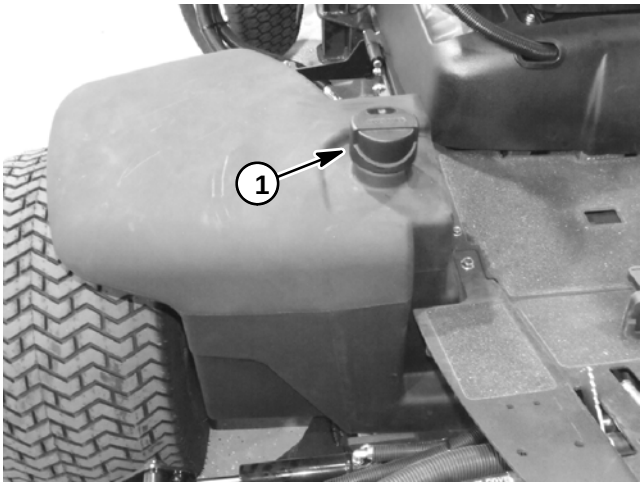



Figure 1

1. **Hydraulic reservoir cap**

## Towing Machine

**IMPORTANT: If towing limits are exceeded, severe damage to the piston (traction) pump may occur.**

If it becomes necessary to tow or push the machine, tow or push at a speed below 3 mph (4.8 kph), and for a very short distance. If the machine needs to be moved a considerable distance, machine should be transported on a trailer. The piston (traction) pump is equipped with a bypass valve that needs to be loosened for towing or pushing (Fig. 2). Refer to Operator's Manual for Towing Procedures.

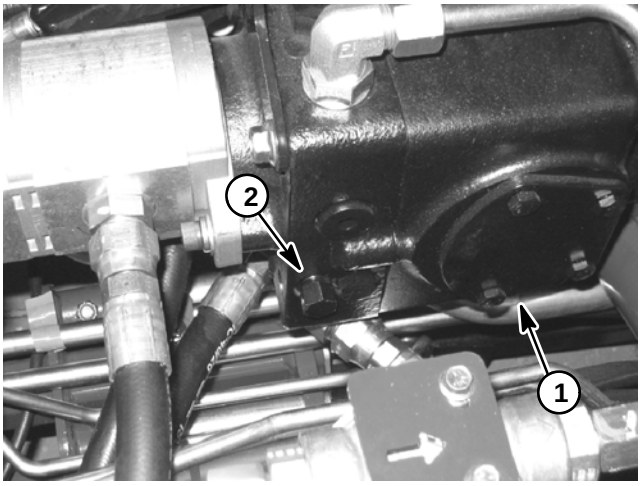



Figure 2

1. **Piston (traction) pump**
2. **Bypass valve**

## Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions or mishandling during operation and maintenance. These conditions can cause hose damage and deterioration. Some hoses are more susceptible to these conditions than others. Inspect all machine hydraulic hoses frequently for signs of deterioration or damage:

Hard, cracked, cut, abraded, charred, leaking or otherwise damaged hose.

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint (layline) on the hose. Use two wrenches when tightening a hose; hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the second wrench (see Hydraulic Hose and Tube Installation in this section). If the hose has an elbow at one end, tighten the swivel nut on that end before tightening the nut on the straight end of the hose.

For additional hydraulic hose information, refer to Toro Service Training Book, Hydraulic Hose Servicing (Part Number 94813SL).

**WARNING**

**Before disconnecting or performing any work on hydraulic system, relieve all pressure in system (see Relieving Hydraulic System Pressure in this section).**

**Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.**

## Hydraulic Hose and Tube Installation (O-Ring Face Seal Fitting)

1. Make sure threads and sealing surfaces of the hose/tube and the fitting are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the face seal O-ring be replaced any time the connection is opened. Make sure the O-ring is installed and properly seated in the fitting groove. Lightly lubricate the O-ring with clean hydraulic oil.

3. Place the hose/tube against the fitting body so that the flat face of the hose/tube sleeve fully contacts the O-ring in the fitting.

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 5. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 – Product Records and Maintenance).

5. If a torque wrench is not available or if space at the swivel nut prevents use of a torque wrench, an alternate method of assembly is the Flats From Wrench Resistance (F.F.W.R.) method (Fig. 4).

A. Using a wrench, tighten the swivel nut onto the fitting until light wrench resistance is reached (approximately 30 in-lb).

B. Mark the swivel nut and fitting body. Hold the hose/tube with a wrench to prevent it from turning.

C. Use a second wrench to tighten the nut to the correct Flats From Wrench Resistance (F.F.W.R.). The markings on the nut and fitting body will verify that the connection has been properly tightened.

| Size | F.F.W.R. |
|---|---|
| 4 (1/4 in. nominal hose or tubing) | 1/2 to 3/4 |
| 6 (3/8 in.) | 1/2 to 3/4 |
| 8 (1/2 in.) | 1/2 to 3/4 |
| 10 (5/8 in.) | 1/2 to 3/4 |
| 12 (3/4 in.) | 1/3 to 1/2 |
| 16 (1 in.) | 1/3 to 1/2 |

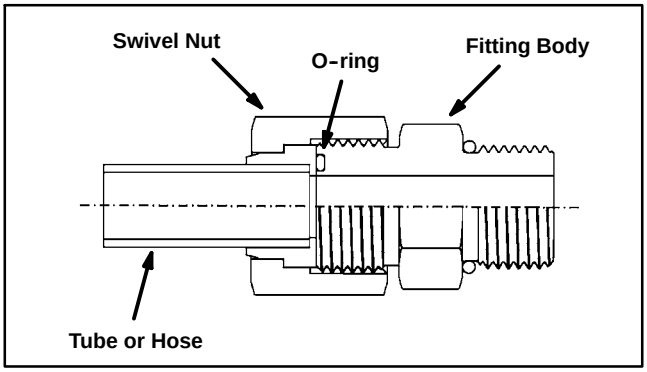



Figure 3

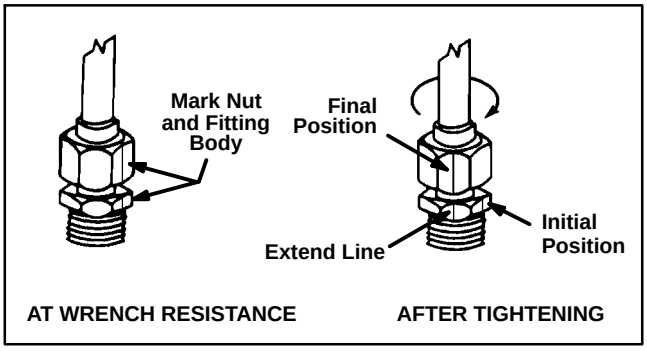



Figure 4

| Fitting Dash Size | Hose/Tube Side Thread Size | Installation Torque |
|---|---|---|
| 4 | 9/16 – 18 | 18 to 22 ft-lb (25 to 29 N-m) |
| 6 | 11/16 – 16 | 27 to 33 ft-lb (37 to 44 N-m) |
| 8 | 13/16 – 16 | 37 to 47 ft-lb (51 to 63 N-m) |
| 10 | 1 – 14 | 60 to 74 ft-lb (82 to 100 N-m) |
| 12 | 1 3/16 – 12 | 85 to 105 ft-lb (116 to 142 N-m) |
| 16 | 1 7/16 – 12 | 110 to 136 ft-lb (150 to 184 N-m) |
| 20 | 1 11/16 – 12 | 140 to 172 ft-lb (190 to 233 N-m) |

Figure 5

## Hydraulic Fitting Installation (SAE Straight Thread O-Ring Fitting into Component Port)

**Non-Adjustable Fitting (Fig. 6)**

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O-ring be replaced any time the connection is opened.

3. Lightly lubricate the O-ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

**IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.**

4. Install the fitting into the port. Then, use a torque wrench and socket to tighten the fitting to the recommended installation torque shown in Figure 7.

**NOTE:** Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be less than the recommended installation torque. See Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 – Product Records and Maintenance to determine necessary conversion information.

5. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method.

A. Install the fitting into the port and tighten it down full length until finger tight.

B. If port material is steel, tighten the fitting to the listed F.F.F.T. If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

| Size | F.F.F.T. |
|---|---|
| 4 (1/4 in. nominal hose or tubing) | 1.00 ± 0.25 |
| 6 (3/8 in.) | 1.50 ± 0.25 |
| 8 (1/2 in.) | 1.50 ± 0.25 |
| 10 (5/8 in.) | 1.50 ± 0.25 |
| 12 (3/4 in.) | 1.50 ± 0.25 |
| 16 (1 in.) | 1.50 ± 0.25 |

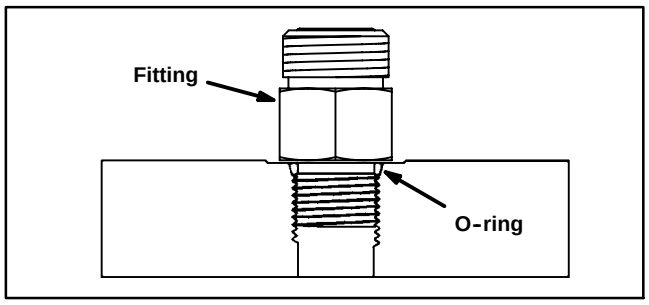



Figure 6

| Fitting Dash Size | Fitting Port Side Thread Size | Installation Torque Into Steel Port | Installation Torque Into Aluminum Port |
|---|---|---|---|
| 4 | 7/16 – 20 | 15 to 19 ft-lb (21 to 25 N-m) | 9 to 11 ft-lb (13 to 15 N-m) |
| 5 | 1/2 – 20 | 18 to 22 ft-lb (25 to 29 N-m) | 11 to 15 ft-lb (15 to 20 N-m) |
| 6 | 9/16 – 18 | 34 to 42 ft-lb (47 to 56 N-m) | 20 to 26 ft-lb (28 to 35 N-m) |
| 8 | 3/4 – 16 | 58 to 72 ft-lb (79 to 97 N-m) | 35 to 43 ft-lb (48 to 58 N-m) |
| 10 | 7/8 – 14 | 99 to 121 ft-lb (135 to 164 N-m) | 60 to 74 ft-lb (82 to 100 N-m) |
| 12 | 1 1/16 – 12 | 134 to 164 ft-lb (182 to 222 N-m) | 81 to 99 ft-lb (110 to 134 N-m) |
| 14 | 1 3/16 – 12 | 160 to 196 ft-lb (217 to 265 N-m) | 96 to 118 ft-lb (131 to 160 N-m) |
| 16 | 1 5/16 – 12 | 202 to 248 ft-lb (274 to 336 N-m) | 121 to 149 ft-lb (165 to 202 N-m) |
| 20 | 1 5/8 – 12 | 247 to 303 ft-lb (335 to 410 N-m) | 149 to 183 ft-lb (202 to 248 N-m) |

Figure 7

**Adjustable Fitting (Fig. 8)**

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O−ring be replaced any time the connection is opened.

3. Lightly lubricate the O−ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

4. Turn back the lock nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1 in Figure 9).

**IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.**

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2 in Figure 9). Make sure that the fitting does not bottom in the port during installation.

6. To put the fitting in the desired position, unscrew it by the required amount to align fitting with incoming hose or tube, but no more than one full turn (Step 3 in Figure 9).

7. Hold the fitting in the desired position with a wrench and use a torque wrench to tighten the lock nut to the recommended installation torque shown in Figure 7. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 − Product Records and Maintenance).

8. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method. Hold the fitting in the desired position with a wrench and, if port material is steel, tighten the lock nut with a second wrench to the listed F.F.F.T (Step 4 in Figure 9). If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

| Size | F.F.F.T. |
|---|---|
| 4 (1/4 in. nominal hose or tubing) | 1.00 ± 0.25 |
| 6 (3/8 in.) | 1.50 ± 0.25 |
| 8 (1/2 in.) | 1.50 ± 0.25 |
| 10 (5/8 in.) | 1.50 ± 0.25 |
| 12 (3/4 in.) | 1.50 ± 0.25 |
| 16 (1 in.) | 1.50 ± 0.25 |

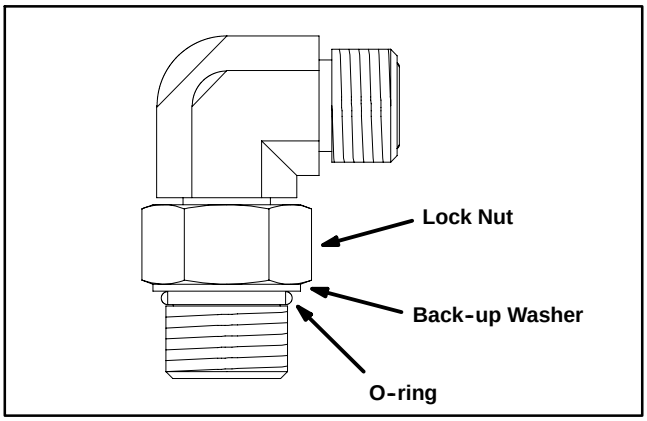



Figure 8

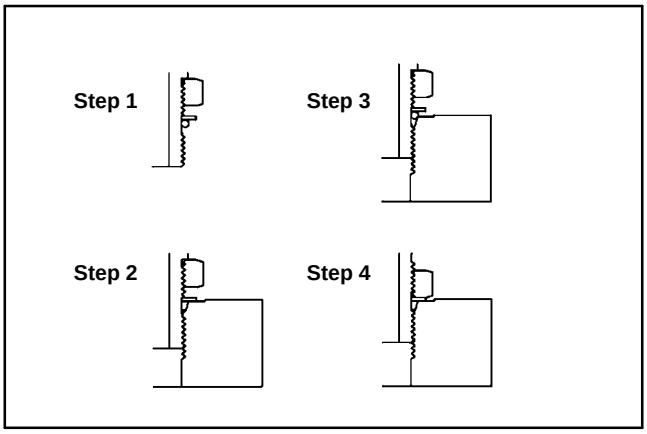



Figure 9

## Relieving Hydraulic System Pressure

Before disconnecting or performing any work on the hydraulic system, all pressure in the hydraulic system must be relieved. Park machine on a level surface, lower cutting decks fully, stop engine and engage parking brake.

To relieve hydraulic pressure in traction circuit, move traction pedal to both forward and reverse directions. To relieve hydraulic pressure in steering circuit, rotate steering wheel in both directions.

System pressure in cutting circuit is relieved when the cutting decks are disengaged.

To relieve hydraulic pressure in lift circuit, turn ignition switch to ON (do not start engine) and fully lower the cutting decks. After decks are fully lowered, turn ignition switch to OFF and remove key from the switch.

**IMPORTANT: If machine will be serviced on a lift or at an elevated position, fully lower the cutting decks after the machine has been raised to ensure that the lift cylinders are fully extended. Pressure will be maintained in the lift cylinders unless they are fully extended.**

## Traction Circuit Component Failure

The traction circuit on Groundsmaster 4300–D machines is a closed loop system that includes the piston (traction) pump and four (4) wheel motors. If a component in the traction circuit should fail, debris and contamination from the failed component will circulate throughout the traction circuit. This contamination can damage other components in the circuit so it must be removed to prevent additional component failure.

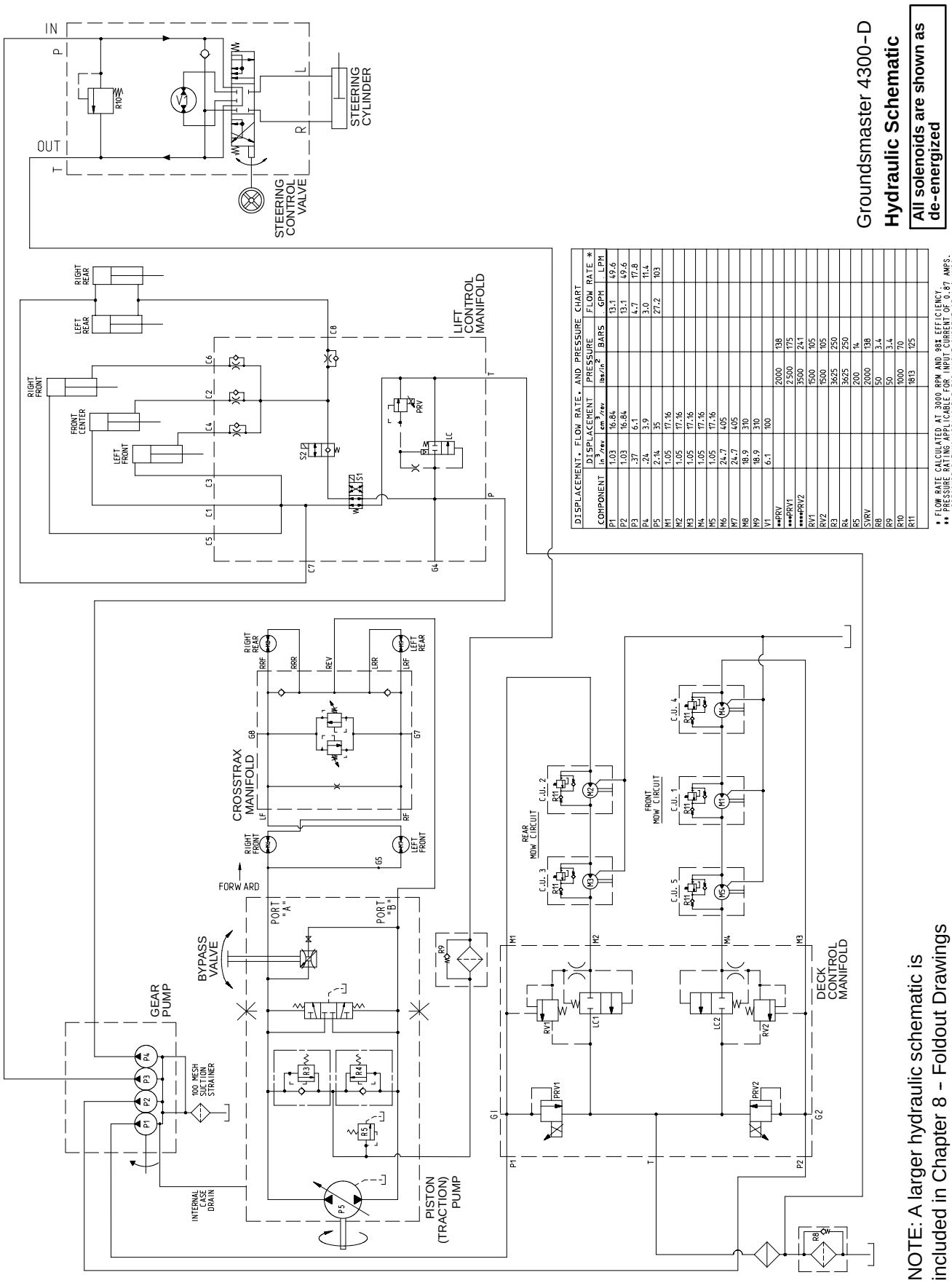
The recommended method of removing traction circuit contamination would be to temporarily install the high flow hydraulic filter (see Special Tools in this chapter) into the circuit. This filter should be used when connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. traction (piston) pump or wheel motor). The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

Once the Toro high flow hydraulic filter kit has been placed in the circuit, raise and support the machine with all wheels off the ground. Then, operate the traction circuit to allow oil flow throughout the circuit. The filter will remove contamination from the traction circuit during operation. Because the Toro high flow filter is bi–directional, the traction circuit can be operated in both the forward and reverse direction. The filter should be removed from the machine after contamination has been removed from the traction circuit. See Filtering Closed–Loop Traction Circuit in the Service and Repairs section of this chapter for additional information on using the Toro high flow hydraulic filter.

The alternative to using the Toro high flow hydraulic filter kit after a traction circuit component failure would be to disassemble, drain and thoroughly clean all components, tubes and hoses in the traction circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional circuit component failure.

**NOTE:** The traction pump case drain could allow any debris in the traction circuit to contaminate other hydraulic circuits on the machine.

# Hydraulic Schematic




NOTE: A larger hydraulic schematic is included in Chapter 8 – Foldout Drawings

# Hydraulic Flow Diagrams

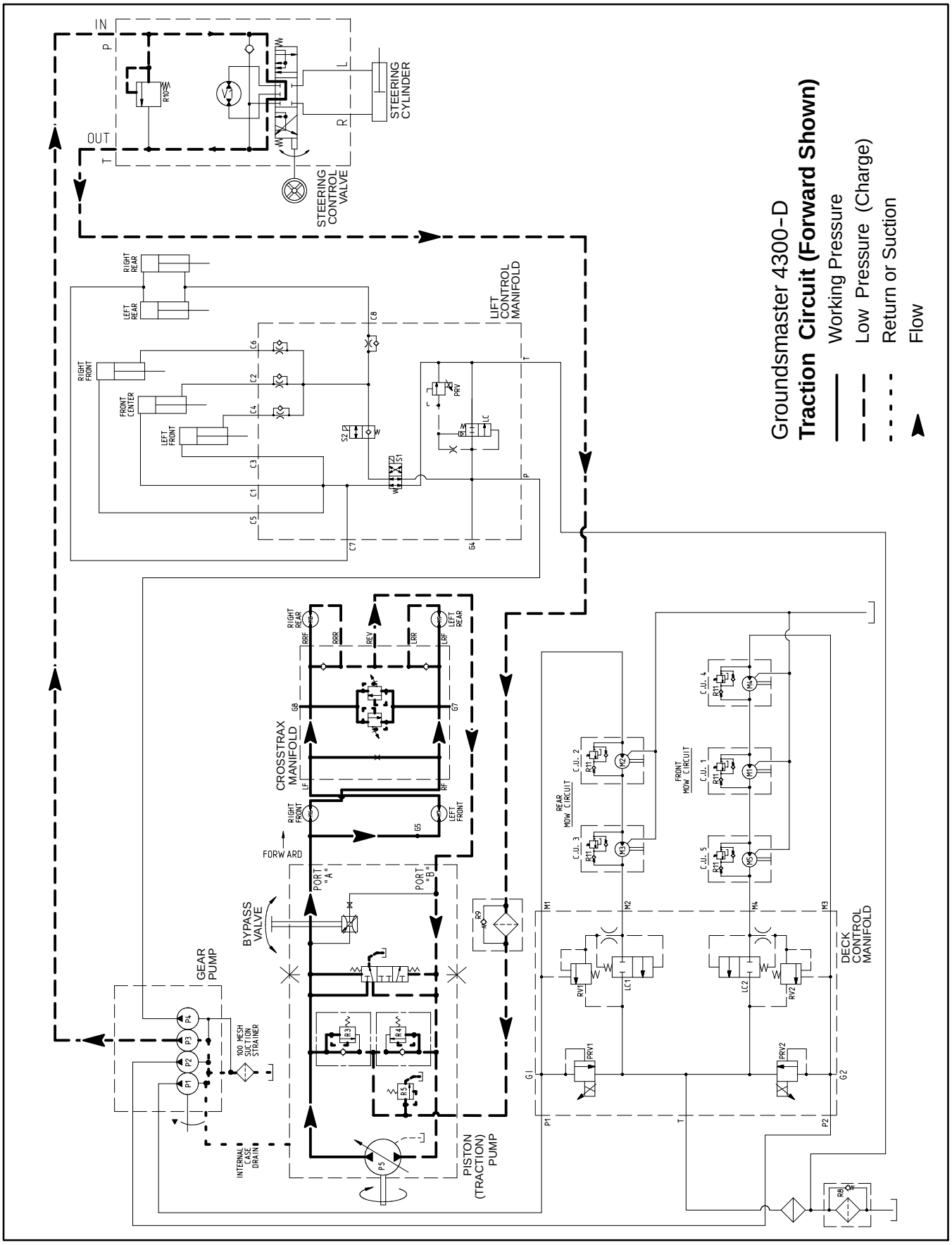



Figure 10

## Traction Circuit

The hydraulic traction circuit consists of a variable displacement piston pump (P5) connected in a closed loop, parallel circuit to four (4) orbital roller vane wheel motors. The traction pump input shaft is rotated by a drive shaft that is driven from the engine flywheel.

Forward traction circuit pressure can be measured at a test port located in the hydraulic tube that connects the front wheel motors. Reverse traction circuit pressure can be measured at test ports in the AWD control manifold.

**Forward Direction (Fig. 10)**

Pushing the top of the traction pedal angles the traction pump swash plate to create a flow of oil. This oil flow is directed to the wheel motors via hydraulic hoses and tubes to drive the wheels in the forward direction. Traction pump flow is directed to the front wheel motors and then to the opposite rear wheel motors to maximize traction. To reduce tire scuffing when turning, traction system pressure is equalized in the AWD control manifold with an orifice and a bi−directional relief valve. Check valves in the AWD manifold allow the rear wheel motors to over−run during tight turns. Forward traction pressure is limited to 3625 PSI (250 bar) by the forward traction relief valve (R3) located in the traction pump.

Oil flowing from the wheel motors returns to the variable displacement pump and is continuously pumped through the traction circuit as long as the traction pedal is pushed.

The angle of the swash plate determines pump flow and ultimately traction speed. When the traction pedal is depressed a small amount, a small swash plate rotation results in low pump output and lower traction speed. When the traction pedal is depressed fully, the pump swash plate rotates fully to provide maximum pump output and traction speed.

Gear pump section (P3) supplies oil flow for the steering circuit and also provides a constant supply of charge oil to the closed loop traction circuit. This charge oil provides lubrication for traction circuit components and also replenishes traction circuit oil that is lost due to internal leakage in the traction circuit.

Gear pump section (P3) takes its suction from the hydraulic reservoir. Charge pump flow is directed to the low pressure side of the closed loop traction circuit. Charge relief valve (R5) located in the traction pump limits the charge relief pressure to 200 PSI (14 bar).

The piston pump is equipped with a case drain to allow internal leakage to be removed from the pump. The case drain is connected to the gear pump inlet.

The piston pump (P5) includes a flushing valve that bleeds off a small amount of hydraulic fluid for cooling of the closed loop traction circuit. The charge system replenishes oil that is bled from the traction circuit by the flushing valve.

**Reverse Direction**

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed. Pushing the bottom of the traction pedal rotates the traction pump swash plate to create a flow of oil. This oil is directed to the wheel motors to drive the wheels in the reverse direction. Reverse traction pressure is limited to 3625 PSI (250 bar) by the reverse traction relief valve (R4) located in the traction pump.

Oil flowing from the wheel motors returns to the traction pump and is continuously pumped through the closed loop traction circuit as long as the traction pedal is pushed.

The charge circuit and flushing valve function the same in reverse as they do in the forward direction.

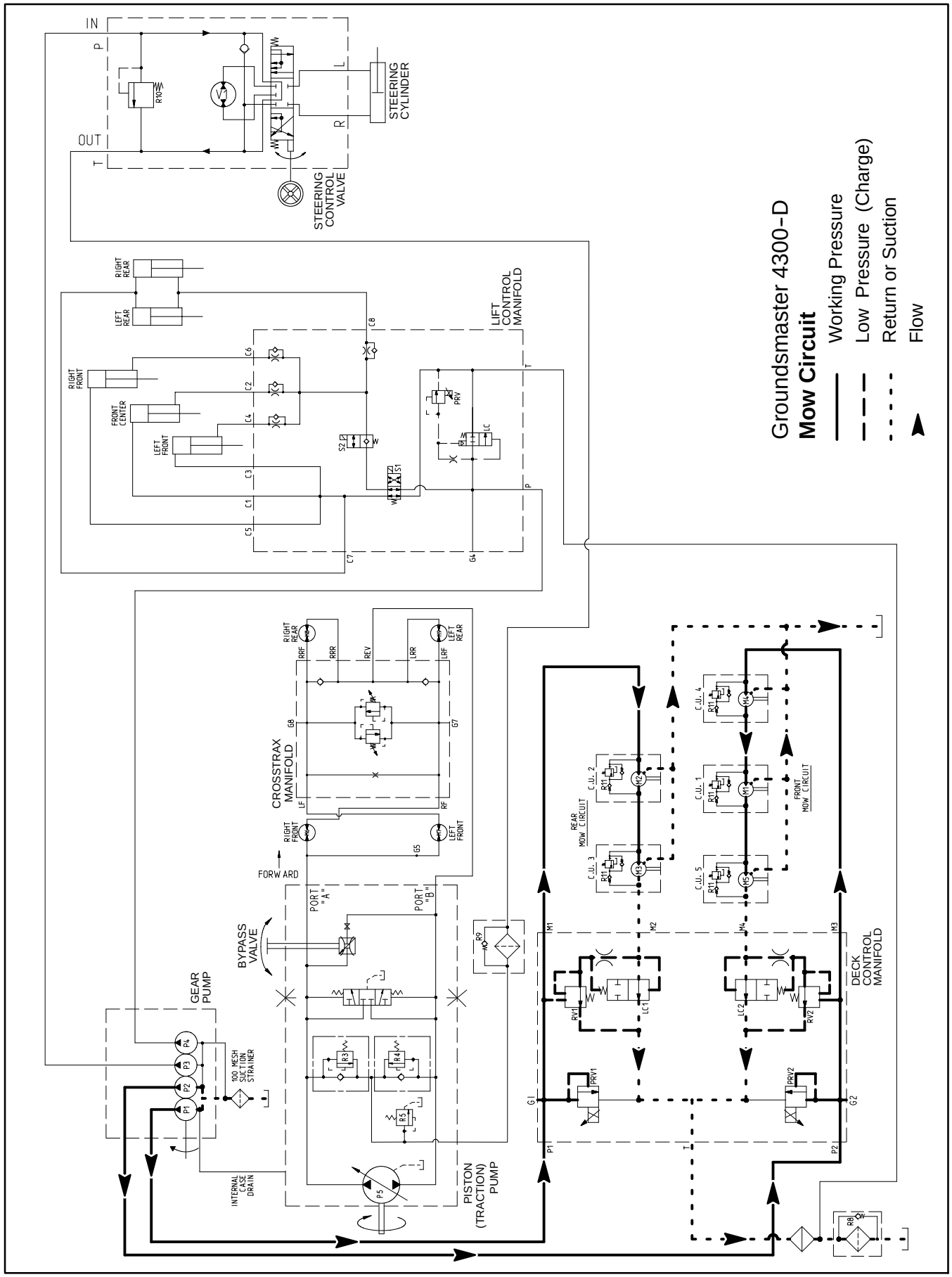

Groundsmaster 4300-D
Mow Circuit
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
IN
OUT
STEERING CONTROL VALVE
STEERING CYLINDER
LIFT CONTROL MANIFOLD
CROSSTRAX MANIFOLD
DECK CONTROL MANIFOLD
GEAR PUMP
BYPASS VALVE
PISTON (TRACTION) PUMP
100 MESH SUCTION STRAINER
INTERNAL CASE DRAIN
FORWARD
REAR MOW CIRCUIT
FRONT MOW CIRCUIT
RIGHT REAR
LEFT REAR
RIGHT FRONT
LEFT FRONT
FRONT CENTER
PORT "A"
PORT "B"

Figure 11

## Mow Circuit

A four section gear pump is coupled to the piston (traction) pump. Gear pump sections (P1) and (P2) supply hydraulic flow for the mow circuit. These gear pumps take their suction from the hydraulic reservoir.

The deck control manifold contains two (2) independent control circuits for the front and rear cutting decks. Each circuit is supplied by its own pump section. Pump section (P1) supplies hydraulic power to the rear cutting decks with circuit control by proportional relief valve (PRV1), relief valve (RV1) and logic cartridge (LC1) in the deck control manifold. Pump section (P2) supplies the front cutting decks with circuit control by proportional relief valve (PRV2), relief valve (RV2) and logic cartridge (LC2) in the deck control manifold. Both circuits share manifold port T, which drains to the oil cooler, oil filter and hydraulic reservoir.

Cutting deck motors are equipped with a cross over relief valve to prevent hydraulic component damage in case a single cutting deck should stall.

The machine controller uses inputs from various machine switches to determine when the solenoids for proportional relief valves (PRV1) and (PRV2) are to be energized. The controller also provides a slight delay in activation of rear cutting decks.

### PTO Not Engaged

When proportional relief valves (PRV1) and (PRV2) are not energized (PTO switch in the OFF position or cutting decks raised), flow from pump sections (P1) and (P2) is directed through the unshifted proportional relief valves, out the mow control manifold port T and then returns to the hydraulic reservoir through the oil filter and oil cooler, bypassing the deck motors. The manifold logic cartridges (LC1 and LC2) remain in the unshifted position to prevent any return flow from the deck motors so the motors will not rotate.

### PTO Engaged (Fig. 11)

When proportional relief valve (PRV1) is energized by the controller (PTO switch in the ON position and cutting decks lowered), the proportional relief valve shifts and prevents pump section (P1) flow through the valve. Pump flow that entered deck control manifold port P1 is then directed toward the rear cutting deck motors. Because logic cartridge LC1 is unshifted, circuit pressure increases until manifold relief valve (RV1) is opened by a manifold pilot piston. The shifted relief valve allows a small amount of hydraulic flow to return to tank through a manifold sensing line. This flow passes through an orifice which causes a pressure differential that shifts logic cartridge LC1. The shifted LC1 allows circuit flow to rotate the rear cutting deck motors. Return oil from the deck motors is directed through the shifted logic cartridge (LC1), manifold port T, oil cooler, oil filter and then to the reservoir. Deck motor case drain leakage returns directly to the hydraulic reservoir.

Mow circuit pressure for the rear cutting decks (pump section P1) can be measured at deck control manifold port G1.

The front cutting deck circuit operates the same as the rear cutting deck circuit. Deck control manifold proportional relief (PRV2), relief valve (RV2) and logic cartridge (LC2) are used to control the front cutting deck circuit. Mow circuit pressure for the front cutting decks (pump section P2) can be measured at deck control manifold port G2.

### Cutting Deck Circuit Relief

Maximum cutting deck circuit pressure is limited by the proportional relief valves in the hydraulic control manifold. The front deck circuit valve (PRV2) is set at 3500 PSI (241 bar) and the rear deck circuit valve (PRV1) is set at 2500 PSI (175 bar).

When increased circuit resistance is met (e.g. a cutting blade should strike an object), the pressure increase is felt at the proportional relief valve. If circuit pressure should exceed the relief setting, the valve will open to allow circuit flow to return to tank through manifold port T. When circuit pressure lowers, the valve closes to allow flow to return to the deck motors.

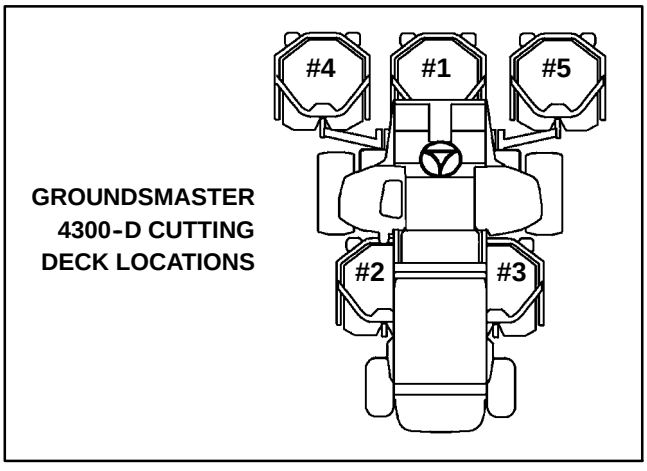



Figure 12

## Mow Circuit Cutting Deck Blade Braking

When the operator turns the PTO switch OFF or if the decks are raised with the PTO switch ON, the deck control manifold proportional relief valves (PRV1 and PRV2) are de−energized causing circuit flow to bypass the deck motors and return to the reservoir out manifold port T (refer to information in Mow Circuit in this section). Without circuit flow, the manifold relief valve (RV1 or RV2) returns to its neutral position which causes the logic cartridge (LC1 or LC2) to shift to its neutral position, blocking return flow from the deck motors and slowing the cutting blades (Fig. 13).

The inertia of the rotating cutting blades, however, effectively turns the deck motors into pumps causing an increase in pressure as the flow from the motor comes up against the closed logic cartridge (LC1 or LC2). When this pressure builds to approximately 1500 PSI (105 bar), the relief valve (RV1 or RV2) re−opens which allows a small amount of hydraulic flow to return to tank through a manifold sensing line (Fig. 14). This flow causes a pressure differential that shifts the logic cartridge (LC1 or LC2) to once again allow oil flow from the motors (Fig. 15). When return pressure drops below 1500 PSI (105 bar), the relief valve (RV1 or RV2) reseats and causes the logic cartridge (LC1 or LC2) to close again, blocking return flow from the deck motors to further slow the cutting blades. This action of the relief valve opening and the logic cartridge shifting occurs several times in a very short time frame as the blades finally come to a stop. Once the blades have stopped, the logic cartridge (LC1 or LC2) remains in the neutral position to keep the deck motors from rotating.

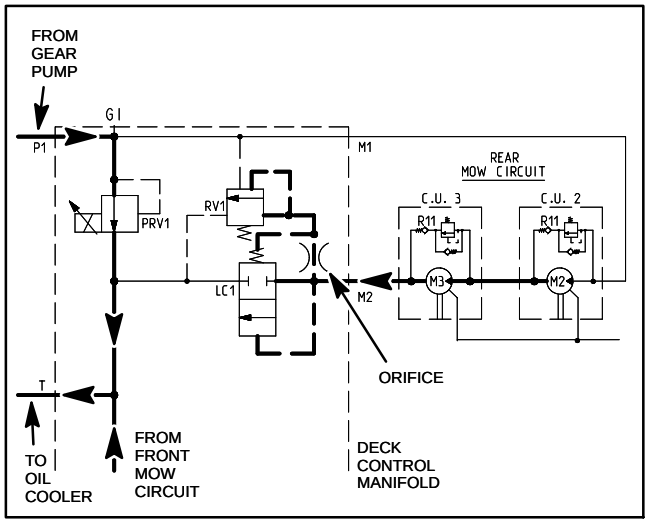



Figure 13

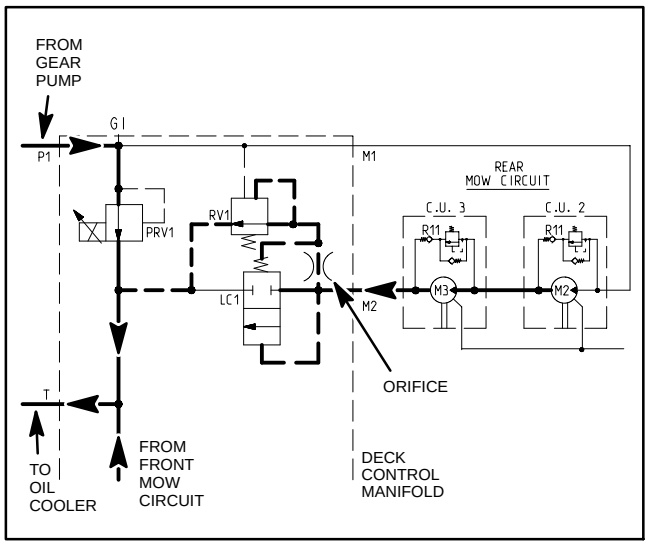



Figure 14

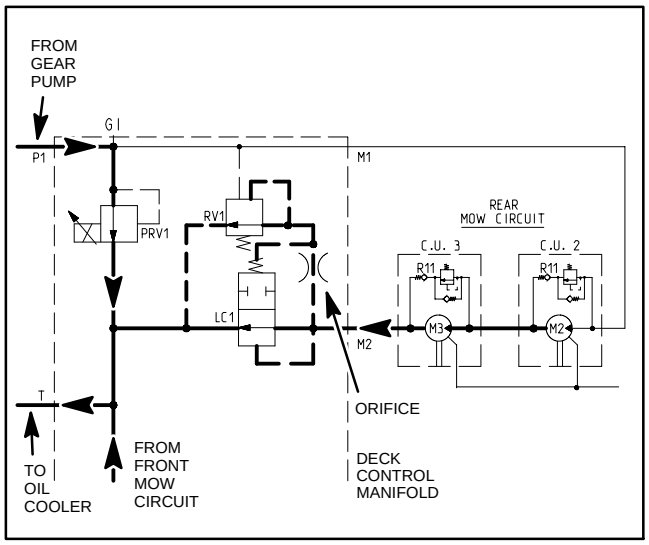



Figure 15

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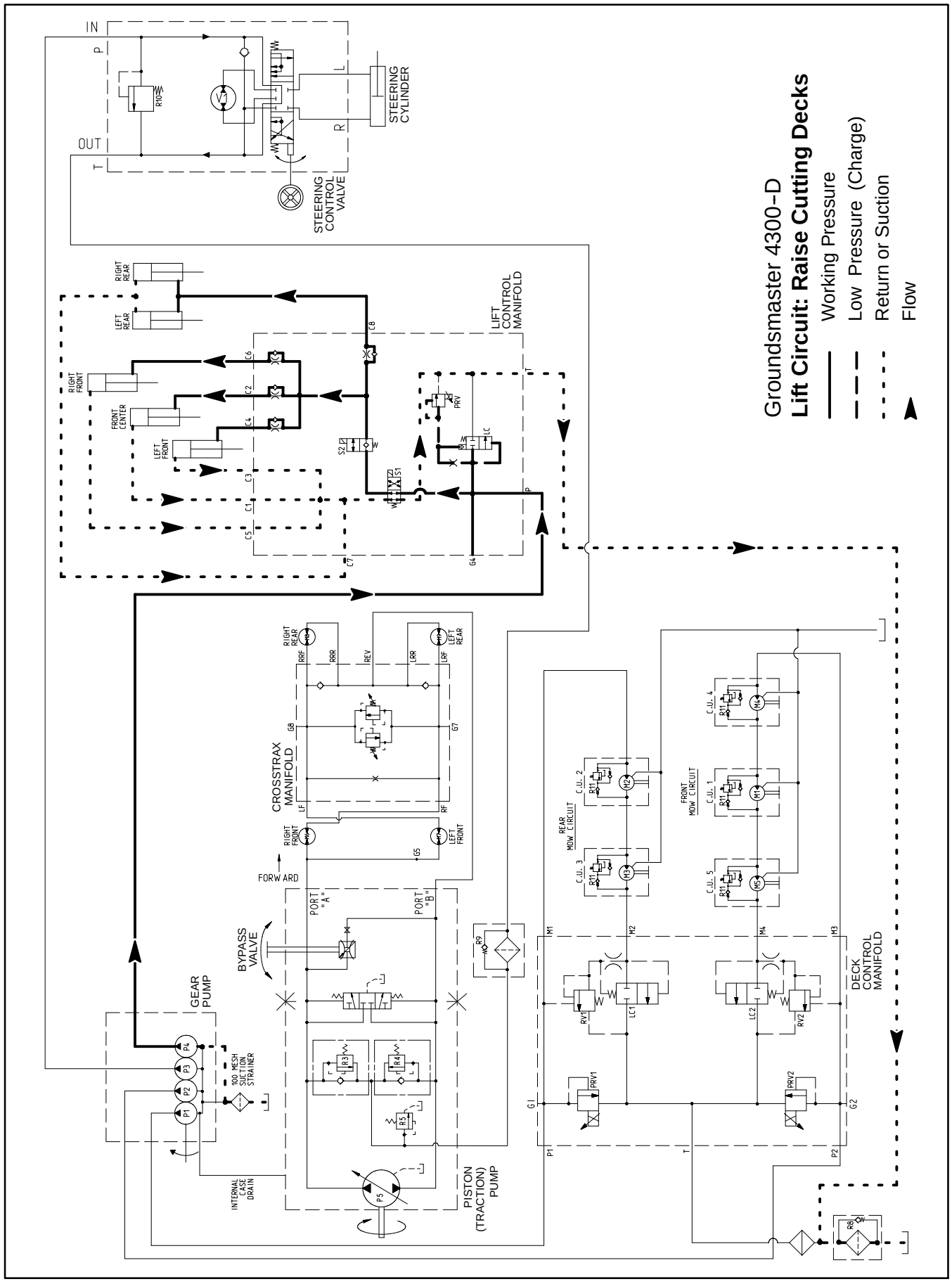
Groundsmaster 4300-D
Lift Circuit: Raise Cutting Decks
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
IN
OUT
STEERING CONTROL VALVE
STEERING CYLINDER
LIFT CONTROL MANIFOLD
RIGHT REAR
LEFT REAR
RIGHT FRONT
FRONT CENTER
LEFT FRONT
PRV
LC
CROSSTRAX MANIFOLD
FORWARD
PORT "A"
PORT "B"
BYPASS VALVE
GEAR PUMP
100 MESH SUCTION STRAINER
INTERNAL CASE DRAIN
PISTON (TRACTION) PUMP
REAR MOW CIRCUIT
FRONT MOW CIRCUIT
C.U. 1
C.U. 2
C.U. 3
C.U. 4
C.U. 5
DECK CONTROL MANIFOLD
PRV1
PRV2
LC1
LC2
RV1
RV2

Figure 16

## Lift Circuit: Raise Cutting Decks

A four section gear pump is coupled to the piston (traction) pump. Gear pump section (P4) supplies hydraulic flow to the lift control manifold and lift cylinders. The gear pump takes its suction from the hydraulic reservoir.

The lift control manifold includes three (3) electrically operated valves. Solenoid valve (S1) is used to direct oil flow to extend the lift cylinders when energized or retract them when de−energized. Solenoid valve (S2) allows hydraulic flow from the rod end of the lift cylinders when energized and prevents oil passage from the lift cylinders when de−energized. Proportional relief valve (PRV) is used to control the operation of the manifold logic cartridge (LC) and also acts as a circuit relief valve.

While operating the machine during conditions of not raising or lowering the cutting decks (joystick in the neutral (center) position) (Fig. 17), all of the lift manifold valves (S1, S2 and PRV) are de−energized. The de−energized relief valve (PRV) allows hydraulic flow to return to tank through the manifold. This flow causes a pressure differential that shifts the logic cartridge (LC) which allows pump flow to bypass the lift cylinders. Flow returns to the oil filter and then to the hydraulic reservoir.

**Raise Cutting Decks (Fig. 16)**

When the joystick is moved to the raise position, the controller energizes the proportional relief valve (PRV). The energized relief valve (PRV) prevents flow through the valve which returns logic cartridge LC to the unshifted position. With lift manifold cartridges in this position, pump flow is directed to the rod end of all lift cylinders to retract the cylinders and raise all cutting decks. Flow to the lift cylinders bypasses the control manifold fixed orifices to prevent flow restriction during deck raising.

While the cutting decks are being raised, the proportional relief valve (PRV) has a secondary function as a circuit relief to limit lift circuit pressure to 2000 PSI (138 bar). Lift circuit pressure can be monitored at lift control manifold port G4.

When the joystick is returned to the neutral (center) position, the proportional relief valve (PRV) is de−energized. The de−energized relief valve (PRV) allows hydraulic flow to return to tank through the manifold. This flow causes a pressure differential that shifts the logic cartridge (LC) which allows pump flow to bypass the lift cylinders. All lift cylinders and cutting decks are held in the raised position by de−energized valve S2.

**LIFT CIRCUIT: NOT RAISING OR LOWERING**

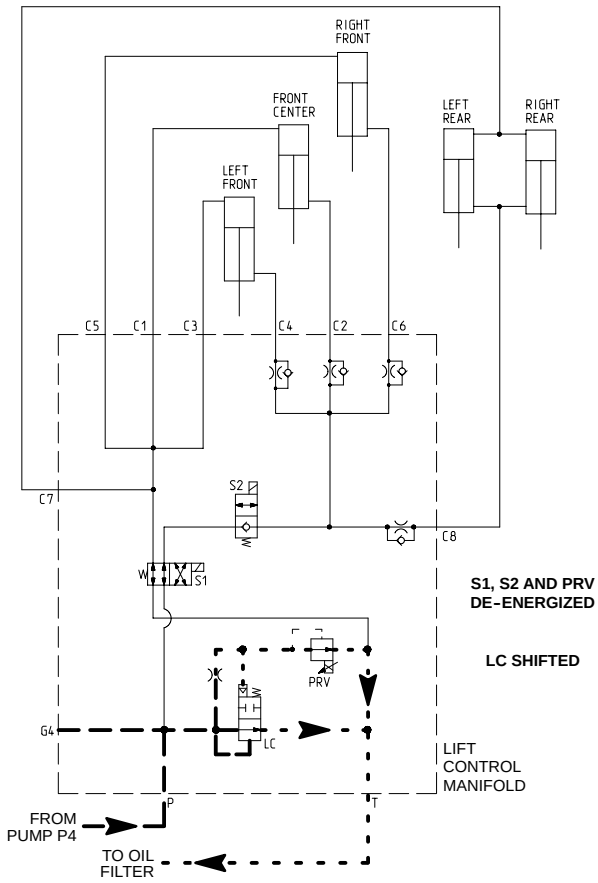


Figure 17

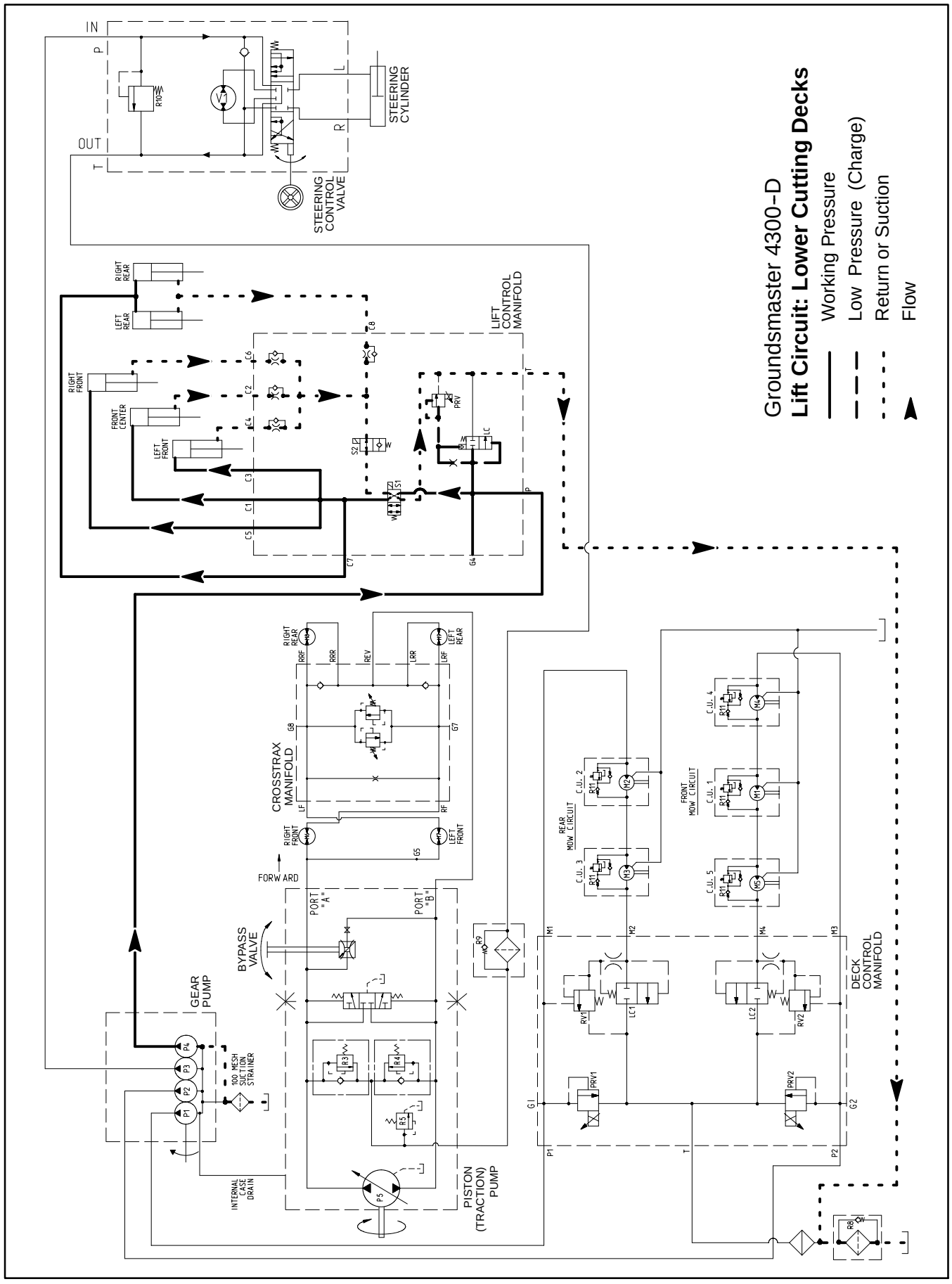
Groundsmaster 4300-D
Lift Circuit: Lower Cutting Decks
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
STEERING CYLINDER
STEERING CONTROL VALVE
LIFT CONTROL MANIFOLD
CROSSTRAX MANIFOLD
BYPASS VALVE
GEAR PUMP
PISTON (TRACTION) PUMP
DECK CONTROL MANIFOLD
REAR MOW CIRCUIT
FRONT MOW CIRCUIT
FORWARD
100 MESH SUCTION STRAINER
INTERNAL CASE DRAIN
RIGHT REAR
LEFT REAR
RIGHT FRONT
FRONT CENTER
LEFT FRONT

Figure 18

## Lift Circuit: Lower Cutting Decks

A four section gear pump is coupled to the piston (traction) pump. Gear pump section (P4) supplies hydraulic flow to the lift control manifold and lift cylinders. The gear pump takes its suction from the hydraulic reservoir.

The lift control manifold includes three (3) electrically operated valves. Solenoid valve (S1) is used to direct oil flow to extend the lift cylinders when energized or retract them when de-energized. Solenoid valve (S2) allows hydraulic flow from the rod end of the lift cylinders when energized and prevents oil passage from the lift cylinders when de-energized. Proportional relief valve (PRV) is used to control the operation of the manifold logic cartridge (LC) and also acts as a circuit relief valve.

While operating the machine during conditions of not raising or lowering the cutting decks (joystick in the neutral (center) position) (Fig. 19), all of the lift manifold valves (S1, S2 and PRV) are de-energized. The de-energized relief valve (PRV) allows hydraulic flow to return to tank through the manifold. This flow causes a pressure differential that shifts the logic cartridge (LC) which allows pump flow to bypass the lift cylinders. Flow returns to the oil filter and then to the hydraulic reservoir.

**NOTE:** When the mow speed limiter is in the transport position, the cutting decks will not lower.

### Lower Cutting Decks (Fig. 18)

When the joystick is moved to the lower position, the controller energizes all of the lift manifold valves (S1, S2 and PRV). The energized relief valve (PRV) prevents flow through the valve which returns logic cartridge LC to the unshifted position. With lift manifold cartridges in this position, pump flow is directed to the barrel end of all lift cylinders to extend the cylinders and lower the cutting decks. Fixed orifices in the lift control manifold (C2, C4, C6 and C8) control the lowering speed of the cutting decks by providing a restriction for the return flow from the lift cylinders.

While the cutting decks are being lowered, the proportional relief valve (PRV) has a secondary function as a circuit relief to limit lift circuit pressure to 2000 PSI (138 bar). Lift circuit pressure can be monitored at lift control manifold port G4.

When the joystick is returned to the neutral (center) position, all of the lift manifold valves (S1, S2 and PRV) are de-energized. The de-energized relief valve (PRV) allows hydraulic flow to return to tank through the manifold. This flow causes a pressure differential that shifts the logic cartridge (LC) which allows pump flow to bypass the lift cylinders. All lift cylinders and cutting decks are held in position by de-energized valve S2.

### Counterbalance

Once the cutting decks are fully lowered, the lift control manifold proportional relief valve (PRV) maintains back pressure (counterbalance) on the deck lift cylinders. This counterbalance pressure transfers cutting deck weight to the machine to improve traction. A set of wires located behind the control arm access cover allow counterbalance pressure to be adjusted to one of three settings.

A pressure transducer located in the forward traction hydraulic tube is used by the controller as an input to determine traction circuit pressure. Based on transducer input and machine counterbalance setting, an electrical output from the controller is provided to the lift control manifold proportional relief valve (PRV) to vary counterbalance pressure. As traction pressure increases (e.g. climbing a hill) the counterbalance pressure also increases to increase the weight on the tires and improve traction.

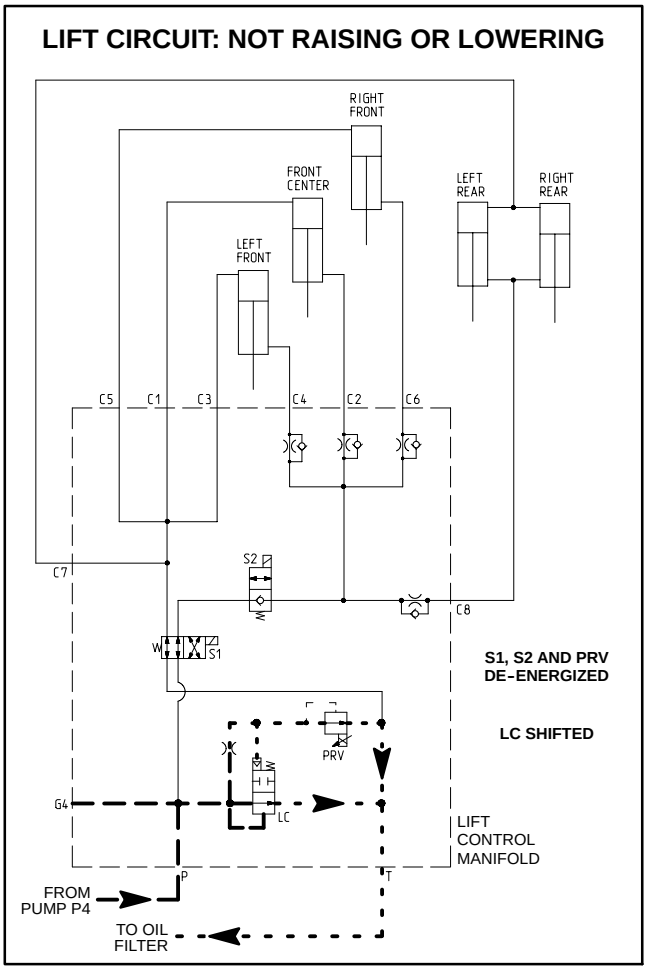


Figure 19

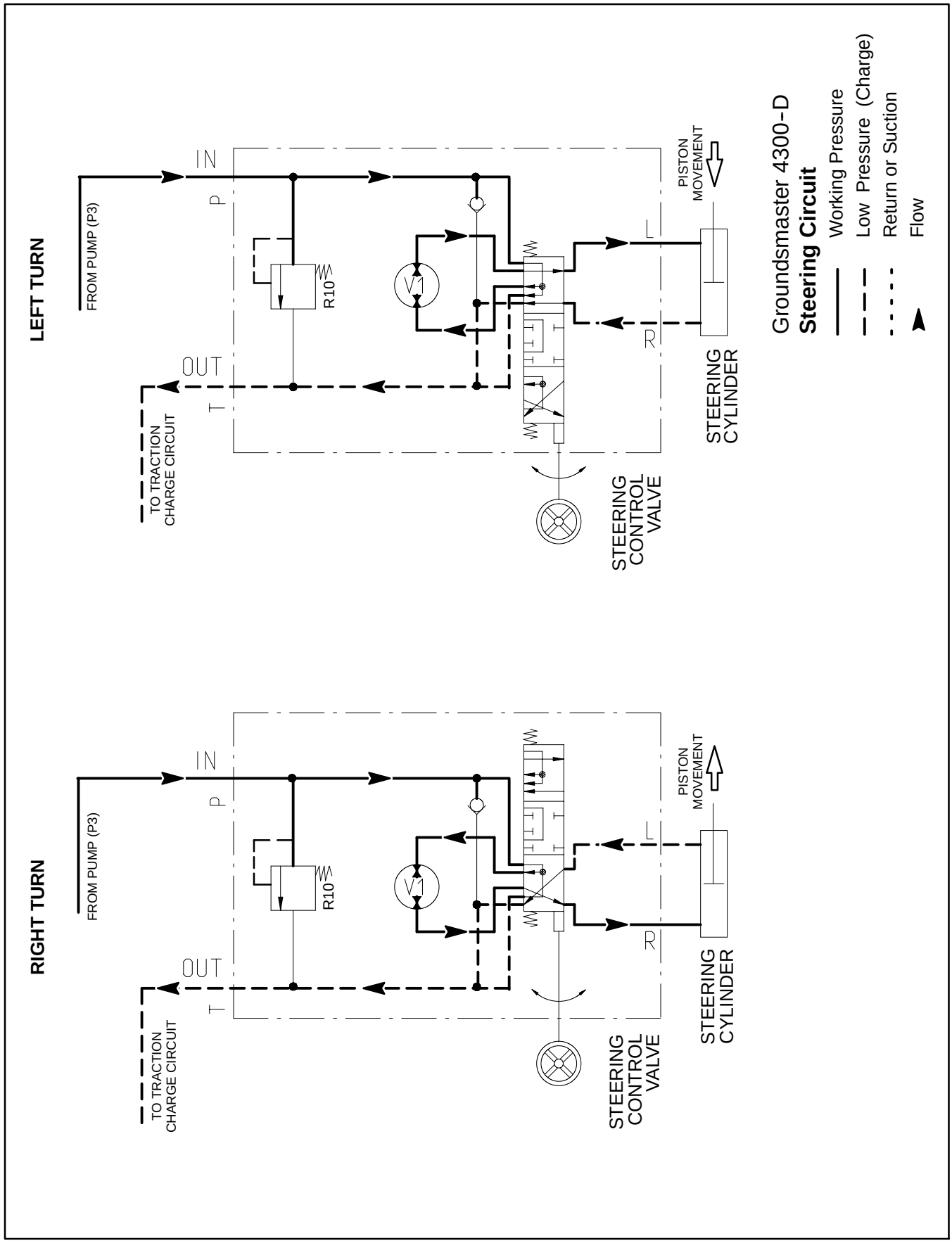
LEFT TURN
FROM PUMP (P3)
IN
P
R10
OUT
T
TO TRACTION CHARGE CIRCUIT
L
R
PISTON MOVEMENT
STEERING CYLINDER
STEERING CONTROL VALVE
RIGHT TURN
FROM PUMP (P3)
IN
P
R10
OUT
T
TO TRACTION CHARGE CIRCUIT
L
R
PISTON MOVEMENT
STEERING CYLINDER
STEERING CONTROL VALVE
Groundsmaster 4300-D
Steering Circuit
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow

Figure 20

## Steering Circuit

A four section gear pump is coupled to the piston (traction) pump. Gear pump section P3 supplies hydraulic flow to the steering control valve and for the traction charge circuit. The gear pump takes its suction from the hydraulic reservoir. Steering circuit pressure is limited to 1000 PSI (70 bar) by a relief valve (R10) located in the steering control valve.

With the steering wheel in the neutral position and the engine running, hydraulic flow enters the steering control valve at the P port and goes through the steering control spool valve, bypassing the rotary meter (V1) and steering cylinder. Flow leaves the control valve through the T port to the transmission oil filter and traction charge circuit.

**Left Turn (Fig. 20)**

When a left turn is made with the engine running, the turning of the steering wheel positions the steering control spool valve so that flow is directed through the bottom of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. First, most of the flow through the valve is bypassed out the T port back to the transmission oil filter and traction charge circuit. Second, the remainder of the flow is directed through the rotary meter (V1) and out the L port. Pressure contracts the steering cylinder piston for a left turn. The rotary meter ensures that the oil flow to the steering cylinder is proportional to the amount of turning on the steering wheel. Fluid leaving the steering cylinder flows back through the steering control spool valve and then out of the steering control valve through the T port.

The steering control valve returns to the neutral position when turning is completed.

**Right Turn (Fig. 20)**

When a right turn is made with the engine running, the turning of the steering wheel positions the steering control spool valve so that flow is directed through the top of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. As in a left turn, most of the flow through the valve is bypassed out the T port back to the transmission oil filter and traction charge circuit. Also like a left turn, the remainder of the flow is directed through rotary meter (V1) but goes out port R. Pressure extends the steering cylinder piston for a right turn. The rotary meter ensures that the oil flow to the steering cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the steering cylinder flows back through the steering control spool valve then through the T port and to the hydraulic reservoir.

The steering control valve returns to the neutral position when turning is completed.

# Special Tools

Order Special Tools from your Toro Distributor.

## Hydraulic Pressure Test Kit

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Kit contains one each: 1000 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in the Testing section of this chapter.

Toro Part Number: **TOR47009**

Figure 21

## 15 GPM Hydraulic Tester Kit (Pressure and Flow)

Use to test hydraulic circuits and components for flow and pressure capacities as recommended in the Testing section of this chapter. This tester includes the following:

1. INLET HOSE: Hose connected from the system circuit to the inlet side of the hydraulic tester.

2. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.

3. PRESSURE GAUGE: Glycerine filled 0 to 5000 PSI gauge to provide operating circuit pressure.

4. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated from 1 to 15 GPM (5 to 55 LPM).

5. OUTLET HOSE: A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

6. FITTINGS: An assortment of hydraulic fittings are included with this kit.

Toro Part Number: **TOR214678**


Figure 22

## 40 GPM Hydraulic Tester (Pressure and Flow)

Use to test hydraulic circuits and components for flow and pressure capacities as recommended in the Testing section of this chapter. This tester includes the following:

1. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.

2. PRESSURE GAUGE: Glycerine filled 0 to 5000 PSI gauge to provide operating circuit pressure.

3. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated from 4 to 40 GPM (20 to 150 LPM).

Toro Part Number: **AT40002**

**NOTE:** This tester does not include hoses (see Hydraulic Hose Kit TOR6007 below).


Figure 23

## Hydraulic Hose Kit

This kit includes fittings and hoses needed to connect 40 GPM hydraulic tester (AT40002) or high flow hydraulic filter kit (TOR6011) to machine hydraulic traction system components.

Toro Part Number: **TOR6007**

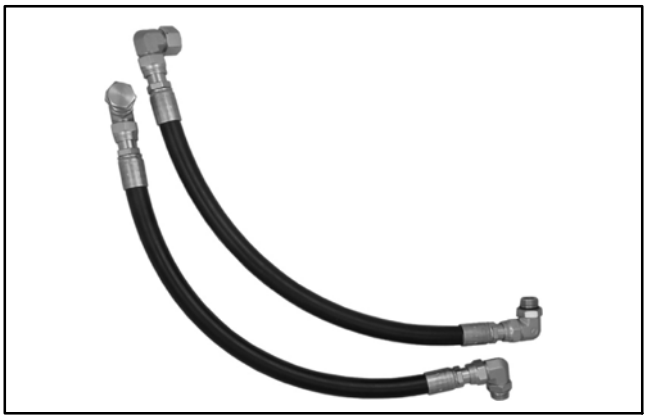

Figure 24

## O-Ring Kit

The O-ring kit includes O-rings in a variety of sizes for face seal and port seal hydraulic connections. It is recommended that O-rings be replaced whenever a hydraulic connection is loosened.

Toro Part Number: **117-2727**


Figure 25

## High Flow Hydraulic Filter Kit

The high flow hydraulic filter kit is designed with large flow (40 GPM/150 LPM) and high pressure (5000 PSI/345 bar) capabilities. This kit provides for bi−directional filtration which prevents filtered debris from being allowed back into the circuit regardless of flow direction.

If a component failure occurs in the closed loop traction circuit, contamination from the failed part will remain in the circuit until removed. When connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. hydrostat or wheel motor), the high flow hydraulic filter can be installed in the traction circuit. The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

Toro Part Number: **TOR6011**

**NOTE:** Use of Hydraulic Hose Kit TOR6007 is recommended when using the high flow hydraulic filter kit.

**NOTE:** Replacement filter element is Toro part number TOR6012. Filter element cannister tightening torque is **25 ft−lb (34 N−m)**.

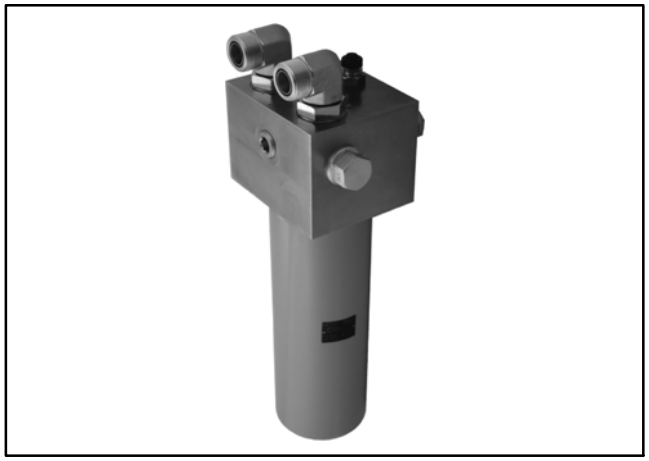

Figure 26

## Hydraulic Test Fitting Kit

This kit includes a variety of O−ring face seal fittings to enable connection of test gauges to the system.

The kit includes: tee's, unions, reducers, plugs, caps and male test fittings.

Toro Part Number: **TOR4079**

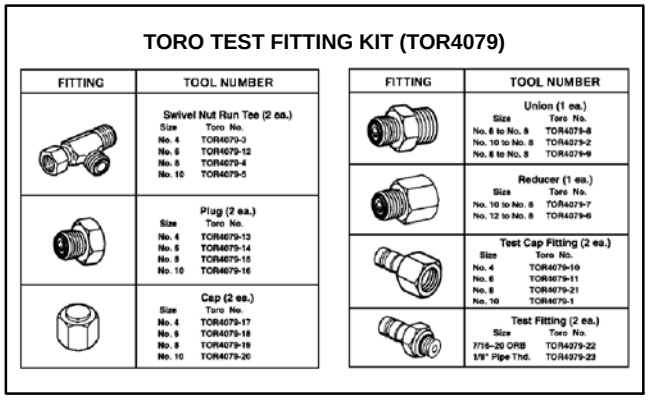


Figure 27

## Spindle Plug

The spindle plug can be used to prevent contaminant entry into the cutting deck spindle assembly when the hydraulic motor is removed from the spindle.

Toro Part Number: **94−2703**

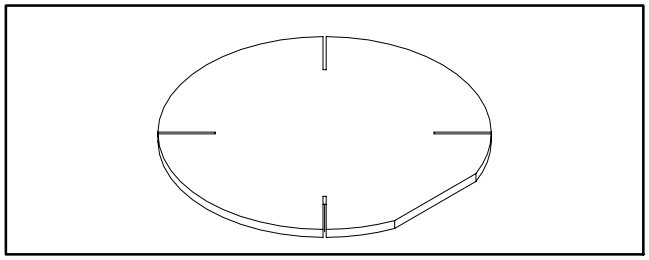

Figure 28

## Wheel Hub Puller

The wheel hub puller allows safe removal of the wheel hub from the wheel motor shaft.

Toro Part Number: **TOR6004**

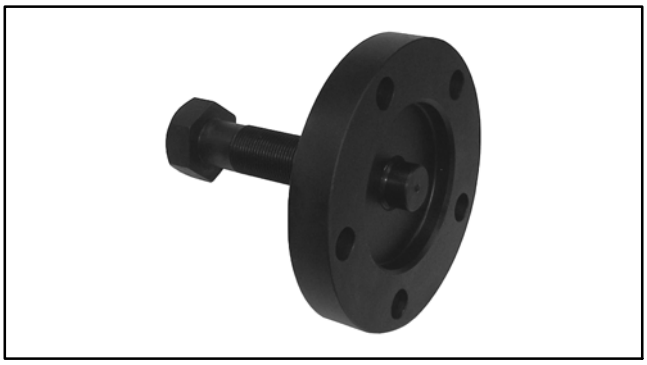

Figure 29

## Measuring Container

Use this graduated container for doing hydraulic motor efficiency testing (motors with case drain lines only). Measure efficiency of a hydraulic motor by restricting the outlet flow from the motor and measuring leakage from the case drain line while the motor is pressurized by the hydraulic system.

The table in Figure 31 provides gallons per minute (GPM) conversion for measured milliliter or ounce leakage.

Toro Part Number: **TOR4077**

Figure 30

| GPM | Milliliters in 15 sec. | Ounces in 15 sec. |
|---|---|---|
| .1 | 95 | 3.2 |
| .2 | 189 | 6.4 |
| .3 | 284 | 9.6 |
| .4 | 378 | 12.8 |
| .5 | 473 | 16.0 |
| .6 | 568 | 19.2 |
| .7 | 662 | 22.4 |
| .8 | 756 | 25.6 |
| .9 | 852 | 28.8 |
| 1.0 | 946 | 32.0 |

Figure 31

# Troubleshooting

The cause of an improperly functioning hydraulic system is best diagnosed with the use of proper testing equipment and a thorough understanding of the complete hydraulic system.

A hydraulic system with an excessive increase in heat or noise has a potential for failure. Should either of these conditions be noticed, immediately stop the machine, turn off the engine, locate the cause of the trouble and correct it before allowing the machine to be used again. Continued use of an improperly functioning hydraulic system could lead to extensive hydraulic component damage.

The charts that follow contain information to assist in troubleshooting. There may possibly be more than one cause for a machine malfunction.

Review the hydraulic schematic and information on hydraulic system operation in the Hydraulic Flow Diagrams section of this chapter. This information will be useful during the hydraulic troubleshooting process.

Refer to the Testing section of this chapter for precautions and specific hydraulic test procedures.

## General Hydraulic System Problems

| Problem | Possible Causes |
|---|---|
| Hydraulic oil leaks from machine | Fitting(s), hose(s) or tube(s) is (are) loose or damaged.<br>O–ring(s) or seal(s) is (are) missing or damaged. |
| Foaming hydraulic fluid | Oil level in hydraulic reservoir is low.<br>Hydraulic system has wrong kind of oil.<br>Pump suction line has an air leak. |
| Hydraulic system operates hot | Traction system pressure is high due to excessive load or brake dragging or binding.<br>Oil level in hydraulic reservoir is low.<br>Hydraulic oil is contaminated or too light.<br>Engine speed is too low.<br>Fan speed is low dues to a loose or damaged belt.<br>Oil cooler is damaged or plugged. Air flow through oil cooler is obstructed.<br>Oil filter is plugged.<br>Piston (traction) pump bypass valve is loosened or is damaged.<br>Charge pressure is low.<br>Piston (traction) pump check valve is not seating or is damaged.<br>Wheel motor(s) and/or piston (traction) pump are worn or damaged (NOTE: If a traction circuit component has internal wear or damage, it is possible that other traction circuit components are also damaged). |

## Traction Circuit Problems

| Problem | Possible Causes |
|---|---|
| Neutral is difficult to find or machine operates in one direction only | Traction control linkage is misadjusted, disconnected, binding or damaged.<br><br>Piston (traction) pump check relief valve is not seating or is damaged (NOTE: Piston (traction) pump check relief valves for forward and reverse are identical and can be reversed for testing purposes).<br><br>Piston (traction) pump is worn or damaged. |
| Traction response is sluggish | Hydraulic oil is very cold.<br><br>Parking brake is dragging or binding.<br><br>Piston (traction) pump bypass valve is loosened or is damaged.<br><br>Charge pressure is low.<br><br>Flushing valve in traction pump is not seating or is damaged.<br><br>Piston (traction) pump charge relief valve is not seating or is damaged.<br><br>Piston (traction) pump check relief valve is not seating or is damaged (NOTE: Piston (traction) pump check relief valves for forward and reverse are identical and can be reversed for testing purposes).<br><br>Piston (traction) pump is worn or damaged. |
| No traction in either direction | Parking brake is applied, dragging or binding.<br><br>Traction control linkage is misadjusted, disconnected, binding or damaged.<br><br>Oil level in hydraulic reservoir is low (other hydraulic systems are affected as well).<br><br>Piston (traction) pump bypass valve is loosened.<br><br>Flushing valve in traction pump is not seating or is damaged.<br><br>Piston (traction) pump check valve is not seating or is damaged.<br><br>Charge pressure is low.<br><br>Wheel motor(s) and/or piston (traction) pump are worn or damaged (NOTE: If a traction circuit component has internal wear or damage, it is possible that other traction circuit components are also damaged). |
| Single wheel motor turns while unloaded, but slows down or stops when load is applied | Wheel motor is worn or damaged (NOTE: If a traction circuit component has internal wear or damage, it is possible that other traction circuit components are also damaged). |

## Traction Circuit Problems (Continued)

| Problem | Possible Causes |
|---|---|
| Wheel motor will not turn | Brakes are binding.<br><br>Wheel motor is worn or damaged (NOTE: If a traction circuit component has internal wear or damage, it is possible that other traction circuit components are also damaged). |
| Wheel motors will not hold load when traction pedal is in neutral | Charge pressure is low.<br><br>Valve plate and/or piston shoes in piston (traction) pump are scored (NOTE: If a traction circuit component has internal wear or damage, it is possible that other traction circuit components are also damaged). |

## Mow Circuit Problems

| Problem | Possible Causes |
|---|---|
| Front cutting deck motors will not operate but rear cutting deck motors will operate | Solenoid valve PRV2 on deck control manifold is faulty (NOTE: Solenoid valves PRV1 and PRV2 are identical and can be reversed for testing purposes).<br><br>An electrical problem exists that prevents PRV2 solenoid coil on deck control manifold from being energized (see Troubleshooting in Chapter 5 – Electrical System).<br><br>Front deck spindle(s) is binding.<br><br>Gear pump section (P2) is worn or damaged. |
| Rear cutting deck motors will not operate but front cutting deck motors will operate | Solenoid valve PRV1 on deck control manifold is faulty (NOTE: Solenoid valves PRV1 and PRV2 are identical and can be reversed for testing purposes).<br><br>An electrical problem exists that prevents PRV1 solenoid coil on deck control manifold from being energized (see Troubleshooting in Chapter 5 – Electrical System).<br><br>Rear deck spindle(s) is binding.<br><br>Gear pump section (P1) is worn or damaged. |
| Single cutting deck motor will not operate or rotates slowly | Cutting deck motor is worn or damaged.<br><br>Cross-over relief valve in cutting deck motor is stuck or faulty.<br><br>NOTE: If appropriate, transfer a suspected damaged motor to another cutting deck. If problem follows the motor, motor needs repair or replacement. |

## Lift Circuit Problems

| Problem | Possible Causes |
|---|---|
| Single cutting deck raises slowly or not at all | Cutting deck has excessive debris buildup.<br>Lift arm or lift cylinder is binding.<br>Flow control orifice in lift control manifold for the affected cutting deck is plugged, stuck or damaged.<br>Lift cylinder leaks internally. |
| Cutting decks raise, but will not remain in the raised position<br>**NOTE:** Lift cylinders and control manifold cartridge valves cannot provide an absolutely perfect seal. The cutting decks will eventually lower if left in the raised position. | Lift circuit hydraulic lines or fittings are leaking.<br>Air exists in lift circuit.<br>Lift cylinder leaks internally.<br>Solenoid valve (S2) in lift control manifold leaks. |
| None of the cutting decks will raise or lower<br>**NOTE:** Mow speed limiter must be in mow speed position in order to lower the cutting decks. | Oil level in hydraulic reservoir is low (other hydraulic systems are affected as well).<br>An electrical problem exists that prevents lift control manifold solenoid valve operation (see Troubleshooting in Chapter 5 – Electrical System).<br>Solenoid valve PRV in lift control manifold is faulty.<br>Logic cartridge LC in lift control manifold is faulty.<br>Solenoid valve S2 in lift control manifold is faulty.<br>Gear pump section (P4) is worn or damaged. |
| Neither of the rear cutting decks will raise or lower but the front cutting decks will raise and lower | Flow control orifice in lift control manifold for the rear cutting decks (port C8) is plugged, stuck or damaged. |
| Single cutting deck lowers very slowly or not at all | Lift arm or lift cylinder is binding.<br>Lift cylinder is damaged.<br>Flow control orifice in lift control manifold for the affected cutting deck is plugged, stuck or damaged. |

## Steering Circuit Problems

| Problem | Possible Causes |
|---|---|
| Steering inoperative or sluggish | Steering components (e.g. tie rods, steering cylinder ends) are worn or binding.<br><br>Steering cylinder is binding.<br><br>Oil level in hydraulic reservoir is low (other hydraulic systems are affected as well).<br><br>Steering relief valve (R10) in steering control valve is stuck or damaged.<br><br>Steering cylinder leaks internally.<br><br>Steering control valve is worn or damaged.<br><br>Gear pump section (P3) is worn or damaged (NOTE: A worn or damaged gear pump section (P3) will also affect the traction (charge) circuit). |

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# Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks (see the Special Tools section in this chapter).

**Before Performing Hydraulic Tests**

**IMPORTANT: All obvious areas such as oil supply, oil filter, binding linkages, loose fasteners or improper adjustments must be checked before assuming that a hydraulic component is the source of a problem.**

**Precautions for Hydraulic Testing**

**CAUTION**

**Failure to use gauges with expected pressure (psi/bar) rating as listed in test procedures could result in damage to the gauge and possible personal injury from leaking hot oil.**

**CAUTION**

**All testing should be performed by two (2) people. One person should be in the seat to operate the machine and the other should read and record test results.**

**WARNING**

**Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Do not use hands to search for leaks; use paper or cardboard. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.**

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination can cause excessive wear or binding of hydraulic components.

2. Review all test steps before starting the test procedure.

3. Before testing, check all control linkages for improper adjustment, binding or broken parts.

4. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

**WARNING**

**Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

5. Put metal caps or plugs on any hydraulic lines left open or exposed during testing or component removal.

6. When using hydraulic tester (pressure and flow), the inlet and the outlet hoses must be properly connected and not reversed to prevent damage to the hydraulic tester or components.

7. Install hydraulic fittings finger tight and far enough to make sure that they are not cross−threaded before tightening them with a wrench.

8. Position tester hoses to prevent rotating machine parts from contacting and damaging the hoses or tester.

9. After connecting test equipment, check oil level in the hydraulic tank to make sure that oil level is correct.

10. When using hydraulic tester (pressure and flow), open tester load valve completely before starting engine to minimize the possibility of damaging components.

11. The engine must be in good operating condition. Use a phototac when performing a hydraulic test. Engine speed can affect the accuracy of the tester readings. Check actual speed of the pump when performing hydraulic flow tests.

12. After hydraulic test procedures have been completed, check oil level in the hydraulic tank to make sure that oil level is correct.

**Which Hydraulic Tests Are Necessary?**

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, cutting (mow) circuit, lift circuit or steering circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

1. If a traction circuit problem exists, consider performing one or more of the following tests: Traction Circuit Relief Valve (R3) and (R4) Pressure, Traction Circuit Charge Pressure, Gear Pump (P3) Flow, Front Wheel Motor Efficiency and/or Piston (Traction) Pump Flow Tests.

**IMPORTANT: Refer to Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit.**

2. If a cutting (mow) circuit problem exists, consider performing one or more of the following tests: Relief Valve (PRV1) and (PRV2) Pressure, Gear Pump (P1) and (P2) Flow and/or Deck Motor Efficiency Tests.

3. If a lift circuit problem exists, consider performing one or more of the following tests: Lift Relief Valve (PRV) Pressure, Gear Pump (P4) Flow and/or Lift Cylinder Internal Leakage Tests.

4. If a steering circuit problem exists, consider performing one or more of the following tests: Steering Relief Valve (R10) Pressure, Steering Cylinder Internal Leakage and/or Gear Pump (P3) Flow Tests.

## Traction Circuit Relief Valve (R3) and (R4) Pressure Test

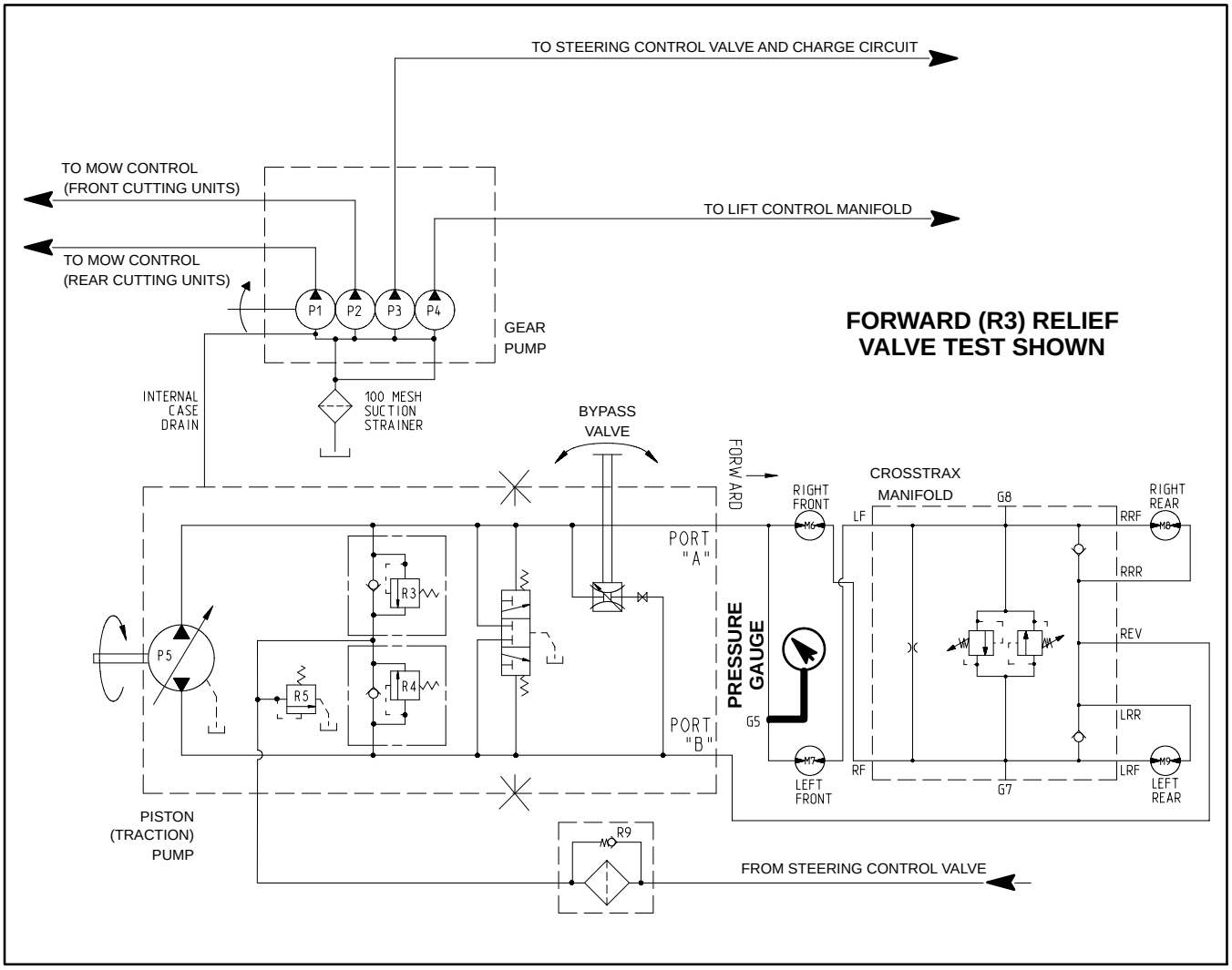


Figure 32

The traction circuit relief pressure test should be performed to make sure that forward and reverse traction circuit relief pressures are correct.

**Procedure for Traction Circuit Relief Valve (R3) and (R4) Pressure Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Drive machine to an open area. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Locate traction circuit test port for direction to be tested. Forward test port is located on hydraulic tube between front wheels (Fig. 33). Reverse test ports are located on AWD hydraulic manifold (Fig. 34). Thoroughly clean test port.

5. Connect a 5000 PSI (350 bar) pressure gauge to test port.

6. After installing pressure gauge, start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

7. Move throttle to full speed **(3200 RPM)**.

8. Sit on seat, and with brakes applied, slowly depress the traction pedal in the direction to be tested (forward or reverse). While pushing traction pedal down, carefully watch the pressure gauge needle. As the traction relief valve lifts, the gauge needle will momentarily stop. Traction system pressure as the relief valve opens should be:

**3625 PSI (250 bar) in both forward (R3) and reverse (R4)**

**NOTE:** If traction pedal continues to be pressed after the relief valve has opened, system pressure can increase higher than relief pressure.

9. Release traction pedal, stop engine and record test results.

**NOTE:** Forward (R3) and reverse (R4) relief valves are identical. Relief valves can be switched in traction pump to help in identifying a faulty relief valve.

10. If problem occurs in one direction only, interchange the relief valves in the traction pump (Fig. 35) to see if the problem changes to the other direction. Clean or replace valves as necessary. These cartridge type valves are factory set, and are not adjustable. If pressure is incorrect and relief valves are in good condition, traction pump and/or wheel motors should be suspected of wear and inefficiency.

11. After testing is completed, make sure that engine is stopped and then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Remove pressure gauge from machine.

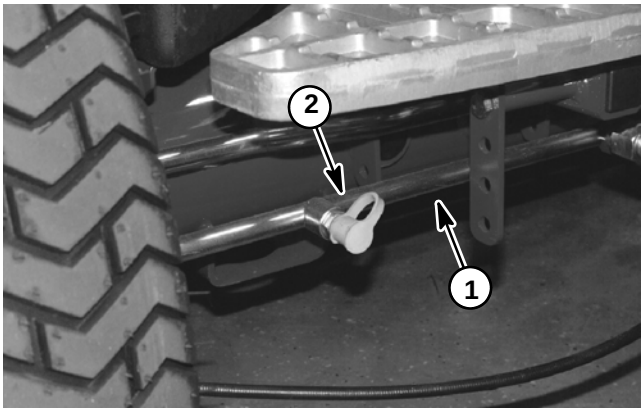


Figure 33

**1. Lower hydraulic tube** **2. Forward test port**

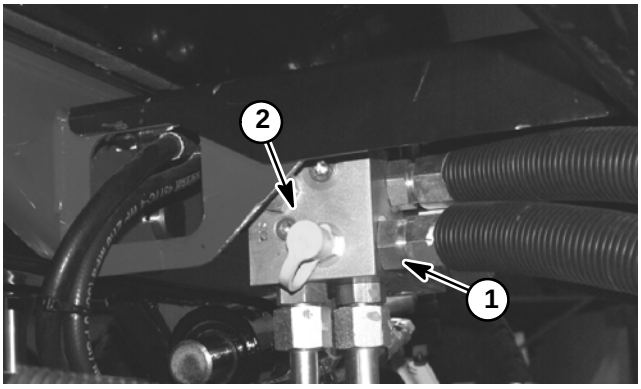


Figure 34

**1. AWD hydraulic manifold** **2. Reverse test port**

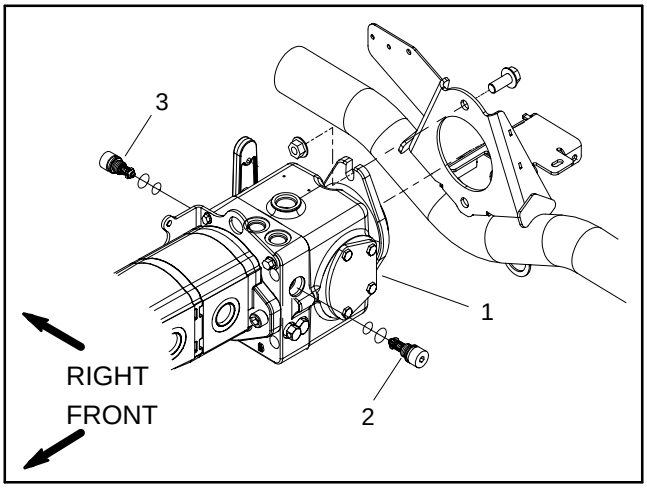


Figure 35

**1. Piston (traction) pump** **3. Forward relief valve (R3)**
**2. Reverse relief valve (R4)**

## Traction Circuit Charge Pressure Test

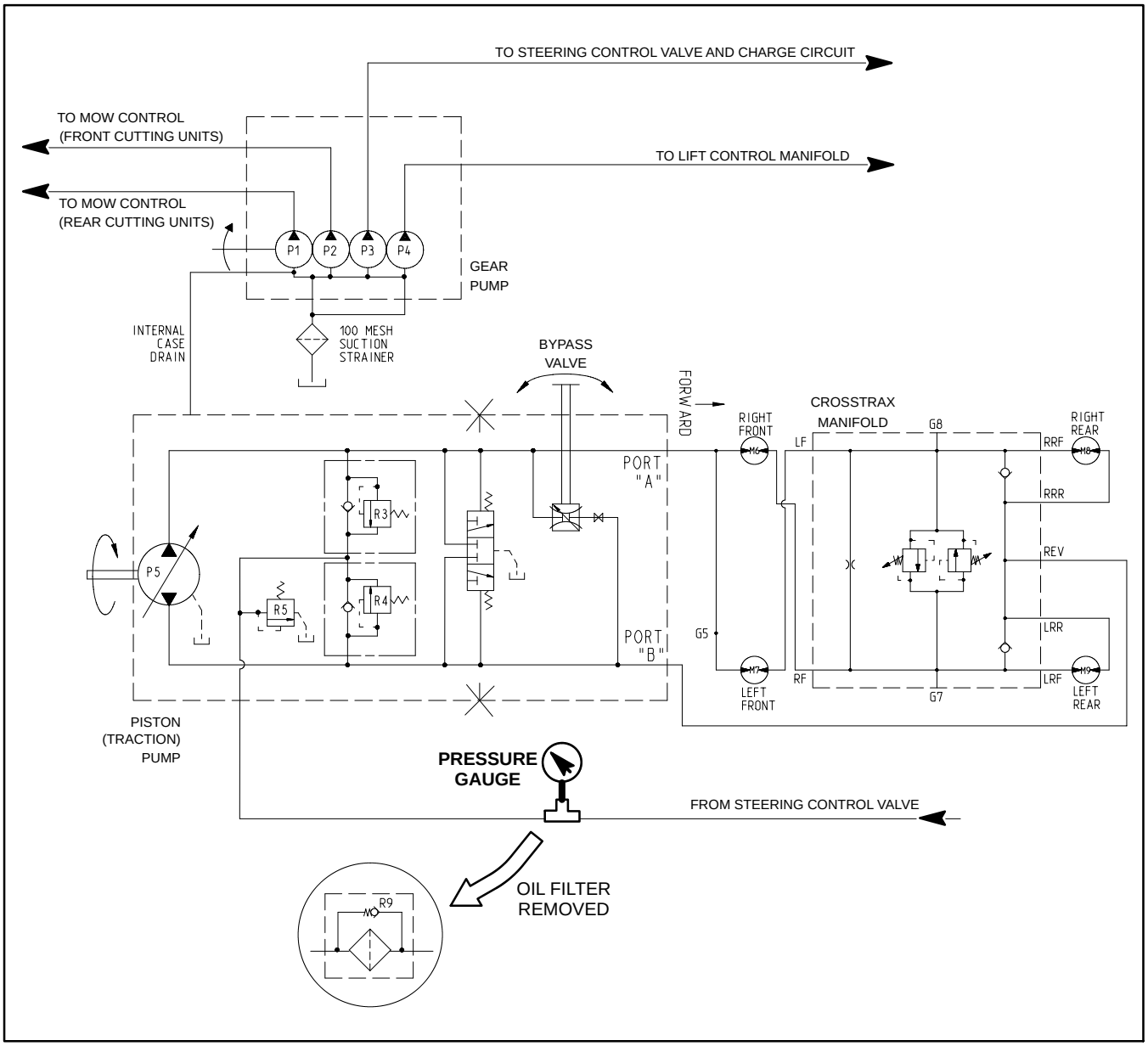


Figure 36

The traction circuit charge pressure test should be performed to make sure that the traction charge circuit is functioning correctly.

**Procedure for Traction Circuit Charge Pressure Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Raise and support operator seat to allow access to hydraulic pump assembly.

5. Thoroughly clean ends of hydraulic tubes that connect to the oil filter (Fig. 37). Disconnect hydraulic tubes from oil filter adapter. Remove two (2) flange head screws that secure oil filter adapter to frame and remove oil filter and adapter assembly from machine.

6. Install tee fitting with 1000 PSI (70 bar) pressure gauge in place of the removed hydraulic filter assembly.

7. Make sure that traction pedal is in neutral, the steering wheel is stationary and parking brake is engaged.

8. Start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

9. Place throttle to full speed **(3200 RPM)** and monitor pressure gauge on tester.

GAUGE READING TO BE **approximately 200 to 250 PSI (13.8 to 17.2 bar)**

10. Next, determine charge pressure under traction load by operating the machine in a direct forward and reverse direction (not steering). Make sure that engine is running at full speed **(3200 RPM)**. Apply the brakes and press the traction pedal in the forward direction and then to reverse while monitoring the pressure gauge. Stop engine and record test results.

GAUGE READING TO BE **approximately 150 to 250 PSI (13.8 to 17.2 bar)**

11. Compare measured charge pressure from step 9 with pressure from step 10:

A. If charge pressure is good under no load (step 9), but drops below specification when under traction load (step 10), the piston pump should be suspected of wear and inefficiency. When the pump is worn or damaged, the charge system is not able to replenish lost traction circuit oil due to excessive leakage in the worn pump.

B. If there is no charge pressure, or pressure is low, check for restriction in gear pump intake line. Inspect charge relief valve and valve seat in the traction pump (see Traction Pump Service in the Service and Repairs section of this chapter). Also, consider a worn or damaged gear pump (P3) (see Gear Pump (P3) Flow Test in this section).

**NOTE:** If gear pump (P3) is worn or damaged, both charge circuit and steering circuit will be affected.

12. After charge pressure testing is completed, make sure that engine is not running and then relieve hydraulic system pressure (See Relieving Hydraulic System Pressure in the General Information section of this chapter). Remove pressure gauge and tee fitting from hydraulic tubes. Install oil filter to machine.

13. Lower and secure operator seat.

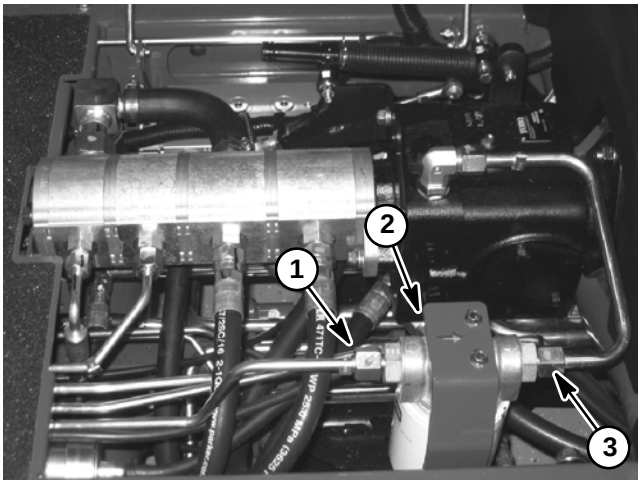


Figure 37

1. **Hydraulic tube**
2. **Oil filter / filter adapter**
3. **Hydraulic tube**

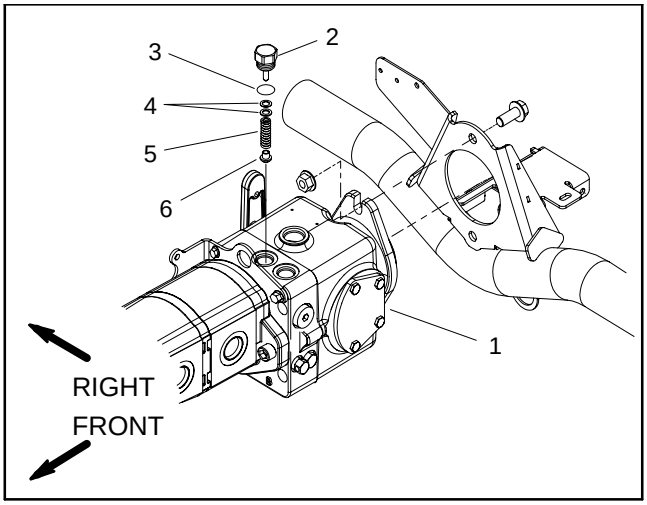


Figure 38

1. **Traction pump**
2. **Plug**
3. **O-ring**
4. **Shim kit**
5. **Spring**
6. **Charge relief poppet**

## Gear Pump (P3) Flow Test
## (Using Tester with Pressure Gauges and Flow Meter)

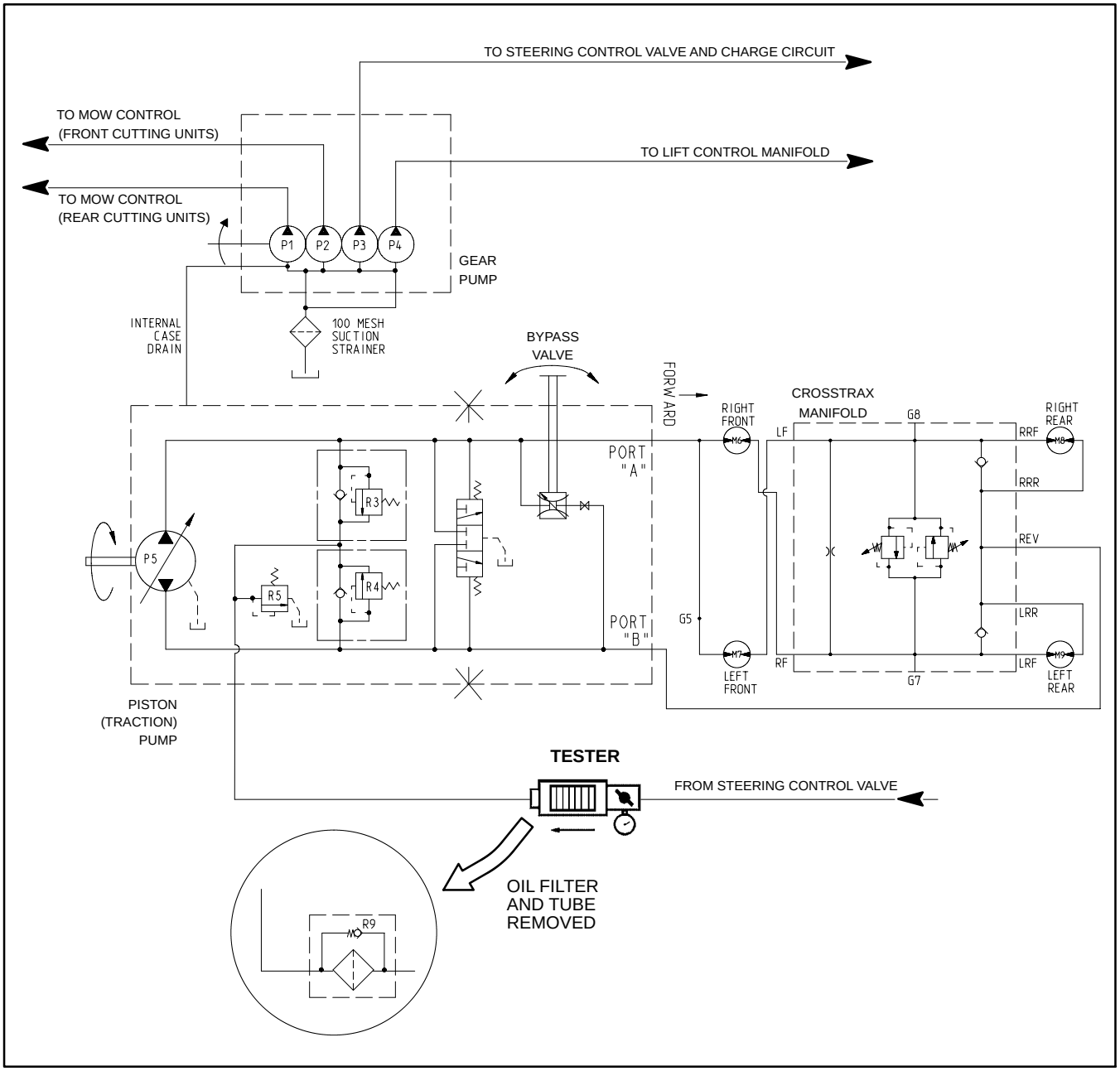


Figure 39

The gear pump (P3) flow test should be performed to make sure that the traction charge circuit and steering circuit have adequate hydraulic flow.

**Procedure for Gear Pump (P3) Flow Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

## CAUTION

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Raise and support operator seat to allow access to hydraulic pump.

5. Thoroughly clean the ends of the hydraulic tubes connected to the oil filter and traction pump inlets (Fig. 40). Disconnect hydraulic tubes from oil filter inlet and traction pump inlet. Remove two (2) flange head screws that secure oil filter adapter to frame. Remove oil filter assembly and hydraulic tube from machine.

**IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the hydraulic tube, through the tester and into the traction pump.**

6. Install tester with pressure gauges and flow meter in place of the removed oil filter assembly and hydraulic tube. Connect tester inlet hose to the hydraulic tube. Connect the tester outlet hose to the traction pump fitting. **Make sure the flow control valve on tester is fully open.**

7. Make sure that the traction pedal is in neutral, the steering wheel is stationary and the parking brake is engaged.

8. Start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

9. Move throttle to full speed **(3200 RPM)**. Use a tachometer to verify that engine speed is correct.

**IMPORTANT: The gear pump is a positive displacement type. If pump flow is completely restricted or stopped, damage to the pump, tester or other components could occur.**

10. While watching pressure gauges, slowly close the tester flow control valve until **800 PSI (55 bar)** is obtained on gauge.

**FLOW TESTER READING TO BE:** A pump in good condition should have a flow of approximately **4.9 GPM (18.5 LPM)** at **800 PSI (55 bar)**.

11. Open the tester flow control valve, stop engine and record test results.

12. If flow is less than **4.4 GPM (16.6 LPM)** or a pressure of **800 PSI (55 bar)** cannot be obtained, consider that a pump problem exists. Check for restriction in pump intake line. If intake is not restricted, remove gear pump and repair or replace pump as necessary (see Gear Pump in the Service and Repairs section of this chapter).

**NOTE:** If the flow from gear pump (P3) is low, the operation of both the charge circuit and the steering circuit will be affected.

13. After testing is completed, make sure that engine is stopped, then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Remove tester and then install oil filter assembly and hydraulic tube to machine.

14. Lower and secure operator seat.

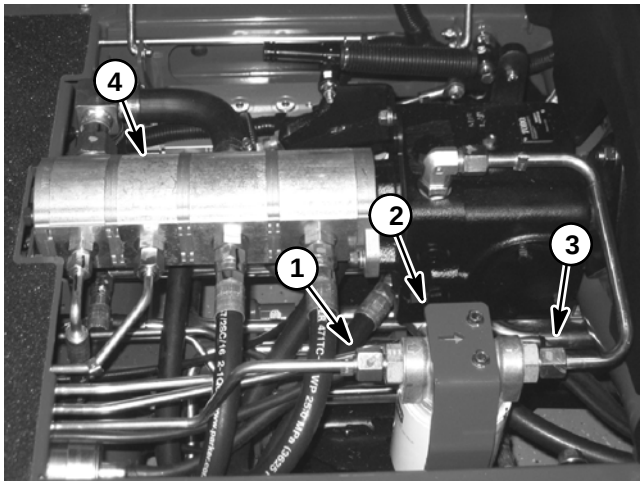


Figure 40

1. **Hydraulic tube**
2. **Oil filter / filter adapter**
3. **Hydraulic tube**
4. **Gear Pump (P3)**

## Front Wheel Motor Efficiency Test

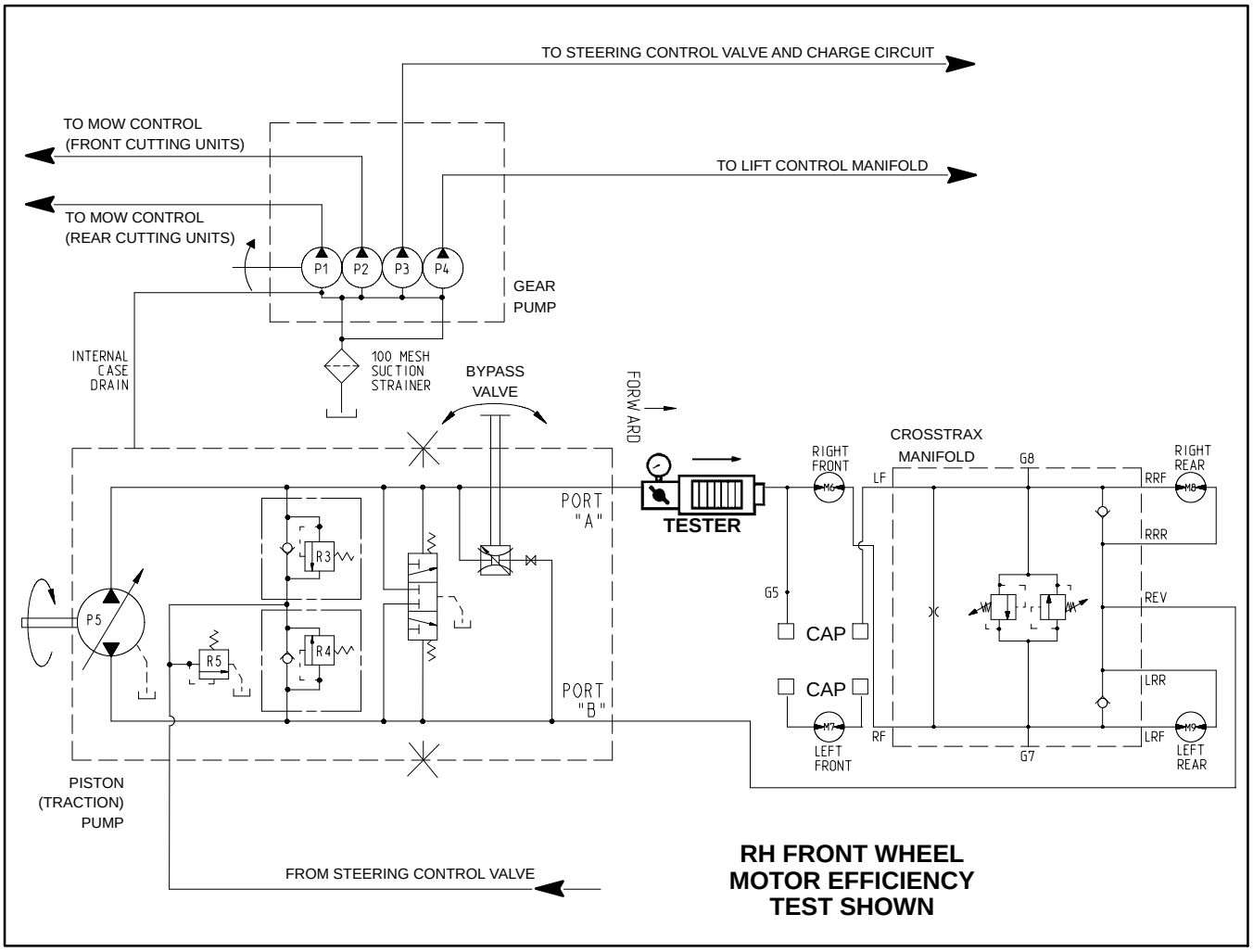


Figure 41

**Procedure for <u>Front Wheel Motor Efficiency</u> Test**

**NOTE:** Over a period of time, a wheel motor can wear internally. A worn motor may bypass oil internally, causing the motor to be less efficient. Eventually, enough oil loss will cause the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect overall machine performance.

**IMPORTANT: Refer to Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit.**

**NOTE:** This test procedure includes steps to test both front wheel efficiency together before testing individual front wheel motors.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Make sure that traction pedal is adjusted to the neutral position (see Operator's Manual).

3. Park machine on a level surface with the cutting decks lowered and PTO switch off. Shut engine off and apply the parking brake.

4. Read Precautions For Hydraulic Testing in this section.

## CAUTION

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

5. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.

6. Chock front wheels to prevent wheel rotation. Make sure parking brake is applied.

7. Jack up and support the rear wheels off the ground to allow flow through the rear wheel motors.

8. Thoroughly clean junction of hydraulic hose and **right** side elbow fitting on bottom of traction pump (Fig. 42). Disconnect hose from right side pump fitting.

**IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the pump, through the tester and into the disconnected hydraulic hose.**

9. Install tester with pressure gauges and flow meter in series with the traction pump and the disconnected hose. **Make sure the tester flow control valve is fully open**.

10. Start engine and move throttle to full speed **(3200 RPM)**.

## CAUTION

**Use extreme caution when performing test. The front tires on the ground will be trying to move the machine forward.**

11. Slowly push traction pedal in **forward** direction until **1000 PSI (70 bar)** is displayed on the tester pressure gauge. Make sure that front wheels are not rotating.

12. Total front wheel motor internal leakage will be shown on flow meter in GPM (LPM). Leakage for the front wheel motors should be **less than 1.5 GPM (5.7 LPM)**.

13. Release traction pedal, shut engine off, rotate both front wheels one−third turn and retest. Testing of wheel motor leakage in three (3) different wheel positions will provide the most accurate test results. If leakage specifications are not met, individual front wheel motors need to be tested.

14. To test individual front wheel motors:

A. Remove front wheel from wheel motor that is **not** being tested. Remove wheel shield to allow access to hydraulic tubes and fittings on wheel motor. Remove fasteners that secure front hydraulic tube r−clamps to frame.

B. On the front wheel motor that is **not** being tested, thoroughly clean junction of both hydraulic tubes and wheel motor fittings. Disconnect both hydraulic lines from wheel motor that is **not** being tested. Cap disconnected hydraulic lines and wheel motor fittings.

C. Use the procedure described in steps 8 to 11 above to identify individual front wheel motor leakage. Individual motor internal leakage will be shown on flow meter in GPM (LPM). Flow should be **less than 1.5 GPM (5.7 LPM)** for the tested wheel motor.

D. If other front wheel motor requires testing, complete steps A, B and C for remaining wheel motor.

15. After testing is completed, stop engine and then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Disconnect tester from hydraulic fitting and hose. Connect hose to pump elbow fitting. Remove caps from hydraulic tubes and reconnect tubes to wheel motor. Secure hydraulic tubes to machine with r−clamps and removed fasteners. Install wheel shield and wheel(s) (see Wheels in the Service and Repairs section of Chapter 6 − Chassis).

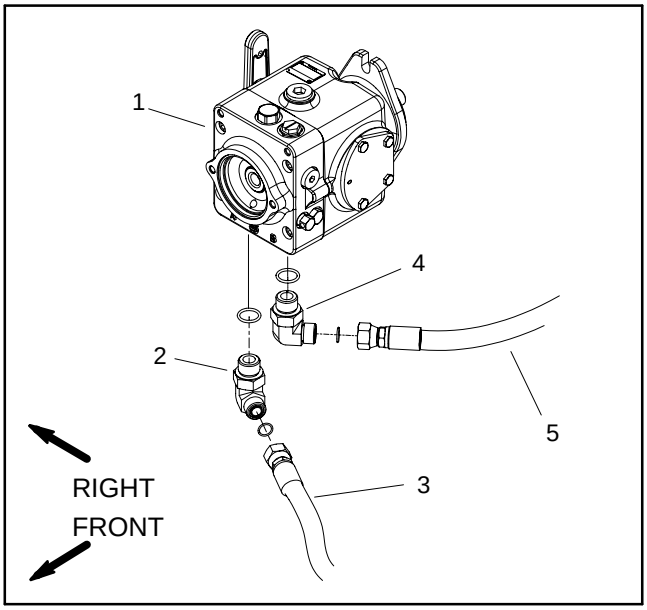


Figure 42

1. **Traction pump**
2. **RH elbow fitting**
3. **Hyd hose (forward)**
4. **LH elbow fitting**
5. **Hyd hose (reverse)**

## Piston (Traction) Pump Flow Test (Using Tester with Flow Meter and Pressure Gauge)

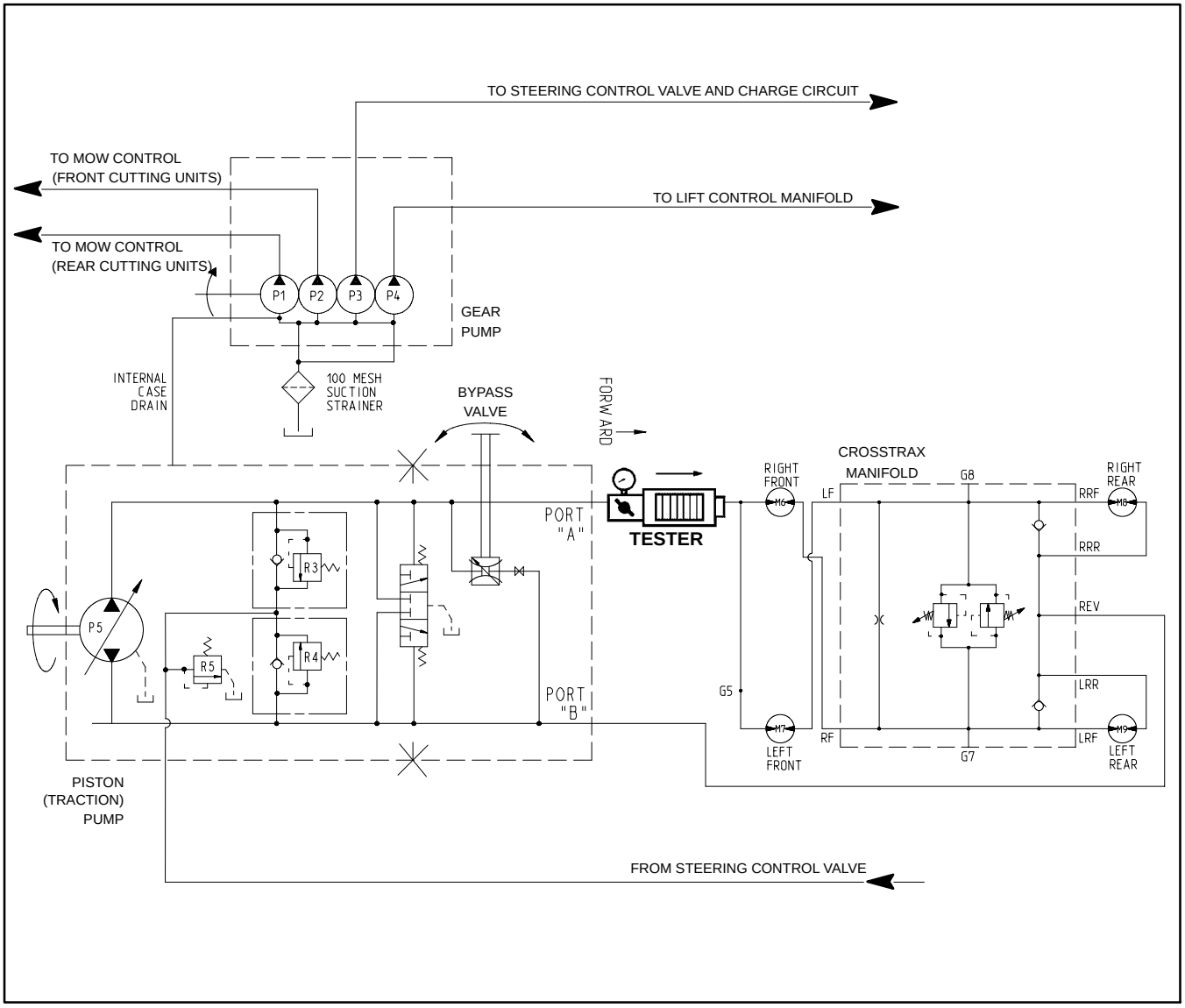


Figure 43

**Procedure for <u>Piston (Traction) Pump Flow</u> Test**

This test measures piston (traction) pump output (flow). During this test, pump load is created at the flow meter using the adjustable load valve on the tester.

**IMPORTANT: Traction circuit flow for the Groundsmaster 4300 is approximately 30 GPM (113.5 LPM). Use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) for this test (see Special Tools in this chapter).**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Shut off engine. Make sure mow speed limiter is in the transport position to allow full movement of traction pedal.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Make sure that traction pedal is adjusted to the neutral position. Also, ensure that traction pump is at full stroke when traction pedal is pushed into fully forward position.

5. Raise and support machine so all wheels are off the ground (see Jacking Instructions in Chapter 1 – Safety).

6. Thoroughly clean junction of hydraulic hose and **right** side fitting on bottom of traction pump (Fig. 44). Disconnect hose from right side pump fitting.

**IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the pump, through the tester and into the disconnected hydraulic hose.**

7. Install tester with pressure gauge and flow meter in series between traction pump fitting and disconnected hose to allow flow from traction pump to tester. Use hydraulic hose kit (see Special Tools in this chapter) to connect tester to machine. Make sure that fitting and hose connections are properly tightened. Also, make sure the flow control valve on tester is fully open.

**CAUTION**

**All wheels will be off the ground and rotating during this test. Make sure machine is supported so it will not move and accidentally fall to prevent injuring anyone near the machine.**

8. Start engine and run at idle speed. Check for any hydraulic leakage from tester and hose connections. Correct any leaks before proceeding.

9. Move throttle so engine is running at high idle speed **(3200 RPM)**.

10. Slowly push traction pedal to fully forward position. Keep pedal fully depressed in the forward position.

11. Have second person watch pressure gauge on tester carefully while slowly closing the flow control valve until **1000 PSI (69 bar)** is obtained. Verify with a phototac that the **engine speed** is still **3200 RPM**.

12. Observe flow gauge. Flow indication should be approximately **28 GPM (106 LPM)**.

13. Release traction pedal to the neutral position, open flow control valve on tester and shut off engine. Record test results.

14. If flow is less than **25 GPM (95 LPM)**, consider the following:

A. The traction pump swash plate is not being rotated fully (e.g. traction pedal linkage may need adjustment, mow speed limiter is not in the transport position).

B. The piston (traction) pump needs to be repaired or replaced as necessary.

C. Make necessary repairs before performing additional tests.

15. When testing is complete, disconnect tester and hose kit from pump fitting and machine hydraulic hose. Reconnect hose to pump fitting.

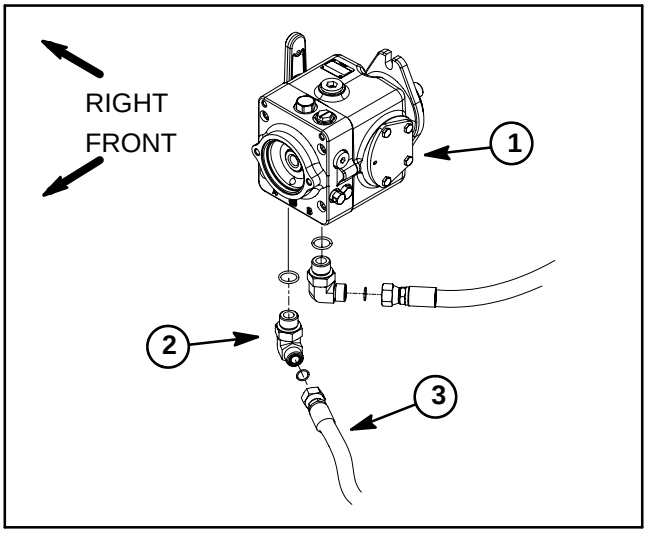


Figure 44

1. **Traction pump**
2. **RH elbow fitting**
3. **Hyd hose (forward)**

## Relief Valve (PRV1) and (PRV2) Pressure Test

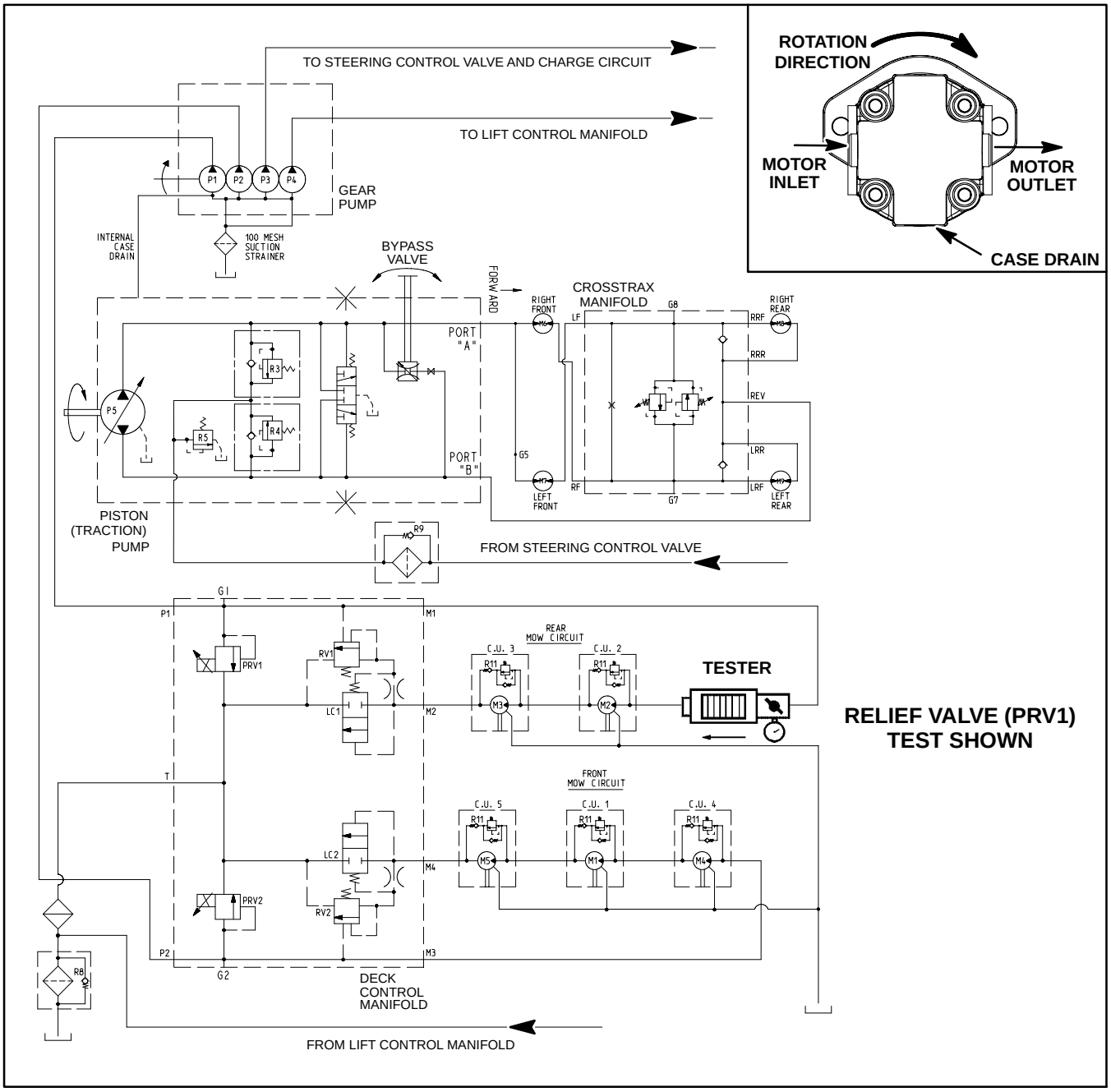


Figure 45

The relief valve (PRV1) and (PRV2) pressure test should be performed to make sure that the cutting deck circuit relief pressures are correct.

**NOTE:** The front cutting deck circuit is protected by proportional relief valve (PRV2) in the deck control manifold. The rear cutting deck circuit is protected by proportional relief valve (PRV1) (see Hydraulic Flow Diagrams in this chapter).

**Procedure for Relief Valve (PRV1) and (PRV2) Pressure Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off and mow speed limiter is in the mow position. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Raise and support operator seat to allow access to hydraulic deck control manifold.

5. Thoroughly clean junction of hydraulic inlet hose and deck motor fitting on left side cutting deck for the relief valve to be tested. Disconnect hose from deck motor fitting (Fig. 46):

#2 cutting deck (left rear) for relief valve (PRV1)

#4 cutting deck (left front) for relief valve (PRV2)

**IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the disconnected hose, through the tester and into the deck motor.**

6. Install tester with pressure gauge and flow meter in series with the disconnected hose and hydraulic fitting on deck motor. **Make sure the flow control valve on tester is fully open.**

7. After installing tester, start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

8. Move throttle to full speed **(3200 RPM)**.

**CAUTION**

**Keep away from cutting decks during test to prevent personal injury from rotating blades.**

9. Have a second person occupy seat, press PTO switch to ON and then move joystick lever forward to engage cutting decks.

**IMPORTANT: When performing this test, do not hold over relief any longer than necessary to obtain pressure reading.**

10. Watch pressure gauge carefully while slowly closing the tester flow control valve. As the relief valve lifts, the pressure gauge needle will momentarily stop.

**NOTE:** Once the relief valve has opened, system pressure may continue to increase.

11. As the relief valve lifts, system pressure should be:

**Approximately 2500 PSI (175 bar) for relief valve (PRV1)**

**Approximately 3500 PSI (241 bar) for relief valve (PRV2)**

12. Open the tester flow control valve, disengage cutting decks and stop the engine.

13. If pressure is incorrect, remove PRV valve on mow manifold and clean or replace valve (see Deck Control Manifold Service in the Service and Repairs section of this chapter). Also, if pressure is still low after valve service, check for restriction in pump intake line. Gear pump (P2) (front cutting deck circuit) and/or pump (P1) (rear cutting deck circuit) could also be suspected of wear, damage or inefficiency (see Gear Pump (P1) and (P2) Flow Test in this section).

14. After testing is completed, make sure that engine is stopped, then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Remove tester from machine and connect hydraulic hose to deck motor fitting.

15. Lower and secure operator seat.

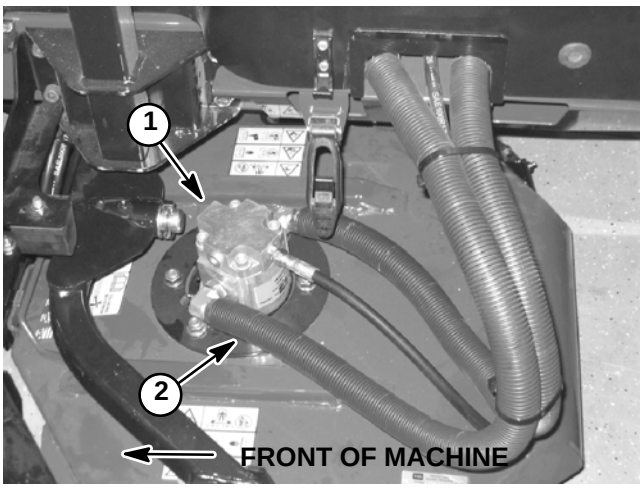


Figure 46

1. **Cutting deck motor (#2 shown)**
2. **Deck motor inlet hose**

## Gear Pump (P1) and (P2) Flow Test
## (Using Tester with Pressure and Flow Capabilities)

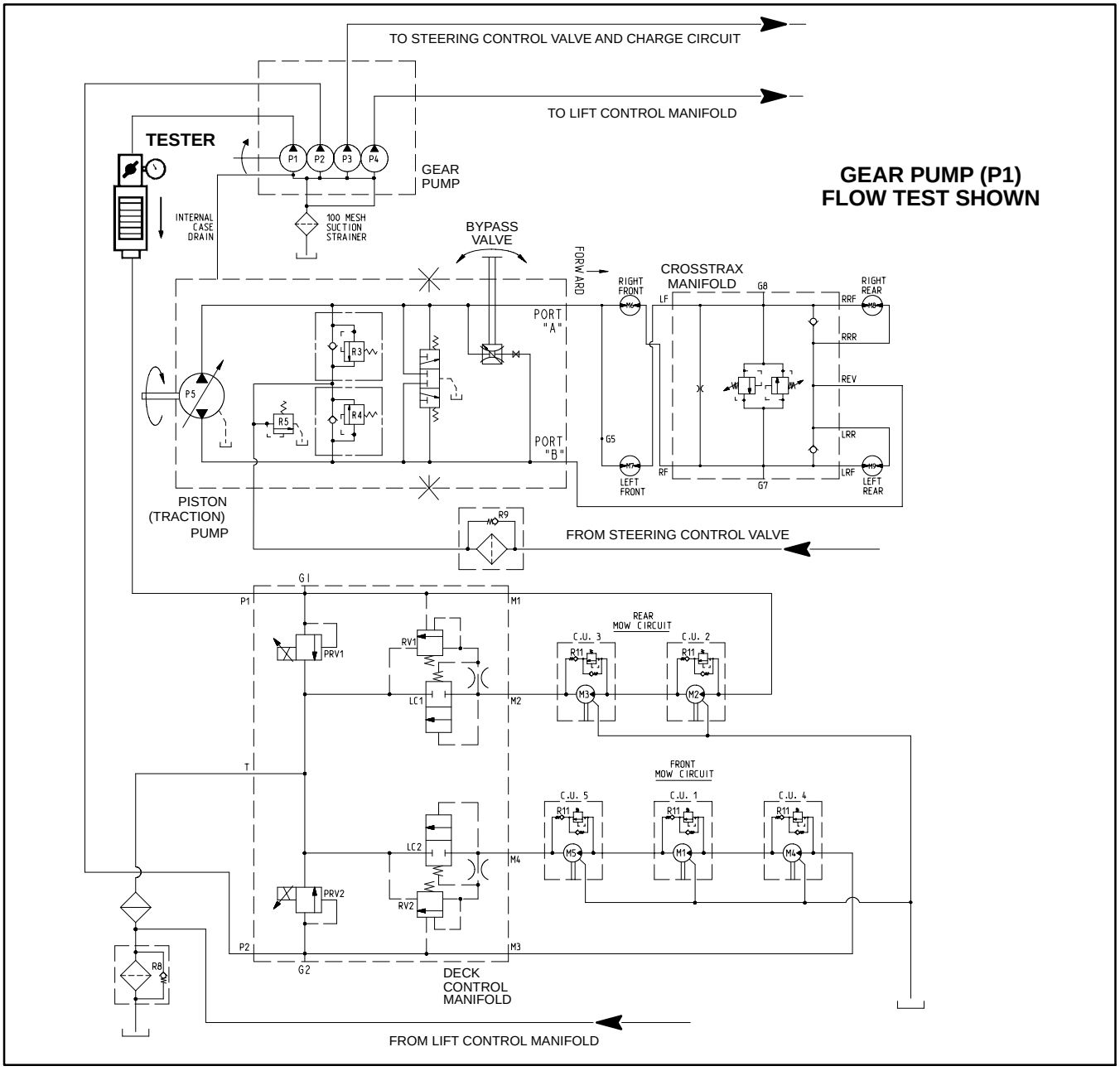


Figure 47

Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump will by-pass oil and make the pump less efficient. Eventually, enough oil can by-pass to cause the decks to stall in heavy cutting conditions. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

**Procedure for <u>Gear Pump (P1) and (P2) Flow</u> Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Raise and support operator seat to allow access to hydraulic pump.

5. Identify suspected faulty pump section to be tested (Fig. 48). Thoroughly clean junction of gear pump fitting and hydraulic outlet hose. Disconnect hose from pump fitting:

Pump section (P1) for rear cutting decks

Pump section (P2) for front cutting decks

**IMPORTANT: Make sure that the oil flow indicator arrow on the flow gauge is showing that the oil will flow from the gear pump, through the tester and into the hose.**

6. Install tester with pressure gauges and flow meter in series between disconnected hose and gear pump fitting. **Make sure the flow control valve on tester is fully open.**

7. After installing tester, start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

8. Make sure the parking brake is engaged. Move throttle to full speed **(3200 RPM)**. **DO NOT** engage the cutting decks. Use a tachometer to verify that engine speed is correct.

**IMPORTANT: The gear pump is a positive displacement type. If pump flow is completely restricted or stopped, damage to the pump, tester or other components could occur.**

9. While watching pressure gauges, slowly close the tester flow control valve until **1500 PSI (103 bar)** is obtained on gauge.

**FLOW TESTER READING TO BE:** A pump in good condition should have a flow of approximately **13.6 GPM (51.2 LPM) at 1500 PSI (103 bar)**.

10. Open the tester flow control valve and stop the engine. Record test results.

11. If flow is less than **12.1 GPM (45.8 LPM)** or a pressure of **1500 PSI (103 bar)** cannot be obtained, consider that a pump problem exists. Check for restriction in pump intake line. If intake is not restricted, remove gear pump and repair or replace pump as necessary (see Gear Pump and Gear Pump Service in the Service and Repairs section of this chapter).

12. After testing is completed, make sure that engine is stopped, then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Remove tester from machine and connect hydraulic hose to gear pump fitting.

13. Lower and secure operator seat.

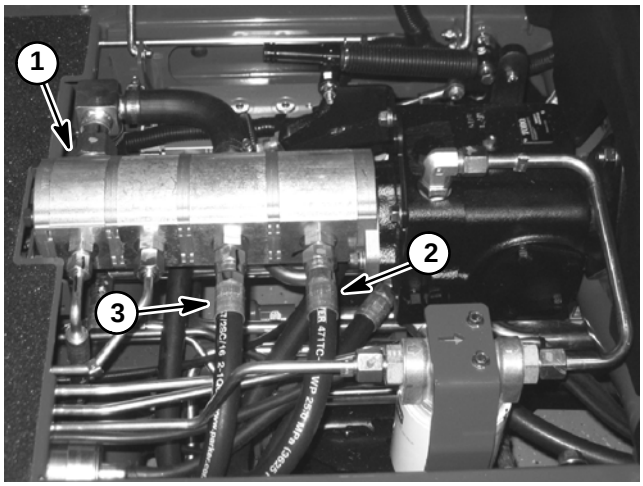


Figure 48

1. **Gear pump assembly**
2. **Pump P1 outlet hose**
3. **Pump P2 outlet hose**

## Deck Motor Efficiency Test
## (Using Tester with Pressure Gauges and Flow Meter)

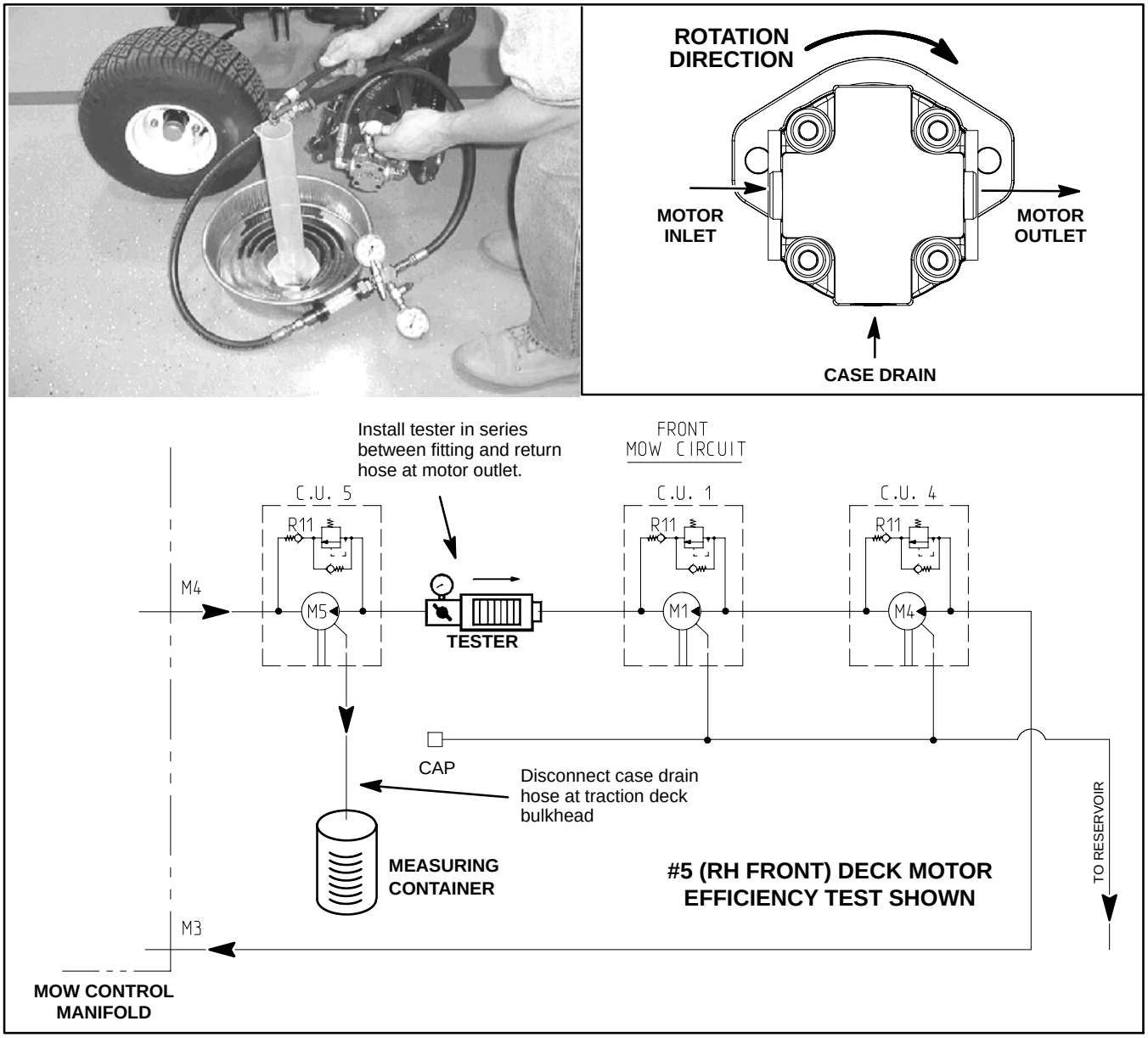


Figure 49

**NOTE:** Over a period of time, a deck motor can wear internally. A worn motor may bypass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the deck motor to stall under heavy cutting conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect quality of cut.

**NOTE:** One way to find a faulty deck motor is to have another person observe the machine while mowing in dense turf. A faulty motor will run slower than other motors, produce fewer clippings and may cause clip marks (a choppy appearance) on the turf.

**Procedure for Deck Motor Efficiency Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Determine which deck motor is malfunctioning.

3. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off and mow speed limiter is in the mow position. Apply the parking brake.

4. Read Precautions For Hydraulic Testing in this section.

## CAUTION

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

**NOTE:** The deck motors are connected in series. To isolate a faulty motor, all motors in the circuit may have to be tested by starting with the upstream motor first.

5. For deck motor to be tested, thoroughly clean junction of the motor case drain hose (small diameter hose) where it connects to traction unit bulkhead (not at the motor) (Fig. 50). Disconnect the case drain hose and put a steel cap on the fitting at the traction unit. Leave the case drain hose from the motor open and place open end of disconnected hose into a drain pan.

**IMPORTANT: Make sure that the oil flow indicator arrow on the flow gauge is showing that the oil will flow from the deck motor, through the tester and into the return hose.**

6. On deck motor to be tested, thoroughly clean junction of hydraulic return hose and deck motor fitting (Fig. 50). Disconnect return hose from the motor. Install tester with pressure gauges and flow meter in series with the motor and disconnected return hose. **Make sure the flow control valve on tester is fully open.**

**NOTE:** Use a graduated container, special tool TOR4077, to measure case drain leakage (Fig. 49).

7. Start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

## CAUTION

**Cutting deck blades will rotate when performing the motor efficiency test. Keep away from cutting decks during test to prevent personal injury from rotating blades. Do not stand in front of the machine.**

8. Sit on seat and move throttle to full speed **(3200 RPM)**. Press PTO switch to ON. Move joystick lever forward to engage cutting decks.

9. While watching pressure gauges, slowly close flow control valve on tester until a pressure of **1200 PSI (83 bar)** is obtained.

10. After achieving **1200 PSI (83 bar)**, place disconnected motor case drain hose into a container graduated in ounces or milliliters (e.g. Toro #TOR4077) and collect hydraulic fluid for **15 seconds**. After **15 seconds**, remove hose end from container. Then move the PTO switch to OFF, open the tester flow control valve and stop the engine.

11. Identify amount of oil collected in the container. Record test results.

    If flow was greater than **22.4 ounces (662 milliliters) (0.7 GPM/2.6 LPM)**, repair or replace the tested deck motor (see Cutting Deck Motor Service in the Service and Repairs section of this chapter).

    If flow is less than **22.4 ounces (662 milliliters) (0.7 GPM/2.6 LPM)**, the tested motor does not have excessive leakage.

12. After testing is completed, make sure that engine is stopped, then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Disconnect tester from motor and return hose. Connect return hose to the deck motor. Remove plug from machine bulkhead fitting and connect case drain hose to the fitting.

13. If necessary, perform motor efficiency test on other deck motors.

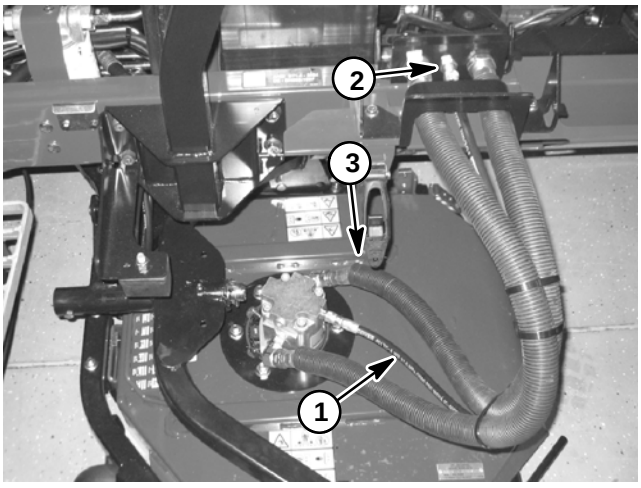


Figure 50

1. **Case drain hose**
2. **Bulkhead fitting**
3. **Return hose**

## Lift Relief Valve (PRV) Pressure Test

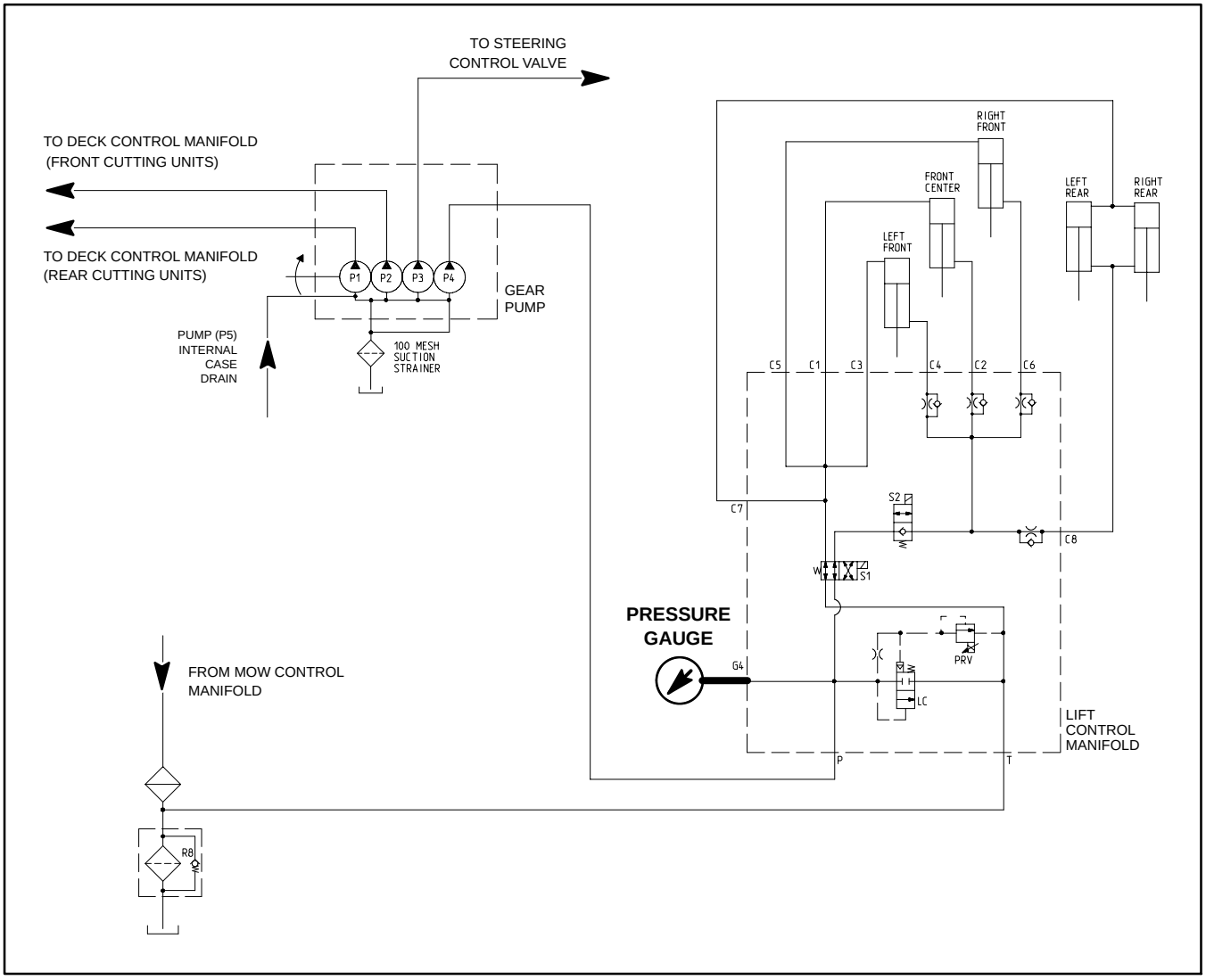


Figure 51

The lift relief valve (PRV) pressure test should be performed to make sure that the lift circuit relief pressure is correct.

**Procedure for Lift Relief Valve (PRV) Pressure Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Gain access to hydraulic lift control manifold by removing the operator floor plate. The lift control manifold is attached to a frame bracket under the floor plate (Fig. 52).

5. Thoroughly clean test port (G4) on bottom of lift control manifold. Connect a 5000 PSI (350 bar) pressure gauge to test port.

6. After installing pressure gauge to manifold test port, start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

7. Move throttle to full speed **(3200 RPM)**.

**IMPORTANT: Do not allow pressure to exceed 2500 PSI (172 bar).**

**IMPORTANT: While performing this test, hold joystick lever in the raise position only long enough to get a system pressure reading. Holding the lever in raise for an extended period may damage system components.**

8. Make sure that PTO switch is OFF and then pull joystick lever rearward to pressurize lift circuit. While holding lever in the raise (rearward) position, watch pressure gauge carefully. As the cutting decks fully raise and the lift relief valve lifts, system pressure should be:

**Approximately 2000 PSI (138 bar)**

9. Return the joystick lever to the neutral position and stop the engine.

10. If measured pressure is incorrect, remove pressure reducing valve (PRV) from lift control manifold and clean or replace valve (see Lift Control Manifold Service in the Service and Repairs section of this chapter). Also, if lift circuit pressure is low, check for restriction in gear pump intake line. Internal lift cylinder leakage would also cause low lift circuit pressure (see Lift Cylinder Internal Leakage Test in this section). Gear pump (P4) could also be suspected of wear, damage or inefficiency (see Gear Pump (P4) Flow Test in this section).

11. After testing is completed, make sure that engine is stopped, then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Disconnect pressure gauge from lift control manifold test port.

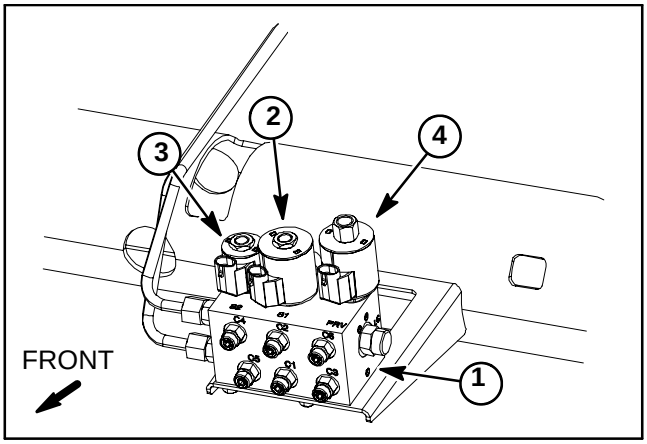


Figure 52

1. **Lift control manifold**
2. **SV1 solenoid**
3. **SV2 solenoid**
4. **PRV solenoid**

## Gear Pump (P4) Flow Test
## (Using Tester with Pressure Gauges and Flow Meter)

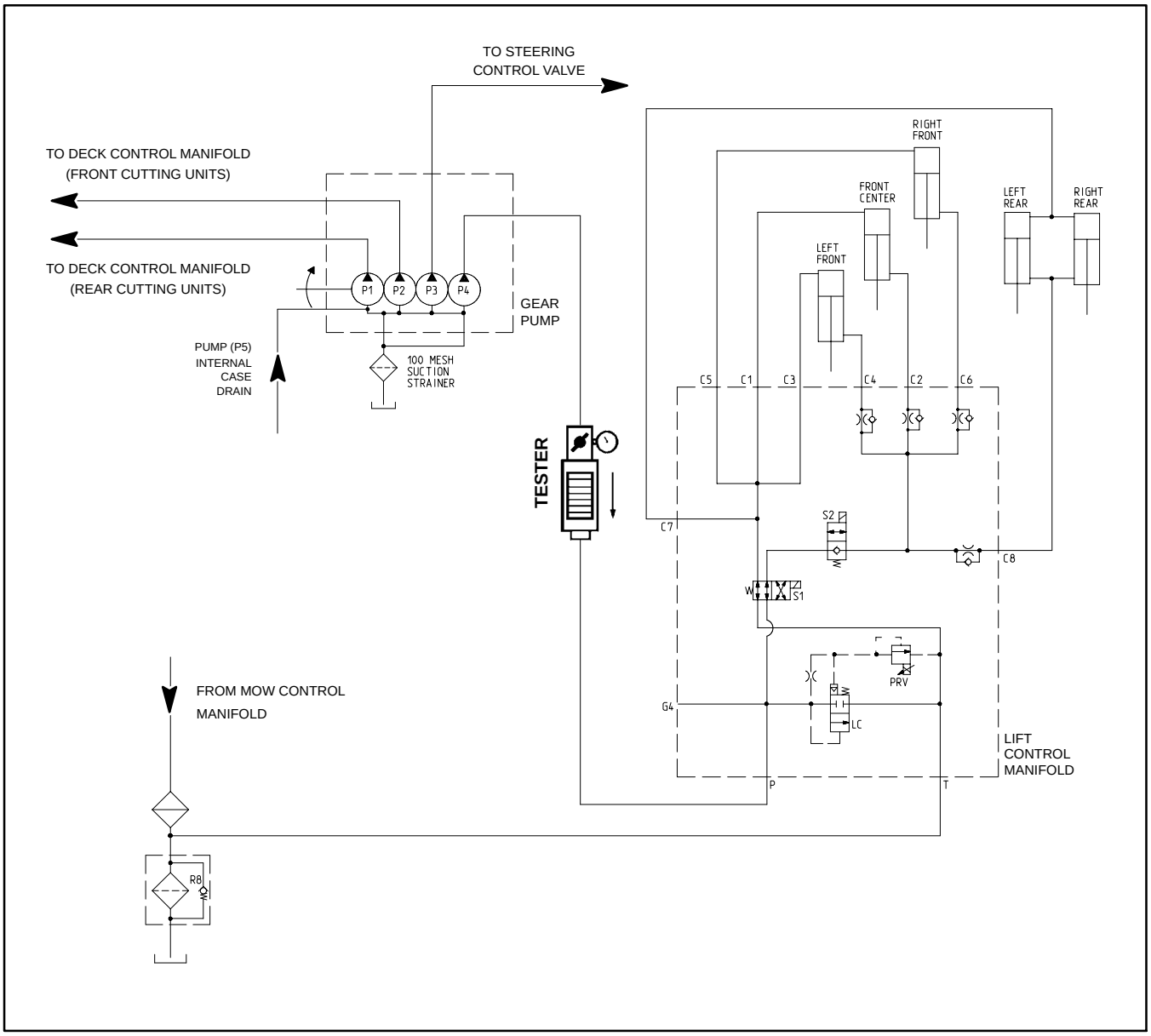


Figure 53

The gear pump (P4) flow test should be performed to make sure that the cutting deck lift circuit has adequate hydraulic flow.

**Procedure for <u>Gear Pump (P4) Flow</u> Test**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Raise and support operator seat to allow access to hydraulic pump.

5. Thoroughly clean both ends of the hydraulic hose that connects gear pump (P4) outlet (Fig. 54) and lift control manifold P4 port. Remove hydraulic hose. Access to hydraulic hose at lift control manifold can be obtained from below the machine.

**IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from pump (P4), through the tester and to the lift control manifold.**

6. Install tester with pressure gauges and flow meter in place of the removed hydraulic hose. Connect tester inlet hose to the pump fitting. Connect the tester outlet hose to the lift control manifold fitting. **Make sure the flow control valve on tester is fully open.**

7. Make sure that the traction pedal is in neutral and the parking brake is engaged.

8. Start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

9. Move throttle to full speed **(3200 RPM)**. Use a tachometer to verify that engine speed is correct.

**IMPORTANT: The gear pump is a positive displacement type. If pump flow is completely restricted or stopped, damage to the pump, tester or other components could occur.**

10. While carefully watching pressure gauges, slowly close the tester flow control valve until **1000 PSI (70 bar)** is obtained on gauge.

**FLOW TESTER READING TO BE:** A pump in good condition should have a flow of approximately **3.2 GPM (11.9 LPM)** at **1000 PSI (70 bar)**.

11. Open the tester flow control valve, stop engine and record test results.

12. If flow is less than **2.8 GPM (10.6 LPM)** or a pressure of **1000 PSI (70 bar)** cannot be obtained, consider that a pump problem exists. Check for restriction in pump intake line. If intake is not restricted, remove gear pump and repair or replace pump as necessary (see Gear Pump in the Service and Repairs section of this chapter).

**NOTE:** If the flow from gear pump (P4) is low, the operation of all lift cylinders will be affected.

13. After testing is completed, make sure that engine is stopped, then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Remove tester and connect removed hydraulic hose to gear pump (P4) outlet and lift control manifold P port.

14. Lower and secure operator seat.

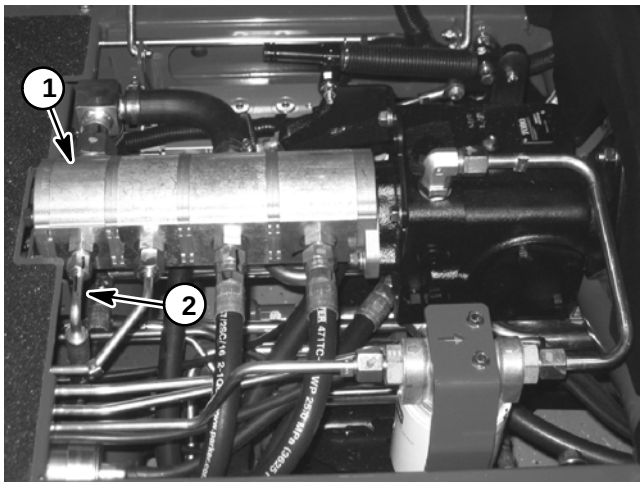


Figure 54

**1. Gear pump (P4)** **2. Hydraulic hose**

## Lift Cylinder Internal Leakage Test

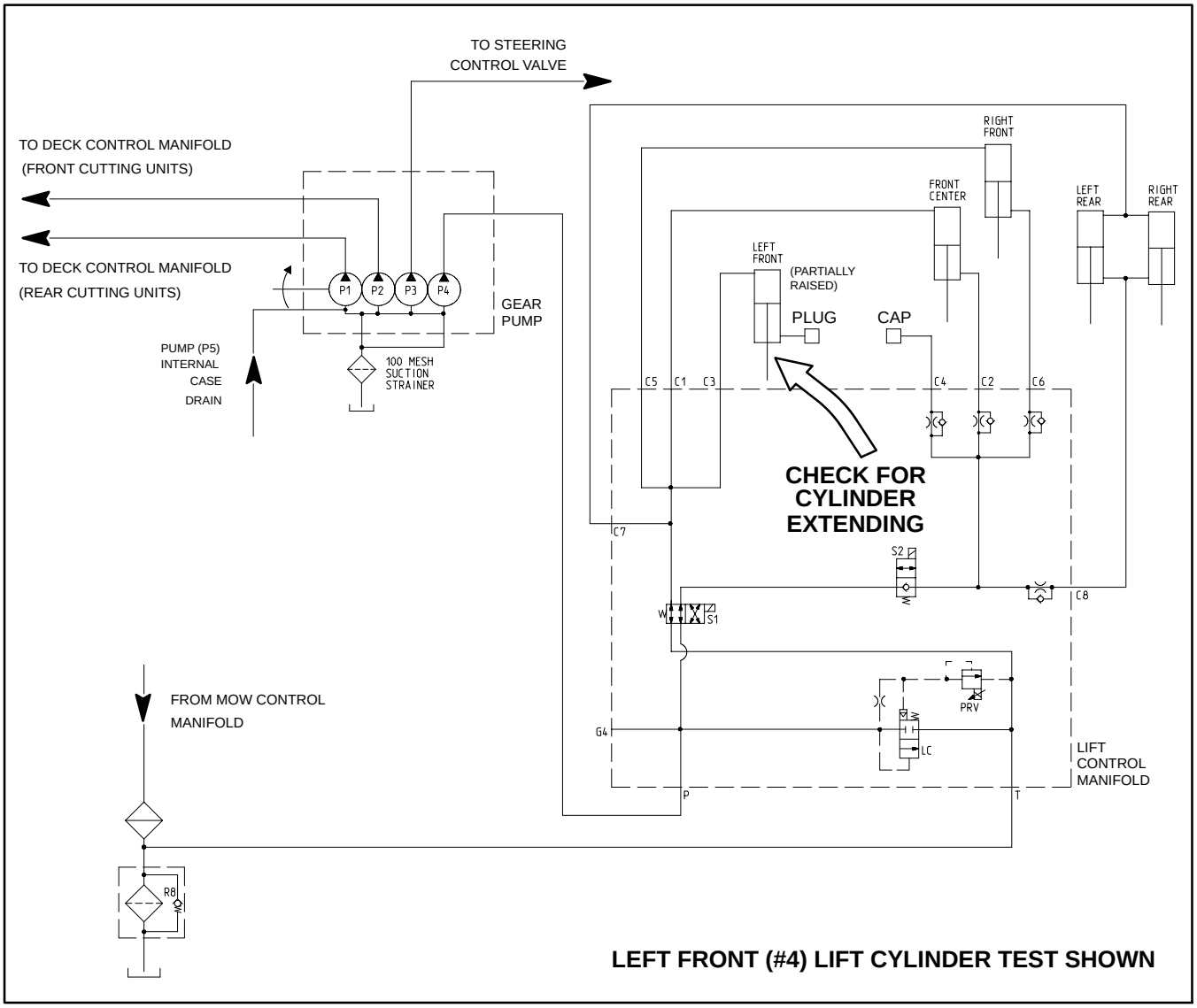


Figure 55

The lift cylinder internal leakage test should be performed if a cutting deck raise and lower problem is identified. This test will determine if a lift cylinder is faulty.

**NOTE:** Cutting deck raise/lower circuit operation will be affected by lift cylinder binding, extra weight on the cutting decks and/or binding of lift components. Make sure that these items are checked before proceeding with lift cylinder internal leakage test.

**Procedure for <u>Lift Cylinder Internal Leakage</u> Test:**

**NOTE:** When performing the lift cylinder internal leakage test, the cutting decks should be attached to the lift arms.

1. Park machine on a level surface with the PTO switch OFF. Position the cutting decks in the turn–around position and turn the engine off. Apply the parking brake.

2. For the lift cylinder that is to be tested, use a jack to raise the lift arm slightly. This will remove the load from the lift cylinder and relieve lift cylinder hydraulic pressure. Leave the jack under the lift arm to support the lift arm and to prevent the lift arm from lowering.

**NOTE:** If either of the rear lift cylinders is being tested, both rear lift arms need to be supported.

3. Thoroughly clean the area around the end of the hydraulic hose at the rod end of the lift cylinder. Disconnect the hydraulic hose from the lift cylinder rod end fitting (Fig. 56).

**IMPORTANT: When capping lift cylinder fitting and hydraulic hose end, use a steel cap and plug to ensure that fluid leakage will not occur. Plastic plugs will not hold hydraulic pressure that will be developed during this test procedure.**

4. Place a steel cap on the open lift cylinder fitting to seal the lift cylinder. Also, install a steel plug in the open end of the disconnected hose to prevent leakage or contamination.

5. Slowly lower the jack and remove it from under the lift arm. The cutting deck should settle slightly and then be supported by the capped lift cylinder.

6. Mark the position of the lift cylinder rod at the lift cylinder head with a piece of tape (Fig. 57).

7. Leave the machine parked for two (2) hours and monitor the lift cylinder. The weight of the cutting deck may cause the lift cylinder to gradually extend. Use the tape location to determine lift cylinder rod movement (Fig. 58).

A. If lift cylinder rod movement is less than 1.250" (31.7 mm) after two (2) hours, make sure that the cutting deck has not settled to the ground. If the cutting deck is still suspended after two (2) hours and lift cylinder rod movement is less than 1.250" (31.7 mm), consider that the lift cylinder is in good condition. A cylinder in good, usable condition will show minimal movement.

B. Rod movement in excess of 1.250" (31.7 mm) after two (2) hours indicates that the lift cylinder may have internal seal damage or excessive wear. Remove and inspect the lift cylinder (see Lift Cylinder and Lift Cylinder Service in the Service and Repairs section of this chapter).

8. Once lift cylinder condition has been determined, use a jack to raise the lift arm slightly which will remove the load from the lift cylinder. Leave the jack to support the lift arm and to prevent it from lowering. Remove the cap from the cylinder fitting and the plug from the hydraulic hose. Connect the hydraulic hose to the lift cylinder fitting.

9. Carefully remove jack from under the lift arm. Start engine and operate lift cylinders through several up and down cycles. Stop the engine and check for any leakage.

10. If needed, repeat steps 2 through 10 for other lift cylinders.

11. After testing is complete, check oil level in hydraulic reservoir and adjust if necessary.

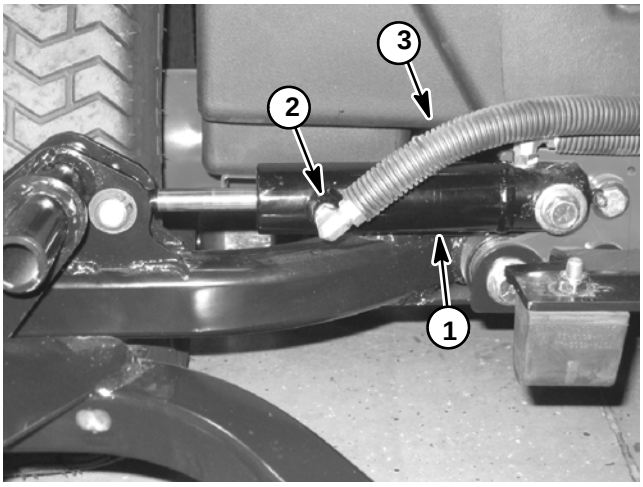


Figure 56

1. Lift cylinder (#5 shown)
2. Cylinder rod end fitting
3. Hydraulic hose

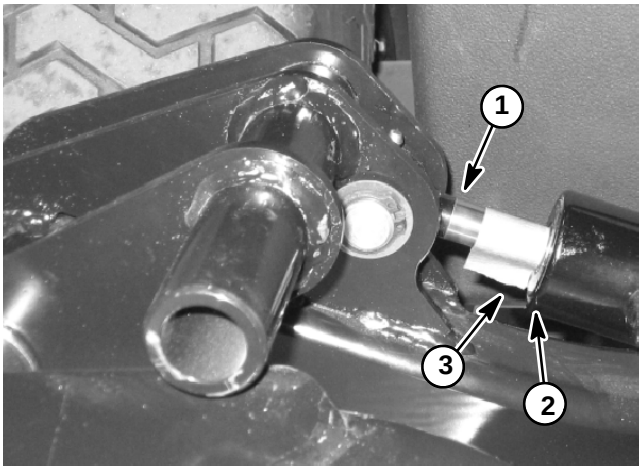


Figure 57

1. Lift cylinder rod
2. Lift cylinder head
3. Tape (initial position)

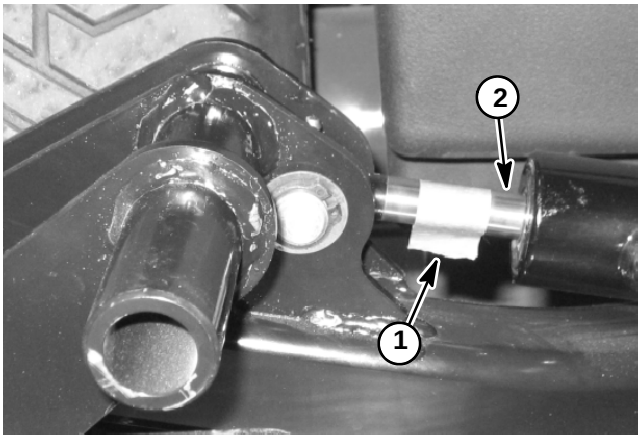


Figure 58

1. Tape (after 2 hours)
2. Cylinder rod movement

## Steering Relief Valve (R10) Pressure Test

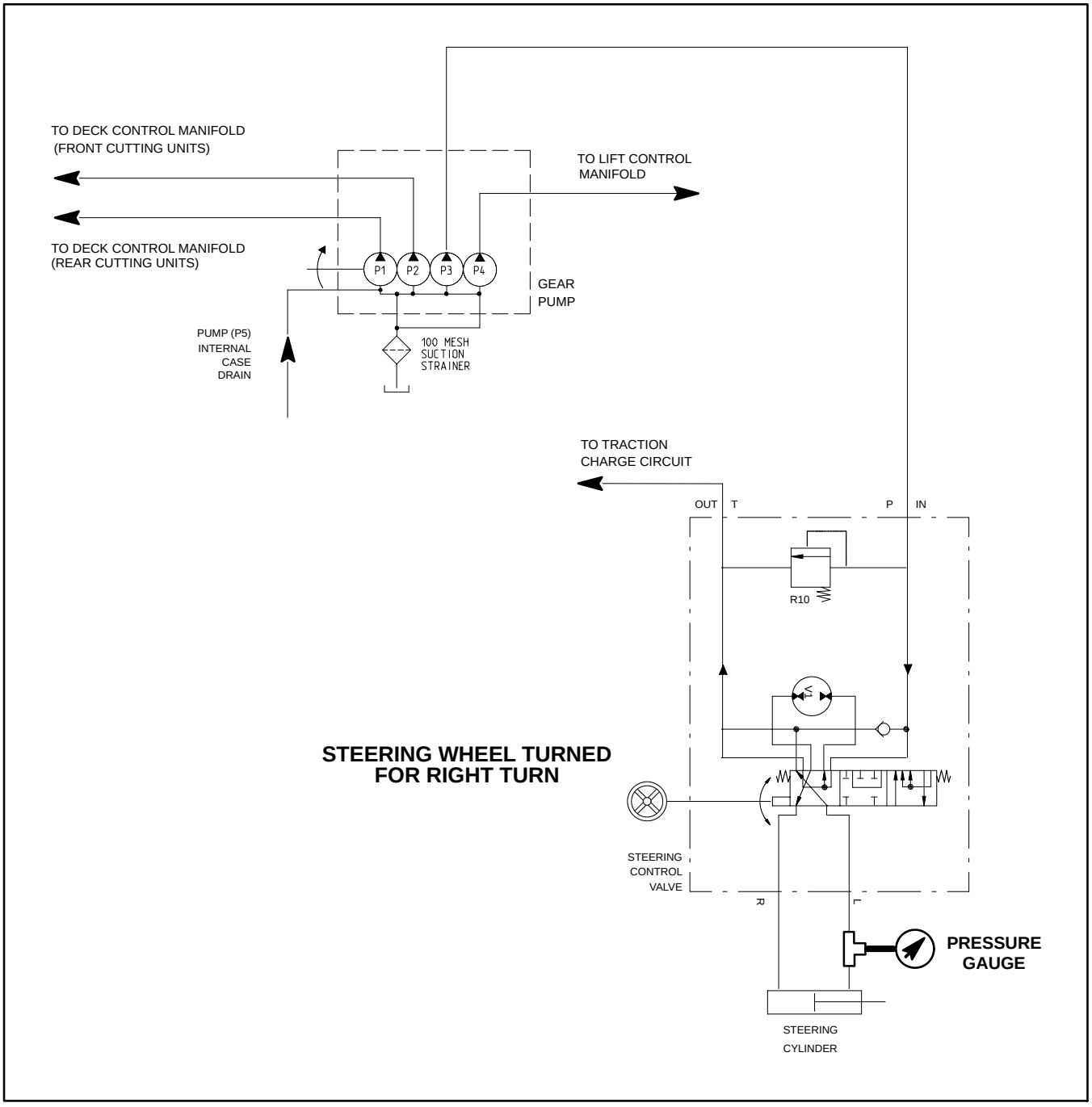


Figure 59

The steering relief valve (R10) pressure test should be performed to make sure that the steering circuit relief pressure is correct.

**Procedure for Steering Relief Valve Pressure Test:**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing in this section.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Thoroughly clean the area around the hydraulic hose at the rod end of the steering cylinder (Fig. 60).

5. Remove hydraulic hose from the fitting on the rod end of the steering cylinder.

6. Install a tee fitting between the disconnected hydraulic hose and the steering cylinder fitting. Install a 5000 PSI (350 bar) pressure gauge to the tee fitting.

7. After installing pressure gauge, start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.

8. Move throttle to full speed **(3200 RPM)**.

**IMPORTANT: Hold steering wheel at full lock only long enough to get a system pressure reading. Holding the steering wheel against the stop for an extended period may damage the steering control valve.**

9. Watch pressure gauge carefully while turning the steering wheel for a left hand turn (counter−clockwise) and holding.

10. System pressure should be approximately **1000 PSI (70 bar)** as the relief valve lifts. Return steering wheel to the neutral position.

11. Shut off engine. Record test results.

12. If specification is **not** met, inspect steering control valve (see Steering Control Valve Service in the Service and Repairs section of this chapter).

13. After testing is completed, make sure that engine is stopped, then relieve hydraulic system pressure (see Relieving Hydraulic System Pressure in the General Information section of this chapter). Remove tee fitting and pressure gauge from hydraulic hose and steering cylinder. Connect hydraulic hose to steering cylinder fitting.

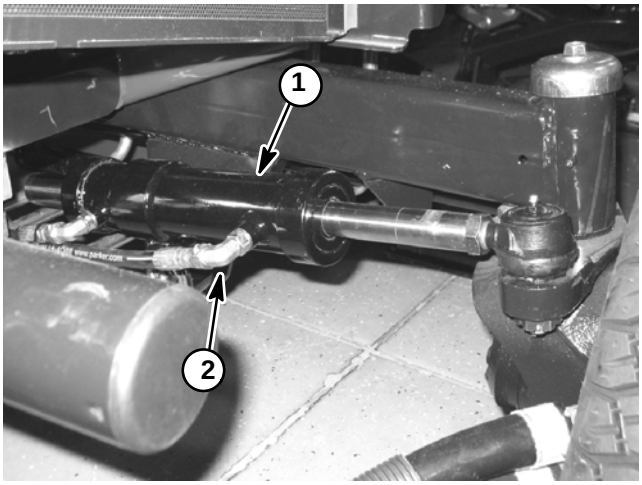


Figure 60

1. **Steering cylinder**
2. **Rod end fitting**

## Steering Cylinder Internal Leakage Test

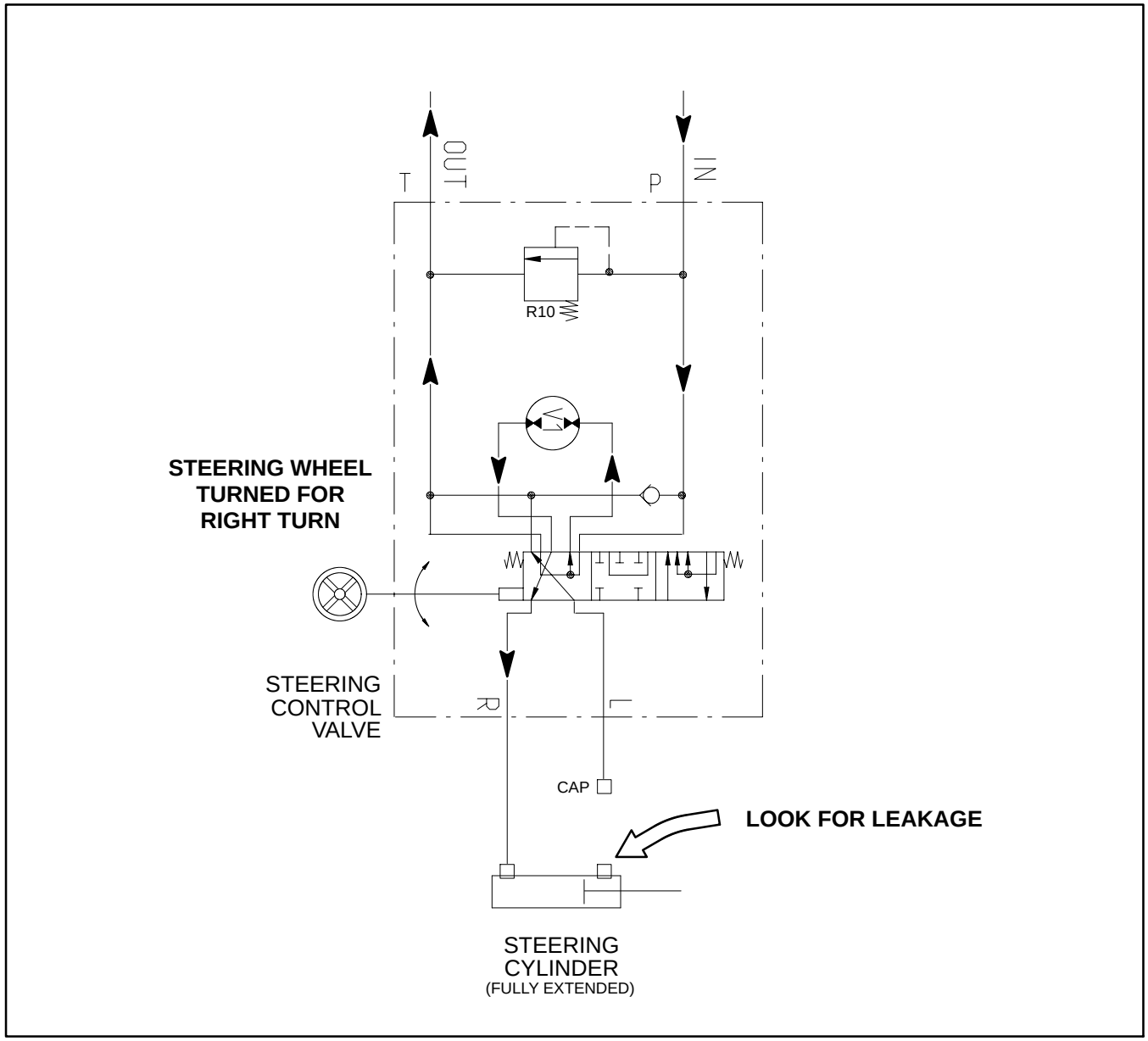


Figure 61

The steering cylinder internal leakage test should be performed if a steering problem is identified. This test will determine if the steering cylinder is faulty.

**NOTE:** Steering circuit operation will be affected by rear tire pressure, steering cylinder binding, extra weight on the vehicle and/or binding of rear axle steering components. Make sure that these items are checked before proceeding with steering cylinder internal leakage test.

**Procedure for Steering Cylinder Internal Leakage Test:**

1. Make sure hydraulic oil is at normal operating temperature.

2. Park machine on a level surface with the cutting decks lowered and PTO switch off. Make sure engine is off. Apply the parking brake.

3. Read Precautions For Hydraulic Testing.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Turn the steering wheel for a right turn (clockwise) so the steering cylinder rod is fully extended.

5. Thoroughly clean the area around the hydraulic hose at the rod end of the steering cylinder (Fig. 62).

6. Place a drain pan under the steering cylinder. Remove hydraulic hose from the fitting on the rod end of the steering cylinder. Cap the end of the hose.

7. Remove all hydraulic oil from drain pan. Make sure that empty drain pan remains under the open fitting of the steering cylinder.

8. With the engine off, continue turning the steering wheel for a right turn (clockwise) with the steering cylinder fully extended. Observe the open fitting on the steering cylinder as the wheel is turned. If oil comes out of the fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and should be inspected and repaired (see Steering Cylinder and Steering Cylinder Service in the Service and Repairs section of this chapter). Check drain pan for any evidence of oil that would indicate internal cylinder leakage.

9. Remove plug from the hydraulic hose. Connect hose to the steering cylinder fitting.

10. If a steering problem exists and the steering cylinder tested acceptably, the steering control valve requires service (see Steering Control Valve and Steering Control Valve Service in the Service and Repairs section of this chapter).

11. Check oil level in hydraulic reservoir and adjust if needed.

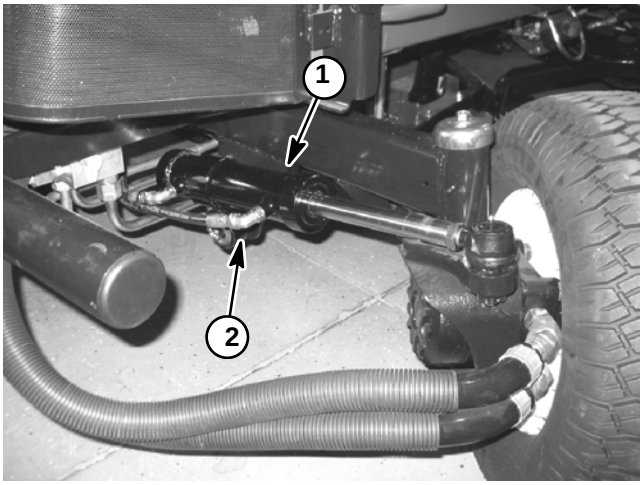


Figure 62

1. **Steering cylinder**
2. **Rod end fitting**

## General Precautions for Removing and Installing Hydraulic System Components

### Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake, lower cutting decks and stop engine. Remove key from the ignition switch.

2. Thoroughly clean machine before disconnecting, removing or disassembling any hydraulic components. Make sure hydraulic components, hose connections and fittings are thoroughly cleaned. Always keep in mind the need for cleanliness when working on hydraulic components.

**CAUTION**

**Before loosening any hydraulic component, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

3. Operate all hydraulic controls to relieve system pressure before loosening any hydraulic connection (see Relieving Hydraulic System Pressure in the General Information section).

4. Put caps or plugs on any hydraulic lines, hydraulic fittings or components left open or exposed to prevent contamination.

5. Before disconnecting hydraulic lines and hoses, place labels to ensure proper installation after repairs are completed.

6. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure that fittings will be aligned properly when reinstalling hydraulic hoses and tubes.

### After Repair or Replacement of Components

1. If a component failure occurred in the closed loop traction circuit (e.g. piston pump or wheel motor), filtering the traction circuit is recommended (see Filtering Closed−Loop Traction Circuit in this section).

2. If component failure is severe or hydraulic system is contaminated, flush hydraulic system (see Flush Hydraulic System in this section).

3. Lubricate O−rings and seals with clean hydraulic oil before installing hydraulic components.

4. Make sure all caps or plugs are removed from hydraulic tubes, hydraulic fittings and components before reconnecting.

5. Use proper tightening methods when installing hydraulic hoses and fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

6. After repairs, check control linkages and cables for proper adjustment, binding or broken parts.

7. After repairs are completed, clean hydraulic components, hose connections and fittings to prevent future accumulation of dirt and debris on hydraulic components.

8. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Hydraulic System Start Up in this section).

9. Check for hydraulic oil leaks. If any leaks are discovered, shut off engine and correct leaks.

10. Check oil level in hydraulic reservoir and add correct oil if necessary.

## Check Hydraulic Lines and Hoses

**CAUTION**

**Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.**

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings or deterioration. Make all necessary repairs before operating the machine.

## Flush Hydraulic System

**IMPORTANT: Flush the hydraulic system any time there is a severe component failure or the system is contaminated. Contaminated oil may appear milky or black or may contain metal particles.**

**IMPORTANT: If a component failure occurred in the closed loop traction circuit (e.g. piston pump or wheel motor), filtering the traction circuit is recommended. See Filtering Closed–Loop Traction Circuit in this section.**

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

2. Drain hydraulic reservoir. Remove suction screen from reservoir and clean thoroughly. Consider removing and cleaning reservoir if necessary.

3. Clean area around the mounting areas of the hydraulic filters. Remove and discard hydraulic filters.

4. Drain entire hydraulic system. Drain all hoses, tubes and components while the system is warm. Flush hoses and tubes to remove any contamination.

5. Make sure the mounting surfaces of the hydraulic filters are clean. Apply clean hydraulic oil to gasket on new filters. Screw filters on until gasket contacts mounting plate, then tighten filter three quarters of a turn.

**IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.**

6. Fill hydraulic reservoir with new hydraulic oil.

7. Disconnect wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting.

8. Make sure traction pedal is in neutral and the PTO switch is OFF. Turn ignition key switch to start; engage starter for ten (10) seconds to prime hydraulic pumps. Wait fifteen (15) seconds to allow the starter motor to cool and then repeat cranking procedure again.

9. Connect wire harness electrical connector to fuel stop solenoid to allow engine to start.

10. Start engine and let it idle at low speed for a minimum of two (2) minutes.

11. Increase engine speed to high idle for minimum of one (1) minute under no load.

12. Rotate steering wheel in both directions several times. Raise and lower cutting decks several times.

13. Move PTO switch to ON to engage cutting decks and let them run for several minutes. Move PTO switch to OFF.

14. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic reservoir and add correct oil if necessary.

15. Operate the machine for two (2) hours under normal operating conditions.

16. Check condition of hydraulic oil. If the fluid shows any signs of contamination, repeat steps 1 through 14 again.

17. Resume normal operation and follow recommended maintenance intervals.

## Filtering Closed-Loop Traction Circuit

Filtering of a closed−loop hydraulic system after a major component failure (e.g. traction (piston) pump or wheel motor) is a requirement to prevent debris from transmitting throughout the system. If a closed−loop hydraulic system filtering tool is not used to ensure system cleanliness, repeat failures, as well as subsequent damage to other hydraulic components in the affected system, will occur. To effectively remove contamination from closed−loop traction circuit, use of the Toro high flow hydraulic filter and hydraulic hose kits are recommended (see Special Tools in this chapter).

1. Park machine on a level surface with engine stopped and key removed from ignition switch.

2. Raise and support machine so all wheels are off the ground (see Jacking Instructions in Chapter 1 − Safety).

**NOTE:** If wheel motor was replaced, install high flow filter to the inlet of the new motor instead of to the traction pump fitting. This will prevent system contamination from entering and damaging the new wheel motor.

3. Thoroughly clean junction of hydraulic hose and **left** side elbow fitting on bottom of traction pump (Fig. 63). Disconnect hose from left side pump fitting.

4. Connect Toro high flow hydraulic filter in series between traction pump fitting and disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) to connect filter to machine. Make sure that fitting and hose connections are properly tightened.

**IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.**

5. After installing high flow filter to machine, check and fill hydraulic reservoir with new hydraulic oil as required.

6. Start engine and run at idle speed. Check for any hydraulic leakage from filter and hose connections. Correct any leaks before proceeding.

**CAUTION**

**All wheels will be off the ground and rotating during this procedure. Make sure machine is well supported so it will not move and accidentally fall to prevent injuring anyone around machine.**

**IMPORTANT: While engaging the traction circuit, monitor the indicator on the high flow hydraulic filter. If the indicator should show red, either reduce pressure on the traction pedal or reduce engine speed to decrease hydraulic flow through the filter.**

7. With engine running at low idle speed, slowly move the traction pedal to the forward direction to allow flow through the traction circuit and high flow filter. Keep traction circuit engaged for five (5) minutes while gradually increasing both forward pressure on traction pedal and engine speed. Monitor filter indicator to make sure that green color is showing during operation.

8. With engine running at high idle speed and traction pedal moved to the forward direction, periodically apply brakes to increase pressure in traction circuit. While monitoring filter indicator, continue this process for an additional five (5) minutes.

**IMPORTANT: If using a filter that is not the Toro high flow filter that is bi−directional, do not press the traction pedal in the reverse direction. If flow is reversed when using a filter that is not bi−directional, debris from the filter will re−enter the traction circuit.**

9. With engine running at high idle speed, alternately move traction pedal from forward to reverse. While monitoring filter indicator, continue this process for an additional five (5) minutes.

10. Shut engine off and remove key from ignition switch.

11. Remove high flow hydraulic filter and hydraulic hose kit from machine. Connect hydraulic hose to left side traction pump fitting. Make sure to properly tighten hose (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

12. Lower machine to ground.

13. Check oil level in hydraulic reservoir and add correct oil if necessary.

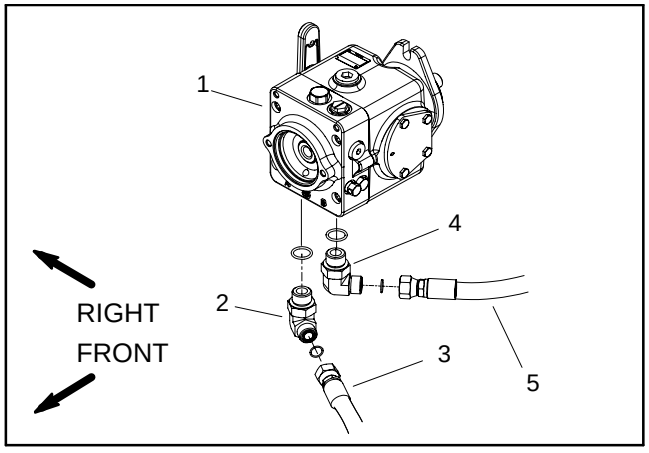


Figure 63

1. **Traction pump**
2. **RH elbow fitting**
3. **Hyd hose (forward)**
4. **LH elbow fitting**
5. **Hyd hose (reverse)**

## Hydraulic System Start-up

**NOTE:** When initially starting the hydraulic system with new or rebuilt components such as pumps, wheel motors or lift cylinders, it is important that this start–up procedure be used. This procedure reduces the chance of damaging the system or its components from not purging the system of air.

1. After the hydraulic system components have been properly installed and if the traction pump was rebuilt or replaced, make sure traction pump housing is at least half full of clean hydraulic oil.

2. Make sure all hydraulic connections and lines are secured tightly.

3. Drain, flush and refill hydraulic system and change hydraulic oil filters if component failure was severe or system is contaminated (see Flush Hydraulic System in this section).

4. Make sure hydraulic reservoir is full. Add correct oil if necessary.

5. Check control linkage for proper adjustment, binding or broken parts.

6. Disconnect wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting.

7. Make sure traction pedal is in neutral and the PTO switch is OFF. Turn ignition key switch to start; engage starter for ten (10) seconds to prime hydraulic pumps. Wait fifteen (15) seconds to allow the starter motor to cool and then repeat cranking procedure again.

8. Connect wire harness electrical connector to fuel stop solenoid to allow engine to start.

9. Make sure traction pedal is in neutral and the PTO switch is OFF. Start engine and run it at low idle. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in thirty (30) seconds, stop the engine and determine the cause.

10. If the traction pump was replaced or rebuilt, run the traction unit so the wheels turn slowly for ten (10) minutes.

11. Operate the traction unit (including steering and cutting deck lift/lower) by gradually increasing the work load to full over a ten (10) minute period.

12. Stop the machine. Check oil level in hydraulic reservoir and add correct oil if necessary. Check hydraulic components for leaks and tighten any loose connections.

## Hydraulic Reservoir

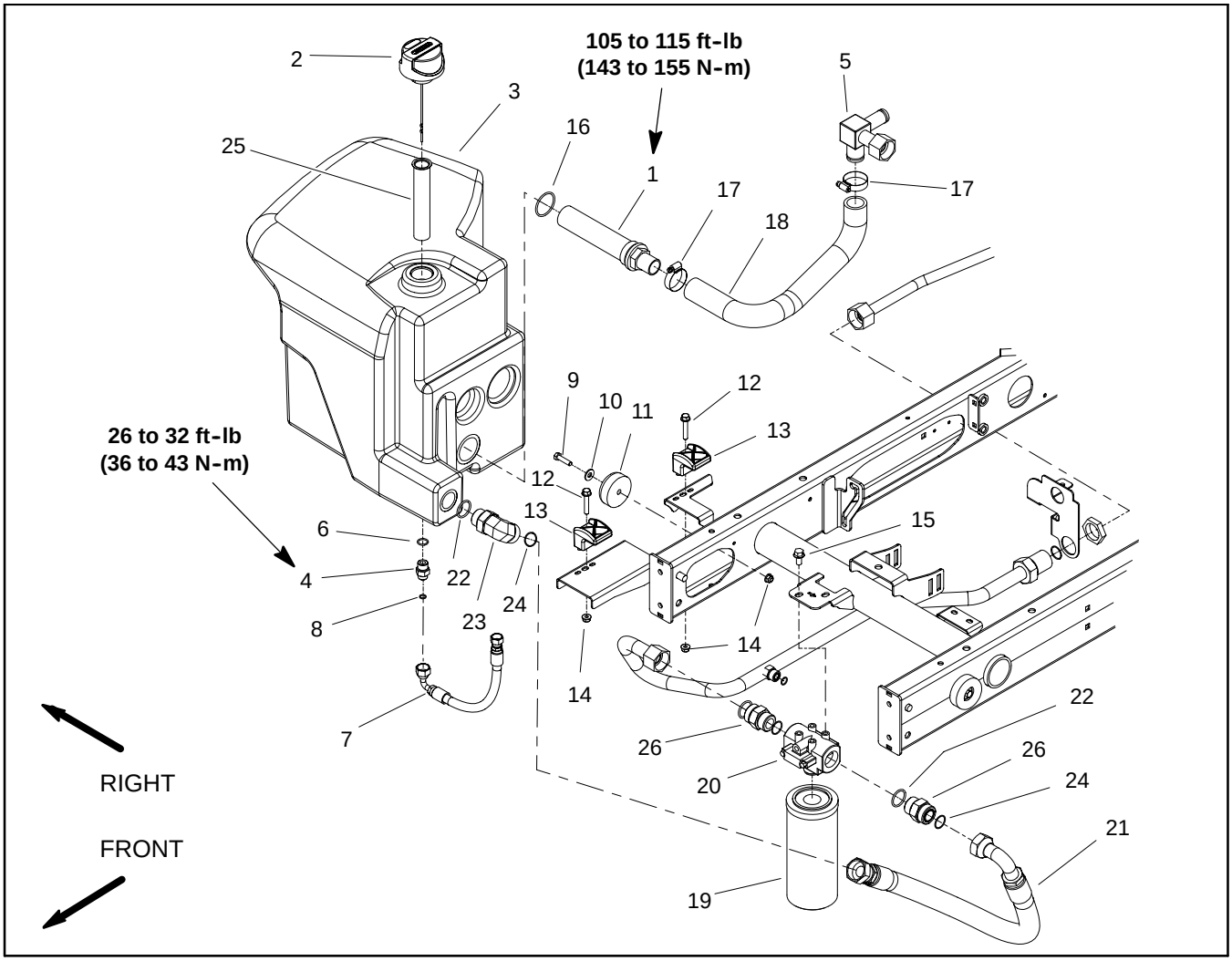


Figure 64

1. Suction strainer
2. Tank cap
3. Hydraulic reservoir
4. Adapter
5. Manifold
6. O-ring
7. Hydraulic hose
8. O-ring
9. Cap screw
10. Flat washer
11. Bumper
12. Washer head screw (2 used)
13. Clamp (2 used)
14. Flange nut
15. Flange head screw (2 used)
16. O-ring
17. Hose clamp (2 used)
18. Hydraulic hose
19. Oil filter
20. Filter head
21. Hydraulic hose
22. O-ring
23. 90º hydraulic fitting
24. O-ring
25. Screen filter
26. Hydraulic fitting

**Removal (Fig. 64)**

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

2. Thoroughly clean hydraulic hose ends and fittings on hydraulic reservoir to prevent hydraulic system contamination. Label hydraulic hoses to assist in installation.

3. Disconnect hydraulic hose (item 7) from adapter fitting on bottom of reservoir to allow draining of reservoir. Drain reservoir into a suitable container.

4. Disconnect remaining hydraulic hoses from reservoir. Allow hydraulic lines to drain into a suitable container. Plug or cap openings of reservoir and lines to prevent contamination.

5. Remove hydraulic reservoir using Figure 64 as a guide.

6. Remove suction strainer from reservoir. Discard O−ring.

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

**Inspection (Fig. 64)**

1. Clean hydraulic reservoir and suction strainer with clean solvent.

2. Inspect hydraulic reservoir for leaks, cracks or other damage.

**Installation (Fig. 64)**

1. If fittings were removed from reservoir, lubricate and place new O−rings onto fittings. Install fittings into reservoir openings 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. Lubricate new suction strainer O−ring and install onto strainer. Thread suction strainer into hydraulic reservoir and torque strainer **105 to 115 ft−lb (143 to 155 N−m)**.

3. Position hydraulic reservoir to machine. Secure reservoir to frame with two (2) clamps (item 13), washer head screws (item 12) and flange nuts (item 14).

4. Remove all plugs and caps placed in hoses and fittings during the removal process.

5. Install hydraulic hoses to fittings on hydraulic reservoir in positions noted during removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Fill hydraulic reservoir with **new** hydraulic fluid.

7. Operate machine. Check hydraulic lines and fittings for leaks. Tighten any loose connections. Check hydraulic oil level and adjust if necessary.

## Hydraulic Pump Drive Shaft

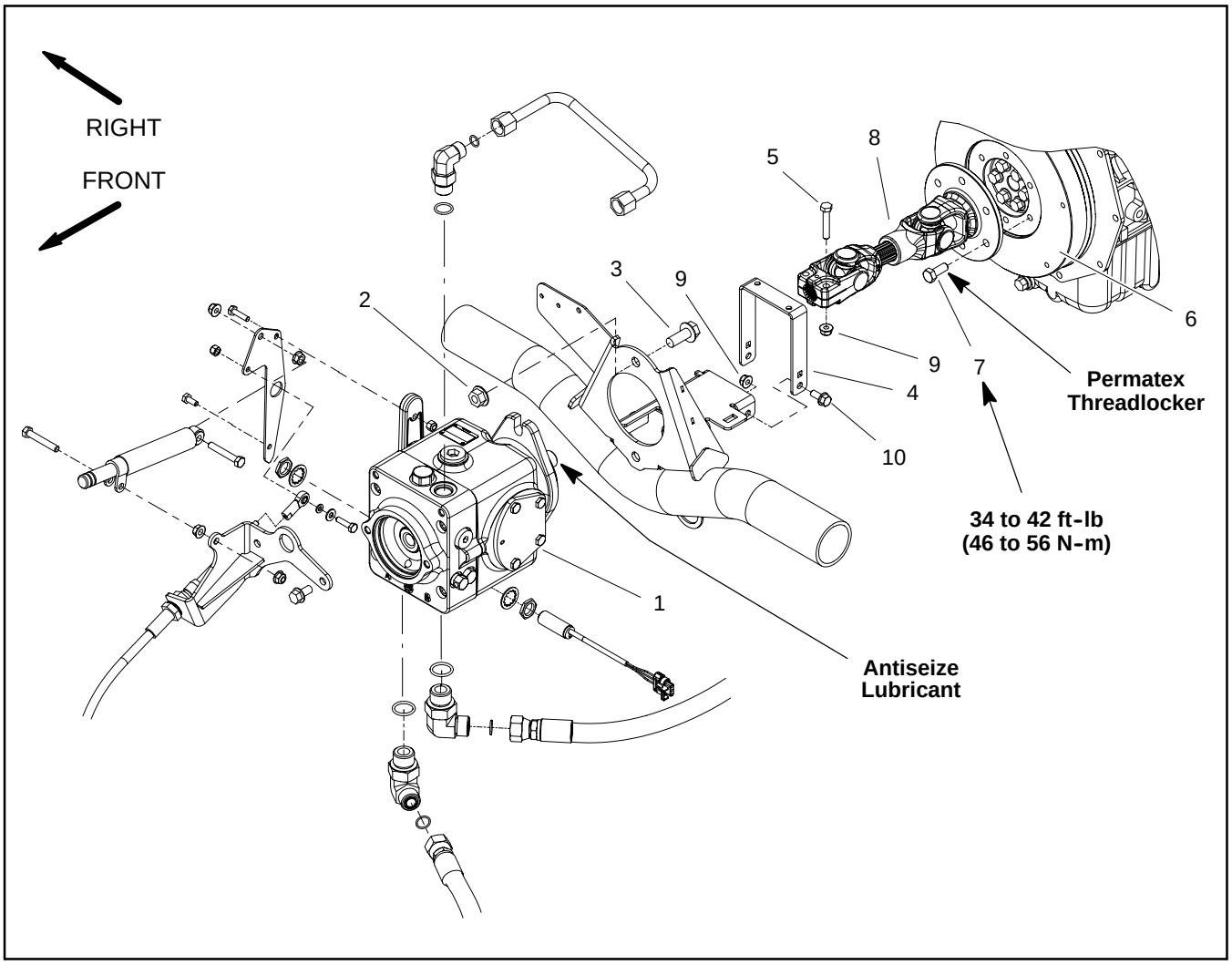


Figure 65

1. **Piston (traction) pump**
2. **Flange nut (2 used)**
3. **Flange head screw (2 used)**
4. **Guard hoop**
5. **Cap screw (2 used)**
6. **Engine flywheel**
7. **Cap screw (6 used)**
8. **Drive shaft assembly**
9. **Flange nut (4 used)**
10. **Flange head screw (2 used)**

**Removal (Fig. 65)**

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

2. Remove two (2) flange head screws and flange nuts that secure drive shaft guard hoop (item 4) to machine frame. Remove guard.

3. Remove two (2) cap screws (item 5) and flange nuts (item 9) that secure drive shaft yoke to piston pump input shaft.

4. Remove six (6) cap screws (item 7) that secure drive shaft flange to engine flywheel.

5. Remove drive shaft assembly from machine.

**Drive Shaft Cross and Bearing Service (Fig. 66)**

1. Remove snap rings that secure bearings in yokes.

**IMPORTANT: Yokes must be supported when removing and installing bearings to prevent damage.**

2. Use a press to remove cross and bearings from yokes. Thoroughly clean drive shaft yokes.

3. To install new cross and bearings:

   A. Apply a coating of grease to bearing bores in end yoke and shaft yoke.

   B. Press one bearing partially into yoke.

   C. Insert cross into yoke and bearing.

   D. Hold cross in alignment and press bearing in until it hits the yoke.

   E. Install snap ring into yoke groove to secure installed bearing.

   F. Place second bearing into yoke bore and onto cross shaft. Press bearing into yoke and secure with snap ring.

   G. Repeat procedure for other yoke.

   H. Grease cross until grease comes out of all four (4) cups.

4. Make sure that assembled joint 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 to identify source of binding.

**Installation (Fig. 65)**

1. Apply antiseize lubricant to traction pump input shaft.

2. Position drive shaft assembly to engine and pump input shaft.

3. Apply Permatex Blue Gel Threadlocker (or equivalent) to threads of cap screws (item 7) that secure drive shaft flange to engine flywheel. Secure drive shaft flange to flywheel with six (6) cap screws (item 7). Torque cap screws from **34 to 42 ft-lb (46 to 56 N-m)**.

4. Slide drive shaft yoke on pump input shaft so yoke is flush with end of input shaft. Secure drive shaft yoke to pump input shaft with two (2) cap screws (item 5) and flange nuts (item 9).

5. Position drive shaft guard hoop to machine frame and secure with two (2) flange head screws and flange nuts.

6. Lubricate grease fittings on drive shaft.

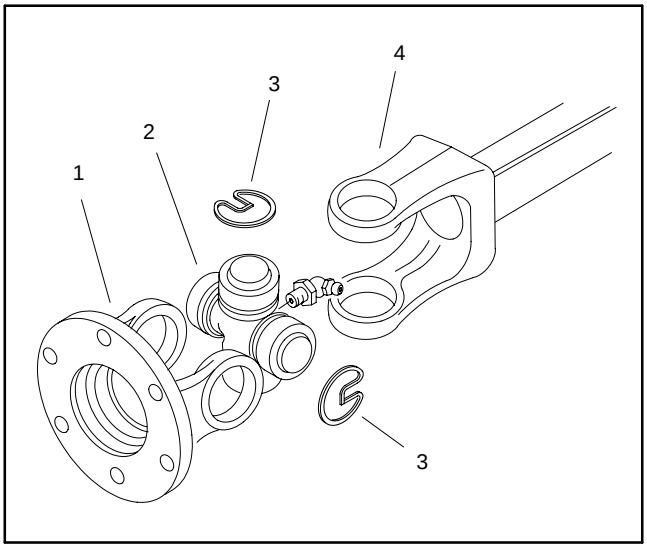


Figure 66

1. **End yoke**
2. **Cross and bearing kit**
3. **Snap ring (4 used)**
4. **Shaft yoke**

## Hydraulic Pump Assembly

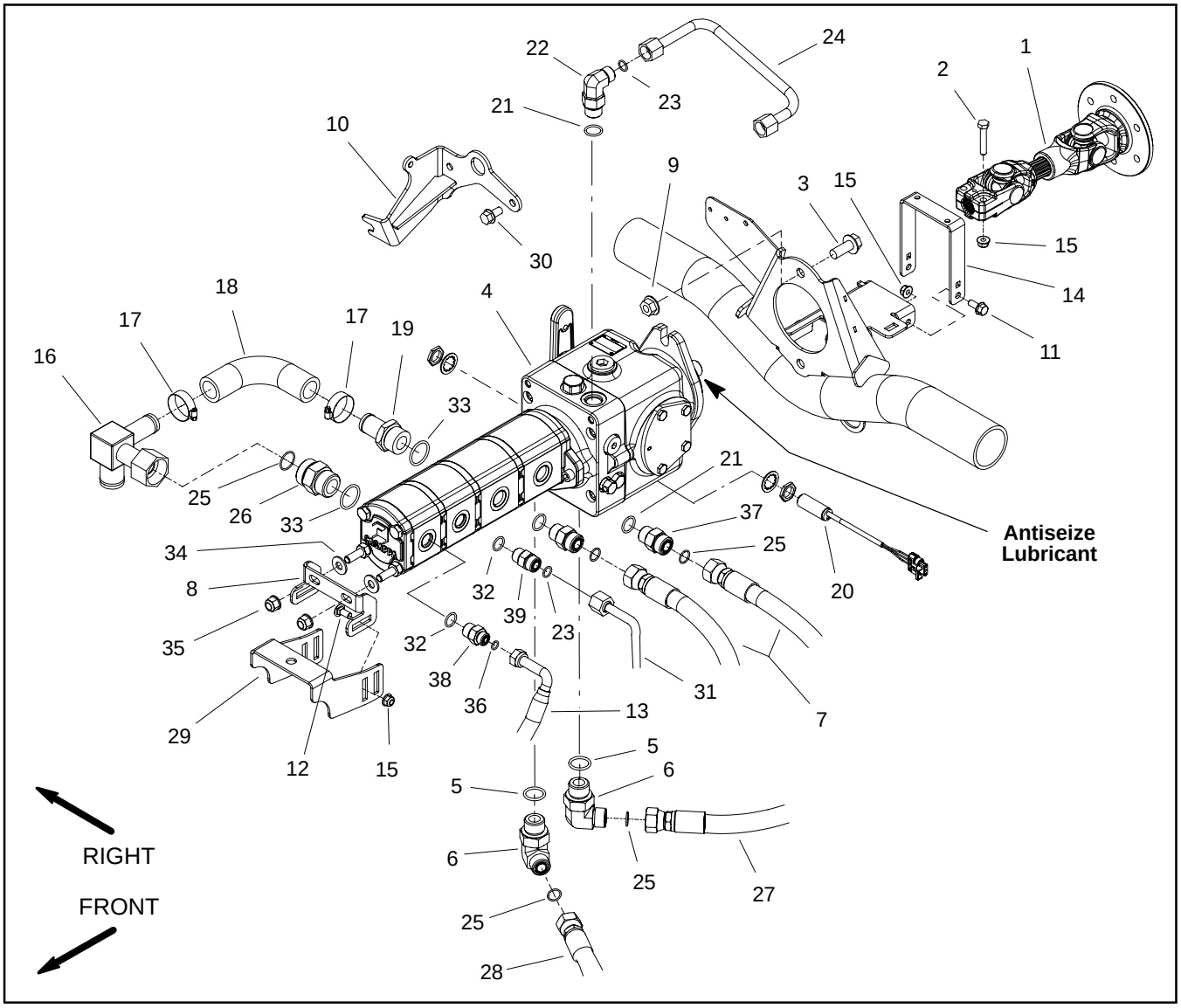


Figure 67

1. Drive shaft assembly
2. Cap screw (2 used)
3. Flange head screw (2 used)
4. Hydraulic pump assembly
5. O-ring
6. 90º hydraulic fitting (2 used)
7. Hydraulic hose (2 used)
8. Pump support bracket
9. Flange nut (2 used)
10. Traction cable bracket
11. Flange head screw (2 used)
12. Carriage screw (2 used)
13. Hydraulic hose
14. Guard hoop
15. Flange nut (6 used)
16. Manifold
17. Hose clamp (2 used)
18. Hydraulic hose
19. Hydraulic fitting
20. Neutral switch
21. O-ring
22. 90º hydraulic fitting
23. O-ring
24. Hydraulic tube
25. O-ring
26. Hydraulic fitting
27. Hydraulic hose
28. Hydraulic hose
29. Frame bracket
30. Flange head screw (2 used)
31. Hydraulic tube
32. O-ring
33. O-ring
34. Flat washer (2 used)
35. Lock nut (2 used)
36. O-ring
37. Hydraulic fitting (2 used)
38. Hydraulic fitting
39. Hydraulic fitting

**NOTE:** Traction pump and gear pump should be removed from machine as an assembly. Once removed from machine, pumps can be separated for service.

**Removal (Fig. 67)**

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

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

3. To prevent contamination of the hydraulic system, thoroughly clean traction and gear pump assembly and all hydraulic connections.

4. Label hydraulic hoses to assist in assembly. Disconnect all hydraulic hoses and tubes from fittings on the traction and gear pump assembly. Allow hydraulic lines to drain into a suitable container. Plug or cap openings of pumps and lines to prevent contamination.

5. Remove hydraulic pump drive shaft (see Hydraulic Pump Drive Shaft Removal in this section).

6. Separate traction cable assembly from traction pump (Fig. 69):

A. Remove flange nut (item 4 in Fig. 69) that secures lever damper (item 14 in Fig. 69) to traction cable bracket.

B. Remove cap screws (items 7 and 13 in Fig. 69) and lock nut (item 8 in Fig. 69) that secure traction lever bracket (item 12 in Fig. 69) to pump lever.

C. Loosen jam nuts that secure traction cable to traction cable bracket (item 6 in Fig. 69).

D. Position traction cable assembly away from pump assembly.

7. Disconnect wire harness electrical connector from traction neutral switch and position harness away from transmission.

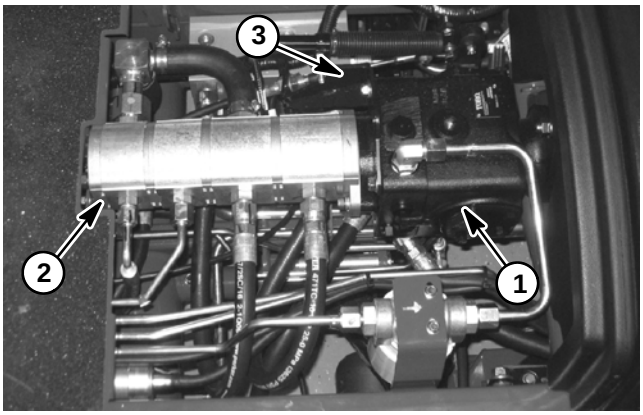


Figure 68

1. **Piston (traction) pump**
2. **Gear pump**
3. **Traction cable bracket**

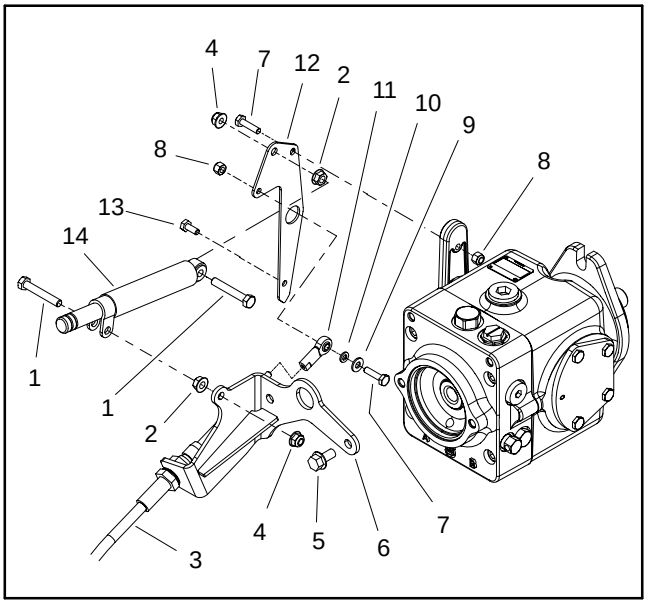


Figure 69

1. **Cap screw (2 used)**
2. **Flange nut (2 used)**
3. **Traction cable**
4. **Flange nut (2 used)**
5. **Flange screw (2 used)**
6. **Traction cable bracket**
7. **Cap screw (2 used)**
8. **Lock nut (2 used)**
9. **Flat washer**
10. **Flat washer**
11. **Ball joint**
12. **Traction lever bracket**
13. **Cap screw**
14. **Lever damper**

**CAUTION**

**Make sure lift or hoist can support the total weight of the pump assembly before removing the cap screws from the pump assembly and frame. Pump assembly weighs approximately 67 pounds (30.5 kg).**

8. Connect a lift or hoist to hole in traction cable bracket on traction pump to support pump assembly and for pump removal.

9. Loosen and remove two (2) carriage screws (item 12) and flange nuts (item 15) that secure pump support bracket (item 8) to frame.

10. Remove two (2) flange screws (item 3) and flange nuts (item 9) that secure traction pump flange to machine frame.

**IMPORTANT: Make sure to not damage machine components while removing the pump assembly.**

11. Carefully lift pump assembly from the machine.

12. Separate traction and gear pumps (Fig. 70):

A. Remove two (2) socket head screws, lock washers and flat washers that secure gear pump to traction pump.

B. Remove gear pump from traction pump. Locate and discard O−ring from between pumps.

C. If necessary, remove two (2) lock nuts that secure pump support bracket to gear pump. Remove bracket and two (2) flat washers from gear pump.

13. If necessary, remove hydraulic fittings from pumps. Note orientation of fittings for assembly purposes.

14. Remove and discard all O−rings from removed hydraulic lines and fittings.

**Installation (Fig. 67)**

1. If fittings were removed from pumps, lightly lubricate new fitting O−rings with clean hydraulic oil. Install fittings with O−rings to the pumps (see Hydraulic Fitting Installation in the General Information section of this chapter). Orientate fittings as noted during removal.

2. Assemble traction and gear pumps (Fig. 70):

A. Lubricate and position new O−ring between pumps.

B. Position gear pump to traction pump and secure with two (2) socket head screws, lock washers and flat washers.

C. If pump support bracket was removed from gear pump, fit flat washers and bracket to gear pump and secure with two (2) lock nuts.

**IMPORTANT: Make sure to not damage machine components while installing the pump assembly.**

3. Carefully lower pump assembly to machine frame.

4. Secure pump assembly to machine frame with two (2) flange screws and flange nuts.

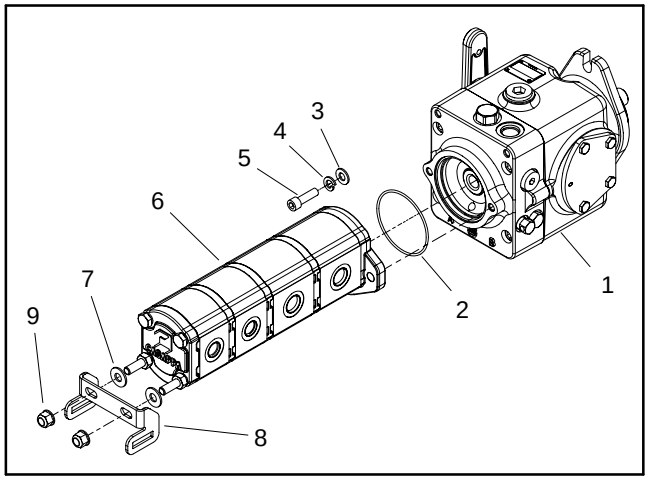


Figure 70

1. **Traction pump**
2. **O−ring**
3. **Flat washer (2 used)**
4. **Lock washer (2 used)**
5. **Socket screw (2 used)**
6. **Gear pump**
7. **Flat washer (2 used)**
8. **Pump support bracket**
9. **Lock nut (2 used)**

5. Secure pump support bracket to inside of frame bracket with two (2) carriage screws (item 12) and flange nuts (item 15).

6. Install hydraulic hoses to fittings on pump assembly in positions noted during removal (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Connect machine wire harness electrical connector to traction neutral switch.

8. Secure traction cable assembly to traction pump (Fig. 69):

A. Position traction cable assembly to pump assembly.

B. Secure traction lever bracket (item 12 in Fig. 69) to pump lever with cap screws (items 7 and 13 in Fig. 69) and lock nut (item 8 in Fig. 69).

C. Secure lever damper (item 14 in Fig. 69) to traction cable bracket with flange nut (item 4 in Fig. 69).

D. Secure traction cable to traction cable bracket (item 6 in Fig. 69) with jam nuts.

9. Install hydraulic pump drive shaft (see Hydraulic Pump Drive Shaft Installation in this section).

10. Check oil level in hydraulic reservoir and add correct oil if necessary.

11. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

12. Check traction drive for neutral and traction neutral switch operation. Adjust if necessary.

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## Piston (Traction) Pump Service

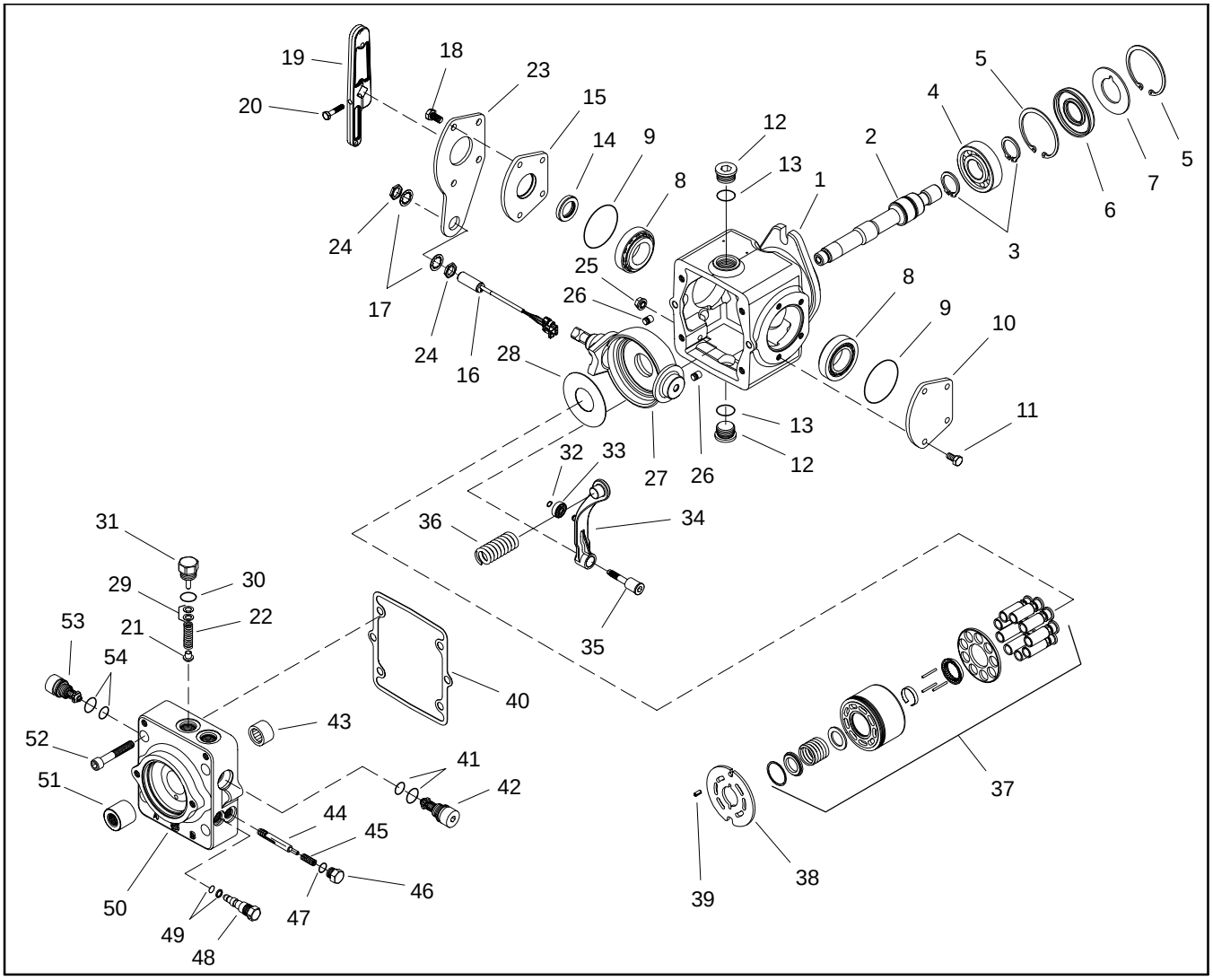


Figure 71

1. Traction pump housing
2. Auxiliary shaft
3. Retaining ring
4. Ball bearing
5. Retaining ring
6. Seal
7. Backup washer
8. Bearing
9. O-ring
10. Trunnion cover
11. Screw (4 used)
12. Plug
13. O-ring
14. Seal
15. Trunnion cover
16. Neutral switch
17. Lock washer
18. Screw (4 used)
19. Control arm
20. Screw
21. Charge relief poppet
22. Spring
23. Bracket
24. Nut
25. Seal nut
26. Pin
27. Swashplate
28. Thrust plate
29. Shim kit
30. O-ring
31. Charge relief plug
32. Retaining ring
33. Bearing
34. Neutral return arm
35. Neutral return pivot
36. Spring
37. Cylinder block kit
38. Valve plate
39. Slotted pin
40. End cap gasket
41. Seal kit
42. Relief valve (reverse)
43. Needle bearing
44. Loop flushing spool
45. Spring
46. Plug
47. O-ring
48. Bypass valve
49. Seal kit
50. End cap
51. Coupling
52. Screw (4 used)
53. Relief valve (forward)
54. Seal kit

**NOTE:** For piston (traction) pump repair information, see the Sauer-Danfoss LPV Closed Circuit Axial Piston Pumps Repair Manual and Service Instructions at the end of this chapter.

**IMPORTANT: If a piston (traction) pump failure occurred, refer to Traction Circuit Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.**

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## Gear Pump Service

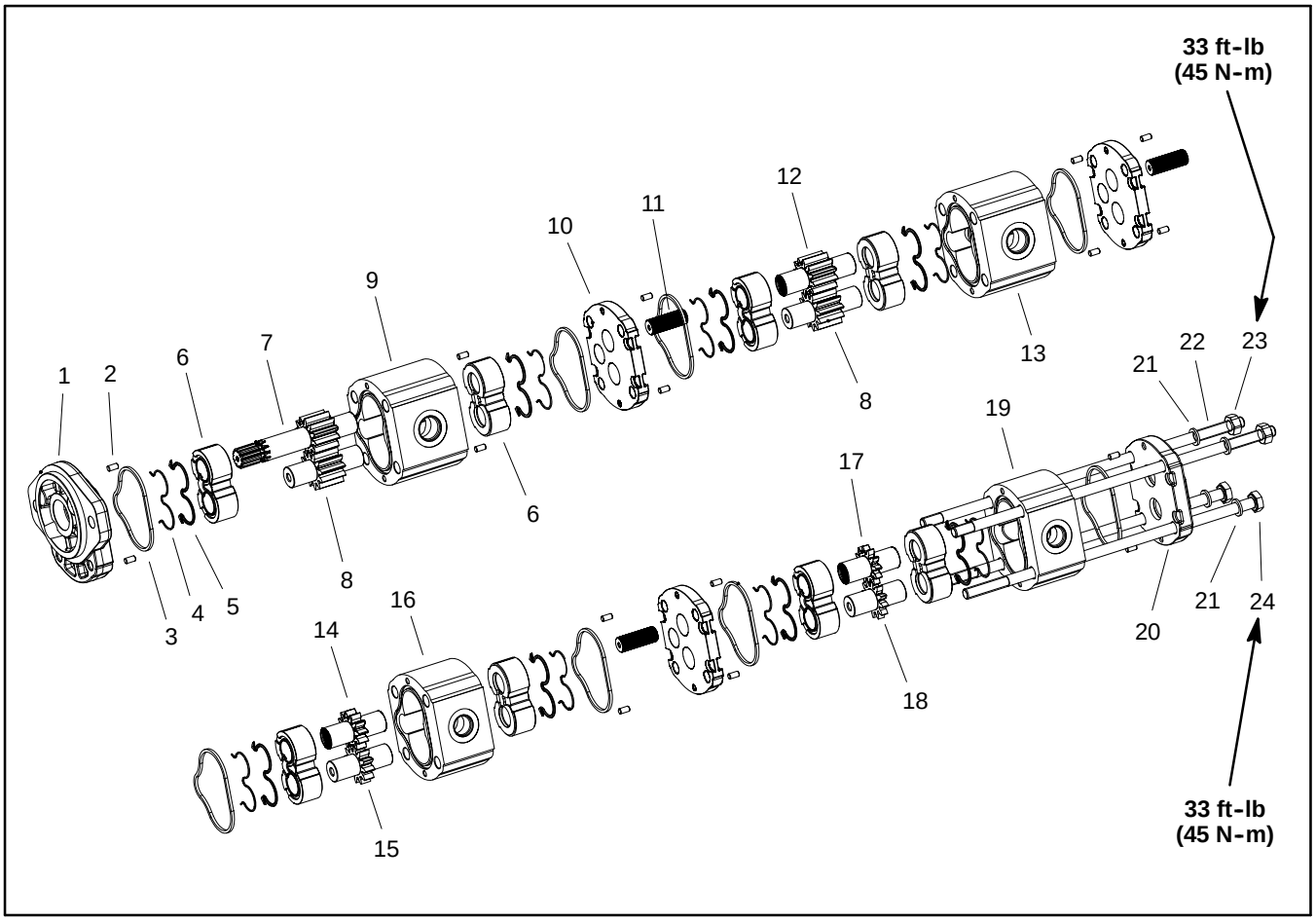


Figure 72

1. **Front cover**
2. **Dowel pin (16 used)**
3. **Square section seal (8 used)**
4. **Back-up ring (8 used)**
5. **Pressure seal (8 used)**
6. **Thrust plate (8 used)**
7. **Drive shaft**
8. **Driven gear (2 used)**
9. **Body (P1 section)**
10. **Flange (3 used)**
11. **Splined connecting shaft (3 used)**
12. **Drive gear**
13. **Body (P2 section)**
14. **Drive gear**
15. **Driven gear**
16. **Body (P3 section)**
17. **Drive gear**
18. **Driven gear**
19. **Body (P4 section)**
20. **Rear cover**
21. **Washer (4 used)**
22. **Stud bolt (2 used)**
23. **Nut (2 used)**
24. **Cap screw (2 used)**

**Disassembly (Fig. 72)**

**NOTE:** The gear pump must be replaced as a complete assembly. Individual gears, housings and thrust plates are not available separately. Disassemble gear pump for cleaning, inspection and seal replacement only.

**IMPORTANT: Keep bodies, gears, flanges and thrust plates for each pump section together; do not mix parts between pump sections.**

1. Plug pump ports and thoroughly clean exterior of pump with cleaning solvent. Make sure work area is clean.

2. Use a marker to make a **diagonal** line across the gear pump for assembly purposes (Fig. 73).

**IMPORTANT: Use caution when clamping gear pump in a vise to avoid distorting any pump components.**

3. Secure the front cover of the pump in a vise with the drive shaft pointing down.

4. Loosen the two (2) cap screws and two (2) nuts that secures pump assembly.

5. Remove pump from vise and remove fasteners.

6. Support the pump assembly and gently tap the pump case with a soft face hammer to loosen the pump sections. Be careful to not drop parts or disengage gear mesh.

**IMPORTANT: Mark the relative positions of the gear teeth and the thrust plates so they can be reassembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.**

7. Remove the thrust plates and seals from each pump section. Before removing each gear set, apply marking dye to mating teeth to retain ”timing”. Pump efficiency may be affected if the teeth are not installed in the same position during assembly. Keep the parts for each pump section together; do not mix parts between sections.

8. Clean all parts. Check all components for burrs, scoring, nicks and other damage.

9. Replace the entire pump assembly if parts are excessively worn or scored.

**Disassembly (Fig. 72)**

1. Apply clean hydraulic oil to all parts before assembling.

**NOTE:** Pressure seals and back–up rings fit in grooves machined into thrust plates. Body seals fit in grooves machined in body faces.

2. Assemble pump sections starting at front cover end. Apply grease or petroleum jelly to new section seals to hold them in position during gear pump assembly.

3. After pump has been assembled, tighten cap screws and nuts by hand. Rotate the drive shaft to check for binding. Protect the shaft if using a pliers.

4. Tighten the cap screws and nuts evenly in a crossing pattern to a torque of **33 ft–lb (45 N–m)**.

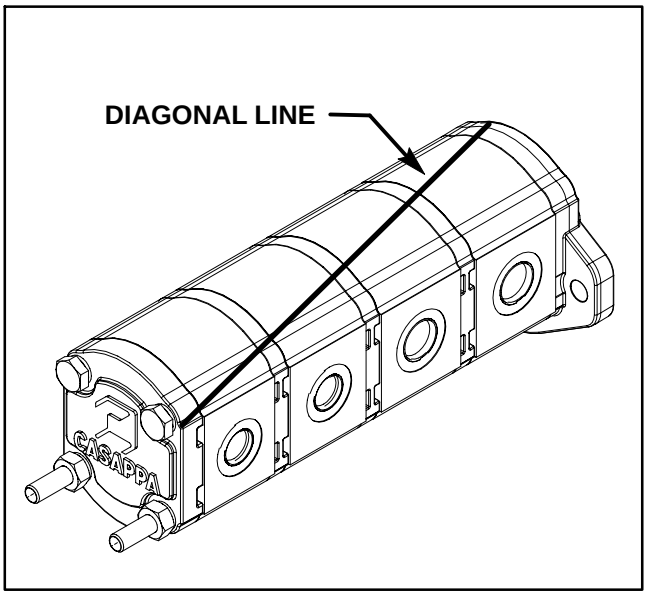


Figure 73

## Front Wheel Motors

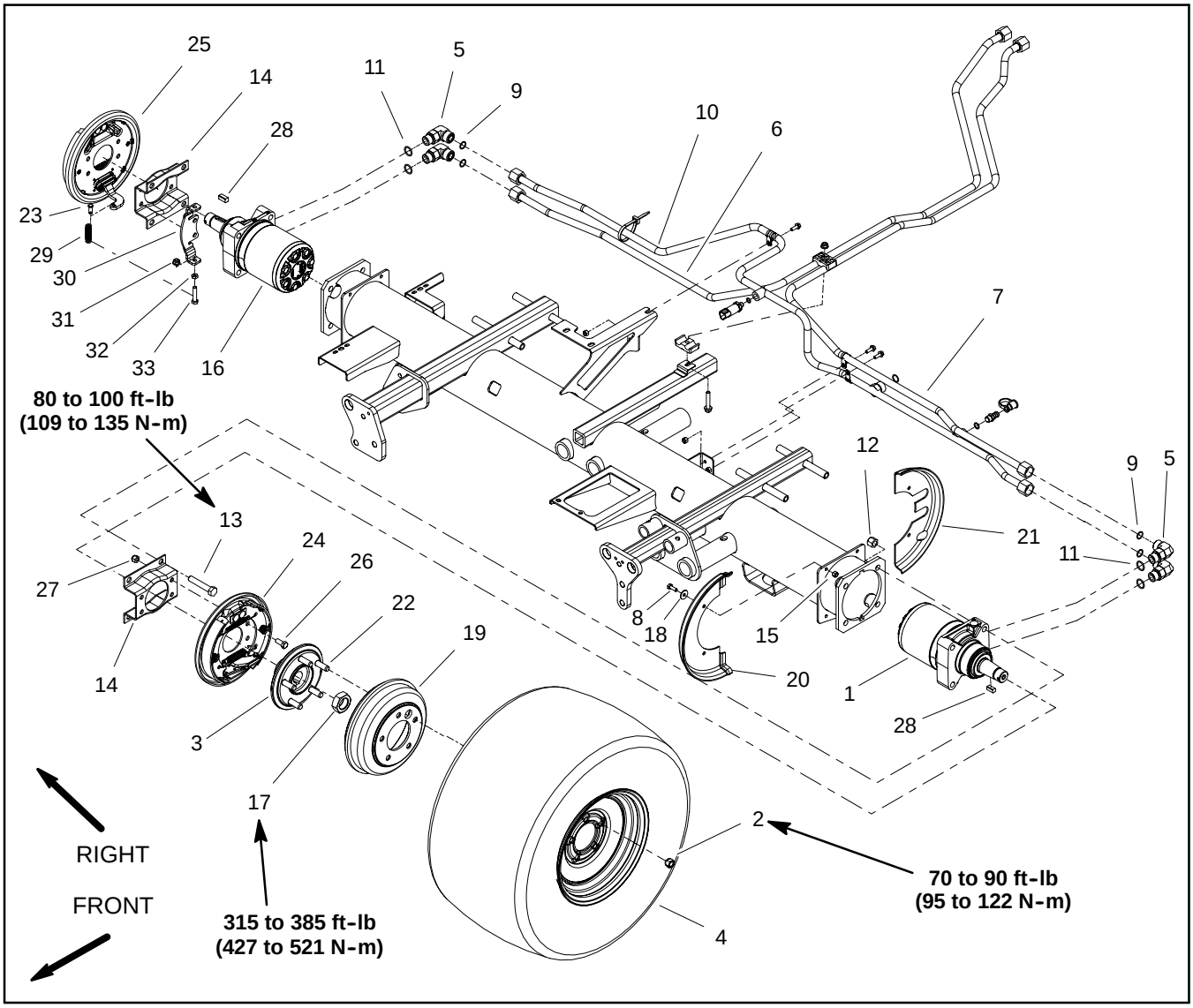


Figure 74

1. LH wheel motor
2. Lug nut (5 used per wheel)
3. Hub
4. Wheel assembly
5. Hydraulic fitting (2 used per motor)
6. Hydraulic tube
7. Hydraulic tube
8. Cap screw (2 used per wheel shield)
9. O-ring
10. Hydraulic tube
11. O-ring
12. Lock nut (4 used per wheel motor)
13. Cap screw (4 used per wheel motor)
14. Brake bracket (2 used)
15. Lock nut (2 used per wheel shield)
16. RH wheel motor
17. Lock nut (2 used)
18. Flat washer (2 used per wheel shield)
19. Brake drum (2 used)
20. Front wheel shield (LH shown)
21. Rear wheel shield (LH shown)
22. Wheel stud (5 used per wheel)
23. Clevis pin (2 used)
24. LH brake assembly
25. RH brake assembly
26. Cap screw (4 used per brake assy)
27. Lock nut (4 used per brake assy)
28. Square key (1 used per motor)
29. Return spring (1 used per bracket)
30. Brake spring bracket (2 used)
31. Flange nut (1 used per bracket)
32. Jam nut (1 used per bracket)
33. Cap screw (1 used per bracket)

## CAUTION

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

**Removal (Fig. 74)**

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

2. Chock rear wheels to prevent machine from shifting.

3. Loosen, but do not remove, five (5) wheel lug nuts and lock nut (item 17) that secures wheel hub to wheel motor.

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

## WARNING

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.**

5. Jack up machine enough to allow the removal of the front wheel. Support machine with jack stands.

6. Remove front wheel from machine (see Front Wheel Removal in the Service and Repairs section of Chapter 6 – Chassis).

7. Remove return spring and clevis pin that secure brake cable clevis to brake actuator lever. Position brake cable clevis away from actuator lever.

8. Remove brake drum.

9. Make sure wheel hub lock nut (item 17) is loosened at least two (2) turns.

**IMPORTANT: DO NOT hit wheel hub, puller or wheel motor with a hammer during wheel hub removal or installation. Hammering may cause damage to the wheel motor.**

10. Use hub puller (see Special Tools in this chapter) to loosen wheel hub from wheel motor.

11. Remove lock nut and wheel hub from motor shaft. Discard lock nut. Locate and retrieve square key.

12. Thoroughly clean hydraulic line ends and fittings on wheel motor to prevent hydraulic system contamination.

13. Label hydraulic connections at wheel motor for assembly purposes.

14. Disconnect hydraulic lines from fittings on wheel motor. Allow lines to drain into a suitable container.

15. Put caps or plugs on disconnected lines and fittings to prevent contamination.

16. Support wheel motor to prevent it from falling. Remove four (4) lock nuts from cap screws that secure motor and brake bracket to frame.

17. Remove four (4) cap screws, brake assembly with brake bracket (item 14) and brake spring bracket (item 30) from wheel motor and frame.

18. Remove wheel motor from machine.

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

**Installation (Fig. 74)**

**IMPORTANT: Because of internal differences in front wheel motors, DO NOT interchange front wheel motors on machine (i.e. do not put right side motor on left side of machine). The left side wheel motor has a yellow identification mark on the motor housing. If necessary, use parts catalog and part number on wheel motor to identify RH and LH motors.**

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

2. Position wheel motor to frame. Slide brake assembly with brake bracket (item 14), brake spring bracket (item 30) and four (4) cap screws onto wheel motor and frame.

3. Install and tighten four (4) lock nuts onto cap screws to secure motor and brake components to frame. Torque cap screws from **80 to 100 ft–lb (109 to 135 N–m)**.

4. Thoroughly clean motor shaft and wheel hub taper.

5. Install square key into the wheel motor shaft keyslot. Align wheel hub with key and slide wheel hub onto motor shaft.

**IMPORTANT: Do not reuse lock nut that secures wheel hub to wheel motor after it has been removed.**

6. Install new lock nut (item 17) onto the wheel motor shaft to secure wheel hub to motor shaft.

7. Remove caps or plugs from disconnected hydraulic lines and fittings.

8. Lubricate and position new O−rings to fittings on wheel motor. Use labels placed during the removal process to properly install hydraulic lines to wheel motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Secure brake cable clevis to brake actuator lever with clevis pin and brake return spring. Make sure that return spring is attached to cap screw on spring bracket.

10. Install front wheel to machine (see Front Wheel Installation in the Service and Repairs section of Chapter 6 − Chassis).

11. Lower machine to ground.

12. Torque lug nuts evenly in a crossing pattern from **70 to 90 ft−lb (95 to 122 N−m)**. Torque wheel hub lock nut (item 17) from **315 to 385 ft−lb (427 to 521 N−m)**.

13. Check and adjust oil level in hydraulic tank.

14. Operate machine functions slowly until air is out of system (see Hydraulic System Start−up in this section).

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## Rear Wheel Motors

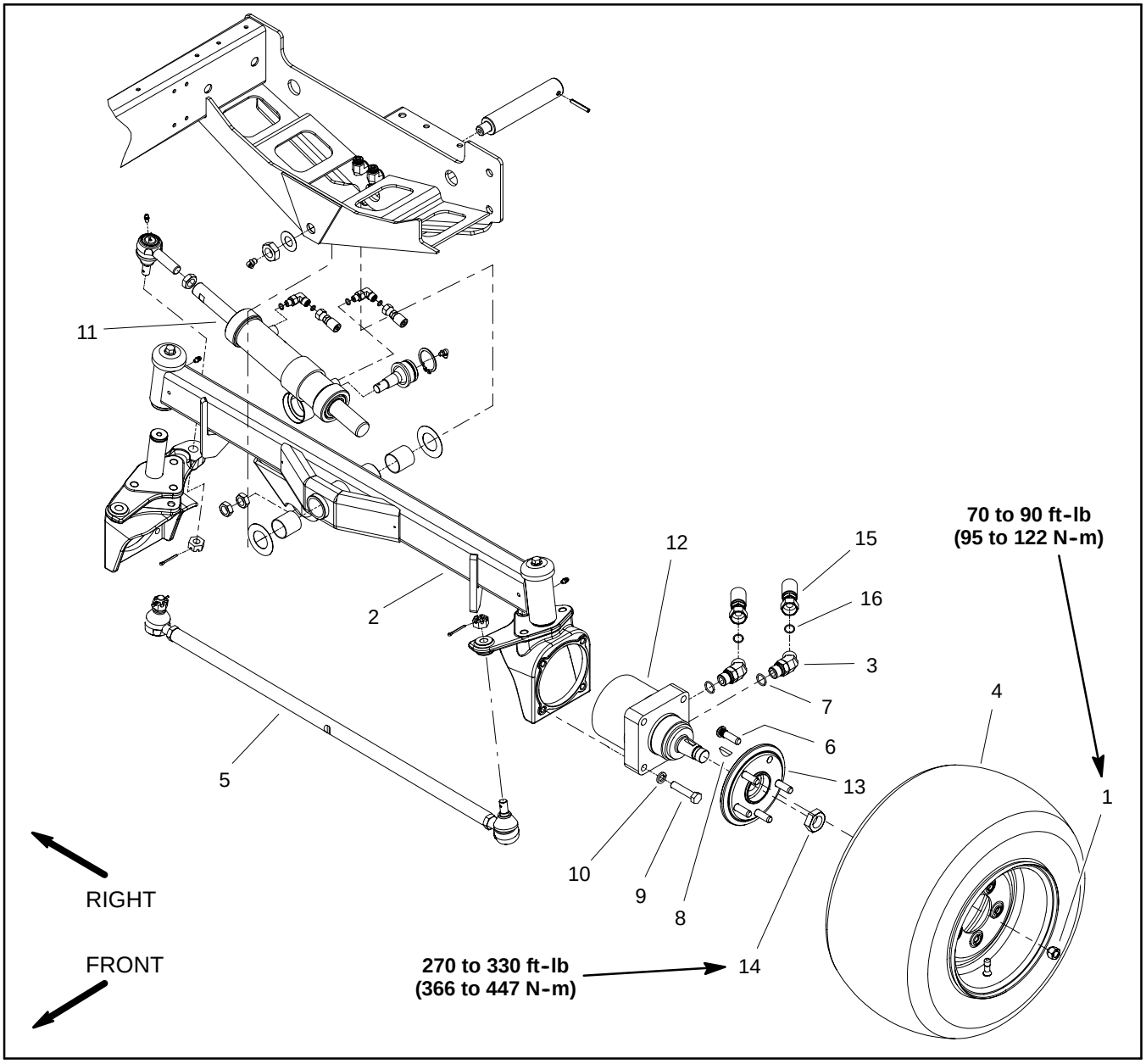


Figure 75

1. Lug nut (5 used per wheel)
2. Rear axle assembly
3. Hydraulic fitting (2 used per motor)
4. Wheel assembly
5. Tie rod
6. Wheel stud (5 used per hub)
7. O-ring
8. Woodruff key
9. Cap screw (4 used per motor)
10. Lock washer (4 used per motor)
11. Steering cylinder
12. Wheel motor (LH shown)
13. Wheel hub assembly
14. Lock nut
15. Hydraulic hose (2 used per motor)

**Removal (Fig. 75)**

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

1. Park the machine on a level surface, engage parking brake, lower cutting decks and stop engine. 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. Chock front wheels to prevent machine from shifting.

4. Loosen, but do not remove, five (5) wheel lug nuts and lock nut (item 14) that secures wheel hub to wheel motor.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.**

5. Jack up machine enough to allow the removal of the rear wheel. Support machine with jack stands.

6. Remove rear wheel assembly from the machine (see Rear Wheel Removal in the Service and Repairs section of Chapter 6 – Chassis).

**IMPORTANT: DO NOT hit wheel hub, wheel hub puller or wheel motor with a hammer during wheel motor removal or installation. Hammering may cause damage to the wheel motor.**

7. Make sure that lock nut (item 14) that secures wheel hub to wheel motor is loosened at least two (2) turns. Use hub puller (see Special Tools in this chapter) to loosen wheel hub from wheel motor.

8. Remove loosened lock nut and wheel hub from motor shaft. Discard lock nut. Locate and retrieve woodruff key from wheel motor shaft.

9. Thoroughly clean hydraulic hose ends and fittings on rear wheel motor to prevent hydraulic system contamination.

10. Label all hydraulic hoses for assembly purposes. Remove hydraulic hoses from fittings on wheel motor. Allow hoses to drain into a suitable container.

11. Put clean plugs in disconnected hydraulic hoses and fittings to prevent system contamination.

12. Support the wheel motor to prevent it from falling during removal.

13. Remove four (4) cap screws and lock washers that secure wheel motor to the steering spindle.

14. Remove wheel motor from frame.

15. If necessary, remove hydraulic fittings from wheel motor. Remove and discard O–rings from fittings.

**Installation (Fig. 75)**

**IMPORTANT: Because of internal differences in rear wheel motors, DO NOT interchange rear wheel motors on machine (i.e. do not put right side motor on left side of machine). The left side wheel motor has a yellow identification mark on the motor housing. If necessary, use parts catalog and part number on wheel motor to identify RH and LH motors.**

1. If fittings were removed from wheel motor, lubricate and install new O–rings to hydraulic fittings. Install fittings into wheel motor ports (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Position rear wheel motor to steering spindle. Make sure that ports in wheel motor are facing toward the rear of the machine.

3. Secure wheel motor to spindle with four (4) cap screws and lock washers.

4. Remove caps or plugs from disconnected hydraulic hoses and wheel motor fittings that were placed during wheel motor removal to prevent contamination.

5. Using labels placed during the removal process, properly connect hydraulic hoses to wheel motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Make sure that tapers of wheel motor shaft and wheel hub are thoroughly clean.

7. Position woodruff key to keyslot in wheel motor shaft.

**IMPORTANT: Do not reuse lock nut that secures wheel hub to wheel motor after it has been removed.**

8. Place wheel hub on motor shaft and secure with new lock nut (item 14).

9. Install wheel assembly to the machine and secure with five (5) lug nuts.

10. Lower the machine to the ground.

**WARNING**

**Failure to properly tighten wheel hub lock nut or wheel lug nuts could result in failure or loss of wheel and may result in personal injury.**

11. Torque wheel hub lock nut (item 14) from **270 to 330 ft-lb (366 to 447 N-m)**.

12. Torque wheel lug nuts evenly in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

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

14. After assembly is completed, verify that hydraulic hoses and fittings do not contact anything through full range of axle motion. Also, check for any hydraulic leaks.

15. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

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## Wheel Motor Service

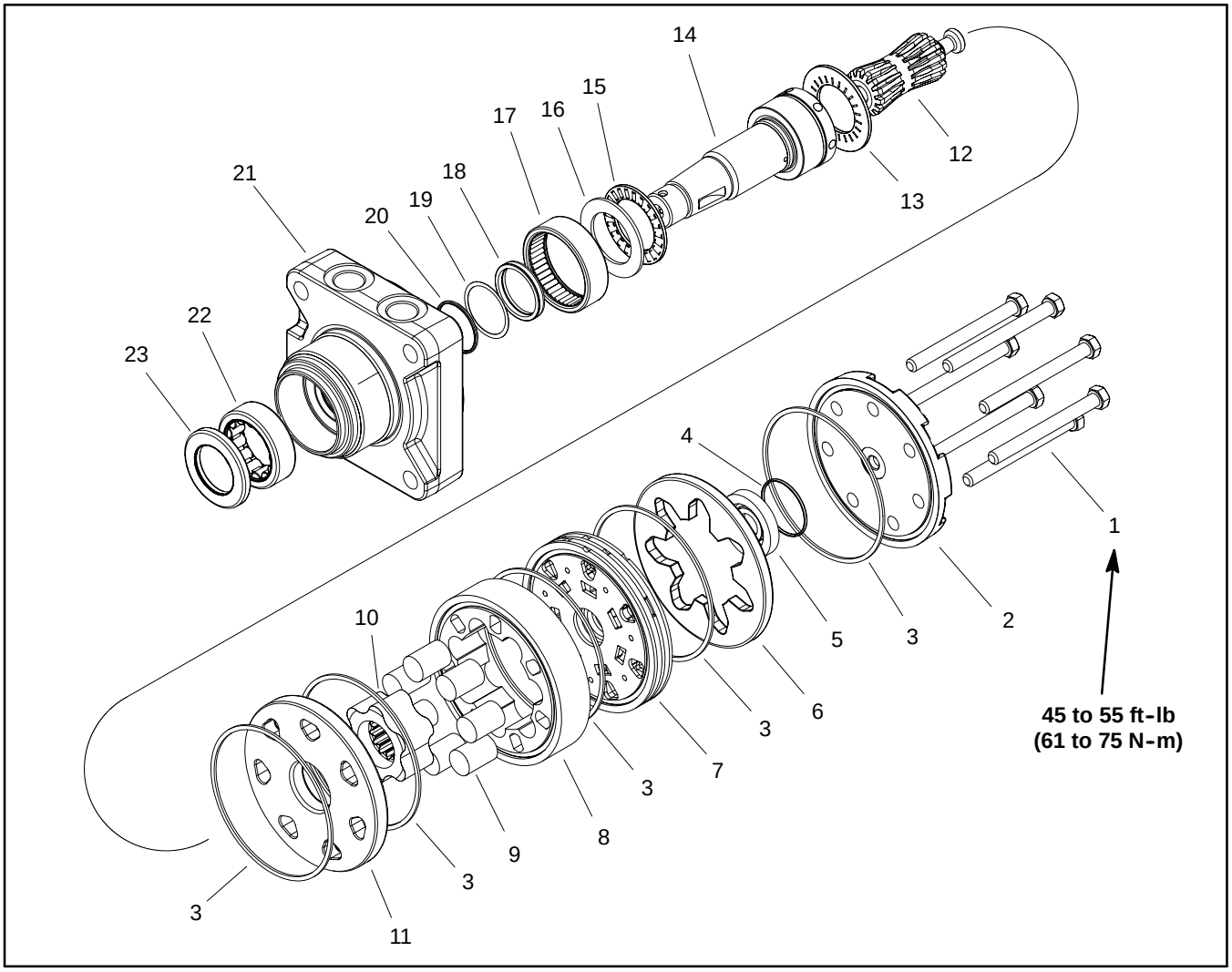


Figure 76

1. **Cap screw (7 used)**
2. **End cover**
3. **Body seal (5 used)**
4. **Commutator ring**
5. **Commutator**
6. **Commutator ring**
7. **Manifold**
8. **Stator**
9. **Vane (7 used)**
10. **Rotor**
11. **Wear plate**
12. **Drive link**
13. **Thrust bearing**
14. **Coupling shaft**
15. **Thrust bearing**
16. **Thrust washer**
17. **Inner bearing**
18. **Shaft seal**
19. **Back-up washer**
20. **Back-up ring**
21. **Housing**
22. **Outer bearing**
23. **Dirt and water seal**

**NOTE:** The front wheel motors on Groundsmaster 4300–D machines are Parker Torqmotor ™ TG Series. The rear wheel motors are Parker Torqmotor™ TL Series. Right and left motors are the same basic design but the right side motors have a reverse timed manifold to allow correct rotation direction for forward and reverse.

**NOTE:** For wheel motor repair procedures, see the Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH and TL Series) at the end of this chapter.

**IMPORTANT: If a wheel motor failure occurred, refer to Traction Circuit Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.**

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## CrossTrax™ AWD Manifold

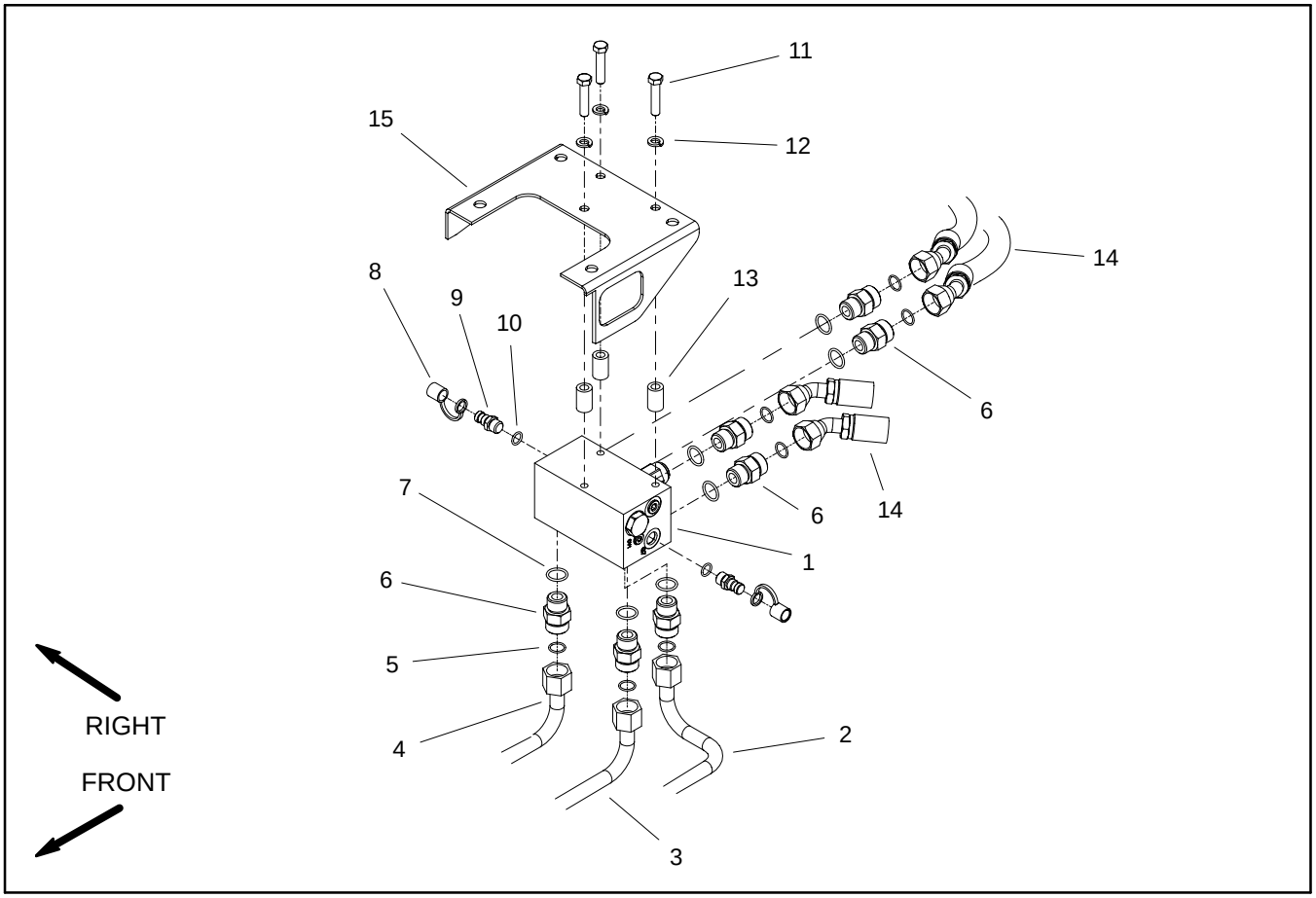


Figure 77

1. **AWD manifold**
2. **Hydraulic tube**
3. **Hydraulic tube**
4. **Hydraulic tube**
5. **O−ring**
6. **Hydraulic fitting (7 used)**
7. **O−ring**
8. **Dust cap (2 used)**
9. **Diagnostic fitting (2 used)**
10. **O−ring**
11. **Cap screw (3 used)**
12. **Lock washer (3 used)**
13. **Spacer (3 used)**
14. **Hydraulic hose (4 used)**
15. **Frame bracket**

**Removal (Fig. 77)**

1. Park the machine on a level surface, engage parking brake, lower cutting decks and stop engine. 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. Locate CrossTrax™ AWD manifold that is attached to bracket at rear of frame.

4. Label all hydraulic connections for assembly purposes. Thoroughly clean hydraulic connections prior to loosening hydraulic lines.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

5. Disconnect hydraulic hoses and tubes from fittings in manifold. Allow lines to drain into a suitable container. Remove and discard O−rings.

6. Put caps or plugs on disconnected lines and fittings to prevent contamination.

7. Support manifold to prevent it from falling. Remove three (3) cap screws and lock washers that secure manifold to machine frame. Locate and retrieve three (3) spacers from between bracket and manifold.

8. Remove AWD manifold from machine.

9. If necessary, remove hydraulic fittings from manifold. Discard any removed O−rings.

**Installation (Fig. 77)**

1. If fittings were removed from AWD manifold, lubricate and place new O−rings to fittings. Install fittings into manifold (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Position manifold and three (3) spacers to frame bracket. Install three (3) lock washers and cap screws but do not fully tighten screws.

3. Remove caps and plugs from disconnected lines and fittings.

4. Lubricate and install new O−ring(s) on manifold fittings. Connect hydraulic lines to hydraulic manifold fittings and properly tighten all connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Secure AWD manifold to frame by tightening three (3) cap screws.

6. Check oil level in hydraulic reservoir and add correct oil if necessary.

7. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

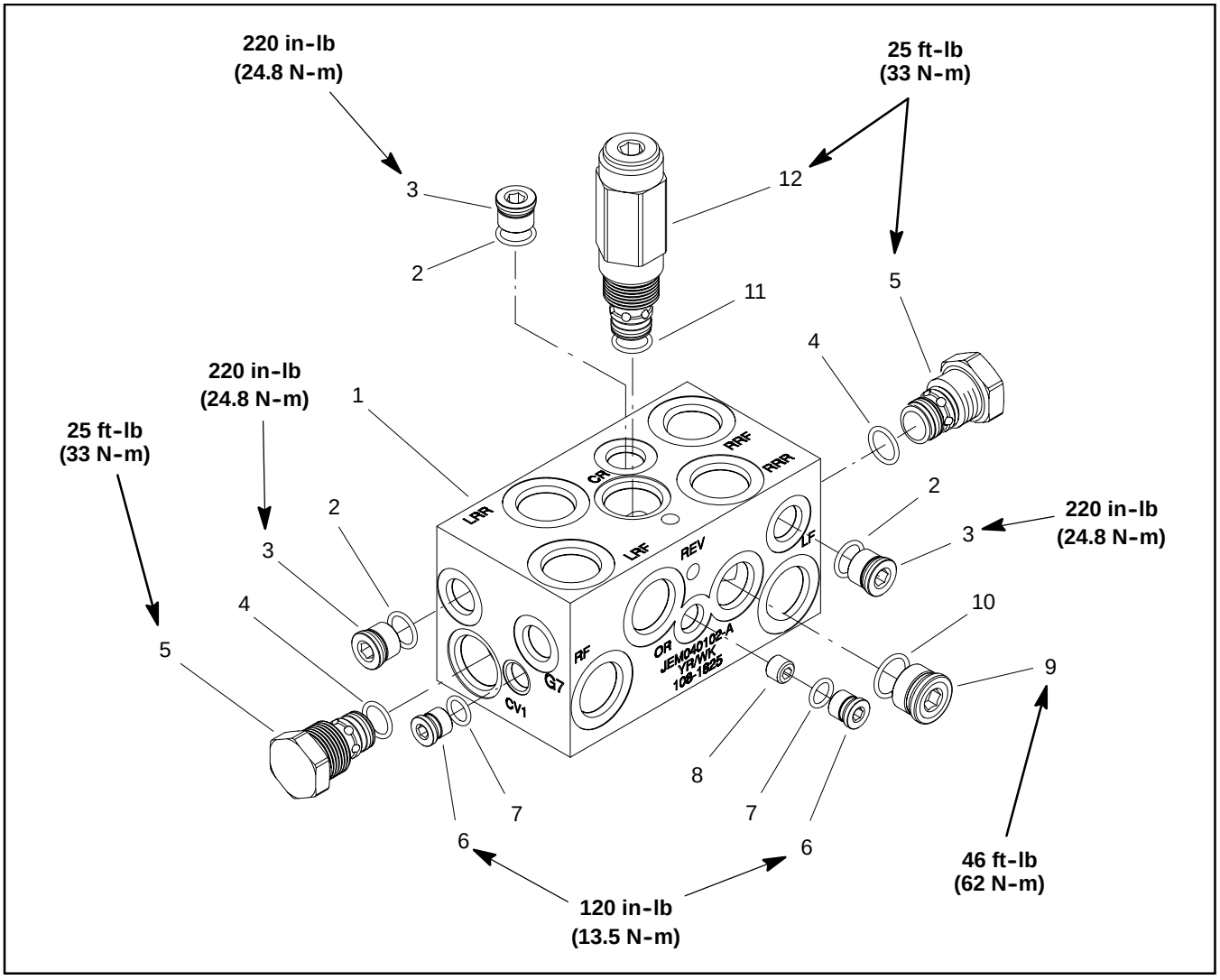


Figure 78

1. AWD manifold
2. O-ring
3. Plug (zero leak #6)
4. Seal kit
5. Check valve
6. Plug (zero leak #4)
7. O-ring
8. Orifice (.040)
9. Plug (zero leak #8)
10. O-ring
11. Seal kit
12. Bi-Directional relief valve

For control manifold service procedures, see Deck Control Manifold Service in this section. Refer to Figure 78 for CrossTrax™ AWD control manifold cartridge valve installation torque.

**NOTE:** Adjustment of Bi-Directional Relief Valve (item 12) is NOT recommended.

**NOTE:** The CrossTrax™ AWD control manifold uses several zero leak 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 to provide 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 into the control manifold, torque plugs to the values identified in Figures 78.

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## Deck Control Manifold

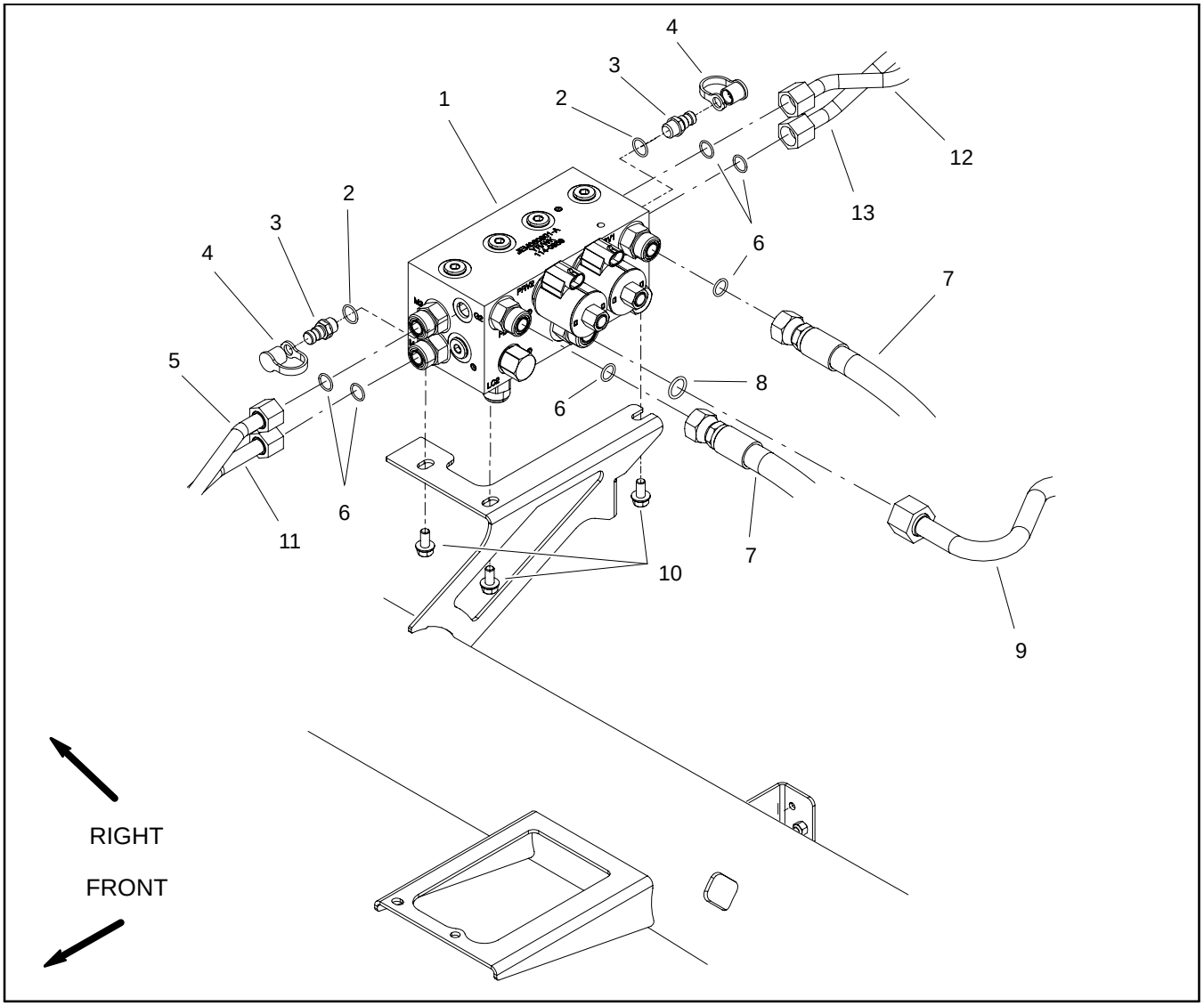


Figure 79

1. **Deck control manifold**
2. **O-ring**
3. **Diagnostic fitting**
4. **Dust cap**
5. **Hydraulic tube**
6. **O-ring**
7. **Hydraulic hose**
8. **O-ring**
9. **Hydraulic tube**
10. **Flange head screw (3 used)**
11. **Hydraulic tube**
12. **Hydraulic tube**
13. **Hydraulic tube**

**Removal (Fig. 79)**

1. Park the machine on a level surface, engage parking brake, lower cutting decks and stop engine. 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. Tilt operator seat and engage seat prop to retain seat in the raised position.

4. Locate hydraulic deck control manifold.

5. Label all hydraulic and electrical connections for assembly purposes. Thoroughly clean hydraulic connections prior to loosening hydraulic lines.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

6. Disconnect hydraulic hoses and lines from fittings in manifold. Allow lines to drain into a suitable container. Remove and discard O−rings from fittings.

7. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

8. Unplug wire harness leads from solenoid coils on manifold.

9. Remove three (3) flange head screws that secure manifold to machine frame.

10. Remove manifold block from machine.

11. If necessary, remove hydraulic fittings from manifold (Fig. 80). Discard any removed O−rings.

**Installation (Fig. 79)**

1. If fittings were removed from deck control manifold, lubricate and place new O−rings on fittings (Fig. 80). Install fittings into manifold (see Hydraulic Fitting Installation in the General Information section of this chapter). Torque fittings to values identified in Figure 80.

2. Position deck control manifold to frame. Install three (3) flange head screws but do not fully tighten.

3. Remove caps and plugs from disconnected lines and fittings.

4. Lubricate and install new O−rings on manifold fittings. Connect hydraulic lines to hydraulic fittings on manifold and properly tighten all connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Secure hydraulic manifold to frame by tightening three (3) flange head screws.

6. Plug wire harness leads to solenoid coils on manifold.

7. Lower and secure operator seat.

8. Check oil level in hydraulic reservoir and add correct oil if necessary.

9. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

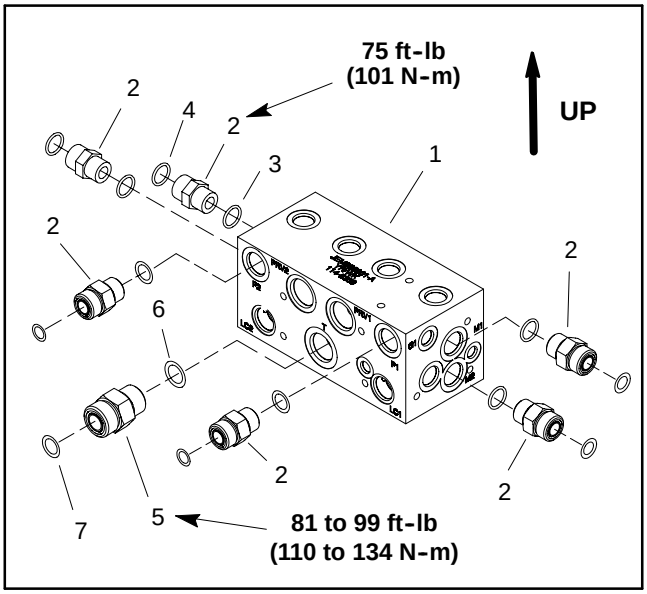


Figure 80

1. Deck control manifold
2. Hydraulic fitting (6 used)
3. O−ring
4. O−ring
5. Hydraulic fitting
6. O−ring
7. O−ring

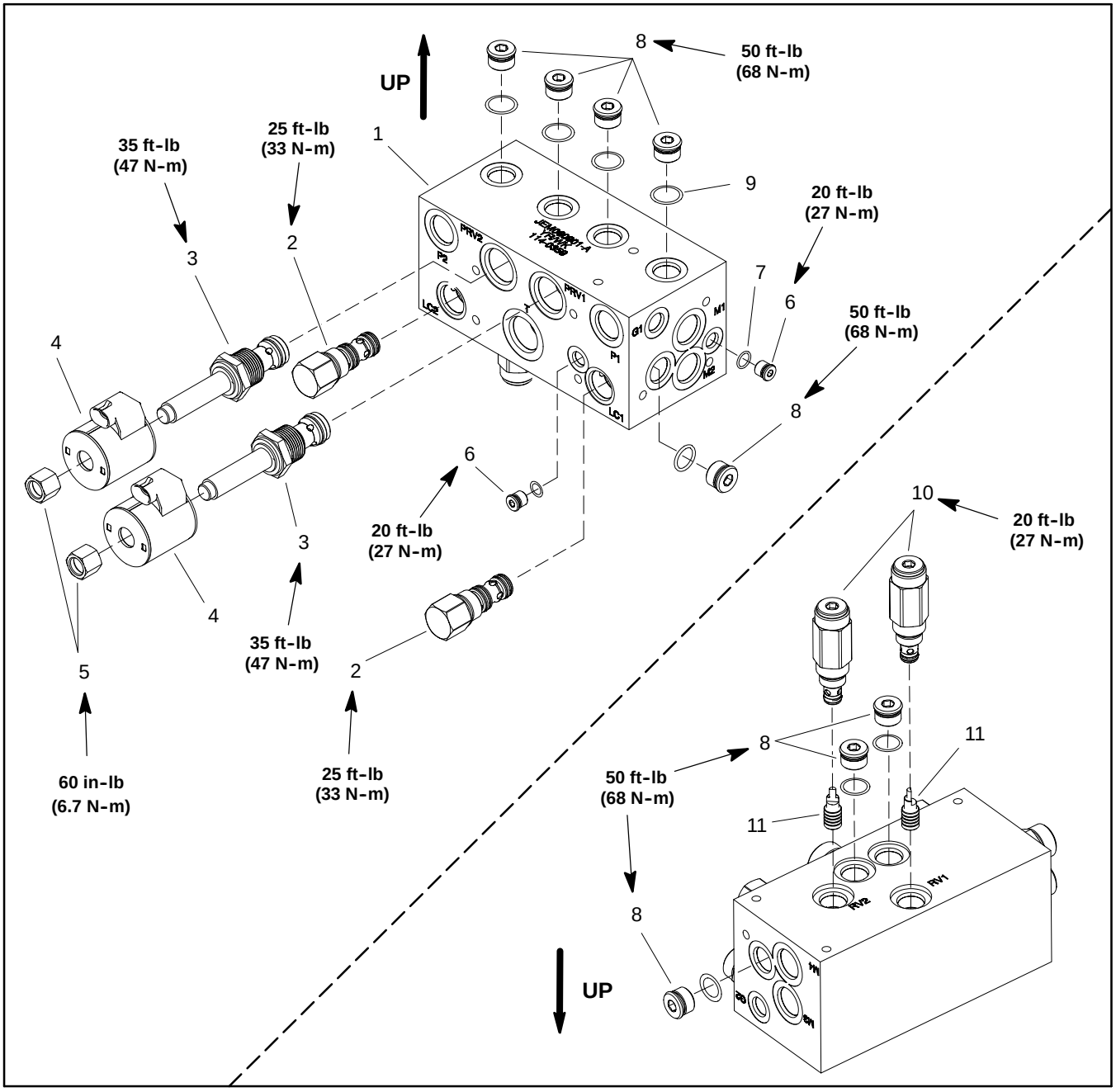


Figure 81

1. **Deck control manifold**
2. **Logic element (LC1/LC2)**
3. **Proportional relief valve (PRV1/PRV2)**
4. **Solenoid coil**
5. **Nut**
6. **Plug (zero leak #4)**
7. **O-ring**
8. **Plug (zero leak #8)**
9. **O-ring**
10. **Relief valve (RV1/RV2)**
11. **Pilot piston**

**NOTE:** The ports on the deck control manifold are marked for easy identification of components. Example: P1 is the pump P1 connection port and PRV2 is the location for the proportional relief valve PRV2 (see Hydraulic Schematic in Chapter 8 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port).

**NOTE:** The deck control manifold uses several zero leak 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 to provide 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 into the control manifold, torque plugs to the values identified in Figures 81.

**Deck Control Manifold Service**

1. Make sure the manifold is thoroughly cleaned before removing any cartridge valve.

2. If solenoid cartridge valve is being serviced, remove nut securing solenoid coil to the cartridge valve. Carefully slide solenoid coil off the valve.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

**IMPORTANT: Use care when removing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.**

3. Using a deep well socket, remove cartridge valve from manifold. Note correct location of O−rings, sealing rings and backup rings. Remove and discard seal kit from valve.

4. Visually inspect the manifold port for damage to the sealing surfaces, damaged threads and contamination.

5. Visually inspect cartridge valve for damaged sealing surfaces and contamination.

   A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing valve malfunction.

   B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

**CAUTION**

**Use eye protection such as goggles when using compressed air for cartridge valve cleaning.**

**CAUTION**

**Abrupt movement of internal spools can cause stored fluid to be released suddenly.**

6. Clean cartridge valve by submerging valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

7. Reinstall cartridge valve into manifold:

   A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The O−rings, sealing rings and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

   **IMPORTANT: Use care when installing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.**

   B. Thread cartridge valve carefully into correct manifold port. The valve should go in easily without binding.

   C. Torque cartridge valve using a deep well socket to values identified in Figure 81.

8. If solenoid coil was removed from cartridge valve:

   A. Carefully install coil onto the valve.

   B. Install nut and torque nut to **60 in−lb (6.7 N−m)**.

## Cutting Deck Motor

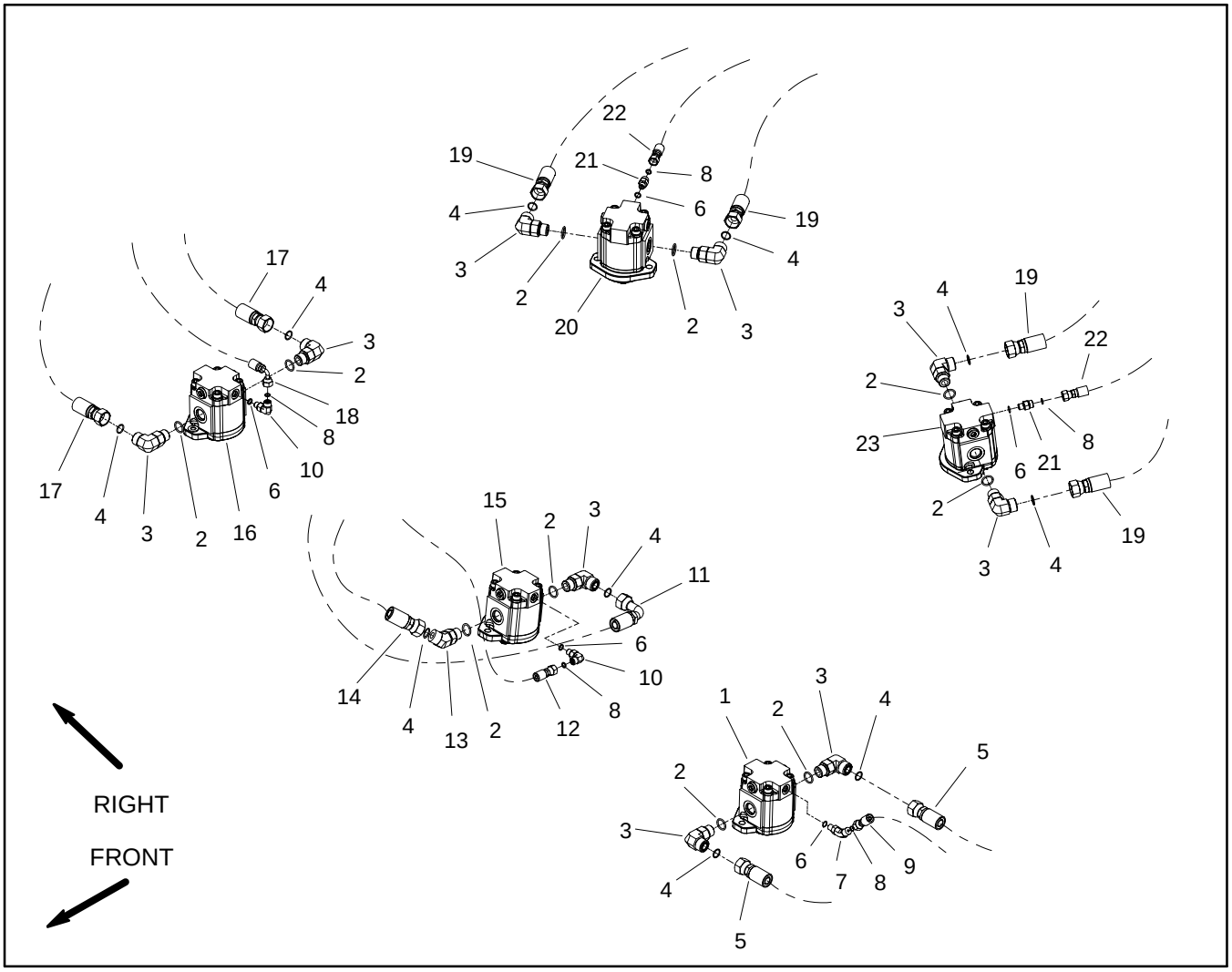


Figure 82

1. **Hydraulic deck motor (#4)**
2. **O−ring**
3. **90º hydraulic fitting**
4. **O−ring**
5. **Hydraulic hose**
6. **O−ring**
7. **45º hydraulic fitting**
8. **O−ring**
9. **Hydraulic hose**
10. **90º hydraulic fitting**
11. **Hydraulic hose**
12. **Hydraulic hose**
13. **45º hydraulic fitting**
14. **Hydraulic hose**
15. **Hydraulic deck motor (#1)**
16. **Hydraulic deck motor (#5)**
17. **Hydraulic hose**
18. **Hydraulic hose**
19. **Hydraulic hose**
20. **Hydraulic deck motor (#3)**
21. **Hydraulic fitting**
22. **Hydraulic hose**
23. **Hydraulic deck motor (#2)**

**Removal (Fig. 82)**

1. Park the machine on a level surface, engage parking brake, lower cutting decks and stop engine. 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. Label all hydraulic connections for assembly purposes. Thoroughly clean hydraulic connections prior to loosening hydraulic lines from deck motor.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

4. Disconnect hydraulic hoses from fittings in deck motor. Allow lines to drain into a suitable container. Remove and discard O−rings.

5. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

6. Remove two (2) socket head screws and flat washers that secure hydraulic motor to the cutting deck (Fig. 84). Remove hydraulic motor and O−ring from deck.

7. Cover top of spindle to prevent debris from entering spindle. A spindle plug (see Special Tools in this chapter) can be used to cover spindle.

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

**Installation (Fig. 82)**

1. If hydraulic fittings were removed from motor, lubricate new O−rings, position O−rings to fittings and install fittings into motor ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Make sure that fittings are orientated correctly.

2. Remove cover from top of spindle that was placed to prevent debris from entering spindle.

3. Make sure that O−ring is positioned to top of spindle housing. Secure hydraulic motor to the cutting deck with two (2) socket head screws and flat washers (Fig. 84).

4. Remove caps or plugs from fittings and hoses.

**IMPORTANT:** When installing the hydraulic hoses, make sure that hydraulic hoses are straight (not twisted) before tightening the hoses to the motor fittings.

5. Lubricate and install new O−rings on motor fittings. Correctly connect hydraulic hoses to the motor using labels placed during removal procedure (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Check oil level in hydraulic reservoir and add correct oil if necessary.

7. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

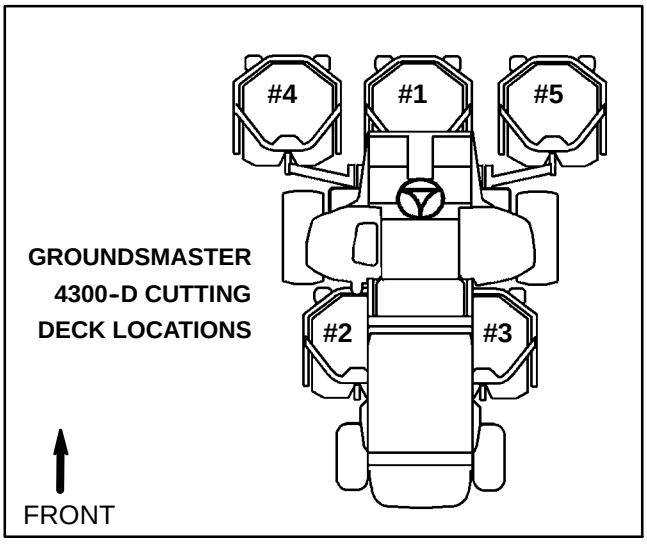


Figure 83

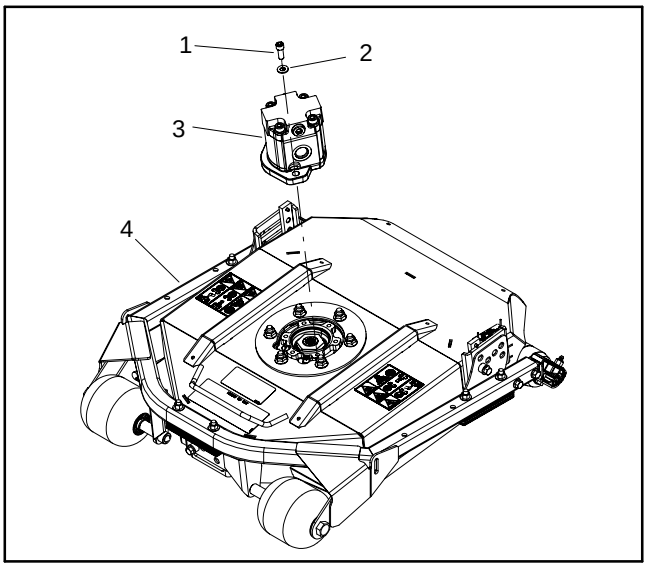


Figure 84

1. **Socket head screw**
2. **Flat washer**
3. **Hydraulic motor**
4. **Cutting deck**

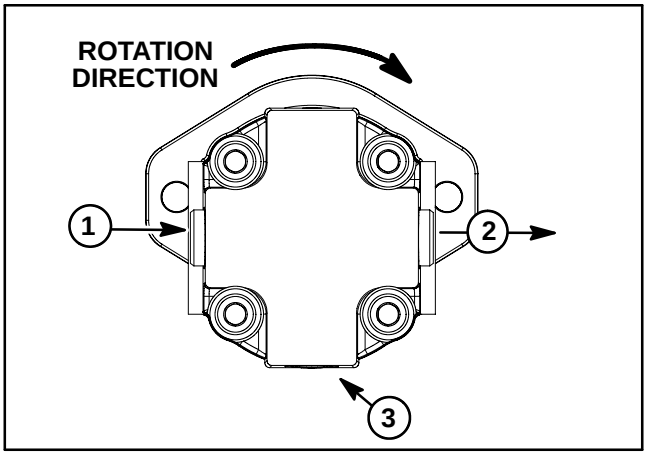


Figure 85

1. **Flow IN**
2. **Flow OUT**
3. **Case drain**

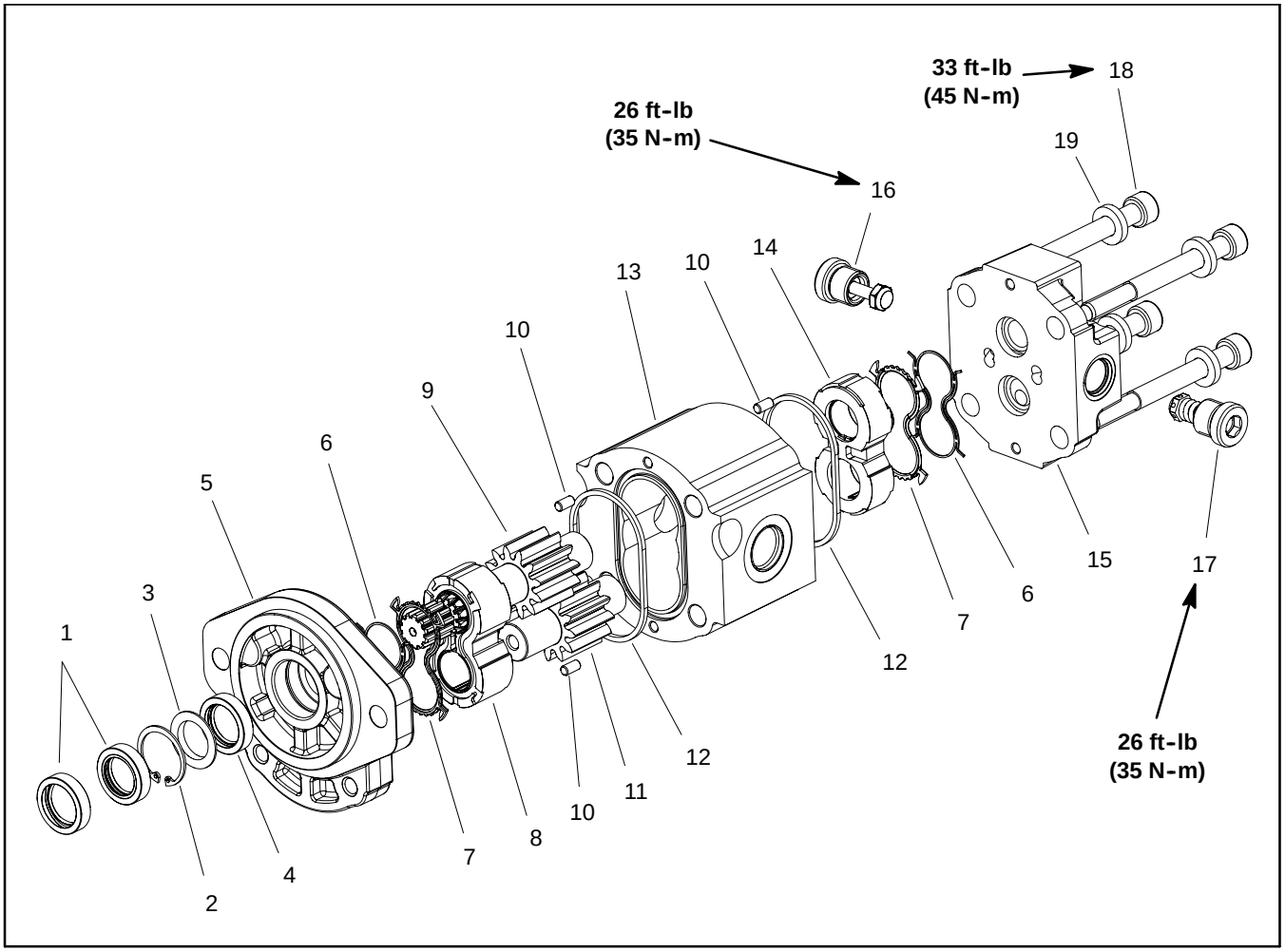


Figure 86

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

**Disassembly (Fig. 86)**

1. Plug motor ports and clean the outside of the motor thoroughly. After cleaning, remove plugs and drain any oil out of the motor.

2. Use a marker to make a **diagonal** line across the front flange, body and rear cover for assembly purposes (Fig. 87).

**IMPORTANT: Prevent damage when clamping the motor into a vise; clamp on the front flange only. Also, use a vise with soft jaws.**

3. Clamp front flange of motor in a vise with soft jaws with the shaft end down.

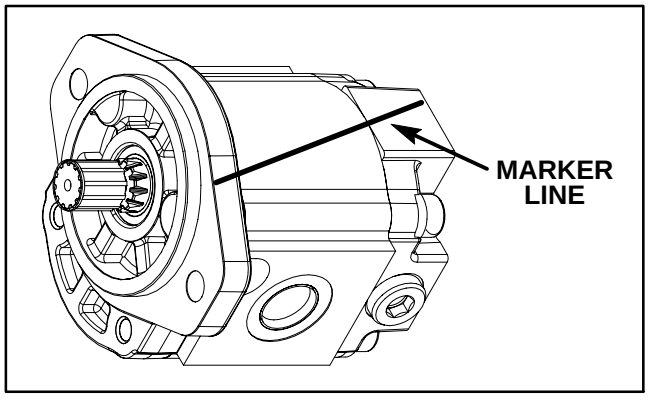


Figure 87

4. Loosen cap screws from the rear cover.

5. Remove motor from the vise. Turn motor so that the shaft end is facing down. Remove cap screws.

6. Separate rear cover from body. Lift rear cover from motor.

7. Carefully remove body. Lift body straight up to remove. Make sure the rear wear plate remains on the drive and idler gear shafts. Remove and discard O–rings from the body. Locate and retrieve dowel pins.

**IMPORTANT: Note position of the open and closed side of the wear plates before removing. Also, identify wear plates (front and rear) with a marker for proper assembly.**

**IMPORTANT: Mark the relative positions of the gear teeth and the wear plates so they can be reassembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.**

8. Carefully remove rear wear plate, idler gear, drive gear and front wear plate from the front flange.

9. Remove and discard back–up gaskets and pressure seals from wear plates.

10. Turn front flange over, with seal side up.

**IMPORTANT: Make sure to not damage the front flange counter bore when removing the seals from the front flange.**

11. Carefully remove dust seals, retaining ring, flange washer and shaft seal from the front flange (Fig. 88). Discard seals.

**Inspection**

1. Remove any nicks and burrs from all parts with emery cloth.

**CAUTION**

**Use eye protection such as goggles when using compressed air.**

2. Clean all parts with solvent. Dry all parts with compressed air.

3. Inspect drive gears and idler gears for the following (Fig. 89):

A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.

B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth must be replaced.

C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into wear plates and, thus, must be replaced.

4. Inspect wear plates for the following:

A. Bearing areas should not have excessive wear or scoring.

B. Face of wear plates that are in contact with gears should be free of wear, roughness or scoring.

C. Thickness of wear plates should be equal.

5. Inspect front flange and rear cover for damage or wear.

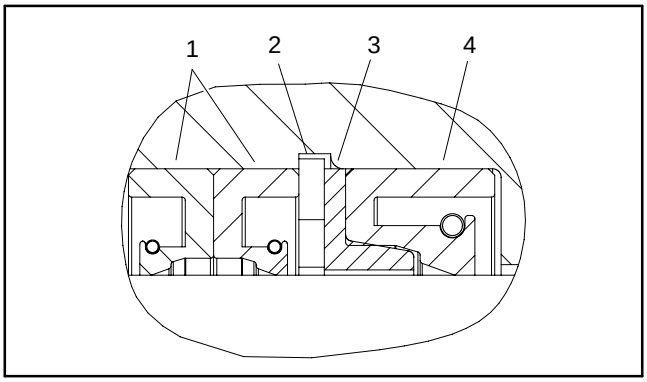


Figure 88

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**

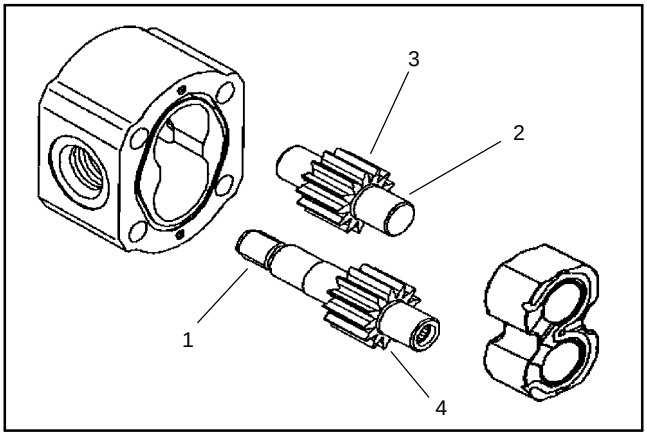


Figure 89

1. **Gear shaft spline**
2. **Gear shaft**
3. **Gear teeth**
4. **Gear face edge**

**Assembly (Fig. 86)**

**NOTE:** When assembling the motor, check the marker line on each part to make sure the parts are properly aligned during assembly.

1. Lubricate O−rings, pressure seals, back−up gaskets and wear plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install new seals into front flange (Fig. 88):

   A. Press shaft seal into front flange until it reaches the bottom of the bore.

   B. Install flange washer into front flange and then install retaining ring into the groove of the front flange.

   C. Install new dust seals into front flange. Inner dust seal should have the seal lip and spring toward the installed retaining ring. The outer dust seal should have the seal lip and spring toward the outside of the motor.

3. Place front flange, seal side down, on a flat surface.

4. Install the pressure seals, flat side outward, into the grooves in the wear plates. Follow by carefully placing the backup gaskets, flat side outward, between the pressure seals and the grooves in the wear plate.

5. Apply a light coating of petroleum jelly to the exposed side of the front flange.

6. Lubricate the drive gear shaft with clean hydraulic oil. Insert the drive end of the drive shaft through the wear plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the motor. Carefully install shaft into front flange.

7. Lubricate the idler gear shaft with clean hydraulic oil. Install idler gear shaft into the remaining position in the front wear plate. Apply a light coating of clean hydraulic oil to gear faces.

8. Install rear wear plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the motor.

9. Apply a light coating of petroleum jelly to new O−rings and O−ring grooves in the body. Install new O−rings to the body.

10. Install locating dowels in body. Align marker line on the body and front flange.

**IMPORTANT: Do not dislodge seals during installation.**

11. Gently slide the body onto the assembly. Firm hand pressure should be sufficient to engage the dowels.

12. Check to make sure that the surface of the rear wear plate is slightly below the face of the body. If the wear plate is not below the body, check assembly for a shifted pressure seal, backup gasket or O−ring. Correct before proceeding.

13. Apply a light coating of petroleum jelly to the exposed side of the rear cover.

14. Place rear cover on assembly using marker line for proper location. Firm hand pressure should be sufficient to engage the dowel pins.

15. Install the four (4) cap screws with washers and hand tighten screws.

**IMPORTANT: Prevent damage when clamping the motor into a vise; clamp on the front flange only. Also, use a vise with soft jaws.**

16. Place front flange of the motor into a vise with soft jaws and alternately torque the cap screws **33 ft−lb (45 N−m)**.

17. Remove motor from vise.

18. Place a small amount of clean hydraulic oil in the inlet of the motor and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the motor and check for assembly problems.

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## Lift Control Manifold

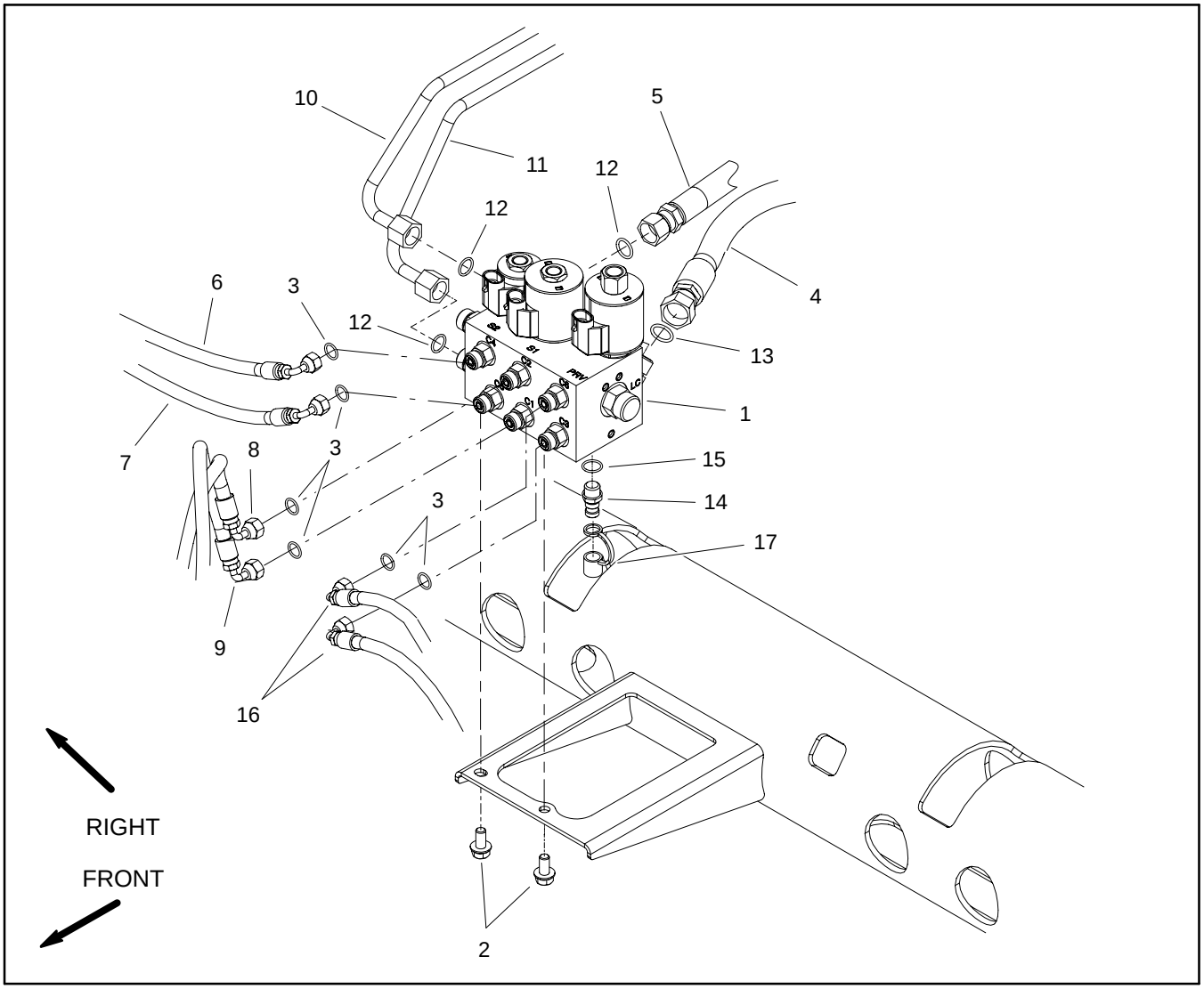


Figure 90

1. **Lift control manifold**
2. **Flange head screw (2 used)**
3. **O-ring**
4. **Hydraulic hose**
5. **Hydraulic hose**
6. **Hydraulic hose**
7. **Hydraulic hose**
8. **Hydraulic hose**
9. **Hydraulic hose**
10. **Hydraulic tube**
11. **Hydraulic tube**
12. **O-ring**
13. **O-ring**
14. **Diagnostic fitting**
15. **O-ring**
16. **Hydraulic hose**
17. **Dust cap**

**Removal (Fig. 90)**

1. Park the machine on a level surface, engage parking brake, lower cutting decks and stop engine. 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. Locate hydraulic lift control manifold that is attached to frame bracket under the front platform.

4. Label all hydraulic connections for assembly purposes. Thoroughly clean hydraulic connections prior to loosening hydraulic lines.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

## WARNING

**Make sure that cutting decks are fully lowered before loosening hydraulic lines, cartridge valves or plugs from lift control manifold. If decks are not fully lowered as manifold components are loosened, decks may drop unexpectedly.**

5. Disconnect hydraulic hoses and lines from fittings in manifold. Allow lines to drain into a suitable container. Remove and discard O−rings.

6. Put caps or plugs on disconnected lines and fittings to prevent contamination.

7. Label all solenoid coil wire harness leads for assembly purposes. Unplug wire harness leads from solenoid coils on manifold.

8. Remove two (2) flange head screws that secure manifold to machine frame.

9. Remove lift control manifold from machine.

**IMPORTANT: A flow control orifice is placed beneath several hydraulic fittings on the lift control manifold (Fig. 91). The lift manifold uses two (2) different orifice sizes. If fittings are removed from manifold and an orifice is in the manifold port, make sure to remove orifice and label its position for assembly purposes.**

10. If necessary, remove hydraulic fittings from manifold (Fig. 91). Discard any removed O−rings. Locate, retrieve and label orifice from manifold port (if equipped).

**Installation (Fig. 90)**

1. If fittings were removed from manifold (Fig. 91):

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

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

   B. For manifold ports with orifice, place correct orifice in port with the orifice slot facing out.

   C. Install fittings into manifold. Torque fittings to torque values identified in Figure 91.

2. Position lift control manifold to frame. Install two (2) flange head screws but do not fully tighten.

3. Remove caps and plugs from disconnected lines and fittings.

4. Lubricate and install new O−ring(s) on manifold fittings. Connect hydraulic lines to hydraulic manifold fittings and properly tighten all connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Secure hydraulic manifold to frame by tightening two (2) flange head screws.

6. Connect wire harness leads to solenoid coils on manifold using labels placed during removal.

7. Check oil level in hydraulic reservoir and add correct oil if necessary.

8. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

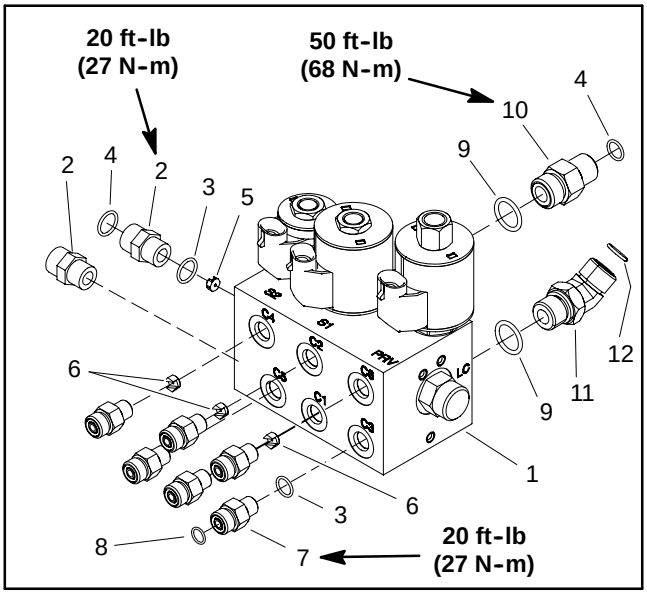


Figure 91

1. Lift control manifold
2. Straight fitting (2 used)
3. O−ring
4. O−ring
5. Orifice (0.030)
6. Orifice (0.046) (3 used)
7. Straight fitting (6 used)
8. O−ring
9. O−ring
10. Straight fitting
11. 45° fitting
12. O−ring

## Lift Control Manifold Service

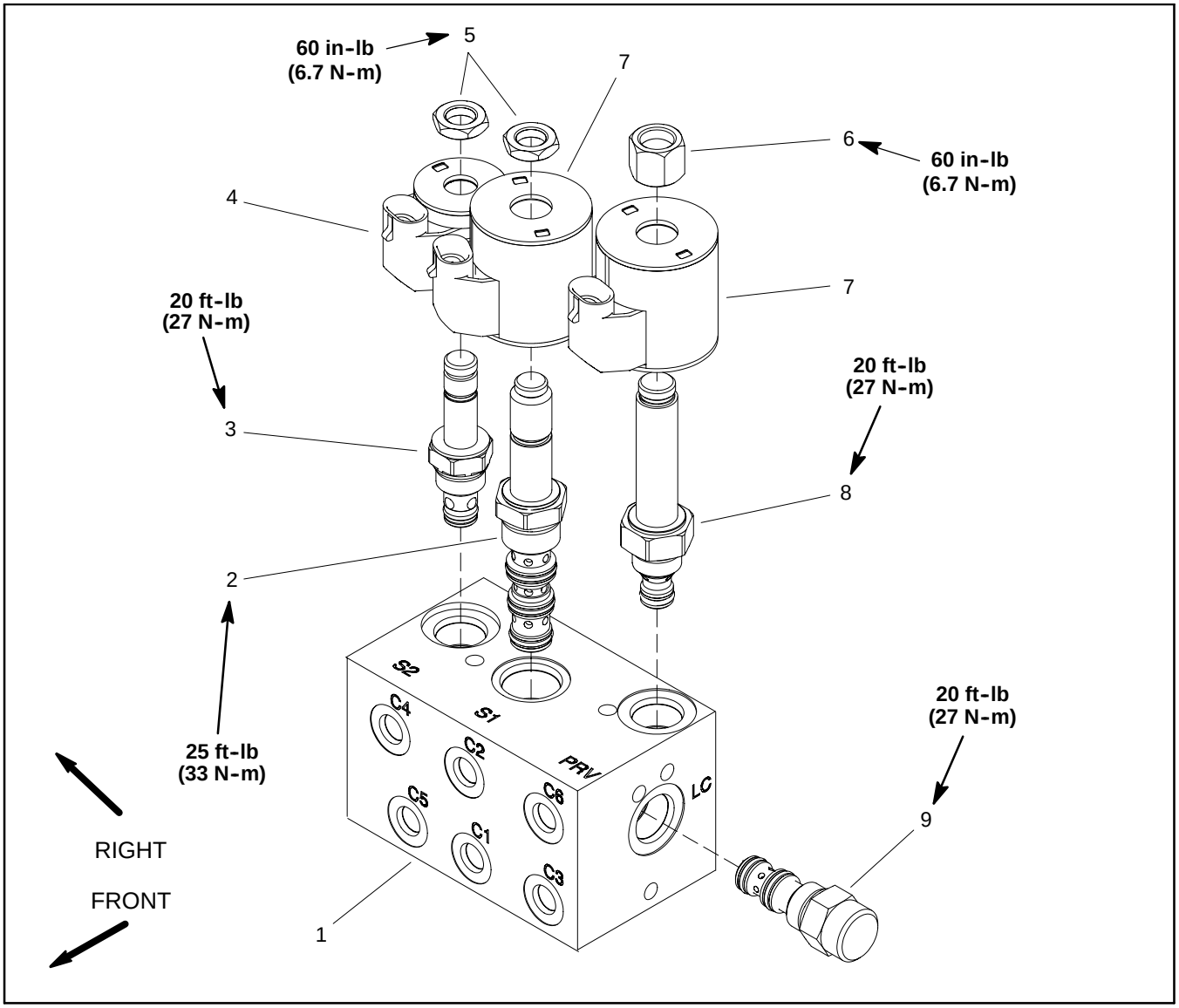


Figure 92

1. **Lift control manifold**
2. **Solenoid valve (S1)**
3. **Solenoid valve (S2)**
4. **Solenoid coil**
5. **Nut**
6. **Nut**
7. **Solenoid coil**
8. **Proportional relief valve (PRV)**
9. **Logic cartridge (LC)**

**NOTE:** The ports on the lift control manifold are marked for easy identification of components. Example: P is the gear pump (P4) connection port and S2 is the location for solenoid valve S2 (see Hydraulic Schematic in Chapter 8 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port location).

For control manifold service procedures, see Deck Control Manifold Service in this section. Refer to Figure 92 for lift control manifold cartridge valve installation torque.

**WARNING**

**Make sure that cutting decks are fully lowered before loosening hydraulic lines, cartridge valves or plugs from lift control manifold. If decks are not fully lowered as manifold components are loosened, decks may drop unexpectedly.**

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## Lift Cylinder

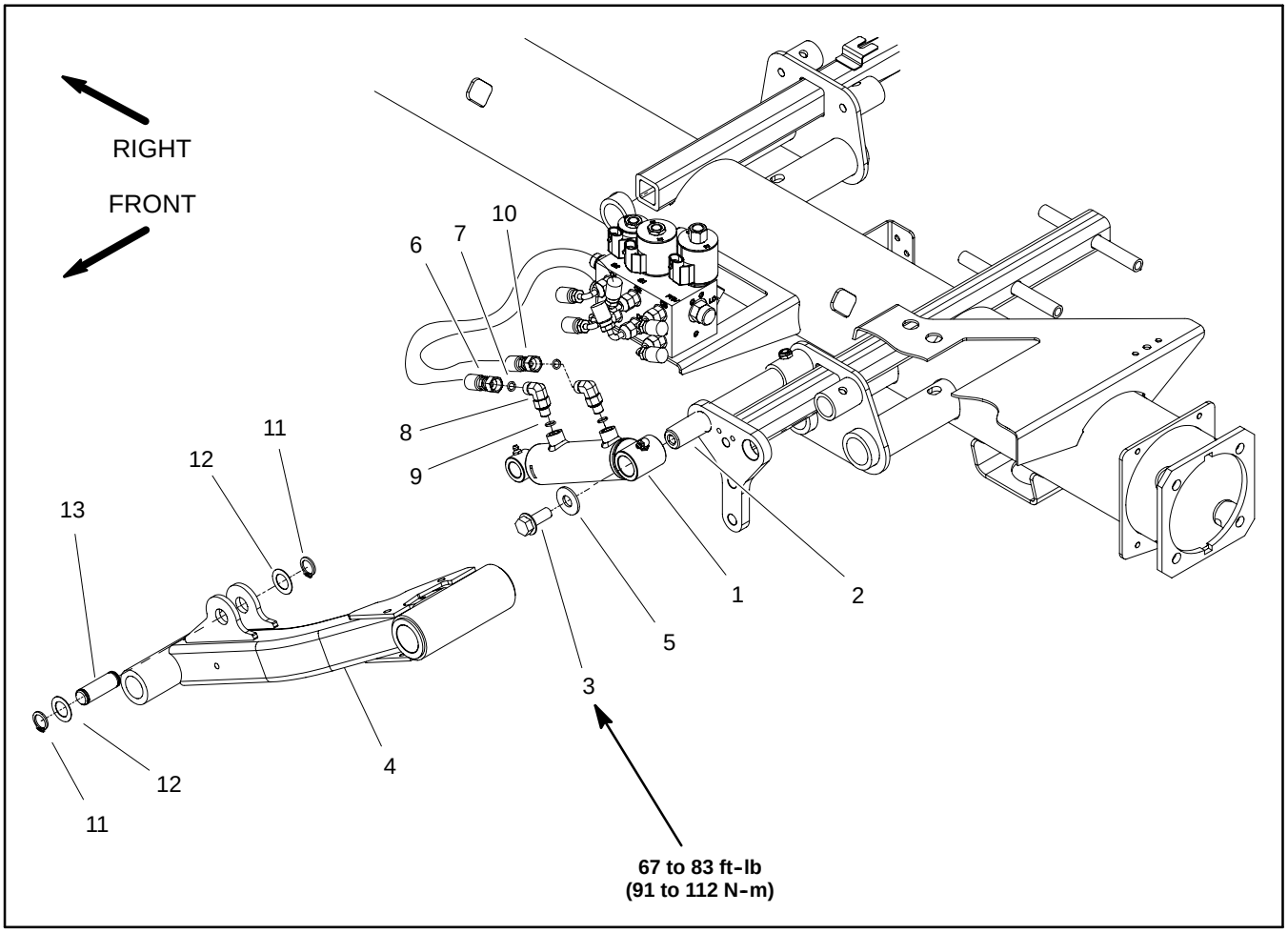


Figure 93

1. **Lift cylinder**
2. **Pivot shaft**
3. **Flange head screw**
4. **Lift arm (#1 shown)**
5. **Flat washer**
6. **Hydraulic hose**
7. **O-ring**
8. **90º hydraulic fitting**
9. **O-ring**
10. **Hydraulic hose**
11. **Retaining ring**
12. **Thrust washer**
13. **Cylinder slide pin**

**NOTE:** The procedure for lift cylinder removal and installation is the same for all Groundsmaster 4300-D lift cylinders. Figure 93 shows the center, front (deck #1) lift cylinder.

**Removal (Fig. 93)**

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

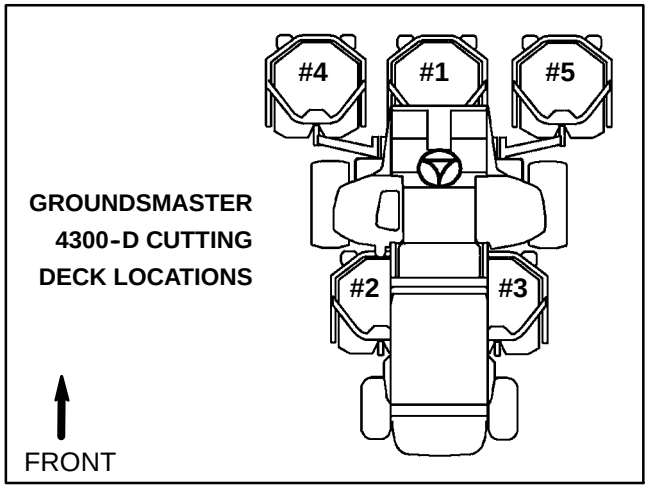


Figure 94

3. If lift cylinder for deck #4 or #5 is being removed, remove flange nut and carriage screw that secure r−clamp to lift cylinder (Fig. 95).

4. Label all hydraulic connections for assembly purposes. Thoroughly clean hydraulic connections prior to loosening hydraulic lines from lift cylinder.

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

5. Disconnect hydraulic hoses from fittings in lift cylinder that is to be removed. Allow hoses to drain into a suitable container. Remove and discard O−rings.

6. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

7. Remove one retaining ring (item 11) and thrust washer (item 12) from the cylinder slide pin (item 13). Pull pin from the lift cylinder and lift arm. Locate and retrieve second thrust washer.

8. Remove flange head screw (item 3) and flat washer (item 5) that retain lift cylinder to pivot shaft.

9. Remove lift cylinder from pivot shaft and frame.

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

**Installation (Fig. 93)**

1. If hydraulic fittings were removed from lift cylinder, lubricate new O−rings, position O−rings to fittings and install fittings into lift cylinder ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Make sure that fittings are orientated correctly.

2. Position lift cylinder to the frame. The lift cylinder barrel end should be attached to the machine frame.

3. Slide barrel end of lift cylinder onto pivot shaft. Secure cylinder with flange head screw (item 3) and flat washer (item 5). Torque screw from **67 to 83 ft−lb (91 to 112 N−m)**.

4. Align lift cylinder to lift arm mounting holes. Slide cylinder slide pin (item 13) (with thrust washer (item 12) and retaining ring (item 11) installed on one end) through the lift cylinder and lift arm. Install second thrust washer on pin and secure with retaining ring (item 11).

5. Remove caps and plugs from disconnected hoses and fittings.

6. Coat new fitting O−rings lightly with clean hydraulic oil, install new O−rings and connect hydraulic hoses to fittings on lift cylinder. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. If lift cylinder for deck #4 or #5 was removed, secure r−clamp to lift cylinder with flange nut and carriage screw (Fig. 95).

8. Check oil level in hydraulic reservoir and add correct oil if necessary.

9. Lubricate lift cylinder grease fittings.

10. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

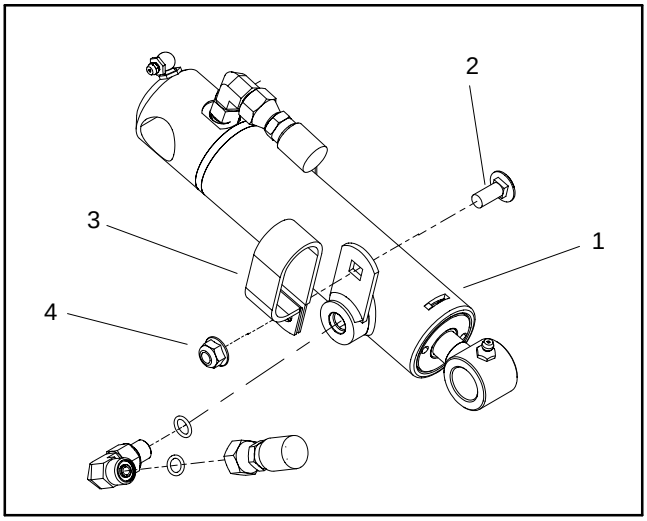


Figure 95

1. **Lift cylinder (#4 shown)**
2. **Carriage screw**
3. **R−clamp**
4. **Flange nut**

## Lift Cylinder Service

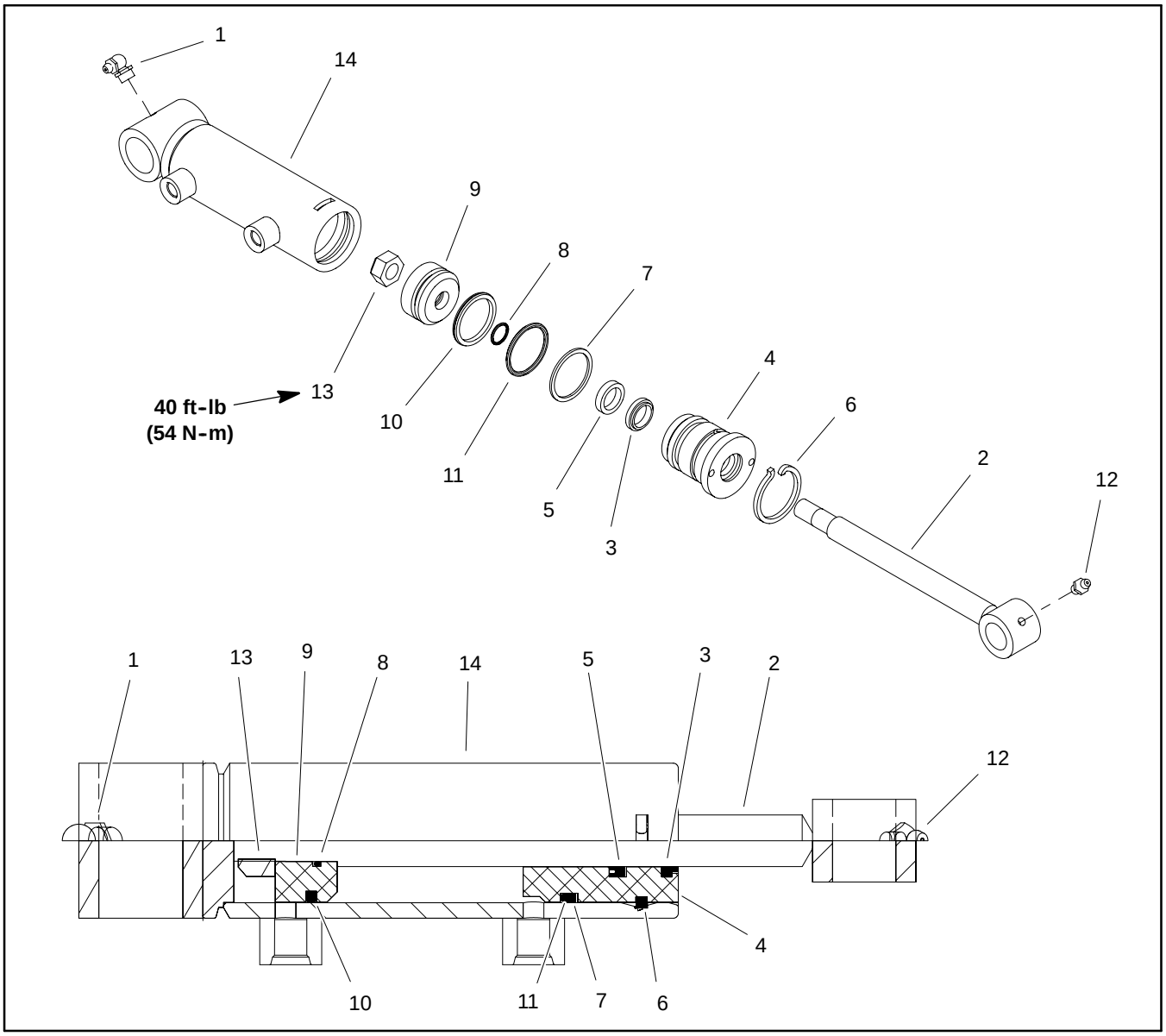


Figure 96

1. **Grease fitting**
2. **Shaft**
3. **Dust seal**
4. **Head**
5. **Head seal**
6. **Retaining ring**
7. **Back up washer**
8. **O-ring**
9. **Piston**
10. **Piston seal**
11. **O-ring**
12. **Grease fitting**
13. **Lock nut**
14. **Barrel**

**NOTE:** The lift cylinders used on Groundsmaster 4300-D machines are very similar. Service procedures for all lift cylinders are the same.

**Disassembly (Fig. 96)**

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 lift cylinder into a vise; clamp on the clevis end of the barrel ONLY.**

2. Mount lift cylinder securely in a vise by clamping on the clevis end of the barrel. Use of a vise with soft jaws is recommended.

3. Using a spanner wrench, rotate head clockwise until the edge of the retaining ring (item 6) appears in the barrel opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counter−clockwise to remove retaining ring from barrel and head.

4. Remove plugs from ports. Extract shaft, head and piston by carefully twisting and pulling on the shaft.

**IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the clevis ONLY.**

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

6. Taking care to not scratch or damage components, remove and discard all seals, back−up rings and O−rings from head and piston.

**Inspection**

**CAUTION**

**Use eye protection such as goggles when using compressed air.**

1. Wash all lift cylinder components in clean solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel for deep scratches, out−of−roundness and bending.

3. Inspect head, shaft and piston for excessive pitting, scoring and wear.

4. Replace lift cylinder if internal components are found to be worn or damaged.

**Assembly (Fig. 96)**

1. Make sure all lift cylinder parts are clean before assembly.

2. Coat new O−rings, back−up washer and other seals with clean hydraulic oil. Carefully install new seals, back−up rings and O−rings to head and piston.

**IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the clevis ONLY.**

3. Mount shaft securely in a vise by clamping on the clevis of the shaft.

   A. Coat shaft with clean hydraulic oil.

   B. Slide head onto the shaft.

   C. Install piston onto the shaft and secure with lock nut. Torque lock nut **40 ft−lb (54 N−m)**.

   D. Remove shaft assembly from the vise.

**IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the clevis end of the barrel ONLY.**

4. Mount barrel securely in a vise by clamping on the clevis end of the barrel.

**IMPORTANT: When installing the head into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the piston and head seals do not lodge in the slot.**

5. Coat all internal parts with a light coat of clean hydraulic oil. Slide piston, shaft and head assembly into the barrel being careful not to damage the seals.

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.

   C. Apply silicone sealer to barrel access slot.

## Steering Control Valve

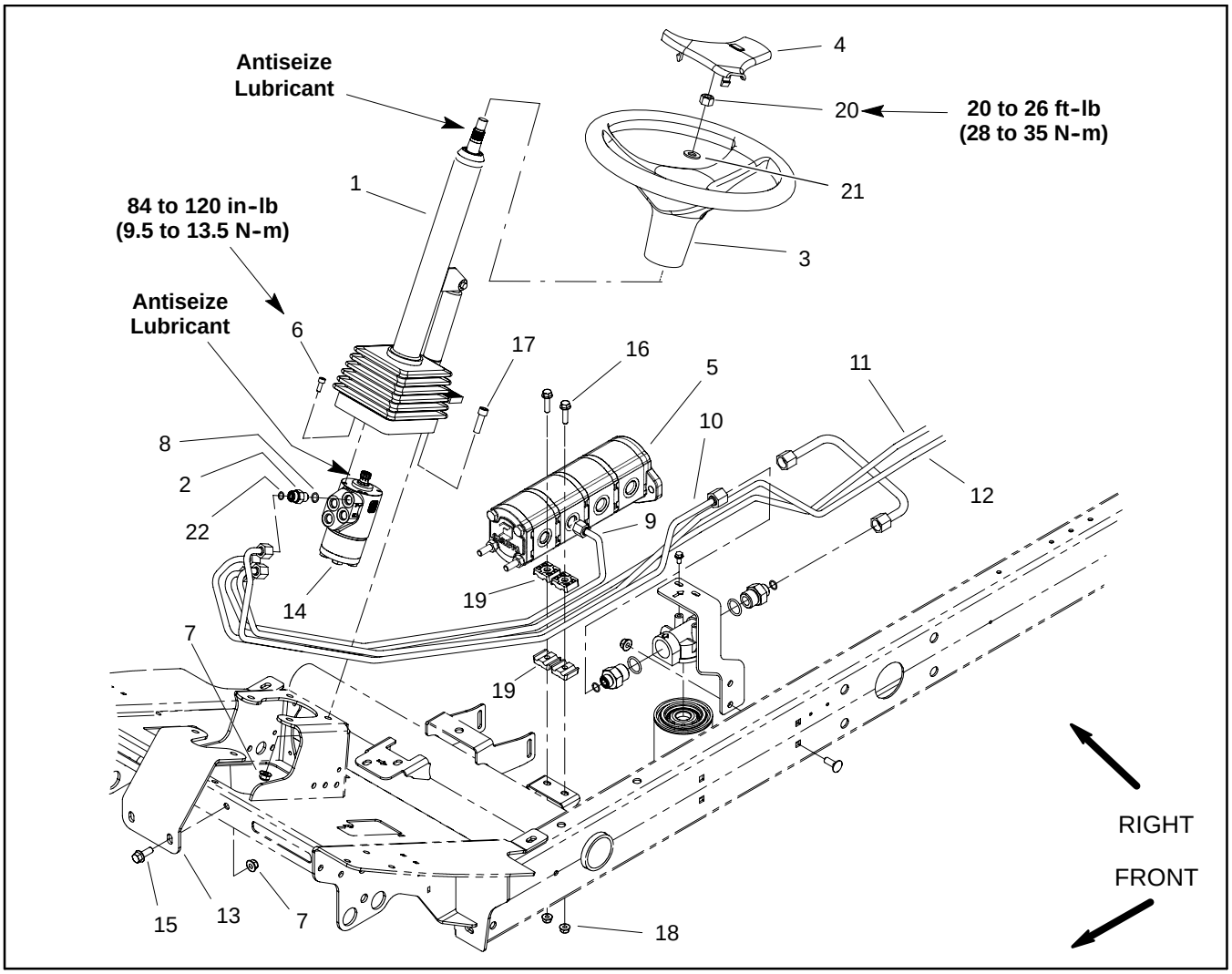


Figure 97

1. Steering column
2. Hydraulic fitting (4 used)
3. Steering wheel
4. Steering wheel cover
5. Gear pump
6. Socket head screw (4 used)
7. Flange nut
8. O-ring
9. Hydraulic tube
10. Hydraulic tube
11. Hydraulic tube
12. Hydraulic tube
13. Column brace
14. Steering control valve
15. Flange head screw (2 used)
16. Flange head screw (2 used)
17. Socket head screw (4 used)
18. Flange nut (2 used)
19. Tube clamp
20. Lock nut
21. Flat washer
22. O-ring

**Removal (Fig. 97)**

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

2. Remove fasteners that secure shroud to front of machine (Fig. 98). Remove shroud from machine to allow access to steering control valve. Locate and retrieve two (2) rubber bushings and spacers.

3. Slide rubber bellows up from bottom of steering column. Support steering column to prevent it from falling.

4. Loosen and remove four (4) screws and flange nuts that secure steering column brace (item 13) to machine. Remove brace.

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

6. Label all hydraulic connections for assembly purposes. Note port designations on steering control valve (Fig. 99). Thoroughly clean hydraulic connections prior to loosening hydraulic lines.

## CAUTION

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

7. Disconnect hydraulic lines from steering control valve. Allow lines to drain into a suitable container.

8. Put caps or plugs on disconnected lines and fittings to prevent contamination.

9. Loosen and remove remaining two (2) socket head screws and flange nuts that secure steering column to machine.

10. Remove steering column and steering control valve assembly from machine.

11. Loosen and remove four (4) socket head screws that secure steering control valve to steering column.

12. Remove steering control valve from steering column.

13. If necessary, remove fittings and O−rings from steering control valve. Discard all removed O−rings.

**Installation (Fig. 97)**

1. If fittings were removed, lubricate new O−rings with clean hydraulic oil and install fittings to steering control valve (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Apply antiseize lubricant to splines of steering control valve shaft.

3. Slide steering control valve shaft into steering column universal joint. Position control valve with ports toward front of machine. Secure steering control valve to steering column with four (4) socket head screws. Torque screws in a criss−cross pattern from **84 to 120 in−lb (9.5 to 13.5 N−m)**.

4. Position steering column assembly to machine. Secure steering column in place with two (2) socket head screws and flange nuts at rear two mounting holes.

5. Remove caps and plugs from disconnected lines and fittings.

6. Lubricate new O−rings and connect hydraulic lines to fittings on steering control valve. Tighten connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Position steering column brace (item 13) to machine and secure with four (4) screws and flange nuts.

8. Slide rubber bellows to bottom of steering column.

9. Place rubber bushings and spacers into holes of shroud (Fig. 98). Position shroud in place and secure with removed fasteners.

10. Check oil level in hydraulic reservoir and add correct oil if necessary.

11. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

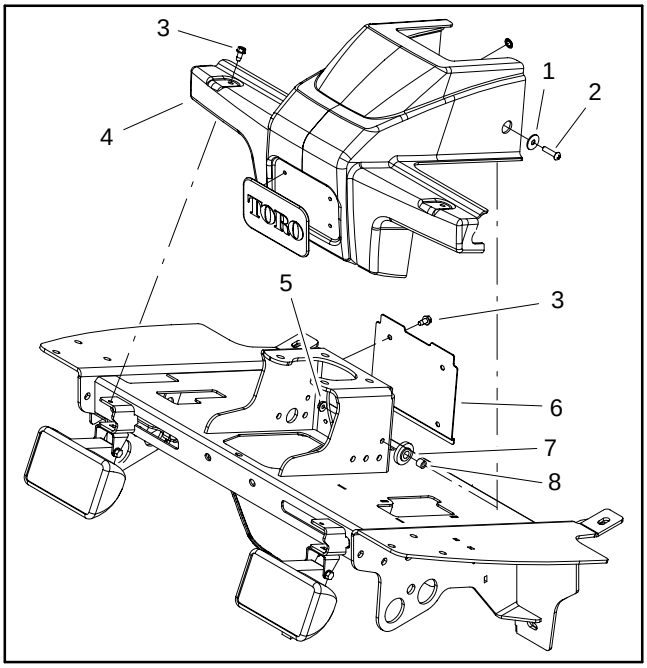


Figure 98

1. **Washer (2 used)**
2. **Screw (2 used)**
3. **Washer head screw**
4. **Platform shroud**
5. **Lock nut (2 used)**
6. **Cover plate**
7. **Bushing (2 used)**
8. **Spacer (2 used)**

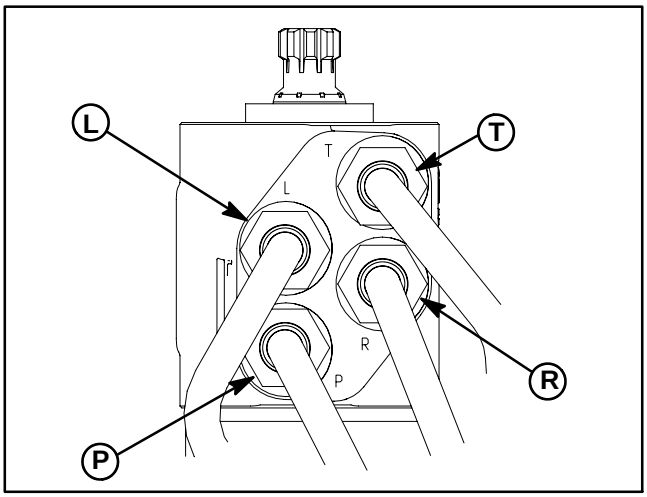


Figure 99

## Steering Control Valve Service

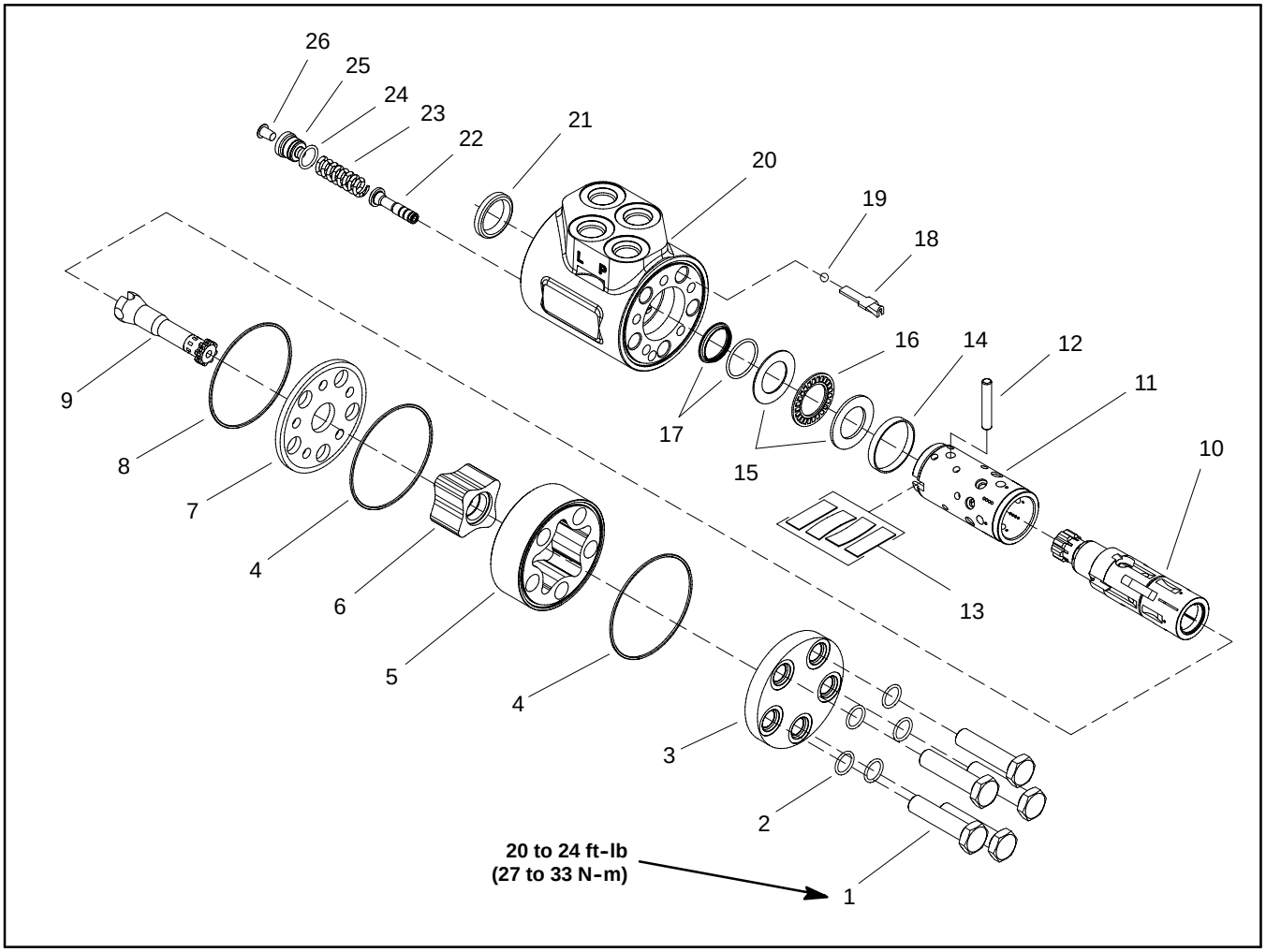


Figure 100

1. **Screw (5 used)**
2. **O-ring (5 used)**
3. **End cover**
4. **O-ring**
5. **Outer gearwheel**
6. **Inner gearwheel**
7. **Distributor plate**
8. **O-ring**
9. **Cardan shaft**
10. **Spool**
11. **Sleeve**
12. **Cross pin**
13. **Spring set**
14. **Ring**
15. **Thrust washer**
16. **Bearing**
17. **Shaft seal**
18. **Ball stop**
19. **Check ball**
20. **Housing**
21. **Dust seal ring**
22. **Relief valve**
23. **Spring**
24. **O-ring**
25. **Plug**
26. **Plug**

**NOTE:** For repair of the steering control valve, see the Sauer-Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

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## Steering Cylinder

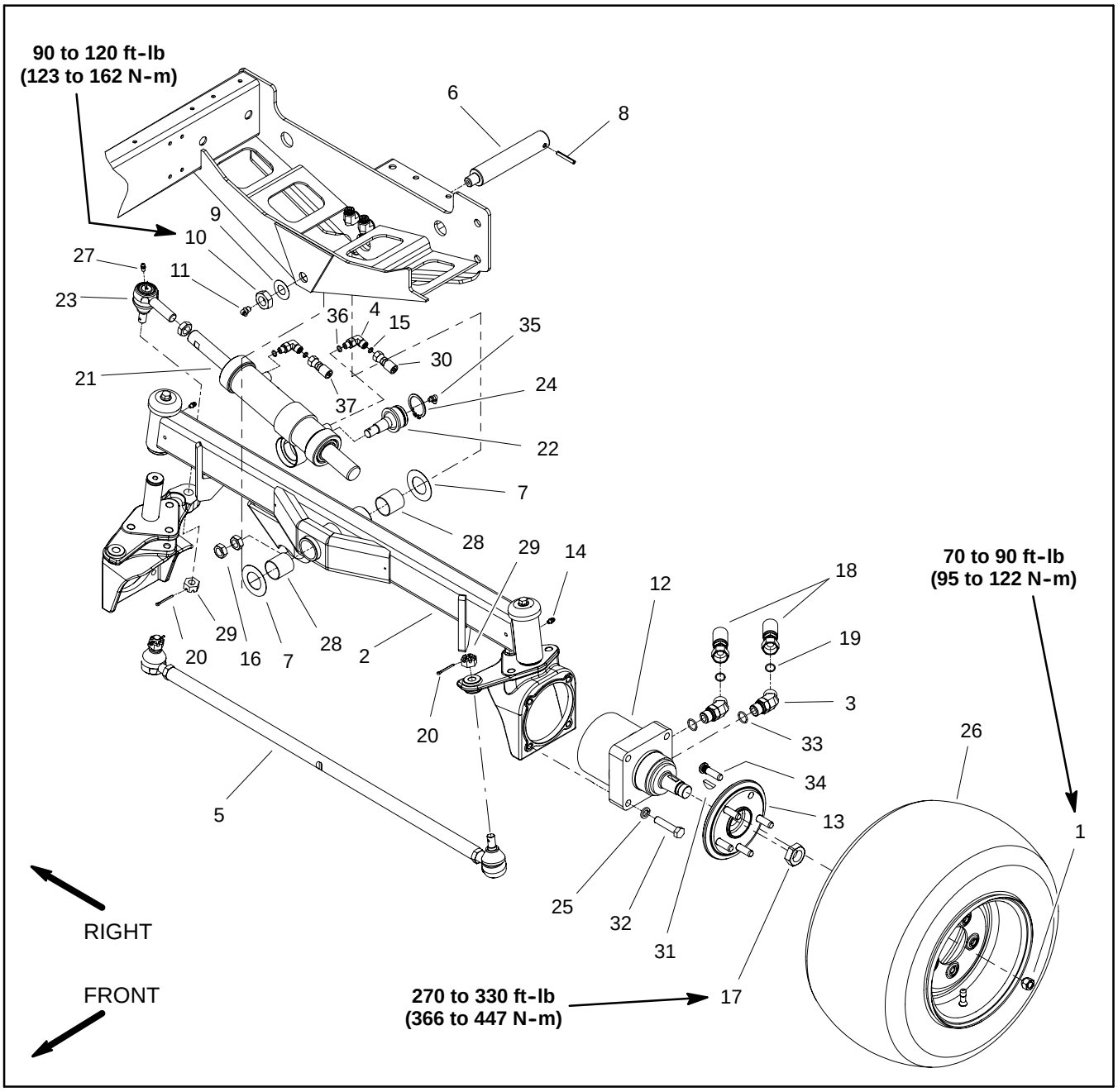


Figure 101

1. Lug nut (5 used per wheel)
2. Rear axle assembly
3. Hydraulic fitting (2 used per motor)
4. Hydraulic fitting (2 used)
5. Tie rod
6. Axle pivot pin
7. Thrust washer
8. Roll pin
9. Thrust washer
10. Jam nut
11. Grease fitting
12. Wheel motor (LH shown)
13. Wheel hub assembly
14. Grease fitting
15. O-ring
16. Jam nut (2 used)
17. Lock nut
18. Hydraulic hose
19. O-ring
20. Cotter pin
21. Steering cylinder
22. Ball joint
23. Ball joint
24. Retaining ring
25. Lock washer (4 used per motor)
26. Wheel assembly
27. Grease fitting
28. Bushing
29. Slotted hex nut
30. Hydraulic hose
31. Woodruff key
32. Cap screw (4 used per motor)
33. O-ring
34. Wheel stud (5 used per hub)
35. Grease fitting
36. O-ring
37. Hydraulic hose

**Removal (Fig. 101)**

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

**CAUTION**

**Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

3. Label all hydraulic connections for assembly purposes. Thoroughly clean hydraulic hose ends prior to disconnecting hoses from the steering cylinder.

4. Disconnect hydraulic hoses from steering cylinder.

5. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

6. Remove two (2) jam nuts (item 16) that secure steering cylinder to axle. Remove cotter pin (item 20) and slotted hex nut (item 29) that secure steering cylinder to RH drag link.

7. Separate steering cylinder ball joints from axle assembly and remove steering cylinder from machine.

8. If necessary, remove ball joints from steering cylinder barrel and shaft. If ball joint is to be removed from cylinder shaft, fully retract cylinder shaft and measure distance from cylinder front head to center of ball joint to ease installation of ball joint into cylinder shaft (Fig. 102).

9. 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.

**Installation (Fig. 101)**

1. If hydraulic fittings were removed from steering cylinder, lubricate new O−rings with clean hydraulic oil, position O−rings to fittings and install fittings into steering cylinder ports (see Hydraulic Fitting Installation in the General Information section of this chapter). Make sure that fittings are orientated correctly.

2. If removed, press ball joint into barrel and secure with retaining ring.

3. If ball joint was removed from cylinder shaft, fully retract cylinder shaft and thread ball joint into shaft so that distance from cylinder front head to center of ball joint is as measured during removal process. Tighten jam nut.

4. Thoroughly clean tapers on ball joints and axle assembly.

5. Position steering cylinder to machine.

6. Secure steering cylinder to axle with jam nuts (item 16). Tighten first jam nut and then, while holding first jam nut with wrench, tighten second jam nut.

7. Secure steering cylinder to RH drag link with slotted hex nut (item 29). Install cotter pin (item 20).

8. Remove caps and plugs from hydraulic hoses and fittings.

9. Lubricate and install new O−rings on steering cylinder fittings. Correctly connect hydraulic hoses to steering cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

10. Check oil level in hydraulic reservoir and add correct oil if necessary.

11. Lubricate steering cylinder ball joint grease fittings.

12. Follow Hydraulic System Start−up procedures (see Hydraulic System Start−up in this section).

13. Check that steering cylinder does not contact the axle or frame as cylinder moves from fully retracted to fully extended. Also, check that distance between the drag links and steering stops are equal on both sides of the machine. If necessary, adjust location of ball joint on cylinder shaft.

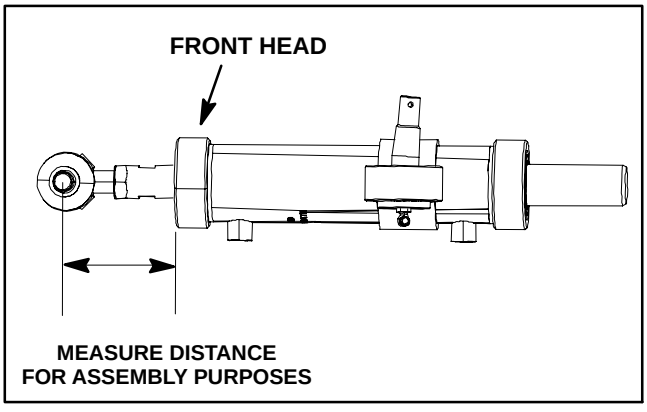


Figure 102

## Steering Cylinder Service

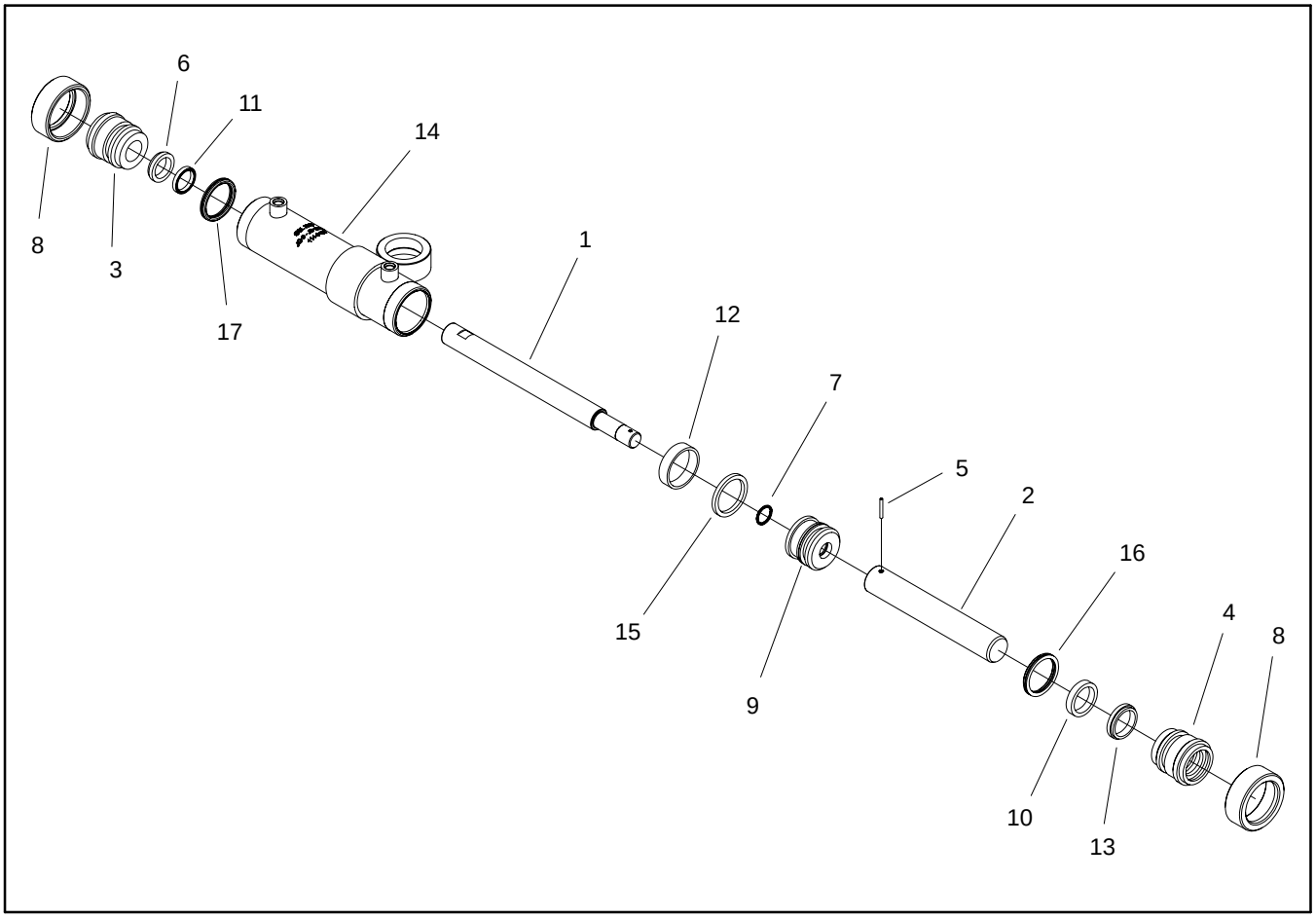


Figure 103

1. **Front shaft (1”)**
2. **Rear shaft (1.250”)**
3. **Front head (1”)**
4. **Rear head (1.250”)**
5. **Roll pin**
6. **Dust seal**
7. **O-ring**
8. **External collar (2 used)**
9. **Piston**
10. **Rear head seal**
11. **Front head seal**
12. **Wear ring**
13. **Dust seal**
14. **Barrel**
15. **Piston seal**
16. **Rear head O-ring/backup ring**
17. **Front head O-ring/backup ring**

**Disassembly (Fig. 103)**

1. Remove oil from steering 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 steering cylinder into a vise; clamp on the barrel clevis ONLY. Do not close vise on barrel.**

2. Mount steering cylinder securely in a vise by clamping on the barrel clevis. Use of a vise with soft jaws is recommended.

3. Using a spanner wrench, loosen and remove external collars from both ends of barrel.

4. Use a twisting and pulling motion to carefully extract the rear head from the barrel and rear shaft.

5. Grasp end of front shaft and use a twisting and pulling motion to carefully extract the rear shaft, piston, front shaft and front head assembly from the barrel.

6. Remove cylinder from vise.

**IMPORTANT: When removing roll pin from front and rear shafts, make sure that shaft surfaces are not damaged.**

7. Remove and discard roll pin (item 5) that secures front shaft to rear shaft. Then remove rear shaft (item 2), piston (item 9) and front head (item 3) from front shaft.

8. Remove and discard seals, O-rings and wear ring from piston and heads.

**Inspection**

**CAUTION**

**Use eye protection such as goggles when using compressed air.**

1. Wash all cylinder components in solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel for deep scratches, out−of−roundness and bending.

3. Inspect head, shaft and piston for excessive pitting, scoring and wear.

4. Replace steering cylinder if internal components are found to be worn or damaged.

**Assembly (Fig. 103)**

1. Use a new seal kit to replace all seals, O−rings and wear ring to piston and heads. Apply clean hydraulic oil to all seal kit components before installing.

2. Install front head (item 3) with new seals onto front shaft (item 1) being careful to not damage head seals during installation.

**IMPORTANT:Make sure to not damage O−ring (item 7) as piston is installed over roll pin hole in front shaft.**

3. Install piston (item 9) with new seal, O−ring and wear ring onto front shaft.

**IMPORTANT:When installing roll pin into front and rear shafts, make sure that shaft surfaces are not damaged.**

4. Slide rear shaft into front shaft and align roll pin holes in shafts. Install new roll pin to secure shafts.

**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 steering cylinder barrel in a vise equipped with soft jaws by clamping on the barrel clevis.

6. Coat all internal cylinder components with clean hydraulic oil. Slide shaft assembly into barrel, being careful to not damage seals during installation.

7. Insert rear head with new seals into the barrel being careful to not damage head seals during installation.

8. Secure front and rear heads in barrel with external collars. Tighten collars with spanner wrench.

## Oil Cooler

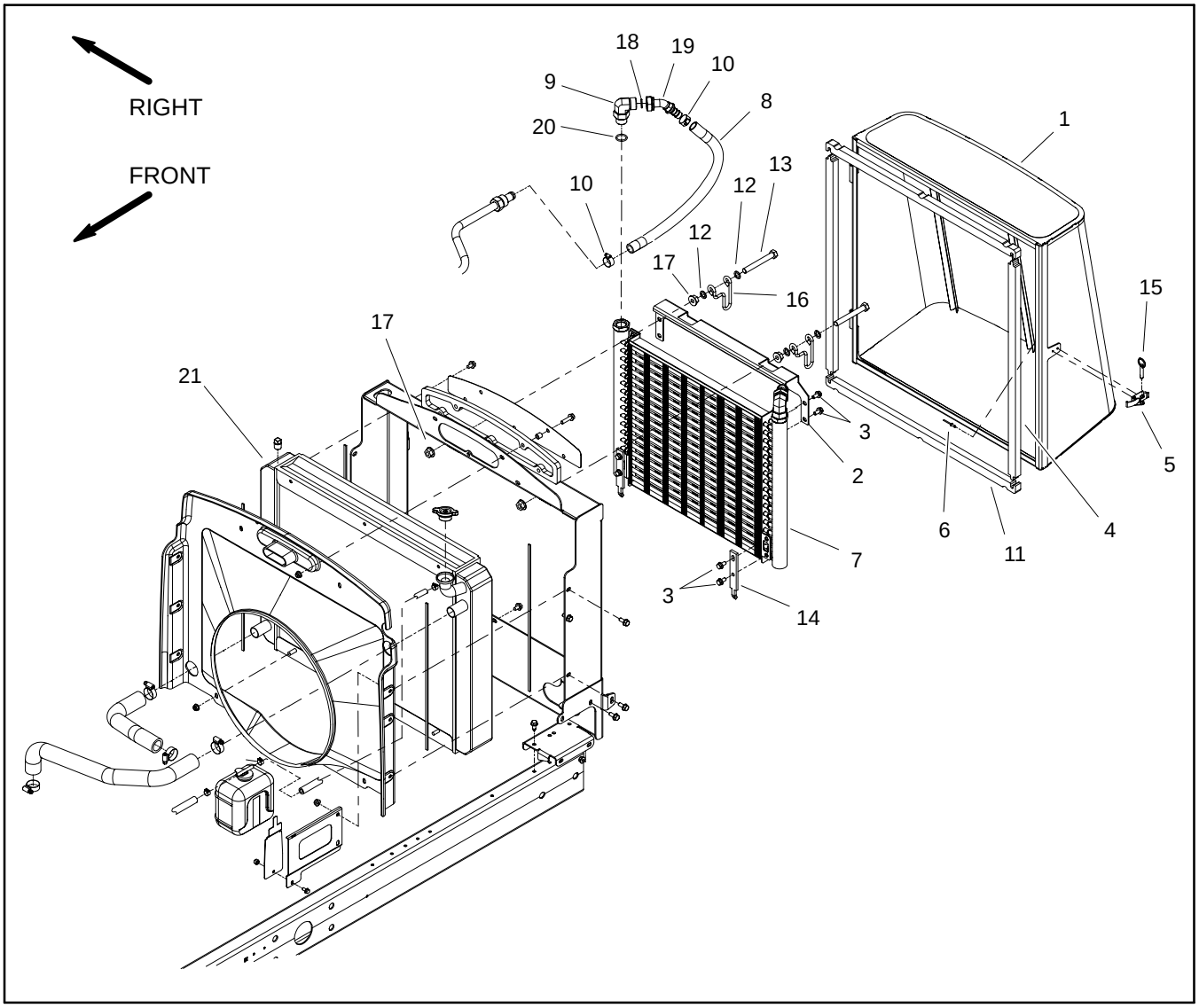


Figure 104

1. **Screen assembly**
2. **Oil cooler bracket**
3. **Flange head screw (8 used)**
4. **Foam seal (2 used)**
5. **Draw latch**
6. **Rivet (2 used)**
7. **Oil cooler**
8. **Hydraulic hose (2 used)**
9. **90º hydraulic fitting (2 used)**
10. **Hose clamp (4 used)**
11. **Foam seal (2 used)**
12. **Washer (4 used)**
13. **Cap screw (2 used)**
14. **Mount plate (2 used)**
15. **Pin**
16. **Clamp (2 used)**
17. **Flange nut (4 used)**
18. **O-ring**
19. **45º hydraulic fitting (2 used)**
20. **O-ring**
21. **Radiator**

**Removal (Fig. 104)**

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

2. Unlatch and open the rear screen.

3. Label all hydraulic connections for assembly purposes. Thoroughly clean hydraulic connections prior to loosening hydraulic hoses.

4. Loosen hose clamps that secure hydraulic hoses to oil cooler fittings. Remove hoses from oil cooler. Allow hoses to drain into a suitable container.

5. Rotate clamps that secure oil cooler to radiator frame.

6. Pull oil cooler from machine.

7. If necessary, remove hydraulic fittings, clamps and brackets from oil cooler using Figure 104 as a guide.

**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 oil cooler 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. 104)**

1. If removed, install hydraulic fittings, clamps and brackets to oil cooler using Figure 104 as a guide.

2. Position oil cooler to radiator and secure with clamps.

3. Install hydraulic hoses to oil cooler fittings and secure with hose clamps.

4. After oil cooler installation, clean oil cooler, hose connections, fittings, radiator and surrounding area of machine to prevent future accumulation of dirt and debris on machine components.

5. Install radiator screen to machine. Lower and secure hood.

6. Check oil level in hydraulic reservoir and add correct oil if necessary.

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# Chapter 5

# Electrical System

## Table of Contents

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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 4300–D machine. Refer to that publication for additional information when servicing the machine.

## Toro Electronic Controller (TEC)

Groundsmaster 4300–D machines use a Toro Electronic Controller (TEC) to manage machine electrical functions. The controller is a microprocessor controlled device that senses the condition of various switches (inputs) and then directs electrical power to control appropriate machine functions (outputs) based on the inputs. The status of inputs to the controllers as well as outputs from the controllers can be monitored with the Diagnostic Display (see Special Tools in this chapter).

**IMPORTANT: Before performing any welding on the machine, disconnect both positive and negative battery cables from the battery, disconnect the wire harness connector from the TEC controller and disconnect the terminal connector from the alternator. This will prevent damage to the electrical system of your Groundsmaster.**

If the wire harness connector is removed from the TEC controller for any reason,tighten the harness connector screw from **25 to 28 in–lb (2.8 to 3.2 N·m)**.

## CAN–bus Communications

The TEC controller used on the Groundsmaster 4300–D communicates with other electrical components on a CAN–bus communication system. 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 reduced.

CAN identifies the Controller Area Network that is used on the Groundsmaster. Two (2) specially designed, twisted cables form the bus. These wires provide the data pathways between machine components. The engineering term for these two (2) 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.

**IMPORTANT: The termination resistors at the ends of the bus cables are required for proper electrical system operation.**

## Electrical Drawings

The electrical schematic and wire harness drawings for Groundsmaster 4300–D machines are located in Chapter 8 – Foldout Drawings.

# Special Tools

Order Special Tools from your Toro Distributor. Some tools may be available locally.

## Multimeter

The multimeter can test electrical components and circuits for current, resistance or voltage. Obtain this tool locally.

**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 could cause damage to circuits not designed to carry it.

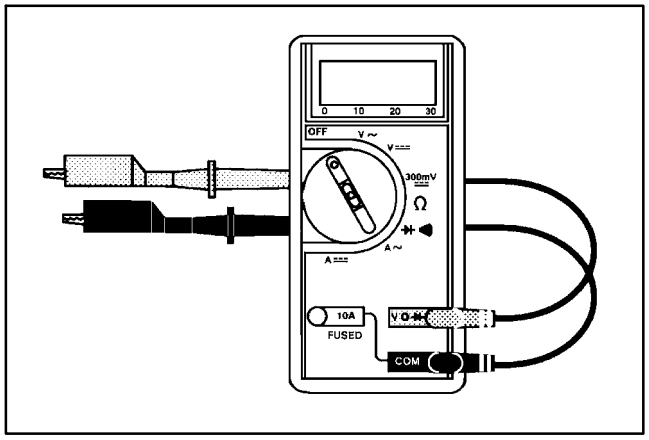



Figure 1

## Skin–Over Grease

Special non–conductive grease which forms a light protective skin to help waterproof electrical switches and contacts.

Toro Part Number: **TOR50547**


Figure 2

## 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 3

## Diagnostic Display

The Diagnostic Display (Fig. 4) can be connected to the wiring harness connector located inside the control arm to verify correct electrical functions of the machine. TEC controller inputs and outputs can be checked using the Diagnostic Display.

Toro Part Number for Diagnostic Display: **85–4750**

Toro Part Number for Overlay (English): **117–0171**

**NOTE:** Diagnostic Display overlays are available in several languages for your Groundsmaster. Refer to your Parts Catalog for overlay language options and part numbers.

**IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of Diagnostic Display is completed, disconnect it from the machine and reconnect loopback connector to harness connector. Machine will not operate without loopback connector installed on harness. Store Diagnostic Display in a dry, secure, indoor location, not on machine.**

Figure 4

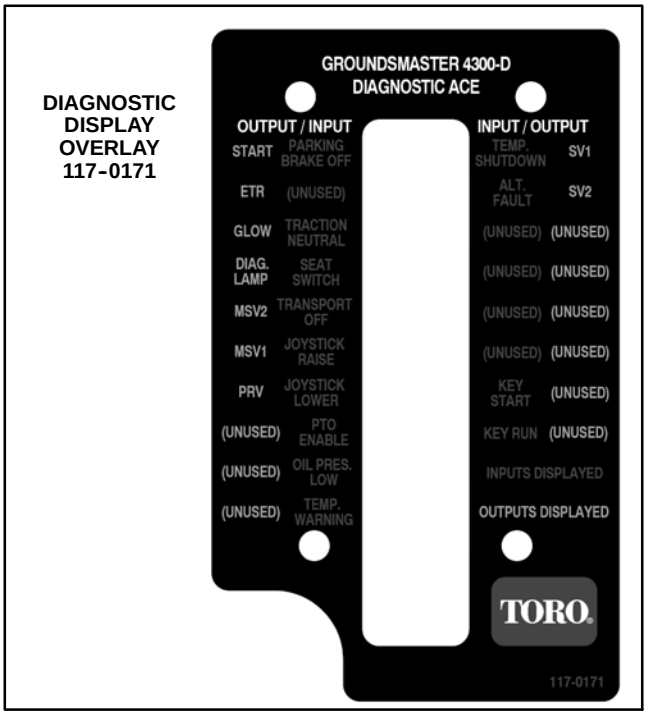



Figure 5

## Battery Hydrometer

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

Figure 6

# 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, there must be a good understanding of the electrical circuits and components used on this machine (see Chapter 8 – Foldout Drawings). If the machine has any interlock switches by–passed, they must be reconnected for proper troubleshooting and safety.

**NOTE:** Use the Diagnostic Display (see Special Tools in this chapter) to test Toro Electronic Controller inputs and outputs when troubleshooting an electrical problem on your Groundsmaster.

## Diagnostic Light

Groundsmaster 4300–D machines are equipped with a diagnostic light that indicates if the machine electrical system is functioning correctly. The diagnostic light is located on the control panel (Fig. 7).

When the ignition switch is moved to the RUN position and the machine electrical system is functioning properly, the diagnostic light will be illuminated for approximately three (3) seconds and then will turn off. The light should remain off during normal machine operation.

If the machine TEC controller detects an electrical system malfunction (fault) during machine operation, the diagnostic light will flash rapidly. The light will stop flashing and will automatically reset when the ignition switch is turned to the OFF position. The fault, however, will be retained in controller memory and can be retrieved at a future time (see Retrieving Fault Codes below).

If the diagnostic light does not illuminate when the ignition switch is turned to the RUN position, possible causes are:

- The loopback connector is not connected to the machine wire harness (Fig. 8).
- The diagnostic light (or circuit wiring) is faulty.
- TEC controller fuses are faulty (see Fuses in the Component Testing section of this chapter).
- The TEC controller is faulty.

Check electrical connections, controller fuses and the diagnostic light to determine malfunction. Make sure that the loopback connector is secured to the wire harness connector.

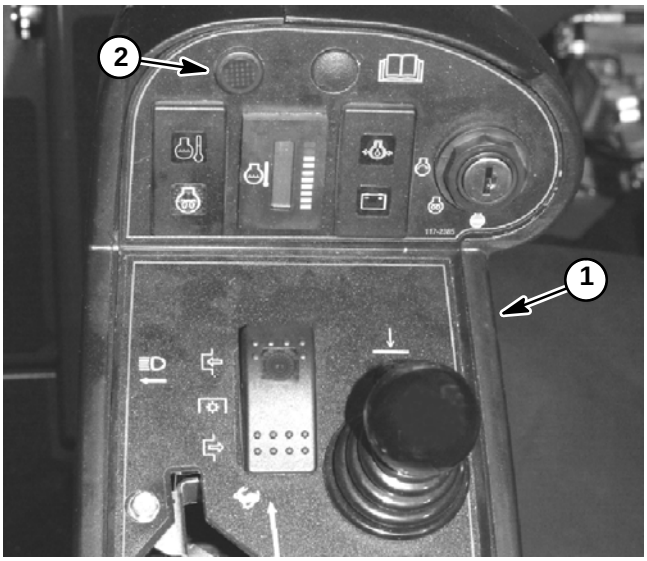



Figure 7

1. **Control panel**
2. **Diagnostic light**

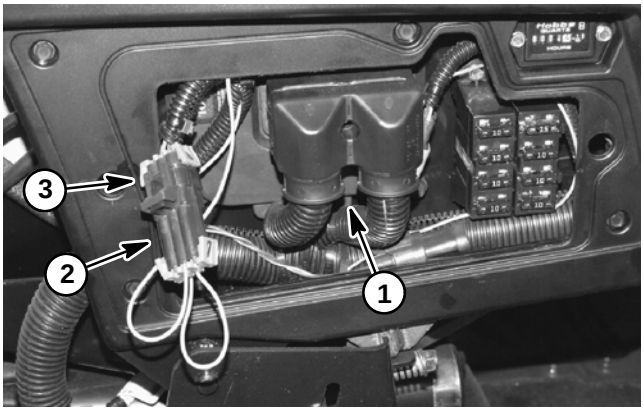



Figure 8

1. **TEC controller location**
2. **Loopback connector**
3. **Harness connector**

**Retrieving Fault Codes**

All machine fault codes are retained in the TEC controller memory. The three (3) most recent fault codes that have occurred within the last forty (40) hours of operation can be retrieved using the diagnostic light. To retrieve these fault codes from the controller memory, perform the following switch sequence:

1. Operator seat should be UNOCCUPIED, traction pedal in neutral, parking brake released and PTO switch in the OFF position.

2. Place mow speed limiter in the TRANSPORT position.

3. Move and hold joystick in the RAISE position.

4. Turn ignition switch to the RUN position.

5. Monitor the diagnostic light for fault code(s).

**NOTE:** Once the diagnostic light begins to display fault codes, the joystick can be released.

Fault codes displayed by the diagnostic light are two digit numbers with no digit higher than five (5). Fault codes are listed in the chart below. There will be a one (1) second pause between the first and second digit of a code. Up to three (3) fault codes retained in controller memory will be displayed by the diagnostic light in order from the most recent fault to the oldest fault. If there are multiple faults in controller memory, there will be a three (3) second pause between codes. The fault codes will continually repeat after a five (5) second pause until the ignition key is turned off.

If there are no faults that have occurred within the last forty (40) hours of operation, the diagnostic light will flash continuously after performing the above switch sequence.

If a fault code is not retrieved from the controller memory within forty (40) hours of machine operating time, the fault cannot be retrieved from controller memory using this procedure. If necessary, contact your Toro distributor to retrieve older fault codes.

| Fault Code (Lamp Flashes) | Fault Description |
|---|---|
| 1 – 1 | High engine temp warning occurred (PTO was shutdown by controller) |
| 1 – 2 | High engine temp shutdown occurred (engine was shutdown by controller) |
| 1 – 3 | Low engine oil pressure occurred |
| 1 – 4 | Engine alternator fault occurred |

**Clearing Fault Codes**

After fault codes have been retrieved, clearing of those faults can be completed using the following switch sequence:

1. Place machine switches in fault retrieval (see above). The diagnostic light should be displaying the fault codes.

2. Operator seat should remain UNOCCUPIED.

3. Move mow speed limiter to the MOW position.

4. Move joystick to the RAISE position.

5. Monitor the diagnostic light for continuous flashing indicating that all faults have been cleared from the controller memory.

## Diagnostic Display

Groundsmaster 4300−D machines are equipped with a TEC controller which controls machine electrical functions. The controller monitors various input switches (e.g. ignition switch, seat switch, etc.) and energizes outputs to actuate solenoids or relays for the requested machine function.

For the controller to control the machine as desired, each of the input switches, output solenoids and relays must be connected and functioning properly.

The Diagnostic Display (see Special Tools in this chapter) is a tool to help the technician verify correct electrical functions of the machine.

**IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of the Diagnostic Display is completed, disconnect it from the machine and reconnect loopback connector to harness connector. The machine will not operate without the loopback connector installed on the harness. Store the Diagnostic Display in a dry, secure, indoor location, not on machine.**

**Verify Diagnostic Display Input Functions**

**CAUTION**

**The interlock switches are for the protection of the operator and bystanders and to ensure correct operation of the machine. Do not bypass or disconnect switches. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.**

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

2. Open control panel cover. Locate wire harness and connectors near TEC controller. Carefully unplug loopback connector from harness connector (Fig. 9).

3. Connect the Diagnostic Display connector to the harness connector (Fig. 10). Make sure correct overlay decal is positioned on the Diagnostic Display (Fig. 11).

4. Turn the ignition switch to the RUN position, but do not start machine.

**NOTE:** The **red** text on the overlay decal refers to controller inputs and the **green** text refers to controller outputs.

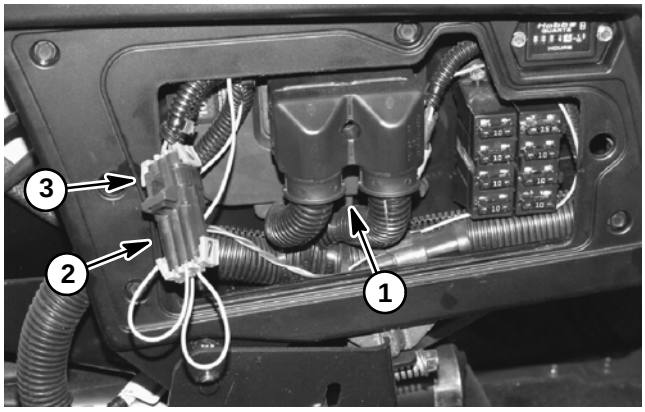



Figure 9

1. **TEC controller location**
2. **Loopback connector**
3. **Harness connector**

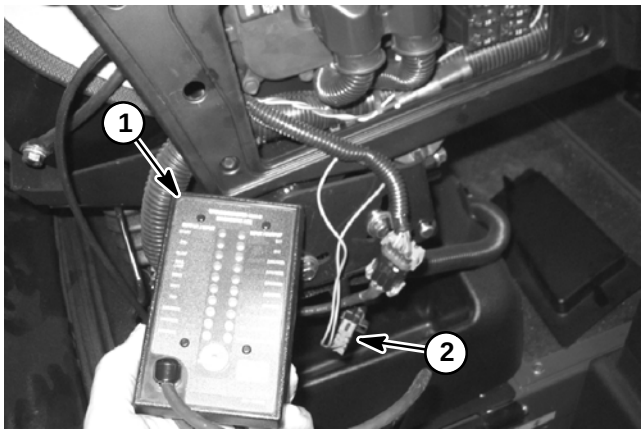



Figure 10

1. **Diagnostic display**
2. **Loopback connector**

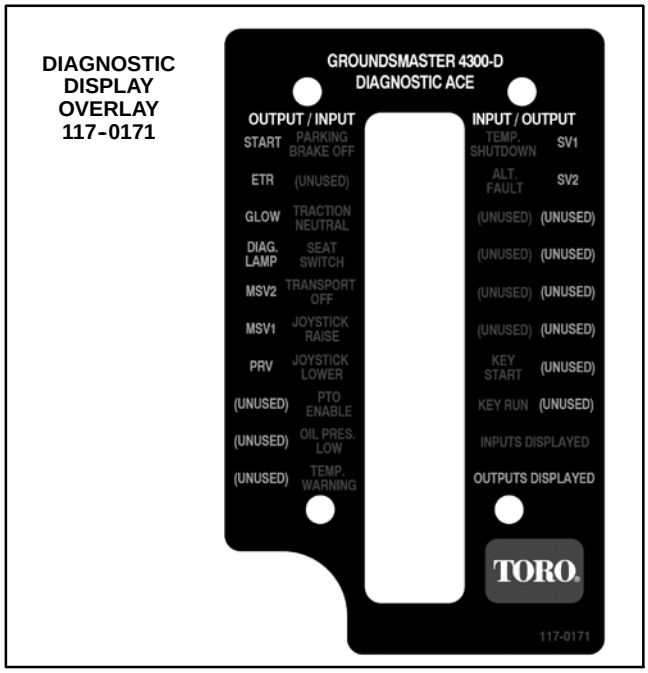



Figure 11

5. The “INPUTS DISPLAYED” LED, on lower right column of the Diagnostic Display, should be illuminated. If the green “OUTPUTS DISPLAYED” LED is illuminated, press the toggle button on the Diagnostic Display to change to “INPUTS DISPLAYED” LED.

6. The Diagnostic Display will illuminate the LED associated with each of the inputs when that input is in the position identified on the Diagnostic Display overlay. Individually, change the position of each of the inputs (i.e. sit on seat, press traction pedal, etc.), and note that the appropriate LED on the Diagnostic Display toggles on and off when the input state is changed (see chart below). Repeat for all inputs that can be changed by hand.

7. If appropriate LED does not toggle on and off when input state is changed, check all wiring and connections to the switch for that input and/or test switch (see Component Testing in this chapter). Replace all defective switches and repair any damaged wiring.

**NOTE:** The TEMP WARNING and ALT FAULT TEC controller inputs can not be reliably tested by grounding the harness leads at the engine temperature sensor or alternator. If engine temperature is very excessive or alternator is faulty, a TEC controller fault should have been detected. Refer to Diagnostic Light in this section for information on retrieval and clearing of TEC controller faults.

**NOTE:** When the ignition switch is in the OFF position, all Diagnostic Display LED’s should be OFF.

8. After input function testing is completed, disconnect the Diagnostic Display from wire harness. Plug loopback connector into harness connector. Install control panel cover.

| **Diagnostic Display TEC Controller Inputs** | **Diagnostic Display LED Operation** |
|---|---|
| PARKING BRAKE OFF | Parking brake released: LED ON<br>Parking brake applied: LED OFF |
| TRACTION NEUTRAL | Traction pedal in neutral: LED ON<br>Traction pedal in forward or reverse: LED OFF |
| SEAT SWITCH | Seat occupied: LED ON<br>Seat NOT occupied: LED OFF |
| TRANSPORT OFF | Mow speed limiter in MOW: LED ON<br>Mow speed limiter in TRANSPORT: LED OFF |
| JOYSTICK RAISE | Joystick moved rearward: LED ON<br>Joystick in neutral: LED OFF |
| JOYSTICK LOWER | Joystick moved forward: LED ON<br>Joystick in neutral: LED OFF |
| PTO ENABLE | PTO switch ON: LED ON<br>PTO switch OFF: LED OFF |
| OIL PRES LOW | Engine not running OR low engine oil pressure: LED ON<br>Engine oil pressure OK: LED OFF |
| TEMP WARNING | Excessive engine temperature: LED ON<br>Normal engine temperature: LED OFF |
| TEMP SHUTDOWN | Very excessive engine temperature: LED ON<br>Normal engine temperature: LED OFF |
| ALT FAULT | Engine not running or alternator faulty: LED ON<br>Alternator OK: LED OFF |
| KEY START<br>(NOTE: Turn PTO switch ON so engine will not start when turning ignition switch to START) | Ignition switch in START: LED ON<br>Ignition switch in RUN: LED OFF |
| KEY RUN | Ignition switch in RUN or START: LED ON |

**Verify Diagnostic Display Output Functions**

The Diagnostic Display also has the ability to detect which output solenoids or relays are turned on by the TEC controller. This is a quick way to determine if a machine malfunction is electrical or hydraulic.

**NOTE:** An open output (e.g. an unplugged connector or a broken wire) cannot be detected with the Diagnostic Display.

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

2. Open control panel cover. Locate wire harness and connectors near TEC controller. Carefully unplug loopback connector from harness connector (Fig. 12).

3. Connect the Diagnostic Display connector to the harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (Fig. 13).

4. Turn the ignition switch to the RUN position.

**NOTE:** The **red** text on the overlay decal refers to controller inputs and the **green** text refers to controller outputs.

5. The green "OUTPUTS DISPLAYED" LED, on lower right column of the Diagnostic Display, should be illuminated. If "INPUTS DISPLAYED" LED is illuminated, press the toggle button on the Diagnostic Display to change the LED to "OUTPUTS DISPLAYED".

**NOTE:** It may be necessary to toggle between "INPUTS DISPLAYED" and "OUTPUTS DISPLAYED" several times to perform the following step. To change from inputs to outputs, press toggle button once. This may be done as often as required. **Do not press and hold toggle button**.

6. Sit on seat, start engine and attempt to operate the desired function of the machine. The appropriate output LED's should illuminate on the Diagnostic Display to indicate that the TEC controller is turning on that function.

**NOTE:** If the "DIAG. LAMP" output LED is blinking, this indicates that the TEC controller has detected a fault during machine operation. Refer to Diagnostic Light in this section for information on retrieval and clearing of controller faults.

A. If the correct output LED's do not illuminate, verify that the required input switches are in the necessary positions to allow that function to occur (see TEC Controller Logic Chart in this section). Verify correct switch function.

B. If the output LED's are on as specified, but the machine does not function properly, consider that the controller is operating correctly and a problem exists with some other component. Inspect electrical components and circuit for the affected function. Also, suspect a non-electrical problem (e.g. hydraulic component problem). Repair as necessary.

C. If each input switch is in the correct position and functioning correctly, but the output LED's are not correctly illuminated, this indicates a controller problem. If this occurs, contact your Toro Distributor for assistance.

7. After output function testing is completed, disconnect the Diagnostic Display from wire harness. Plug loopback connector into harness connector. Install control panel cover.

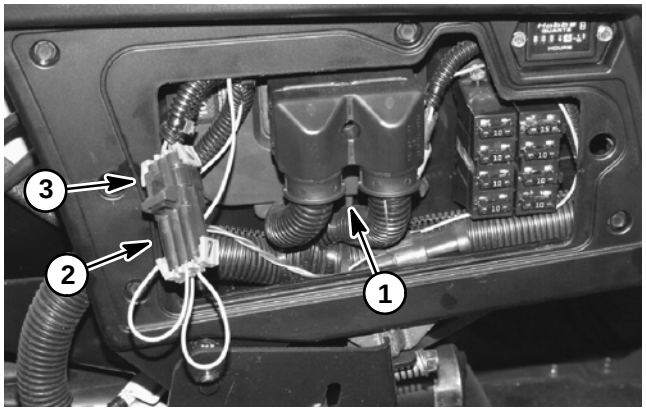



Figure 12

1. **TEC controller location**
2. **Loopback connector**
3. **Harness connector**

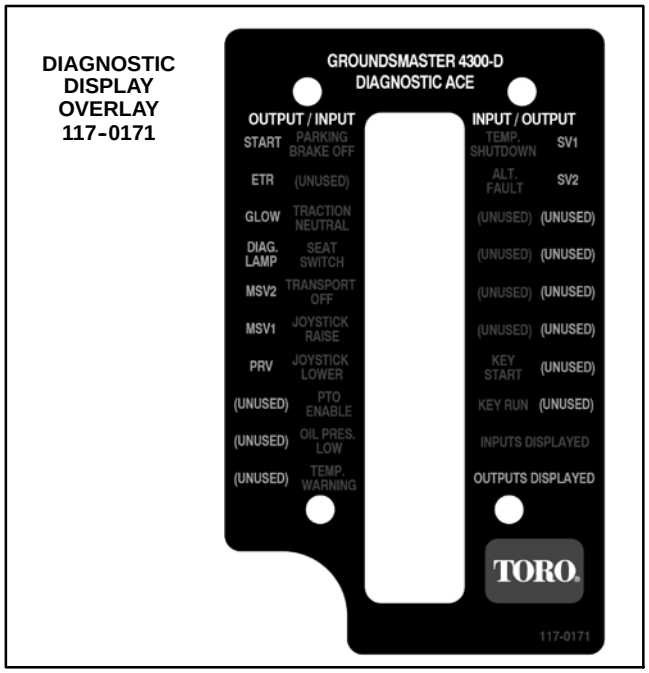



Figure 13

## TEC Controller Logic Chart

Each line of the following chart identifies the necessary component position (INPUTS) in order for the TEC controller to energize the appropriate OUTPUTS for machine operation.

Example: To start the engine with no operator in the seat, when the ignition key is in start, the traction pedal is in neutral and the parking brake is applied, the glow plugs and other necessary engine starting components will be energized.

**KEY TO CHART**

| | |
|---|---|
| X | Component (Input) Position |
| | Not Relevent for Function |
| P | Component (Output) Energized |

| MACHINE FUNCTION | INPUTS: Ignition Key in RUN | Ignition Key in START | Traction Pedal in NEUTRAL | Seat Occupied | Parking Brake Applied | Normal Coolant Temperature | Joystick Pulled to Rear (Raise) | Joystick Pushed Forward (Lower/Raise) | PTO Switch in ON | Mow speed limiter in MOW | OUTPUTS: Lift Manifold S1 Energized | Lift Manifold S2 Energized | Lift Manifold PRV Energized | Deck Manifold PRV2 (Front Decks) Energized | Deck Manifold PRV1 (Rear Decks) Energized | Engine Glow Plugs Energized | Engine Run Solenoid Hold Coil Energized | Engine Start (Run Solenoid and Start Solenoid Energized) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preheat | X | | | | | | | | | | | | | | | P | | |
| Start (No Operator in Seat) | | X | X | | X | | | | | | | | | | | P | | P |
| Start (Operator in Seat) | | X | X | X | | | | | | | | | | | | P | | P |
| Run (No Operator in Seat) | X | | X | | X | X | | | | | | | | | | | P | |
| Run (Operator in Seat) | X | | | X | | X | | | | | | | | | | | P | |
| Lower Cutting Units to Ground | X | | | | | | | X | | X | | P | P | P | | | P | |
| Mow (C.U. on Ground) | X | | | X | | X | | | X | X | | | P | P | P | P | P | |
| Raise (from Mow to Turn Around Position) | X | | | X | | | X | | X | X | | | | P | | | P | |
| Lower/Mow (from Turn Around Position) | X | | | X | | X | | X | X | X | | P | P | P | P | P | P | |
| Raise (to Transport Position) | X | | | | | | X | | | | | | | P | | | P | |
| Diagnostic Light Fault Retrieval | X | | X | | | | X | | | | | | | | | | | |
| Clearing Faults (From Retrieval Mode) | X | | | | | | X | | | X | | | | | | | | |

**NOTE:** For **Start** machine function, the joystick must be in the neutral (center) position and the PTO switch must be OFF.

**NOTE:** When the **Lower/Mow** machine function is completed, the front cutting decks engage while lowering to the ground followed shortly by the rear cutting decks engaging while lowering to the ground. The timing of this sequence is provided by the TEC controller.

**NOTE:** The **Diagnostic Light Fault Retrieval** machine function requires that the seat be unoccupied, the mow speed limiter be in the TRANSPORT position, the PTO switch be OFF and the cutting decks be in the lowered, mow position.

## Starting Problems

| Problem | Possible Causes |
|---|---|
| No electrical power to machine (including gauges). | Battery is discharged.<br>Ignition switch or circuit wiring is faulty.<br>Fusible link harness at the engine starter motor is faulty.<br>Battery cables are loose or corroded.<br>Fuse F1–1 (15 amp) or F1–2 (10 amp) is faulty. |
| Starter solenoid clicks, but starter will not crank.<br>**NOTE:** If the starter solenoid clicks, the problem is **not** in the interlock circuit. | Battery is discharged.<br>Battery cables are loose or corroded.<br>Ground cable is loose or corroded.<br>Wiring at the starter motor is faulty.<br>Starter solenoid or starter motor is faulty. |
| Engine starts, but stops when the ignition switch is released from the START position. | Engine fuel stop solenoid or circuit wiring is faulty (pull coil operates but hold coil is faulty). |
| Engine cranks, but does not start. | Engine and/or fuel may be too cold.<br>Fuel tank is empty.<br>Glow plugs or circuit wiring are faulty.<br>Engine fuel stop solenoid or circuit wiring is faulty.<br>Engine or fuel system is malfunctioning (see Chapter 3 - Kubota Diesel Engine).<br>Hydraulic load is slowing engine cranking speed (disconnect hydraulic pump drive shaft from engine to test). |

## Starting Problems (Continued)

| Problem | Possible Causes |
|---|---|
| Engine cranks, but should not, when the traction pedal is depressed. | Traction neutral switch is out of adjustment.<br>Traction neutral switch or circuit wiring is faulty. |
| Nothing happens when start attempt is made. Control panel lights and gauges operate with the ignition switch in RUN. | Traction pedal is not in neutral position.<br>Operator seat is unoccupied OR the parking brake is not applied.<br>Cutting decks are engaged (PTO switch is ON).<br>Traction neutral switch is out of adjustment.<br>Traction neutral switch or circuit wiring is faulty.<br>Seat switch or circuit wiring is faulty.<br>Parking brake switch or circuit wiring is faulty.<br>Joystick switch (raise or lower position) is faulty.<br>Ignition switch or circuit wiring is faulty.<br>Start relay or circuit wiring is faulty.<br>Main power relay or circuit wiring is faulty (headlights and powerpoint inoperative as well).<br>TEC controller fuses are faulty.<br>Fusible link harness at the engine starter motor is faulty.<br>Wiring to start circuit components is loose, corroded or damaged (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).<br>High temperature shutdown switch or circuit wiring is faulty.<br>Starter solenoid or starter motor is faulty.<br>TEC 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. | Engine fuel stop solenoid is faulty.<br>Ignition switch or circuit wiring is faulty.<br>Main power relay or circuit wiring 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.<br>Traction neutral switch is out of adjustment.<br>Traction neutral switch or circuit wiring is faulty.<br>TEC controller is faulty. |
| The engine stops during operation, but is able to restart.<br>**NOTE:** Excessive coolant temperature will cause the cutting decks to be disengaged and can lead to engine shutdown. 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 ten (10) seconds before the engine shuts down again. | Parking brake is engaged.<br>Operator is raising from the seat (seat switch not fully depressed).<br>Seat switch or circuit wiring is faulty.<br>Ignition switch or circuit wiring is faulty. |
| The engine kills when the traction pedal is depressed. | Parking brake is engaged.<br>Operator is not fully depressing the seat switch.<br>Seat switch or circuit wiring is faulty.<br>TEC controller fuses are faulty.<br>TEC controller is faulty. |
| Battery does not charge. | Wiring to charging circuit components is loose, corroded or damaged (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).<br>Alternator belt is loose or damaged.<br>Battery cables are loose or corroded.<br>Fusible link harness at the engine starter motor is faulty.<br>Alternator is faulty.<br>Battery is faulty. |

## Cutting Deck Operating Problems

| Problem | Possible Causes |
|---|---|
| The cutting decks remain engaged, but should not, with no operator in the seat. | Seat switch or circuit wiring is faulty.<br>TEC controller is faulty. |
| Cutting decks run, but should not, when raised. Cutting decks shut off with PTO switch. | A hydraulic problem in cutting deck circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).<br>TEC controller is faulty. |
| Cutting decks run, but should not, when raised. Cutting decks do not shut off with PTO switch. | PTO switch or circuit wiring is faulty.<br>A hydraulic problem in cutting deck circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).<br>TEC controller is faulty. |
| None of the cutting decks operate. Cutting decks are able to raise and lower.<br>**NOTE:** For cutting deck operation, operator seat needs to be occupied, mow speed limiter needs to be in mow position, decks need to be fully lowered and PTO switch needs to be engaged. | PTO switch is in the OFF position.<br>High coolant temperature has disabled cutting decks.<br>Seat switch or circuit wiring is faulty.<br>PTO switch or circuit wiring is faulty.<br>Mow/transport switch or circuit wiring is faulty.<br>Temperature sender or circuit wiring is faulty.<br>Circuit wiring to deck control manifold solenoids may be faulty.<br>A hydraulic problem in cutting deck circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).<br>TEC controller is faulty. |
| Cutting decks run, but should not, when lowered with joystick and PTO switch in the OFF position. | The PTO switch or circuit wiring is faulty.<br>TEC controller is faulty. |
| The front cutting decks do not operate. Rear cutting decks operate. Cutting decks are able to raise and lower. | Deck control manifold PRV2 solenoid coil or circuit wiring is faulty.<br>A hydraulic problem in front mow circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).<br>TEC controller is faulty. |

## Cutting Deck Operating Problems (Continued)

| Problem | Possible Causes |
|---|---|
| The rear cutting decks do not operate. Front cutting decks operate. Cutting decks are able to raise and lower. | Deck control manifold PRV1 solenoid coil or circuit wiring is faulty.<br><br>A hydraulic problem in rear mow circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).<br><br>TEC controller is faulty. |
| None of the cutting decks will lower. | Mow speed limiter is in the transport position.<br><br>Lower/mow switch on joystick or circuit wiring is faulty.<br><br>Mow/transport switch or circuit wiring is faulty.<br><br>Lift control manifold PRV solenoid coil or circuit wiring is faulty.<br><br>Lift control manifold S1 solenoid coil or circuit wiring is faulty.<br><br>A hydraulic problem in cutting deck lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).<br><br>TEC controller is faulty. |
| None of the cutting decks will raise. | Raise switch on joystick or circuit wiring is faulty.<br><br>Lift control manifold PRV solenoid coil or circuit wiring is faulty.<br><br>Lift control manifold S2 solenoid coil or circuit wiring is faulty.<br><br>A hydraulic problem in cutting deck lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).<br><br>TEC controller is faulty. |
| One cutting deck will not raise or lower, but all other cutting decks will raise and lower. | A hydraulic problem in cutting deck lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System). |

# Electrical System Quick Checks

## Battery Test (Open Circuit Test)

Use a digital multimeter to measure the battery voltage.

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

**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).

| Voltage Measured | Battery Charge Level |
|---|---|
| 12.68 volts | Fully charged (100%) |
| 12.45 volts | 75% charged |
| 12.24 volts | 50% charged |
| 12.06 volts | 25% charged |
| 11.89 volts | 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 **(3200 RPM)**. Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

After running the engine for at least three (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 |

## Glow Plug System Test

This is a fast, simple test that can help to determine the integrity and operation of your Groundsmaster glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Use a digital multimeter and/or inductive Ammeter (AC/DC Current Transducer). Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions) and set the multimeter to the correct scale. With the ignition switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system by turning the ignition switch to RUN and record the multimeter results.

The Groundsmaster 4300–D glow plug system should have a reading of approximately 36 amps total (9 amps per glow plug). If low current reading is observed, one (or more) glow plugs is faulty.

## Check Operation of Interlock Switches

**CAUTION**

**The interlock switches are for the protection of the operator and bystanders and to ensure correct operation of the machine. Do not bypass or disconnect switches. 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 Traction Unit Operator's Manual. Your Groundsmaster is equipped with a TEC controller which monitors interlock switch operation. Information on the controller is described in the Traction Unit 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 neutral switch, the parking brake switch, 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 Diagnostic Display (see Special Tools in this chapter) to test TEC controller inputs and outputs before further troubleshooting of an electrical problem on your Groundsmaster.

## Traction Neutral Switch

The traction neutral switch is a normally open proximity switch that closes when the traction pedal is in the neutral position. The switch mounts to a bracket on the traction pump (Fig. 14). The sensing plate for the traction neutral switch is the traction lever bracket that is secured to the pump control arm.

### Adjustment

1. Before adjusting the traction neutral switch, check and adjust traction system neutral position (see Traction Unit Operator's Manual).

**IMPORTANT: To prevent traction neutral switch damage, make sure that traction lever bracket does not contact switch.**

2. When the traction lever is in the neutral position, the gap between the head of neutral switch and the traction lever bracket should be from 0.070" to 0.100" (1.8 to 2.5 mm) (Fig. 15).

3. If gap is incorrect, loosen jam nuts that secure neutral switch to pump bracket. Position switch with jam nuts to allow correct gap between switch and traction lever bracket. Jam nuts should be torqued from **162 to 198 in-lb (18.4 to 22.4 N-m)**. After jam nuts are tightened, make sure that clearance between head of neutral switch and traction lever bracket has not changed.

4. After adjustment to the traction neutral switch, use the Diagnostic Display (see Special Tools in this chapter) to verify that traction neutral switch and circuit wiring are functioning correctly (see Traction Neutral Switch in the Component Testing section of this chapter).

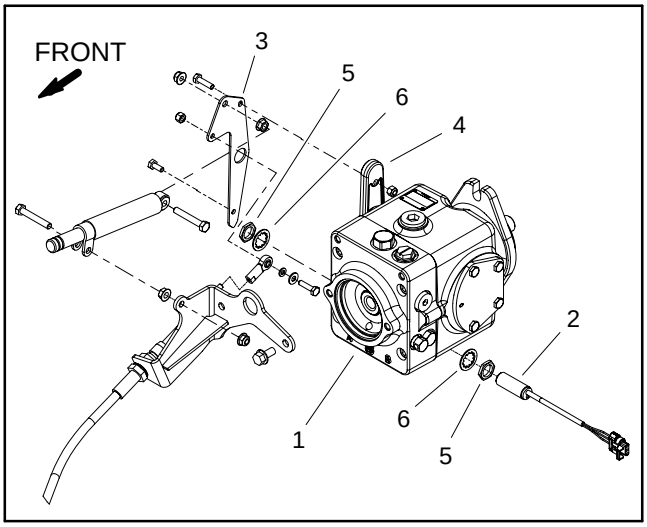



Figure 14

1. Traction pump
2. Traction neutral switch
3. Traction lever bracket
4. Pump control arm
5. Jam nut (2 used)
6. Lock washer (2 used)

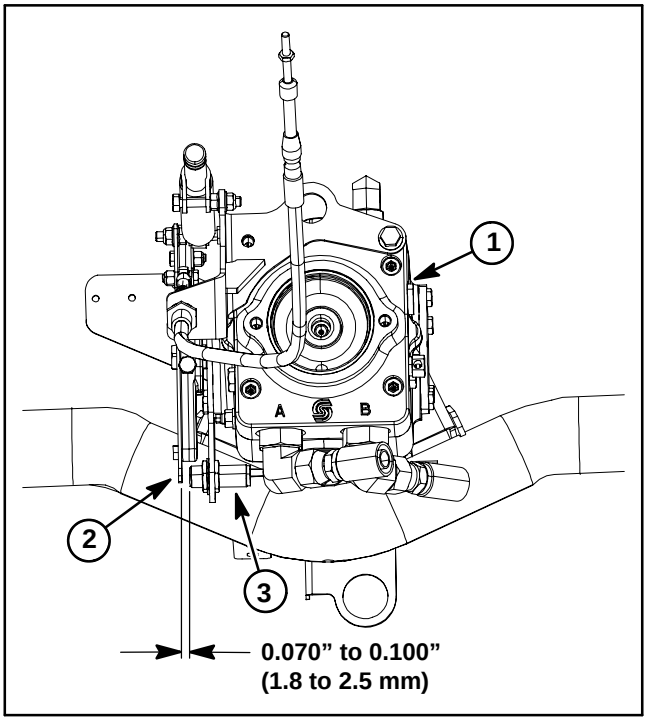



Figure 15

1. Traction pump
2. Traction lever bracket
3. Traction neutral switch

## Parking Brake Switch

The parking brake switch is a normally open proximity switch. The parking brake switch is attached to the bottom of the brake pedal (Fig. 16).

When the parking brake is not applied, the parking brake detent is positioned near the target end of the parking brake switch so the switch is closed. The parking brake detent is moved away from the switch when the parking brake is applied causing the switch to open.

### Adjustment

1. When the parking brake is not applied, the gap between the parking brake switch and the tab on the parking brake detent should be from 0.070" to 0.100" (1.8 to 2.5 mm).

2. If gap is incorrect, loosen jam nuts that secures switch to brake lever. Position switch with jam nuts to allow correct gap between switch and detent tab. Tighten jam nuts to secure adjustment. Jam nuts should be torqued from **162 to 198 in-lb (18.4 to 22.4 N-m)**. After jam nuts are tightened, make sure that clearance between head of parking brake switch and tab on the parking brake detent has not changed.

3. After adjustment to the parking brake switch, use the Diagnostic Display (see Special Tools in this chapter) to verify that parking brake switch and circuit wiring are functioning correctly (see Parking Brake Switch in the Component Testing section of this chapter).

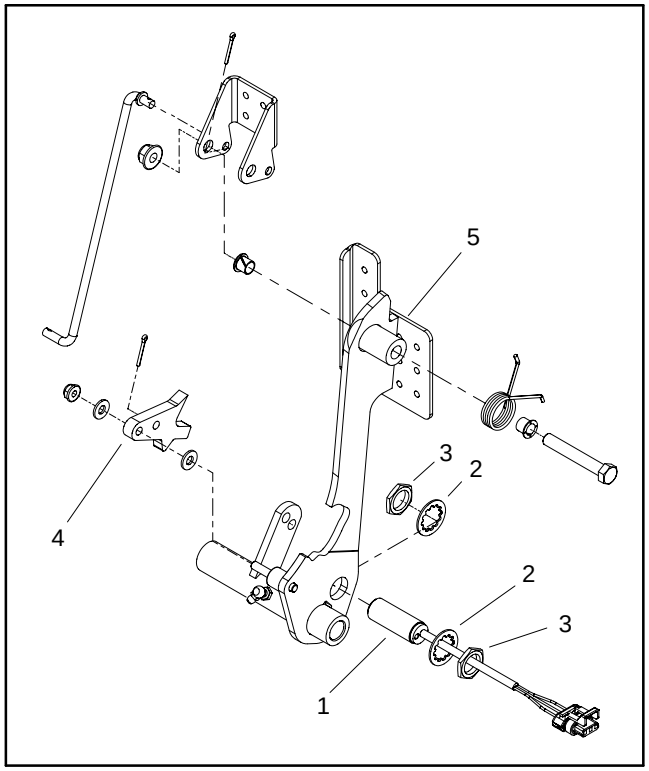



Figure 16

1. **Parking brake switch**
2. **Lock washer (2 used)**
3. **Jam nut (2 used)**
4. **Parking brake detent**
5. **Brake pedal**

## Mow/Transport Switch

The mow/transport switch is a normally closed proximity switch that opens when the mow speed limiter is placed in the transport position. The switch mounts to a bracket on the footrest platform (Fig. 17). The sensing plate for the mow/transport switch is a tab on the mow speed limiter.

### Adjustment

1. The gap between the mow/transport switch and the mow speed limiter should be from 0.070” to 0.100” (1.8 to 2.5 mm).

2. If gap is incorrect, loosen jam nuts that secure switch to footrest platform. Position switch with jam nuts to allow correct gap between switch and mow speed limiter. Tighten jam nuts to secure adjustment. Jam nuts should be torqued from **162 to 198 in-lb (18.4 to 22.4 N-m)**. After jam nuts are tightened, make sure that clearance between head of mow/transport switch and the mow speed limiter has not changed.

3. After adjustment to the mow/transport switch, use the Diagnostic Display (see Special Tools in this chapter) to verify that mow/transport switch and circuit wiring are functioning correctly (see Mow/Transport Switch in the Component Testing section of this chapter).

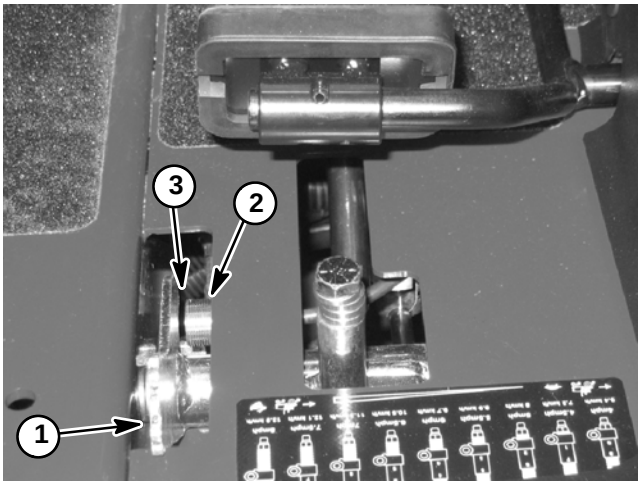



Figure 17

1. **Mow speed limiter**
2. **Mow/transport switch**
3. **Gap**

# Component Testing

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

**NOTE:** Electrical troubleshooting of any 12 volt power connection can be performed through voltage drop tests without disconnecting the component.

**NOTE:** Use the Diagnostic Display (see Special Tools in this chapter) to test TEC controller inputs and outputs before further troubleshooting of an electrical problem on your Groundsmaster.

**NOTE:** For engine component testing information, see the Kubota Workshop Manual, Diesel Engine, 05–E3B Series at the end of Chapter 3 – Kubota Diesel Engine.

**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 switch is mounted on the control console.

### 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 Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that ignition switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Diagnostic Display determines that ignition switch and circuit wiring **are not** functioning correctly, proceed with test procedure.

2. Remove outside control arm cover to gain access to ignition switch (see Control Arm Disassembly in the Service and Repairs section of Chapter 6 – Chassis). Disconnect wire harness electrical connector from the switch.

3. 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 switch position. The ignition switch terminals are marked as shown in Figure 18. The circuitry of this switch is shown in the chart below. Verify continuity between switch terminals.

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

4. Replace ignition switch if necessary.

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

6. Connect wire harness electrical connector to the ignition switch.

7. Install control arm cover to machine (see Control Arm Assembly in the Service and Repairs section of Chapter 6 – Chassis).

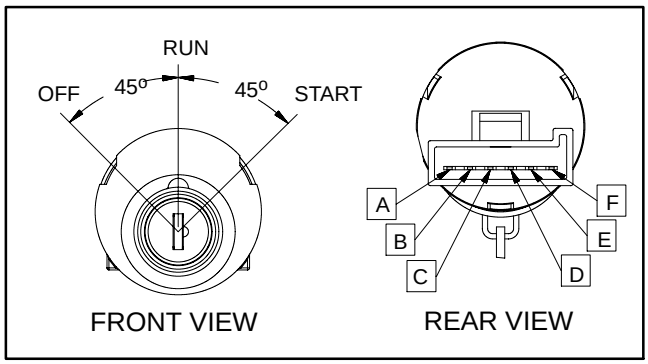



Figure 18

## Indicator Lights

### Glow Plug Indicator Light

The glow plug indicator light should come on when the ignition switch is placed in the RUN position prior to placing the ignition switch in START. The light should stay lit for approximately six (6) seconds while the ignition switch is left in the RUN position. The indicator light should also be illuminated when the ignition switch is in the START position.

### High Temperature Warning Light

If the engine coolant temperature reaches 221°F (105°C) (approximate), the high temperature warning light should come on.

**NOTE:** When machine is in mow operation, high coolant temperature will cause the cutting decks to shut off in addition to warning light illumination.

### Engine Oil Pressure Light

The engine oil pressure light should come on when the ignition switch is in the RUN position with the engine not running. Also, it should illuminate with the engine running if the engine oil pressure drops to an unsafe level.

To test the oil pressure light and circuit wiring, ground the wire attached to oil pressure switch located on the engine near the oil filter. Turn ignition switch to the RUN position; the engine oil pressure light should come on indicating correct operation of the indicator light and circuit wiring.

### Charge Indicator Light

The charge indicator light should come on when the ignition switch is in the RUN position with the engine not running. Also, it should illuminate with an improperly operating charging circuit while the engine is running.

### Testing Indicator Lights

If testing of the indicator lights is necessary:

1. Remove control arm covers to gain access to indicator light and harness connectors (see Control Arm Disassembly in the Service and Repairs section of Chapter 6 – Chassis).

2. Locate the indicator light to be tested and disconnect the wire harness electrical connector from the light.

3. Apply 12 VDC to terminals 1A and 2A (Fig. 20).

4. Ground terminals 1B and 2B (Fig. 20).

5. Both indicator lights should illuminate.

6. Connect wire harness electrical connector to the indicator light.

7. Install control arm cover to machine (see Control Arm Assembly in the Service and Repairs section of Chapter 6 – Chassis).

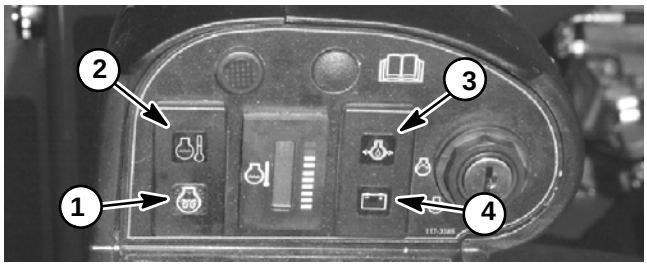



Figure 19

1. **Glow plug indicator**
2. **High temp warning**
3. **Engine oil pressure**
4. **Charge indicator**

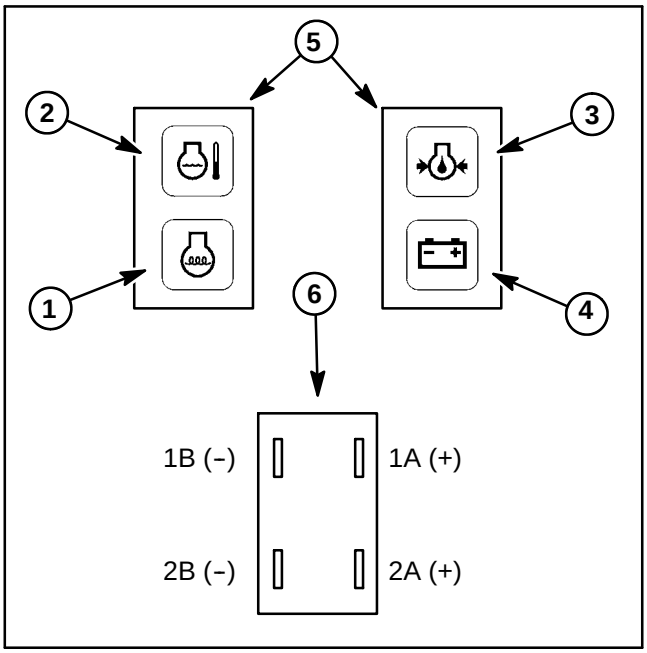



Figure 20

1. **Glow plug indicator**
2. **High temp warning**
3. **Engine oil pressure**
4. **Charge indicator**
5. **Indicator light front**
6. **Indicator light back**

## Hour Meter

The hour meter is located on the outside of the control arm.

1. Remove control arm covers to gain access to hour meter and meter terminals (see Control Arm Disassembly in the Service and Repairs section of Chapter 6 – Chassis).

2. Make sure ignition switch is in the OFF position. Locate the hour meter and disconnect the wire harness electrical connector from the meter.

3. Connect the positive (+) terminal of a 12 VDC source to the positive (+) terminal of the hour meter.

4. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

5. The hour meter should move 1/10 of an hour every six (6) minutes.

6. Disconnect the voltage source from the hour meter.

7. Replace the hour meter if necessary.

8. Connect wire harness electrical connector to the hour meter.

9. Install control arm covers to machine (see Control Arm Assembly in the Service and Repairs section of Chapter 6 – Chassis).

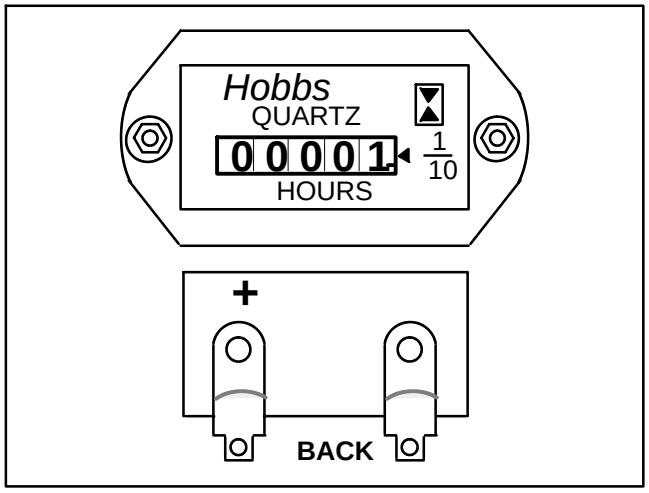



Figure 21

## Temperature Gauge

The temperature gauge on the control panel indicates engine coolant temperature level during machine operation. The changing resistance of the engine temperature sender signals the temperature gauge.

The temperature gauge should display the first green segment when the ignition switch is turned to RUN. The first yellow segment on the gauge should display when engine coolant temperature is approximately 212°F (100°C).

When engine coolant temperature rises to approximately 221°F (105°C), the temperature gauge should display the first red segment. At this point, the temperature gauge provides an input to the TEC controller. This controller input causes the high temperature warning light on the control panel to illuminate and the cutting decks to shut down.

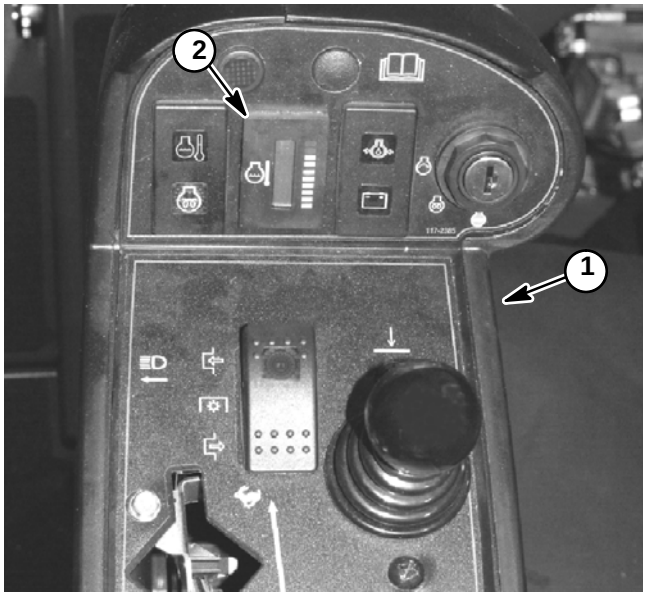



Figure 22

1. **Control panel**
2. **Temperature gauge**

## PTO Switch

The PTO switch is mounted on the control panel and allows the cutting decks to operate when the front of the switch is depressed. An indicator light on the switch identifies when the PTO switch is engaged.

The TEC 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 controller controls the energizing of the hydraulic solenoid valves used to drive the cutting deck motors.

**NOTE:** To engage the PTO, the seat has to be occupied, the mow speed limiter has to be in the mow position and the cutting decks have to be fully lowered.

### 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 Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the PTO switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Diagnostic Display determines that the PTO switch and circuit wiring **are not** functioning correctly, proceed with test procedure.

2. Remove control arm covers to gain access to PTO switch (see Control Arm Disassembly in the Service and Repairs section of Chapter 6 – Chassis).

3. Make sure ignition switch is in the OFF position. Disconnect wire harness electrical connector from the PTO switch.

4. 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 switch position. The PTO switch terminals are marked as shown in Figure 24. The circuitry of this switch is shown in the chart below. Verify continuity between switch terminals.

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

5. Replace PTO switch if necessary.

6. If PTO switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).

7. Connect wire harness electrical connector to the PTO switch.

8. Install control arm cover to machine (see Control Arm Assembly in the Service and Repairs section of Chapter 6 – Chassis).

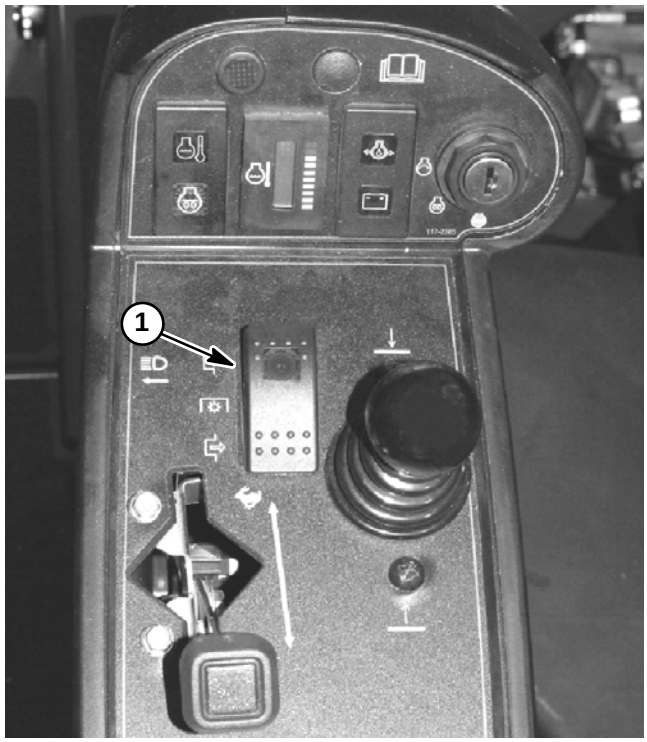
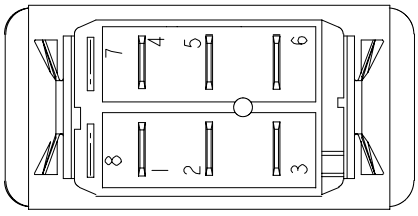



Figure 23

**1. PTO switch**




**BACK OF SWITCH**

Figure 24

**NOTE:** PTO switch terminals 7 and 8 are for the switch indicator light. Switch terminals 1, 4, 5 and 6 are not used on Groundsmaster 4300–D machines.

## Headlight Switch

The headlight switch is located on the operator side of the control arm. This rocker switch allows the headlights to be turned on and off.

### Testing

1. Remove inside control arm cover to gain access to headlight switch (see Control Arm Disassembly in the Service and Repairs section of Chapter 6 – Chassis).

2. Make sure ignition switch is in the OFF position. Disconnect wire harness electrical connector from the headlight switch.

3. 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. The switch terminals are marked as shown in Figure 26. The circuitry of the headlight switch is shown in the chart below. Verify continuity between switch terminals.

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

4. Replace headlight switch if necessary. Connect wire harness electrical connector to the headlight switch.

5. Install control arm cover to machine (see Control Arm Assembly in the Service and Repairs section of Chapter 6 – Chassis).

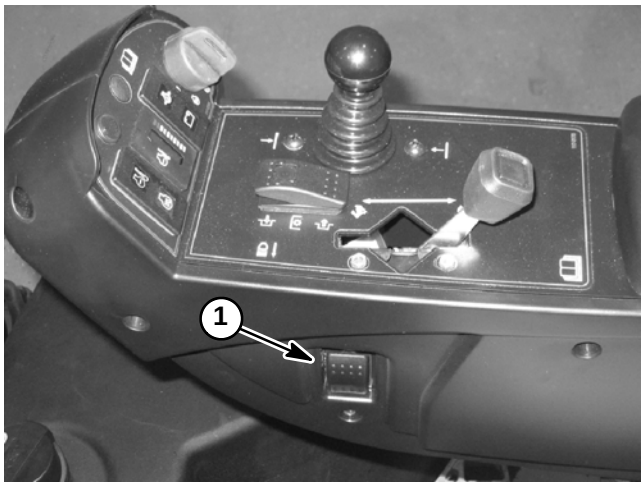



Figure 25

**1. Headlight switch**

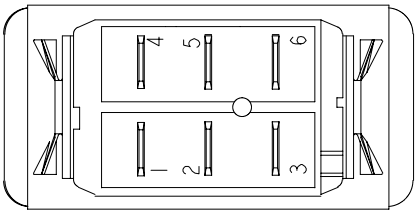



Figure 26

**NOTE:** Headlight switch terminals 3, 4, 5 and 6 are not used on Groundsmaster 4300–D machines.

## Seat Switch

The seat switch is normally open and closes when the operator seat is occupied. This switch is used as an input for the TEC controller. If the traction system or PTO switch is engaged when the operator raises out of the seat, the engine will stop. The seat switch is located directly under the operator seat.

### 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 Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the seat switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Diagnostic Display determines that the seat switch and circuit wiring **are not** functioning correctly, proceed with test procedure.

2. Make sure ignition switch is in the OFF position.

3. Disconnect wire harness electrical connector from the seat switch electrical lead near the operator manual tube under the operator seat (Fig. 27).

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

5. With no pressure on the seat, there should be no continuity (open) between the seat switch terminals.

6. Press directly onto the seat switch through the seat cushion. There should be continuity (closed) as the seat cushion approaches the bottom of its travel.

7. If seat switch is faulty, replace switch (see Operator Seat Removal in the Service and Repairs section of Chapter 6 – Chassis).

8. If the seat switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).

9. Connect wire harness electrical connector to the seat switch electrical lead.

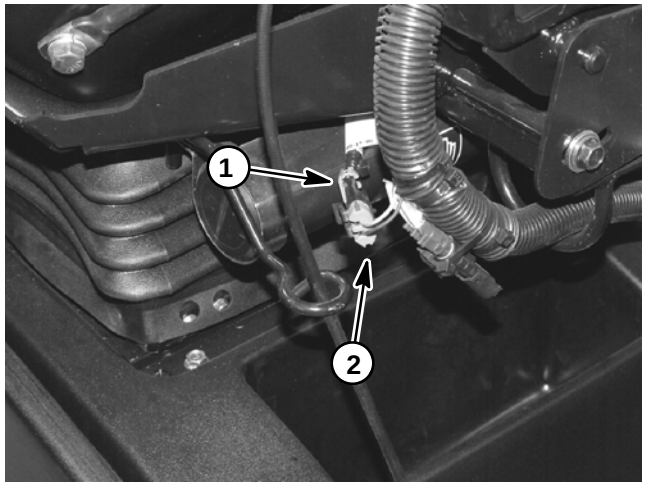



Figure 27

**1. Seat switch lead** **2. Electrical connector**

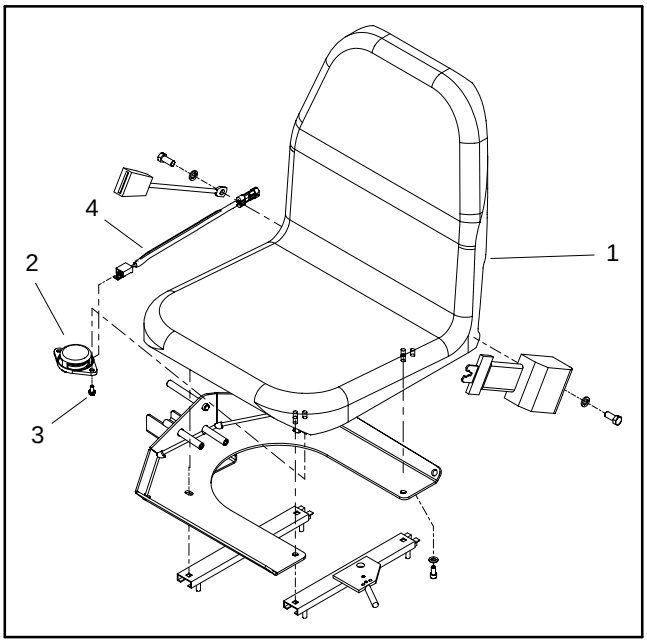



Figure 28

**1. Operator seat** **3. Screw (2 used)**
**2. Seat switch** **4. Seat wire harness**

## Joystick Raise and Lower Switches

Two (2) micro switches for the joystick are located on the lift control that is attached to the control arm. The rear switch on the control is used to lower (and engage) the cutting decks and the front switch to raise (and disengage) them. These switches are used as inputs for the TEC controller. A normally open contact in the switch closes when the joystick is positioned to either lower or raise the cutting decks. Each switch has an electrical connector to make sure the normally closed contact on the switch is not used. The raise switch has yellow/blue and black harness wires connected to it and the lower switch has orange and black harness wires connected to it.

### Testing

1. Before disconnecting the joystick switches for testing, the switches and their circuit wiring should be tested as TEC controller inputs with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the joystick switches and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Diagnostic Display determines that either joystick switch and circuit wiring **are not** functioning correctly, proceed with test procedure.

2. Remove control arm covers to gain access to joystick switches (see Control Arm Disassembly in the Service and Repairs section of Chapter 6 – Chassis).

3. Make sure ignition switch is in the OFF position.

4. Disconnect wire harness electrical connector from the raise or lower switch that is to be tested (Fig. 29).

5. Connect a multimeter (ohms setting) across the normally open (NO) and common terminals of the switch (Fig. 30).

6. With the joystick in the neutral (center) position, there should be no continuity (open) across the switch terminals.

7. Move and hold the joystick to activate the switch being tested. There should be continuity (closed) across the switch terminals.

8. If joystick switch is faulty, replace switch.

9. If the joystick switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).

10. Connect wire harness electrical connector to the joystick switch.

11. Install control arm covers to machine (see Control Arm Assembly in the Service and Repairs section of Chapter 6 – Chassis).

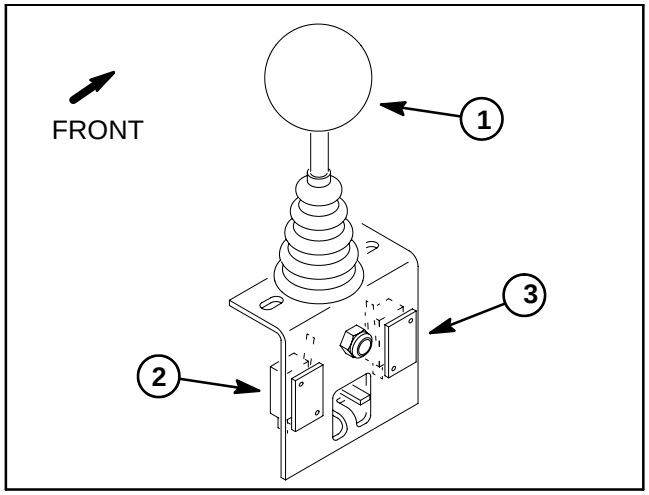



Figure 29

1. **Joystick**
2. **Lower switch**
3. **Raise switch**

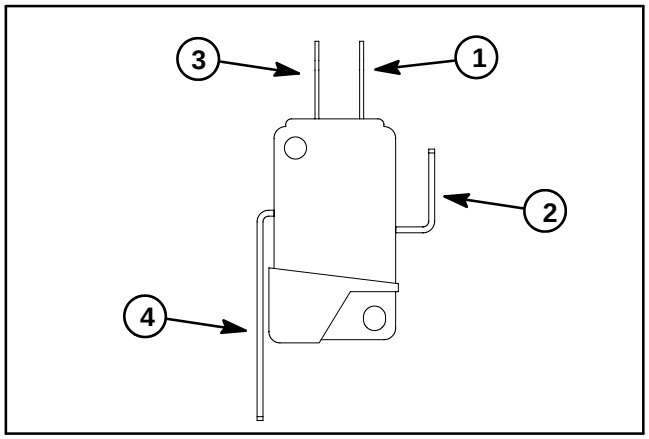



Figure 30

1. **NO terminal**
2. **Common terminal**
3. **NC terminal (not used)**
4. **Switch lever**

## Traction Neutral Switch

The traction neutral switch is a normally open proximity switch that closes when the traction pedal is in the neutral position. The switch mounts to a bracket on the traction pump (Fig. 31). The sensing plate for the traction neutral switch is the traction lever bracket that is secured to the pump control arm. The neutral switch is used as an input for the TEC controller.

### Testing

1. Before disconnecting the traction neutral switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the traction neutral switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Diagnostic Display determines that the traction neutral switch and circuit wiring **are not** functioning correctly, proceed with testing procedure.

2. Turn ignition switch to the ON position (do not start engine) and check LED on cable end of neutral switch (Fig. 31). LED **should be** illuminated when the traction pedal **is** in the neutral position.

3. With the ignition switch still in the ON position (do not start engine), press traction pedal out of the neutral position and check LED on cable end of neutral switch. LED **should not be** illuminated when the traction pedal **is not** in the neutral position.

4. If the neutral switch LED did not function correctly:

   A. Make sure that neutral switch is properly adjusted (see Traction Neutral Switch in the Adjustments section of this chapter). If necessary, adjust switch and return to step 2 above.

   B. Make sure ignition switch is OFF and disconnect the traction neutral switch connector from the machine wire harness.

   C. Verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

   D. Turn ignition switch to the ON position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

   E. If black wire is closed to ground, pink wire has system voltage present and switch LED did not function, replace traction neutral switch. Adjust switch after installation (see Traction Neutral Switch in the Adjustments section of this chapter).

5. If the neutral switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).

6. Make sure that traction neutral switch is connected to wire harness when testing is complete.

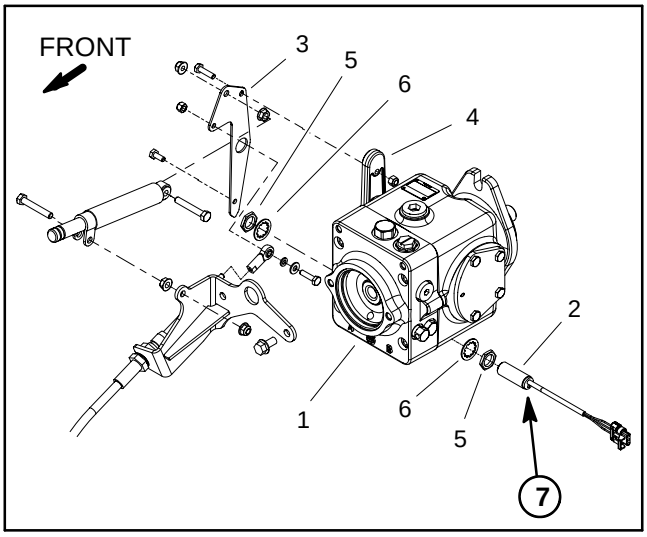



Figure 31

1. **Traction pump**
2. **Traction neutral switch**
3. **Traction lever bracket**
4. **Pump control arm**
5. **Jam nut (2 used)**
6. **Lock washer (2 used)**
7. **Switch LED location**

## Parking Brake Switch

The parking brake switch is a normally open proximity switch. The parking brake switch is attached to the bottom of the brake pedal (Fig. 32). The parking brake switch is used as an input for the TEC controller.

When the parking brake is not applied, the parking brake detent is positioned near the target end of the parking brake switch so the switch is closed. The parking brake detent is moved away from the switch when the parking brake is applied causing the switch to open.

**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 Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the parking brake switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Diagnostic Display determines that the parking brake switch and circuit wiring **are not** functioning correctly, proceed with testing procedure.

2. Turn ignition switch to the ON position (do not start engine) and check LED on cable end of brake switch (Fig. 32). LED **should be** illuminated when the parking brake **is not** applied.

3. With the ignition switch still in the ON position (do not start engine), apply parking brake and check LED on cable end of parking brake switch. LED **should not be** illuminated when the parking brake **is** applied.

4. If the brake switch LED did not function correctly:

   A. Make sure that brake switch is properly adjusted (see Parking Brake Switch in the Adjustments section of this chapter). If necessary, adjust switch and return to step 2 above.

   B. Make sure ignition switch is OFF and disconnect the parking brake switch connector from the machine wire harness.

   C. Verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

   D. Turn ignition switch to the ON position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

   E. If black wire is closed to ground, pink wire has system voltage present and switch LED did not function, replace parking brake switch. Adjust switch after installation (see Parking Brake Switch in the Adjustments section of this chapter).

5. If the parking brake switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).

6. Make sure that parking brake switch is connected to wire harness when testing is complete.

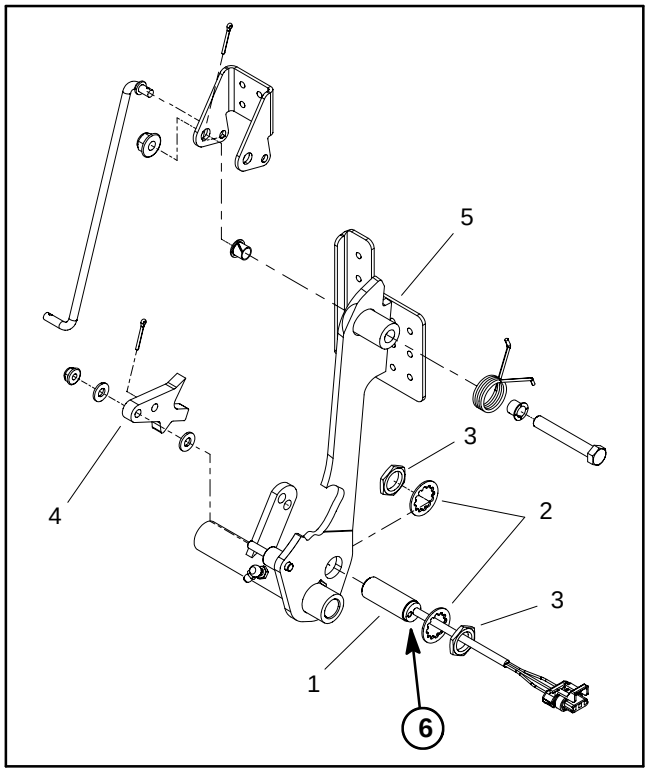



Figure 32

1. **Parking brake switch**
2. **Lock washer (2 used)**
3. **Jam nut (2 used)**
4. **Parking brake detent**
5. **Brake pedal**
6. **Switch LED location**

## Mow/Transport Switch

The mow/transport switch is a normally closed proximity switch that opens when the mow speed limiter is placed in the transport position. The switch mounts to a bracket on the footrest platform. The sensing plate for the mow/transport switch is the mow speed limiter. The mow/transport switch is used as an input for the TEC controller.

### 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 Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the mow/transport switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Diagnostic Display determines that the mow/transport switch and circuit wiring **are not** functioning correctly, proceed with testing procedure.

2. Turn ignition switch to the ON position (do not start engine) and check LED on cable end of mow/transport switch (Fig. 33). LED **should be** illuminated when the mow speed limiter is in the MOW position. The LED **should not be** illuminated when the limiter is in the TRANSPORT position.

3. If the mow/transport switch LED did not function correctly:

   A. Make sure that the mow/transport switch is properly adjusted (see Mow/Transport Switch in the Adjustments section of this chapter). If necessary, adjust switch and return to step 2 above.

   B. Make sure ignition switch is OFF and disconnect the mow/transport switch connector from machine wire harness.

   C. Verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

   D. Turn ignition switch to the ON position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

   E. If black wire is closed to ground, pink wire has system voltage present and switch LED did not function, replace mow/transport switch. Adjust switch after installation (see Mow/Transport Switch in the Adjustments section of this chapter).

4. If the mow/transport switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).

5. Make sure that mow/transport switch is connected to wire harness when testing is complete.

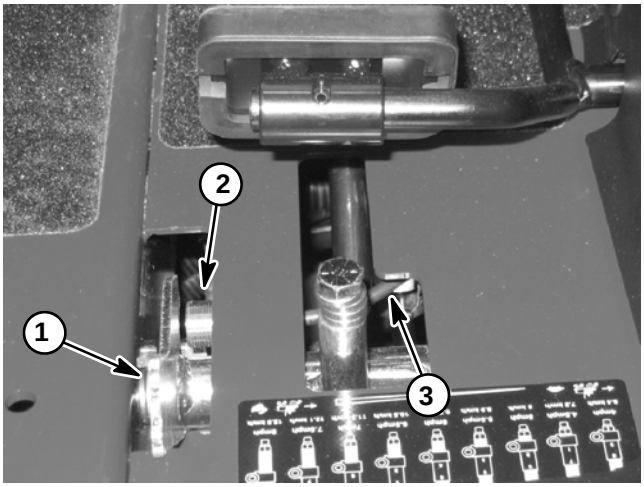



Figure 33

1. **Mow speed limiter**
2. **Mow/transport switch**
3. **Switch cable**

## Start Relay

The start relay is used in the engine starting circuit. When energized by the TEC controller, the start relay provides a current path to energize the engine starter solenoid. The start relay is attached to a frame bracket under the hood next to the hydraulic pump drive shaft (Fig. 34).

The TEC controller controls and monitors the operation of the start relay. The relay and its circuit wiring **should** be tested as a controller output with the Diagnostic Display before disconnecting and testing the relay (see Diagnostic Display in the Troubleshooting section of this chapter). If the controller has detected a malfunction in the start relay circuit, the Diagnostic light can be used to identify the fault (see Diagnostic Light in the Troubleshooting section of this chapter).

### Testing

1. Before disconnecting the start relay for testing, test relay and its circuit wiring as a TEC controller output with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the relay and circuit wiring **are** functioning correctly, no further relay testing is necessary.

2. If the Diagnostic Display determines that start relay and circuit wiring **are not** functioning correctly, park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to relay.

3. Locate start relay and disconnect the machine wire harness connector from the relay. Remove relay from machine 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 of the component you are testing.

4. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 35). Resistance should be between 70 and 90 ohms.

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

6. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.

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

8. When testing is completed, disconnect voltage and multimeter leads from the relay terminals. Replace relay if necessary.

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

10. Lower and secure hood.

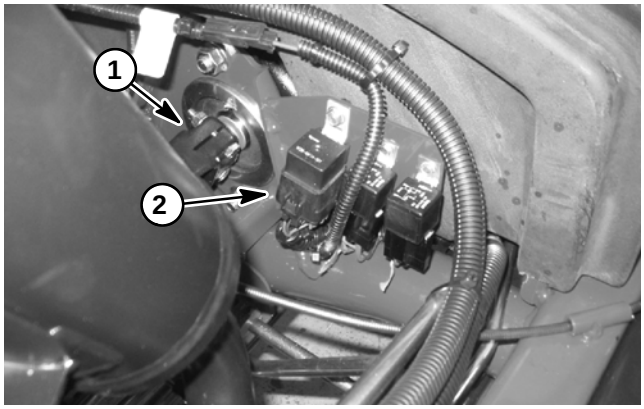



Figure 34

1. **Pump drive shaft**
2. **Start relay**

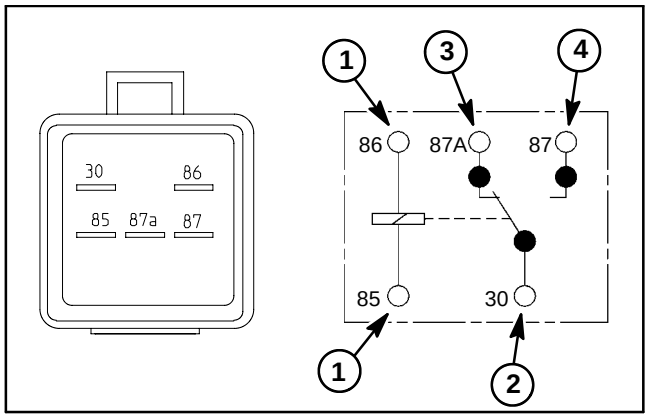



Figure 35

1. **Coil terminal**
2. **Common terminal**
3. **Normally closed term.**
4. **Normally open term.**

## Main Power and Glow Relays

The Groundsmaster electrical system includes two identical relays for current control. The main power and glow relays are attached to a frame bracket under the hood next to the hydraulic pump drive shaft (Fig. 36). Relays can be identified by a tag on the wire harness.

The main power relay is used to provide current to the TEC controller, headlights, power point and optional electric equipment. When the ignition switch is in the RUN or START position, the main power relay is energized.

The glow relay is used to provide current to the engine glow plugs when energized by the TEC controller. The controller controls and monitors the operation of the glow relay. The glow relay and its circuit wiring **should** be tested as a controller output with the Diagnostic Display before disconnecting and testing the relay (see Special Tools and Troubleshooting in this chapter).

### Testing

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

2. Open hood to gain access to relay.

3. Locate relay and disconnect the machine wire harness connector from the relay. Remove relay from machine 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 from the measured value of the component you are testing.

4. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting) (Fig. 37). Resistance should be approximately 72 ohms.

5. 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.

6. Disconnect voltage and test leads from the relay terminals. Replace relay if necessary.

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

8. Lower and secure hood.

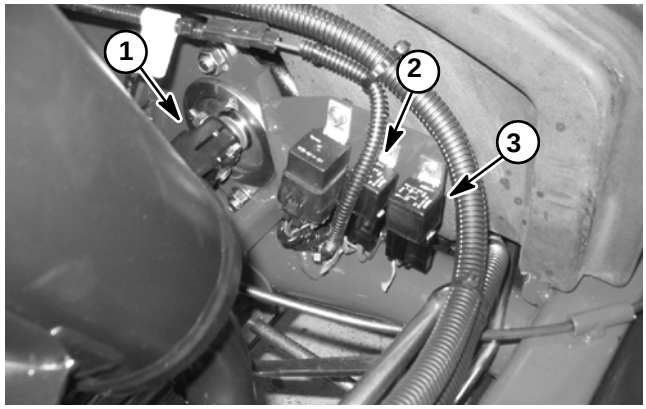



Figure 36

1. **Pump drive shaft**
2. **Main power relay**
3. **Glow relay**

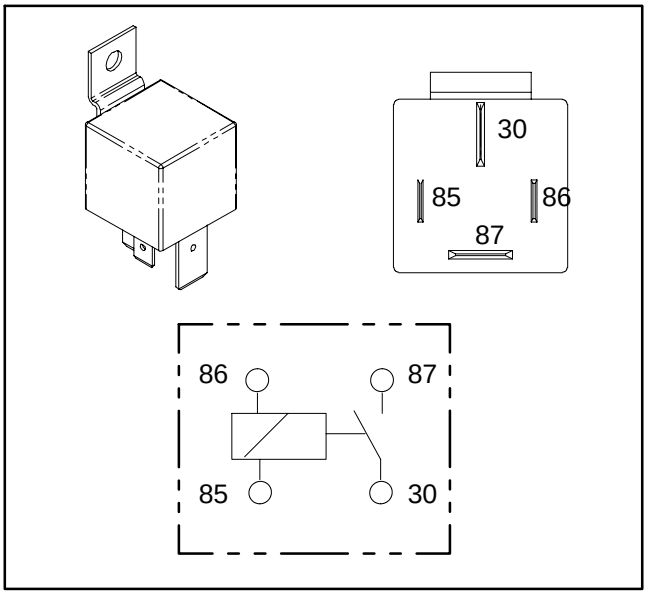



Figure 37

## Toro Electronic Controller (TEC)

The Groundsmaster 4300–D uses a Toro Electronic Controller (TEC) to monitor the condition of various switches (inputs) and then direct power output to allow certain machine functions. The controller is located behind the control arm access cover next to the fuse block (Fig. 38). The handheld Diagnostic Display (see Special Tools in this chapter) with the correct overlay should be used when checking inputs and outputs of the controller used on your Groundsmaster (see Troubleshooting in this chapter).

Inputs from the ignition, neutral, parking brake, PTO, seat, mow/transport, joystick lower/raise, temperature gauge output, hydraulic pressure, engine oil pressure and engine high temperature shutdown switches are all monitored by the controller.

Current output to the cutting deck circuit hydraulic valve solenoid coils, lift circuit hydraulic valve solenoid coils, diagnostic light and engine components (glow plug relay, start relay, fuel pump and engine run solenoid) are controlled based on the inputs received by the controller.

If the controller detects a malfunction in any of the controlled circuits, the diagnostic light can be used to identify the fault (see Diagnostic Light in the Troubleshooting section of this chapter).

Because of the solid state circuitry built into the controller, there is no method to test it directly. The controller may be damaged if an attempt is made to test it with an electrical test device, such as a digital multimeter.

**IMPORTANT: Before performing any welding on the machine, disconnect both positive and negative battery cables from the battery, disconnect the wire harness connector from the TEC controller and disconnect the terminal connector from the alternator. This will prevent damage to the electrical system of your Groundsmaster.**

If the wire harness connector is removed from the TEC controller for any reason,tighten the harness connector screw from **25 to 28 in–lb (2.8 to 3.2 N·m)**.

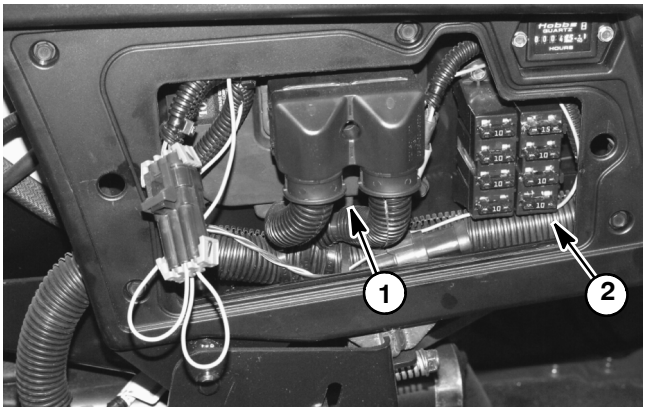



Figure 38

1. **TEC controller**
2. **Fuse block**

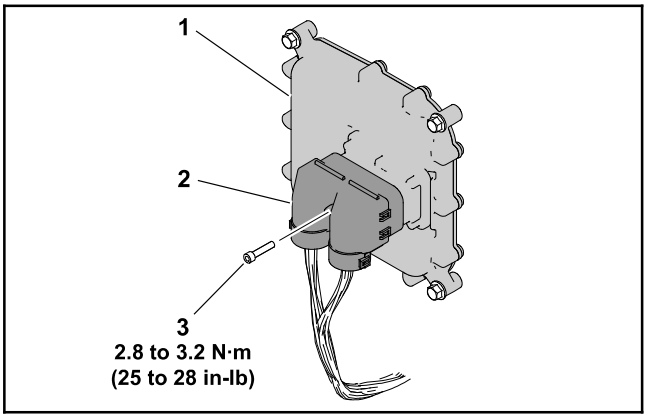



Figure 39

1. **TEC controller**
2. **Harness connector**
3. **Socket head screw**

## Fuses

The fuse block is located behind the control arm access cover (Fig. 39).

In addition to the fuses in the fuse block, a 2 amp fuse (F3) is included in the wire harness to protect the logic power circuit for the TEC controller. This fuse resides in a fuse holder near the battery (Fig. 41).

### Identification and Function

Use Figure 40 to identify each individual fuse and its correct amperage. Fuses for your Groundsmaster have the following function:

**F1 – 1 (15 Amp):** Protects starter circuit power supply.

**F1 – 2 (10 Amp):** Protects main power supply.

**F1 – 3 (10 Amp):** Protects power supply for headlights.

**F1 – 4 (10 Amp):** Protects power supply for power point.

**F2 – 1 (7.5 Amp):** Protects power supply for TEC controller outputs.

**F2 – 2 (7.5 Amp):** Protects power supply for TEC controller outputs.

**F2 – 3 (7.5 Amp):** Protects power supply for TEC controller outputs.

**F2 – 4 (15 Amp) (if equipped):** Protects power supply for the optional air ride operator seat.

### Testing

Turn ignition switch to the ON position (do not start engine). With the fuse installed in the fuse block, use a multimeter to verify that 12 VDC exists at both of the terminal test points on the fuse. If 12 VDC exists at one of the fuse test points but not at the other, the fuse is faulty.

If necessary, remove fuse from the fuse block to check fuse resistance. Fuse should have continuity between the fuse terminals.

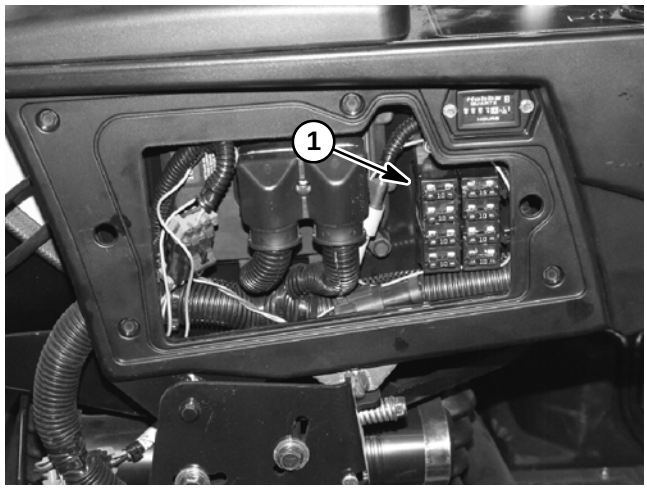



Figure 39

1. **Fuse block**

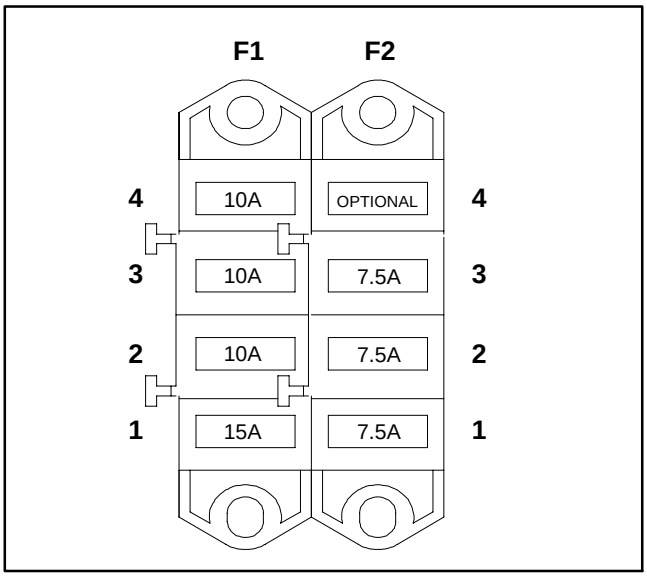



Figure 40

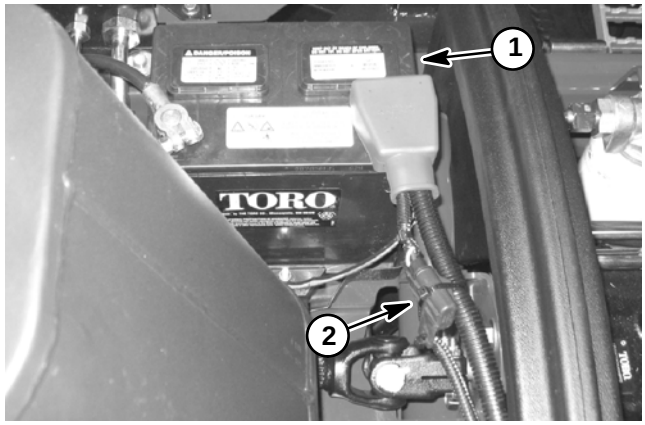



Figure 41

1. **Battery**
2. **Fuse F3**

## Diode Assembly

A diode assembly (Fig. 42) is used in the Groundsmaster 4300−D engine wire harness. The diode is used for circuit protection from voltage spikes that occur when the engine starter solenoid is de−energized. Refer to wire harness drawings in Chapter 8 − Foldout Drawings for additional diode assembly information.

### Testing

Locate diode assembly and remove cable tie that secures diode to wire harness. Unplug the diode from the wire harness for testing. The diode (Fig. 43) can be tested using a digital multimeter (diode test or ohms setting) and the table below. After testing is complete, make sure that diode is fully installed into harness connector and secured to harness with cable tie.

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

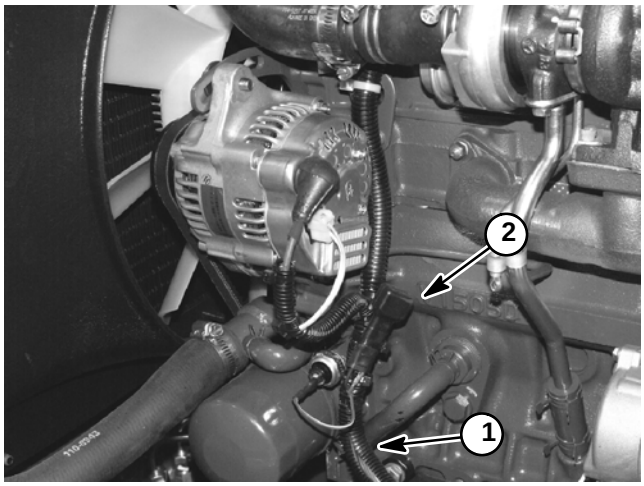



Figure 42

1. **Engine wire harness**
2. **Diode assembly**

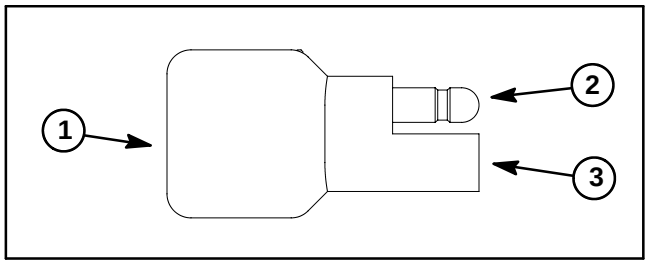



Figure 43

1. **Diode**
2. **Male terminal**
3. **Female terminal**

## Fusible Link Harness

The Groundsmaster 4300−D uses four (4) fusible links for circuit protection. Three (3) of these fusible links are located in a harness that connects the starter B+ terminal to the wire harness (Figs. 44 and 45). The remaining fusible link is included in the wire harness and connects the starter terminal to the engine run solenoid pull coil. If any of these links should fail, current to the protected circuit will cease. Refer to wire harness drawings in Chapter 8 − Foldout Drawings for additional fusible link information.

### Testing

Make sure that ignition switch is OFF. Disconnect negative (−) battery cable from battery terminal and then disconnect positive (+) cable from battery (see Battery Service in the Service and Repairs section of this chapter). Locate and unplug fusible link connector from machine wire harness. Use a multimeter to make sure that continuity exists between the fusible link terminal on the starter B+ terminal (terminal J1 on fusible link harness) and each of the terminals in the link harness connector P1. If any of the fusible links are open, replace the fusible link harness.

**NOTE:** It is not recommended to replace individual fusible link conductors of the fusible link harness. If any of the harness links are open (failed), replace the entire fusible link harness.

After testing is complete, make sure that fusible link is securely attached to starter B+ terminal and machine wire harness. Connect positive (+) battery cable to battery terminal first and then connect negative (−) cable to battery.

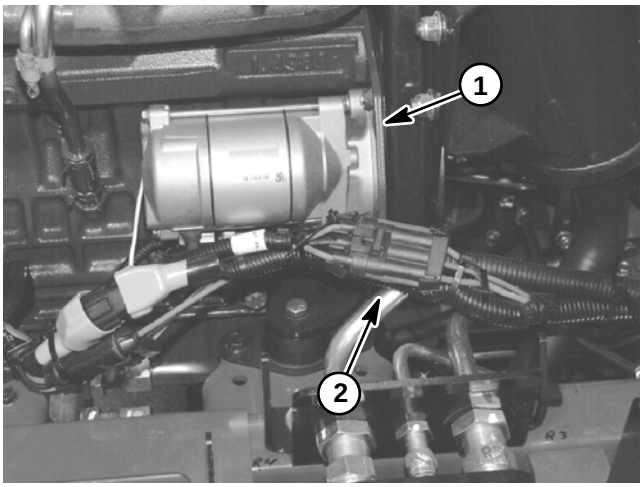



Figure 44

**1. Starter motor** **2. Fusible link harness**

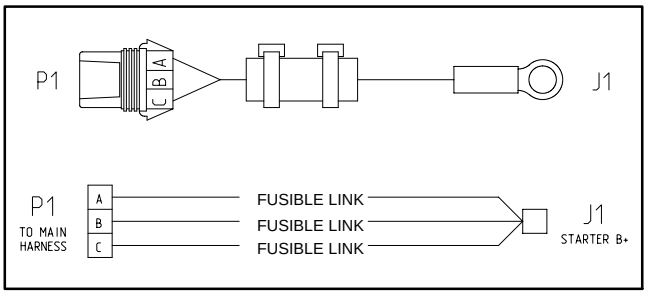



Figure 45

## Hydraulic Solenoid Valve Coil

The Groundsmaster 4300−D hydraulic system uses several hydraulic solenoid valve coils for system control. The deck control manifold includes two (2) solenoid valves (Fig. 46) and the lift control manifold includes three (3) solenoid valves (Fig. 47). When the solenoid coils are energized, hydraulic valve shift occurs to control hydraulic flow. Testing of the coils can be done with the coil installed on the hydraulic valve.

### Testing

1. Before disconnecting solenoid valve coils, test the solenoids and their circuit wiring as TEC controller outputs with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that solenoid coils and circuit wiring **are** functioning correctly, no further testing is necessary.

2. If the Diagnostic Display determines that coils and circuit wiring **are not** functioning correctly, park machine on level surface, lower cutting decks, stop engine, apply parking brake and remove key from ignition switch.

3. To gain access to deck control manifold (Fig. 46), raise and prop the operator seat. Access to the lift control manifold (Fig. 47) can be obtained by removing the operator floor plate.

4. Disconnect harness electrical connector from hydraulic solenoid valve coil that is to be tested (Fig. 46 or 47).

**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 the measured value of the component you are testing.

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

| Solenoid Valve Coil | Resistance |
|---|---|
| PRV1 and PRV2 (deck) | 7.1 ohms |
| SV1 and PRV (lift) | 7.1 ohms |
| SV2 (lift) | 8.7 ohms |

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

**NOTE:** The two (2) solenoid valve coils on the deck control manifold (PRV1 and PRV2) are identical. Solenoid valve coils SV1 and PRV on the lift control manifold are identical and are the same as those used on the deck manifold. The remaining lift manifold coil (SV2) is different. To assist in troubleshooting, identical coils can be exchanged. If the problem follows the exchanged coil, an electrical problem likely exists with the coil. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. switch, circuit wiring, hydraulic problem).

7. Connect wire harness electrical connector to the solenoid valve coil after testing is completed.

8. Lower and secure seat if deck control manifold was accessed. Install operator floor plate if lift control manifold was accessed.

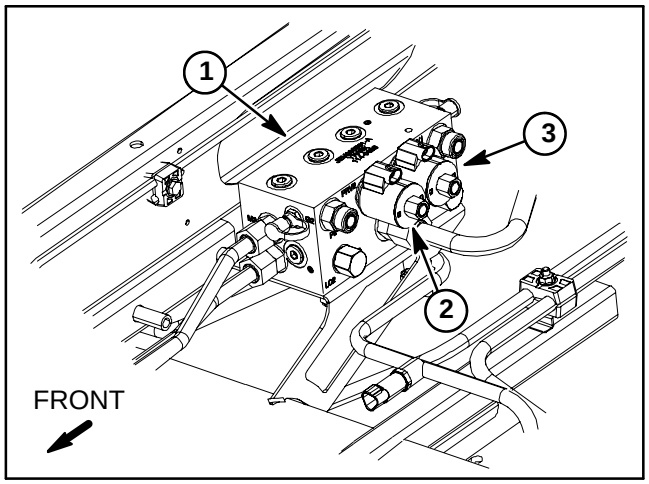



Figure 46

1. **Deck control manifold**
2. **PRV2 solenoid**
3. **PRV1 solenoid**

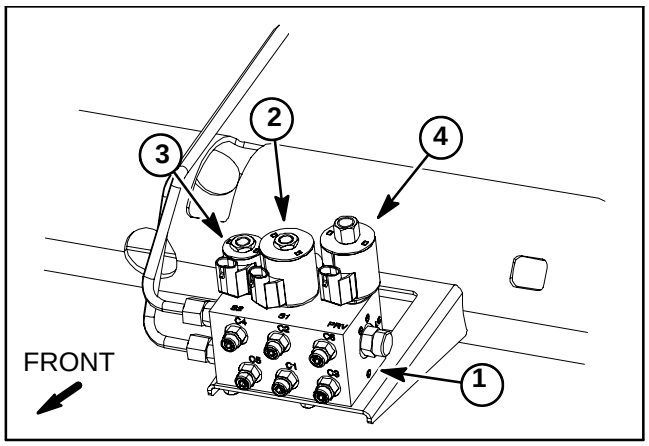



Figure 47

1. **Lift control manifold**
2. **SV1 solenoid**
3. **SV2 solenoid**
4. **PRV solenoid**

## Temperature Sender

The temperature sender is attached to the water pump housing on the engine and has a gray wire attached to it (Fig. 48). The resistance of the temperature sender reduces as the engine coolant temperature increases.

The changing resistance of the temperature sender signals the console temperature gauge to indicate engine coolant temperature level during machine operation. When coolant temperature rises to approximately 221ºF (105ºC), temperature sender resistance causes the temperature gauge to provide an input to the TEC controller. This controller input causes the high temperature warning light to illuminate and the cutting decks to shut down. The temperature gauge, temperature sender and circuit wiring **should** be tested as a controller input with the Diagnostic Display (see Special Tools and Troubleshooting in this chapter).

If the excessive coolant temperature caused the controller to shut down the cutting decks, the Diagnostic light can be used to identify the fault (see Diagnostic Light in the Troubleshooting section of this chapter).

### Testing

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

**CAUTION**

**Make sure engine is cool before removing the temperature sender from engine.**

2. Lower the coolant level in the engine, remove wire harness connector from temperature sender and remove the sender from the engine.

3. Put the end of the sender in a container of oil with a thermometer and slowly heat the oil (Fig. 49).

**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 temperature increases. Replace sender if specifications are not met.

| COOLANT TEMP | TEMP SENDER RESISTANCE |
|---|---|
| 100ºF (38ºC) | 460 ohms (approximate) |
| 160ºF (71ºC) | 140 ohms (approximate) |
| 200ºF (93ºC) | 54 to 78 ohms |
| 221ºF (105ºC) | 50 ohms (approximate) |

5. After testing, install sender to the engine housing.

   A. Clean threads of housing and sender thoroughly. Apply a light coating of thread sealant to the threads of the sender.

   B. Thread sender into the housing. Torque sender from **16 to 20 ft-lb (22 to 27 N-m)**.

   C. Connect wire harness connector to sender.

6. Fill engine cooling system (see Radiator Installation in the Service and Repairs section of Chapter 3 – Kubota Diesel Engine).

7. Lower and secure hood.

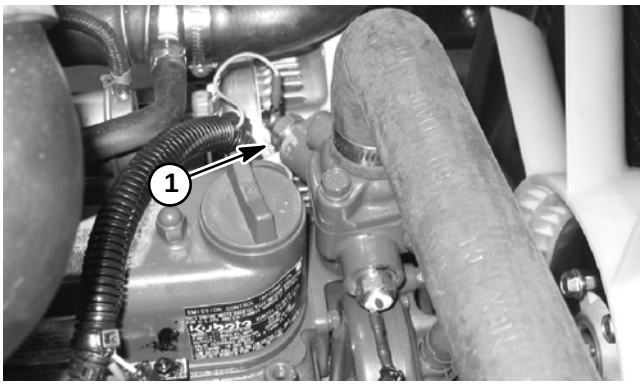



Figure 48

**1. Temperature sender**

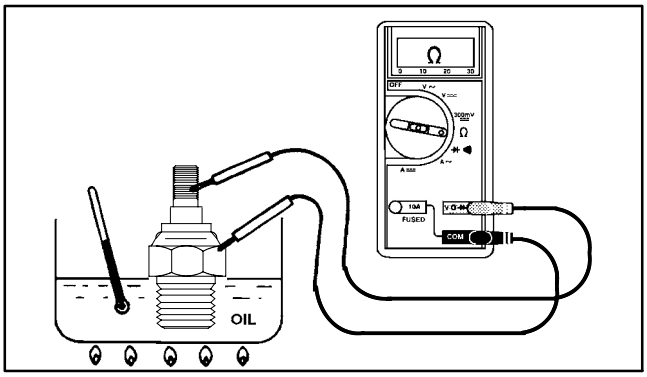



Figure 49

## High Temperature Shutdown Switch

The high temperature shutdown switch is located on the water pump housing (Fig. 50). The high temperature shutdown switch is normally open and closes when engine coolant temperature reaches approximately 239ºF (115ºC). When excessive coolant temperature causes the shutdown switch to close, the engine shuts down. There is a tan wire attached to the shutdown switch.

**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 ten (10) seconds before the engine shuts down again.

The TEC controller monitors the operation of the high temperature shutdown switch. The switch and its circuit wiring **should** be tested as a controller input with the Diagnostic Display (see Special Tools and Troubleshooting in this chapter).

If excessive coolant temperature caused the TEC controller to shut down the engine, the Diagnostic light can be used to identify the fault (see Diagnostic Light in the Troubleshooting section of this chapter).

**Testing**

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from ignition switch. Open and support hood to gain access to engine.

**CAUTION**

**Make sure engine is cool before removing the temperature switch from engine.**

2. Lower the coolant level in the engine and remove the high temperature shutdown switch from the engine.

3. Put the end of the switch in a container of oil with a thermometer and slowly heat the oil (Fig. 51).

**CAUTION**

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

4. Check resistance of the switch with a multimeter (ohms setting) as the oil temperature increases. The high temperature shutdown switch is normally open and should close from 234º to 244ºF (112º to 118ºC).

5. Replace shutdown switch if specifications are not met.

6. After testing is complete, install shutdown switch to the engine housing.

   A. Clean threads of housing and switch thoroughly. Apply a light coating of thread sealant to the threads of the switch.

   B. Thread switch into the housing. Torque switch from **22 to 28 ft-lb (30 to 39 N-m)**.

   C. Reconnect harness wire to switch.

7. Fill engine cooling system (see Radiator Installation in the Service and Repairs section of Chapter 3 - Kubota Diesel Engine).

8. Lower and secure hood.

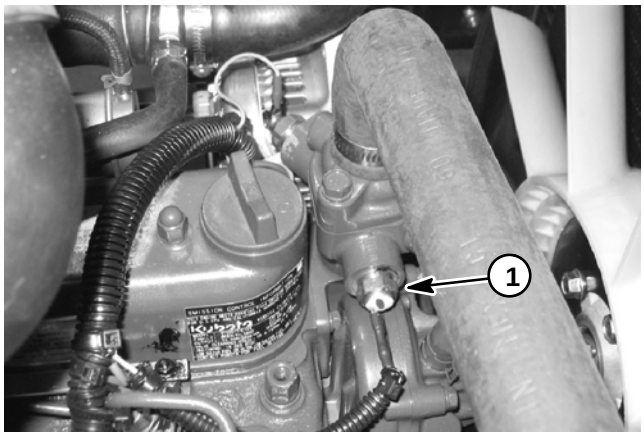



Figure 50

**1. High temperature shutdown switch**

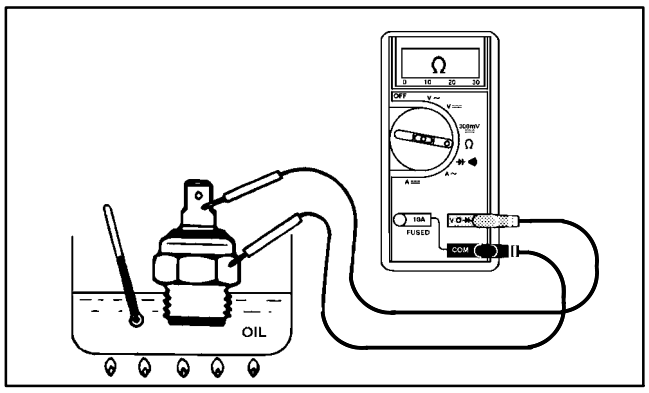



Figure 51

## Oil Pressure Switch

The engine oil pressure switch is located on the engine near the oil filter (Fig.52). The oil pressure switch is a normally closed switch that opens with pressure.

The oil pressure switch should open at approximately 8 PSI (0.56 kg/cm$^2$).

The TEC controller monitors the operation of the oil pressure switch. The switch and its circuit wiring **should** be tested as a controller input with the Diagnostic Display (see Special Tools and Troubleshooting in this chapter).

If low engine oil pressure allowed the oil pressure switch to close during engine operation, the Diagnostic light can be used to identify the fault (see Diagnostic Light in the Troubleshooting section of this chapter).

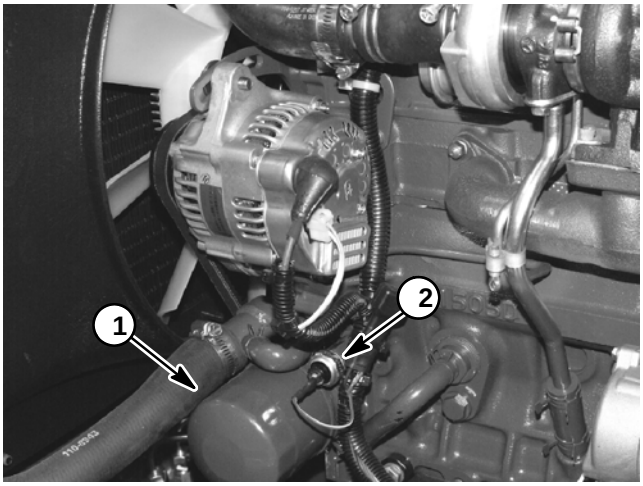



Figure 52

**1. Oil filter** **2. Oil pressure switch**

### Testing

**NOTE:** Refer to Kubota Workshop Manual, Diesel Engine, 05−E3B Series at the end of Chapter 3 − Kubota Diesel Engine for information regarding engine lubrication system and testing.

1. Turn the ignition switch to the RUN position. The oil pressure indicator light on the control panel should be illuminated.

2. If the indicator light is not illuminated, open hood to gain access to engine.

3. Locate oil pressure switch on engine and disconnect the wire harness connector from the switch.

4. With the ignition switch in the RUN position, ground the disconnected wire to the engine block.

5. If the indicator light comes on, the oil pressure switch is faulty.

6. If the indicator light does not come on after step 5, check the oil pressure indicator light and circuit wiring (see Indicator Lights in this section).

7. After testing is completed, connect the wire harness connector to the oil pressure switch. Lower and secure hood.

## Fuel Stop Solenoid

The fuel stop solenoid used on your Groundsmaster must be energized for the diesel engine to run. The solenoid is mounted to the injection pump on the engine (Fig. 53).

The TEC controller monitors the operation of the fuel stop solenoid. The solenoid and its circuit wiring **should** be tested as a controller output with the Diagnostic Display (see Special Tools and Troubleshooting in this chapter).

If the controller detected a fuel stop solenoid problem during engine operation, the Diagnostic light can be used to identify the fault (see Diagnostic Light in the Troubleshooting section of this chapter).

**Testing**

1. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

2. Disconnect wire harness connector from fuel stop solenoid.

**NOTE:** The fuel stop solenoid may be removed from the engine or tested in place.

3. If the solenoid is removed from the engine, make sure that the solenoid plunger moves freely and is free of dirt, debris and corrosion.

**NOTE:** Prior to taking small resistance readings with a digital multimeter, short the 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 of the component you are testing.

4. Using a digital multimeter (ohms setting), touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 54). The resistance of the pull coil should be less than 1 ohm (but not zero).

5. Using a digital multimeter (ohms setting), touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 54). The resistance of the hold coil should be approximately 15 ohms.

6. If either coil resistance is incorrect, replace fuel stop solenoid.

7. Connect wire harness connector to the fuel stop solenoid.

8. Lower and secure hood.

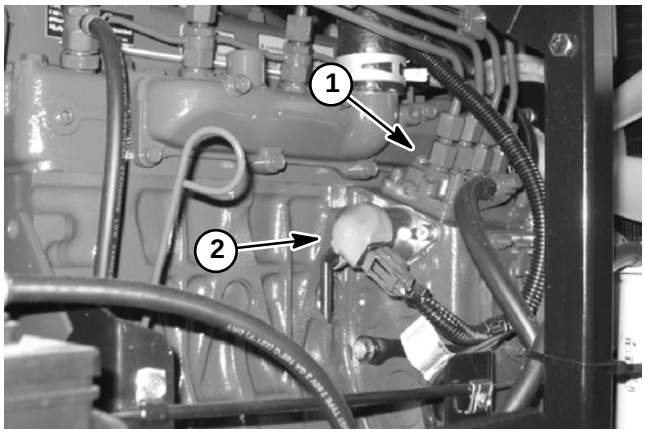



Figure 53

1. **Injection pump**
2. **Fuel stop solenoid**

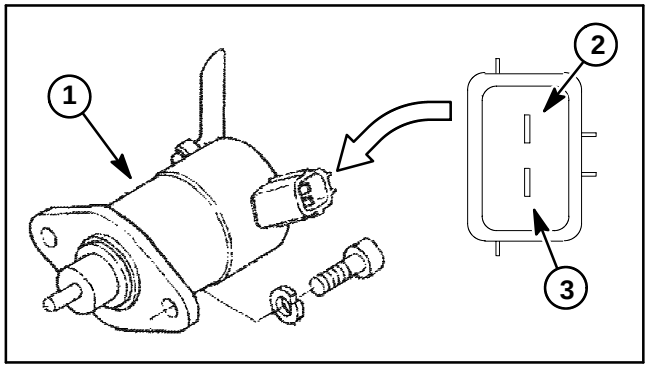



Figure 54

1. **Fuel stop solenoid**
2. **Pull coil terminal**
3. **Hold coil terminal**

## Fuel Pump

The fuel pump used on the Groundsmaster 4300−D is attached to the inside of the left side frame rail near the fuel tank (Fig. 55).

**IMPORTANT: When testing fuel pump, make sure that pump is not operated without fuel.**

**DANGER**

**Because diesel fuel is highly flammable, use caution when handling it. Do not smoke while testing the fuel pump. Do not test fuel pump while engine is hot. Make sure that there is adequate ventilation when testing. Always wipe up any spilled fuel before starting the engine.**

### Fuel Pump Capacity Test

1. Park machine on a level surface, lower cutting decks, stop engine and engage parking brake. Remove key from ignition switch. Raise and support operator seat and hood.

2. Disconnect wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting (see Fuel Stop Solenoid in this section).

3. Disconnect fuel hose (pump discharge) from the fuel/water separator inlet fitting (Fig. 56).

4. Make sure fuel hoses attached to the fuel pump, fuel filter and fuel tank suction tube screen are free of obstructions.

5. Place disconnected fuel hose into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

**IMPORTANT: When testing the fuel pump, DO NOT turn ignition switch to START.**

6. Collect fuel in the graduated cylinder by turning ignition switch to the RUN position. Allow pump to run for 15 seconds, then turn ignition switch to OFF.

7. Fuel collected in the graduated cylinder should be approximately 16 fl oz (475 ml) after 15 seconds.

8. Replace fuel pump if necessary.

9. Install fuel hose to the fuel/water separator. Make sure to secure fuel hose with hose clamp.

10. Connect wire harness electrical connector to the engine fuel stop solenoid.

11. Bleed the fuel system.

12. Lower and secure operator seat and hood.

### Fuel Pump Specifications

| | |
|---|---|
| Pump Capacity | 64 fl oz/min (1.9 l/min) |
| Pressure | 7 PSI (48.3 kPa) |
| Current Draw | 2.0 amp |

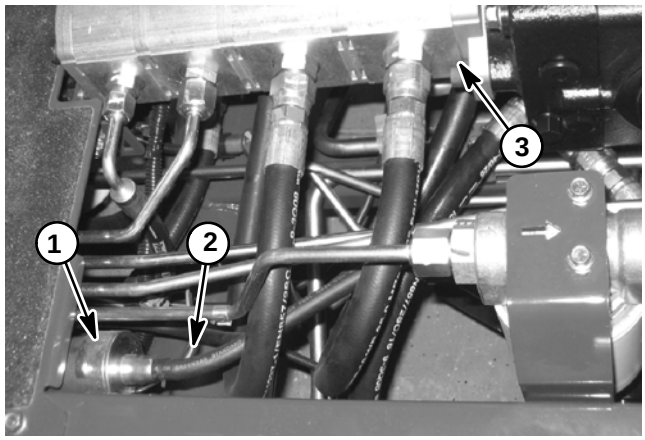



Figure 55

1. **Fuel pump**
2. **Pump discharge hose**
3. **Hydraulic gear pump**

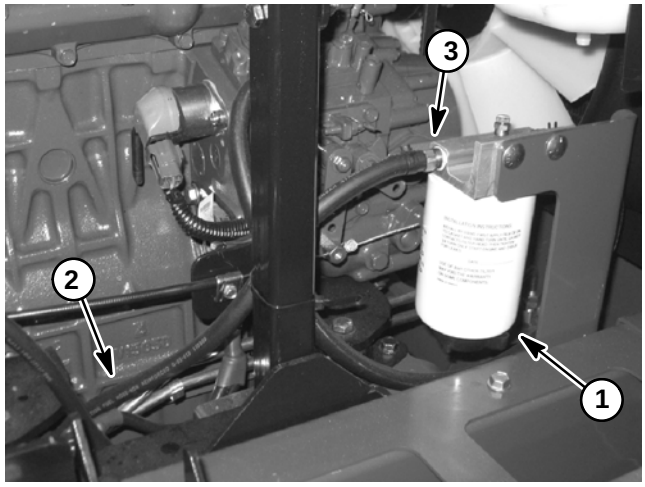



Figure 56

1. **Fuel/water separator**
2. **Fuel hose (from pump)**
3. **Inlet fitting**

# Service and Repairs

**NOTE:** See the Kubota Workshop Manual, Diesel Engine, 05–E3B Series at the end of Chapter 3 – Kubota Diesel Engine for engine electrical component repair information.

## Battery Storage

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

1. Remove the battery from the machine and charge it fully (see Battery Service in this section).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service in this section).

## 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.

**CAUTION**

**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 battery 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.

**CAUTION**

**Connecting battery cables to the wrong battery post could result in personal injury and/or damage to the electrical system.**

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (–) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable 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 battery is 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.**

**Electrolyte Specific Gravity**
Fully charged: 1.265 corrected to 80ºF (27ºC)
Discharged: less than 1.240

**Battery Specifications**
BCI Group Size 55
585 CCA at 0ºF (–18ºC)
Reserve Capacity of 95 minutes at 80ºF (27ºC)

**Dimensions (including terminal posts)**

| | |
|---|---|
| Length | 8.3 inches (211 mm) |
| Width | 6.0 inches (152 mm) |
| Height | 8.5 inches (216 mm) |

### Battery Removal and Installation (Fig. 57)

1. Raise and support hood.

2. Loosen and remove negative (–) cable from battery. After negative (–) cable is removed, loosen and remove positive (+) cable.

3. Loosen flange nut that secures battery retainer.

4. Carefully remove battery from machine.

5. Install battery in reverse order making sure to connect and tighten positive (+) cable to battery before connecting negative (–) cable.

**NOTE:** Before connecting the negative (ground) cable 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. Lower and secure hood.

### Battery Inspection and Maintenance

1. Perform the following inspections and maintenance:

   A. Check battery case for cracks. Replace battery if cracked or leaking.

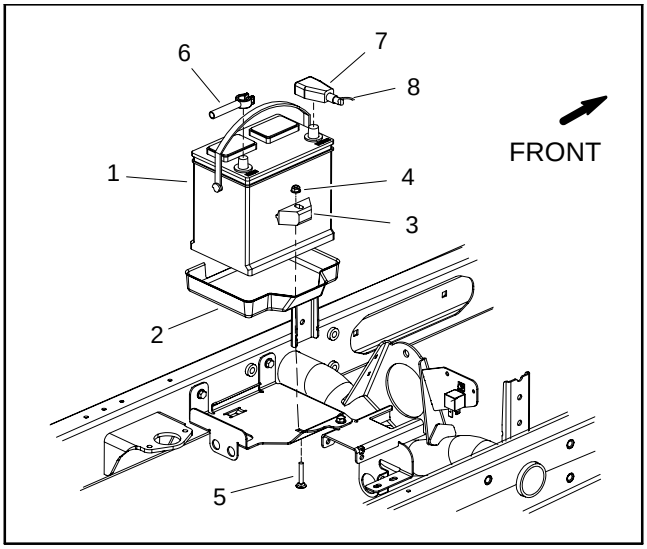



Figure 57

1. **Battery**
2. **Battery tray**
3. **Retainer**
4. **Flange nut**
5. **Carriage screw**
6. **Negative battery cable**
7. **Positive battery cable**
8. **Fusible link**

B. Check battery terminals for corrosion. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (–) cable first. Clean cable clamps and battery terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107–0392) or petroleum jelly to prevent corrosion.

**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 away. 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 (see battery charging in this section).

**Battery Testing**

1. 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 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

| | |
|---|---|
| Example: Cell Temperature | 100°F |
| Cell Gravity | 1.245 |
| 100°F minus 80°F equals 20°F | |
| (37.7°C minus 26.7°C equals 11.0°C) | |
| 20°F multiply by 0.004/10°F equals 0.008 | |
| (11°C multiply by 0.004/5.5°C equals 0.008) | |
| ADD (conversion above) | 0.008 |
| Correction to 80°F (26.7°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** in this section or until specific gravity of all cells 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.

2. 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 battery load tester manufacturer's instructions when using a battery load tester.**

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, charge the battery (see battery charging in this section).

B. If the battery has recently been charged, remove the battery surface charge before performing the load test. Disconnect the engine fuel stop solenoid to prevent the engine from starting. Engage the starter motor for ten (10) seconds to remove battery surface charge. Reconnect the fuel stop solenoid.

C. Make sure battery terminals are free of corrosion.

D. Measure the 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 295 amps (one half the Cranking Performance rating of the battery) for 15 seconds.

G. Take a battery voltage reading after 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading:

| Minimum Voltage | Battery Electrolyte Temperature | |
|---|---|---|
| 9.6 | 70°F (and up) | 21°C (and up) |
| 9.5 | 60°F | 16°C |
| 9.4 | 50°F | 10°C |
| 9.3 | 40°F | 4°C |
| 9.1 | 30°F | -1°C |
| 8.9 | 20°F | -7°C |
| 8.7 | 10°F | -12°C |
| 8.5 | 0°F | -18°C |

I. If the test voltage is below the minimum voltage 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 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 commonly 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 60°F (16°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 125°F (52°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 (3) consecutive readings.

## Hydraulic Solenoid Valve Coil

A hydraulic solenoid valve coil on the deck control manifold (Fig. 58) or lift control manifold (Fig. 59) can be replaced without opening the hydraulic system.

### Removal

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.

   A. Tilt operator seat up to gain access to hydraulic deck control manifold. Refer to Figure 58 for solenoid coil locations on the deck control manifold.

   B. The lift control manifold is attached to a frame bracket under the operator floor plate. Access to the lift control manifold can be obtained by removing the floor plate. Refer to Figure 59 for solenoid coil locations on the lift control manifold.

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.

### Installation

1. Slide new coil assembly onto the hydraulic valve.

2. Install the nut onto the valve and torque nut from **48 to 60 in-lb (5.4 to 6.7 N-m)** (do not over-tighten).

3. Connect the machine wire harness connector to the solenoid coil.

4. Lower and secure seat if deck control manifold was accessed. Install operator floor plate if lift control manifold was accessed.

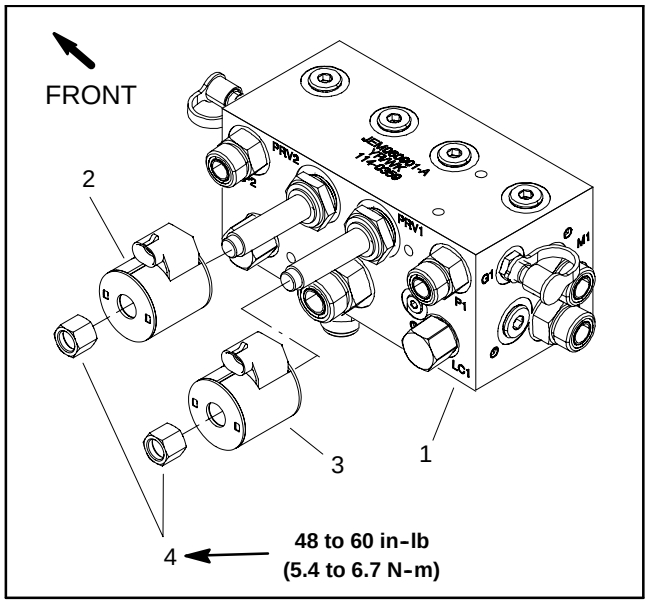



Figure 58

1. **Deck control manifold**
2. **Solenoid coil PRV2**
3. **Solenoid coil PRV1**
4. **Nut**

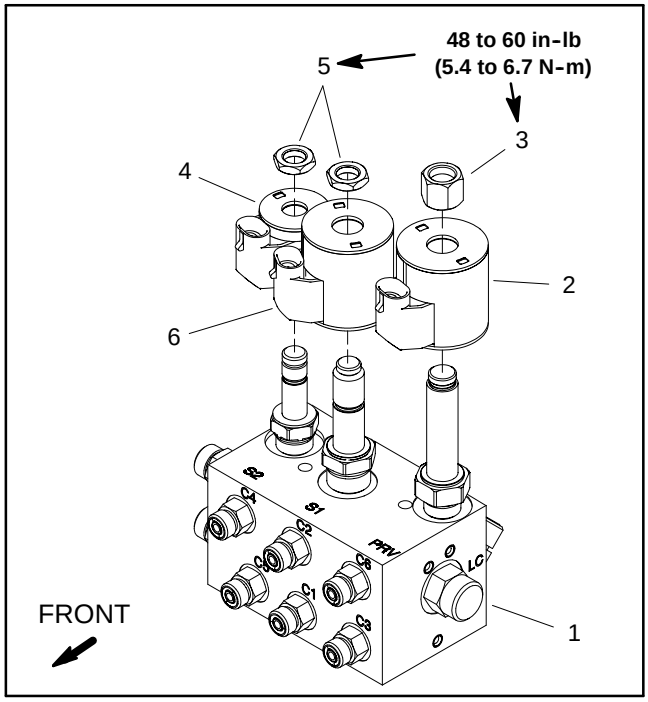



Figure 59

1. **Lift control manifold**
2. **Solenoid coil PRV**
3. **Nut**
4. **Solenoid coil S2**
5. **Nut**
6. **Solenoid coil S1**

# Chapter 6

# Chassis

## Table of Contents

# Specifications

| Item | Description |
|---|---|
| Front Tire Pressure (26.5 x 14.0 – 12, 4 ply, tubeless) | 12 to 15 PSI (83 to 103 kPa) |
| Rear Tire Pressure (20 x 12.0 – 10, 4 ply, tubeless) | 12 to 15 PSI (83 to 103 kPa) |
| Wheel Lug Nut Torque | 70 to 90 ft–lb (95 to 122 N–m) |

# General Information

## Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster 4300–D machine. Refer to that publication for additional information when servicing the machine.

# Special Tools

Order Special Tools from your Toro Distributor.

## Wheel Hub Puller

The wheel hub puller allows safe removal of the wheel hub from the wheel motor shaft.

Toro Part Number: **TOR6004**

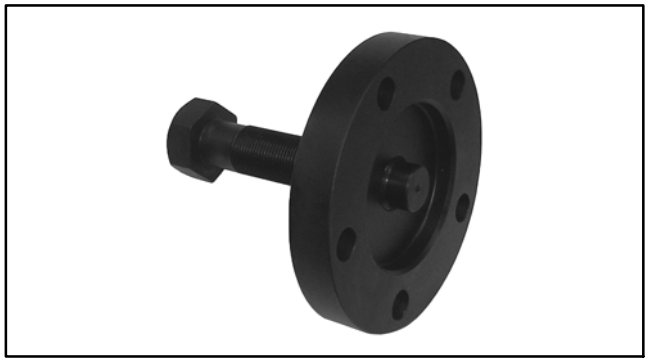


Figure 1

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## Wheels

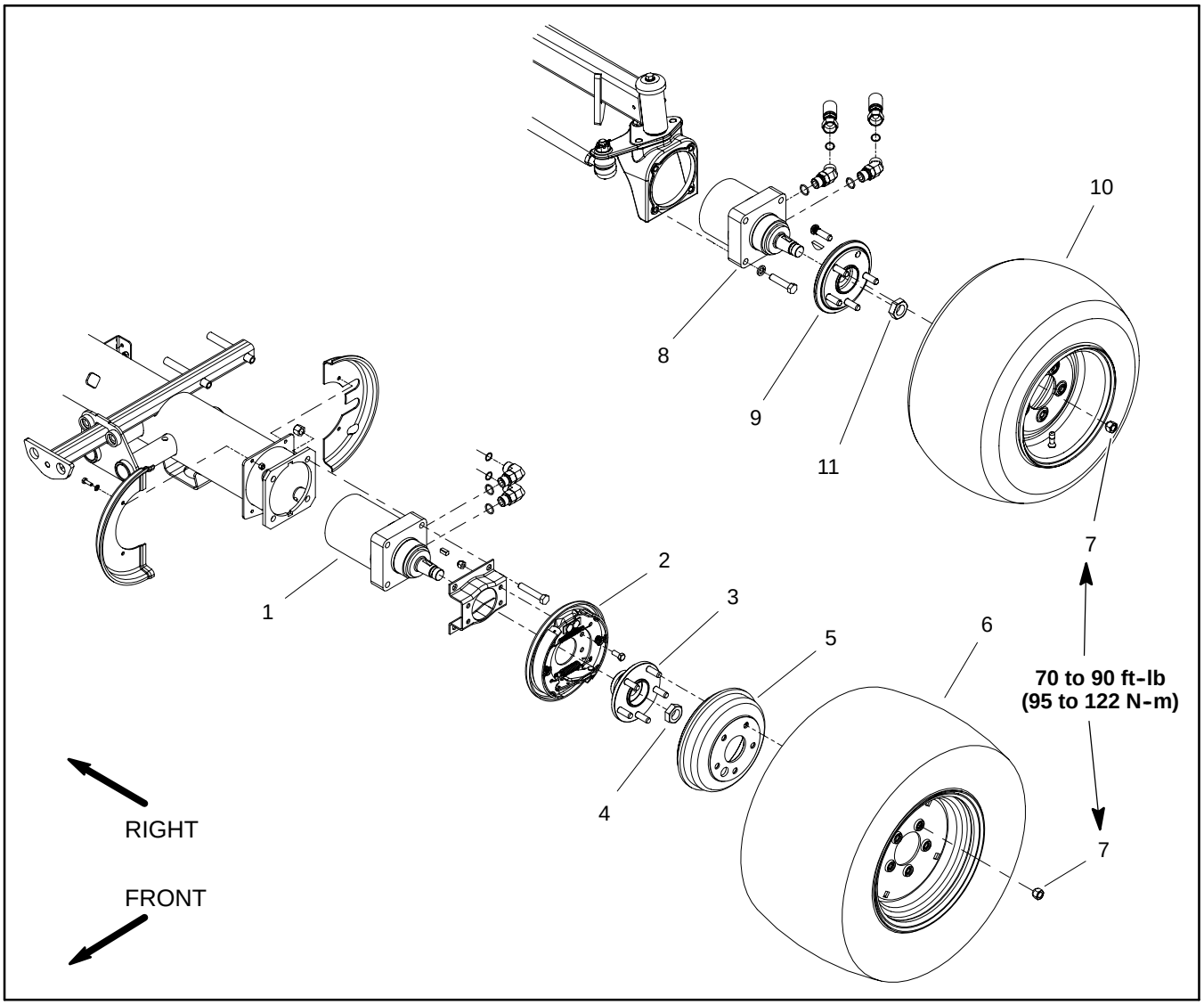


Figure 2

1. **Front wheel motor (LH shown)**
2. **Brake assembly (LH shown)**
3. **Front wheel hub**
4. **Lock nut**
5. **Brake drum**
6. **Front wheel**
7. **Lug nut (5 used per wheel)**
8. **Rear wheel motor (LH shown)**
9. **Rear wheel hub**
10. **Rear wheel**
11. **Lock nut**

**Removal (Fig. 2)**

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

2. Chock wheels to prevent machine from shifting.

3. Loosen wheel lug nuts.

**CAUTION**

**When changing attachments, tires or performing other service, use correct supports, hoists and jacks. 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 jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.**

4. Using a jack, raise machine so wheel is off ground (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands.

5. Remove lug nuts and then remove wheel from machine.

**Installation (Fig. 2)**

1. Install wheel and secure with five (5) lug nuts.

2. Lower machine to ground.

3. Torque lug nuts evenly in a crossing pattern from **70 to 90 ft–lb (95 to 122 N–m)**.

## Steering Column

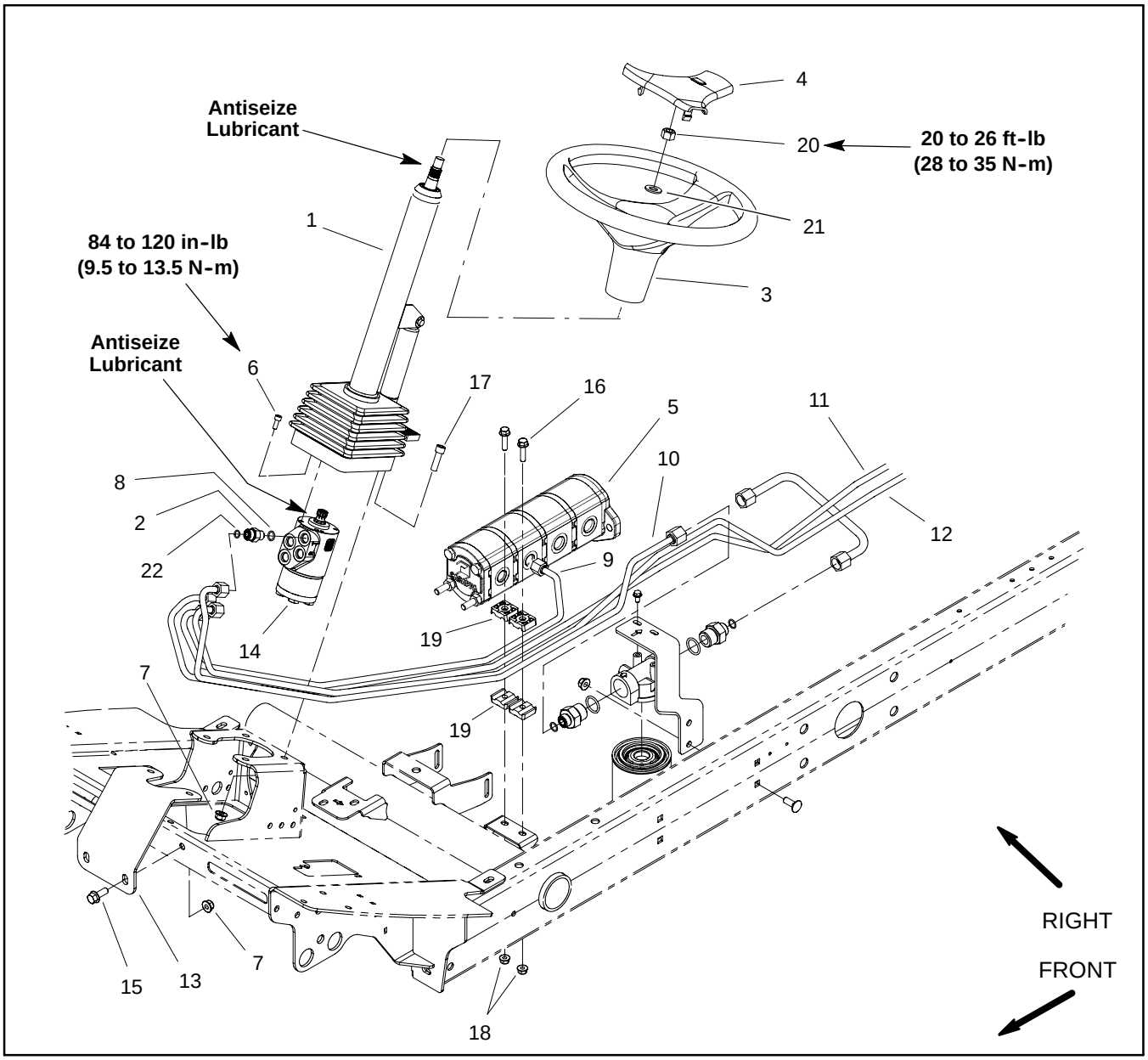


Figure 3

1. Steering column
2. Hydraulic fitting (4 used)
3. Steering wheel
4. Steering wheel cover
5. Gear pump
6. Socket head screw (4 used)
7. Flange nut
8. O-ring
9. Hydraulic tube
10. Hydraulic tube
11. Hydraulic tube
12. Hydraulic tube
13. Column brace
14. Steering control valve
15. Flange head screw (2 used)
16. Flange head screw (2 used)
17. Socket head screw (4 used)
18. Flange nut (2 used)
19. Tube clamp
20. Lock nut
21. Flat washer
22. O-ring

**Removal (Fig. 3)**

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

2. Remove cover from steering wheel by carefully prying up on one of the cover spokes.

3. Remove lock nut and flat washer that secure steering wheel to steering column.

4. Use a suitable puller to remove steering wheel from steering column.

5. Remove platform shroud from machine to allow access to steering column fasteners (Fig. 4).

A. Remove cover plate from platform.

B. Remove fasteners that secure shroud to machine.

C. Remove shroud from machine.

D. Locate and retrieve two (2) rubber bushings and spacers.

6. Slide rubber bellows up steering column to allow access to fasteners that secure steering column to machine.

7. Support steering control valve to prevent it from falling during steering column removal.

8. Loosen and remove four (4) socket head screws (item 6) that secure steering control valve to steering column.

9. Loosen and remove four (4) socket head screws (item 17) and flange nuts (item 7) that secure steering column to machine.

10. Slide steering column assembly from steering control valve and machine.

11. Disassemble steering column assembly as needed using Figure 5 as a guide.

**Installation (Fig. 3)**

1. Apply antiseize lubricant to input shaft of steering control valve.

2. Slide steering column onto steering control valve. Secure steering column in place with four (4) socket head screws (item 17) and flange nuts (item 7).

3. Secure steering control valve to steering column with four (4) socket head screws (item 6).

4. Slide rubber bellows to bottom of steering column.

5. Place rubber bushings and spacers into holes of platform shroud (Fig. 4). Position shroud in place and secure with removed fasteners.

6. Thoroughly clean tapered surfaces of steering wheel and steering column.

7. Apply antiseize lubricant to splines of steering column taking care to keep antiseize lubricant from column taper. Slide steering wheel onto steering column.

8. Secure steering wheel to steering column with flat washer and lock nut. Torque lock nut from **20 to 26 ft-lb (28 to 35 N-m)**.

9. Install steering wheel cover to steering wheel.

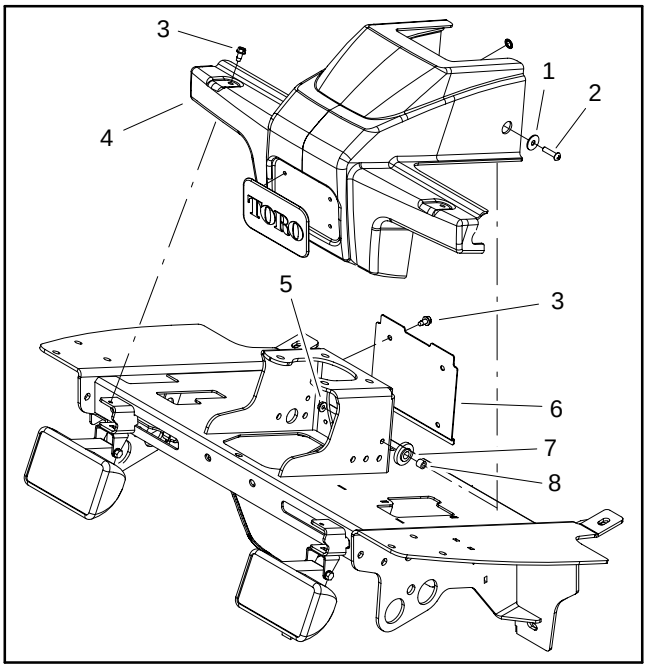


Figure 4

1. **Washer (2 used)**
2. **Screw (2 used)**
3. **Washer head screw**
4. **Platform shroud**
5. **Lock nut (2 used)**
6. **Cover plate**
7. **Bushing (2 used)**
8. **Spacer (2 used)**

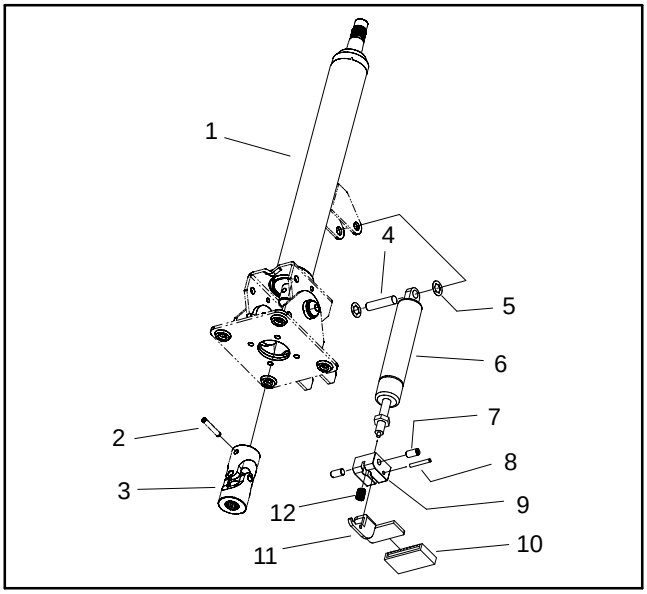


Figure 5

1. **Steering column**
2. **Pin**
3. **Universal joint**
4. **Pin**
5. **Lock washer (2 used)**
6. **Cylinder**
7. **Bolt (2 used)**
8. **Pin**
9. **Pedal block**
10. **Pedal cover**
11. **Pedal**
12. **Spring**

## Brake Service

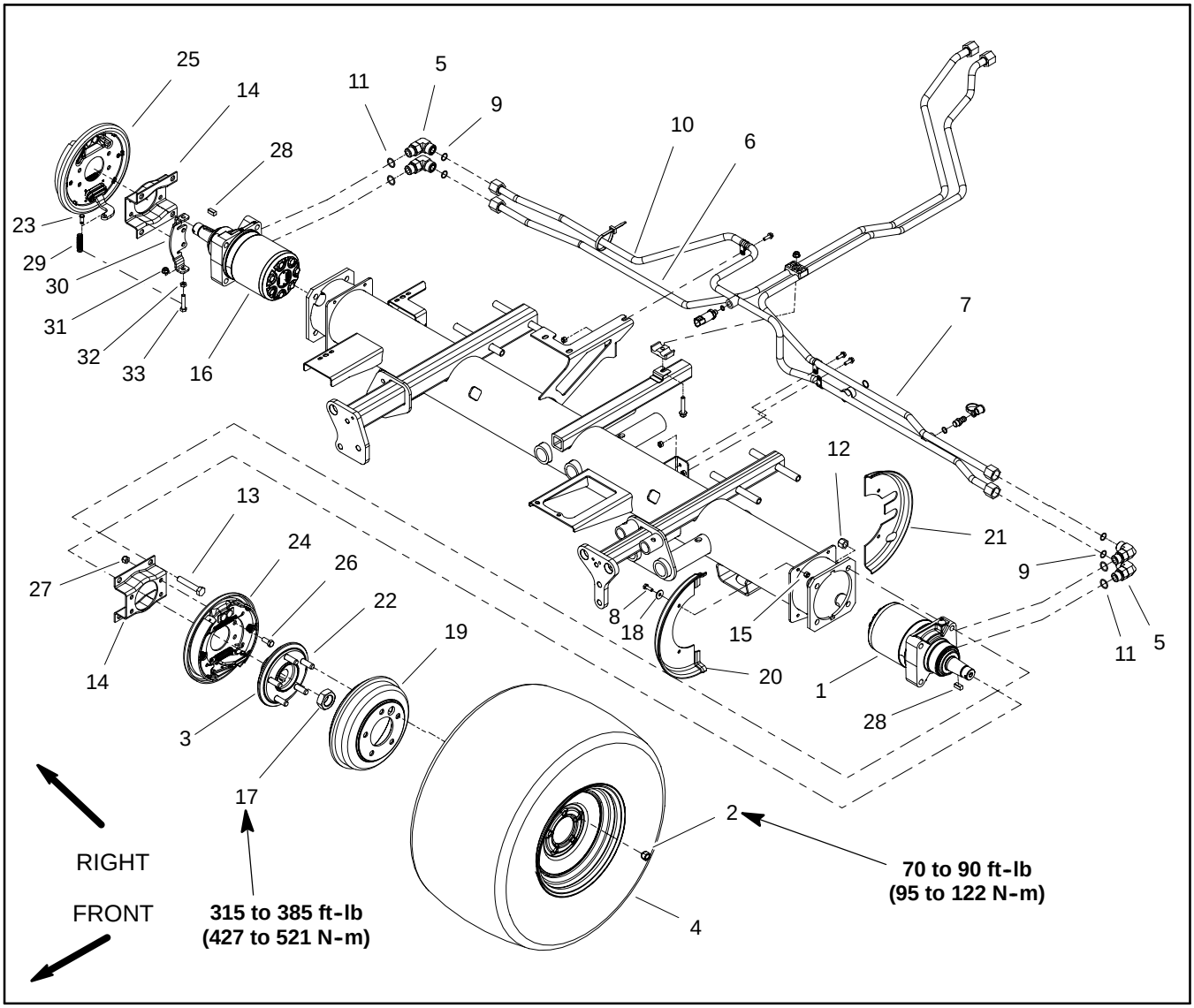


Figure 6

1. **LH wheel motor**
2. **Lug nut (5 used per wheel)**
3. **Hub**
4. **Wheel assembly**
5. **Hydraulic fitting (2 used per motor)**
6. **Hydraulic tube**
7. **Hydraulic tube**
8. **Cap screw (2 used per wheel shield)**
9. **O-ring**
10. **Hydraulic tube**
11. **O-ring**
12. **Lock nut (4 used per wheel motor)**
13. **Cap screw (4 used per wheel motor)**
14. **Brake bracket (2 used)**
15. **Lock nut (2 used per wheel shield)**
16. **RH wheel motor**
17. **Lock nut (2 used)**
18. **Flat washer (2 used per wheel shield)**
19. **Brake drum (2 used)**
20. **Front wheel shield (LH shown)**
21. **Rear wheel shield (LH shown)**
22. **Wheel stud (5 used per wheel)**
23. **Clevis pin (2 used)**
24. **LH brake assembly**
25. **RH brake assembly**
26. **Cap screw (4 used per brake assy)**
27. **Lock nut (4 used per brake assy)**
28. **Square key**
29. **Return spring (1 used per bracket)**
30. **Brake spring bracket (2 used)**
31. **Flange nut (1 used per bracket)**
32. **Jam nut (1 used per bracket)**
33. **Cap screw (1 used per bracket)**

### Removal (Fig. 6)

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

2. Chock rear wheels to prevent machine from shifting.

3. Loosen, but do not remove, wheel lug nuts and lock nut (item 17) from wheel motor shaft.

4. Jack up front of machine and remove front wheel assembly (see Wheel Removal in this section). Make sure to support machine with jack stands.

5. Make sure parking brake is disengaged.

6. Remove return spring and clevis pin that secure brake cable to brake actuator lever. Position brake cable end away from lever.

7. Remove brake drum.

**IMPORTANT: DO NOT hit wheel hub, puller or wheel motor with a hammer during wheel hub removal or installation. Hammering may cause damage to the wheel motor.**

8. Make sure that lock nut on wheel motor shaft is loosened at least two (2) turns. Use hub puller (see Special Tools) to loosen wheel hub from wheel motor.

9. Remove lock nut and wheel hub from motor shaft. Discard lock nut. Locate and retrieve square key.

**NOTE:** If desired, the complete brake assembly can be removed from the machine for disassembly (see step 12).

10. Remove upper and lower shoe springs from brake shoes.

11. Remove shoe hold down cups and hold down springs. Remove brake shoes and hold down pins from backing plate.

12. If necessary, remove brake backing plate from machine by loosening and removing four (4) cap screws (item 26) and lock nuts (item 27).

**Installation (Fig. 6)**

1. Remove rust and debris from all brake parts with a wire brush prior to installation. Clean all parts. Inspect brake shoe contact surfaces of the brake drum for excessive wear. Replace any worn or damaged parts.

2. If brake backing plate was removed from machine, secure backing plate to brake bracket with four (4) cap screws (item 26) and lock nuts (item 27).

3. Lightly lubricate brake shoe pivot points with general purpose grease.

4. Position one brake shoe to the backing plate. Install brake hold down pin and secure with hold down spring and cup. Repeat for second brake shoe.

5. Install upper and lower shoe springs to brake shoes. Make sure that brake shoes are properly positioned to pivot and actuator points.

**IMPORTANT: Before wheel hub is installed, thoroughly clean tapers of wheel hub and wheel motor shaft. Make sure that tapers are free of grease, oil and dirt. Do not use antiseize lubricant when installing wheel hub.**

6. Mount square key in the wheel motor shaft, then install the wheel hub onto the wheel motor shaft.

**IMPORTANT: Do not reuse lock nut that secures wheel hub to wheel motor after it has been removed.**

7. Install new lock nut (item 17) onto the wheel motor shaft to secure wheel hub to motor shaft.

8. Install brake drum.

9. Position brake cable end to brake actuator lever. Secure cable to actuator lever with clevis pin and return spring.

10. Install front wheel assembly (see Wheel Installation in this section).

11. Check and adjust brakes.

12. Lower machine to ground.

13. Torque lug nuts evenly in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**. Torque lock nut (item 17) that secures wheel hub from **315 to 385 ft-lb (427 to 521 N-m)**.

**CAUTION**

**After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.**

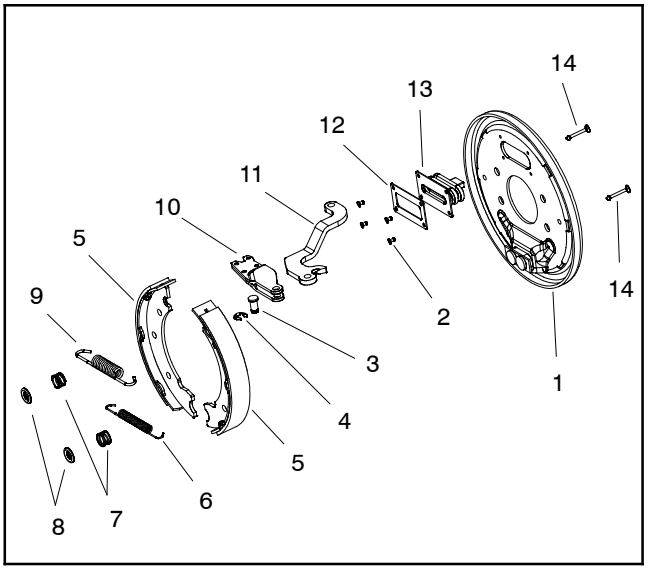


Figure 7

1. Backing plate
2. Rivet (4 used)
3. Clevis pin
4. Retaining ring
5. Brake shoe
6. Lower shoe spring
7. Hold down spring
8. Hold down cup
9. Upper shoe spring
10. Brake actuator
11. Actuator lever
12. Back-up plate
13. Boot
14. Hold down pin

**Burnish Brake Pads**

After brake pad replacement, burnish (break-in) the brakes before use

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.

2. Repeat this procedure 10 times. To avoid overheating the brakes, wait 1 minute between each stop.

## Rear Axle Motor Housings

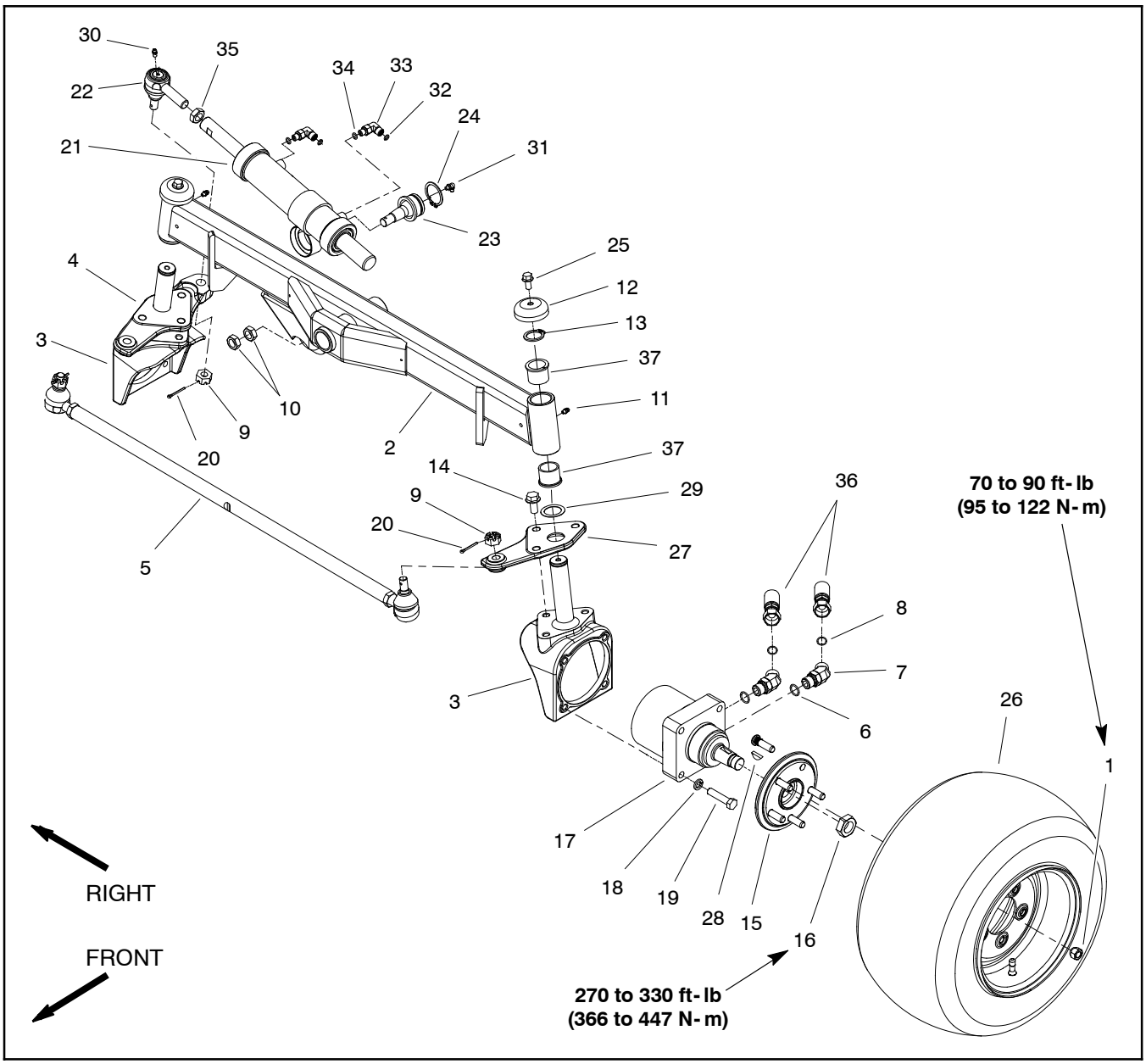


Figure 8

1. Lug nut (5 used per wheel)
2. Rear axle
3. Motor housing (2 used)
4. RH drag link
5. Tie rod
6. O- ring
7. Hydraulic fitting (2 used per motor)
8. O- ring
9. Slotted hex nut
10. Jam nut
11. Grease fitting
12. Spindle cap
13. Retaining ring
14. Flange head screw (3 used per link)
15. Wheel hub
16. Lock nut
17. Wheel motor (LH shown)
18. Lock washer (4 used per motor)
19. Cap screw (4 used per motor)
20. Cotter pin
21. Steering cylinder
22. Ball joint
23. Ball joint
24. Retaining ring
25. Flange head screw
26. Wheel assembly
27. LH drag link
28. Woodruff key
29. Thrust washer
30. Grease fitting
31. Grease fitting
32. O- ring
33. Hydraulic fitting (2 used)
34. O- ring
35. Jam nut
36. Hydraulic hose
37. Flange bushing (4 used)

**Removal (Fig. 8)**

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. Loosen, but do not remove, rear wheel lug nuts.

4. Jack up rear of machine and remove rear wheel assembly (see Wheel Removal in this section). Make sure to support machine with jack stands.

5. Remove cotter pin and slotted hex nut that secure the tie rod end to the drag link. Separate the tie rod end from the drag link.

6. If right side motor housing is being removed, remove cotter pin and slotted hex nut that secure steering cylinder ball joint to drag link. Separate steering cylinder from drag link.

7. Remove four (4) cap screws and lock washers that secure wheel motor to motor housing. Slide wheel motor assembly (with wheel hub and hydraulic hoses attached) from motor housing. Position wheel motor away from housing.

8. Support motor housing to prevent it from falling.

9. Remove the flange head screw, spindle cap and retaining ring that secure the motor housing shaft into the axle tube. Slide the motor housing out of the axle tube. Locate and retrieve thrust washer (item 29) from motor housing shaft.

10. If necessary, remove drag link from motor housing.

11. Thoroughly clean the motor housing shaft. Inspect the shaft for wear and replace motor housing if shaft is worn or damaged.

12. Thoroughly clean the rear axle bore and inspect the flange bushings in rear axle for wear or damage. If bushings need replacement:

A. Use a bushing removal tool to extract both flange bushings from the axle tube. Take care to not damage the bore of the axle tube.

B. Clean the inside of the axle tube to remove any dirt or foreign material.

C. Apply grease to the inside and outside of the new flange bushings.

D. Press new flange bushings into the top and bottom of the axle tube until bushing flange bottoms on tube.

E. After bushing installation, make sure that motor housing shaft slides easily into bushings. If binding is noted, locate and correct source of binding.

**Installation (Fig. 8)**

1. If removed, secure drag link to motor housing.

2. Apply a light coating of grease to motor housing shaft.

3. Install thrust washer (item 29) onto the motor housing shaft and slide the shaft up through the axle tube. Hold the motor housing in place and install the retaining ring (item 13) onto the end of the spindle shaft.

4. Place the spindle cap to the top of the motor housing shaft and secure with flange head screw.

5. Slide wheel motor assembly (with wheel hub and hydraulic hoses attached) into motor housing. Secure wheel motor to motor housing with four (4) cap screws and lock washers.

6. Connect the tie rod end to the drag link with slotted hex nut and cotter pin.

7. If right side motor housing was removed, secure steering cylinder ball joint to drag link with slotted hex nut and cotter pin.

8. Lubricate the motor housing shafts through the grease fittings on the rear axle.

9. Install rear wheel assembly (see Wheel Installation in this section). Make sure that lug nuts are torqued evenly in a crossing pattern from **70 to 90 ft- lb (95 to 122 N- m)**.

10. Check rear wheel toe- in (see Operator's Manual).

11. After all adjustments have been made, make sure that no contact is made between any machine components as the rear wheels are moved from lock to lock. Adjust if necessary.

## Rear Axle

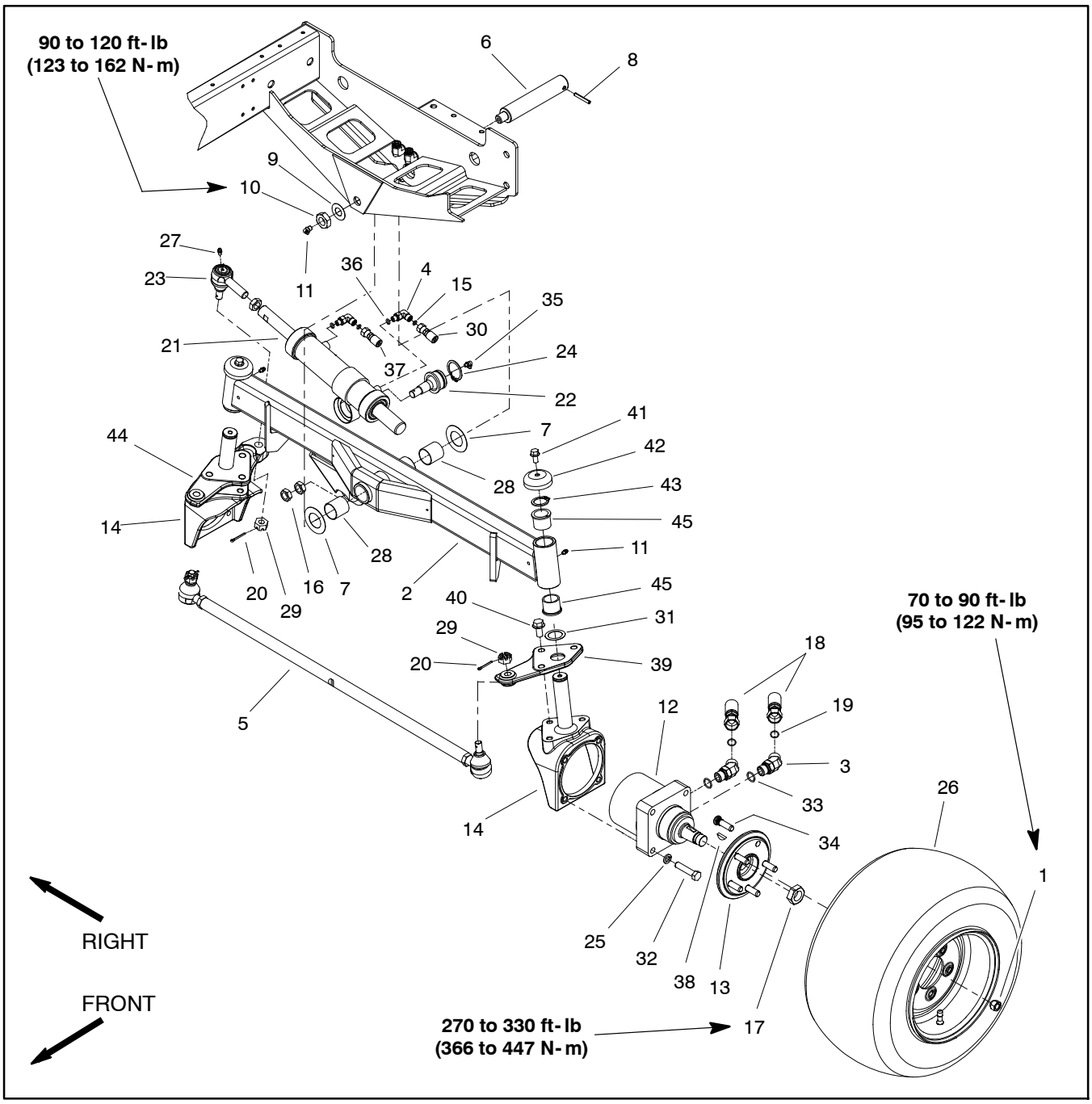


Figure 9

1. Lug nut (5 used per wheel)
2. Rear axle assembly
3. Hydraulic fitting (2 used per motor)
4. Hydraulic fitting (2 used)
5. Tie rod assembly
6. Axle pivot pin
7. Thrust washer
8. Roll pin
9. Thrust washer
10. Jam nut
11. Grease fitting
12. Wheel motor (LH shown)
13. Wheel hub assembly
14. Motor housing
15. O- ring
16. Jam nut (2 used)
17. Lock nut
18. Hydraulic hose
19. O- ring
20. Cotter pin
21. Steering cylinder
22. Ball joint
23. Ball joint
24. Retaining ring
25. Lock washer (4 used per motor)
26. Wheel assembly
27. Grease fitting
28. Bushing
29. Slotted hex nut
30. Hydraulic hose
31. Thrust washer
32. Cap screw (4 used per motor)
33. O- ring
34. Wheel stud (5 used per hub)
35. Grease fitting
36. O- ring
37. Hydraulic hose
38. Woodruff key
39. LH drag link
40. Flange head screw (3 used per link)
41. Flange head screw
42. Spindle cap
43. Retaining ring
44. RH drag link
45. Flange bushing (4 used)

**Rear Axle 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. Chock front wheels to prevent machine from shifting.

3. Remove both rear wheel assemblies (see Wheel Removal in this section). Make sure that machine is supported with appropriate jack stands.

4. Remove cotter pins and slotted hex nuts that secure the tie rod ends to the drag links. Separate the tie rod ends from the drag links and remove tie rod from axle.

5. Remove steering cylinder from rear axle (see Steering Cylinder Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

6. Remove wheel motor housings from rear axle (see Rear Axle Motor Housing Removal in this section).

7. To allow removal of the rear axle pivot pin, remove the three (3) cap screws, lock washers and spacers that secure CrossTrax™ AWD control manifold to frame (Fig. 10). Lower and support manifold taking care to not damage hydraulic tubes.

8. Remove the jam nut (item 10) and thrust washer (item 9) that secure the axle pivot pin (item 6) to the frame.

9. Support rear axle to prevent it from falling.

10. Pull the axle pivot pin from frame and rear axle. This will release the rear axle and thrust washers (item 7) from the frame.

11. Carefully remove the rear axle from the machine. Take care to not damage the CrossTrax™ AWD control manifold or attached hydraulic tubes during axle removal.

**Rear Axle Service**

1. Thoroughly clean the rear axle pivot pin. Inspect the pin for wear and replace pivot pin if worn or damaged.

2. Thoroughly clean the rear axle pivot and inspect the bushings in rear axle for wear or damage. If bushings need replacement:

   A. Use a bushing removal tool to extract both bushings from the axle pivot. Take care to not damage the bore of the axle.

   B. Clean the inside of the axle pivot to remove any dirt or foreign material.

   C. Apply grease to the inside and outside of the new bushings.

   D. Press new bushings into the axle pivot bore until bushing is flush with axle.

   E. After bushing installation, make sure that pivot pin slides easily into bushings. If binding is noted, locate and correct source of binding.

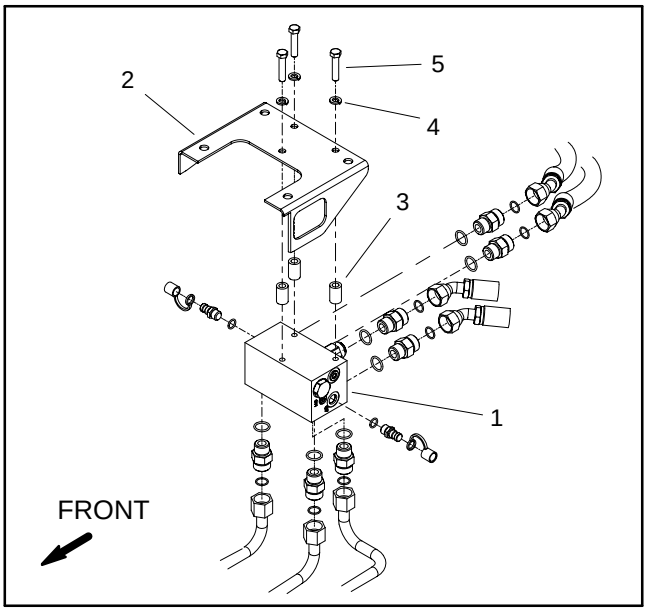


Figure 10

1. **AWD control manifold**
2. **Frame bracket**
3. **Spacer (3 used)**
4. **Lock washer (3 used)**
5. **Cap screw (3 used)**

**Tie Rod Assembly (Fig. 11)**

**NOTE:** The tie rod ball joint and jam nut at the grooved end of the tie rod have left hand threads.

1. Loosen jam nuts and then unscrew ball joints from tie rod.

2. Thread new ball joints equally into tie rod so that ball joint center to center length is 36.240” (920.5 mm).

3. Thoroughly clean the tapered surfaces of the tie rod ball joints before installing tie rod to drag links on rear axle.

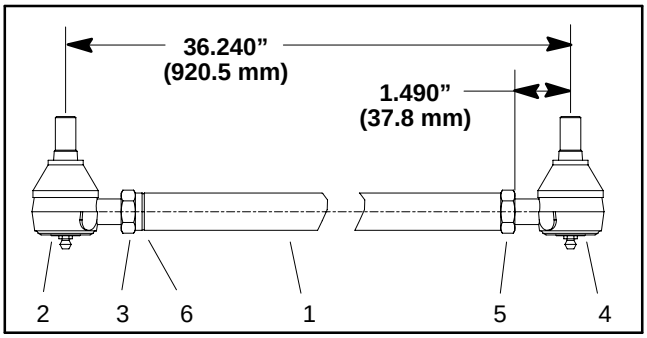


Figure 11

1. **Tie rod**
2. **Ball joint (LH thread)**
3. **Jam nut (LH thread)**
4. **Ball joint**
5. **Jam nut**
6. **Tie rod groove**

**Rear Axle Installation (Fig. 9)**

1. Position the rear axle assembly to the frame. Install thrust washer (item 7) between each side of axle and frame. Slide pivot pin through frame, thrust washers and axle. Make sure that roll pin on pivot pin is positioned in frame reliefs.

2. Install thrust washer (item 9) and jam nut (item 10) onto pivot pin. Torque jam nut (item 10) from **90 to 120 ft-lb (123 to 162 N-m)**. Make sure that rear axle can still pivot freely after jam nut is tightened.

3. Raise the CrossTrax™ AWD control manifold to the frame. Position spacers between manifold and frame (Fig. 10). Secure manifold to frame with three (3) cap screws and lock washers.

4. Install wheel motor housings to rear axle (see Rear Axle Motor Housing Installation in this section).

5. Install steering cylinder to rear axle (see Steering Cylinder Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

6. Position tie rod to axle and insert tie rod ends to drag links. Secure tie rod ends to drag links with slotted hex nuts and cotter pins.

7. Install both rear wheel assemblies (see Wheel Installation in this section). Make sure that lug nuts are torqued evenly in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

8. Check rear wheel toe-in (see Operator's Manual).

9. Check oil level in hydraulic reservoir.

10. Lubricate the rear axle grease fittings.

11. After all adjustments have been made, make sure that no contact is made between any machine components as the rear wheels are moved from lock to lock. Adjust if necessary.

12. Operate machine and check hydraulic connections for leaks.

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## Control Arm

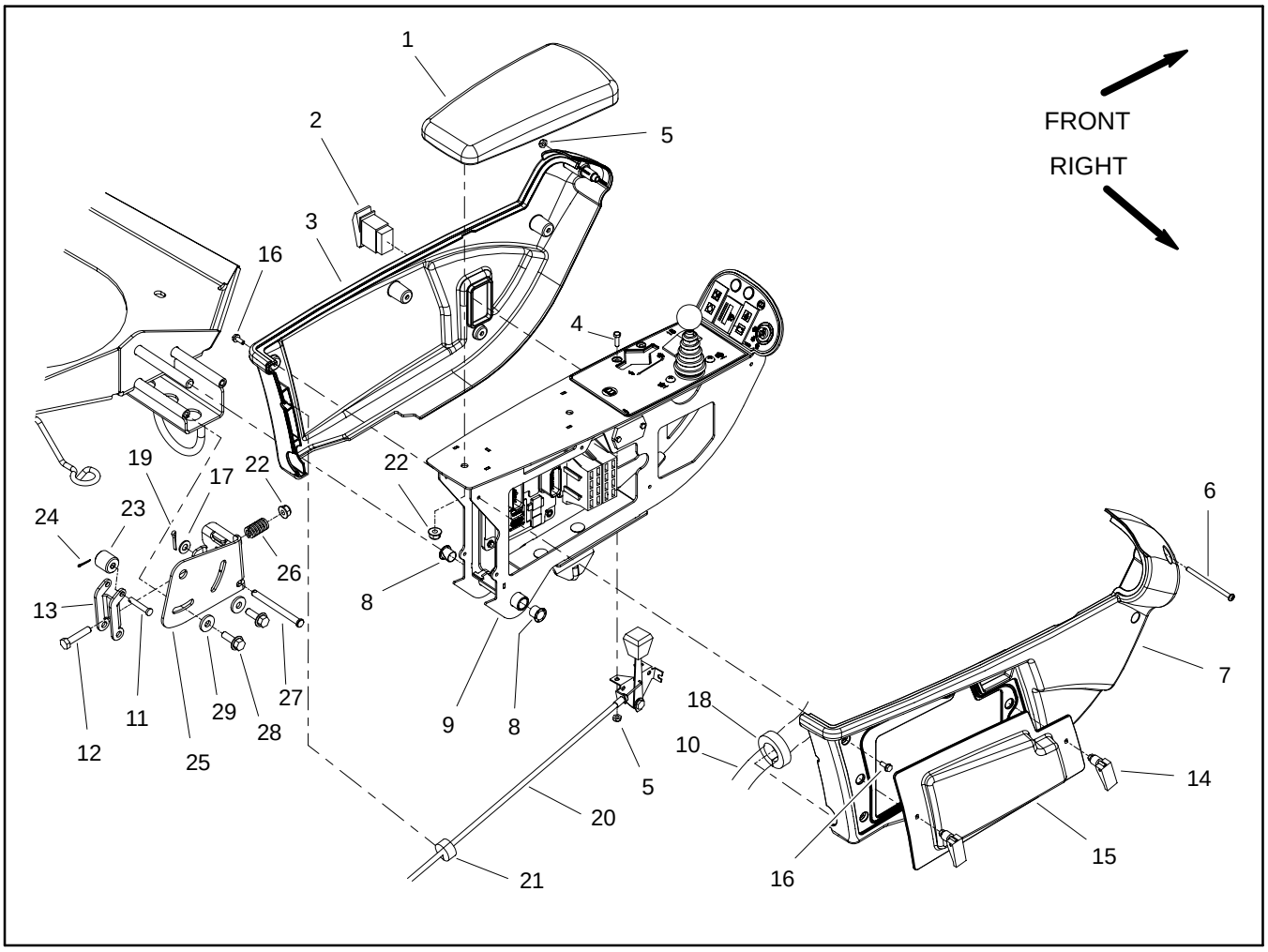


Figure 12

1. **Arm rest**
2. **Headlight switch**
3. **LH control arm cover**
4. **Screw (2 used)**
5. **Lock nut**
6. **Screw**
7. **RH control arm cover**
8. **Bushing**
9. **Control arm assembly**
10. **Seat wire harness**
11. **Clevis pin**
12. **Cap screw**
13. **Latch**
14. **Swell latch (2 used)**
15. **Access cover**
16. **Washer head screw (10 used)**
17. **Flat washer**
18. **Foam seal**
19. **Cotter pin**
20. **Throttle control assembly**
21. **Foam seal**
22. **Flange nut**
23. **Spacer**
24. **Cotter pin**
25. **Retainer bracket**
26. **Spring**
27. **Clevis pin**
28. **Flange head screw (2 used)**
29. **Flat washer (2 used)**

**Disassembly (Fig. 12)**

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

2. Loosen latches and remove access cover from outside of control arm.

3. At front of control arm, remove screw (item 6) and lock nut (item 5) that secure control arm covers to each other.

4. Remove five (5) washer head screws (item 16) that secure each cover to control arm.

5. Remove control arm covers from machine. As LH control arm cover (item 3) is removed from control arm, unplug wire harness connector from headlight switch.

6. Remove electrical components from control arm as needed using Figure 14 as a guide.

**Assembly (Fig. 12)**

1. Install all removed electrical components to control arm using Figure 14 as a guide.

2. Position covers to control arm. As LH cover (item 3) is placed, plug wire harness connector to headlight switch. Also, make sure that wire harness and throttle control cable are routed correctly through cover openings (Fig. 13).

3. Secure each cover to control arm with five (5) washer head screws (item 16). Install screw (item 6) and lock nut (item 5) to secure covers at front of control arm.

4. Install access cover to outside of control arm.

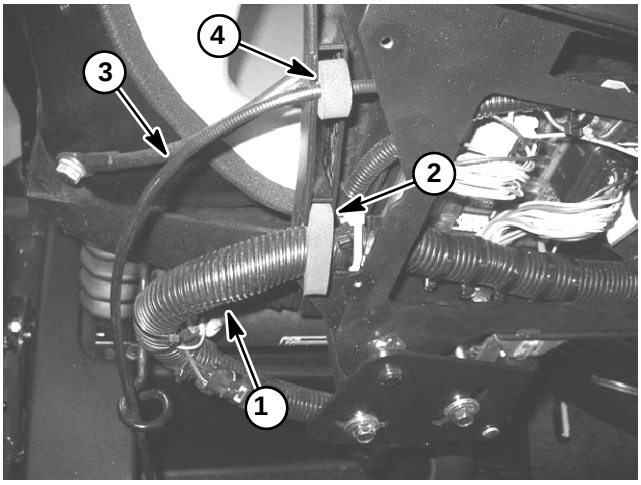


Figure 13

1. **Wire harness**
2. **Harness foam seal**
3. **Throttle control cable**
4. **Cable foam seal**

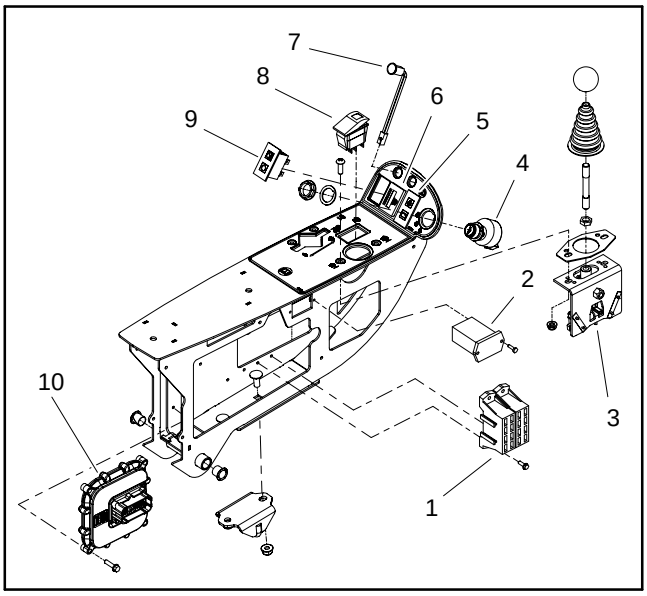


Figure 14

1. **Fuse block**
2. **Hour meter**
3. **Joystick assembly**
4. **Ignition switch**
5. **Indicator light**
6. **Temperature gauge**
7. **Diagnostic light**
8. **PTO switch**
9. **Indicator light**
10. **TEC controller**

## Operator Seat

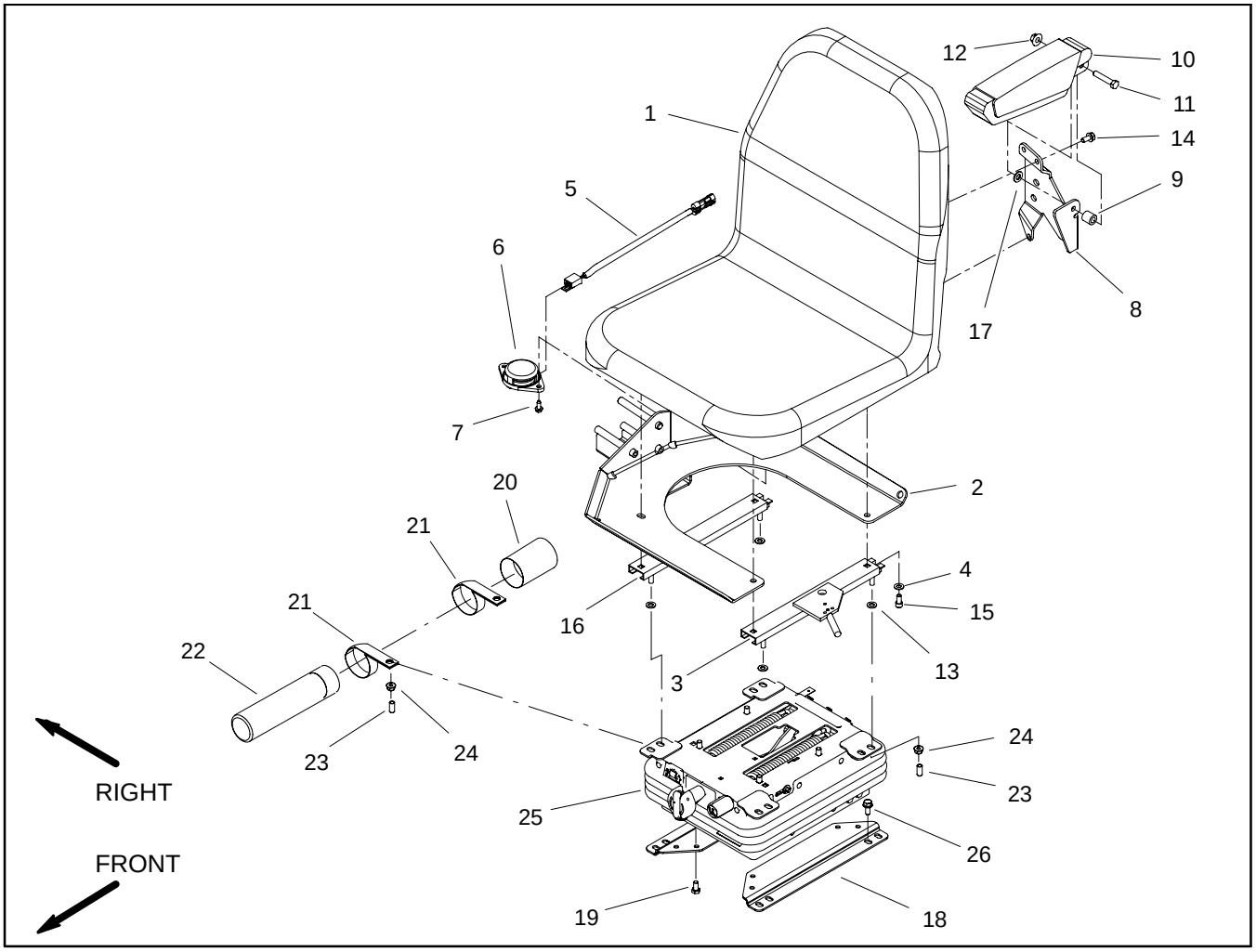


Figure 15

1. Seat
2. Seat base
3. Seat adjuster w/latch
4. Flat washer (4 used)
5. Seat switch harness
6. Seat switch
7. Washer head screw (2 used)
8. Armrest bracket
9. Spacer
10. Armrest
11. Cap screw
12. Flange nut
13. Flat washer (4 used)
14. Flange head screw (3 used)
15. Socket head screw (4 used)
16. Seat adjuster
17. Flat washer
18. Seat bracket (2 used)
19. Cap screw (4 used)
20. Housing cap
21. R–clamp (2 used)
22. Manual housing
23. Cap (4 used)
24. Flange nut (4 used)
25. Seat suspension
26. Flange head screw (4 used)

**IMPORTANT: The operator seat, seat base and control arm assembly are attached to the machine with the same fasteners. Make sure to support the seat base and control arm to prevent them from shifting when removing the seat. Damage to the throttle cable, control arm electrical components and control arm wiring harness can occur if the seat base and control arm are not properly supported during seat removal.**

**Removal (Fig. 15)**

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

2. Disconnect negative battery cable from battery (see Battery Service in the Service and Repairs section of Chapter 5 – Electrical System).

3. Disconnect seat switch electrical connector from wire harness (Fig. 16).

4. Remove two (2) flange head screws and flat washers that secure control arm assembly to seat base (Figs. 16 and 17).

**IMPORTANT: Take care to not damage the throttle cable or electrical harness when removing seat and control arm assembly from machine.**

5. Carefully slide control arm assembly from seat base. Locate and retrieve two (2) bushings (Fig. 17). Position and support control arm assembly to allow seat removal.

6. Remove four (4) socket head screws and flat washers that secure seat and seat base to seat adjusters.

7. Support seat base to keep it positioned on seat adjusters.

8. Remove operator seat from seat adjusters.

**Installation (Fig. 15)**

1. Position seat and seat base to seat adjusters.

2. Secure seat and seat base to seat adjusters with four (4) flat washers and socket head screws.

**IMPORTANT: Take care to not damage throttle cable or electrical harness when installing control arm assembly to machine.**

3. Make sure that two (2) bushings are positioned in control arm. Carefully slide control arm assembly onto seat base post. Secure control arm assembly to seat base with two (2) flange head screws and flat washers (Figs. 16 and 17).

4. Connect seat switch electrical connector to wire harness (Fig. 16).

5. Connect negative battery cable to battery (see Battery Service in the Service and Repairs section of Chapter 5 – Electrical System).

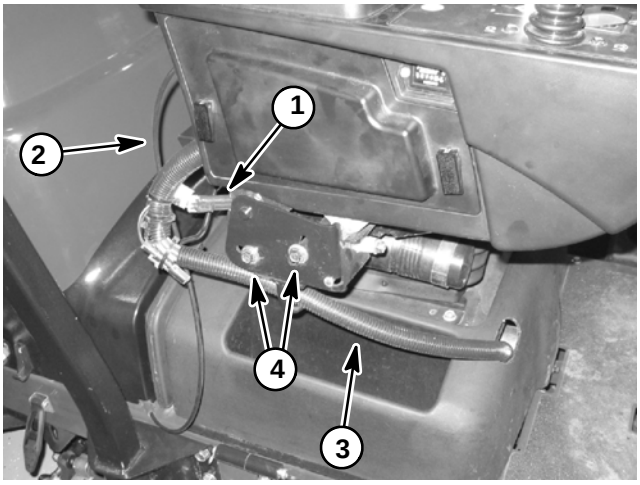


Figure 16

1. **Seat switch lead**
2. **Throttle cable**
3. **Wire harness**
4. **Flange head screw**

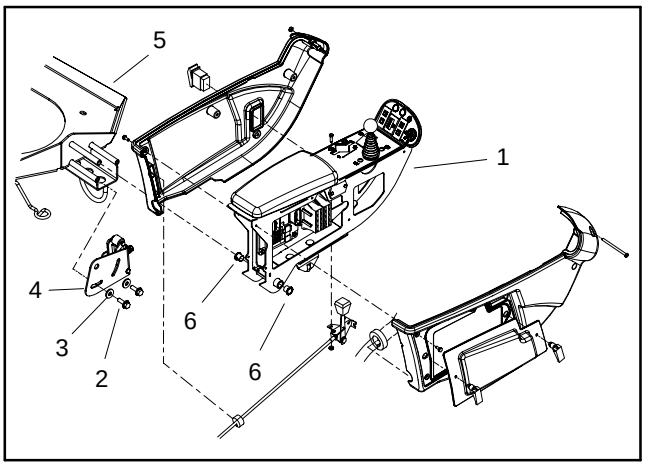


Figure 17

1. **Control arm assembly**
2. **Flange screw (2 used)**
3. **Flat washer (2 used)**
4. **Retainer bracket assy.**
5. **Seat base**
6. **Bushing**

## Mechanical Seat Suspension

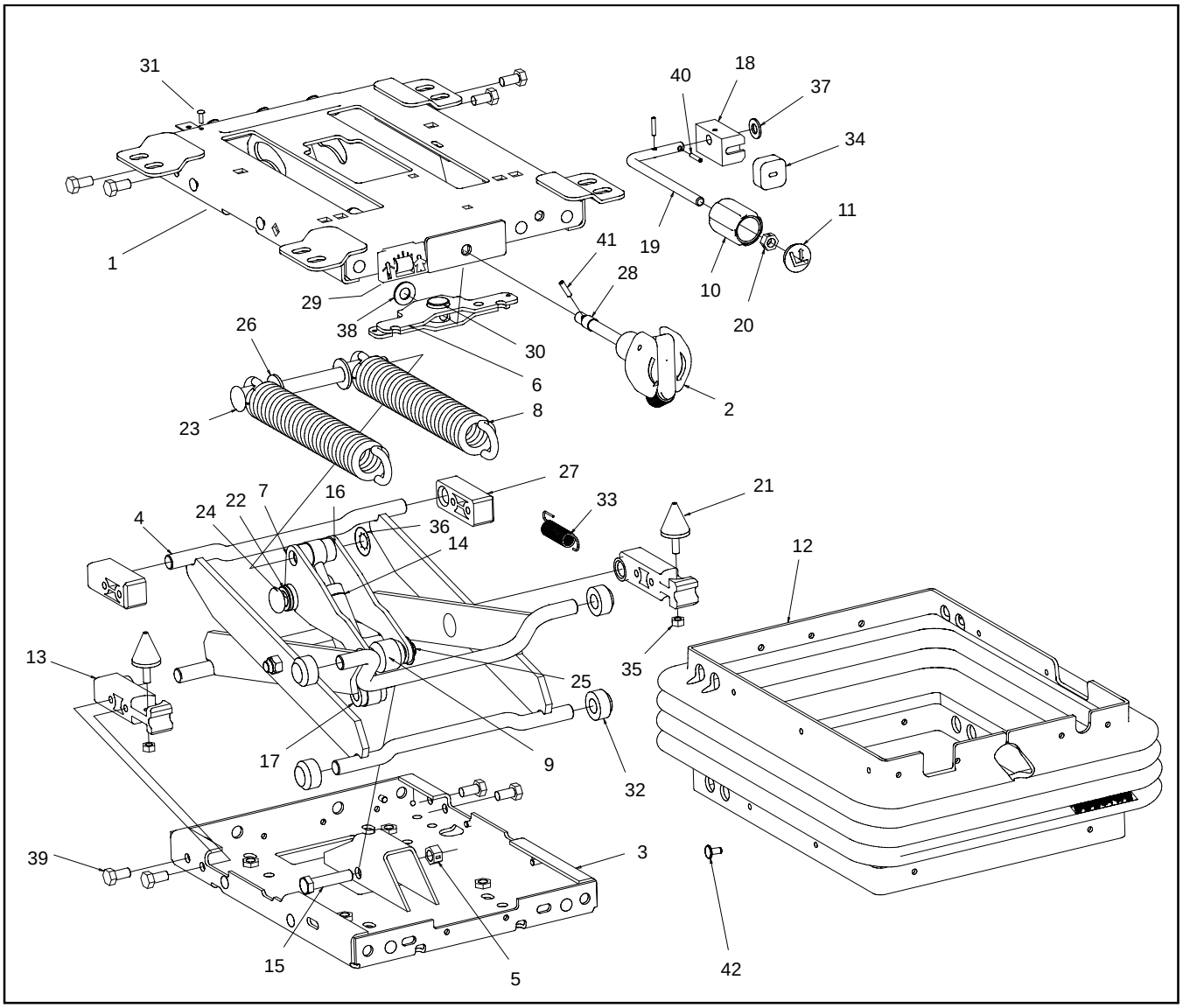


Figure 18

1. Upper housing
2. Weight adjust knob
3. Lower housing
4. Scissor assembly
5. Lock nut
6. Weight adjuster
7. Drive arm
8. Extension spring (2 used)
9. Roller guide
10. Weight adjust knob
11. Cap
12. Suspension boot
13. Pivot block (2 used)
14. Damper
15. Lower shock bolt
16. Upper shock bushing (2 used)
17. Lower shock bushing (2 used)
18. Stop bumper
19. Height adjust rod
20. Lock nut
21. Stop bumper (2 used)
22. Bearing tube (2 used)
23. Spring shaft
24. Pivot pin
25. Roller pin
26. Spring bushing (2 used)
27. Shaft block (2 used)
28. Weight adjust spacer
29. Weight indicator assembly
30. Weight adjust nut
31. Rivet
32. Roller (4 used)
33. Extension spring
34. Bumper
35. Hex nut (2 used)
36. Retainer (3 used)
37. Flat washer
38. Flat washer
39. Thread forming screw (8 used)
40. Roll pin (2 used)
41. Roll pin
42. Clip (20 used)

**IMPORTANT: When removing the seat suspension, make sure to support the control arm to prevent damage to the throttle cable, control arm electrical components and control arm wiring harness.**

**Removal (Figs. 18 and 19)**

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

2. Disconnect negative battery cable from battery (see Battery Service in the Service and Repairs section of Chapter 5 – Electrical System).

3. Remove seat from machine (see Operator Seat Removal in this section).

**IMPORTANT: Take care to not damage the throttle cable or electrical harness when removing seat suspension from machine.**

4. Tilt and support seat frame to allow access to seat suspension fasteners.

5. Support seat suspension to prevent it from falling. Remove four (4) flange head screws (Figure 19 item 8) and flange nuts (Figure 19 item 5) that secure seat suspension to seat frame.

6. Remove seat suspension from machine. Locate and retrieve four (4) spacers (Figure 19 item 7) from between seat suspension and seat frame.

7. Remove seat suspension components as needed using Figures 18 and 19 as guides.

**Installation (Figs. 18 and 19)**

1. Install all removed seat suspension components using Figures 18 and 19 as guides.

**IMPORTANT: Take care to not damage the throttle cable or electrical harness when installing seat suspension to machine.**

2. Position seatbase cover and four (4) spacers (Figure 19 item 7) to seat frame.

3. Position seat suspension to seat frame and secure with four (4) flange head screws (Figure 19 item 8) and flange nuts (Figure 19 item 5). Use forward holes in seat brackets to mount suspension.

4. Install seat to machine (see Operator Seat Installation in this section). Make sure to connect harness electrical connector to the seat switch.

5. Connect negative battery cable to battery (see Battery Service in the Service and Repairs section of Chapter 5 – Electrical System).

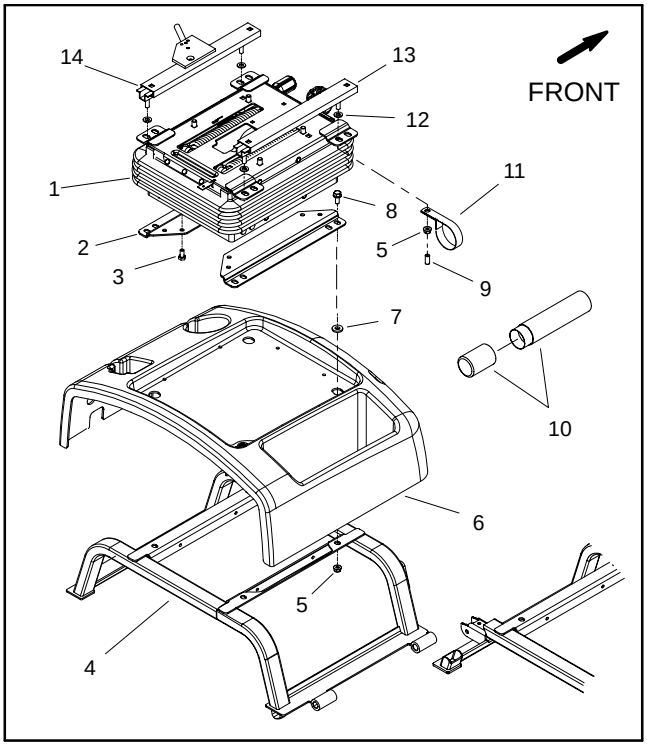


Figure 19

1. **Seat suspension**
2. **Seat bracket (2 used)**
3. **Screw (4 used)**
4. **Seat frame**
5. **Flange nut (8 used)**
6. **Seatbase cover**
7. **Spacer (4 used)**
8. **Flange screw (4 used)**
9. **Cap (4 used)**
10. **Manual tube**
11. **R–clamp (2 used)**
12. **Flat washer (4 used)**
13. **Seat adjuster**
14. **Seat adjuster w/latch**

## Front Lift Arms

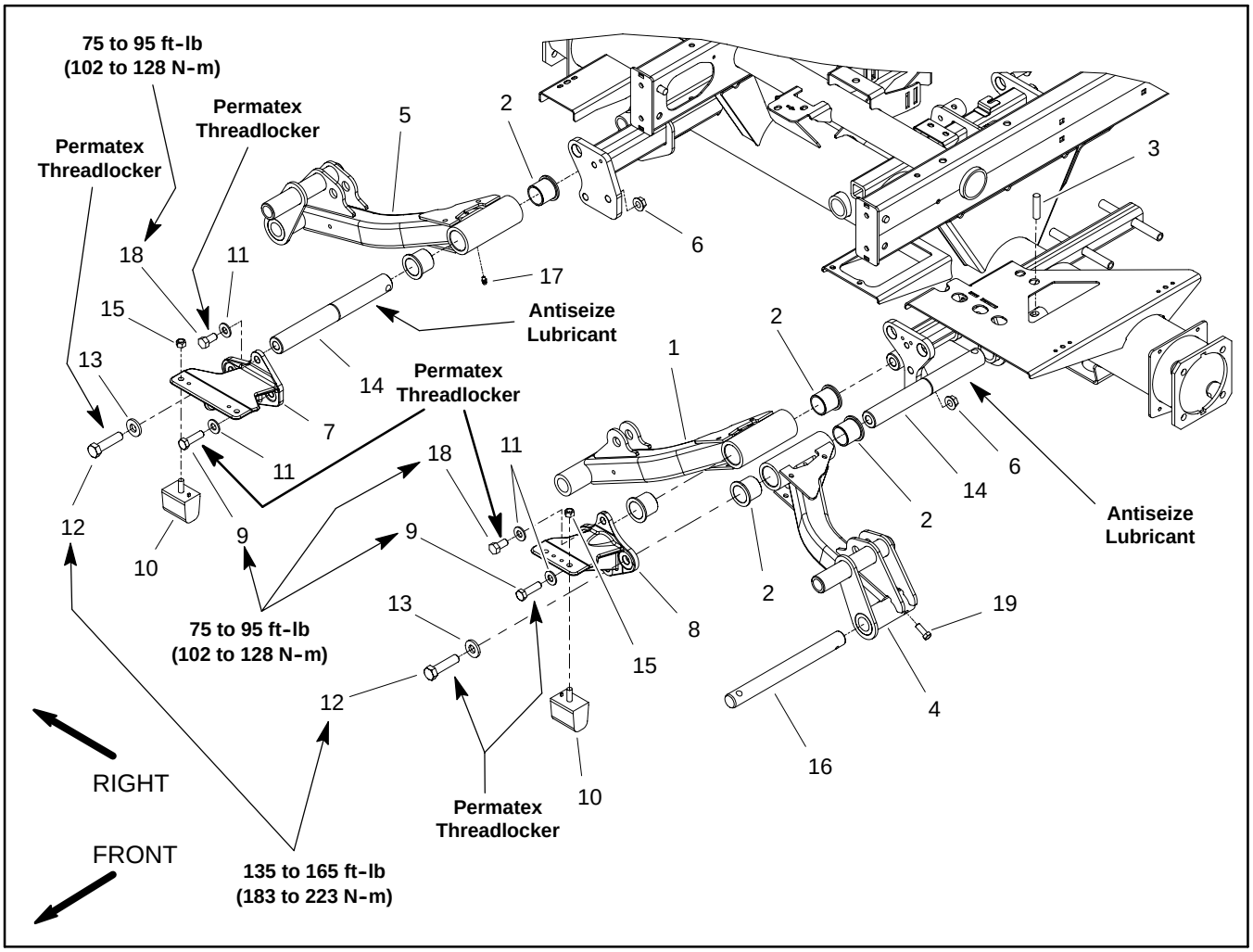


Figure 20

1. #1 lift arm
2. Flange bushing (2 used per lift arm)
3. Roll pin (1 used per lift arm)
4. #4 lift arm
5. #5 lift arm
6. Flange nut (2 used)
7. RH tipper bracket
8. LH tipper bracket
9. Cap screw (2 used)
10. Bumper (4 used)
11. Flat washer
12. Cap screw (1 used per lift arm)
13. Flat washer (1 used per lift arm)
14. Lift arm pivot shaft (3 used)
15. Lock nut (4 used)
16. Pivot shaft (1 used per lift arm)
17. Grease fitting (1 used per lift arm)
18. Cap screw (2 used)
19. Cap screw (1 used per lift arm)

**Removal (Fig. 20)**

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

2. Remove cutting deck from front lift arm to be removed (see Cutting Deck Carrier Frame Removal in the Service and Repairs section of Chapter 7 – Cutting Decks).

3. Disconnect lift cylinder from lift arm (Fig. 21):

   A. Remove one (1) retaining ring and thrust washer from the cylinder pin that secures lift cylinder to lift arm.

   B. Pull cylinder pin from the lift cylinder and lift arm. Locate and retrieve second thrust washer.

   C. Pivot lift cylinder rod end away from lift arm.

4. Remove fasteners that secure tipper bracket (item 7 or 8) to machine. Remove tipper bracket.

5. Slide front lift arm from lift arm pivot shaft.

6. Inspect flange bushings in lift arm for wear or damage. If necessary, replace bushings:

   A. Use bushing removal tool to extract bushings from the lift arm. Take care to not damage the bore.

   B. Clean the inside of the bore to remove any dirt or foreign material.

   C. Apply grease to the inside and outside of the new bushings.

   D. Use an arbor press to install the bushings into lift arm. Lift arm bushings should be pressed until bushing flange is against lift arm bore.

   E. After bushing installation, make sure that lift arm slides easily onto pivot shaft. If binding is noted, locate and correct source of binding.

7. If necessary, remove cap screw that secures pivot shaft (item 16) in lift arm. Remove pivot shaft from lift arm.

8. If necessary, remove roll pin (item 3) and lift arm pivot shaft (item 14) from frame. Discard roll pin.

**Installation (Fig. 20)**

1. If lift arm pivot shaft (item 14) was removed from frame, apply antiseize lubricant to pivot shaft surface and insert shaft into frame. Align holes in frame and pivot shaft. Secure pivot shaft with new roll pin.

2. If pivot shaft (item 16) was removed from lift arm, insert pivot shaft in lift arm and secure with cap screw (item 19).

3. Slide front lift arm onto pivot shaft.

4. Secure front lift arm to machine:

   A. Apply Permatex Blue Gel Threadlocker (or equivalent) to threads of screws (items 9, 12 and 18).

   B. Position tipper bracket to lift arm and frame bracket.

   C. Install screws, flat washers (items 11 and 13) and flange nut (item 6) to tipper bracket, pivot shaft and frame bracket.

   D. Torque 1/2" fasteners (items 9 and 18) from **75 to 95 ft-lb (102 to 128 N-m)**. Then, torque 5/8" fasteners (item 18) from **135 to 165 ft-lb (183 to 223 N-m)**.

5. Connect lift cylinder to lift arm (Fig. 21):

   A. Align lift cylinder rod end to lift arm mounting hole

   B. Slide cylinder pin with retaining ring and thrust washer through the lift cylinder and lift arm.

   C. Install second thrust washer on pin and secure with second retaining ring.

6. Mount cutting deck to lift arm (see Cutting Deck Carrier Frame Installation in the Service and Repairs section of Chapter 7 – Cutting Decks).

7. Lubricate lift arm and lift cylinder grease fittings.

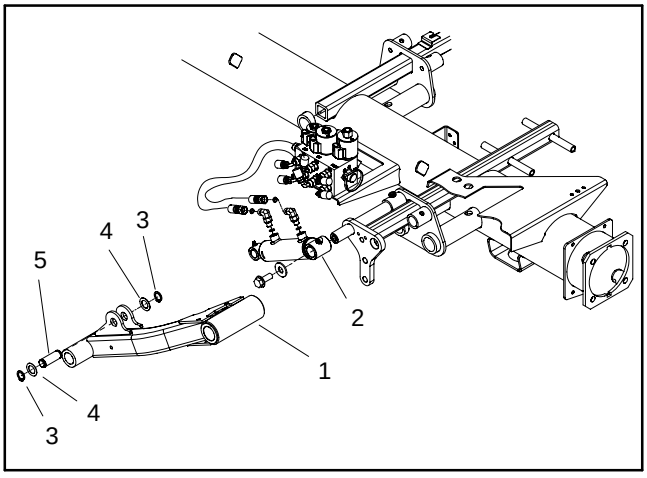


Figure 21

1. **Lift arm (#1 shown)**
2. **Lift cylinder**
3. **Retaining ring**
4. **Thrust washer**
5. **Cylinder pin**

## Rear Lift Arms

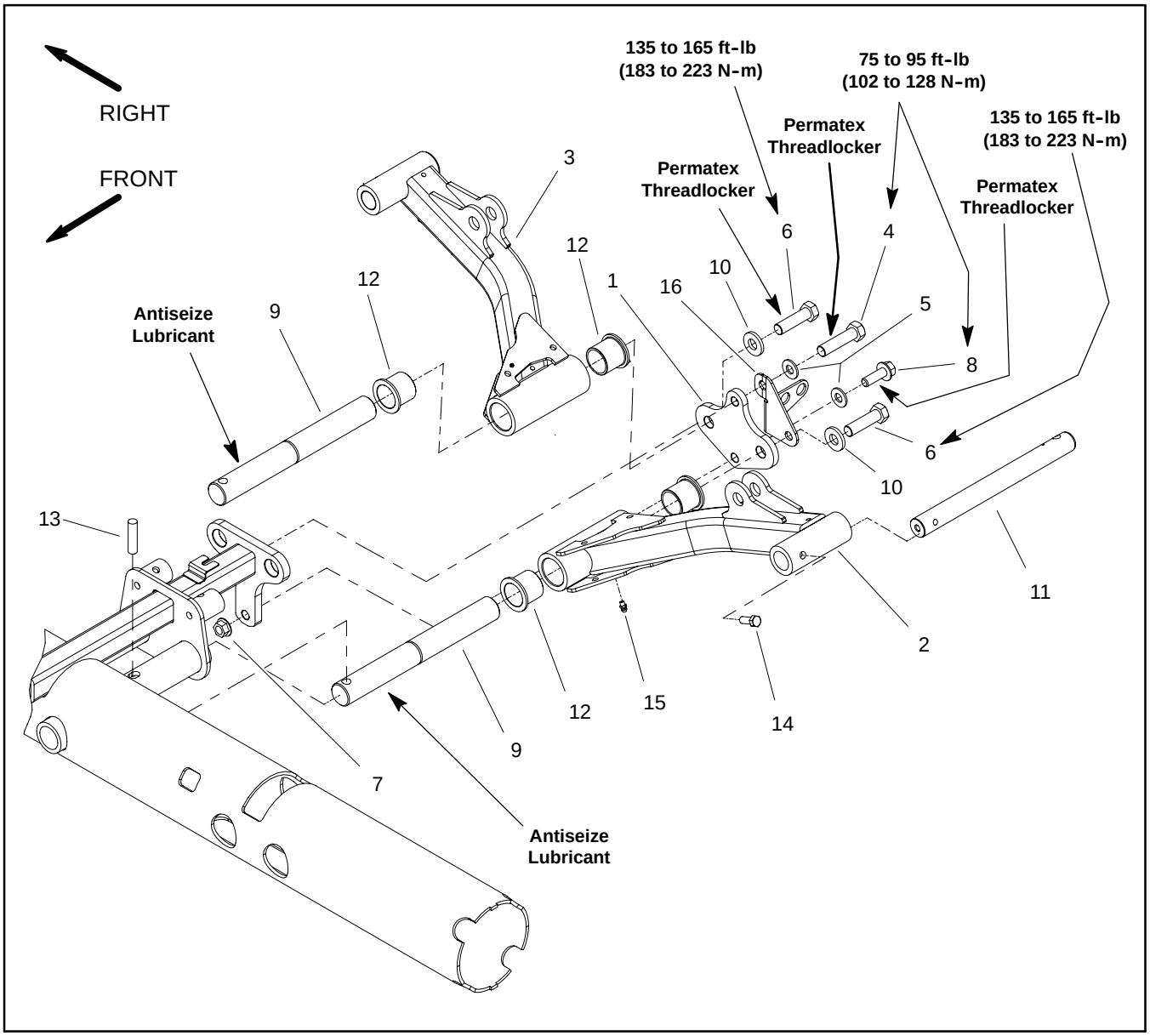


Figure 22

1. **Bridge plate**
2. **#2 lift arm**
3. **#3 lift arm**
4. **Cap screw**
5. **Thrust washer (2 used)**
6. **Cap screw (2 used)**
7. **Flange nut**
8. **Flange head screw**
9. **Lift arm pivot shaft (2 used)**
10. **Flat washer (2 used)**
11. **Pivot shaft (1 used per lift arm)**
12. **Flange bushing (2 used per lift arm)**
13. **Roll pin (1 used per pivot shaft)**
14. **Cap screw (1 used per pivot shaft)**
15. **Grease fitting (1 used per lift arm)**
16. **Bulkhead bracket**

**Removal (Fig. 22)**

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

2. Remove cutting deck from rear lift arm to be removed (see Cutting Deck Carrier Frame Removal in the Service and Repairs section of Chapter 7 – Cutting Decks).

3. Disconnect lift cylinder from lift arm (Fig. 23):

   A. Remove one (1) retaining ring and thrust washer from the cylinder pin that secures lift cylinder to lift arm.

   B. Pull cylinder pin from the lift cylinder and lift arm. Locate and retrieve second thrust washer.

C. Remove screw that secures r−clamp to lift arm. Position r−clamp and hydraulic hoses away from lift arm.

D. Pivot lift cylinder rod end away from lift arm.

4. Remove fasteners that secure bridge plate (item 1) and bulkhead bracket (item 16) to machine. Position bulkhead bracket with attached hydraulic hoses away from lift arm. Remove bridge plate.

5. Slide rear lift arm from lift arm pivot shaft.

6. Inspect flange bushings in lift arm for wear or damage. If necessary, replace bushings:

A. Use bushing removal tool to extract both flange bushings from the lift arm. Take care to not damage the lift arm bore.

B. Clean the inside of the bore to remove any dirt or foreign material.

C. Apply grease to the inside and outside of the new flange bushings.

D. Use an arbor press to install the bushings into lift arm. Bushings should be pressed until bushing flange is against lift arm bore.

E. After bushing installation, make sure that lift arm slides easily onto pivot shaft. If binding is noted, locate and correct source of binding.

7. If necessary, remove cap screw that secures pivot shaft (item 11) in lift arm. Remove pivot shaft from lift arm.

8. If necessary, remove roll pin (item 13) and lift arm pivot shaft (item 9) from frame. Discard roll pin.

**Installation (Fig. 22)**

1. If lift arm pivot shaft (item 9) was removed from frame, apply antiseize lubricant to pivot shaft surface and insert shaft into frame. Align holes in frame and pivot shaft. Secure pivot shaft with new roll pin (item 13).

2. If pivot shaft (item 11) was removed from lift arm, insert pivot shaft into lift arm and secure with cap screw (item 14).

3. Slide rear lift arm onto pivot shaft.

4. Secure rear lift arm to machine:

A. Apply Permatex Blue Gel Threadlocker (or equivalent) to threads of screws (items 4, 6 and 8).

B. Position bridge plate and bulkhead bracket with attached hydraulic hoses to lift arm and frame bracket.

C. Install screws, flat washers (items 5 and 10) and flange nut (item 7) to bridge plate, bulkhead bracket, pivot shafts and frame bracket.

D. Torque 1/2” fasteners (items 4 and 8) from **75 to 95 ft−lb (102 to 128 N−m)**. Then, torque 5/8” fasteners (item 6) from **135 to 165 ft−lb (183 to 223 N−m)**.

5. Connect lift cylinder to lift arm (Fig. 21):

A. Align lift cylinder rod end to lift arm mounting holes.

B. Slide cylinder pin with retaining ring and thrust washer through the lift cylinder and lift arm.

C. Install second thrust washer on pin and secure with second retaining ring.

D. Position r−clamp and hydraulic hoses to lift arm. Secure r−clamp with screw.

6. Mount cutting deck to lift arm (see Cutting Deck Carrier Frame Installation in the Service and Repairs section of Chapter 7 − Cutting Decks).

7. Lubricate lift arm and lift cylinder grease fittings.

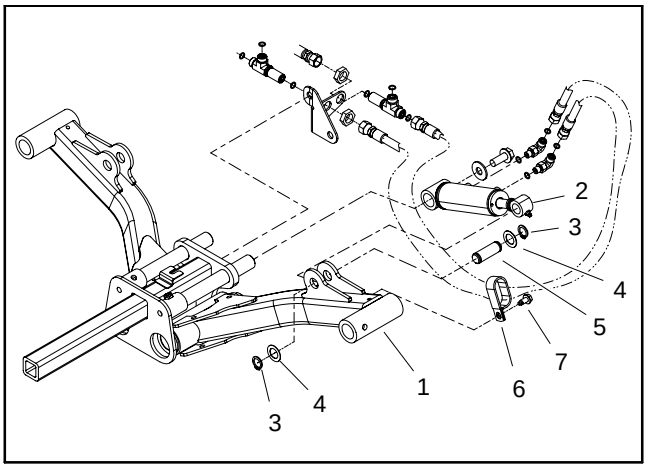


Figure 23

1. **Lift arm (#2 shown)**
2. **Lift cylinder**
3. **Retaining ring**
4. **Thrust washer**
5. **Cylinder pin**
6. **R−clamp**
7. **Screw**

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# Chapter 7

# Cutting Decks

## Table of Contents

# Specifications

**MOUNTING:** All cutting decks are supported by independent lift arms and are interchangeable to any cutting deck positions. The Groundsmaster 4300–D uses five (5) cutting decks.

**CONSTRUCTION:** Deck chamber and frame are welded steel construction reinforced with channels and plates.

**HEIGHT–OF–CUT RANGE:** 3/4 to 4 inch (19 to 101 mm) in 1/4 inch (6.4 mm) increments. Height–of–cut adjustment is made by repositioning deck on deck frame.

**DECK DRIVE:** Closed loop, integrated relief, hydraulic system operates cutting deck hydraulic motors. Blade spindles are 1–1/4 inch (31.7 mm) shafts supported by greaseable, tapered roller bearings in a ductile iron housing.

**CUTTING BLADE:** Each cutting deck equipped with a 22 inch (559 mm) length, 0.250 inch (6.4 mm) thick, heat treated, steel blade. Anti–scalp cup installed on cutting blade. The standard blade is optimized for most cutting applications. Optional high lift, angled sail and Atomic blades are available for those situations where the standard blade is not ideal.

**DISCHARGE:** Clippings are discharged from the rear of the mowing decks. Pre–drilled mounting holes in the cutting deck allow attachment of optional mulching baffle.

**CUTTING DECK LIFT:** Cutting decks on the Groundsmaster 4300–D are controlled with the operator joystick.

**SUSPENSION SYSTEM:** A fully floating suspension with hydraulic counterbalance. Main center pivot allows side–to–side deck oscillation. Individual decks supported with two (2) front rollers and one, full width, rear roller.

**WEIGHT:** Individual cutting deck weighs approximately 140 lb (63.5 kg).

# General Information

**CAUTION**

**Never install or work on the cutting decks or lift arms with the engine running. Always stop engine and remove key from ignition switch first.**

## Operator's Manual

The Cutting Deck Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the cutting deck on your Groundsmaster machine. Refer to that publication for additional information when servicing the cutting deck.

# 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, “sponginess”, uneven ground conditions or attempting to cut off too much grass height may not always be overcome by adjusting the machine. It is important to remember that the lower the height−of−cut, the more critical these factors are.

Remember that the “effective” or actual height−of−cut depends on cutting deck weight, counterbalance setting 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. | Check maximum governed engine speed. Adjust speed to specifications if necessary. |
| 2. Blade speed. | All deck blades should rotate at the same speed.<br><br>See items in Troubleshooting Section of Chapter 4 − Hydraulic System. |
| 3. Tire pressure. | Check air pressure of each tire. Adjust to pressures specified in Operator’s Manual. |
| 4. Blade condition. | Sharpen blades if their cutting edges are dull or nicked.<br><br>Inspect blade sail for wear or damage. Replace blade if needed. |
| 5. Mower housing condition. | Make sure that cutting chambers are in good condition.<br><br>Keep underside of deck clean. Debris buildup will reduce cutting performance. |
| 6. Height−of−cut. | Make sure all cutting decks are set at the same height−of−cut. Adjust cutting decks as specified in the Cutting Deck Operator’s Manual.<br><br>Adjust height−of−cut setting to remove only 1 inch (25 mm) or 1/3 of the grass blade when cutting. |
| 7. Cutting deck alignment and ground following. | Check lift arms and cutting deck pivot linkages for wear, damage or binding. Also inspect for bent or damaged pivot shafts. |
| 8. Roller condition. | All rollers should rotate freely. Replace bearings if worn or damaged. |
| 9. Grass Conditions. | Mow when grass is dry for best cutting results. |

# Special Tools

Order special tools from your Toro Distributor.

## Rear Roller Bearing and Seal Installation Tools

These tools are used to assemble the cutting deck rear roller.

Toro Part Numbers:

| | |
|---|---|
| Inner Seal Tool | **115-0852** |
| Bearing/Outer Seal Tool | **115-0853** |
| Bearing Installation Washer | **107-8133** |

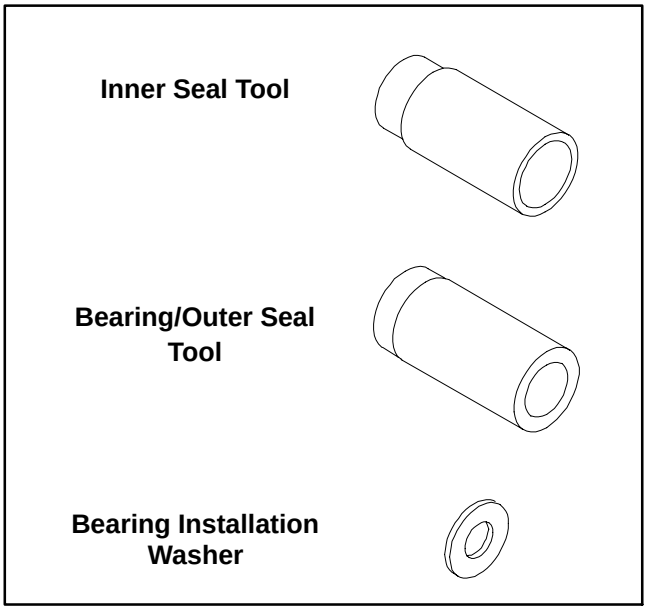


Figure 1

## Spindle Plug

The spindle plug can be used to prevent contaminant entry into the cutting deck spindle assembly when the hydraulic motor is removed from the spindle.

Toro Part Number: **94-2703**

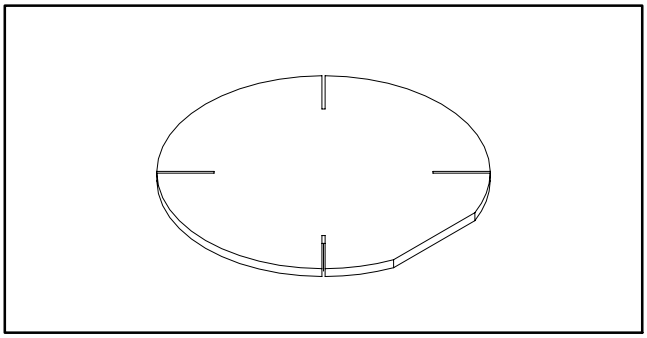

Figure 2

# Adjustments

**CAUTION**

**Never install or work on the cutting decks or lift arms with the engine running. Always stop engine and remove key from ignition switch first.**

See the Cutting Deck Operator's Manual for adjustment procedures for cutting decks on the Groundsmaster 4300–D.

## Blade Stopping Time

The blades of the cutting decks are to come to a complete stop in approximately five (5) seconds after the PTO is disengaged.

**NOTE:** Make sure the decks are lowered onto a clean section of turf or hard surface to avoid dust and debris.

To verify this stopping time, have a second person stand back from the machine at least twenty (20) feet and watch the blade on one of the cutting decks. Have the machine operator disengage the PTO and record the time it takes for the cutting deck blade to come to a complete stop. If this time is greater than seven (7) seconds, the deck control manifold braking valve (RV) may need adjustment.

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# Service and Repairs

**CAUTION**

**Never install or work on the cutting decks or lift arms with the engine running. Always stop engine and remove key from ignition switch first.**

## Blade Spindle Assembly

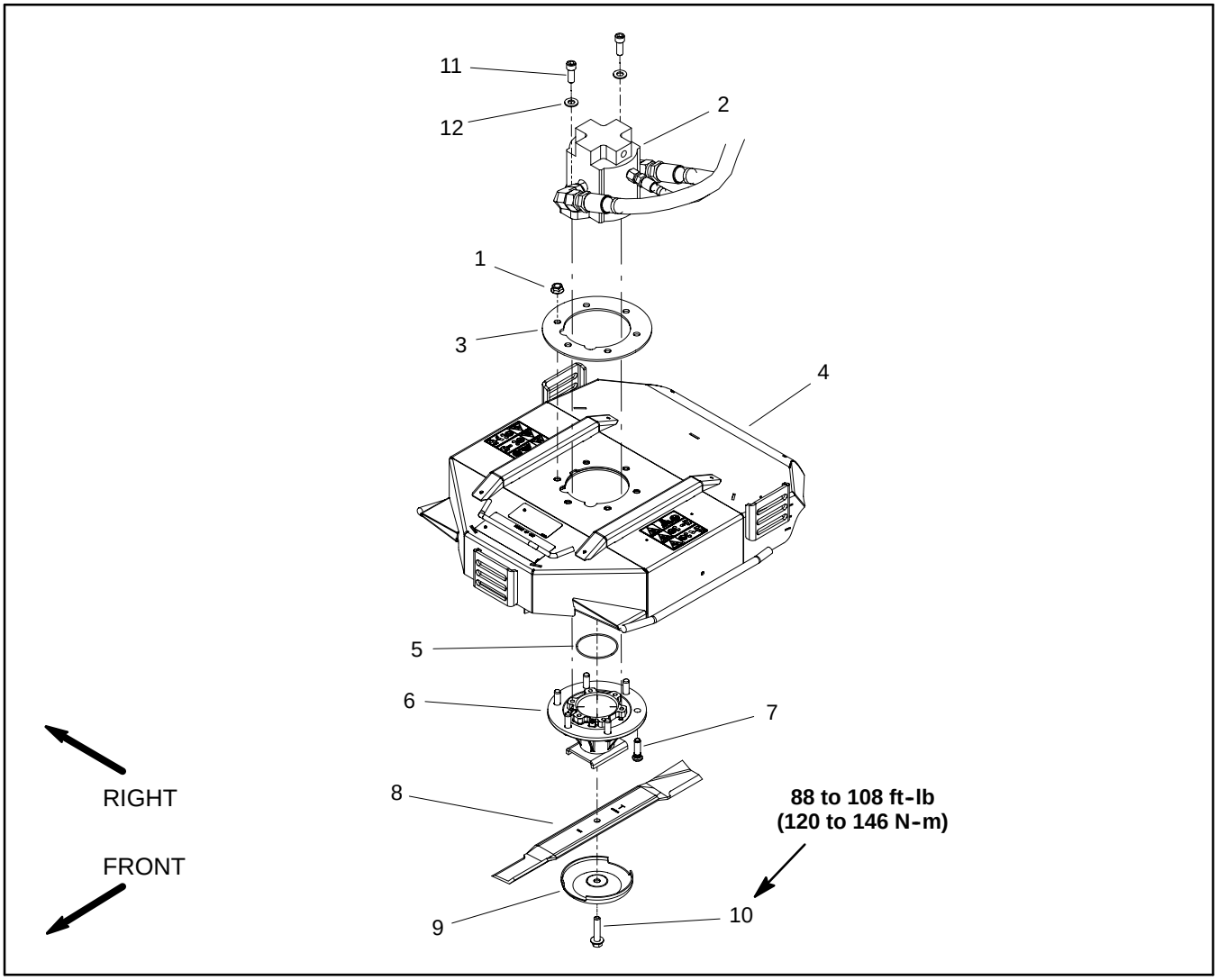


Figure 3

1. Flange nut (6 used)
2. Hydraulic deck motor
3. Spindle plate
4. Cutting deck
5. O-ring
6. Spindle assembly
7. Stud (6 used)
8. Cutting blade
9. Anti-scalp cup
10. Blade bolt
11. Socket head screw (2 used)
12. Flat washer (2 used)

**Removal (Fig. 3)**

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) socket head screws and flat washers that secure hydraulic motor to the cutting deck (Fig. 4). Remove hydraulic motor and O−ring from deck.

3. Cover top of spindle to prevent debris from entering spindle. A spindle plug (see Special Tools in this chapter) can be used to cover spindle.

4. Start the engine and raise the cutting deck. Stop engine and remove key from the ignition switch. Support the cutting deck so it cannot fall accidentally. If required for easier service, remove cutting deck from machine.

5. Remove blade bolt, anti−scalp cup and cutting blade.

6. Remove six (6) flange nuts that secure spindle assembly to cutting deck. Slide spindle assembly out the bottom of the deck. Remove spindle plate from top of deck.

7. If necessary, press studs from spindle housing.

**Installation (Fig. 3)**

1. If studs were removed from spindle housing, press studs fully into housing holes. Make sure that stud head is seated squarely against housing.

2. Position spindle assembly and spindle plate to cutting deck. Align grease fittings on spindle with notches on cutting deck and spindle plate toward front of deck.

3. Secure spindle to cutting deck with six (6) flange nuts. Tighten flange nuts in a star pattern.

4. Install cutting blade, anti−scalp cup and blade bolt. Tighten blade bolt from **85 to 110 ft−lb (115 to 149 N−m)**.

5. Remove cover from top of spindle that was placed to prevent debris from entering spindle.

6. Make sure that O−ring is positioned to top of spindle housing. Secure hydraulic motor to the cutting deck with two (2) socket head screws and flat washers.

**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.**

7. Attach a hand pump grease gun to one of the grease fittings on housing and fill housing cavity with grease until grease starts to come out of lower seal.

8. After assembly, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

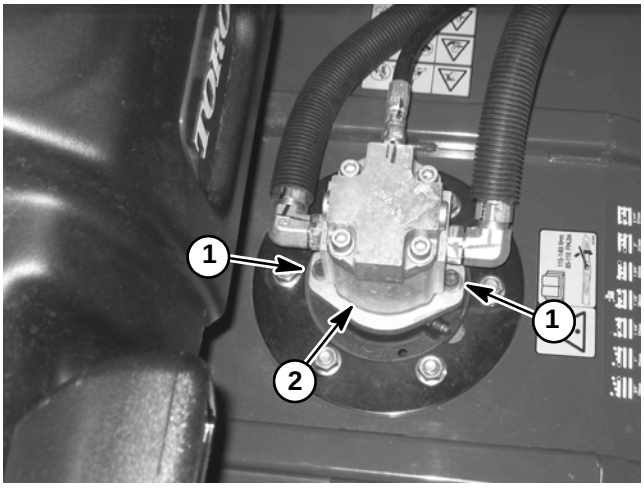


Figure 4

1. **Socket head screw**
2. **Hydraulic motor**

## Blade Spindle Service

### Disassembly (Fig. 5)

1. Remove blade spindle from cutting deck (see Blade Spindle Removal in this section).

2. Loosen and remove spindle nut from top of spindle shaft.

3. 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.

4. Carefully remove oil seals from spindle housing noting direction of seal lips.

5. Allow the bearing cones, inner bearing spacer and spacer ring to drop out of the spindle housing.

6. Using an arbor press, remove both of the bearing cups and the outer bearing spacer from the housing.

7. The large snap ring can remain inside the spindle housing. Removal of this snap ring is very difficult.

### Assembly (Fig. 5)

**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. 6). These parts cannot be purchased separately. 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. 6). 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 large 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 large 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 groove.

2. Install outer bearing spacer into top of spindle housing. The spacer should fit against the large snap ring.

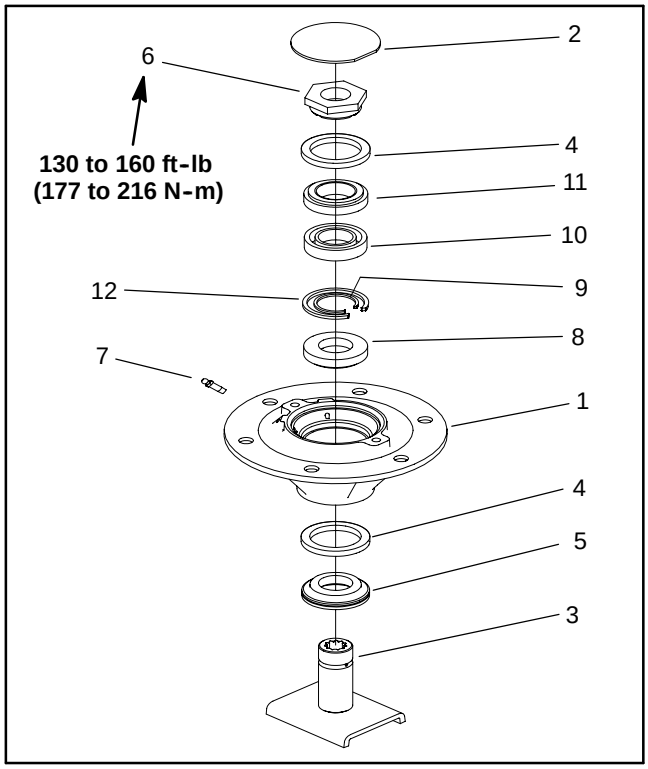


Figure 5

1. **Spindle housing**
2. **Spindle plug**
3. **Spindle shaft**
4. **Oil seal**
5. **Shaft spacer**
6. **Spindle nut**
7. **Grease fitting (2 used)**
8. **Bearing**
9. **Spacer ring**
10. **Spacer set (2 piece)**
11. **Bearing**
12. **Large snap ring**

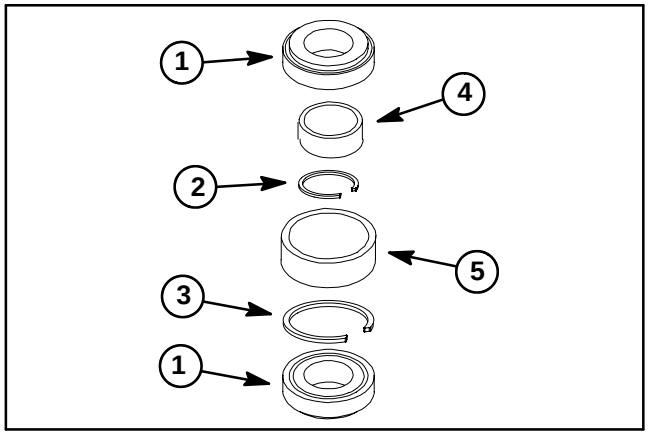


Figure 6

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 large snap ring. Make sure that the assembly is correct by supporting the first bearing cup and pressing the second cup against it (Fig 7).

4. Pack the bearing cones with grease. Apply a film of grease on lips of oil seals.

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. 8). 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 the new bearing set (Fig. 6).**

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 out (up) (Fig. 8).

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 should fit together when the spindle is fully installed.

10. Thread spindle nut onto shaft and tighten nut from **130 to 160 ft-lb (177 to 216 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.**

11. Attach a hand pump grease gun to one of the grease fittings on housing and fill housing cavity with grease.

12. Rotate spindle shaft to make sure that it turns freely.

13. Install blade spindle assembly to cutting deck (see Blade Spindle Installation in this section).

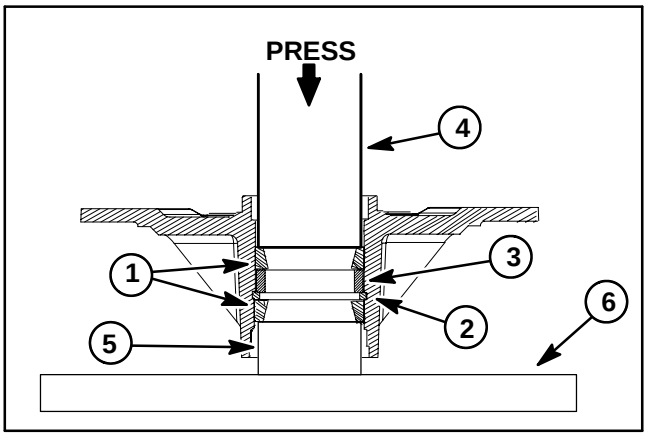


Figure 7

1. **Bearing cups**
2. **Large snap ring**
3. **Large spacer**
4. **Arbor press**
5. **Support**
6. **Arbor press base**

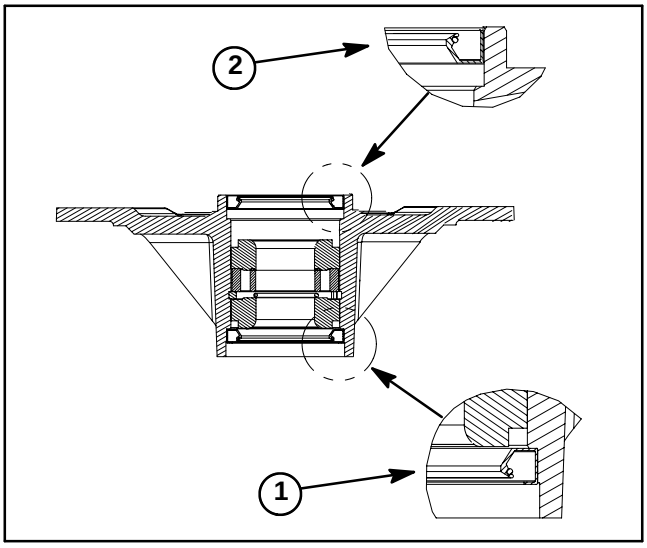


Figure 8

1. **Bottom seal installation**
2. **Upper seal installation**

## Rear Roller

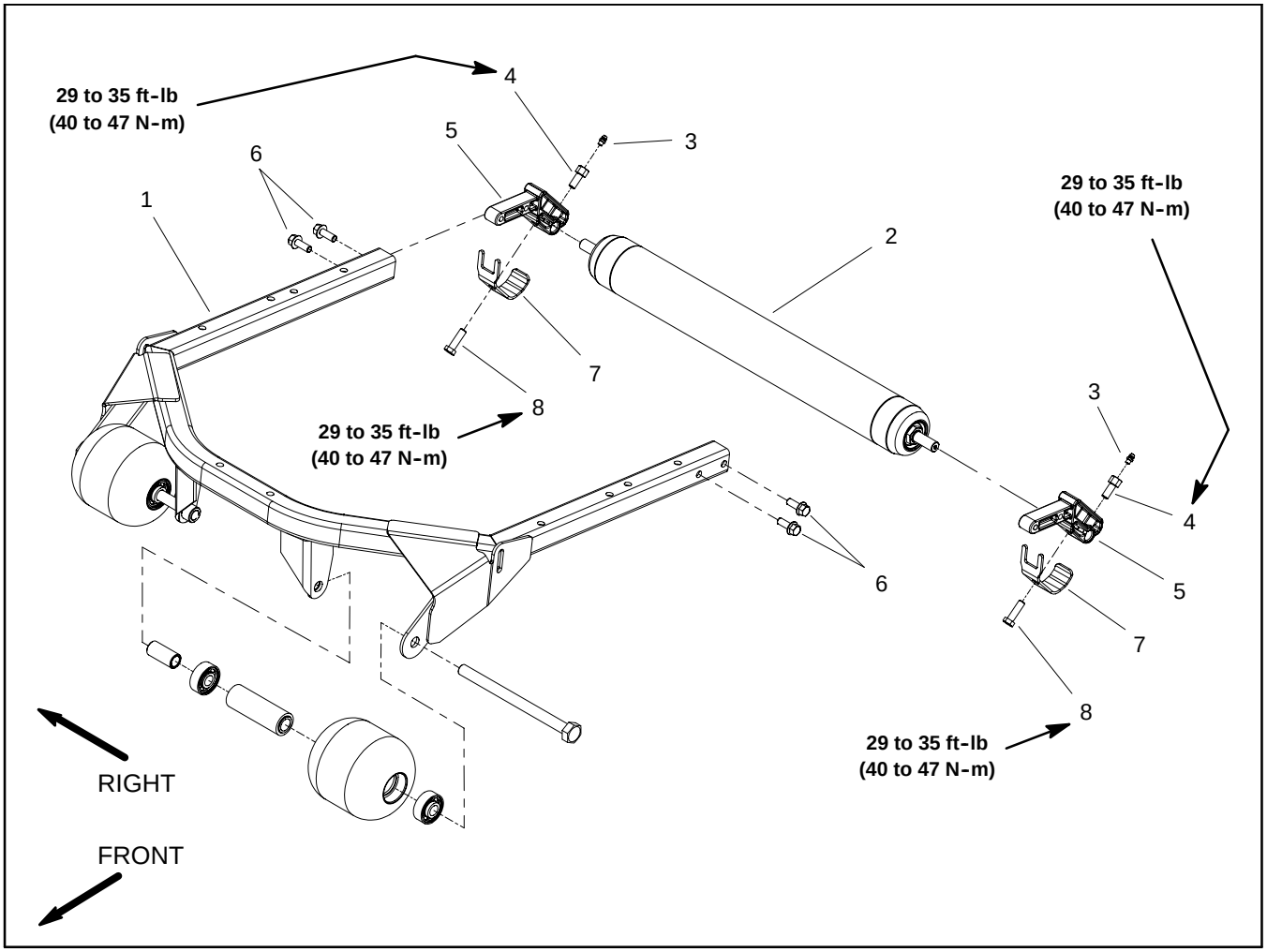


Figure 9

1. Deck frame
2. Rear roller assembly
3. Grease fitting
4. Roller shaft screw
5. Roller mount
6. Flange head screw
7. Skid bracket
8. Cap screw

**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. If cutting deck is equipped with a roller scraper (Fig. 10), remove fasteners securing left and right scraper rod brackets to roller mounts. Remove scraper rod assembly.

3. Remove four (4) flange head screws securing roller mounts to rear of deck frame. Remove roller mounts and rear roller assembly from deck frame.

4. Loosen fasteners securing each end of roller to roller mounts. Remove mounts and skid brackets from roller.

**Installation (Fig. 9)**

1. Slide roller mounts onto roller shaft.

2. Install roller and roller mount assembly into rear of deck frame. Secure assembly to deck frame with four (4) flange head screws.

**IMPORTANT: During assembly, make sure the grease groove in each roller mount aligns with the grease hole in each end of the roller shaft.**

3. Align roller shaft grease hole with the roller mount grease groove. Use alignment mark on end of roller shaft to assist with alignment.

4. Position skid brackets to roller mounts and install cap screws to retain brackets in place.

5. If equipped with scraper rod, install and adjust scraper rod assembly to roller mounts (Fig. 10). The gap between the scraper rod and roller should be from 0.020 to 0.040 in (0.5 to 1.0 mm). Torque cap screws **30 ft-lb (41 N-m)**.

6. Install and tighten fasteners that secure each end of roller to roller mounts. Torque roller shaft screws (item 4) and cap screws (item 8) from **29 to 35 ft-lb (40 to 47 N-m)**.

7. After assembly, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

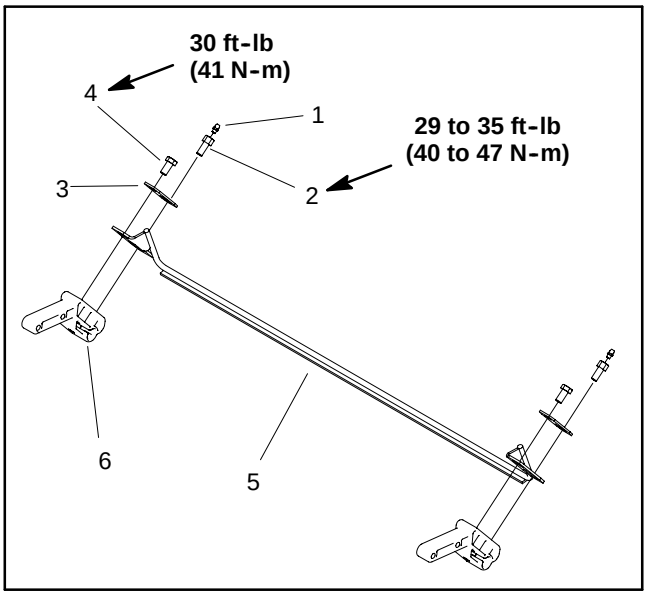


Figure 10

1. **Grease fitting**
2. **Roller shaft screw**
3. **Scraper plate**
4. **Cap screw**
5. **Roller scraper**
6. **Roller mount**

## Rear Roller Service

**Disassembly (Fig. 11)**

1. Remove bearing lock nut from each end of roller shaft.

2. Loosely secure roller assembly in bench vise and lightly tap one end of roller shaft until outer seals and bearing are removed from opposite end of roller tube. Remove second set of outer seals and bearing from roller tube by tapping on opposite end of shaft. Remove shaft from roller tube.

3. Carefully remove inner seal from both ends of roller tube taking care to not damage tube surfaces.

4. Discard removed seals and bearings.

5. Clean roller shaft and all surfaces on the inside of the roller tube. Inspect components for wear or damage. Also, carefully inspect seating surface and threads of bearing lock nuts. Replace all damaged components.

**Assembly (Fig. 11)**

1. Install inner seals into roller tube making sure that seal lip (and garter spring) faces end of tube. Use inner seal tool (see Special Tools in this chapter) and soft face hammer to fully seat seals against roller shoulder (Fig. 12). Apply a small amount of grease around the lip of both inner seals after installation.

**IMPORTANT: During assembly process, frequently check that bearings rotate freely and do not bind. If any binding is detected, consider component removal and reinstallation.**

2. Install new bearing and outer seals into one end of roller tube:

   A. Position a new bearing into one end of roller tube. Use bearing/outer seal tool (see Special Tools in this chapter) with a soft face hammer to fully seat bearing against roller shoulder (Fig. 13). After bearing installation, make sure that it rotates freely with no binding.

   B. Apply a small amount of grease around the lip of both outer seals.

   C. Install first outer seal into roller tube making sure that seal lip (and garter spring) faces end of tube. Use bearing/outer seal tool (see Special Tools in this chapter) and soft face hammer to lightly seat seal against roller shoulder (Fig. 14). Make sure that bearing still freely rotates after seal installation.

   D. Using the same process, install second outer seal making sure to not crush the installed outer seal. Again, make sure that bearing still freely rotates.

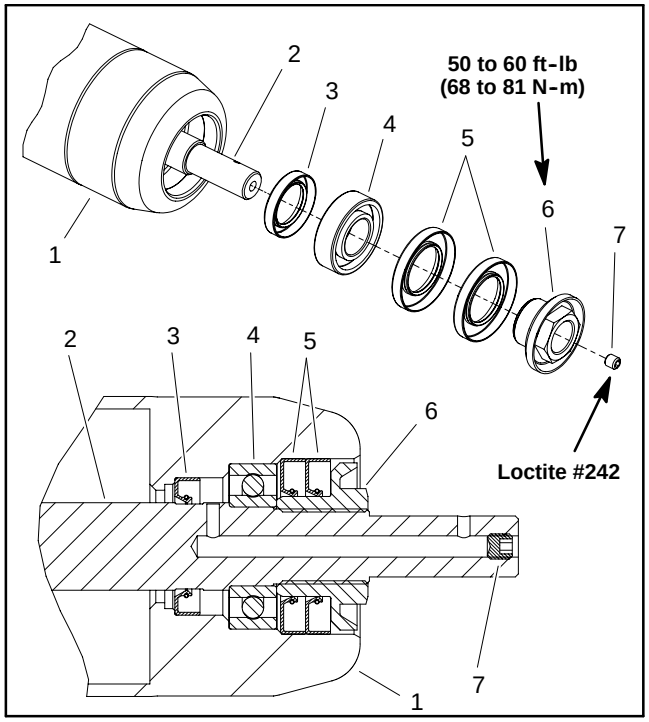


Figure 11

1. Roller tube
2. Roller shaft
3. Inner seal
4. Bearing
5. Outer seal
6. Bearing lock nut
7. Set screw

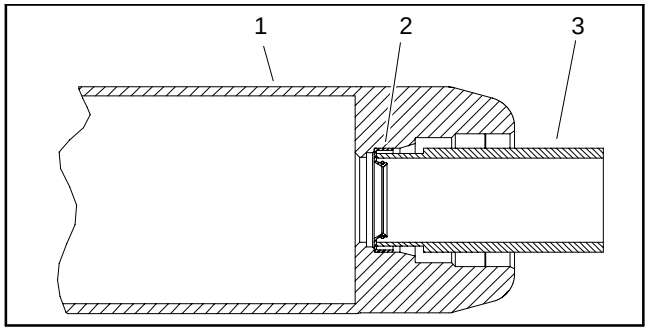

Figure 12

1. Roller tube
2. Inner seal
3. Inner seal tool

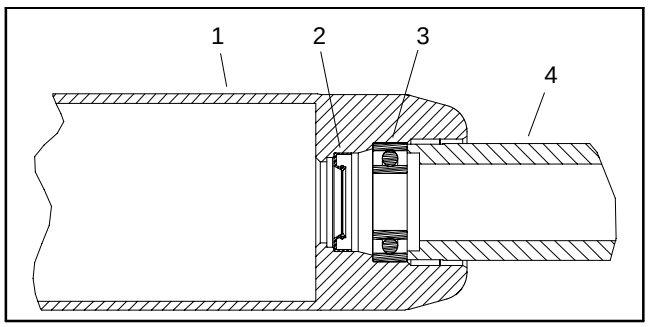

Figure 13

1. Roller tube
2. Inner seal
3. Bearing
4. Bearing/outer seal tool

3. From the roller tube end with only the inner seal installed, carefully install the roller shaft into the roller tube. Make sure that seals are not damaged as shaft is installed.

4. Install new bearing and outer seals into second end of roller tube:

A. Position a second new bearing to roller shaft and tube. Position washer (see Special Tools in this chapter) on bearing to allow pressing on both inner and outer bearing races simultaneously.

B. Use washer and bearing/outer seal tool (see Special Tools in this chapter) with a soft face hammer to fully seat bearing (Fig. 15). After bearing installation, make sure that shaft freely rotates and that no binding is detected. If necessary, lightly tap bearing and/or shaft ends to align shaft and bearings. Remove washer from roller.

C. Apply a small amount of grease around the lip of both outer seals.

D. Carefully install first outer seal into roller tube making sure that seal lip (and garter spring) faces end of tube. Use bearing/outer seal tool (see Special Tools in this chapter) and soft face hammer to lightly seat seal (Fig. 16). Make sure that shaft and bearings still freely rotate after seal installation.

E. Using the same process, install second outer seal making sure to not crush the installed outer seal. Again, make sure that shaft and bearings still freely rotate.

**IMPORTANT: Make sure that all grease is removed from shaft threads to prevent bearing lock nut loosening.**

5. Thoroughly clean threads on both ends of roller shaft.

**NOTE:** If original bearing lock nut(s) are being used, apply Loctite #242 (or equivalent) to threads of lock nut(s).

6. Install bearing lock nut onto each end of the roller shaft. Make sure that outer seals are not damaged during nut installation. Torque lock nuts from **50 to 60 ft-lb (68 to 81 N-m)**.

7. If set screw was removed from either end of roller shaft, apply Loctite #242 (or equivalent) to threads of removed set screw and install into roller shaft. Tighten set screw until it bottoms in shaft and is recessed in shaft.

**IMPORTANT: When roller assembly is installed to cutting deck, make sure that grease groove in each roller mount aligns with the grease hole in each end of roller shaft.**

**NOTE:** After roller is installed to cutting deck, lubricate roller grease fittings, rotate roller to properly distribute grease in bearings and clean excess grease from roller ends. A properly assembled roller should rotate with less than 5 in-lbs (0.68 N-m) resistance.

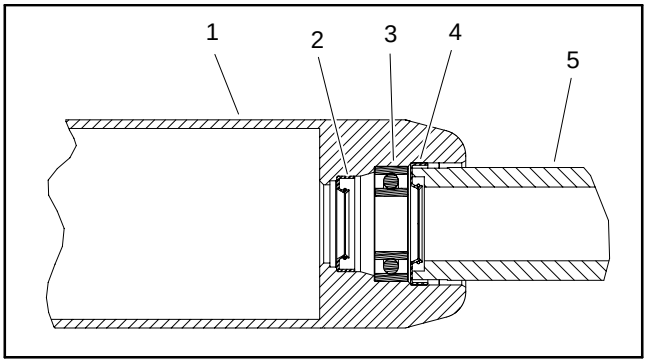


Figure 14

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Outer seal**
5. **Bearing/outer seal tool**

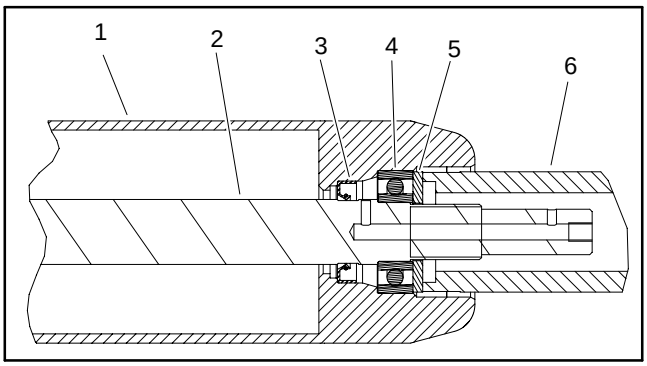


Figure 15

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Washer**
6. **Bearing/outer seal tool**

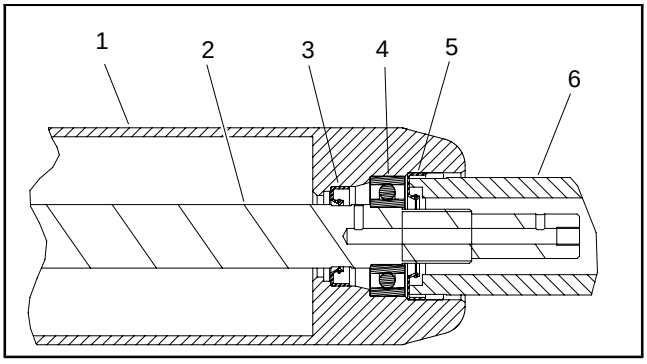


Figure 16

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing/outer seal tool**

## Front Roller Service

**Disassembly (Fig. 17)**

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

2. Remove front roller mounting bolt.

3. Remove front roller assembly and spacer from deck frame.

4. To remove bearings and bearing spacer from front roller:

   A. Insert punch through end of roller and drive opposite bearing out by alternating taps to opposite side of inner bearing race. There should be a lip of inner race exposed for this process.

   B. Remove bearing spacer. Remove second bearing from roller using a press.

   C. Discard bearings after removal.

5. Inspect roller housing and bearing spacer for damage or wear. Replace components as needed.

**Assembly (Fig. 17)**

1. Install new bearings and bearing spacer into front roller:

   A. Press first bearing into roller. Press on outer race only or equally on inner and outer races.

   B. Insert bearing spacer.

   C. Press second bearing into roller pressing equally on inner and outer races until the inner race comes in contact with the bearing spacer.

2. Install front roller assembly and spacer to deck frame.

3. Insert mounting bolt and torque to **65 to 95 ft-lb (89 to 128 N-m)**.

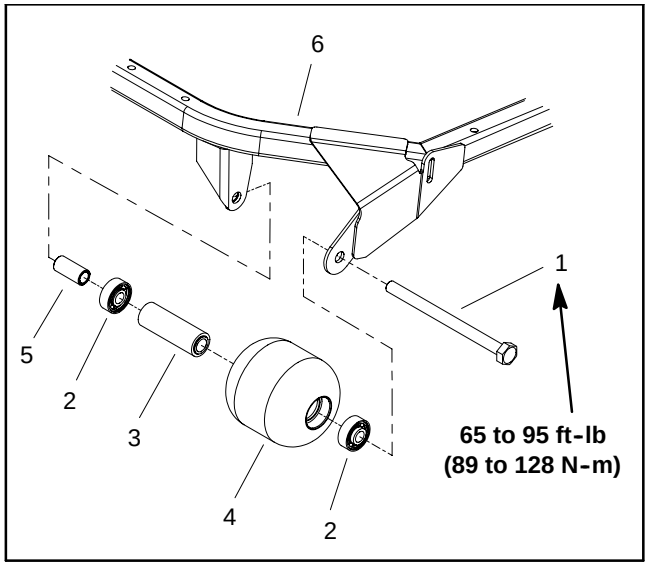


Figure 17

1. **Mounting bolt**
2. **Bearing**
3. **Bearing spacer**
4. **Front roller**
5. **Spacer**
6. **Deck frame**

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## Cutting Deck Carrier Frame

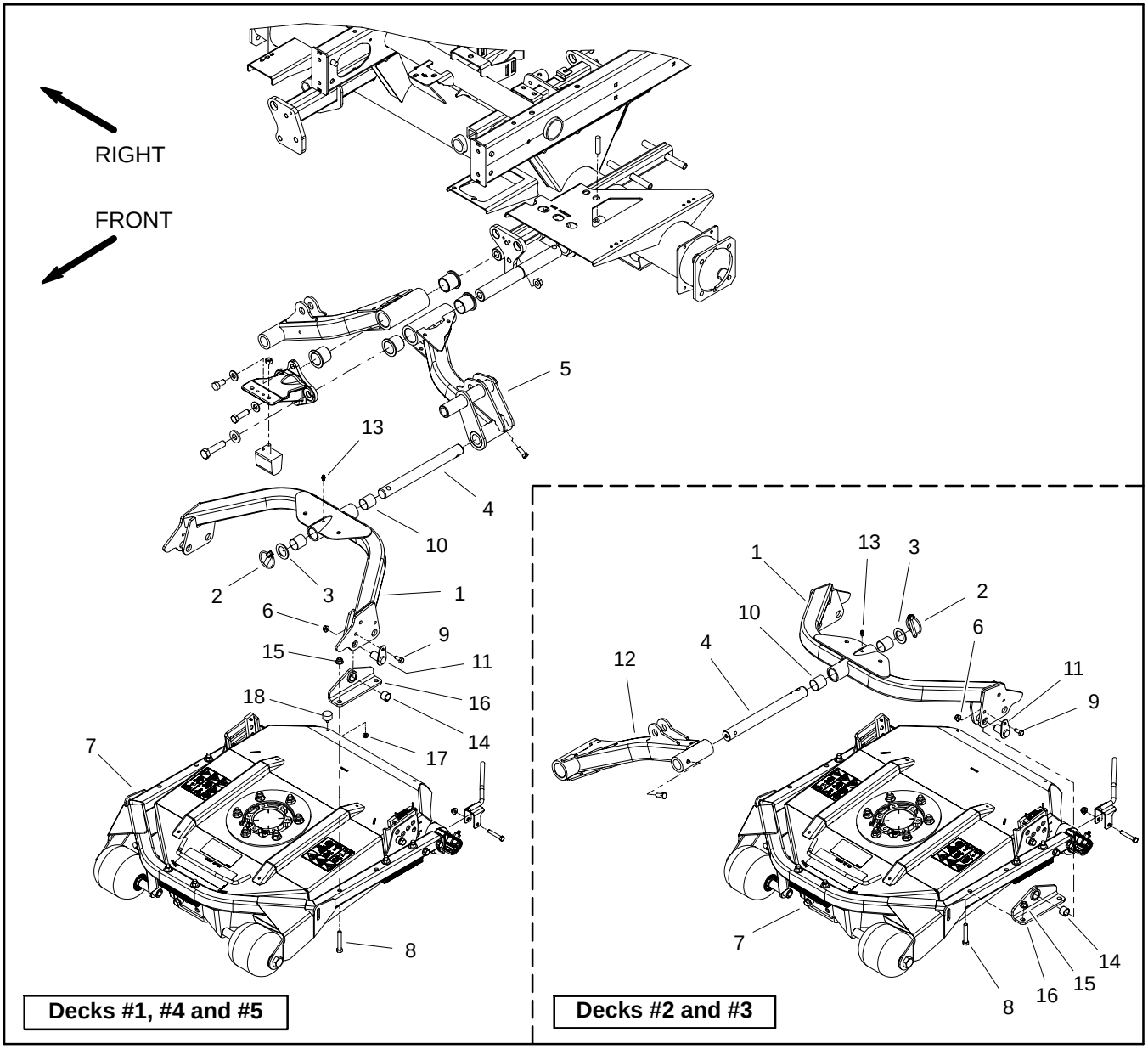


Figure 18

1. **Carrier frame**
2. **Lynch pin**
3. **Thrust washer**
4. **Pivot shaft**
5. **Lift arm (#4 shown)**
6. **Flange nut (2 used per deck)**
7. **Cutting deck assembly**
8. **Cap screw (4 used per deck)**
9. **Cap screw (2 used per deck)**
10. **Bushing (2 used per frame)**
11. **Pin (2 used per deck)**
12. **Lift arm (#2 shown)**
13. **Grease fitting**
14. **Bushing**
15. **Flange nut (4 used per deck)**
16. **Pivot bracket (2 used per deck)**
17. **Flange nut**
18. **Bumper**

**Removal (Fig. 18)**

Each cutting deck is suspended from a carrier frame. The cutting deck carrier frame is attached to the lift arm and allows the cutting deck to pivot on the lift arm pivot shaft. Cutting deck positions are identified in Figure 19.

To remove cutting decks from the lift arm pivot shaft:

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

2. Remove lynch pin and thrust washer that secures carrier frame to lift arm pivot shaft.

3. Slide cutting deck assembly off pivot shaft and away from machine.

4. Disassemble carrier frame as needed using Fig. 18 as a guide.

**Installation (Fig. 18)**

1. Assemble carrier frame as needed using Fig. 18 as a guide.

2. Slide cutting deck assembly onto pivot shaft on lift arm.

3. Secure cutting deck to pivot shaft with thrust washer and lynch pin.

4. Lubricate carrier frame grease fittings.

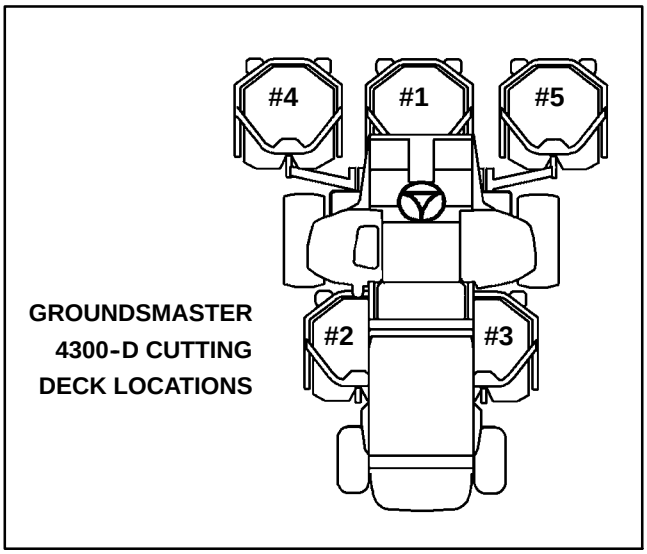


Figure 19

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TORO

# Chapter 8

# Foldout Drawings

## Table of Contents

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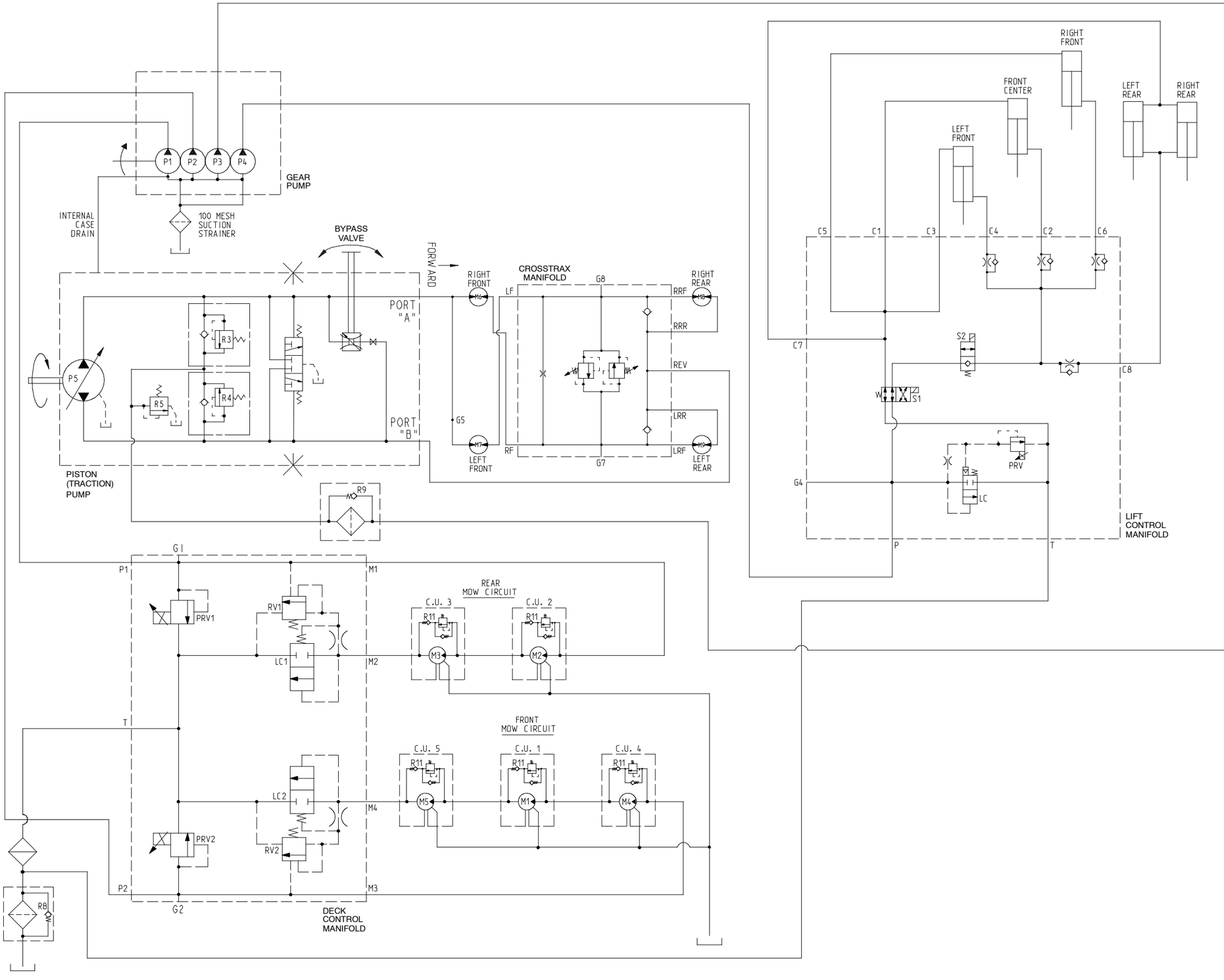
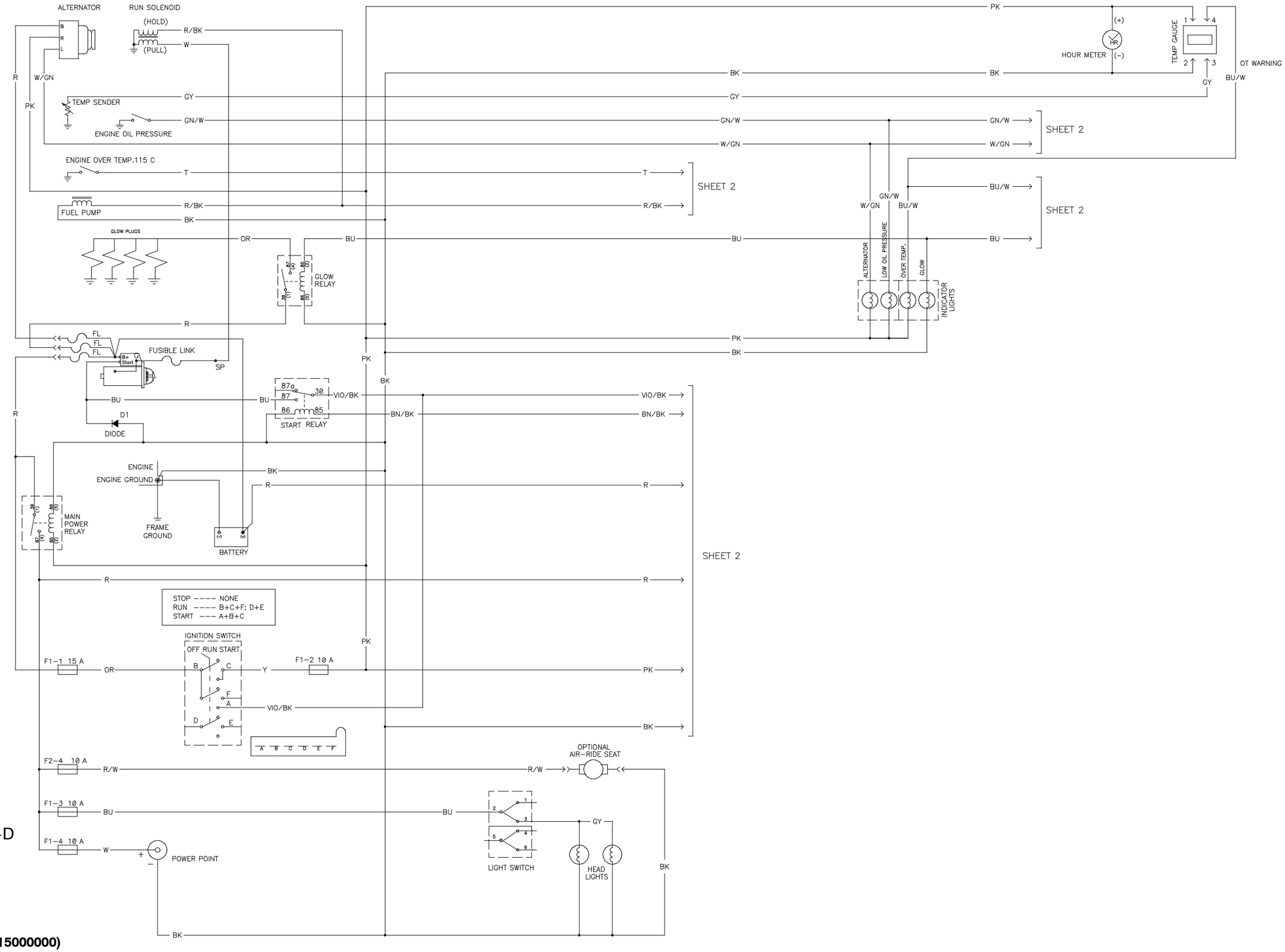



| DISPLACEMENT, FLOW RATE, AND PRESSURE CHART | | | | | | |
|---|---|---|---|---|---|---|
| | DISPLACEMENT | | PRESSURE | | FLOW RATE * | |
| COMPONENT | $in^3/rev$ | $cm^3/rev$ | $lbs/in^2$ | BARS | GPM | LPM |
| P1 | 1.03 | 16.84 | | | 13.1 | 49.6 |
| P2 | 1.03 | 16.84 | | | 13.1 | 49.6 |
| P3 | .37 | 6.1 | | | 4.7 | 17.8 |
| P4 | .24 | 3.9 | | | 3.0 | 11.4 |
| P5 | 2.14 | 35 | | | 27.2 | 103 |
| M1 | 1.05 | 17.16 | | | | |
| M2 | 1.05 | 17.16 | | | | |
| M3 | 1.05 | 17.16 | | | | |
| M4 | 1.05 | 17.16 | | | | |
| M5 | 1.05 | 17.16 | | | | |
| M6 | 24.7 | 405 | | | | |
| M7 | 24.7 | 405 | | | | |
| M8 | 18.9 | 310 | | | | |
| M9 | 18.9 | 310 | | | | |
| V1 | 6.1 | 100 | | | | |
| **PRV | | | 2000 | 138 | | |
| ***PRV1 | | | 3500 | 241 | | |
| ****PRV2 | | | 2000 | 138 | | |
| RV1 | | | 1500 | 105 | | |
| RV2 | | | 1500 | 105 | | |
| R3 | | | 3625 | 250 | | |
| R4 | | | 3625 | 250 | | |
| R5 | | | 200 | 14 | | |
| SVRV | | | 2000 | 138 | | |
| R8 | | | 50 | 3.4 | | |
| R9 | | | 50 | 3.4 | | |
| R10 | | | 1000 | 70 | | |
| R11 | | | 1813 | 125 | | |

* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.
** PRESSURE RATING APPLICABLE FOR INPUT CURRENT OF 0.87 AMPS.
*** PRESSURE RATING APPLICABLE FOR INPUT CURRENT OF 1.2 AMPS.
**** PRESSURE RATING APPLICABLE FOR INPUT CURRENT OF 0.8 AMPS.

Groundsmaster 4300-D
**Hydraulic Schematic**




Groundsmaster 4300-D

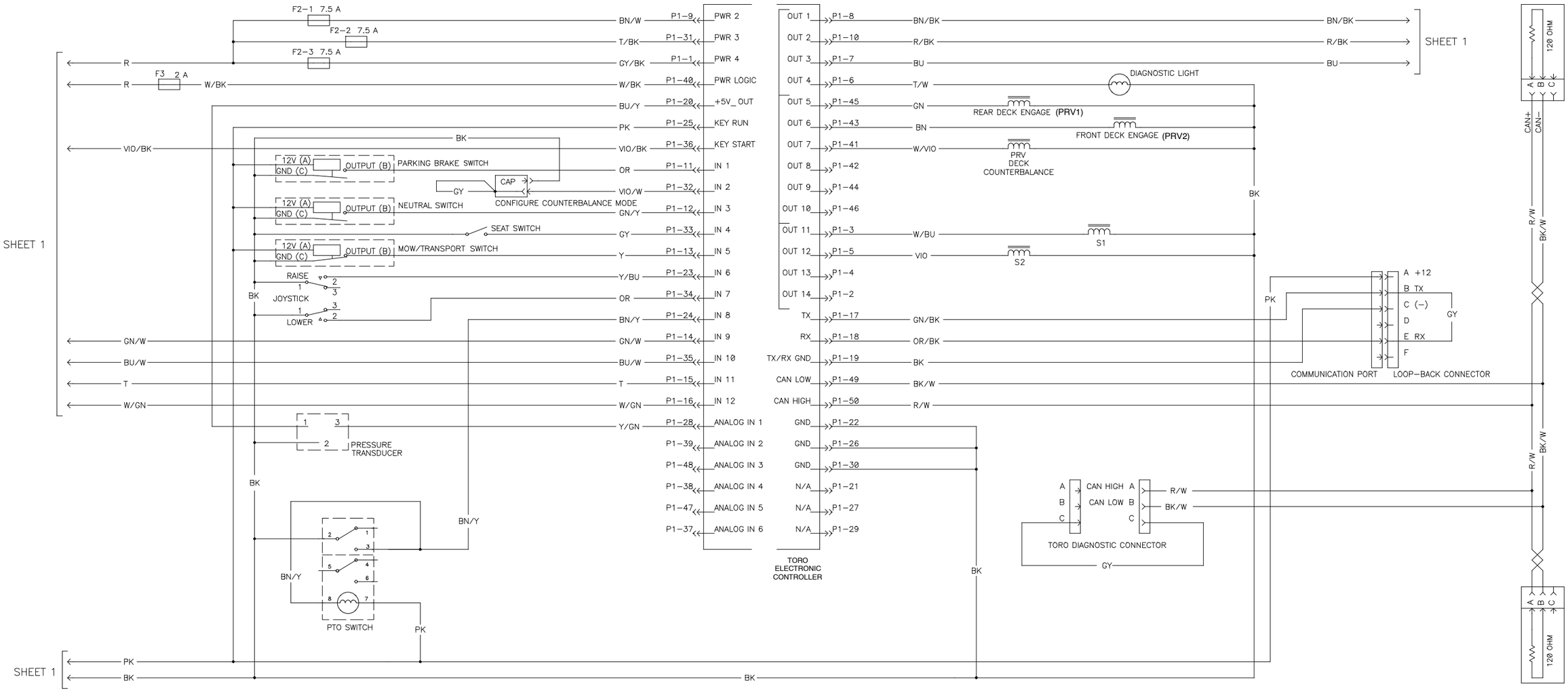
**Electrical Schematic**

Sheet 1 of 2

**All relays and solenoids are shown as de-energized.**

**All ground wires are black.**

**(Serial numbers below 315000000)**



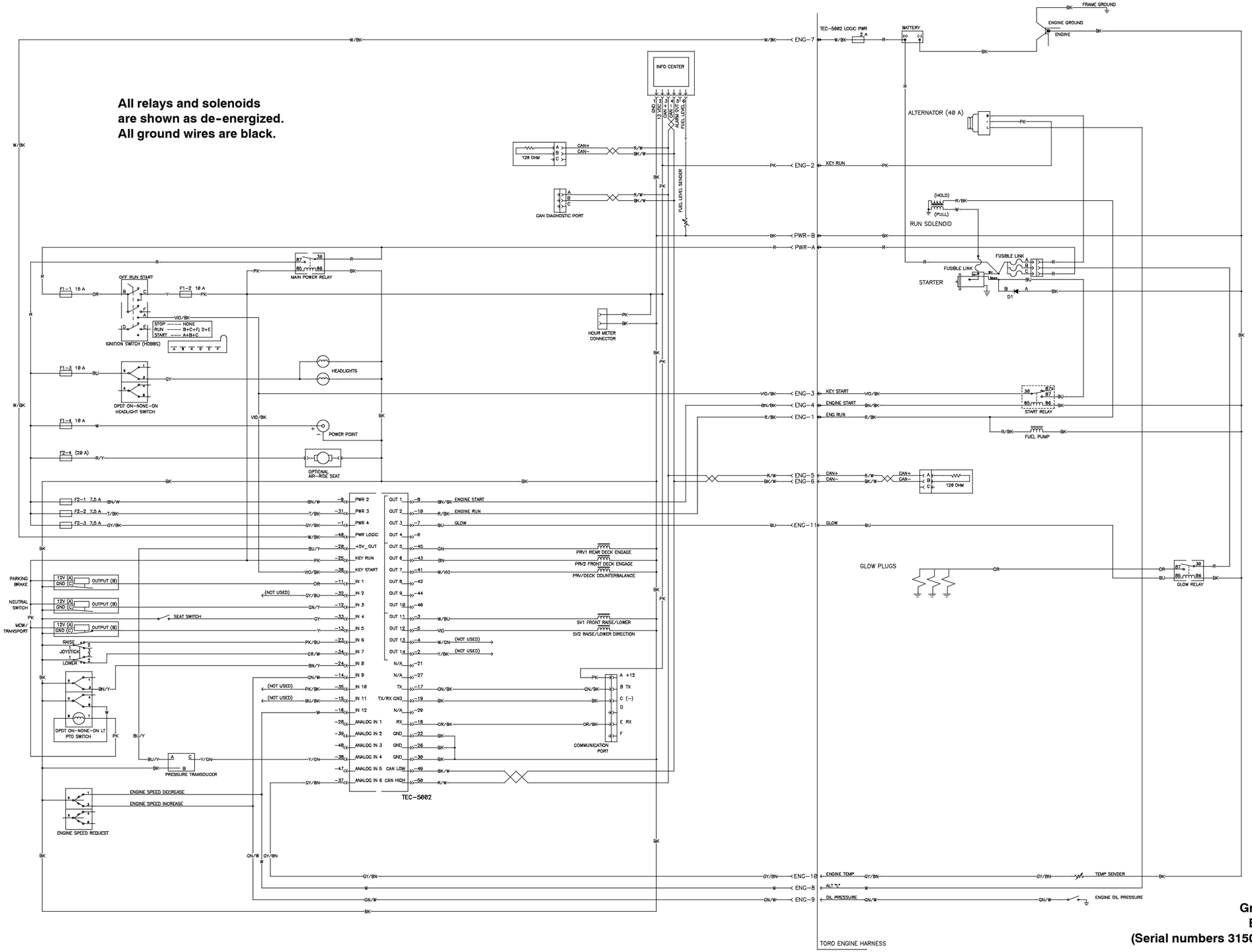

Groundsmaster 4300-D
**Electrical Schematic**
Sheet 2 of 2

**All relays and solenoids are shown as de-energized.**

**All ground wires are black.**

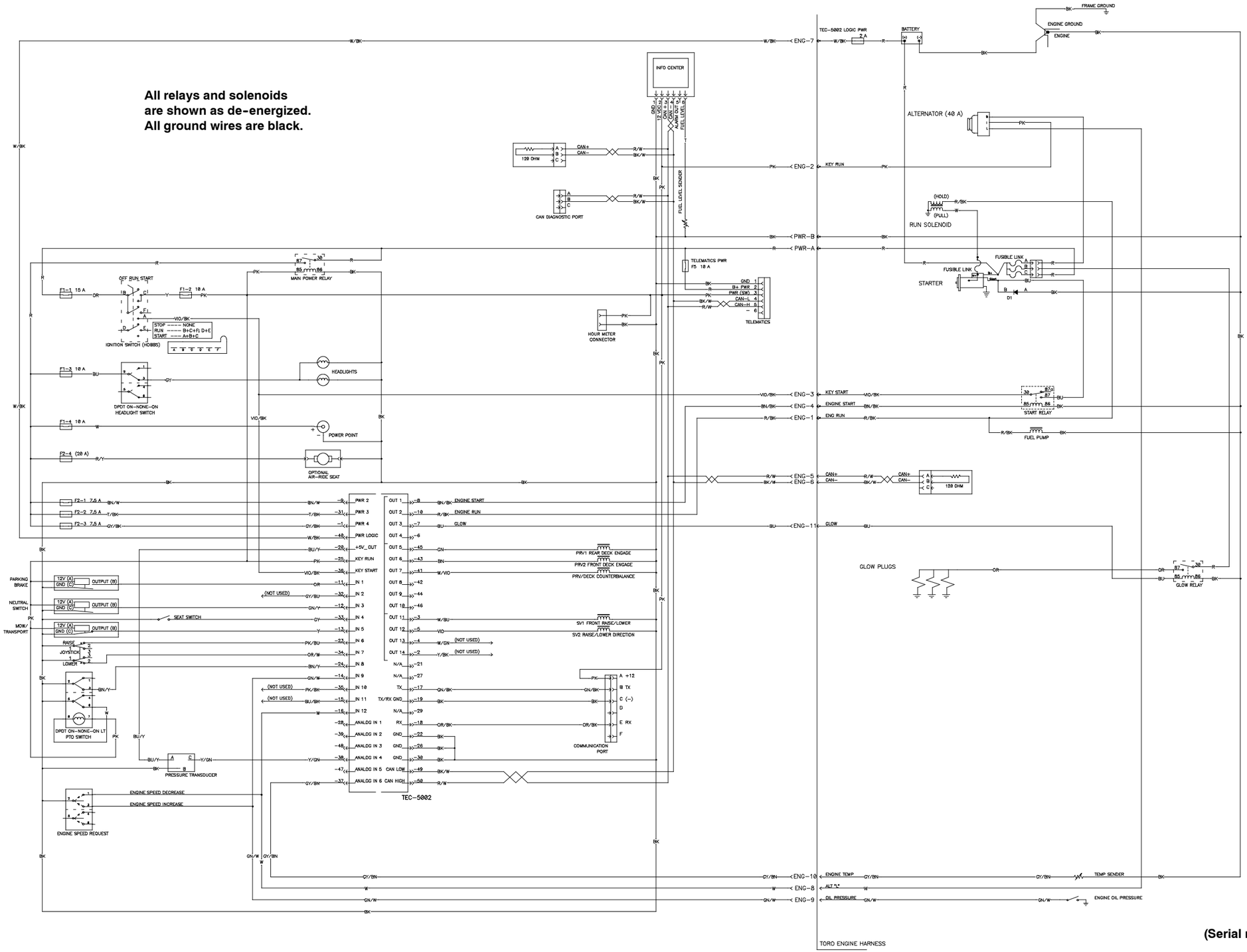
**(Serial numbers below 315000000)**

**All relays and solenoids are shown as de-energized. All ground wires are black.**

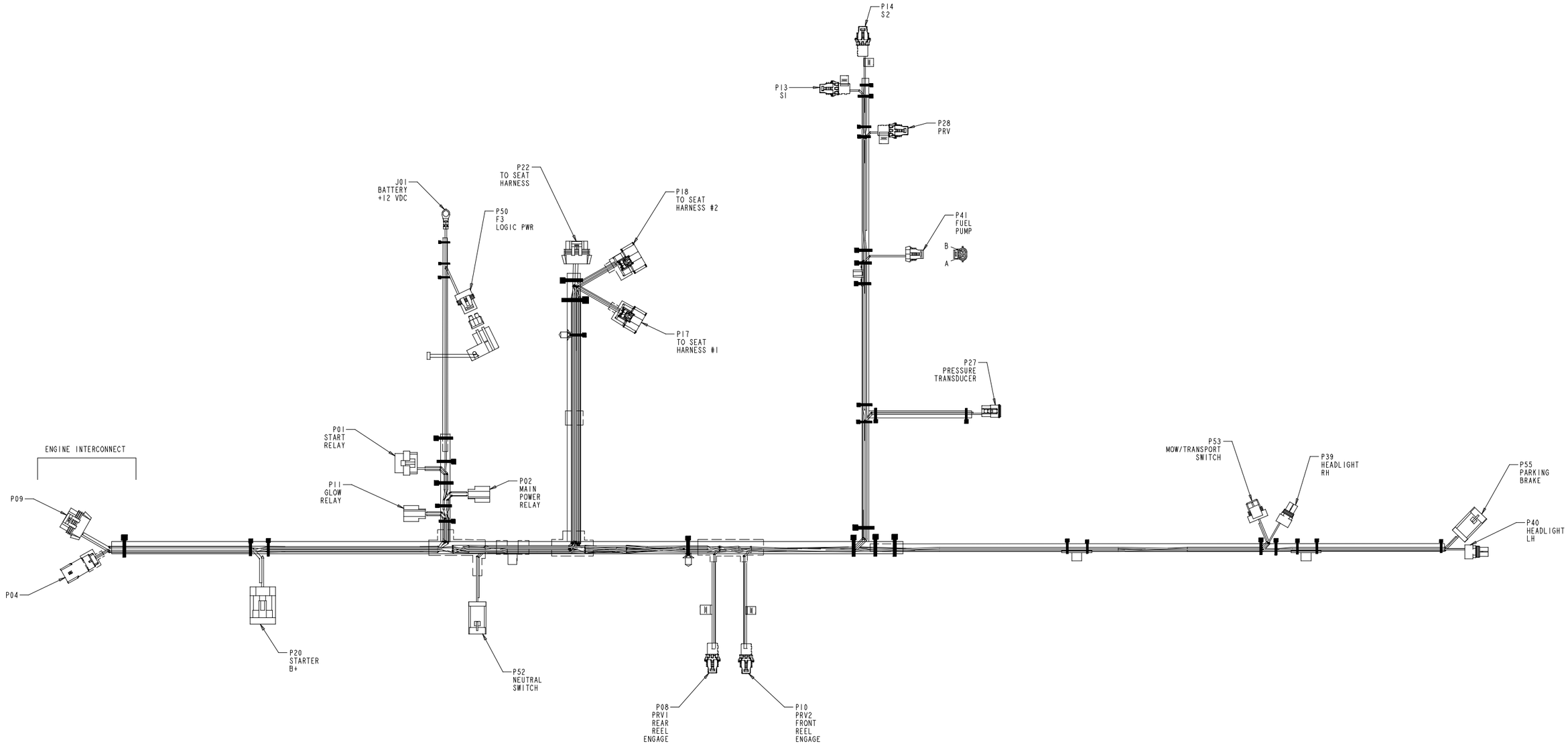



**122-0217 Rev A**
**Groundsmaster 4300-D**
**Eclectrical Schematic**
**(Serial numbers 315000001 to 403430000)**

**All relays and solenoids are shown as de-energized. All ground wires are black.**



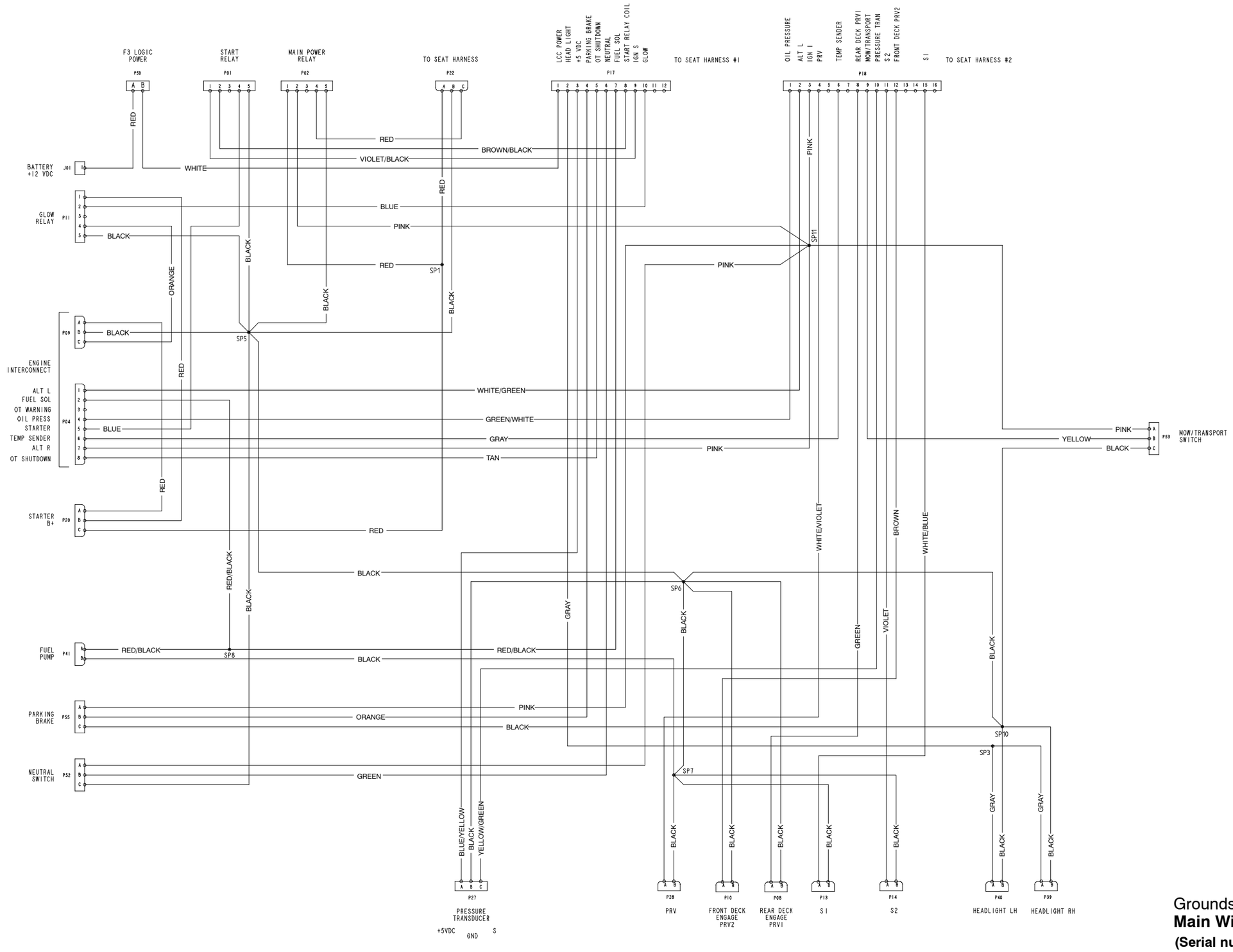

**122-1540 Rev A**
**Groundsmaster 4300-D**
**Eclectrical Schematic**
**(Serial numbers above 403430001)**




Groundsmaster 4300-D

**Main Wire Harness Drawing**

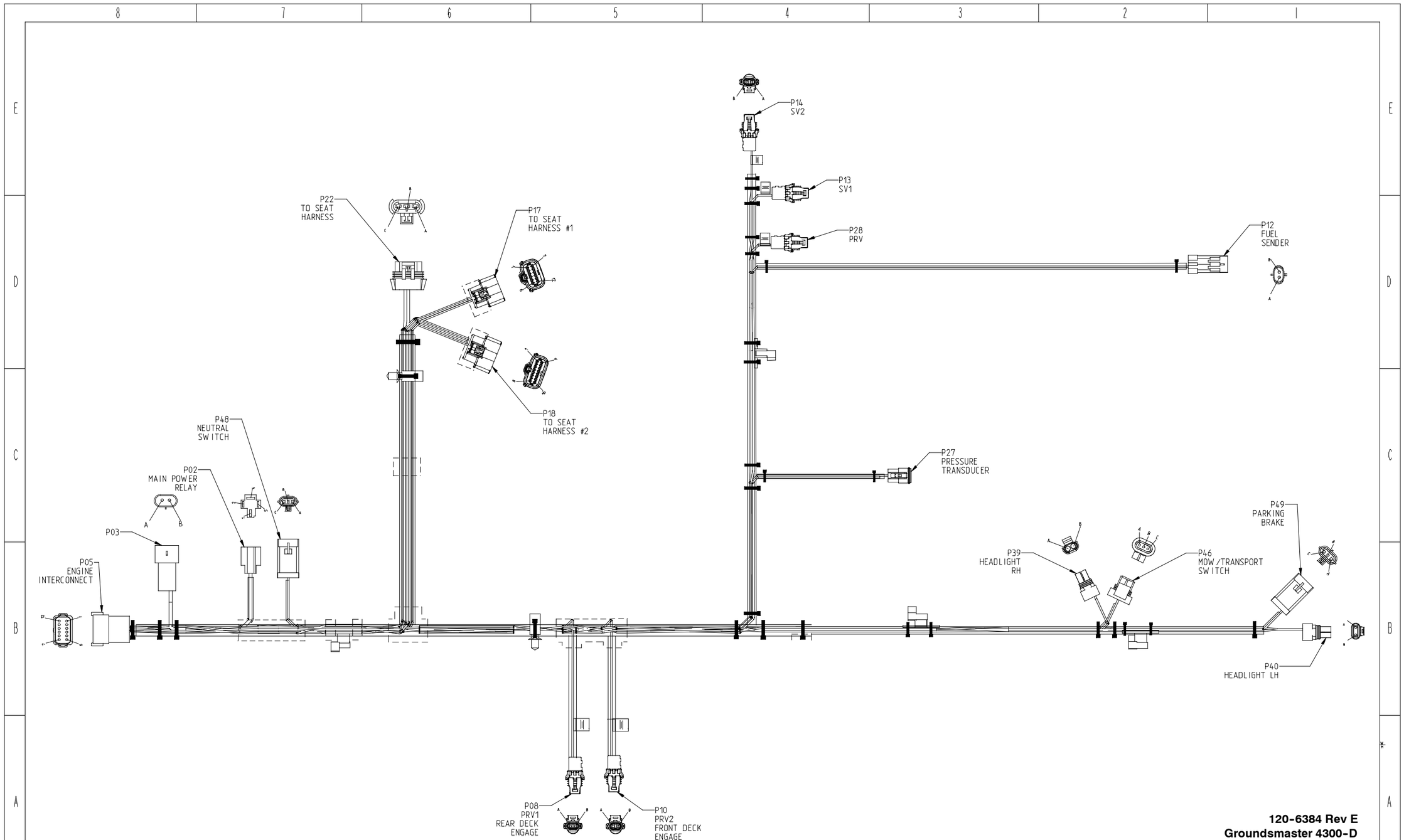
**(Serial numbers below 315000000)**



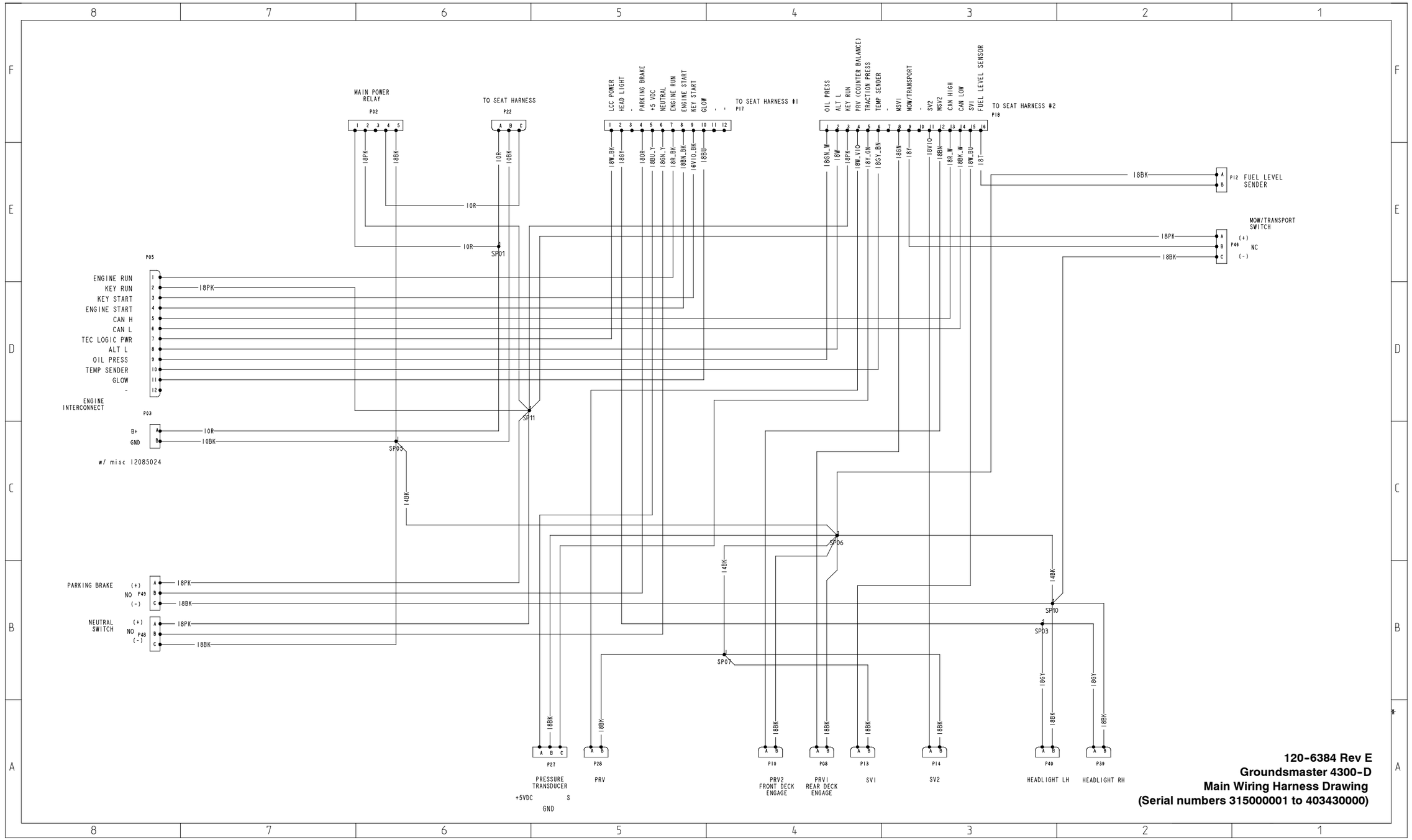

Groundsmaster 4300-D

**Main Wire Harness Diagram**

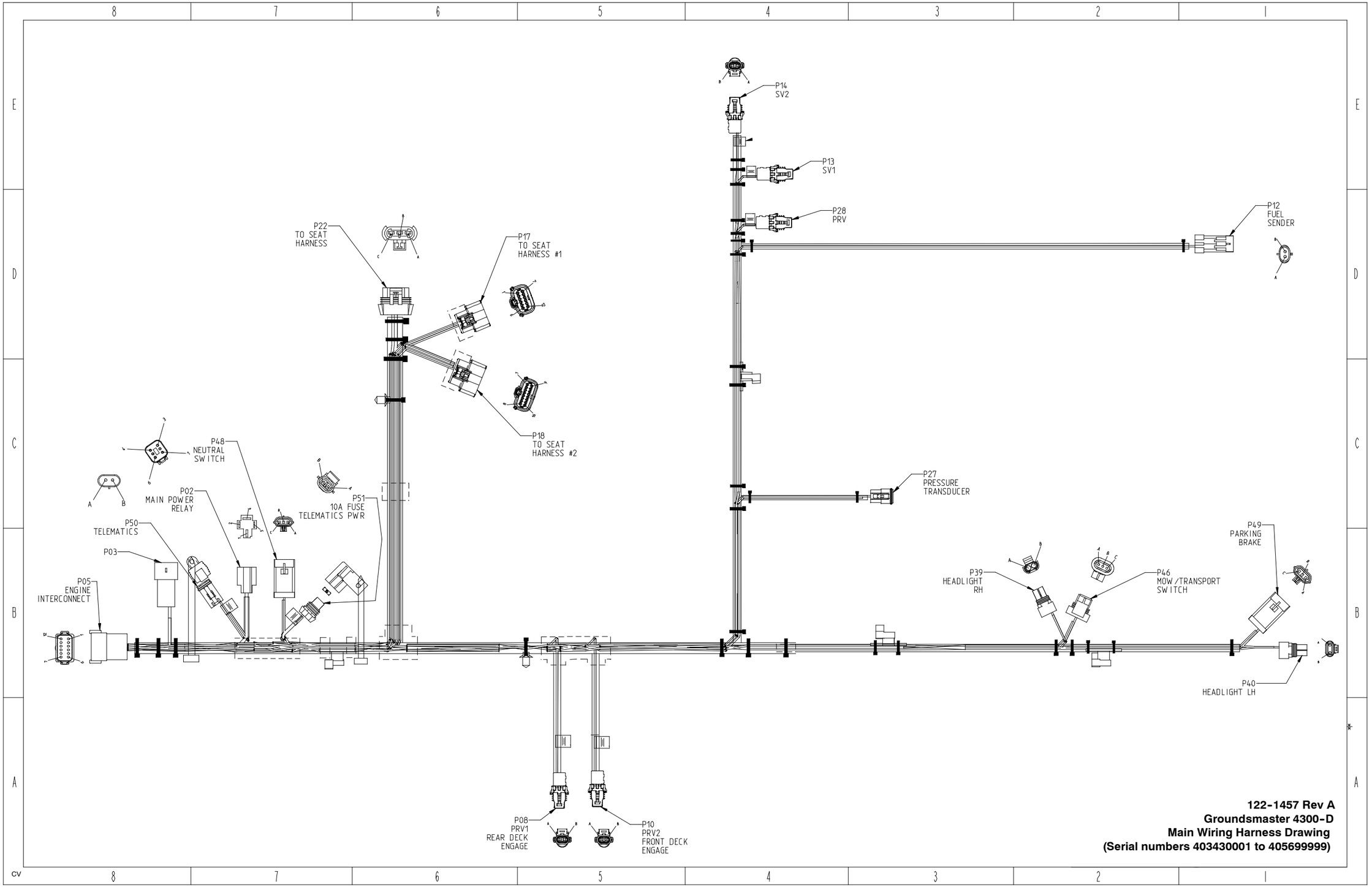
**(Serial numbers below 315000000)**

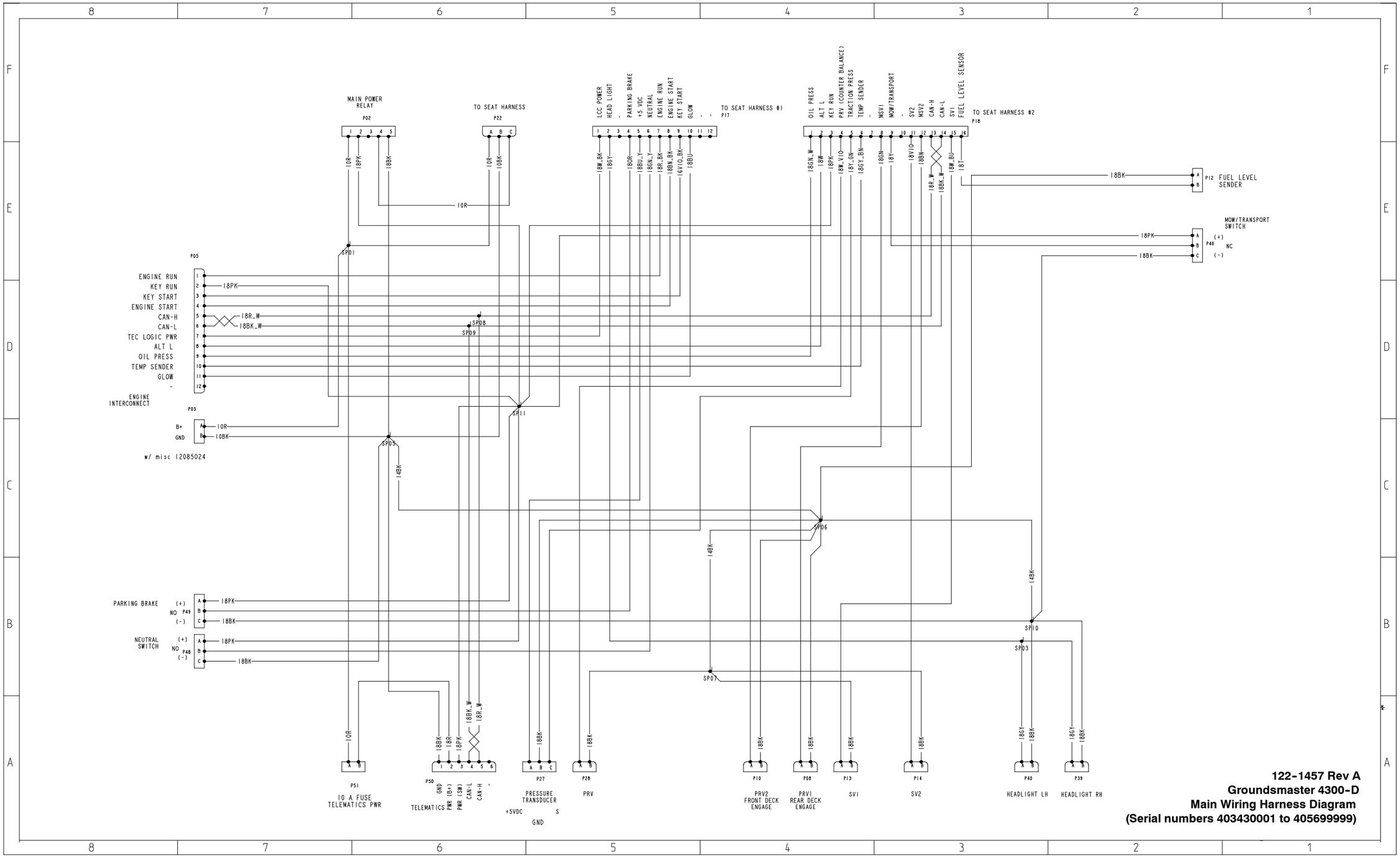


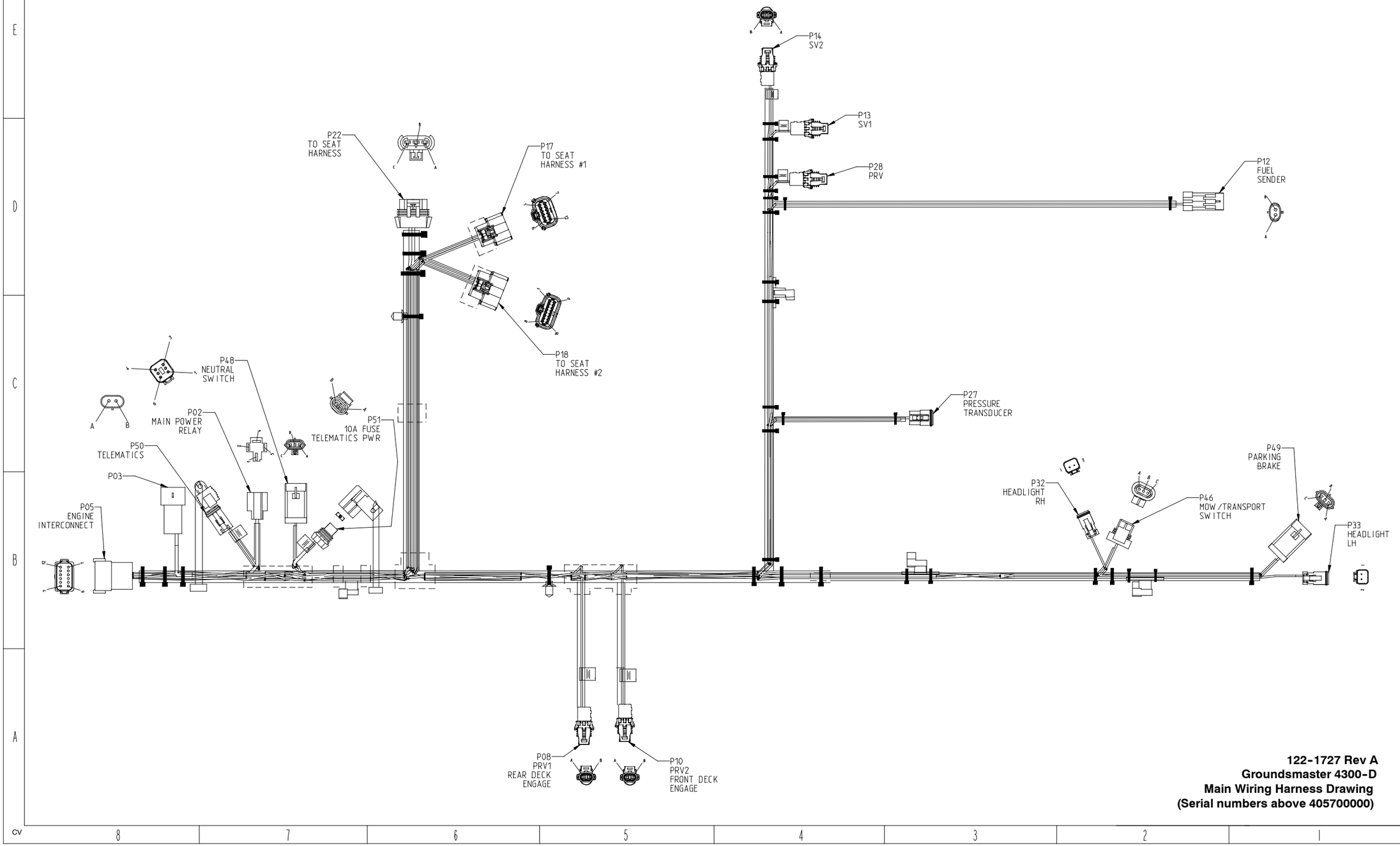

**120-6384 Rev E**
**Groundsmaster 4300-D**
**Main Wiring Harness Drawing**
**(Serial numbers 315000001 to 403430000)**



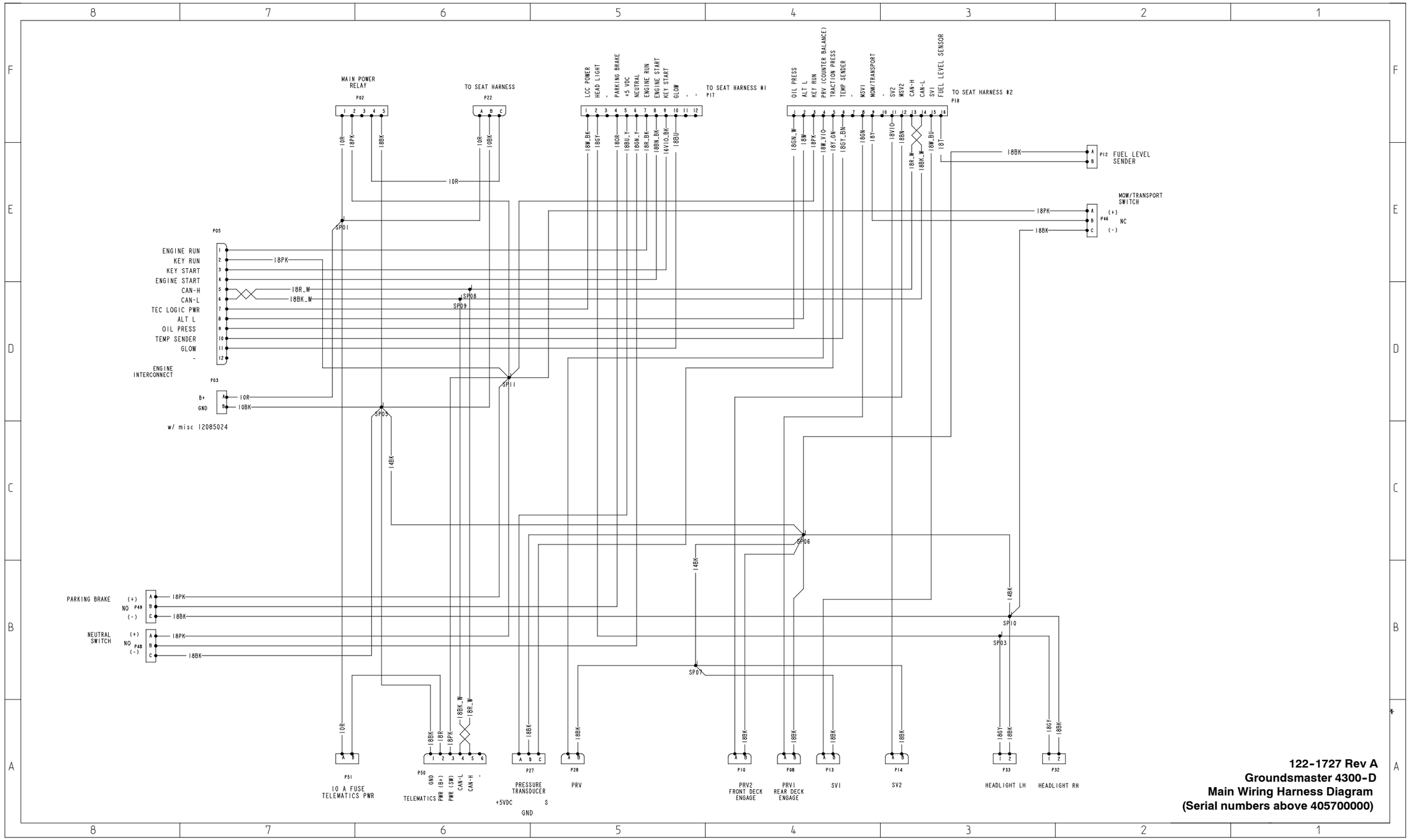

**120-6384 Rev E**
**Groundsmaster 4300-D**
**Main Wiring Harness Drawing**
**(Serial numbers 315000001 to 403430000)**


P14
SV2
P13
SV1
P28
PRV
P12
FUEL
SENDER
P22
TO SEAT
HARNESS
P17
TO SEAT
HARNESS #1
P18
TO SEAT
HARNESS #2
P48
NEUTRAL
SWITCH
P02
MAIN POWER
RELAY
P51
10A FUSE
TELEMATICS PWR
P50
TELEMATICS
P03
P05
ENGINE
INTERCONNECT
P27
PRESSURE
TRANSDUCER
P49
PARKING
BRAKE
P39
HEADLIGHT
RH
P46
MOW /TRANSPORT
SWITCH
P40
HEADLIGHT LH
P08
PRV1
REAR DECK
ENGAGE
P10
PRV2
FRONT DECK
ENGAGE
122-1457 Rev A
Groundsmaster 4300-D
Main Wiring Harness Drawing
(Serial numbers 403430001 to 405699999)

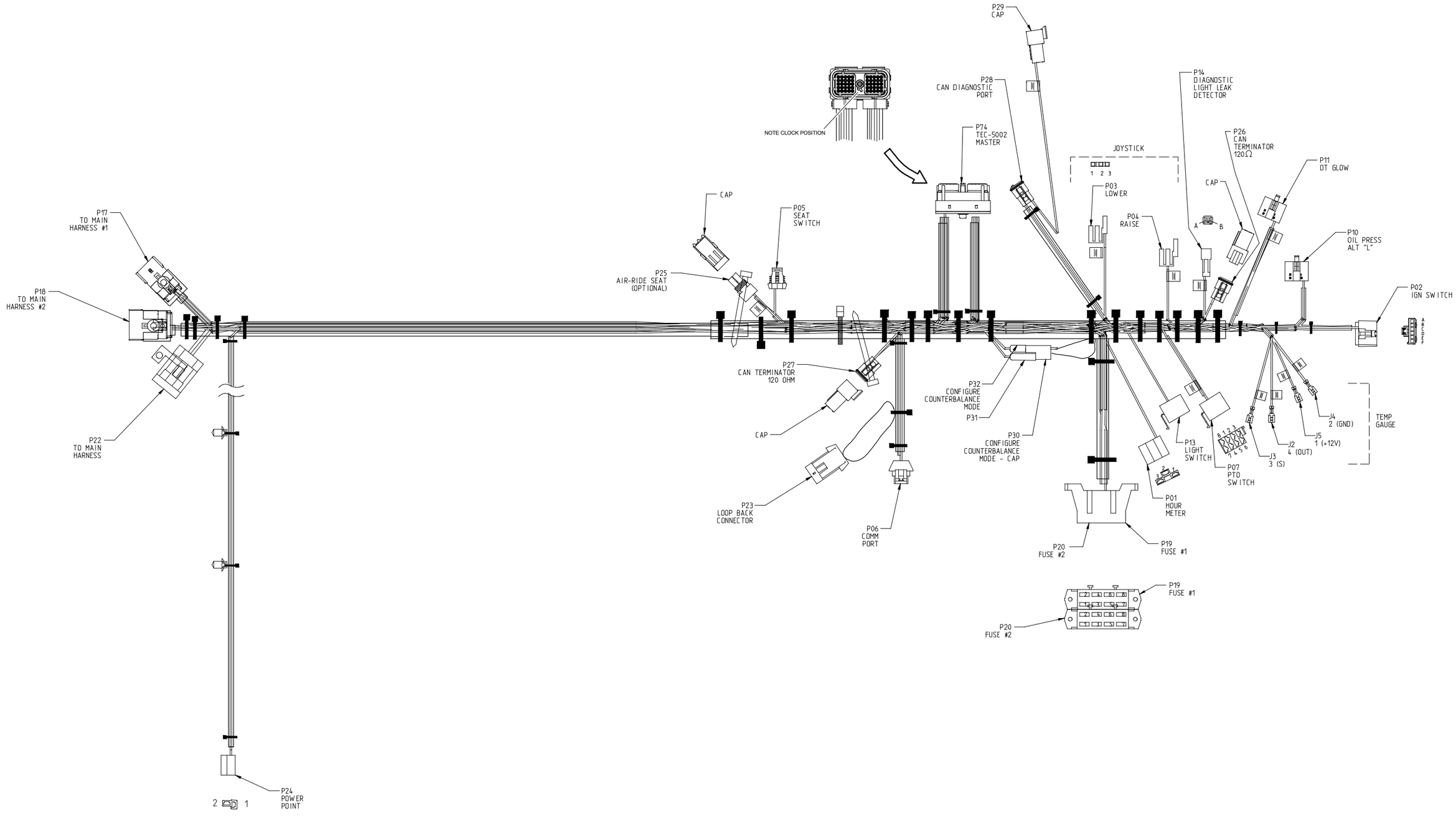

MAIN POWER RELAY
P02
TO SEAT HARNESS
P22
LCC POWER
HEAD LIGHT
-
PARKING BRAKE
+5 VDC
NEUTRAL
ENGINE RUN
ENGINE START
KEY START
GLOW
- -
TO SEAT HARNESS #1
P17
OIL PRESS
ALT L
KEY RUN
PRV (COUNTER BALANCE)
TRACTION PRESS
TEMP SENDER
-
MSV1
MOW/TRANSPORT
-
SV2
MSV2
CAN-H
CAN-L
SV1
FUEL LEVEL SENSOR
TO SEAT HARNESS #2
P18
18BK
P12 FUEL LEVEL SENDER
MOW/TRANSPORT SWITCH
18PK
P46
(+)
NC
(-)
18BK
SP01
P05
ENGINE RUN
KEY RUN
KEY START
ENGINE START
CAN-H
CAN-L
TEC LOGIC PWR
ALT L
OIL PRESS
TEMP SENDER
GLOW
-
18PK
18R_W
18BK_W
SP08
SP09
SP11
ENGINE INTERCONNECT
P03
B+
GND
10R
10BK
w/ misc 12085024
SP05
14BK
SP06
14BK
14BK
SP10
SP03
SP07
PARKING BRAKE
NEUTRAL SWITCH
P49
P48
NO
(+)
(-)
18PK
18BK
10R
18BK
18R
18PK
18BK_W
18R_W
18BK
18BK
18BK
18BK
18BK
18BK
18G1
18BK
18G1
18BK
P51
10 A FUSE
TELEMATICS PWR
P50
GND
PWR (B+)
PWR (SW)
CAN-L
CAN-H
TELEMATICS
P27
PRESSURE TRANSDUCER
+5VDC
S
GND
P28
PRV
P10
PRV2
FRONT DECK ENGAGE
P08
PRV1
REAR DECK ENGAGE
P13
SV1
P14
SV2
P40
HEADLIGHT LH
P39
HEADLIGHT RH
122-1457 Rev A
Groundsmaster 4300-D
Main Wiring Harness Diagram
(Serial numbers 403430001 to 405699999)



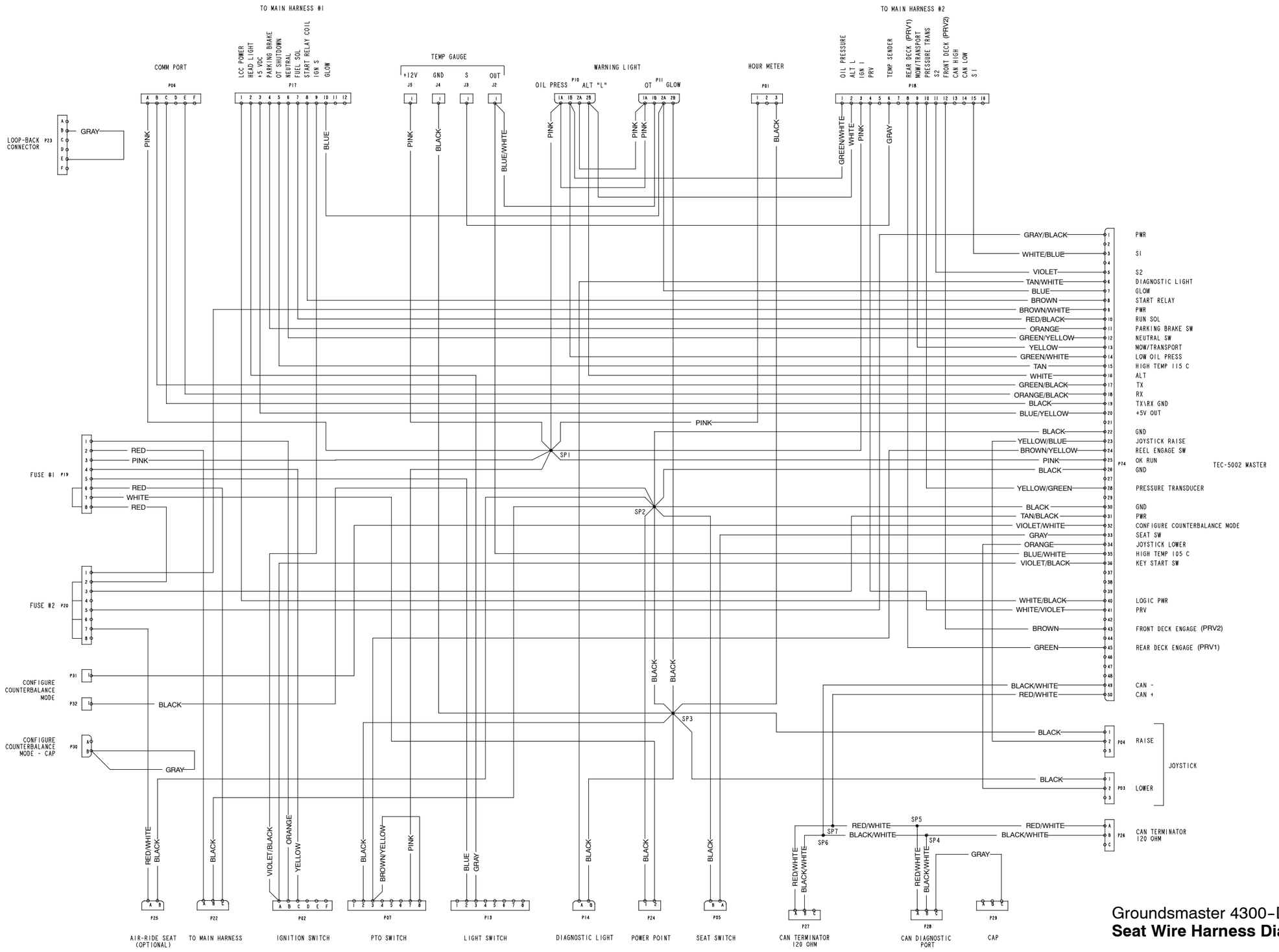

**122-1727 Rev A**
**Groundsmaster 4300-D**
**Main Wiring Harness Drawing**
**(Serial numbers above 405700000)**



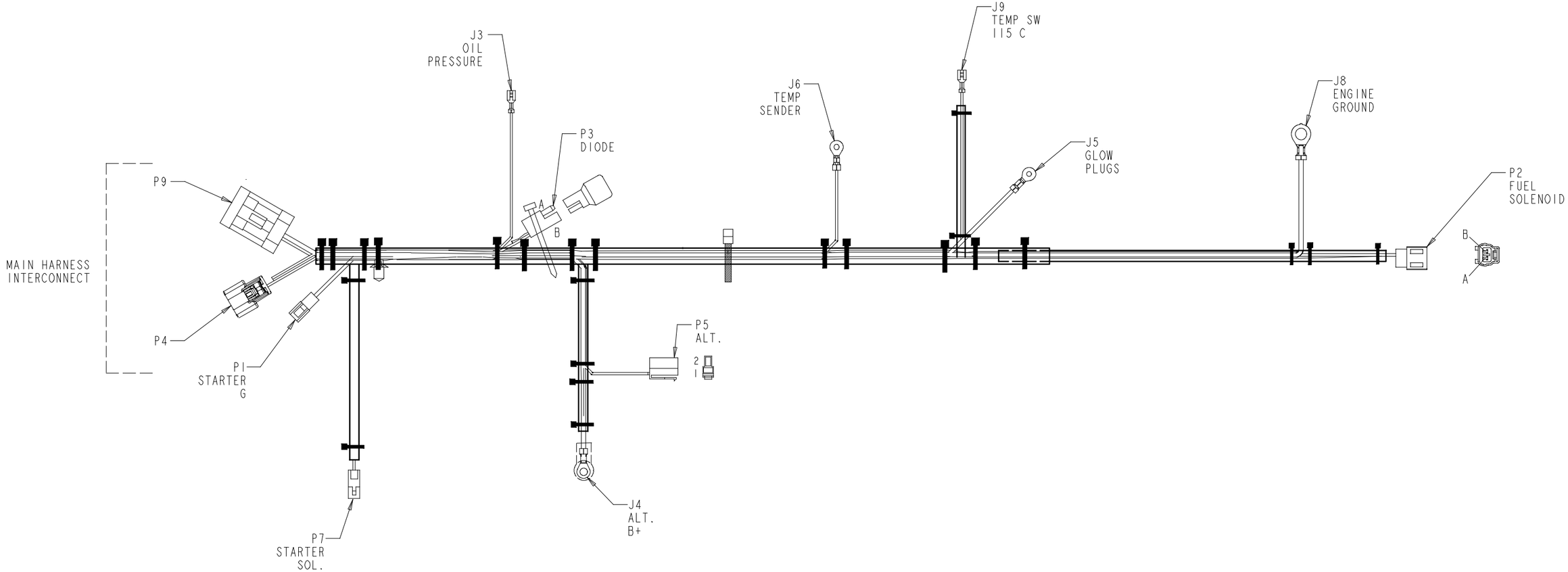

**122-1727 Rev A**
**Groundsmaster 4300-D**
**Main Wiring Harness Diagram**
**(Serial numbers above 405700000)**



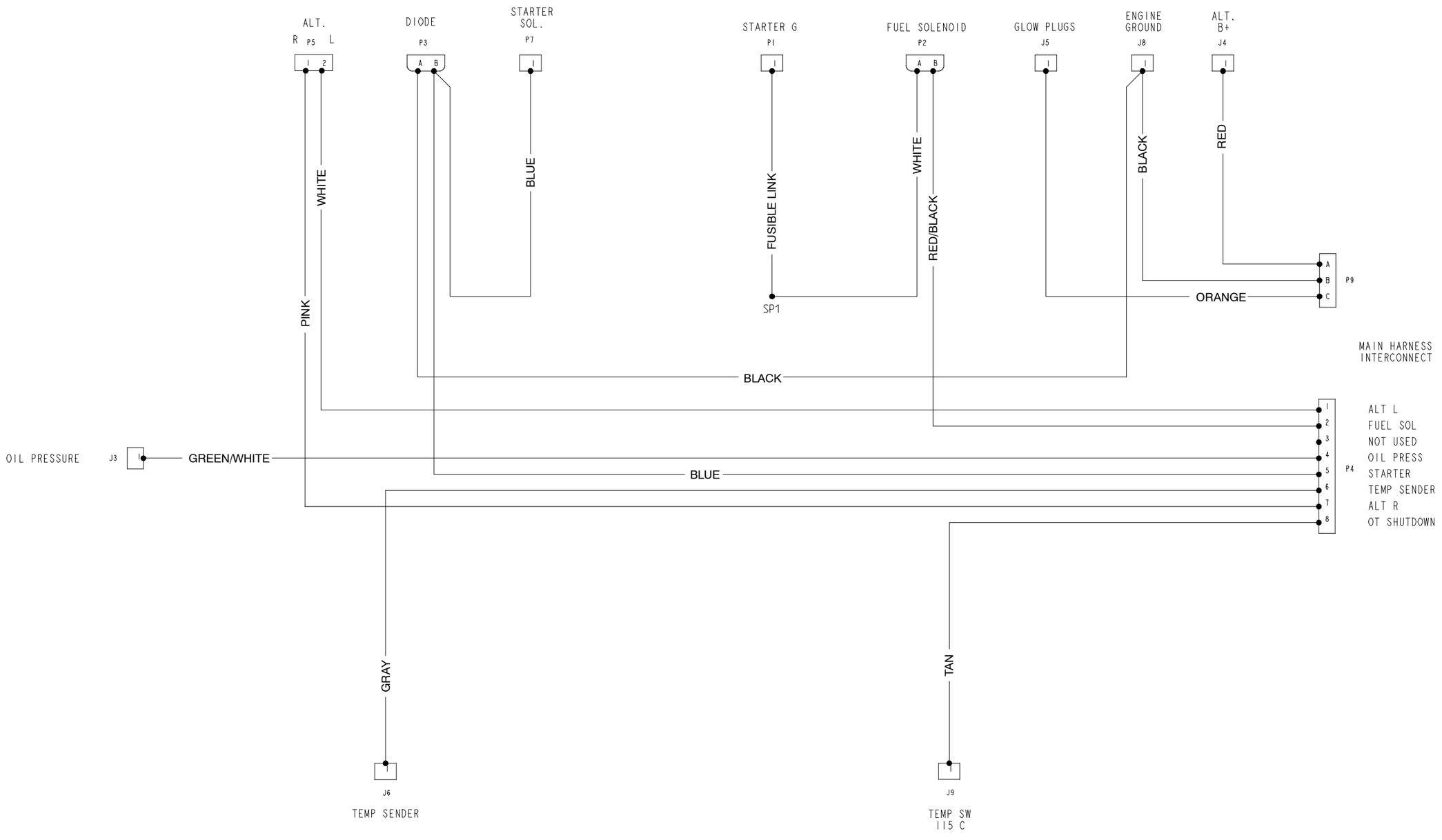

Groundsmaster 4300-D
**Seat Wire Harness Drawing**




Groundsmaster 4300-D
**Seat Wire Harness Diagram**




Groundsmaster 4300-D
**Engine Wire Harness Drawing**




Groundsmaster 4300-D
**Engine Wire Harness Diagram**